INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries

2006 Review

OECD

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-six of the OECD's thirty member countries. The basic aims of the IEA are:

- to maintain and improve systems for coping with oil supply disruptions;
- to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- to operate a permanent information system on the international oil market;
- to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- to assist in the integration of environmental and energy policies.

The IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission takes part in the work of the IEA.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of thirty democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission takes part in the work of the OECD.

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FOREWORD

Reviewing the energy policies of member countries is a central activity of the International Energy Agency. For this purpose, the policies of individual member countries are periodically assessed in depth by their peers. In intervening years, brief standard reviews update the main energy policy developments. These regular reviews have contributed substantially over the years to policy making at the national level. In addition to the above country-specific reviews, a comprehensive overview of the energy-related developments across the countries is also essential for sound policy making. The purpose of this *Energy Policies of the IEA Countries*, the annual compendium, is to provide comprehensive analysis of key themes across countries, based on country-specific information.

This edition focuses on recent developments in energy policies, including key policy trends across member countries in energy security, energy market reform, climate change mitigation, energy efficiency, renewable energies and energy R&D. Notable developments in key non-member countries, including major findings of the *World Energy Outlook 2006*, are also presented.

The beginning of 2006 was earmarked by the dispute on natural gas supply between Russia and Ukraine which has shifted energy security to the top of the political agenda in many countries. Together with continued concern about global climate change, energy efficiency policies have been accelerated. In direct response to the 2005 G8 Gleneagles Plan of Action which asked the IEA to analyse and make recommendations on best practices in energy efficiency worldwide. This edition contains – for the first time – a separate chapter on energy efficiency that sets out the most important recent developments in this field covering both IEA member countries and key non-members. The chapter also shows that energy efficiency is a successful policy tool that can be implemented in a market-based framework.

This book does not contain summaries of the in-depth reviews of the countries since they are available on the IEA website. Key statistical information is also included.

Claude Mandil
Executive Director

ACKNOWLEDGEMENTS

Much of the information in this report is drawn from in-depth reviews conducted by representatives of IEA member countries and members of the IEA Secretariat. The information contained in this publication is the best available as of September 2006 and is subject to change.

Jun Arima, the outgoing head of the Country Studies Division, and Hisashi Yoshikawa, its incoming head, supervised preparations for this book with the help of Andreas Biermann. Noé van Hulst, the Director of the Office of Long-Term Co-operation and Policy Analysis, provided support and encouragement throughout the project. Many members of the IEA staff contributed to this book. Major contributions came from Andreas Biermann, Alan Meier, Paul Waide (energy efficiency), Fatih Birol (*WEO 2006*), Hiroshi Hashimoto (gas), Brian Ricketts (coal), Christof van Agt (producer-consumer dialogue), François Nugyen (electricity), Sierra Peterson (climate change), Peter Tulej, Nobuyuki Hara (renewables), Jeppe Bjerg (R&D), Jonathan Sinton (China), Dagmar Grazyk (India), Brett Jacobs (South-East Asia), Ghislaine Kieffer (Latin America, Africa), Isabel Murray (Russia), Meredydd Evans (Ukraine), Emmanuel Bergasse (Slovak Republic) and Elena Merle-Beral. Karen Treanton and Paul Dowling prepared Key Statistics and Indicators with the assistance of Ana Belen Padilla, Monica Petit prepared the figures and Marilyn Ferris provided administrative assistance for the project. Rebecca Gaghen, Muriel Custodio, and Corinne Hayworth from the Communication and Information Office provided substantial help in producing this book. Viviane Consoli proofread the text.

In past years summaries of *In-Depth Reviews* conducted in the cycle covered by this book, as well as Standard Reviews, were published as part of the book. From this year they will only be available from the IEA's website on www.iea.org.

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ENERGY EFFICIENCY

Energy efficiency has always been an essential tool in energy policy in the view of the IEA, and it has recently also become a greater priority in all IEA member countries' energy policies because of the unprecedented increase in energy prices. In addition, concerns about energy prices, the security of energy supply and global climate change have increased significantly and are driving energy efficiency policies worldwide. Nevertheless, energy efficiency policy is not receiving sufficient emphasis compared with renewable energy policy, even though they have similar benefits in terms of energy security and climate change mitigation, and energy efficiency is often the more cost-effective of the two. It will therefore be important for IEA member countries – as well as others – to pursue energy efficiency more actively as a long-term policy, regardless of the development of fuel prices. It was in this context that the G8 leaders at their 2005 summit meeting instructed the IEA to identify and share best practices in all areas of energy use. This chapter sets out the most important recent developments in energy efficiency policies of IEA member and key non-member countries, while also providing detailed analysis of particular policies identified in *In-Depth Reviews* of member countries over the last three years.

The examples in the chapter illustrate the effectiveness of energy efficiency as a policy tool that can be implemented in a market-based framework, as the United Kingdom's Energy Efficiency Commitment shows. In addition, even in countries, such as Denmark, where significant improvements in energy efficiency have already been achieved without stymieing economic growth, further significant improvements are planned. Finally, the nascent international co-operation on energy efficiency standards should be pursued further, and broadened to cover more products for which a global supply chain exists, since there are demonstrated cases where government intervention has brought about increases in energy efficiency at very low or negative costs. Using real policy examples such as an in-depth analysis of the UK's Energy Efficiency Commitment or the Danish building regulations, the chapter conveys a clear message that the huge potential for efficiency gains can be achieved by sharing and implementing best practice examples.

WORLD ENERGY OUTLOOK 2006

The world is facing twin energy-related threats: that of not having adequate and secure supplies of energy at affordable prices and that of environmental harm caused by consuming too much of it. Soaring energy prices and recent geopolitical events have reminded us of the essential role affordable energy plays in economic growth and human development, and of the vulnerability of the global energy system to supply disruptions. Safeguarding energy supplies is once again at the top of the international policy agenda. Yet the current pattern of energy supply carries the threat of severe and irreversible environmental damage – including changes in global climate. Reconciling the goals of energy security and environmental protection requires strong and co-ordinated government action and public support.

The need to curb the growth in fossil energy demand, to increase geographic and fuel supply diversity and to mitigate climate-destabilising emissions is more urgent than ever. G8 leaders, meeting with the leaders of several major developing countries and heads of international organisations – including the International Energy Agency – at Gleneagles in July 2005 and in St. Petersburg in July 2006 called on the IEA to "advise on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future". *World Energy Outlook 2006* responds to that request. It confirms that fossil fuel demand and trade flows, and greenhouse gas emissions would follow their current unsustainable paths through to 2030 in the absence of new government action – the underlying premise of our Reference Scenario. It also demonstrates, in an Alternative Policy Scenario, that a package of policies and measures that countries around the world are considering would, if implemented, significantly reduce the rate of increase in demand and emissions. Importantly, the economic cost of these policies would be more than outweighed by the economic benefits that would come from using and producing energy more efficiently.

Bringing modern energy to the world's poor is an urgent necessity. Although steady progress is made in both Reference and Alternative Policy Scenarios in expanding the use of modern household energy services in developing countries, many people still depend on traditional biomass in 2030. The inefficient and unsustainable use of biomass has severe consequences for health, the environment and economic development. Action to encourage more efficient and sustainable use of traditional biomass and help people switch to modern cooking fuels and technologies is needed urgently.

ENERGY SECURITY

HIGH PROFILE OF ENERGY SECURITY IN POLICY DEBATE

Recent developments in energy markets show that energy security concerns are becoming more acute. These include a tightened global energy supply/demand balance, soaring energy prices, growing geopolitical risks and the emerging tendency of resource nationalism. Accordingly, energy security is moving to the top of many countries' policy agenda and is a current concern for decision-makers at the highest political level. It is also a priority of multilateral institutions such as the European Union, which is currently developing a policy approach to energy security, and the G8 Summit, which ended with a declaration on energy security.

There have been numerous policy developments (*e.g.* the European Union Green Paper, the Advanced Energy Initiative and Global Nuclear Energy Partnership in the United States, the UK Energy Review, the New National Energy Strategy in Japan) from 2005 to 2006, triggered, in particular, by energy security concerns.

G8 DECLARATION ON ENERGY SECURITY

The 2006 G8 Summit in St. Petersburg gave serious consideration to security of energy supply, and issued an action plan on energy security focusing on improving transparency, predictability and the investment climate in the energy industry, increasing energy efficiency and energy diversification, securing critical infrastructure, and reducing energy poverty and the environmental impact of energy use. The summit also reinforced the IEA's message about the importance of achieving the 3Es, Energy security, Economic development, and Environmental protection.

SECURITY OF GAS SUPPLY

Natural gas accounts for 21% of global energy supply. While rapid growth since 2000 is expected to moderate in the second half of the decade, global demand is still expected to increase from 2.8 trillion cubic metres in 2005 to 3.2 tcm in 2010, by over 14%. Increasing gas use and dependence on imports in IEA countries, as well as short-term tightness of supply and high gas prices, are heightening concerns over security of supply of natural gas, as expressed at the IEA Gas Security Workshop in Paris in June 2006. In the short term, efforts must be made to enable the prevention of sudden supply disruptions or, if unavoidable, to ensure the proactive management of such disruptions, with an emergency plan as part of the planning. In the long term, this means investing in sufficient production and transportation capacity of natural gas, creating transparent markets for gas, and encouraging efficiency measures on the demand side should be prioritised.

For IEA countries, security of natural gas supply is of particular relevance as dependence on non-IEA countries is growing at a rapid pace. Gas reserves are concentrated in a limited number of countries, mostly outside the IEA, and import dependence is now a fact of life for IEA regions, according to the *2006 Gas Market Review*. Russia, Iran and Qatar hold almost two-thirds of global reserves. Norway and Australia are the only IEA countries which can significantly increase production. The expected expansion of international trade in liquified natural gas (LNG) could alleviate some of the risks of long-distance supply chains if it leads to more diversified supplies. LNG is going to play a more important role in security of supply in IEA North America and Europe, to say nothing of IEA Asia, where LNG dominates natural gas markets. Although an increasingly global market of LNG generally means diversified choices for both consumers and producers, greater competition could create some uncertainties.

The IEA published the *Natural Gas Market Review 2006*, which reflects the priorities expressed by member countries' governments at the 2005 Ministerial Meeting. This publication is the first in a series of similar reports, reflecting the growing importance of worldwide trade in natural gas.

COAL IN THE WORLD PRIMARY ENERGY SUPPLY

Meeting 25% of the world's primary energy demand, coal contributes significantly to energy security, especially in electricity generation. A well-functioning, international market and abundant reserves of almost 170 years at current production rates, indicate that coal's role as a competitive fuel will continue. Indeed, high energy prices over the last few years have stimulated investment in coal mines and transport infrastructure. However, increased coal consumption, whether in the rapidly expanding economy of China or elsewhere, is hard to combine with the aim of reducing global GHG emissions, unless clean coal technologies, such as ultimately carbon dioxide capture and storage, can be deployed. A number of large-scale demonstration projects are proposed or under way, and work in this area forms part of the G8 work undertaken by the IEA, *e.g.* through a workshop held in India early in 2006 and ongoing through the Clean Coal Centre. To encourage widespread adoption of such technologies will require new policies that allow investors to recover the additional costs of these low-emission, clean coal technologies.

PRODUCER-CONSUMER DIALOGUE

The "Producer-Consumer Dialogue" has evolved significantly since its inception in 1991, and its latest meeting, the 10th International Energy Forum (IEF), was held in Qatar in April 2006. Ministers and representatives from 59 producing and consuming countries and six international organisations discussed a range of global energy issues, including energy security, investment requirements to meet future energy demand, and access to modern and sustainable energy. The IEA stressed the need for significant investment throughout the energy sector, together with energy efficiency improvements along the entire energy chain to overcome the challenges we confront in today's energy markets. All parties gathered in Doha agreed that prices were too high. In the short term, there is no other way to cope with these prices apart from saving energy – either by reducing demand or introducing further energy efficiency measures. Participants also emphasised the importance of reliable and transparent data in all energy markets and the contribution of the IEF Joint Oil Data Initiative (JODI) in this regard. The next meeting will take place in Rome in 2008.

ENERGY MARKET REFORM

In 2005-2006, the process of electricity market liberalisation has been undertaken by many IEA countries, albeit at different paces. In general, market reform has continued to face significant challenges; for example, there are still significant barriers to cross-border electricity trade in Europe and a lack of energy price transparency in US power markets. *Lessons from Liberalised Electricity Markets*, a new report released by the IEA in December 2005, concluded, among other things, that electricity market liberalisation has brought significant benefits to consumers where reform has been comprehensively implemented. It has required strong and ongoing government involvement and response in a fundamentally different market setting. The United States adopted a key policy initiative, the *Energy Policy Act of 2005* (EPA2005), which contains several provisions relevant to electricity restructuring. Europe is moving towards an internal electricity and gas market, with full market opening scheduled for July 2007. A recent report by the European Commission, *Progress in Creating the Internal Electricity and Gas Market,* revealed that electricity market opening has largely been a success to date, although much more needs to be done by member states to ensure that the full benefits of market liberalisation can be realised. Canada, Australia and Japan also witnessed further developments in implementing market reform.

While there has been a continuous general trend to further liberalise gas markets across IEA regions, there are various issues to overcome, including market concentration, vertical foreclosure, insufficient market integration, lack of transparency, and a lack of market-based pricing. Heightening concerns over security of supply of natural gas should also be taken into full account in market design considerations. The general trend over 2005-2006 was for gas prices to increase in all major markets, although the US (4th quarter 2005) and the UK (1st quarter 2006) markets have both had supply shocks which induced prices to suffer short-term peaks. These markets have both seen a decrease in prices in the run-up to winter 2006 as the market has taken account of better supply fundamentals than had been expected. While different regions use different pricing systems, interaction between the regions is increasing, creating potential friction and opportunities. Whether liquefied or not, natural gas is much more difficult and costly to move from one region to another than oil, although transportation costs are much lower than ten years ago. Prices in one region are likely to influence prices in other regions through new opportunities for trade. Arbitrage possibilities sometimes exist between various markets through diversion of LNG cargoes, or through pipeline/LNG swaps. Where these deals are arranged, pricing signals from one market are directly transferred to another, meaning that the price differential affects the demand/supply balance in both regions – an essential factor to bear in mind in market design. Gas markets are no longer isolated, and events in one region will have an impact on other regions. The gas market is not yet global, but policy makers and other stakeholders can no longer ignore what is happening in other regional markets.

CLIMATE CHANGE

In 2005 and 2006, IEA countries addressed global warming with a broad array of initiatives, implementing mitigation measures of local, domestic and multinational scope. Major regional developments in climate change policy included the first meeting of the Parties to the UNFCCC's Kyoto Protocol (COP/MOP 1) in Montreal, since the Protocol's entry into force in February 2005 and the first full year of regulated emissions trading in the European Union (EU-ETS). The G8 and the Asia-Pacific Partnership, in which many IEA nations participate, both inaugurated broad strategic plans to include developing economies in common climate change mitigation goals.

Looking forward, the European Union sought to define the post-2012 period within the context of its Emissions Trading Scheme, to provide governments and market players with more certainty regarding energy investments. Discussion began in earnest among members of the UNFCCC on worldwide measures to curb GHG emissions and adapt to climate change following the end of the Kyoto Protocol's first period in 2012. It is clear that despite action undertaken so far, CO_2 emissions are still rising worldwide.

On a domestic scale, many IEA countries attempted to curb emissions across their economies, targeting the sectors of energy production, buildings, transport and industry. Within each sector, nations used a range of policy instruments to promote energy efficiency and renewable energy sources, and to reduce the carbon intensity of fossil fuel use. Despite these efforts, emissions continued to rise, indicating that policies implemented thus far are not sufficient.

RENEWABLE ENERGY

The development and deployment of renewable energy technologies are important components for the future of a balanced global energy economy. The IEA full-scale study, "*Renewable Energy: RD&D Priorities*", looks at various types of renewable energy with the objective of better targeting renewable energy technology RD&D to ensure a higher market penetration. Renewable heating sources have potential for growth and can replace substantial amounts of fossil fuels and electricity currently used for heating purposes. To exploit the full potential of renewable heating and cooling, it is necessary to invest more in RD&D for a considerable time, to further increase their overall efficiency and reduce the technology cost.

In 2005, about 2% of the world's gasoline market and 0.2% of the world's diesel market were supplied by biofuels. There is substantial potential to reduce the costs of all biofuel production processes by 2030. Technologies under development could widen the range of feedstocks and improve the economics of biofuels, thereby reducing carbon emissions from transport. Support mechanisms are needed to speed the transition to second-generation technologies. However, quota policies in IEA member countries that provide incentives to biofuel production and stimulate demand can be costly in terms of carbon emissions avoided, and do not necessarily lead to the development of new and improved technologies.

With current technology, the sugar cane process is much more efficient and has much greater environmental gain than processes using temperate region crops. Bioethanol from sugar cane contains eight times the amount of energy that is needed to produce it, whereas for corn bioethanol the ratio can be much less than two to one. Sugar cane bioethanol can reduce CO_2 emissions from transport by 90%, whereas the savings with root and cereal crops are only in the region of 10-15%.

TECHNOLOGY, RESEARCH & DEVELOPMENT POLICY

In 2006 the IEA's new global technology analysis *Energy Technology Perspectives* looked into the role technology could play up to 2050. The book takes a detailed look at status and prospects for key energy technologies in power generation, buildings, industry and transport. It puts forward strategies for attaining scenarios unimaginable under current trends. The conclusions are clear: by employing technologies that already exist or are under development, such as more efficient processes and products, carbon capture and storage, renewables, and nuclear, the world could be brought onto a much more sustainable energy path. But urgent action is needed from the governments in IEA countries to bring about this change.

Despite the critical role to be played by energy technologies, the current level of energy R&D, in both the public and private sectors, is a serious cause for concern. After a significant increase from the mid-1970s to early

1980s, government energy R&D budgets in member countries have declined, and stayed on a relatively stable, low level since the late 1990s. It is unlikely that the technological challenges facing the energy sector can be addressed without significant increases to R&D budgets in IEA member countries.

Chapter 8 on energy technology and R&D presents overall conclusions from the *Energy Technology Perspectives* book, and discusses the policies required and recent trends in technology development in IEA member countries. It concludes that moving towards carbon-free electricity is possible by 2050 with considerable effort, while moving towards carbon-free transport will take considerably longer to achieve.

ENERGY POLICIES IN KEY NON-MEMBER COUNTRIES

There have been various developments in major non-IEA countries in terms of energy security, energy market reform and environmental protection. This book contains a short introduction to such developments in China, India, South-East Asia, Latin America, Russia, Caspian and Central Asia, Central and South-Eastern Europe and sub-Saharan Africa.

Energy security remains central to **India**'s public policy debate. The proposed integrated energy policy was released in December 2005. This proposed policy document stresses the need to promote competitive and transparent energy markets and to have independent regulation for areas where market forces alone cannot deliver policy objectives. It places great emphasis on energy efficiency and demand-side management, and identifies a 25% potential for improvement in energy intensity. Implementation of the Electricity Act 2003 and several legislative and policy initiatives were undertaken, including the notification of the National Tariff Policy and the launch of a scheme aimed at providing electricity to all villages and habitations within four years. The "Petroleum and Natural Gas Regulatory Bill" was approved in early 2006. The act foresees the creation of a downstream regulatory authority for petroleum and natural gas, in order to promote competition. However, pricing of petroleum and natural gas is excluded from the act and will remain under government control. The National Auto Fuel Policy announced in 2003 is gradually being implemented in line with the road map spelled out in the policy document. The "National Energy Labelling Programme" for electrical items was launched in May 2006. Under the programme, six electrical appliances have been selected. Labels will become mandatory within six months of the launch of labelling for each appliance. The second draft of the "New and Renewable Energy Policy Statement" was prepared in 2005, providing a strategic vision up to 2100 for new and renewable energy sources in India.

Russia is and will remain an energy superpower. Over the decades, it has historically been a reliable supplier of oil and especially of natural gas, even through politically turbulent times. While the controversy relating to gas delivery between Ukraine and Russia early in 2006, which affected the stability of gas supply in Europe, was not symptomatic of imminent Russian delivery problems, it did serve to focus the world on the security of Russian gas supply. This incident has raised concerns about Russia's future ability to deliver gas, especially after several years of watching Russia's oil production growth rate decline as investors lost confidence in the stability or adequacy of Russia's investment regime. Underinvestment in Russian oil and gas production is a critical issue to world oil markets as Russia had become a key driver of non-OPEC supply growth in recent years. Creeping nationalisation in the oil sector, with Yukos and Sibneft now under state monopoly control, has raised questions about whether continued investments would be timely, especially in view of the need to develop more difficult fields in East Siberia and Northern Russia. The IEA's long-standing concerns about fiscal, legal and regulatory reform (including streamlined environmental and safety regulations) remain unchanged. More transparent and fair third-party access to oil and gas transmission systems continues to be a key need to provide for more competition, especially in the upstream natural gas sector. Such regimes will be increasingly critical to ensure an attractive environment for oil and gas company investments and to buoy Russian economic growth and global energy market stability.

The IEA published *Optimising Russian Natural Gas* in July 2006, analysed the potential to free 30 billion cubic metres of gas production per year by reducing gas losses and GHG emissions in the Russian natural gas sector and to limit natural gas flaring by oil companies. This is increasingly important given the era of "cheap" gas coming to an end for Gazprom. A clear win-win option to reduce pressure on gas deliverability is a strategy to slow rising domestic gas demand as the Russian economy grows, through intensifying energy efficiency programmes and more market-based gas pricing.

INTRODUCTION

OVERVIEW

Energy efficiency has seen increased policy attention and action in IEA member countries in recent years, with a number of member countries and the European Union (EU) introducing new initiatives to make them more energy-efficient. This new momentum is driven by increased fuel prices, and increasing concerns about long-term security of supply and climate change.

In the 2005 IEA Ministerial Meeting, ministers instructed the IEA Secretariat to monitor IEA member countries' efforts to improve their energy efficiency policies, including in its peer Country Reviews, and to share best practices globally. One of the key areas in the Gleneagles Plan of Action is "Transforming the Way We Use Energy", and the IEA has been asked to identify best-practice policies in buildings, appliances, surface transport and industry.

Barriers, Opportunities and Policy Solutions

Existing technologies offer cost-effective energy savings in every sector of the economy. In some end uses and locations, the savings potential can exceed 40%. The recent increases in energy prices, however, do not yet appear to have stimulated a level of investment in conservation that would achieve these potentials. This raises the question of why consumers fail to implement the available measures to achieve those savings, and whether government policies could help overcome the reluctance to invest in energy efficiency. Typically, several explanations contribute to what at first may appear to be behaviour that is difficult to understand. These explanations are sometimes referred to as "market barriers", but some in fact represent reasonable consumer behaviour, given the environment in which decisions are made.

Getting the price signal right is an important element in encouraging appropriate efficiency investments; however, there are many situations where the person selecting an energy-consuming device does not pay for the device's energy running costs, and in such cases, even the correct price signal will not have an impact on decision-making. While the most obvious case is the relationship between a landlord investing (or failing to invest) in energy efficiency, and a tenant who pays the energy bills, these split incentives (sometimes called "principal agent" problems) do not only occur in landlord-tenant situations. For example, most large firms and governments maintain separate capital and operating budgets. Transferring anticipated operating savings into the capital budget for efficiency investments is often resisted for a variety of technical and institutional reasons. Efficiency investments may therefore be smaller and the transaction costs associated with them will make these investments difficult to aggregate to a scale comparable to other items in the capital budget.

Another barrier exists in the form of so-called "Regulatory Failures", distortions in energy use caused by regulations designed to accomplish some other goal (such as the encouragement of less efficient domestically manufactured products), and these may also discourage efficiency investments.

Even when these barriers do not exist, consumers may have little access – especially at the time of the purchasing decision – to energy and economic investment data. Labels, databases, and information campaigns regarding products can all help to reduce the transaction cost and the perceived risks of efficiency investments by giving this information to the consumer/investor at the time of purchase.

Finally, many other potential investments compete for a consumer's/investor's limited time and money. It is easy to imagine a residential consumer who is considering whether to buy insulation, a new roof, or an upgraded video system, having to weigh up these kinds of benefits, to understand that corporations face similar problems.

Efficiency improvements are impeded by a series of barriers. For some consumers, the benefits are sufficiently large to overcome the barriers, but for many others they either prevent or delay action. Government policies exist to reduce these barriers, and because of the diverse nature of the barriers, a portfolio of policies will be more effective. Most of these policies fall into the following categories:

- Make certain that the energy price reflects the costs of supplying the energy and, at the same time, ensure that decision makers (with regard to both efficiency investments and operation of equipment) actually see the price signal and can benefit from reacting to it.

- Provide information to decision makers in order to improve their ability to accurately consider the costs and benefits of efficiency. An environment richer in information will also reduce the decision maker's perceived risk in an investment.

- Use regulatory measures and financial instruments where market failures or barriers are too complex to overcome.

- Evaluate policies on a regular basis to encourage efficient consumer actions to ensure that energy savings are indeed occurring.

- Promote research to develop more efficient products. These innovations often lead to greater diffusion of products as a result of wider technical applicability or lower costs.

- In the case of internationally traded products and in certain other situations, efficiency measures can be introduced more quickly, at lower costs, through international co-ordination of test procedures and specifications.

Energy Efficiency's Role

In the *Energy Policies of the IEA Countries (Compendium)* 2004 and 2005, common policy challenges and "good practices" in addressing such challenges were identified in the fields of general energy policy, energy and the environment, energy efficiency, renewables, energy market reform, security of supply, nuclear, and energy R&D. The *2006 Compendium* highlights "good practices" in energy efficiency, in line with the instructions from the IEA 2005 Ministerial and the Gleneagles Plan of Action.

Given the recent developments in energy markets, the role of energy efficiency is again highlighted in addressing energy security and climate change mitigation. These developments include *i)* the tightening global energy supply/demand balance due to rapid demand growth in emerging economies, *ii)* a concurrent lack of investment in energy production that has contributed to soaring prices of all types of fuels, *iii)* the growing dependence on imported oil and gas from fewer supplier countries in IEA member states, and *iv)* the simultaneous growth in geopolitical risks.

The examples below will hopefully show what can be achieved in the field of energy efficiency policy making, using a variety of primarily market-based measures, working in the same manner as the individuals and organisations who are to make the investments required. Many of these policies are still relatively new, and it will be instructive to observe any analysis and evaluation undertaken of their effects so far. Many "good examples" are taken from recent in-depth reviews. Other positive developments, reflecting the recommendations of previous in-depth reviews, are also taken as "good examples". It should be borne in mind that any list of good practices is not exclusive, and that other commendable examples exist elsewhere.

Nevertheless, in the recent in-depth reviews, it was often pointed out that energy efficiency policy is not receiving sufficient emphasis compared with renewable energy policy, even though they have similar benefits in terms of energy security and climate change mitigation, and energy efficiency is often the more cost-effective of the two. It will be important for IEA member countries – as well as others – to pursue energy efficiency more actively as a long-term policy, regardless of the level of fuel prices.

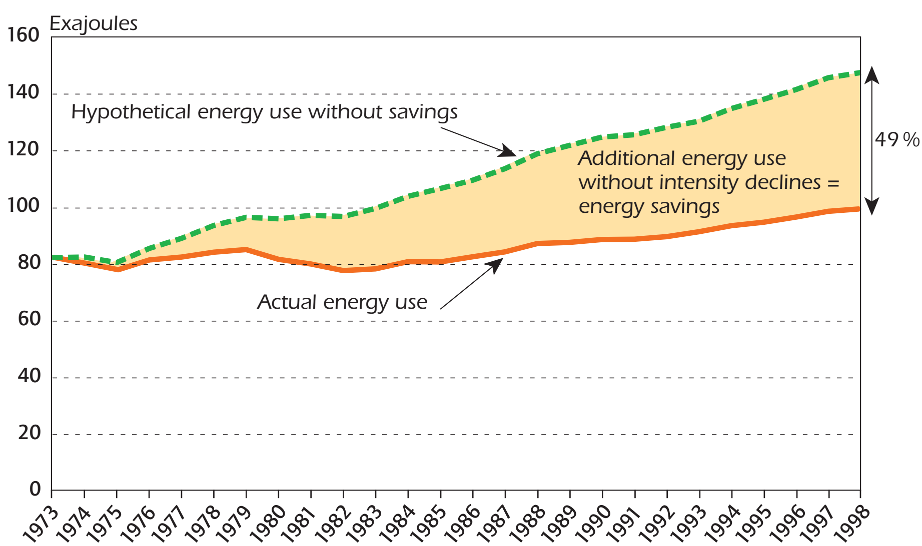
With increasing globalisation of production of energy-consuming goods, and increasing energy demand in non-member countries, it will also be important to consider the broadening of international approaches. Encouraging examples of international co-operation exist and are briefly outlined below. Work on them should be continued.

HISTORY OF ENERGY EFFICIENCY IN IEA MEMBER COUNTRIES

In the past, energy efficiency was primarily driven by energy price developments. The first wave of efficiency improvement in industrialised countries was seen following the oil crises of 1973 and 1980. At that time, together with emergency preparedness and energy diversification, energy efficiency was one of the primary policy pillars in addressing energy security and the increased price of oil, reducing exposure to volatile energy markets. The impact of the price-driven adjustments of the 1970s and 1980s can best be seen when analysing the observed energy demand increase compared to a counterfactual that assumes these savings had not been made. In such an analysis, the 1973 OECD countries' energy consumption would have been 49% higher without the efficiency savings between the first oil crisis of 1973 and 1998 (see Figures 1 and 2).

Figure 1

Actual Energy Use and Hypothetical Energy Use without Intensity Reductions, OECD-11, 1973 to 1998

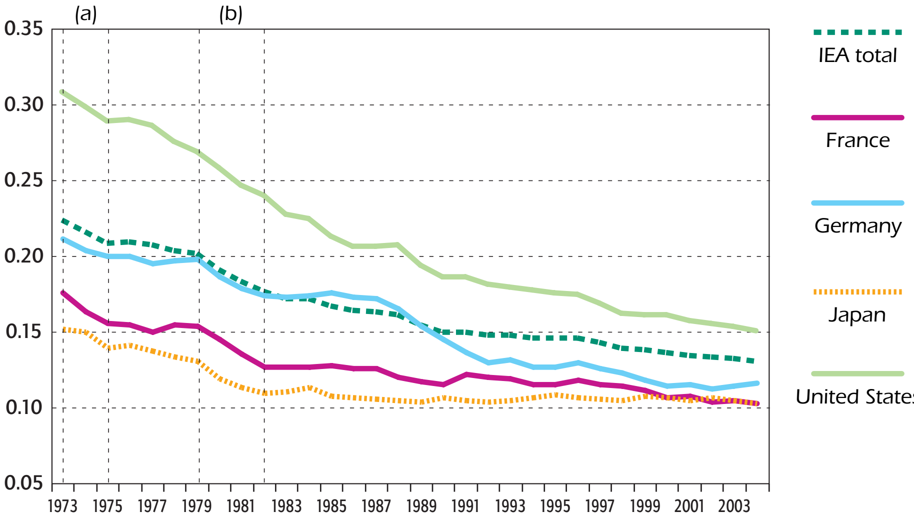


Source: *Oil Crises & Climate Challenges: 30 Years of Energy Use in IEA Countries*, IEA/OECD Paris, 2004.

Figure 2

Energy Intensity in Selected IEA Countries, 1973 to 2004

(toe per thousand USD at 2000 prices and purchasing power parities)



(a) corresponds to the first oil shock (end 1973) and macroeconomic recession induced by this shock.
(b) corresponds to the second twin oil shock (early 1979 and end-1980) and the macroeconomic recession induced by this double shock

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006, and *National Accounts of OECD Countries*, OECD Paris, 2006.

Lower prices for energy since the mid-1980s have led to a lessening of interest in energy efficiency for energy security and economic reasons, and efficiency gains in OECD countries have slowed. During the 1990s and early 2000s, increasing environmental concerns about the emissions from fuel combustion made energy efficiency increasingly an environmental policy issue, in which policies primarily aimed to reduce emissions of all types of pollutants coming from energy use. Now, however, many member governments regard energy efficiency in a more balanced way, as a primary tool to achieve the 3Es (Energy security, Economic development and Environmental protection) at very low or even no cost. Energy efficiency is now sometimes viewed like other energy reserves available to a country, available to supply a part of the country's energy requirements.

POLICY DEVELOPMENT

Remaining Potential

The global potential of further energy efficiency improvements is enormous. The *World Energy Outlook 2004* shows for example that to achieve the

Alternative Scenario, significant efficiency improvements will have to come from a range of measures to improve end-use efficiency such as more efficient vehicles, industrial processes, and appliances, as well as stricter building standards. These would lead to a reduction of demand by 10%, compared to the Reference Scenario, and this would in turn account for 60% of the Alternative Scenario's reduction in CO_2 emissions (see Figure 3), with the remainder achieved by increased use of renewables.

Considering the historical precedents and the available potential, it is reasonable to expect that higher energy prices could become the most important signal for increased efficiency in energy use. However, owing to the lag in investment, delayed availability of statistics, and also to numerous market imperfections, it is still too early to see these prices reflected in efficiency improvements. Finally, energy efficiency is often trapped by market failures, barriers and inadequate government regulation. That is why stronger energy efficiency policies are necessary to reverse the declining trend of energy efficiency improvement and to capture abundant cost-effective energy efficiency potentials, instead of relying only on the impact of higher energy prices.

Lessons that emerge from the successful energy efficiency policies portrayed in the chapter are summarised below:

General

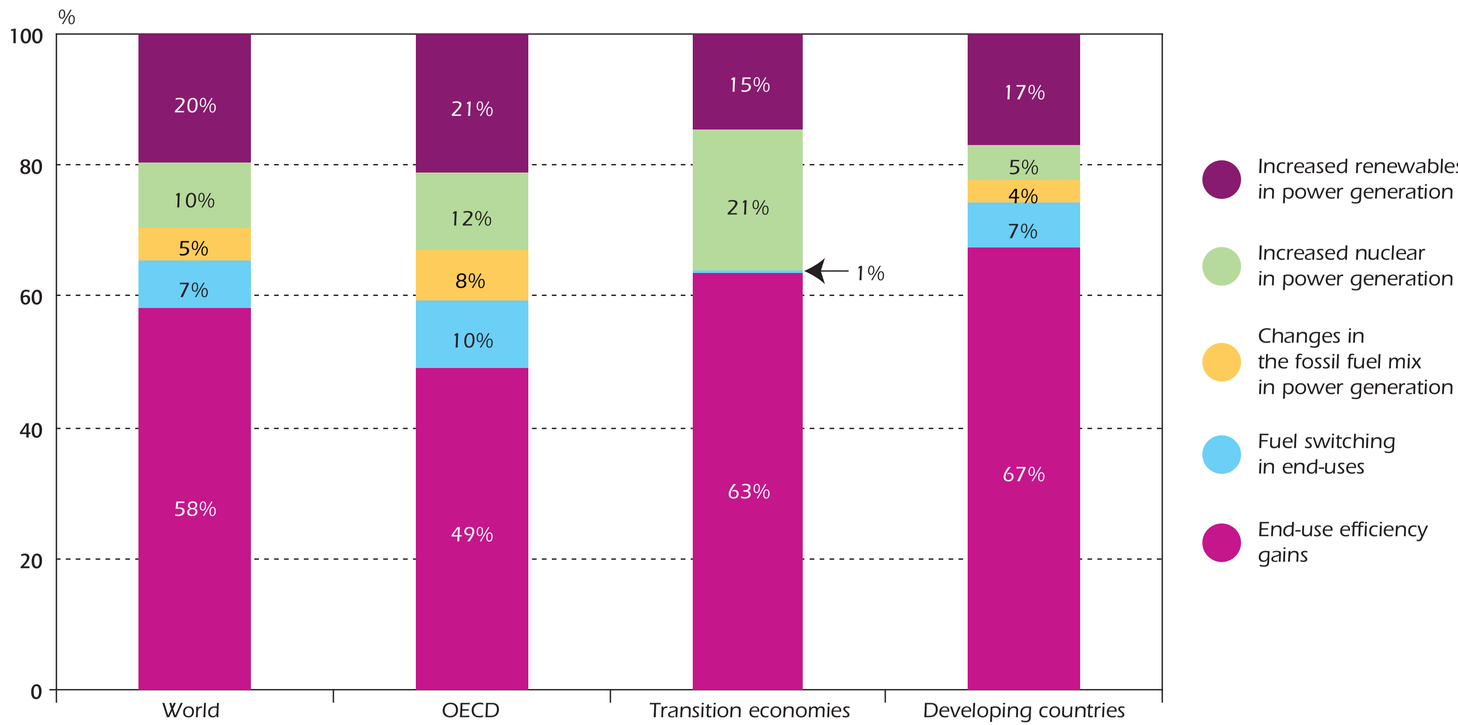
- Energy efficiency should receive a higher profile in the national energy policy.
- Energy efficiency policies should be promoted by developing a comprehensive strategy with clear targets, realistic timetables and concrete policies and measures.
- Setting up a special institution, or giving responsibility for implementation and support of energy efficiency to an existing body which is independent from central government budgetary constraints, could be instrumental in achieving successful policies.
- The impact of energy efficiency policies and measures should be closely monitored and assessed.

Industry

- Monitoring energy consumption trends and exploring efficiency potentials are crucial in designing policies for the industrial sector.
- Voluntary agreements with industries should have wide coverage and clear and measurable targets, and in particular aim for savings beyond business-as-usual. If they fail, they should be replaced by mandatory measures.
- Government procurement can play a significant role in encouraging the uptake of energy-efficient products.

Figure 3

Reduction in Energy-related CO_2 Emissions in the Alternative Scenario* by Contributory Factor,, 2002 to 2030



* compared with the Reference Scenario.

Source: *World Energy Outlook 2004*, IEA/OECD Paris, 2004.

- Energy audits are an important tool in shaping awareness for industrial and commercial energy users.

Transport

- The tightening of fuel efficiency standards is instrumental. Furthermore, the efficiency of specific components, which may not be captured in the current fuel efficiency tests, needs to be addressed.
- Road charging and regulations can be effective (while their net impacts remain to be seen).
- Vehicle taxation based on fuel efficiency or CO_2 emissions, rather than on engine size or vehicle weight, is instrumental.
- Eco-driving lessons can be a cost-effective means to achieve savings.

Buildings and Appliances

- Tight minimum efficiency standards with wide coverage of products are instrumental. The conditions of energy efficiency tests need to reflect realistic predictions of actual energy use.
- 38% of global lighting electricity consumption could be saved cost-effectively by the widespread adoption of efficient lighting technology and practices.
- Stringent building codes, which are strengthened over time with predictability, are effective.
- Relatively simple energy saving obligations on energy suppliers seem to be working. The impact of the more sophisticated White Certificate scheme remains to be seen.

CROSS-COUNTRY OVERVIEW

The cross-country overview of this chapter outlines recent developments and examples of good practice, and is organised by sector of energy use and field of policy. Best practice examples are presented in textboxes, enabling policy makers to judge the policies presented, and consider their appropriateness for their own countries.

GENERAL ENERGY EFFICIENCY POLICY

Energy Efficiency in the Energy Policy Mix

In order to explore energy efficiency potential to the maximum extent possible, energy efficiency measures need to receive high priority in the national energy policy. In the IEA in-depth reviews, it is usually recommended that this should take the form of a comprehensive governmental strategy to achieve energy efficiency, with concrete goals, a realistic timetable covering the medium term, identified sources of funding, and procedures for monitoring.

In ***Spain***, the government developed the E4 energy efficiency strategy through interministerial co-operation in 2004. Such co-operation is useful good practice in developing energy efficiency strategies, because it leads to reduced friction at the time of implementation. While the strategy was agreed in 2004, it took until 2005 to agree on the funding of the implementation plan, highlighting a major challenge that governments may face and should plan for when trying to work across ministerial and budgetary boundaries. The strategy covers all sectors of the economy, but expects that almost half the savings of 7.2% of total final consumption (TFC) compared to a business-as-usual scenario will be achieved in the transport sector. It is described in detail in *Energy Policies of Spain – 2005 Review*.

In ***Germany***, the government has made energy efficiency a key policy element featuring in discussions at the three energy summits in 2006 and 2007, bringing energy suppliers, major users, and politicians together.

In ***Denmark***, despite an already good record for national energy intensity, which is 35% below the IEA average, the government made improved energy efficiency a major part of its new energy strategy in June 2005. An historic increase in energy efficiency has been achieved, together with strong economic growth, and relatively constant energy consumption. Even though Denmark is already one of the most energy-efficient members of the IEA, the government sees further potential for increasing the efficiency of energy use in Denmark.

Denmark's principal political parties worked out an agreement on future energy-saving initiatives, which is a central element in an energy strategy. The parties agreed that overall energy consumption, exclusive of transport, must be reduced by 7.5 petajoules (PJ) per year on average (equal to 1.7% of final energy consumption, excluding transport) from the baseline scenario during the period 2006-2013. The savings objective set in the agreement is approximately three times higher than current actual savings. With the agreement by the parties, in September 2005 the government published the final *Action Plan for Renewed Energy Conservation Efforts* (see box below).

ACTION PLAN FOR RENEWED ENERGY CONSERVATION EFFORTS IN DENMARK

The September 2005 Action Plan estimates the total potential energy savings available in the Danish economy. Although significant energy savings have been achieved over several years, the document claims that there are still major, potential savings to be gained from technological development.

The document concludes that using low-cost measures, the profitable, cost-effective savings potential with today's technology is currently at least 10% of energy consumption. If savings are realised when equipment, processes and buildings are being improved, maintained or replaced, it will be possible to realise attractive cost-effective savings amounting to nearly 25% over the next ten years, assuming that technological development from increased research and development continues.

Like the political agreement, the Action Plan excludes treatment of energy use in the transport sector, and calls for energy savings in three main areas:

- ***Savings through energy distribution companies***

  A significant part of the increased energy savings will be achieved through savings delivered by the electricity, natural gas, district heating and oil network and distribution companies. This must occur within current economic frameworks, meaning that tariffs will not be increased to cover the costs of new energy efficiency measures. Monitoring will be introduced, and companies will have a large degree of choice when it comes to the methods adopted. They will be able to work in any industry they wish and in any field or jurisdiction they wish. They will also be able to trade obligations among themselves and to buy savings from other actors.

- ***Savings through new building codes and enforcement***

  Energy conservation efforts will increasingly be made regarding energy consumption in buildings. The main initiatives include strengthened energy requirements in the Building Regulations, a new and improved energy labelling scheme, enhanced inspection of boilers and ventilation systems and, finally, increased efforts in the public sector.

- ***Savings in the public sector***

  Saving energy in the public sector is another focal area. The public sector must procure energy-efficient products and implement profitable savings. A circular has been issued on improving energy efficiency in government institutions. As a result of the political agreement, municipalities and regions must meet the same requirements as those applying to government institutions regarding energy-efficient procurement and achievement of energy savings, with up to five years' payback time.

Many of the details concerning the measures to be implemented in these three categories are still being worked out at the time of writing. In early January 2006, the government and the distribution companies finalised a draft agreement on the distribution companies' activities, including how much energy savings they would be required to contribute to the 7.5 PJ target. This draft agreement is under approval in the companies. Table 1 shows the savings that had been realised under the existing system, the savings allocation based on the December 2004 draft Action Plan which targeted 1.0% annual energy savings, and the draft savings obligations by sector to reach the 1.7% target of 7.5 PJ of annual savings.

Table 1

Existing and Draft Energy Savings by Sector

Annual savings excl. transport, PJ	*Actual*	*Draft Action Plan*	*Draft Agreement*
Electricity Saving Trust	0.39	0.49	0.6
Electricity grid companies	0.78	0.97	1.4
Natural gas companies	0.08	0.10	0.5
District heating companies	0.16	0.20	0.9
Oil companies	0.0	0.0	0.15
New buildings	0.00	0.70	0.7
Existing buildings	0.60	1.82	1.85
Public sector	0.00	0.25	0.4
Appliances	0.30	0.30	0.5
Industry	0.40	0.50	0.4
Total	**2.71**	**5.33**	**7.5**

Source: Danish Energy Agency.

Energy Savings Potential

Potential energy savings are tabulated according to both private economy and socio-economic criteria. For energy savings potential corresponding to the private economy criteria, all energy efficiency measures and investments that make long-term economic sense to the individual energy user are included, and the effect of their savings added together. The criteria include only the initial cost of the efficiency investment and the discounted savings over the lifetime of this investment. The socio-economic criteria require a more complex model intended to assess all the effects on society of any given action, in this case, increased efficiency. The costs include the investments required, as well as the loss of tax revenue through reduced energy sales. A distortionary factor of 20% is added to these lost tax revenues (as additional cost) since it is assumed that they would have to be recovered in other ways (such as income tax) which have negative secondary effects on the economy. In addition, there is another cost of 17% added to the investment being made to account for the fact that this money cannot be used elsewhere and was, in fact, not used optimally because the investor/energy user was influenced by the government. The benefits in the socio-economic model include the discounted savings realised through reduced energy costs over the life of the efficiency investment. In addition, value is given to the reduced CO_2, NO_x and SO_x emissions. No value is given to enhanced energy security or other emissions, such as particulates.

The major difference between the calculation methods is the treatment of taxes. For the private economy potential, the decreased taxes corresponding to decreased energy consumption are only a benefit. For the socio-economic calculations, the reduction in payments is counted as a benefit for the consumer, a cost for the government, and a 20% distortionary cost to the economy as a whole, since taxes must be gathered in other ways. Hence, there is a net cost in this model of 20% for any reduction in energy tax payments resulting from savings. As a result, energy investments appear much more attractive under the private economy calculation methodology than under the socio-economic calculation methodology. So potential energy savings are greater using the private economy calculation than the socio-economic calculation, as shown in Table 2 below.

Table 2

Potential for Energy Savings in Various Sectors

End use	*Final energy consumption 2003 (PJ)*	*Socio-economic potential up to 2015*		*Private economy potential (%)*	
		%	*PJ*	*Currently*	*Up to 2015*
Space heating	217.6	24	51.3	18	47
Industrial processes	66.5	25	16.5	13	27
Lighting	24.0	24	5.7	19	60
Cooling/freezing	15.1	28	4.3	10	35
Electric motors	12.4	15	1.9	10	30
Ventilation	11.9	40	4.8	13	38
Pumping	8.4	35	2.9	14	42
Other	71.3	24	17.2	11	33
Total	**427.2**	**24**	**104.5**	**16**	**42**

Source: Action Plan for Renewed Energy Conservation Efforts.

China is currently very active in improving energy efficiency. It is a topic that appears regularly in high-profile speeches of top leaders. The National People's Congress, the country's top legislative body, is engaged in drafting a revision to the Energy Conservation Law, which came into effect in 1998 and has been only weakly enforced. The *11th Five-Year Plan*, which was released in March 2006 and is intended to guide socio-economic development policy from 2006 to 2010, calls for a reduction of 20% in the country's energy use per unit of GDP. Recent news articles in China have raised alarms that China is off-track from this goal, and call for redoubled efforts to reach it. A number of new programmes are being rolled out, and some existing ones are being reinvigorated.

Energy efficiency has been added to the list of factors considered in evaluating the performance of local government officials, creating a personal incentive for this powerful class. Under a new national programme, the country's largest 1 000 industrial and energy facilities will have their energy use monitored, agree to targets to improve efficiency, and develop specific plans to reach those targets. Incentive policies will be offered to encourage enterprises to meet and exceed their targets. Some localities are extending similar programmes to cover even more enterprises. In 2004, the National Development and Reform Commission, China's top executive agency, released the *Medium- and Long-term Plan for Energy Conservation* setting out efficiency targets for industry, energy sectors, transportation and buildings. This *Plan for Energy Conservation* was reaffirmed in the *11th Five-Year Plan*, with the focus going to ten key projects, covering areas from renovation of coal-fired industrial boilers to improving electric motors systems, and encouraging government agencies to revise procurement rules to require the purchase of efficient equipment. Other areas of activity include energy standards and labels for household appliances, lighting equipment and office equipment, as well as a programme to encourage more efficient, less polluting motor vehicles. The government continues to support public awareness campaigns, including an annual "Energy Conservation Week", marked by public events for television and other media, exhibitions, and workshops.

Creating Institutions to Increase Efficiency

Some IEA member governments have set up special institutions whose task it is to support energy efficiency, often with a remit to overcome perceived market failures. When setting up such an institution, it is important to consider from the outset their independence from central government budgetary constraints in order to ensure that they can work without too much variation, and to set them up with a long-term framework to ensure that their partners take them seriously as actors in the energy efficiency field. Approaches chosen to achieve this budget stability include the Danish initiative of raising a levy on electricity consumption, or the Norwegian policy of creating a dedicated fund financed by a levy on the distribution tariff, the proceeds of which are used to finance the annual budget of the institution. It is also important to set clear medium- or long-term goals for the institution that are realistic and challenging. The institution's performance against the targets should also be subject to independent assessment.

A particularly instructive example comes from ***Norway***, where the government has set up Enova SF as a public agency tasked with achieving energy savings and supporting renewables and fuel-switching for heating. The underlying structure of Enova as an independent body with its own long-term funding and clear objectives is exemplary. The 2002/2003 programme of support for energy efficiency in the residential sector has shown that such an institution can be highly successful (see box).

ENOVA – NORWAY

Enova SF is a public agency owned by the Norwegian Ministry of Petroleum and Energy (MPE). It was officially created on 22 June 2001, and became operational on 1 January 2002. The basis for Enova's creation was a Storting (parliament) decision in 2001. Enova's tasks are to promote more efficient energy use, production of new renewable forms of energy, and environment-friendly use of natural gas. Quantitative targets have been set for Enova's activities in a contract between Enova and the MPE. Enova's work within energy production and use was previously split between the Norwegian Energy and Water Resources Directorate NVE and the electricity distribution utilities.

Mission

Enova's main mission is to support the environmentally sound and rational use and production of energy, by using financial instruments and incentives to support the deployment of renewable energy production and development of energy efficiency in Norway. Enova has a limit on the number of its employees, and is only supposed to work at a high strategic level, not in administering programmes.

Finance

For the purpose of financing Enova's activities, the Energy Fund was established in January 2002. The administration of the Energy Fund is regulated by an agreement between the MPE and Enova. The purpose of the agreement is to ensure that Enova manages the Energy Fund in line with the objectives and intentions decided upon by the Storting in the spring of 2000. The Energy Fund is financed by a dedicated levy (raised to NOK 0.01/kWh in 2004) on the distribution tariff for electricity, and an ordinary contribution of NOK 60 million from the state budget was allocated for 2004. This delivered NOK 530 million to Enova's 2004 budget. The core budget is guaranteed to Enova under a long-term framework, and is not subject to annual allocation by the government. This gives Enova the ability to conduct long-term planning within a secure funding environment. In the state budget for 2005 and 2006, no money has been allocated to Enova – *i.e.* from 2005 its activities are solely financed by the levy on the distribution tariff.

The government has set a new goal for renewable energy and energy efficiency of 30 TWh/year by 2016 compared with 2001. The government will renegotiate the agreement with Enova to reflect the increased funds and targets. In 2006, it was decided that a further NOK 20 billion will be added to the fund, giving Enova NOK 800 million per annum in additional funding from 2009, to finance investment into achieving the increased targets.

Impact

The establishment of Enova signalled a shift in the way the Norwegian government organises and implements its energy efficiency and renewable energy policies. The aim of creating Enova was to gather strategic policy responsibilities into a small, flexible, independent, and market-oriented organisation, allowing more flexible decision-making. The intent by the Norwegian government was to create a proactive agency capable of stimulating energy efficiency and renewables investment by market actors, leading to a self-sustaining market for these products without government support in the future. The government has given Enova very broad targets, so it enjoys considerable freedom in the choice and composition of its operational focus and policy measures. Reporting on energy results, activities and other achievements is done annually.

Enova advises the ministry on questions relating to energy efficiency and new renewable energy. Enova is also involved in international projects through EU funding, and represents Norway's energy efficiency and renewables policy in various international forums.

Enova was originally set the following targets:

- To limit energy use considerably more than would be the case if current trends were allowed to continue unchecked.
- To increase the annual use of central heating from new renewable energy sources, heat pumps and waste heat by 4 TWh/year by the year 2010.
- To increase wind power production capacity to 3 TWh/year by the year 2010.

In all, these three elements should amount to at least 12 TWh/year of energy savings and new energy supply by the end of 2010. By the end of 2005, Enova reported the following results for the first three years of its activity:

Enova works with both the energy supply and the energy demand sides, and the development and adoption of reliable methodologies for performance measurement and verification of results are high priorities of Enova's work. Moreover, Enova is not restricted by sector, and works with the domestic and commercial, industry and public sectors at the same time. To achieve these goals, Enova has organised its activities into main programme areas. Organisations interested in participating are invited to apply for funding within various programmes. In the prioritisation process between projects in the programmes, energy yield is treated equally in both energy-saving and energy production projects.

Table 3

Energy Results and Financial Investments into Energy Efficiency by Enova, 2002 to 2004

Sector	2002 GWh[1]		2003 GWh		2004 GWh		Total GWh	
Commercial	158	35%	180	43%	233	36%	571	38%
Construction	5	1%	26	6%	13	2%	44	3%
Residential	0	0%	49	12%	14	2%	63	4%
Newbuild	0	0%	0	0%	30	5%	30	2%
SME	n/a	–	n/a	–	65	10%	65	4%
Industry	140	31%	115	27%	291	45%	546	36%
Training	3	1%	40	9%	–	–	43	3%
Others	144	32%	13	3%	–	–	157	10%
Total	**450**	**100%**	**423**	**100%**	**646**	**100%**	**1,519**	**100%**
Sector	*2002 mNOK*[2]		*2003 mNOK*		*2004 mNOK*		*Total mNOK*	
Commercial	28	24%	38	38%	61	44%	127	36%
Construction	2	2%	5	5%	4	3%	11	3%
Residential	0	0%	14	14%	5	4%	19	5%
Newbuild	0	0%	0	0%	9	6%	9	3%
SME	n/a	–	n/a	–	10	7%	10	3%
Industry	19	8%	17	17%	51	36%	77	22%
Training	0	0%	17	17%	–	–	17	5%
Others	77	66%	10	10%	–	–	87	24%
Total	**116**	**100%**	**101**	**100%**	**140**	**100%**	**357**	**100%**

1. Over the lifetime of 10 years.
2. One-off investment in the year.

Source: *Energy Policies of IEA Countries: Norway, 2005 Review.*

Enova works with a broad network of players in all sectors of the economy, including decision-makers in commerce and industry, end-users, municipalities and other public-sector and regulatory bodies. Enova does not have regional offices, but has a network of subcontractors to co-ordinate and implement its programmes.

A formal external evaluation of Enova's activities will be made during 2006 by the MPE, making recommendations on funding and objectives for the subsequent period from 2007 to 2010. Ahead of this evaluation, the Norwegian government decided to set Enova new, more ambitious targets, and to extend the funding from the Energy Fund that is available to Enova. This decision is a clear vote of confidence in an institution that has performed remarkably well.

The President of ***Ukraine*** announced the creation of a new National Agency on Efficient Energy Use in 2005, which has now been set up and allocated a budget, in line with recommendations for good practice in this policy area. The government has developed a number of draft laws and sectoral programmes on energy efficiency, and has also passed several legislative amendments. The draft Energy Strategy for Ukraine foresees a halving of energy intensity by 2030. This would correspond to energy savings of 390 million tonnes of oil equivalent (570.3 million tonnes of coal equivalent), or 65% of planned energy consumption in a "business-as-usual" scenario; 228 Mtoe, or 40%, of this reduction would come from structural changes as the economy shifts away from heavy industry to a more service-oriented GDP. An even larger share of the reduction would result from technological improvements.

Policy Development Based on Experience

Close monitoring and evaluation of energy efficiency policies and measures are prerequisites for a successful energy efficiency policy. The ***UK*** provides a good example in this context. In December 2005, the government published the *Energy Efficiency Innovation Review: Summary Report.* This report summarises the conclusions of the Energy Efficiency Innovation Review (EEIR) launched jointly by the Department of Environment, Food and Rural Affairs (Defra) and the UK Treasury Department (Her Majesty's Treasury/HMT) in the Pre-Budget Report 2004. The document offers a detailed analysis of the scope, costs and benefits of existing and potential enhanced action on energy efficiency. It states that while the UK has made good progress in reducing emissions, it would need to take substantial new action to meet the goal of reducing CO_2 emissions to 20% below 1990 levels by 2010. The report analyses existing programmes in the household and business sectors and various ways to effectively expand them, *e.g.* finding that the introduction of the Energy Efficiency Commitment (see box below) led to a more than 50% increase in the number of cavity wall insulations in the UK. The report is also forward-looking and takes account of technological innovation in considering new demand-side efficiency technologies that go beyond established solutions, *e.g.* in the field of metering of small-scale energy consumer, and the provision of feedback.

Tradable Obligations: The Energy Efficiency Commitment (EEC) in the UK

Background

The Energy Efficiency Commitment (EEC) is the principal policy mechanism driving improved efficiency in existing homes. Under the EEC, electricity and gas suppliers are required to achieve targets for the promotion of energy efficiency improvements in the household sector. These targets do not prescribe the exact manner in which suppliers should attain these improvements. Instead, suppliers can fulfil their obligations by carrying out any combination of approved measures, including installing insulation or supplying and promoting low-energy light bulbs, high-efficiency appliances or boilers. Suppliers must achieve all their savings in the household sector and at least half of their savings obligation must come from households which receive income-related benefits and/or tax credits, the so-called "priority sector".

Suppliers are not accorded any explicit supplemental revenue to compensate them for the costs of achieving their savings obligations. Since they are in a competitive market with other firms threatening to capture their market share, they can pass through whatever percentage of these added costs as possible. Information on the extent of these costs and the resulting increases on customers' bills is provided below.) Many suppliers are using their EEC obligations as an opportunity to get close to their customers and enhance brand awareness.

Expanding levels of savings in the EEC phases

The first phase of EEC ran from April 2002 to March 2005. Energy suppliers successfully met their targets and were able to bank additional activity into the next phase of the scheme. EEC 2002-2005 is expected to save 0.37 million tonnes of carbon (MtC) annually by 2010. The current phase of EEC, running from April 2005 to March 2008, will deliver roughly double the level of activity of EEC 2002-2005, and is expected to achieve carbon savings of around 0.62 MtC annually by 2010. The Climate Change Programme of March 2006 recently expanded the EEC further, targeting around 1.1 of annual MtC savings for EEC3, the period 2008-2011. Table 4 shows the continuing growth of this programme in its different phases, including its initial incarnation as the Energy Efficiency Standards of Performance Programme (EESoP) from 2000 to 2002.

Table 4

Progression of Scope for the EEC Programme

	EESoP 2000-2002	*EEC1 2002-2005*	*EEC2 2005-2008*	*EEC3 2008-2011*	*Accumulated Total 2000-2011*
Annual carbon savings, MtC	0.07 (1)	0.4	0.6	1.1	2.2
% of emissions from residential sector	0.2%	1.0%	1.5%	2.7%	5.3%
% of total UK emissions	0.05%	0.3%	0.4%	0.7%	1.5%
Total energy savings, TWh (2)	13	62	130	204 (1)	409

1. Approximation.
2. These savings are derived from the formulae the government uses to determine savings for each measure implemented. Since it involves discounting the savings from future years, the actual level of savings over the lifetimes of the projects will be greater.

Sources: Ofgem; British Gas; *CO_2 Emissions from Fuel Combustion,* IEA/OECD Paris, 2005.

EEC administration

While EEC policy and targets are shaped by Defra, programme operation is handled by the regulator, Ofgem. This includes setting suppliers' targets, assessing proposals for savings schemes, monitoring activity, approving compliance schemes and enforcing compliance when necessary. The savings realised by suppliers for any specific measure implemented are calculated in the following way. First, a determination is made for both business-as-usual energy use and energy use with the measure put in place. The annual energy saving is the difference between the two. This annual energy saving is then discounted over the expected lifetime of the product. Finally, the discounted energy saving is fuel-standardised. This takes into account the carbon content of the fuel being displaced and thus determines each measure's level of emissions reduction.

Table 5 shows the measures allowable under the EEC scheme.

Twelve supplier groups were set a target under EEC1: Atlantic Electric and Gas, British Gas, Cambridge Gas, Dee Valley, EDF Energy, RWE npower, Opus Energy, Powergen, Scottish and Southern Energy, Scottish Power, Telecom Plus and TXU Energi. Obligated suppliers that do not meet their savings targets are subjected to penalties equal to 10% of their revenue. Thus far, no suppliers have failed to meet their targets, except for TXU Energi which went into administration in 2002 and Atlantic Electric and

Table 5

Energy Efficiency Measures Accredited under EEC1

(measures in bold accounted for 98.7% of savings realised)

Cavity wall insulation	**Jug kettles**
Loft insulation	**Condensing boilers**
DIY loft insulation	**Heating controls**
Draught stripping	**Thermostatic radiator valves**
Hot water tank insulation	**New central heating**
External wall cladding	**Upgraded heating**
Insulation of pipes and valves	Ground sourced heat pumps
Radiator panels	Combined heat and power
Refrigerators	Upgrading district heating boiler
Fridge freezers	Kiltox heat fans
Freezers	**Compact fluorescent lamps (CFLs)**
Washing machines	**Luminaires designed solely for CFLs**
Dishwashers	

Source: "Evaluation of the Energy Efficiency Commitment 2002-05", Eoin Lees Energy, 28 February 2006.

Gas which went into administrative receivership in 2004. While savings obligations can technically be traded among suppliers, very little of this activity has taken place.

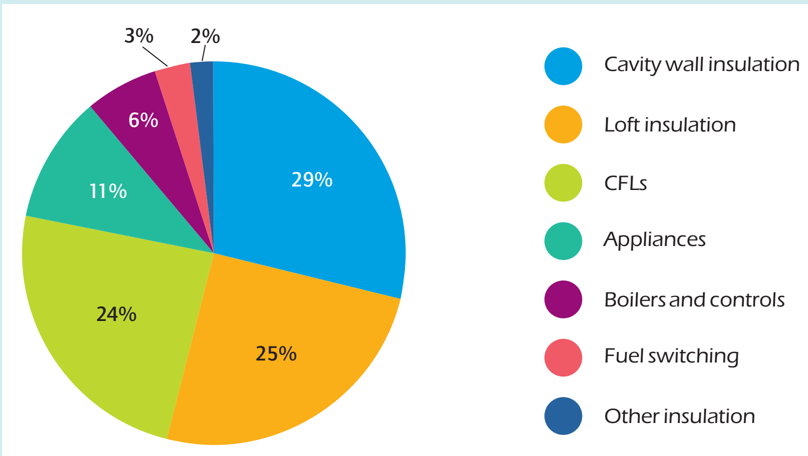
Results

The results of the EEC have thus far been positive. Suppliers have met – and very often exceeded – their targets, and the costs for doing so have been less than expected by Defra. During the three-year period of EEC1 (2002-2005), measures put in place are expected to result in 86.8 TWh of savings. This is nearly 40% higher than the target of 62 MtC of savings from that time period. The "extra" savings can be carried over to the EEC2 (2005-2008). Savings in the priority sector were around 45 TWh, while those in the non-priority sectors were around 42 TWh. The chart below shows how much each set of measures contributed to the total savings for all obligated suppliers.

Results thus far for EEC2 (2005-2008) show that savings are being achieved at rates well above the obligation levels. The carry-overs from EEC1 equal 27% of the suppliers' EEC2 obligations for the whole three-year period. EEC2 activity from April 2005 through year-end 2005 generated another 21% of the savings obligation. In addition, anecdotal evidence suggests that, in part because of the high UK energy prices seen this past winter, a great deal of energy savings activity has taken place thus far in 2006. Thus, it is likely that suppliers will meet their EEC2 obligations without undue difficulty and are likely to again carry over substantial savings to the subsequent period.

Figure 4

Energy Savings by Measure Type as % of Total Savings for EEC1



Source: *Energy Efficiency Commitment Update,* Issue 13, August 2005, Ofgem.

In its February 2006 report to Defra on the EEC1,[1] Eoin Lees Energy calculates that the EEC1 measures have been realised at a total cost of 1.3 p/kWh for electricity and 0.5 p/kWh for gas. These figures include all costs from both the obligated supplier and the consumer who may contribute to some of the cost of the measures implemented. The cost of savings for both electricity and gas is less than the consumer prices for these fuels, which the report cites as 6.7 p/kWh for electricity and 1.7 p/kWh for gas in 2004. (These consumer prices have risen significantly in 2005 and 2006.)

As for the effect on customers' bills, Eoin Lees Energy in the same report calculates that the average customer's bill has risen by GBP 3.18 per year per fuel. This is around 20% less than the expected customer bill increase estimated by Defra. Ofgem estimated in April 2006 that for EEC2, the likely increase to each customer's bill will be GBP 9 per fuel per year. To put this indicative figure in context, energy bills in the UK currently average GBP 330 and GBP 520 per year for electricity and gas respectively[2], Of course, the activity of the suppliers and the degree to

1. Evaluation of the Energy Efficiency Commitment 2002-05", Eoin Lees Energy, 28 February 2006.
2. Energywatch, February 2006.

which they must financially encourage consumers to implement energy savings measures is inversely related to energy prices. High energy prices – and public and press attention to these prices – will motivate consumers to be more energy-efficient even in the absence of supplier activities. It is therefore possible that the amount suppliers need to spend to achieve their savings obligations will be less than anticipated for EEC2.

Defra has estimated[3] that the measures implemented in EEC1 resulted in a negative cost of around GBP 300 per tonne of carbon emissions reduced. In other words, the measures were cost-effective without taking the benefits of reduced emissions into account.

Given that energy consumption in the residential/commercial sector is continuously growing in many IEA countries, this instrument addressing the household sector, which is not subject to Climate Change Levy or EU-ETS, is innovative and highly successful. In the first phase (2002-2005), energy suppliers surpassed their targets with net benefits. The programme's success can be attributed to various factors. First, putting obligations on a limited number of energy suppliers instead of numerous end-users has made the system management relatively simple. Second, the calculation of energy saving has been relatively easy because the measures have focused on insulation, heating, appliances and lighting. Ofgem published a list of all pre-approved measures the suppliers may implement and how much energy savings each measure will be worth. This substantially lightens the administrative load for everyone involved. Third, there have been plenty of "low hanging fruit" for achieving the targets. The majority of the target has been achieved through insulation, an area where UK housing has traditionally been poor. Fourth, there have been various initiatives by the Energy Saving Trust, involving consumers and manufacturers/retailers of energy-efficient equipments to supplement the EEC.

These are all commendable and it is understandable that the government doubled the target for the second phase (2005-2008), and nearly doubled it for the coming third phase (2008-2011). Having said that, there are several challenges to be addressed. First, given that low hanging fruit will be gradually exploited, broader measures such as microgeneration, behavioural changes and smart metering will need to be incorporated. In the mid to long term, the EEC can be utilised to encourage innovative low-carbon technologies, which are essential in achieving the government's long-term target of 60% emissions reduction in 2050. Second, the government and Ofgem should ensure that such a wider scope will not result in unduly complicated and cumbersome administrative procedures. The current limited range of measures already requires energy suppliers to devote administrative efforts in order to meet their obligations. It is a challenging task to broaden the scope while

3. "Assessment of EEC 2002-05 Carbon, Energy and Cost Savings", April 2006, Defra.

minimising administrative burdens. For this purpose, developing standardised and simple methodology for calculating energy savings from any newly introduced measures is essential.

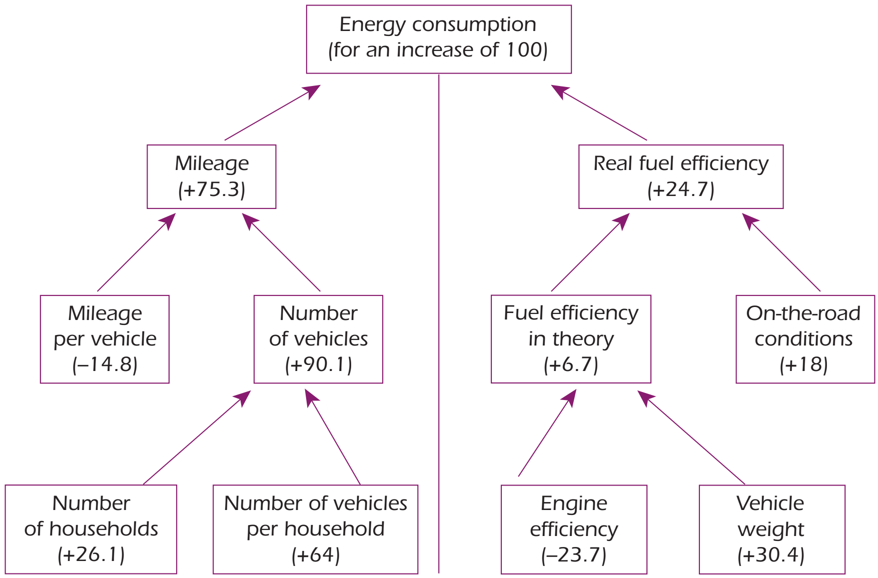
Given that the "low hanging fruits" of cost-effective demand-side measures will be increasingly exploited as the EEC targets are expanded, the government may consider additional measures for changing the behaviour of the household sector, together with incorporating broader measures in the EECs. Certain UK actors have suggested that there could be a tax incentive (*e.g.* reduction of community tax) for reduction of energy consumption. While ensuring that policies targeted to end-users and those targeted to energy suppliers would not hamper their overall efficiency and effectiveness, such options would merit consideration.

Third, the efficacy of incorporating social policy objectives in the EEC should be carefully evaluated. Currently, energy suppliers must realise at least half of their energy savings in the priority sector *(i.e.* low-income households). However, imposing such constraints is likely to reduce the overall cost-effectiveness of the system. In fact, it is likely that suppliers could realise savings at lower cost in wealthier households since such end-users would be able to pay for a greater share of the measures put in place. And, consumer contributions aside, any type of restrictions put on the suppliers will raise the cost of the entire system. There is, of course, an equity issue to be considered. Since all consumers contribute equally to the cost of the EEC (through higher energy rates), supplier activity heavily weighted towards upper-income customers would result in a subsidy from the less well-off to the more well-off. In addition, lifting the 50% obligation for the priority sector would diminish the EEC's effectiveness as a tool for combating fuel poverty. However, the EEC was launched as an energy efficiency programme and the 50% requirement could hamper its ability to achieve its goals. While equity and fuel poverty are important policy issues, they can be pursued more effectively through more direct and targeted policies that are not incorporated in the EEC programme itself.

In ***Japan***, the government carried out a comprehensive analysis of which factors cause an increase in energy consumption and the effect of energy efficiency measures, such as the Top Runner Programme (see box below), in its energy efficiency policy review in 2001. For example, the transport-sector analysis showed that all gains in engine efficiency through the Top Runner Programme were more than offset by increased vehicle weight and driving conditions. It became clear that two-thirds of the increase in fuel consumption in the transport sector could be attributed to increased mileage and the remainder to reduced on-the-road fuel efficiency. Such analysis enabled Japan to specify the areas where further efforts would be needed to improve energy efficiency in the transport sector, outlined in Figure 5.

Figure 5

Factors in the Increase of Energy Use by Private Vehicles in FY1990 to 1998



Source: METI.

Evaluation

In ***Denmark***, a private consulting firm evaluated the performance of the Electricity Saving Trust, an independent organisation established in 1996 to promote electricity conservation in homes and the public sector, in October 2004. The report, *Evaluation of the Danish Electricity Saving Trust*, was the product of a study commissioned by the Board of the Danish Electricity Saving Trust as a means of evaluating its performance and gathering recommendations for the way forward. While the overseeing agency or ministry should ideally commission such an evaluation, the Danish report nevertheless provides a good example of what an evaluation report should consider. For example, the report analyses the trust's achievements compared to its objectives; it also calculated annual electricity saving from the trust's activities, and total fuel savings (see box below).

In ***Norway***, the government has evaluated the state-owned company Enova (see box above) through its internal consulting arm. The results of the evaluation will be made public.

Results of the Danish Electricity Saving Trust's Evaluation

The Trust has achieved very significant electricity and fuel savings

Annual electricity savings were projected to be 1 000 GWh, or approximately 28% more than the Trust's objectives for 2004. In terms of fuel savings, the Trust's results also exceeded the defined objectives. In 2007, its activities are expected to contribute to fuel savings of 6.4 PJ, which is well above the target of 2.7 PJ.

CO_2 reduction achieved in an environmentally and economically efficient way

In 2007, the electricity savings achieved will amount to a CO_2 reduction of approximately 777 000 tonnes. The reference point for the Trust was Energy 21.[4] In Energy 21 the efficiency requirement in relation to CO_2 reduction was a maximum CO_2 shadow price of DKK 600 per tonne. By comparison, the Trust has managed to achieve an average CO_2 shadow price at DKK 55 per tonne.

Electricity savings have been socio-economically beneficial

Study analyses show that the financial value of the savings surpasses the cost of generating the savings. On average, the value of the savings which can be ascribed to the activities of the Trust amounts to DKK 0.04 per kWh saved, equivalent to a total socio-economic gain of DKK 338 million.

High return on consumer electricity savings charge

The Trust can be seen as a mutual fund in which DKK 0.006 per kWh of electricity consumption in dwellings and the public sector is invested. This electricity savings charge contributes a total budget of approximately DKK 90 million per year which, from 1997 to 2004, constituted a budget of approximately DKK 72 billion. The total lifetime user savings on current and completed projects amount to DKK 7.8 billon for a return of more than ten times the investment.

The Trust has employed cost-effective initiatives

The initiatives employed by the Trust are cost-effective. The Trust has spent DKK 90 on initiatives per tonne of CO_2 reduced. The most efficient

4. Launched in 1996, Energy 21 is a government plan for sustainable energy development in Denmark in an international context.

initiative in terms of kroner spent has been the "Elspareskinne" (auto power saver plug bank) at a cost of DKK 0.003 per kWh saved. The Standby campaign has the lowest efficiency, showing a cost of DKK 3.8 per kWh saved. The weighted average of all programmes shows a cost in initiatives and subsidies equal to DKK 0.075 per kWh saved over the lifetime of the programmes.

The Trust has influenced the market for electrically-powered appliances

The evaluation shows that the Trust has been able to influence the market, resulting in a permanent improvement in the availability of energy-efficient products such as A-labelled appliances and low-energy light bulbs.

The Trust has developed new and effective initiatives

The first seven years of the Trust have been characterised by innovation. The initiatives used by the Trust constitute a wide range of traditional subsidies, clubs, procurement agreements, price overviews, web sites, voluntary agreements, concept development and other measures. The Trust has contributed a high level of effective innovation.

Tax Credits

In the United States, the 2005 Energy Policy Act established a range of tax credits and subsidies to encourage more rapid introduction of energy-efficient products. Tax credits were established for a range of measures such as energetic refurbishment, solar cells, fuel cells, Energy Star-compliant appliances, and efficient cars. An unusual incentive was created for *manufacturers* of certain appliances and for home builders, when they achieve specified efficiencies. They will then directly receive a tax credit *e.g.* for each high-efficiency refrigerator sold or for each home built. This upstream subsidy is likely to have much greater leverage with manufacturers than the same amount given to consumers.

Energy Saving Obligations and White Certificates

Market-based tradeable obligations, or white certificates, continue to spark interest as various countries move closer to bringing the systems into the market, while the results from the ***UK***'s Energy Efficiency Commitment's first phase have been impressive. Under such an obligation or white certificate system, consumers or suppliers who use energy more efficiently will receive certificates equal to their level of savings. By setting a target for energy savings, these certificates gain a value to the participants in the scheme, in the same way that emission rights in the EU Emissions Trading Scheme, for example, have a value. Alternatively, energy suppliers could be obliged to obtain a predetermined number of certificates, thus creating a market that values the certificates, encouraging energy-efficient behaviour among all energy users, and allowing energy suppliers freedom to choose the least-cost opportunity to achieve savings.

France, ***Italy***, and other countries have launched white certificate systems and are at different stages of implementation, while the ***UK*** has already finished one three-year period of an obligation system, and started the second phase. According to the 2006 Energy White Paper, it is considering extending the system beyond 2012, to 2020.

Individual states in the ***United States*** have undertaken their own efficiency policies to supplement federal programmes or to address perceived gaps in federal activities. The ***State of California*** approved legislation that requires electric utilities to first undertake all cost-effective energy efficiency and demand reduction measures before constructing new power plants. The plans – which will cost almost two billion dollars – are expected to provide over 2 000 GWh in annual savings for the state by 2008. At this rate, the utilities' annual electricity savings will exceed 1% of annual load.

Before white certificates can be fully accepted as a credible efficiency policy, a number of administrative questions remain to be answered, such as how savings will be measured and who will issue certificates and administer the system. It will be important to keep administrative costs low, so as not to outweigh the system's benefits, while ensuring that the savings are legitimate, are not double-counted, and persist for the period assumed.

INDUSTRIAL AND COMMERCIAL SECTORS

The industrial sector is the heaviest energy user in many IEA member countries. It is also a very price-sensitive sector, and in the member countries of the EU, usually subject to emissions trading regulations, under which manufacturing plants are assigned tradeable emission credits on a site level. Energy prices, especially at their current levels, and pricing emissions of CO_2, already have a significant impact on energy efficiency in industrial applications, but a number of IEA member governments also have ongoing programmes to help industrial energy consumers to become more energy-efficient. A number of examples exist of the different approaches taken by IEA member governments.

Monitoring and Reporting of Energy Use

Understanding and monitoring energy consumption, *e.g.* through energy audits, and exploring ways to improve energy efficiency, are only a point of departure. Some member countries are introducing legislation that obliges energy-consuming industries to monitor energy use and to assess energy-saving potentials.

Australia has undertaken a new initiative to increase the visibility of the energy performance of large firms and to raise efficiency in the commercial and industrial sectors.[5] In 2006, all large Australian businesses will be required to perform mandatory energy assessments every five years and publicly disclose the results of the assessment. These reports must include details of energy efficiency opportunities (including percentage of energy that can be saved with paybacks up to 4 years), as well as information on the energy performance of the firm. The law requires all businesses consuming more than 0.5 PJ/year (equal to the consumption of about 10 000 Australian households) to participate. The legislation was designed to include firms with dispersed energy consumption, such as supermarket and fast food chains. The goal of the legislation is to raise the energy accountability of firms. It is hoped that firms will publish the outcomes of the audits in their annual reports so that shareholders can monitor the firms' goals and performance. Individual states have supplemented the federal legislation with stronger measures. In Victoria, for example, certain firms will be required to undertake measures with very short payback times. The details of these measures still need to be worked out.

In ***Japan,*** large-scale factories (manufacturing, mining and electricity, gas and heat supply) with an annual fuel consumption of at least 3 000 kilolitres of crude oil equivalent (0.12 PJ), or industries with an annual electricity consumption of at least 12 GWh, have been subject to energy efficiency requirements since 1979, under the Law Concerning the Rational Use of Energy. Through the amendments in 1999, 2002 and 2005, these requirements have been extended to all industry and service sector users of energy as well as to energy-sector operators. In its 2005 amendment, the law was extended to cover factories or offices with total annual energy consumption (electricity and heat) of at least 1 500 kilolitres of crude oil equivalent (0.06 PJ). They are obliged to record energy use and submit an annual report to the Ministry of Economy, Trade and Industry (METI). Large-scale energy-consuming factories/offices with annual energy consumption of at least 3 000 kilolitres of crude oil equivalent (0.12 PJ) must appoint certified energy managers, and other facilities must have energy management staff. In addition, large-scale factories/offices have an obligation to submit medium- to long-term plans for the rational use of energy. As a result, currently 13 000 factories and offices are covered under the law. This represents 70-80 % of energy consumption in the industrial sector.

Voluntary Agreements and Benchmarking

Voluntary agreements have been widely set up with industries in member countries to improve energy efficiency and reduce GHG emissions. This policy tool has been favoured partly because of its flexibility and relative light-

5. http://www.dpmc.gov.au/publications/energy_future/docs/factsheet_6.pdf.

handedness compared with the introduction of legal regulations or obligations. This is particularly important for industrial sectors exposed to international competition.

Under the E4 Energy Efficiency Strategy in ***Spain***, Spanish oil refineries have identified and agreed to implement a range of measures to improve energy efficiency as a result of participating in the development of the E4 strategy. These measures should lead to estimated savings of 577 ktoe/year after implementation, 25% of the total savings target specified for industry in the strategy. From estimations by the Association of Oil Producers in Spain, these measures should have a total cost of EUR 149 million, which indicates that they will generate a positive payback for the refineries undertaking them that will be at least comparable to commercial investment projects. These savings are possible even though the Spanish refining industry has already invested significantly in efficiency improvements in the past.

Clear and measurable quantitative benchmarks and effective monitoring are essential to ensure the effectiveness of voluntary agreements, because without them there is a risk that savings claimed by the participants would have occurred anyway, as a result of already scheduled investments, for example. In the ***Netherlands***, the government has created a system of voluntary agreements under which participating companies are given incentives if they sign up to a programme under which they aim to reduce their energy use to the level of global best practice. The programme is generally seen to be successful, and is evaluated on a regular basis by the Dutch government agency Senter-NOVEM (see box below). ***Belgium*** has a similar system.

Industrial Energy Efficiency by Agreement: The Case of the Netherlands

The Dutch Long-term Agreements on Energy Efficiency (LTAs) are covenants between companies and the government. As of 30 June 2002, about 520 companies had applied to join LTA2, and the voluntary covenants covered most of the Netherlands' industrial energy consumption. The benchmark companies account for about 80% of the total energy consumption of the industry, whereas those who have joined the LTA2 account for over 15% of the total. Encouraged by good results in the past, and to avoid regulatory and tax measures, Benchmarking Covenants and LTA2 have attracted wide industry participation. The EU Emissions Trading Scheme has also encouraged participation because the initial allocation was made on the basis of the performance of the covenant.

The first generation of LTAs, called the Benchmarking Covenant, identified the benchmark in each sector with the help of an independent consultant. The benchmark is the top 10% of the most energy-efficient installations worldwide. When defining world leaders, anticipated energy efficiency improvements by 2012 are taken into account. Moreover, the top performers must be redefined every four years. In order to meet the benchmark, members of the covenant must prepare energy efficiency plans and file them with the Benchmarking Verification Agency, which is an independent bureau established to monitor the practical aspects of the covenant. To date, 215 energy efficiency plans have been submitted. Once a plan has been approved by the agency, it will be incorporated into the environmental licence. The plan must be reviewed every four years, when the world lead is redefined. The covenant contains criteria governing the rate of return; companies must begin by taking the most cost-effective measure, followed by measures that are less cost-effective. To reach the target level, the companies can start using flexible instruments, such as emissions trading.

The new LTA2 was signed in December 2001 for the period running up to 2010 and is aimed at medium-sized and occasionally small businesses which cannot join the Benchmarking Covenant. Small companies can collectively join LTA2 if they have a total energy consumption of at least 1 PJ per year. Each participating company has to draw up an Energy Conservation Plan, which sets an energy efficiency target, proposes specific measures and establishes a schedule for their implementation. The plans have to be updated twice, by October 2004 for the 2005-2008 period, and by October 2008 for the 2009-2012 period. Principally, the participants agree to make energy efficiency investments with payback times of a maximum of five years, or with positive net present value calculated at 15% of internal rate of return. The investment criteria for LTA2 were clearly defined for participating companies.

The Long-term Agreements are seen as a very successful instrument to increase energy efficiency in the Netherlands, even though the average industrial facility participating in the Benchmarking Covenants already belongs to the world top 10% in its sector. This means that energy efficiency improvements in large industries may not be very big during the life of the covenant. Nevertheless, some companies that are not yet among the top 10% are likely to improve, and some that already are have announced plans to make further investments in energy efficiency, driven by the covenant.

The Dutch government agency Senter-Novem monitors the progress of LTA2 and receives annual progress reports from the participants.

Small and medium-sized enterprises often fall outside the scope of voluntary agreements. They are not subject to stringent measures such as the EU-ETS, and they are difficult to target with other measures, because they may lack focused energy management capacities that would be present in large industrial users. If such companies account for a large share of energy consumption, addressing them with voluntary agreements could be effective. The wider coverage of voluntary agreements can therefore lead to higher effectiveness. In terms of the coverage of voluntary agreements, ***Finland*** provides a good example. It has nine energy conservation agreements, which cover not only industry and energy companies but also municipalities, the property and building sector, the transport sector (truck, buses and vans), and the housing sector. These arrangements cover more than 55% of Finland's total energy consumption, which is wider than coverage rates in other IEA member countries.

In ***Japan***, the government is now considering the concept of supply-chain efficiency to increase industrial energy efficiency in a framework of heavy use of Just-In-Time logistics. Under this concept, efficiency would be measured across the production/logistics chain, and steps taken to improve logistics would be considered to contribute to improvements in the industrial process.

Technology Procurement

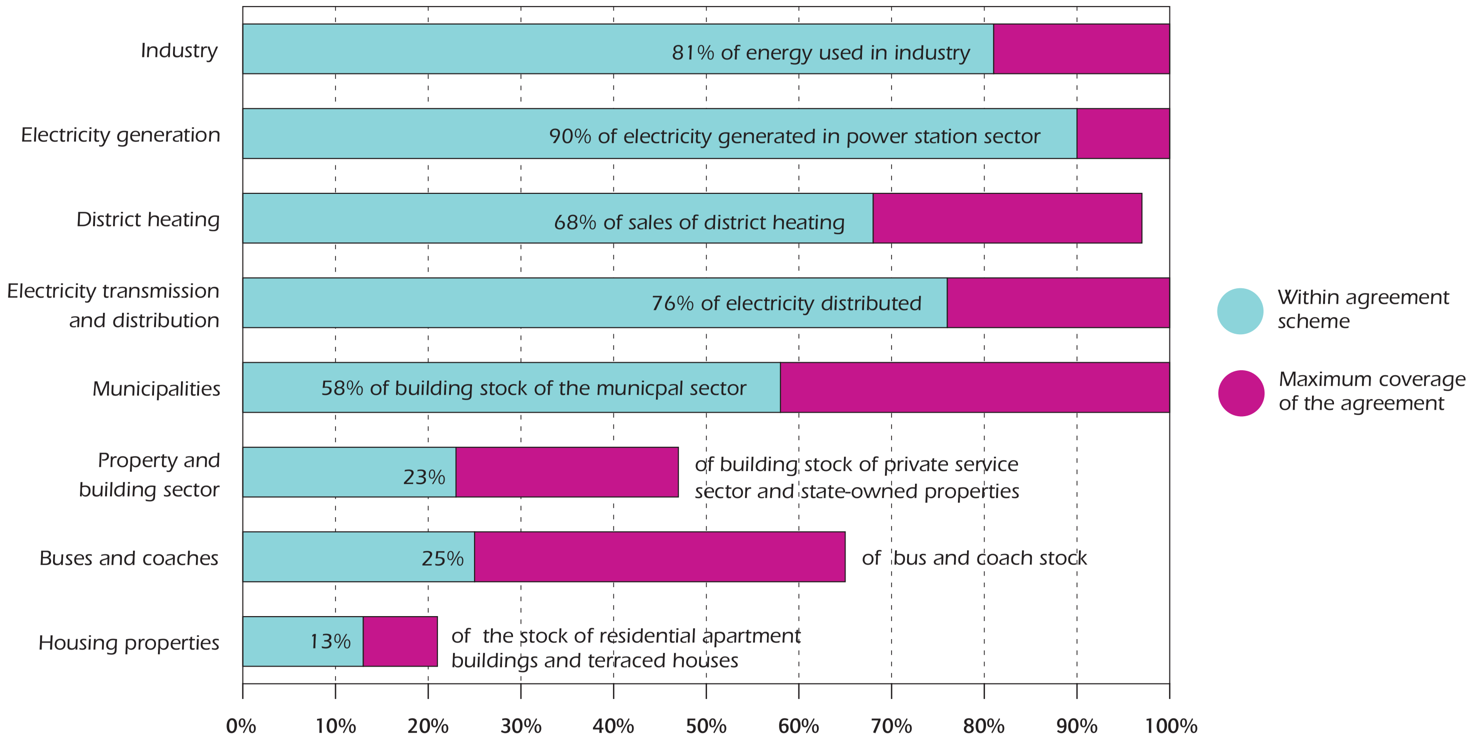
Technology procurement of energy-efficient products and systems is a realistic and effective means of encouraging development and deployment. Public-sector procurement has a large amount of turnover and can play a significant role. In ***Sweden***, the government is running a successful Technology Procurement Programme (see box below).

Industrial Energy Efficiency: Technology Procurement

In Sweden, the Technology Procurement Programme aims to improve the energy efficiency of products by using companies' competitive abilities to make better products. The government canvasses potential buyers of selected technologies to determine their criteria for the products regarding performance, energy efficiency and price. Suppliers can then choose to compete to manufacture these products if they can meet the criteria established by the potential buyers. If one or more suppliers can meet these criteria, they proceed with manufacture in the knowledge that buyers are prepared to purchase their output. One new technology procurement project with industrial application, automation of sawmill plants, has recently been launched. Dissemination of information to promote a wider uptake of products from the Technology Procurement Programme was undertaken from 1999 to 2002.

Figure 6

Coverage of Voluntary Efficiency Programmes in Finland



Source: Motiva Oy, December 2003.

TRANSPORT SECTOR

The transport sector has shown the highest growth of energy consumption in many IEA countries. Addressing the energy demand of this sector has proved to be very difficult for many IEA member governments, because of continuing increases in demand for transport services, mainly in the road transport sector. Owing to the diffuse nature of transport demand, the primary instruments available to governments are technical or emission standards, road pricing, and taxation. Governments can also affect transport indirectly by introducing policies aiming to achieve modal shifts of transport users.

Higher oil prices have led to increased efforts to reduce fuel consumption in the transport sector. These efforts have taken many different forms, including regulations on new types of vehicles, improvements in specific vehicle components, and changes in tax regulations.

Standards and Regulation on Fuel Efficiency

In ***Japan***, the amendment to the Law Concerning the Rational Use of Energy introduced the Top-Runner Programme, which replaced the "energy efficiency standards". While energy efficiency standards had been set at the level slightly above the average energy efficiency performance of the product category, in the Top-Runner Programme, the best performing items in their category set the minimum standard for a future year, pushing efficiency that is already at a high level even further. Under this programme, car manufacturers are obliged to improve fuel efficiency by 23% (for gasoline vehicles) and 15% (for diesel vehicles) between 1995 and 2010.

In *Japan*, for example, Top-Runner efficiency standards have been extended to cover heavy-duty freight vehicles (exceeding 3.5 tonnes) and buses with diesel engines. This is the first fuel efficiency standard for heavy-duty vehicles. The standard relies on a completely different type of test method. Efficiency tests for light-duty vehicles are performed on a dynamometer (or rollers). Heavy-duty vehicles are too large to conveniently test on dynamometers, so the Top-Runner standard is based on measurements of individual components. A simulation model combines the component efficiencies to predict fuel economy. The standard calls for a 12% reduction in fuel consumption by 2015.

There are two examples of voluntary agreements with car manufacturers to reduce fuel consumption and carbon emissions. ***Canada*** recently established its own fuel economy guidelines, starting with an initial voluntary agreement. If manufacturers are unable to meet their targets, then the government will impose mandatory limits. An unusual aspect of the agreement is that an absolute ceiling is set on emissions and credits awarded for measures that may not appear in fuel economy tests. The

Canadian agreement is unique in that it focuses on absolute carbon emissions of the entire vehicle fleet rather than just the fuel economy of new vehicles. This approach opens up many other fuel-saving options, including after-market measures, travel demand management, and improvements that may not appear on the conventional fuel economy test. The ***EU's*** voluntary agreement with car manufacturers calls for new vehicles to have, on average, less than 140 g/km of carbon emissions by 2008. It appears unlikely that vehicle manufacturers will meet this goal.

Many states in the ***USA*** have enacted targets and incentives for purchasing efficient vehicles. ***The State of California*** intends to establish carbon emissions limits on vehicles. These limits will be stricter than the existing fuel economy limits (CAFE) for the entire United States. ***Massachusetts*** government agencies must purchase hybrid or alternative fuel vehicles to the maximum extent feasible at a minimum rate of 5% annually. The bill would require a minimum of 50% of the motor vehicles owned and operated by the Commonwealth of Massachusetts to be hybrid or alternative energy vehicles by the year 2010.

Policies are being developed to improve the efficiency of specific components, not all of which are captured in the current fuel economy tests. One approach is to lower the rolling resistance of tyres. About 20% of a car's fuel consumption is used to overcome the rolling resistance of the tyres. Existing tyres have a wide range of rolling resistance but this information is not widely available. A 10% reduction in rolling resistance translates into a roughly 1% reduction in fuel consumption. Tyre replacement applies to most vehicles, including vehicles already on the road, so savings can be achieved faster than through improvements limited to new vehicles. Consumers and firms are unable to select low rolling resistance tyres because this characteristic is not typically listed in the specifications or in publicly available databases. The IEA held a workshop to explore policies to encourage the use of higher-efficiency components in vehicles, with special emphasis on lower rolling resistance tyres. The ***European Union*** and the ***State of California*** have announced plans to collect information, and potentially regulate, tyre rolling resistance.

Road Charging and Regulation

In February 2003, the ***City of London*** in the ***UK*** introduced a "congestion charge", which appears to have had a positive impact on the number of journeys undertaken in the city, and has led to a modal shift towards public transport (which was improved at the same time). A daily fee of GBP 5 (GBP 8 since July 2005) must be paid by the registered owner of a vehicle that enters, leaves or moves around within the congestion charge zone between 7am and 6.30pm, Monday to Friday. Some vehicles, such as buses, minibuses (over a certain size), taxis, emergency service vehicles (*i.e.* ambulances, fire engines and police vehicles), motorcycles, alternative fuel vehicles and bicycles are exempt from the charge. Recent estimates found that this scheme has reduced traffic in Central London by about 30%. Estimates suggest that about 50% of those previously driving to Central London have switched to public transport, while another 15-25% have switched to cycling, motorcycling and car-pooling. Overall car occupancy is estimated to have increased by about 10%. On the basis of these initial estimates, it is likely that vehicle travel and fuel consumption have decreased, although it would be difficult to give precise estimates. In September 2005, the city confirmed that the congestion zone would be expanded westward, a change that will come into effect in February 2007.

The strict enforcement of speed limit regulations on motorways introduced in recent years is expected to reduce fuel consumption, as well as bring down the number of accidents. In ***France,*** the government estimates that stringent speed limit enforcement will reduce CO_2 by 3 million tonnes (Mt) from the business-as-usual (BAU) projection in the transport sector in 2010, but no evaluation has taken place so far.

In ***Germany***, the government has introduced a motorway toll system for heavy-goods vehicles (above 7.5t of maximum weight). The system is relatively new, and it remains to be seen whether it will lead to a modal shift of freight away from the road to alternative means, such as rail and river barges. The system is very sophisticated, utilising remote sensors and on-board computers installed on trucks, and it charges by mileage driven on motorways. One negative aspect has been trucks switching to secondary federal roads of good quality, but this is being addressed through restrictions on truck traffic on these roads, and the German government is considering the introduction of toll-charging for the most obvious bypass routes.

Vehicle Taxation

Cars assigned to company employees ("company cars") account for nearly half of new car sales in the UK, Belgium, and Australia. Tax codes in many countries may work in a perverse fashion by encouraging employees to buy less efficient vehicles and to drive them longer distances. In 2002, the ***UK*** reformed its tax codes that encourage the purchase of higher-efficiency vehicles and less driving. A recently completed evaluation of the tax reforms, (see box below), concluded that the companies indeed responded to the revised signals in three ways: purchasing fewer company cars, purchasing more efficient vehicles, and driving less. Reduced carbon emissions from company cars were credited with reducing overall motor vehicle emissions by 0.5% in the first year of the programme, and were expected to eventually grow to 0.5 – 1.0 Mt/year.

Evaluation of the New Company Car Tax System in the UK[6]

The new company car tax system was implemented from 6 April 2002. For most company cars, it is based on the level of CO_2 emissions they produce. The previously existing business mileage discounts have been removed in order to eliminate the financial incentive for some company car drivers to do unnecessary business miles. For company cars which run solely on petrol or diesel, the tax level applied to the prices of the cars still varies between 15% and 35%, as was the case before. However, the exact percentage used in the calculation is determined by the amount of CO_2 emissions the company car produces. This is done using the official figure from type approval tests of the grams of CO_2 per kilometre travelled that the car produces. In 2002/03, the percentage charge was 15% if the CO_2 emissions figure was 165g/km or less. This lower threshold of CO_2 emissions has been reduced to 155g/km for 2003/04, and will reduce further to 145g/km in 2004/05 and to 140g/km in 2005/06. The tightening of the lower threshold is a recognition that new cars are becoming more fuel-efficient every year. It is also to ensure that the system maintains an effective incentive for manufacturers to continue to produce more fuel-efficient cars, and for employers and employees to continue to choose cars that are least harmful to the environment. For each additional 5g/km by which the CO_2 emissions figure exceeds the lower threshold, the percentage charge increases by 1%. Diesel cars not meeting Euro IV emission standards incur an additional charge of 3%. Company cars running on alternative fuels, such as electricity and liquid petroleum gas, qualify for additional discounts to the percentage charge as they produce relatively lower levels of harmful emissions. The reduction for older company cars that was available under the previous system was removed, as older cars tend to produce higher levels of harmful emissions than newer equivalents.

Effect on business mileage

Business miles travelled are no longer taken into account in calculating the company car tax charge. The UK Treasury (HMT) estimates that removing the incentive to travel more miles has directly led to a reduction of between 300-400 million miles being travelled in company cars in the UK in 2002/03, and that this will continue in subsequent years.

6. Inland Revenue Service (2004), *Report on the Evaluation of the Company Car Tax Reform*, London.

Assuming that the reduction in business miles is not counteracted by increased but not reported travel, it is estimated to equate to a reduction of 25-35 kt CO_2 emissions in 2002/03. This represents a reduction in CO_2 emissions equivalent to about 0.1% of all CO_2 emissions from road transport in the UK.

Effect on CO_2 emissions

HMT research suggests that the average CO_2 emissions of new company cars has decreased significantly from a level of around 196 grams per kilometre (g/km) in 1999 (when the intention to switch to a new company car tax system based on environmental principles was first announced by the government), to around 182g/km in 2002. HMT believes that the company car tax reform has played a significant part in reducing levels of CO_2 emissions in the UK, and estimates that in 2003 there will be a reduction of around 0.15 - 0.2 million tonnes of carbon due to the reform. This is fully on track to meet the long-term target of reductions of 0.5 - 1 million tonnes of carbon per year from the change in the taxation system.

Effect on numbers of company cars and fuel type

A significant decrease in the numbers of company cars in the UK was observed as a consequence of the scheme. HMT's estimate is that in the two years to November 2003 there was a decrease of around 250 000 company cars, from around 1.6 million to around 1.35 million. The reform of the company car tax system does appear to have been a factor in this reduction, alongside the increased popularity of cash alternatives and employee car ownership schemes. It is early days in the new company car tax system, and HMT intends to continue to monitor how the tax system influences choice as understanding of the charge grows. HMT also observed significant increases in the levels of sales and registrations of diesel cars since Budget 1999 and Budget 2000 when the details of the company car tax reform were first announced. From research, HMT believes that the proportion of company cars running on diesel could now be around 40-45% and estimates that this proportion could be set to increase to around 50-60% by 2005.

Impact on employers: compliance costs

Before the reform was introduced, HMT estimated the cost effect on employers of complying with the new tax system. In the Regulatory Impact Assessment (RIA) required for new policies and published in

March 2000, HMT estimated that employers would face one-off costs of GBP 50 million to deal with the changes, but that they would then save GBP 20 million a year in recurring costs. HMT now believes that the company car tax reform has actually led to a net year-on-year reduction in recurring compliance costs of **GBP 35 million** in 2002/03, saving businesses an extra GBP 15 million per year more than originally estimated. HMT has assessed that employers' one-off costs were around GBP 55 million, close to the original estimate.

Modal Shifts

Dedicated busways (also called Bus Rapid Transit) have gained increasing attention as a means of raising average bus speeds, saving fuel, and reducing emissions. Compared to fixed rail systems, dedicated busways are inexpensive and can be built quickly. Seoul, ***Republic of Korea***, is in the midst of an aggressive plan to provide dedicated busways in major transport corridors, despite already having about 60% of journeys undertaken on public transport. Average bus speeds have nearly doubled on these routes, enabling more passengers to be carried with less energy and air pollution. Similar busways are being constructed in many other countries, including the United States and France. Developing countries, such as China and Indonesia, are installing them at a much more rapid rate.

Eco-driving

Improving the skills of drivers is also essential. Without more efficient driving techniques, the effect of stringent fuel efficiency standards can be largely offset. A programme in the ***Netherlands*** introduced techniques for more efficient driving. This is sometimes called "eco-driving". The Dutch programme sought to influence drivers, driving instructors, and other decision-makers.[7] Activities that have contributed most to CO_2 emissions reductions included *i)* their implementation in driving school curricula, *ii)* public campaigns to reach existing drivers, *iii)* subsidised activities to reach professional drivers, and *iv)* tax exemption for in-car devices. Between 2000 and 2004, the cost efficiency of the Eco-drive programme for end-users ranged from EUR -234 to EUR -414 per avoided tonne of CO_2 emissions. The negative costs of conserved carbon can be explained by the high value of the fuel savings as a result of the implementation of eco-driving and relatively low investments by car owners for in-car devices. Cost efficiency for *society* is estimated at EUR -105/tonne to EUR 73/tonne of avoided CO_2 emissions. While the programme was unable to achieve the targeted energy savings, savings continue to increase as more drivers receive training.

7. Van den Hoed, Robert (2006), Evaluation of the Dutch Ecodrive Programme, Project in the framework of the Energy Intelligence for Europe programme, contract number EIE-2003-114.

RESIDENTIAL AND TERTIARY SECTORS

Stationary energy use in the tertiary and residential sectors has seen much slower growth than that in the transport sector, despite constantly rising living standards and appliance/electronic equipment use in households and business. This raises the possibility that enforcing standards for household goods have had an effect in restricting the growth of energy demand in these sectors.

Updating Standards and Labels

Technical improvements and changes in functional requirements occasionally cause energy efficiency tests to diverge from a realistic prediction of actual daily energy use. Ongoing field verification is the only way to ensure that energy test procedures, standards, and labels are realistic.

Recently, ***Japan*** revised the test procedures for its refrigerators because it found that field consumption had diverged from laboratory measurements as a result of design changes and new features. Australia announced its intent to revise test procedures for all major white goods (washing machines, dryers, etc.) to include standby power use. Japan will also include use of the air-conditioner in its automobile fuel economy test, more accurately reflecting actual use of vehicle components.

The ***US*** will revise the fuel economy test for motor vehicles to better account for changing driving habits (such as more rapid acceleration), and widespread use of air-conditioning. Energy Star extended its specifications for personal computers to include all of the major functional modes. In this way, the specifications will capture a greater fraction of a computer's annual electricity consumption.

Lighting

A variety of government policies are working to reduce electricity consumption in the lighting sector, which currently accounts for almost 19% of global electricity consumption. These include: minimum energy performance standards applied to lamps and ballasts, requirements for minimum lighting system performance specified through building codes, market transformation programmes targeting lighting, utility- and/or government-sponsored efficient lighting programmes and public procurement programmes. Although the collective impact of these policies is uncertain, it is likely to be substantial. An analysis presented in the recent IEA publication, *Light's Labour's Lost: Policies for Energy Efficient Lighting* (OECD/IEA, 2006) projects that lighting energy efficiency policies implemented since 1990 are on course to save over 17% of global lighting electricity demand with the majority of savings occurring in OECD countries. However, the same study estimates that much more remains to be done if the available potential for cost-effective energy savings is to be realised. The *Light's Labour's Lost* study estimates that almost 40% of global lighting electricity consumption could be saved cost-effectively by the widespread adoption of efficient lighting technology and practices.

Under the Least Life Cycle Cost from 2008 scenario, savings accrue from:

- Phasing out unnecessary use of incandescent lighting, replacing it with high-quality compact fluorescent lamps (CFLs).
- Replacing low-efficacy mercury vapour street and high-space lighting with higher efficiency sodium and/or ceramic metal halide alternatives.
- Phasing out the lower-efficacy varieties of linear fluorescent lamps and ballasts in favour of higher-efficiency alternatives.
- Greater deployment of switches and intelligent automatic lighting controls.

Even greater savings could accrue from the avoidance of unnecessarily high illuminance recommendations for lit environments (variations of up to a factor of 15 exist for comparable spaces between OECD countries) and by making better use of daylight in building designs. At present, there are considerable cost-effective savings opportunities in all IEA countries and non-IEA countries alike, although the precise nature of the savings opportunity varies by country.

To address this opportunity, there are signs of increasing activity in lighting energy efficiency policy. The communiqué of the 2006 St. Petersburg G8 Summit invites the IEA to continue to work with member states to increase lighting energy efficiency. A growing number of economies, including Australia, California, the UK and China, are adopting relatively comprehensive lighting market transformation programmes that aim to improve the energy efficiency of the majority of major lighting end-uses. In Europe, the implementation of the Energy Performance in Buildings Directive has required 25 EU member states and 3 accession states to adopt minimum energy performance requirements for buildings based on the "whole building" method which takes into account all energy flows, including lighting, and thus, for the first time in the majority of these states, imposes a regulatory incentive to improve the energy performance of installed lighting systems. In many EU member states this requirement has also been extended to major retrofits of existing buildings, and some have gone further by including specific minimum energy performance requirements for installed lighting systems in addition to those collectively addressing all building energy flows (*e.g.* the UK, France, and Belgian Flanders). The same directive also requires larger buildings to be subject to mandatory energy performance certification based on the whole building method, thus including lighting energy flows. New measures addressing the efficiency of lighting equipment are under consideration for office lighting and street lighting under the terms of the Eco-design of End-Use Equipment Directive.

In the ***US***, the 2005 Energy Policy Act (see section on Appliances and Equipment Efficiency Standards, below) adopted a range of measures applying to lighting, including: the adoption of several new minimum energy performance requirements for major and niche lamp types, the strengthening of the model building code to include more stringent lighting power-density requirements that apply to new build and retrofits and which also include some incentives regarding the appropriate use of switches. The act also includes important fiscal incentives to building owners and developers to upgrade property to be significantly more energy-efficient than current norms, with specific measures for lighting. A number of voluntary building energy certification schemes operate in the ***US***, including the *US* government's Energy Star Buildings scheme and the Green Building Council's LEED scheme, which include lighting energy use within their ratings. Considering their voluntary nature, these schemes are attaining quite significant adoption rates, although the majority of the US building stock has not yet been certified for its energy performance. The ***US*** and ***Canadian*** building codes (for both new construction and renovation) are increasingly incorporating energy budgets for lighting, so that as of 2005, about 87% of the US population was living in states that included lighting energy performance requirements within their building codes. The stringency of these requirements varied quite significantly depending on the generation of the building codes adopted, with the latest ASHRAE 90.1-2004 and IECC-2003 codes having appreciably firmer requirements than previous generations of the same codes. In 2005, the ***Californian*** Title-24 2005 code had the most comprehensive and stringent requirements for lighting, including measures applying to residential buildings and outdoor lighting.

Increasing attention is being focused on the progressive phase-out of incandescent lamps. Korea and California have imposed minimum energy performance requirements for such lamps that preclude all but the most efficient models from public sale. In some countries, government-imposed utility energy efficiency obligation schemes have targeted the replacement of incandescent lamps with CFLs (most notably in ***Brazil*** where such measures have led to there being about the same number of CFLs in place as incandescent lamps; and in the ***UK***, where domestic CFL ownership rates doubled in three years). ***The Republic of South Africa*** and ***Canada*** are among other governments that have announced the preparation of measures to significantly reduce incandescent lamp usage, while many countries, including ***Vietnam*** and ***Indonesia***, have organised major bulk procurement of CFLs for use in utility DSM programmes. Other policies have targeted different portions of the lighting market. The majority of halogen torchiere lamps, which typically draw large amounts of power and provide very inefficient illumination, have been prohibited from sale in the ***USA*** through the provisions of the 2005 Energy Policy Act (see section on Appliances and Equipment Efficiency Standards, below), although these lamps can still be legally sold in other OECD markets. The ***USA*** has also effectively phased out mercury vapour street lamps and the majority of magnetic ballasts in favour of higher-efficiency electronic ballasts. Solid-state lighting, based on lighting emitting diode technology, is also making inroads into important niche lighting markets where it can already offer a higher-efficiency alternative to traditional technologies. In the ***USA,*** new traffic signals and exit signs are now required to be as efficient as models based on solid-state lighting. There is also great interest in the potential for solid-state lighting to become a high-efficiency alternative for mainstream indoor lighting and street lighting applications. Many OECD countries have now launched substantial industrial RD&D support programmes to accelerate the development and commercialisation of solid-state lighting technologies.

Air-conditioning

A particular concern regarding stationary energy use, which has emerged during the last review cycle, is the emergence of air-conditioning as a major driver for electricity use in many European countries, for example ***Spain***. This is of particular concern for the electricity system of these countries, because it creates a summer peak in electricity demand, during a season which was traditionally low-demand, and used to schedule plant maintenance and refuelling at nuclear stations. Similar concerns about the development of a summer demand peak also exist in Greece, the UK, and Hungary.

Appliances and Equipment Efficiency Standards

Japan has the most comprehensive set of minimum efficiency standards (Top-Runner Programme) covering twenty-one products (vehicles, air-conditioners, TV sets, video-cassette recorders, fluorescent lights, copying machines, computers, refrigerators, vending machines, etc.). Unlike conventional energy efficiency standards that are set at the average level in the same product group, the threshold under the Top-Runner Programme is set at the level of the most efficient equipment on the national level at the time the policy measure is developed. The manufacturers of the products covered by this programme are obliged to achieve the standard by the relevant target year.

The Top-Runner Programme in Japan

The Law Concerning the Rational Use of Energy of 1993 established "energy efficiency standards" for certain electric equipment and vehicles. The standards were established as absolute targets to be achieved by FYs 1998 to 2000. For example, in the case of computers, energy efficiency performance was supposed to improve by 30% from FY1992 to FY2000. If manufacturers and equipment importers failed to comply with the standards, they were then subject to recommendations given by METI.

The 1999 amendment to the law introduced the Top-Runner Programme, which replaced the "energy efficiency standards". While energy efficiency standards had been set at the level slightly above the average energy efficiency performance of the product category, in the Top-Runner Programme the best performing items in their category set the minimum standard for a future year. The programme originally covered electric appliances (refrigerators and freezers, air-conditioning, televisions, video players, lamps and computers) as well as cars and light trucks, for both gasoline and diesel engines. The coverage of the programme has been extended to include heating equipment using oil, gas and electricity, vending machines and electric transformers. Each type of equipment is divided into several groups and the energy efficiency target is established for each group. Development is not monitored for each product, but for the whole group. METI can issue recommendations and orders if targets are not reached. If the manufacturer or importer does not comply with the order, penalties are imposed. This is a significant improvement compared with the 1993 law. The government intends to tighten the targets every few years to ensure continued gains in efficiency. The estimated energy savings to be achieved by the current targets are shown in Table 6.

Table 6

Energy Conservation Targets for Designated Equipment under Top-Runner Programme

Equipment		*Base year*	*Target year*	*Approximate improvement of efficiency*	*Actual improvement of efficiency*
Air-conditioning (heating & cooling)	< 4 kw	FY1997	Refrigerating[1] Fiscal2004	63.0%	67.8%
	all other	FY1997	Refrigerating Fiscal2007		
Air-conditioning (cooling)		FY1997	FY2007	14.0%	
Space heaters	Gas	FY2000	FY2006	1.4%	
	Oil			3.8%	
Electric refrigerators		FY1998	FY2004	30.5%	55.2%
Electric freezers		FY1998	FY2004	22.9%	29.6%
Fluorescent lights		FY1997	FY2005	16.6%	
Televisions	Cathode ray tube	FY1997	FY2003	16.4%	25.7%
	Liquid crystal plasma	FY2004	FY2008	15.3%	
Video players		FY1997	FY2003	58.7%	73.6%
Magnetic disk devices		FY1997	FY2005	78.0%	
		FY2001	FY2007	71.0%	

Table 6 *(continued)*

Energy Conservation Targets for Designated Equipment under Top-Runner Programme

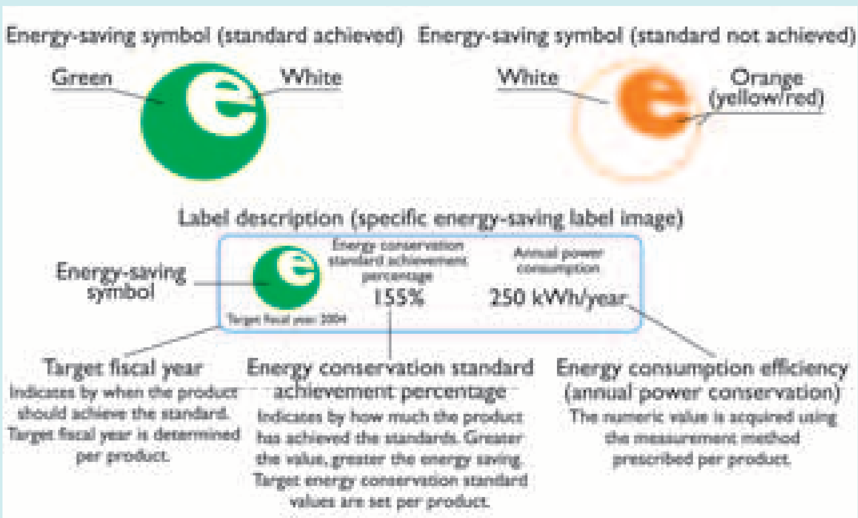
Equipment		*Base year*	*Target year*	*Approximate improvement of efficiency*	*Actual improvement of efficiency*
Copy machines		FY1997	FY2006	30.0%	
Computers		FY1997 FY2001	2005 2007	83.0% 69.0%	
Gas cooking appliances	Burner section	FY2000	2006	13.9%	
	Grill section	FY2002	2008	27.4%	
	Oven section	FY2002	2008	20.3%	
Gas water heaters	Gas instant water heaters and bath tub gas water heaters	FY2000	2006	4.1%	
	Gas heaters with no hot water supply functions	FY2002	2008	3.3%	
	Gas heaters with hot water supply functions	FY2002	2008	1.1%	
Oil water heaters		FY2000	2006	3.5%	
Electric toilet seats		FY2000	2006	10.0%	
Vending machines		FY2000	2005	33.9%	
Transformers	Oil filled	1999FY	2006	30.3%	
	Molded	1999FY	2007		
Passenger vehicles,	Gasoline	FY1995	2010	23.0%	
	LP gas	FY2001		11.4%	
Passenger vehicles, diesel		FY1995	2005	15.0%	
	Route bus	FY2002	2015	11.1%	
	General bus	FY2002	2015	12.8%	
Freight vehicles, gasoline		FY1995	2010	13.0%	
Freight vehicles, diesel		FY1995	2005	7.0%	
	Truck and so on	FY2002	2015	12.2%	
	Tractors	FY2002	2015	9.7%	
Electric rice cookers		FY2003	2008	11.1%	
Microwave ovens		FY2004	2008	8.5%	
DVD recorders		FY2004	2008	22.4%	

1. Refrigerating Fiscal → 1st October to 30 September.

Whereas the Top-Runner Programme itself targets manufacturers and importers, it is implemented and made visible to consumers through the energy labelling of products. In July 2000, a voluntary labelling system was introduced for air-conditioning equipment, refrigerators, freezers, televisions and lighting. The label shows the relative energy efficiency of these products compared to their top-runner targets. In addition to informing end-users, the objective of the labelling system is to encourage manufacturers and importers to satisfy the top-runner standards even ahead of the target year.

Figure 7

Japanese Energy Label



Source: METI.

The Top-Runner Programme encourages manufacturers to develop more efficient technologies. Its targeted efficiency levels are ambitious for most products, making significant energy savings and CO_2 emissions reductions likely. The target levels are clear, firmly set and analytically simple (requiring only a statistical appraisal of the efficiency of products on the current market). The monitoring results show that the programme has had a positive impact on the efficiency of, for example, vehicles and household appliances. Some researchers, however, have found that lifecycle engineering-economic analyses may provide both a stronger foundation and a more aggressive rate of improvement. Lack of engineering-economic analysis means that the full economic implications of adopting a given target level are not fully known. The top of the domestic market (at the time the targets are determined) may or may not be consistent with a least-cost approach to energy use, CO_2 emissions reductions or other policy goals. It is possible for the targets to be too lax or too stringent from a least-cost perspective. One more potential problem is that the manufacturers may either collude (whether tacitly or overtly) to halt efficiency improvements or attempt to create targets attainable only with proprietary technologies. Japan should consider conducting a review of standard setting, and identify which approach will provide the greatest benefit.

In the ***US***, the Energy Policy Act of 2005 became law, and is the first major federal energy legislation since 1992. The new law includes over USD 2 billion in tax incentives for the installation of certain energy-saving technologies, new minimum energy efficiency standards, and many smaller provisions to encourage greater efficiency. The U.S. Department of Energy must conduct rule-making to revise some appliance standards, and consider standards on several additional products, including refrigerated beverage-vending machines, external power supplies, dehumidifiers, many types of commercial refrigeration systems, and ice-makers (see Table 7). This act marks an expansion of energy efficiency regulations into the commercial sector, and at least six standards originate from previous, voluntary specifications established by Energy Star. Few measures address oil conservation and almost no measures were taken to improve fuel efficiency in vehicles.

These regulations build upon existing regulations for more common domestic appliances (such as those addressed by the Ecodesign Framework Directive described below). The wide scope of these regulations, that is, the large number of products being addressed, also illustrates the diffuse nature of demand-side programmes.

The State of California is also extending and broadening its efficiency standards for buildings and equipment. This year, for example, it approved the first mandatory limits on standby for many consumer electronics and external power supplies. Other states are copying California's regulations. Most manufacturers will supply the same product to the whole country, so California's appliance efficiency standards are, in practice, national standards.

The ***European Union*** adopted the Ecodesign Framework Directive in 2005.[8] This directive empowers the European Commission (EC) to establish minimum energy efficiency and environmental standards for a wide range of products. The Ecodesign Directive will address the products listed in Table 7 in the first round of analyses. Products for which an implementing measure is prepared include:

8. http://ec.europa.eu/enterprise/eco_design/directive_2005_32.pdf

Table 7

Standards Set in the Energy Policy Act of 2005

(Table 2. Standards Set in the Energy Policy Act of 2005)

Product	*Effective date**	*Standard*
Residential		
Ceiling fan light kits	2007	Packaged with ENERGY STAR v2 screw-in CFLs or meet ENERGY STAR Residential Light Fixture v4 specification. Standard for specialised products determind by DOE by 1/1/07
Dehumidifiers	Oct. 2007	ENERGY STAR v1 specification
Compact fluorescent lamps	2006	ENERGY STAR v2 specification
Torchiere lighting fixtures	2006	190 W maximum
Commercial		
Air-conditioners and heat pumps (unitary equipment 240–760k Btu/hr)	2010	Capacity — Minimum EER (AC/HP) 65–134k Btuh — 11.2/11.0 135–239 — 11.0/10.6 240–759 — 10.0/9.5 (EER 0.2 lower for units with integrated heating that is not electric resistance) For HP, also 3.2 COP@47.F except 3.3 for 65–134k Btuh equipment
Clothes washers	2007	MEF at least 1.26 and WF no more than 9.5
Distribution transformers (low voltage)	2007	Meet NEMA standard TP-1-2002
Exit signs	2006	ENERGY STAR v2 specification
Fluorescent lamp ballasts (F34 and F96ES types)	2009	Closes loophole in DOE regulations so that these ballasts will be electronic, like other covered ballasts
Ice-makers (cube type, 50–2 500 lbs/day)	2010	California Energy Commission (CEC) standard, which is almost identical to Consortium for Energy Efficiency (CEE) Tier 1
Mercury vapor vamp ballasts	2008	Bans sale of mercury vapor lamp ballasts
Pedestrian signals	2006	ENERGY STAR v1.1 specification
Pre-rinse spray valves	2006	Maximum 1.6 gallon/minute
Refrigerators and freezers (packaged)	2010	California Energy Commission (CEC) standard, which is almost identical to ENERGY STAR specification
Traffic signals	2006	ENERGY STAR v1.1 specification
Unit heaters	Aug. 2008	Must be equipped with an intermittent ignition device and have power venting or an automatic flue damper

* Effective in January unless otherwise specified.

Source: Nadel, Steven (2005), *The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts,* American Council for an Energy-Efficient Economy, ACEEE Report No. E053, September: Washington, D.C.

- Boilers, including combi-boilers (all fuels)
- Water heaters (all fuels)
- PCs and computer monitors
- Copiers, faxes, printers, scanners, multifunctional devices (imaging equipment)
- Consumer electronics: televisions
- Standby and off-mode losses
- Battery chargers and external power supplies
- Office lighting
- Street lighting
- Residential room-conditioning appliances
- Electric motors
- Commercial refrigerators and freezers
- Domestic refrigerators and freezers
- Domestic dishwashers and washing machines

A unique feature of the Ecodesign Directive is that the EC may negotiate voluntary agreements with manufacturers when the EC judges that savings can be achieved at a lower cost or more quickly than through mandatory standards. While the criteria for a voluntary agreement have been clearly established, the mechanism for reaching this decision still needs to be established.

Building Codes and Labelling

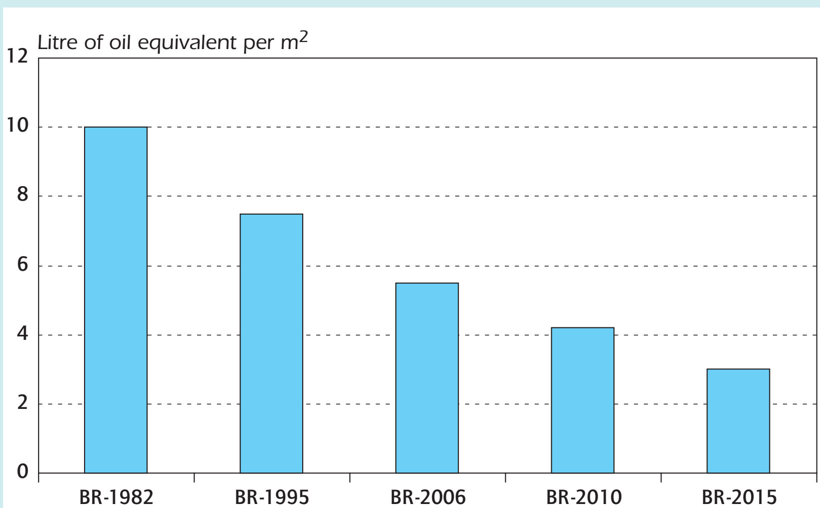
The energy performance of buildings has a significant impact on energy demand from the residential and tertiary sectors. The primary government tool for affecting energy demand from buildings is the establishment and enforcement of building codes specifying minimum performance requirements for new buildings, or buildings undergoing major refurbishment. This approach overcomes the fundamental market failure that exists in the case of many new buildings, the split between the interest of the builder and the future owner/occupier. A particularly pertinent example of the potential of building codes to improve energy performance in the building sector is provided by Denmark, and is discussed below.

The Impact of Building Regulations, Codes, Labelling: Denmark

Denmark has historically designed and implemented strong building codes to curb heating needs. These are viewed as some of the strongest and most effective energy-saving tools. New building codes have just been implemented and came into force in 2006. They tighten the energy requirements of new buildings by 25% to 30% from the previous standards, which were already stricter than those of most other IEA countries. These codes are expected to be tightened again in 2010. Figure 8 shows the historical progression of building code requirements and expectations for the future.

Figure 8

Building Code Requirements on Space Heating



Source: Danish Energy Authority.

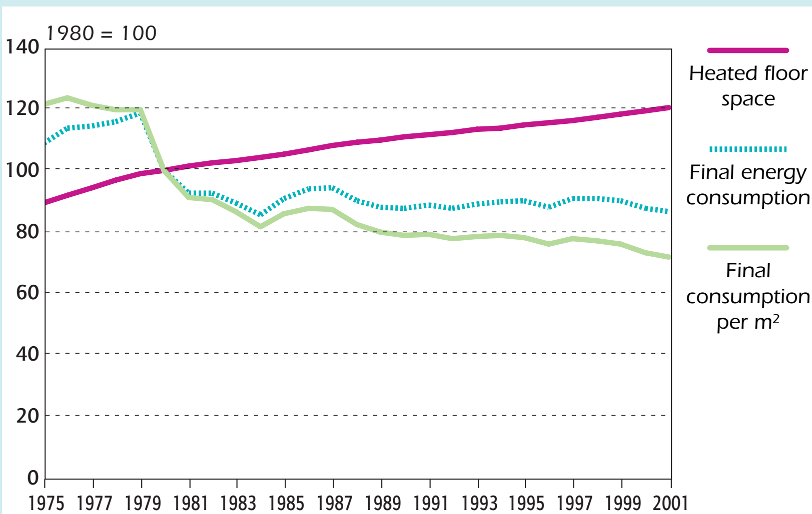
Another important step to increase energy savings through building codes is the enforcement system. Previously, Danish architects or builders had merely to bring the plans for a new or renovated structure to the appropriate government office to demonstrate on paper how they intended to meet the building codes. Actual construction that conformed to these plans was left up to the builders. There was no system for government follow-up to ensure that actual heating/insulation requirements were being met. Concurrent with the new tightened building codes that came into force in January 2006 is the introduction of regular checks by the government of new or newly renovated buildings to ensure that these constructions do meet the code's requirements.

Reduction in heating demand

From 1975 to 2001, heating floor space has increased by 34%, but the primary supply needed to heat this space has decreased by more than 20%. The resulting energy supply per unit of heated space has declined by more than 40%. Figure 9 below shows this progression graphically.

Figure 9

Energy Supplied for Space Heating, 1975 to 2001



Source: Danish Energy Authority.

This decrease in energy going to heating in buildings is a result of two factors. First, insulation in buildings has improved dramatically over the last 30 years, driven by the increasing requirements of building regulations. Second, the introduction and rapid spread of combined heat and power (CHP) and connected district heating (DH) systems has improved the efficiency of the heat delivery system. Whereas on-site oil and gas boilers, particularly of older design, lose significant amounts of heat in the combustion process, CHP makes double use of the combustible energy and thus has the potential to enjoy a higher efficiency.

At the same time, the net heat demand per unit of floor space has also declined over the last 20 years. This parameter measures only the usable heat delivered to a building and not the energy input, either off-site with a district heating system or on-site with a boiler. Consequently, it does not capture the efficiency improvements through CHP as explained above. The reduction in net heat per unit of floor space is thus lower (24%) than the reduction in primary energy supply per unit of floor space (40%).

Potential for energy savings

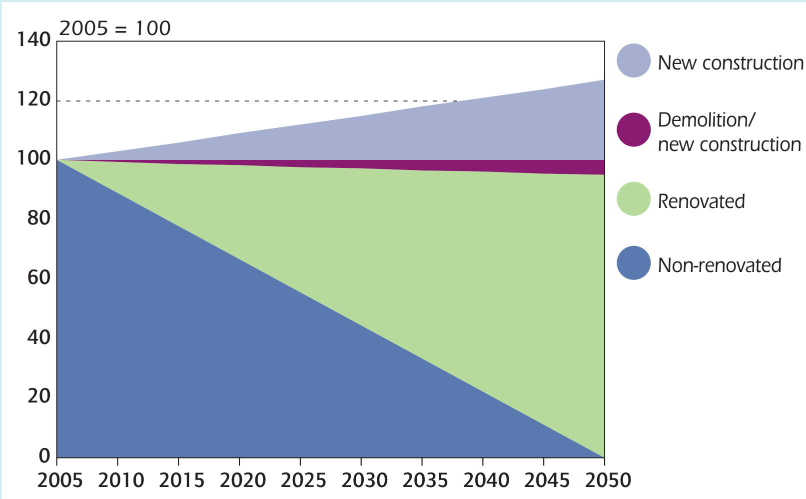
The Technical University of Denmark has estimated the potential for savings in space heating in residential buildings. Researckers assume a real interest rate of between 0.0% and 2.5%, real energy prices between 8 and 16 eurocents per kWh, and a calculation period of 30 years. The results show the possibility of lowering energy use for residential space heating from the 2005 figure of 122 PJ per year to 86 PJ per year in 2020, and 22 PJ per year in 2050. This last figure would represent an 80% reduction in energy use from current levels.

One of the difficulties in improving the efficiency of heating in buildings is the large existing stock of older buildings and the relatively low turnover rates. Existing buildings pose a particular problem when trying to save heating energy. Not only do they represent a majority of the housing stock, but their energy consumption is 14.1 litres of oil per m^2, or nearly three times the requirements for the new building codes, which would only apply to an existing building in the case of a major renovation. Energy labelling is expected to become one of the most effective ways to curb energy use in existing buildings, and the Danish case is discussed in a separate box below.

While building codes in many IEA member countries, including Denmark, were tightened in the late 1970s resulting in greater insulation for new buildings, 75% of the Danish building stock was built before 1979 and thus did not adhere to the tighter codes during construction. New building construction and major renovations that require adherence to the newer tighter building codes will only occur slowly, but by taking a longer-term view, the potential for energy savings in space heating becomes more obvious. Figure 10 below shows the turnover of building stock in Denmark and how by 2050, all buildings could either be renovated or new construction.

Figure 10

Projection of Trends in Stock of Residential Buildings



Source: *Energy savings in Danish residential building stock*, H. Tommerup, S. Svendsen. Technical University of Denmark.

In terms of market-based approaches to improving the quality of buildings, building labelling is currently being introduced in the ***EU***. There are currently no experiences from large-scale building labelling programmes anywhere in the world, and it will be instructive to evaluate the EU programme in the future. A major challenge for all EU countries is to train the required number of energy auditors, and to ensure compliance with labelling regulations. Energy labelling of buildings is based on the very successful experience of labelling of consumer goods, and is addressing the same issue, of overcoming the information deficit at the time of purchase (or renting), to enable the new owner/occupant to consider the running cost of the property they wish to acquire, in relation to the purchase cost. It is expected that energy labelling will lead to a shift in value, increasing the value of properties with lower energy demand. Energy labelling is a market-based measure that is intended to harness economic decision-making to reduce energy demand in the building sector.

In ***Denmark***, energy labelling for buildings has been introduced, and is described in more detail in the box below.

India launched its "National Energy Labelling Programme" for electrical items in May 2006. Under the programme, six electrical appliances have been selected, and labelling will be launched successively for those. Labels will become mandatory within six months of the launch of labelling for each

Energy Labelling for Buildings

The energy labelling of buildings in Denmark was developed in the context of a long history of energy-saving policy initiatives. Energy labelling was and still is seen as an important way to achieve energy savings in buildings – both existing and new – since the potential for energy savings in these areas is considered quite large. Denmark has implemented the following two energy-labelling schemes for buildings:

1) Energy management in large buildings of more than 1 500 m^2 (the ELO Scheme).

2) Energy management in small buildings, concerning one-family houses, apartments and other residential buildings of less than 1 500 m^2 (the EM Scheme).

In order to increase the efficacy of labelling, the Danish government has taken the following steps:

- Introduce a requirement specifying that in connection with major renovations in all existing buildings, and not only buildings over 1 000 m^2, energy improvements specified in the energy label must be implemented.
- Introduce specific requirements in the Building Regulations relating to replacement of roofs, windows in a façade, and oil and gas boilers, and to change heat supply.
- Through legislation, implement a more efficient and user-friendly energy labelling of buildings that are to be sold or rented.
- Set the validity of energy labels for small buildings at a maximum of five years.
- Set the frequency of regular energy labelling of buildings over 1 000 m^2 at a maximum of five years.
- Introduce regular energy labelling of all public buildings regardless of size.
- After three years, assess on the basis of the experience gained, whether regular labelling of all buildings should be introduced.
- Introduce inspection schemes for oil and gas boilers and ventilation systems.

Energy labelling for windows

Improvement of the energy aspects of windows is an important element in Danish energy conservation measures. Major energy savings can be gained by the improvement of windows as they account for a large element of heat loss from buildings. Solar heat is also collected by windows for a large part of the year, which means they play a significant part in maintaining comfort levels within buildings. Current measures consist of the following three elements:

- The new energy provisions in Danish building codes set standards for energy properties in façade windows for both new buildings and replacement of windows in existing buildings. Large-scale replacement of windows in existing buildings will also be subject to energy requirements.
- The Danish trade organisations have entered into a voluntary energy-labelling scheme for windows, and labelling schemes will be introduced for windows and internal double glazing. The schemes will categorise products into a scale from A to C.
- The DEA, the glass industry, glaziers' trade organisation and Vinduesproducenternes Samarbejds Organisation (VSO) (window manufacturer's co-operation organisation) have entered into an agreement on the phasing-out of traditional sealed units and promotion of energy-efficient window solutions.

During the last review cycle, the ***UK*** changed the minimum efficiency regulations for household gas boilers in new and retrofit installations from 78% efficiency (at higher heating value) to 86%, a significant increase of more than 10%. The change in regulation has already had the effect of increasing the share of condensing boilers from below 20% of the market to above 80%, according to the EEIR.

appliance. The programme will start with frost-free refrigerators and fluorescent lights, and will be expanded within one year to include direct cool refrigerators, air-conditioners, electric motors and ceiling fans. India also issued a draft building code in December 2005 in response to the booming construction industry that turned the energy efficiency of buildings into a priority area for the government.

INTERNATIONALLY CO-ORDINATED MEASURES

As energy efficiency rises on the policy agenda of governments, more policies are likely to be co-ordinated across international borders. ***Energy Star*** of the ***US***, which is the world's largest voluntary efficiency programme, continues to work closely with Europe, Japan, Australia and other countries. In 2006, Europe and the United States agreed to extend the Energy Star treaty. These countries have worked together to establish definitions, test methods, and specifications for various kinds of office equipment.

The IEA proposed and co-ordinated the "***Global 1-Watt Plan***" to reduce standby power in 1998. This has been adopted by several countries, including Australia and Korea. In 2005, the G8 reaffirmed its support for the 1-Watt Plan and urged the IEA to pursue it. Similar initiatives are being pursued in lighting. Also in 2005, the IEA convened a meeting to address the anticipated rapid rise in electricity use of television set-top boxes. This meeting resulted in a proposed specification for the largest category of set-top boxes, the Digital Television Adaptor (DTA). Since then, several regions, including Australia, the European Union, the United States (Energy Star) and California, have adopted the specification. In effect, a *de facto* international efficiency specification has been established for this product. On the basis of this and other experiences, in 2006 Australia proposed an ***International Community of Practice*** as a means of advancing co-ordinated efficiency specifications for products. This approach is now being applied to compact fluorescent lights.

WORLD ENERGY OUTLOOK 2006

WEO-2006 depicts an energy future, based on current government policies, which is vulnerable, dirty and expensive. But it also shows how new policies can create an alternative energy future which is clean, clever and competitive – the challenge posed to the IEA by the G8 leaders and IEA ministers.

In a Reference Scenario, which assumes no new government action, global primary energy demand increases by just over one-half between now and 2030, with over 70% of the increase coming from developing countries. The use of fossil fuels, imports of oil and gas in the OECD and developing Asia, and global energy-related greenhouse gas emissions grow even faster. World oil demand reaches 116 million barrels per day in 2030, up from 84 mb/d in 2005. Most of this increase is met by a small number of major producers. Global carbon dioxide (CO_2) emissions reach 40 gigatonnes in 2030, a 55% increase over today's level. These trends would accentuate consuming countries' vulnerability to a severe supply disruption and resulting price shock. They would also amplify the risk of global climate change.

Strong policy action is needed to move the world onto a more sustainable energy path. An Alternative Policy Scenario analyses the impact of the policies and measures that governments around the world are currently considering. In this scenario, global energy demand is reduced by 10% – equivalent to China's entire energy consumption today – and global carbon dioxide emissions are reduced by 16% in 2030. Improved efficiency of energy use contributes most to the energy savings. The shifts in energy trends described in this scenario would serve all three of the principal goals of energy policy: greater security, more environmental protection and improved economic efficiency. These policies are very cost-effective. There are additional costs involved, but they are quickly outweighed by savings in fuel costs. And the additional investment by consumers is less than the reduction in investment in energy supply infrastructure.

Underinvestment in new energy supply constitutes a real risk. The global energy industry needs to invest more than USD 20 trillion in real terms over 2005-2030 in the Reference Scenario – substantially more than was previously projected. There has been an apparent surge in investment, but it is, to a large extent, illusory. Drilling, material and personnel costs in the industry have soared in recent years, so that investment in 2005 in cost inflation-adjusted terms was barely higher than that in 2000. Investment in the second half of the present decade is expected to be significantly higher than in the first half, on the basis of current company plans and assuming costs stop rising. But there are doubts about whether all the investment that we project will be needed will be forthcoming *beyond* 2010.

The *Outlook* demonstrates that nuclear power could make a major contribution to reducing dependence on imported gas and curbing CO_2 emissions. But this will happen only if the governments of countries where nuclear power is acceptable play a stronger role in facilitating private investment, especially in liberalised markets. Nuclear power generating costs are less vulnerable to fuel price changes than coal- or gas-fired generation. Moreover, uranium resources are abundant and widely distributed around the globe. These two advantages make nuclear power a potentially attractive option for enhancing the security of electricity supply and mitigating carbon dioxide emissions – if concerns about plant safety, nuclear waste disposal and the risk of proliferation can be solved to the satisfaction of the public.

Biofuels are expected to make a significant contribution to meeting future road-transport energy needs, helping to promote energy diversity and reduce emissions. Biofuels reach 4% of road-fuel use in the Reference Scenario in 2030 and 7% in the Alternative Policy Scenario, up from 1% today. But rising food demand, which competes with biofuels for existing arable and pasture land, and the need for subsidy in many parts of the world will constrain the long-term potential for biofuels production using current technology. New biofuels technologies being developed today, notably ligno-cellulosic ethanol, could allow biofuels to play a much bigger role – if major technological and commercial challenges can be overcome.

HIGH PROFILE OF ENERGY SECURITY IN POLICY DEBATE

Recent energy market and geopolitical developments show that energy security concerns are becoming increasingly acute. Global energy supply and demand is tight, owing to rapid growth in the emerging economies and inadequate investment in energy-producing and -consuming countries. Energy prices (oil, gas, coal and electricity) remain high. Geopolitical risks (*e.g.* Iran, Iraq, Nigeria, etc.) are growing. A stronger tendency towards resource nationalism (*e.g.* Venezuela, Bolivia, etc.) is emerging. The events between Russia and Ukraine in January 2006 alerted the world to the issues surrounding the security of Russian gas supply. Weather-related catastrophes (*e.g.* hurricane Katrina) are adding to the risks of supply disruption. As a result, energy security is now at the top of many countries' policy agenda. Between 2005 and 2006, numerous policy developments were introduced in each IEA region and in non-IEA regions, mainly triggered by energy security concerns.

HURRICANE KATRINA

In late August 2005, Katrina, a major hurricane, hit the United States' Gulf of Mexico, causing severe damage to New Orleans and to a substantial part of United States' offshore oil and gas production. In following months, hurricanes Rita and Wilma caused further damage to onshore and offshore oil and gas production and processing. Under normal conditions, about 1.5 million barrels of oil per day and 0.3 billion cubic metres/day (10 billion cubic feet/day) of gas is produced from the United States' offshore Gulf coast; for gas this represents 17% of total domestic consumption, and for oil 7%. Additionally, 2 mbo/d of refining capacity were lost because of the storm.

In response to the damage caused by the hurricane, the IEA initiated an emergency response action on 2 September, which was concluded on 22 December 2005. The action, combined with other measures and effects, such as flexible refinery operation, additional efforts by producers, and reduced demand, successfully addressed the impact of Katrina. The action target was to make available 60 million barrels of crude oil and oil products to the market, with nearly all of these coming from emergency stocks and increased indigenous production.

EU: GREEN PAPER

In March 2006, the European Commission set out its vision for an energy strategy for Europe in *Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy*. With a strong belief that the energy challenges of the 21st century require a common EU response, the Green Paper has identified six priority areas.

Completion of the Internal Energy Market

In order to complete the internal energy market, which would put downward pressure on prices, improve security of supply and boost competitiveness, the Green Paper suggests new measures such as: a European energy grid code, a priority European interconnection plan, a European Regulator and new initiatives to ensure a level playing field, particularly regarding the unbundling of networks from competitive activities.

An Internal Energy Market Guaranteeing Security of Supply

To ensure security of supply in the internal energy market and solidarity among member states, the Green Paper proposes various measures, including the establishment of a European Energy Supply Observatory and a revision of the existing Community legislation on oil and gas stocks to ensure they can deal with potential supply disruptions.

Sustainable, Efficient and Diverse Energy Mix

While the choice of a member state's energy mix is, and will remain, a question of subsidiarity[9], the choice made by one member state inevitably has an impact on the energy security of its neighbours and the rest of the Community. With this in mind, the Green Paper proposes the Strategic EU Energy Review, covering all aspects of energy policy, analysing all the advantages and drawbacks of different sources of energy, from renewable to coal and nuclear. This may lead to objectives being established at the Community level regarding the EU's overall energy mix to ensure security of supply while respecting the right of member states to make their own energy choices.

Tackling Climate Change

To address the challenges of global warming, the Green Paper puts forward possible contents for an Action Plan on energy efficiency to be adopted by the Commission in late 2006. The Action Plan will identify the measures

9. Subsidiarity is defined as the principle that decisions should always be taken at the lowest possible level or closest to where they will have their effect, for example in a local area rather than nationally.

necessary for the EU to save 20% of the energy that it would otherwise consume by 2020. In addition, it proposes that the EU prepare a new Road Map for renewable energy sources in the EU, with possible targets to 2020 and beyond, in order to provide a stable investment climate to generate more competitive renewable energy in Europe.

Strategic Energy Technology Plan

Energy-efficient and low-carbon technologies constitute a rapidly growing international market in the coming years. The goal of the strategic energy technology plan is to make European industries world leaders in the new generation of technologies and processes.

Common External Energy Policy

The Green Paper also stresses the need for a common external energy policy. In order to react to the challenges of growing demand, high and volatile energy prices, increasing import dependence and climate change, the Paper emphasises that Europe needs to speak with a single voice in the international arena. To this end, the Commission proposes that its Strategic Energy Policy Review should: *i)* identify infrastructure priorities for the EU's security of supply (including pipelines and LNG terminals), and agree on concrete action to ensure that they are realised; *ii)* identify a renewed approach with regard to Europe's partners, including Russia, reflecting their mutual interdependence; and *iii)* propose a new Community mechanism to enhance rapid and co-ordinated reactions to emergency external energy supply situations.

UK: ENERGY POLICY REVIEW

In November 2005, the UK government launched a review of UK energy policy, which reported in July 2006. The review assesses progress against the four goals set by the 2003 Energy White Paper:

- To cut CO_2 emissions by 60% in 2050 with real progress by 2020.
- To maintain reliable energy supplies.
- To promote competitive markets in the UK and beyond.
- To ensure that every home is adequately and affordably heated.

The rather small lag between the 2003 White Paper and today's review was prompted by: *i)* emissions mitigation slower than expected, *ii)* gas supplies declining more than anticipated, and *iii)* substantial price rises for both gas and electricity. The public consultation was closed in April 2006. The key questions posed by the consultation document include:

- What more could the government do on the demand or supply side for energy to ensure the long-term goal of reducing CO_2 emissions?
- With the UK becoming a net energy importer and with big investments to be made over the next twenty years in generating capacity and networks, what further steps, if any, should the government take to develop a market framework for delivering reliable energy supplies? What are the implications of increased dependence on gas imports?
- Are there particular considerations that should apply to nuclear, as the government re-examines the issues bearing on new build, including long-term liabilities and waste management? If so, what are these, and how should the government address them?
- Are there particular considerations that should apply to carbon abatement and other low-carbon technologies?
- What further steps should be taken towards meeting the government's goals for ensuring that every home is adequately and affordably heated?

In July 2006, the government released *The Energy Challenge*, the first report from its Energy Policy Review launched in late 2005. The visit of the IEA in-depth review team to London and the writing of the in-depth review took place prior to this document's release and, thus, most of this book concerns policies in place prior to the Energy Policy Review. However, we do provide a brief summary and assessment of the July 2006 report below, and have changed the text of the book in those areas addressed, or likely to be changed, by the ongoing Energy Review.

Based on the July 2006 report – a more detailed White Paper is expected at the turn of the year – the Energy Policy Review does not represent a major shift in approach or philosophy for the UK. Instead, it reinforces the UK's use of the market to meet energy goals. While details of some programmes are still to be released, no dramatically new policy tools will be introduced. Market forces and market tools – individual decision-making, prices set by supply and demand, and active trading between market participants – will continue to factor heavily in all energy policies.

The continued embrace of a market philosophy is shown in the following aspects of the review report.

For energy security, the government will:

- Promote more open and competitive international markets.
- Further develop a domestic market framework that is positive for investment and diversity of supplies, and allows the private sector to make the necessary investment decisions.

- Remove barriers to nuclear power, but leave the private sector to initiate, fund, construct and operate nuclear plants, covering the full cost of decommissioning and waste storage.
- Create a framework to promote diversity, but leave the decision on how much gas the country uses to energy producers and consumers.

For GHG emissions reduction, the government will:

- Strengthen and expand the Renewables Obligation (RO), a market-based certificate trading scheme.
- Maintain an approach to energy savings that gives consumers more information and clearer incentives to make better use of energy, letting individuals make decisions.
- Consult on an emissions trading scheme for small and medium-sized enterprises.
- Work to develop the European Union Emissions Trading Scheme (EU-ETS) into a long-term international framework for pricing carbon.
- Press the European Commission (EC) to consider the inclusion of road transport and aviation in the EU-ETS.
- Have trials to provide real-time information to households about their energy use, letting them decide, instead of creating a mandate from government.

Although the IEA was unable to examine the details of the report, we would generally support its major tenets. In fact, many of the steps outlined in the review are consistent with the recommendations made in our in-depth review. Such shared conclusions include government plans to:

- Provide more certainty for market players on, among other areas, climate change, renewable energy and nuclear power.
- Look for ways to streamline the planning process for new energy infrastructure.
- Improve the quality of energy-related data provided to the market.
- Provide a framework for new nuclear plants and plan for dealing with legacy costs, but leave decisions and financing of new nuclear plants to the private sector without subsidy.
- Expand energy-saving programmes to small and medium-sized enterprises (SMEs).
- Increase efforts to improve energy efficiency in the transport sector.

GERMANY: ENERGY SUMMIT

In April 2006, the German government organised an "energy summit" between political and energy-industry representatives. The summit's aim was to map out an overall energy policy concept until the year 2020, with a view to reducing dependence on energy imports and preventing a rise in energy prices.

The energy industry promised the federal government that it would invest 20 billion euros in new power plants and the energy infrastructure between now and 2012. It plans to invest another 40 billion euros in the further development and expansion of renewable energies. The government plans to increase funds for energy research by 2 billion euros up to 2009, aimed at promoting further research in all energy sources.

At the time of writing, the discussion about the overall concept was scheduled to continue at a further energy summit in October 2006. Three working groups were commissioned to prepare the summit. They will deal with the international and national aspects of the energy policy and the topic of energy efficiency.

US: ADVANCED ENERGY INITIATIVE AND GLOBAL NUCLEAR ENERGY PARTNERSHIP

Advanced Energy Initiative (AEI)

In his State of the Union Address in January 2006, President Bush set a national goal of replacing more than 75% of oil imports from the Middle East by 2025. To achieve this goal, the government announced the Advanced Energy Initiative, which provides for a 22% increase in clean energy research at the Department of Energy (DOE). The objective of this initiative is to accelerate technology breakthroughs in two areas: how to power homes and businesses, and how to power automobiles.

Changing the way to power homes and businesses

With a view to reducing overall demand for natural gas and ensuring lower energy costs, research in clean coal technologies, clean and safe nuclear energy and revolutionary solar and wind technologies will be accelerated. To this end, the Advanced Energy Initiative proposes speeding up research in three promising areas, namely, the Coal Research Initiative, the Solar America Initiative and Expanding Clean Energy from Wind. The proposed amounts for each area in the 2007 Budget are USD 281 million, 65 million and 44 million respectively.

Changing the way to power automobiles

To accelerate the development of domestic renewable energy alternatives to gasoline and diesel fuels, the government will accelerate research in cutting-edge methods of producing celulosic ethanol with the goal of making it competitive within six years. The government will also speed up research in better batteries for use in hybrid and electric cars and in pollution-free cars running on hydrogen. The proposed amounts in the 2007 Budget for the Biorefinery Initiative, the deployment of more efficient vehicles and the Hydrogen Fuel Initiative are USD 150 million, 30 million and 289 million respectively.

Global Nuclear Energy Partnership (GNEP)

As part of the Advanced Energy Initiative, President Bush announced the Global Nuclear Energy Partnership (GNEP) in February 2006 to develop worldwide consensus on enabling expanded use of economical, carbon-free nuclear energy to meet growing electricity demand. This will use a nuclear fuel cycle that enhances energy security while promoting non-proliferation. It seeks to achieve its goals by having nations with secure, advanced nuclear capabilities provide fuel services – fresh fuel and recovery of used fuel – to other nations that agree to employ nuclear energy for power generation purposes only. The closed fuel cycle model envisioned by this partnership requires development and deployment of technologies that enable recycling and consumption of long-lived radioactive waste.

The GNEP strategy includes the following seven elements:

- Building of a new generation of nuclear power plants in the US.
- Developing and deploying new nuclear recycling technologies.
- Working to effectively manage, and eventually store, spent fuel in the US.
- Designing Advance Burner Reactors that would produce energy from recycled nuclear fuel.
- Establishing a fuel services programme that would allow developing nations to acquire and use nuclear energy economically while minimising the risk of nuclear proliferation.
- Developing and constructing small-scale reactors designed for the needs of developing countries.
- Improving nuclear safeguards to enhance the proliferation-resistance and safety of expanded nuclear power.

JAPAN: NEW NATIONAL ENERGY STRATEGY

In view of the current energy situation, including soaring crude oil prices and growing geopolitical risks, the Ministry of Economy, Trade and Industry (METI) announced the New National Energy Strategy in May 2006. The strategy has three overall objectives: establishing a reliable energy security system; establishing the basis for sustainable growth through a comprehensive approach on energy and environment, and active contribution in addressing Asian and global energy problems. To this end, the strategy has identified three areas where particular policy efforts will be devoted, namely, establishing the most advanced energy supply/demand structure, enhancing energy diplomacy and energy/environment co-operation, and enhancing emergency-response measures. These efforts will be backed by numerous concrete programmes, including the Energy Conservation Frontrunner Plan, the Next Generation Transport Energy Plan, the New Energy Innovation Plan, the National Nuclear Power Plan, the Asia Energy and Environment Co-operation Strategy, and the Energy Technology Strategy. Furthermore, with a view to ensuring a solid and stable approach by public and private sectors, the strategy has set out five numerical targets.

- Improving energy efficiency by more than 30% by 2030.
- Decreasing oil dependence below 40% by 2030.
- Decreasing oil dependence in the transport sector to 80% by 2030.
- Ensuring the share of nuclear in power generation at 30-40% or more up to 2030 and thereafter.
- Increasing the share of oil developed by Japanese companies out of total imports up to 40% by 2030.

G8 ST. PETERSBURG SUMMIT

The G8 Summit in St. Petersburg gave serious consideration to security of energy supply, and published an action plan on energy security focusing on improving transparency, predictability, and the investment climate in the energy industry, increasing energy efficiency and energy diversification, securing critical infrastructure, and reducing energy poverty and the environmental impact of energy use. The Summit reinforced the IEA's message about the importance of achieving the 3Es, with a particular focus on energy efficiency. The IEA is continuing its G8 work and is continuously reporting on individual items of work.

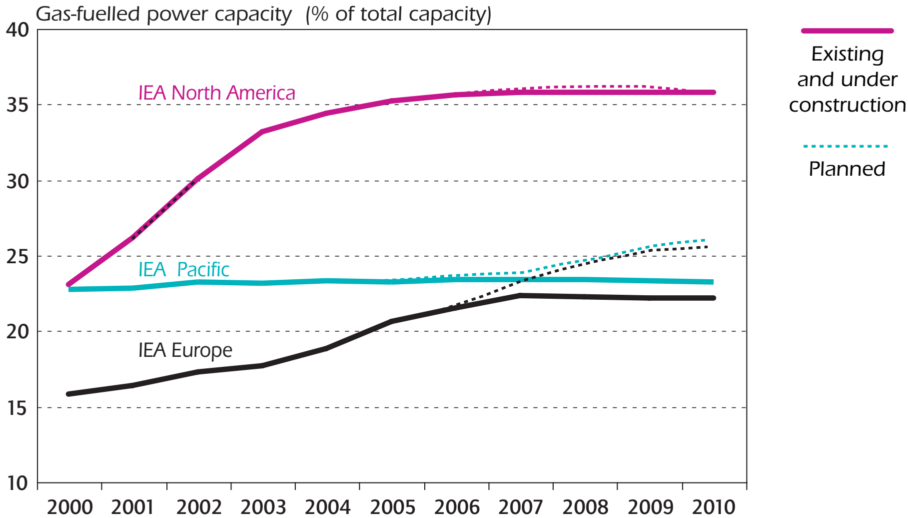
SECURITY OF GAS SUPPLY

A MOMENTOUS YEAR FOR GAS SECURITY ISSUES

Natural gas accounts for 21% of global energy supply, with slightly higher proportions in North America and Europe's relatively mature markets. While rapid growth since 2000 is expected to moderate in the second half of the decade, global demand is still expected to increase from 2.8 trillion cubic metres in 2005 to 3.2 tcm in 2010. The main driver of this growth in IEA countries is power generation. Despite current high gas prices, the vast majority of new power generation on line in this decade will be gas-fired. This trend is only likely to level off if current high prices for natural gas persist, and concerns about gas supply security rise.

Figure 11

Rising Shares of Natural Gas-fuelled Power Generating Capacity in IEA Regions, 2000 to 2010



Source: *Natural Gas Market Review 2006*, IEA/OECD Paris, 2006.

IEA countries' increasing gas use and dependence on imports, along with short-term tightness of supply and high gas prices, are heightening concerns about the security of supply of natural gas. In the short term, this means the prevention of sudden supply disruptions or, if unavoidable, proactive management of such disruptions. In the long term, this means investing in sufficient production and transportation capacity of natural gas and encouraging efficiency measures on the demand side.

For IEA countries, security of natural gas supply is of particular relevance, as dependence on non-IEA countries is growing at a rapid pace. Gas reserves are concentrated mostly outside the IEA, with Russia, Iran and Qatar holding almost two-thirds of global reserves. Norway and Australia are the only IEA countries that can significantly increase production.

The expected expansion of international LNG trade could alleviate some of the risks of long-distance supply chains if it leads to more diversified supplies. Increased short-term trading will also make LNG supplies more flexible. Liquefied natural gas is going to play a more important role in security of supply in IEA North America and Europe, to say nothing of IEA Asia, where LNG dominates natural gas markets.

Although an increasingly global market of LNG generally means diversified choices for both consumers and producers, greater competition could create some uncertainties. Spot LNG cargoes tend to be attracted to destinations where the highest netbacks are yielded. That is where the value to the producer is maximised after transport costs are deducted. This may not necessarily correspond to the destination of long-term contracts from the same producer.

The IEA's comprehensive study on natural gas, *Natural Gas Market Review 2006*, analyses the most recent developments in a momentous year for natural gas, as well as the marked evolution towards a global gas market. It is the first in a new series of in-depth studies on the gas market that will become a regular publication from the IEA in the future, taking account of the increasing importance of natural gas in the fuel mix in many countries, and the rapid globalisation of the natural gas market through increased use of LNG.

Russia/Ukraine Gas Dispute

Russia's Gazprom supplied around 150 bcm to Western Europe in 2005 (over a quarter of gas demand) of which around 80% transited through Ukraine. On 1 January 2006, following a lengthy commercial dispute, Gazprom gas supplies reduced markedly to Ukraine. This resulted in a reduction of deliveries to many Western European countries for a period beginning early in the morning on that day and lasting for about 1.5 days. In total about 100 mcm that was expected in countries west of Ukraine was not delivered. In addition, Ukraine itself suffered a shortfall of 150 mcm.

In Western Europe, drawdown of storage and voluntary fuel-switching were able to make up the shortfall relatively easily, because the duration of the interruption was short. The dispute and consequent interruptions did, however, cause serious concerns over security of supply and dependence on Russia in many European countries.

On 4 January, price terms were agreed between Russia and Ukraine, in a complex deal involving averaging prices with Central Asian suppliers. The deal seems weak and lacks transparency, with many unresolved issues. Prices are set only to mid-2006 and need renegotiation thereafter. Should the deal or renegotiation collapse, the consequences for security of supply of countries relying on transit gas are not easy to predict, but further interruptions should not be discounted. It is described in more detail in the IEA's *Energy Policy Review of Ukraine 2006*.

Hurricanes in North America

In the first three months after the hurricanes, a total of 12% less was marketed compared to normal[10] production, so 2005 gas output was down by

10. Taken as the average of the same months in the period 2001-2004.

Figure 12

Ukraine is a Major Transit Country

The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.
Source: *Natural Gas Market Review 2006*, IEA/OECD Paris, 2006.

nearly 3%. By spring 2006, however, production had almost completely recovered. The five United States' LNG import terminals operated only at about half capacity, because importers in other markets were prepared to pay even higher prices, and global availability of LNG was lower than expected.

Given the lack of supply, the market was mainly balanced by adjustments on the demand side. Residential and commercial consumers did not change their gas consumption since demand in this market segment is normally more sensitive to temperature than to price. However, industrial consumers used significantly less gas in the aftermath of the hurricanes. It is unknown to what extent this should be attributed to (temporary) disruption of operation, or to fuel switching. It is likely that at least some industrial consumers using natural gas as a feedstock stopped or shifted production.

Power producers appear to have consumed natural gas at levels around "normal" demand. It is likely that power producers have been able to pass on the higher fuel costs to the consumers, either through the rate base or through strong spark-spreads.

A notably mild winter, especially January 2006, allowed stocks to build up to high levels, and prices moderated from highs of 15 USD/MBtu to around 7-8 USD/MBtu by spring 2006, well above the 2004 maximum price of around 6 USD/MBtu. On an oil-equivalent basis, a price of 8 USD/MBtu corresponds to around 50 USD/barrel, well below corresponding crude prices of around 70 USD/barrel.

High Prices in the United Kingdom

During much of the winter 2005/06, prices in the United Kingdom were above 10 USD/MBtu, as a result of an exceptionally tight supply/demand balance. Price spikes even reached 30 USD/MBtu in November 2005 and March 2006.

During 2005, the decline in United Kingdom's gas production accelerated, and the country became more reliant on imports of natural gas. Imports to the United Kingdom are available through the interconnector from Belgium (maximum capacity 45.2 mcm/d), and in the form of LNG at Isle of Grain near London (13.5 mcm/d). Domestic production and storage are relatively certain sources of supply, although they are subject to normal technical availability (maintenance and interruptions). Supply through the interconnector is dependent on the prevailing price differentials, the availability of surplus gas on the European continent, and the availability of capacity to supply Zeebrugge at the Belgium end of the interconnector. Because of geographical factors, when the United Kingdom is suffering from cold snaps, the conditions on the continent are often even more severe, reducing the chance of spare capacity and volumes on the continent. Supply of LNG is dependent on global LNG availability and global price differentials.

Even during average winter weather, some imports are needed. Winter weather was average to mild in the first half of the winter, so no serious supply disruptions occurred. Later in the winter, there was a brief cold snap which coincided with a fire at the United Kingdom's main storage facility (which had been considered "certain supply"). This caused the National Grid to issue an emergency warning and prices spiked for a few days.

Concerns were raised in the United Kingdom as to why import capacity was not fully used despite the high gas price. From the first of November until the end of March, a net import of 5.2 bcm into the United Kingdom was realised, whereas over the same period 8.7 bcm would have been technically possible. Since December 2005, Ofgem, the British regulator, has been very strict in applying the use-it-or-lose-it principle for capacity at the Grain LNG terminal, and since mid-January 2006, the capacity at the terminal has been almost fully utilised. The interconnector, on the other hand, has only rarely been used at maximum capacity, despite high price differentials, which caused the United Kingdom government to file a complaint with the European Commission on the functioning of markets on the continent.

In the future, the United Kingdom's import demand will rise steadily. A number of additional supply projects are anticipated in coming years to meet this need. The BBL (Balgzand-Bacton Line) pipeline connecting the Netherlands with the United Kingdom is due on stream in December 2006, capable of supplying an additional 44 mcm/d. It is unclear whether the total capacity can be used immediately, owing to possible capacity constraints in the Dutch grid, which is currently debottlenecked, and the (non) availability of surplus gas on the continent.

The existing interconnector is due to be expanded with an additional 19.1 mcm/d by December 2006 (regarding flow towards the United Kingdom) whilst a new pipeline from Norway, Langeled (South), became operational, ahead of schedule, in September 2006. Langeled (South) has provided a link for some existing production in the Norwegian sector of the North Sea (including the massive Troll field) to be shipped to the UK, but it is not yet linked to a dedicated upstream. The dedicated upstream field, Ormen Lange, will only be tied into the Langeled pipeline system in 2007. This will boost flows to 74 mcm/day. Other major new infrastructure coming on stream in 2007 includes LNG capacity expansion at Isle of Grain (adding 23 mcm/d) and two new terminals at Milford Haven (25 + 16 mcm/d). LNG, in particular, should provide some much-needed diversity of supply.

Supply Tightness in Italy

Italy suffered severe natural gas supply shortages in the winter of 2005/06, as a result of the combination of unusually cold weather and an extraordinarily high demand of gas for power generation. This, in turn, was a result of the start-up of a large amount of gas-fired power generation and strong electricity exports. Annual natural gas demand in Italy is around 90 bcm, with an expected growth rate of 3-5% per annum; 15% of gas supply is produced domestically and the rest is imported from Northern Europe, Russia, Libya and Algeria. One LNG import terminal is available. Imports are around 250 mcm/d, plus domestic production of 30 mcm/d.

Following a cold November and December and higher use of gas-fired power, demand was running as high as 400 mcm/day. Italy has storage capacity of about 12.7 bcm (working volume), of which 5.1 bcm are considered strategic. During the course of January, storage use provided 100-140 mcm/d, meeting around 30% of national demand. By the end of January 2006, more than two-thirds of storage had been depleted, and deliverability had begun to drop. To address this situation, a first set of government measures was adopted in early January, including maximisation of imports, interruptible supply contracts, fuel switching, improving energy efficiency, both by decree and by a call on customers. A special law was issued to enable certain power generators to use different fuel oils from those that environmental law would normally allow. Further measures were implemented in February, including further relaxation of environmental standards. On 22 March, the emergency situation came to an end. By that time, 1.2 bcm of strategic stocks had been used.

Mention needs to be made of the role of Russian supplies in this situation. Russian deliveries were lower than expected throughout January and February, mainly because of higher off-take in Russia and Ukraine. ENI reports that Russian imports of 74 mcm/d had been requested over the winter. The difference between delivery and request of Russian gas was around 5 mcm/d, or a little over 1% of domestic demand. In February, up to 12 mcm/d had been requested but not delivered. The total amount not delivered is around 190 mcm. Notwithstanding these shortfalls, loss of Russian gas contributed to, but is clearly not the main reason for, Italian gas market difficulties.

The Italian situation underlines the barriers to free movement of gas in Europe, given that a number of large gas-consuming countries in the region retained comfortable levels of gas stocks and supplies through this period. Besides, market signals should have either lessened the incentive for power producers to produce electricity from gas in times of scarcity, or higher gas prices should have resulted in lower demand in other sectors. Additional gas-fired power generation is due on line in 2006, and the Italian government is aiming at enhancing stocks for next winter. It also expects to increase domestic production and to speed up the development of infrastructure projects (new LNG terminals, interconnectors and expanding capacity of existing pipelines, such as fully utilising the capacity of the Greenstream pipeline from Libya in 2006).

Recent LNG Outages

Although new LNG exporting plants were commissioned recently, a number of unplanned outages at LNG plants and unusually long ramp-up periods at new production facilities created a squeeze in the LNG supply in the second half of

2005 and the start of 2006. Producers diverted excess LNG production from other trains to cover long-term contracts on trains that suffered outages. This was one of the main factors that contributed to low deliveries of LNG to the US, despite record high prices in North America.

- In Australia, a technical problem shut down Train 4 of the North West Shelf project for all of September 2005, resulting in production losses of several cargoes. The North West Shelf project managed the shortfall and minimised disruption to LNG deliveries.
- In Nigeria, a leak in the main feedgas pipeline ignited a fire on 26 August 2005 and forced the shutdown of Trains 2 and 3, leaving Nigeria LNG operating at one-third of its capacity (a loss of seven cargoes).
- In Trinidad and Tobago, a long outage at Train 1 of Atlantic LNG in August 2005 cost the United States' market several cargoes.
- In Egypt, although completed early, slow ramp-up of the new projects also resulted in the loss of some cargoes.
- Declining reserves at Indonesia's Arun LNG plant and the requirements to provide feedgas to local fertiliser plants have reduced LNG production and forced Pertamina to defer nine cargoes for 2005. At Bontang, the diversion of gas to the fertiliser industry has caused the LNG seller to ask its Japanese buyers to cancel 41 LNG cargoes for 2005. More Indonesian cargoes are to be cancelled in 2006, possibly leading again to shortages in the LNG spot market.

It is difficult to predict whether the large increase in LNG production coming on stream in the next half of the decade will be adequate to meet demand. To a large extent, LNG will be used to offset declining production from pipeline sources, meaning that it will not contribute to overall alleviation of supply tightness. The power market functions as a demand cushion, being able to absorb much more gas when the price of gas is competitive with other fuels, particularly in the United States.

One conclusion can be drawn: LNG will function more and more as an essential part of gas supply to a number of IEA countries, making the difference between enough and too little gas, thereby increasing their reliance on the Middle East, Russia, North Africa and Nigeria.

Policies to Encourage Resource Development

With the increase in gas prices in IEA regions, recent years have seen unprecedented interest from the hydrocarbon industry in gaining access to new gas resources (as well as increasing production and recovery rates). In IEA countries, monetising gas reserves usually involves high-cost and technically-challenging projects, *e.g.* deep-water, long-distance pipelines, or unconventional gas deposits. This has resulted in government efforts to encourage investment in unconventional gas resources and to promote the building of pipelines to link these reserves to markets.

Examples can be seen in the United States (Alaskan North Slope) and Canada (Mackenzie River), as well as in Norway and the United Kingdom (North Sea Continental Shelf).

In the United States, drilling in the Arctic National Wildlife Refuge (ANWR) and in offshore areas (the Outer Continental Shelf – OCS) is so far excluded from exploration and production activities. These regions are potentially an important part of gas supply, as the regions include large resources of hydrocarbons.

In Canada, oil producers have been attracted to Alberta's oil sands as an economic source of heavy crude, particularly because of cost savings in the mining process in recent years, coupled with continuing high crude oil prices. Since the process consumes large volumes of gas, the Canadian government has started to look at new sources of gas by encouraging drilling offshore and by facilitating the building of a pipeline from proven reserves in the North West to the market.

Norway has also taken steps to increase production in its waters, given recent signs that parts of the Norwegian Continental Shelf is also reaching maturity. In response, the latest licensing round offered an increased number of blocks, some of which were located in the Barents Sea – a site of great untapped wealth in hydrocarbon deposits, but which faces particular environmental issues.

The United Kingdom and Norway have also recently concluded a framework to develop hydrocarbon reserves which sit astride their joint territories. Also, "stranded gas" fields located in areas of disputed nationality have stimulated much interest from governments keen to realise their development. Negotiations between Australia and East Timor have opened the path to enable gas projects in the Timor Sea to proceed.

Domestic policies to open up access in non-IEA countries (where 90% of world gas reserves are found) are of considerable importance also. For example, Algeria and to a greater extent Qatar have achieved considerable progress in resource development by means of policies aimed at deregulating and opening up their upstream sectors to investment.

Role of Gas Storage

Recent events have triggered a lively debate on the role of gas storage, especially among countries with a high dependence on gas imports. Strategic gas storage[11] is a potential option to protect downstream markets, and in fact,

11. Strategic gas storage is defined as storage that is not for commercial purposes, which usually means that the storage is under direct government control.

some projects have been initiated as a reaction to supply disruptions. But it is expensive, technically more challenging, and not as flexible or effective as oil stocks. Also, power markets are increasingly using gas-fired generation to provide power flexibility in the absence of efficient methods of storing power. This, in turn, makes gas markets more volatile, resulting in increased demand for high storage that is both capable of holding high volumes across seasons, and of delivering high volumes of gas into the network in times of high demand of gas, *e.g.* for power generation. This increases the cost of such storage projects.

At the end of 2004, IEA Europe had nearly 100 underground gas storage facilities with a working volume of 63 bcm, equivalent to 45 days of average consumption. Three countries dominate the European storage scene, accounting for two-thirds of capacity: Germany (29% of capacity), Italy (20%) and France (17%). These countries are all largely dependent on gas imports.

Storage at LNG import terminals also plays a role in IEA European countries, particularly Belgium and Spain. There are 14 LNG regasification terminals in Europe with a capacity of 75 bcm/year and a storage capacity of approximately 1.4 bcm of gas (2% of European storage capacity).

The use of underground gas storage is not common in IEA Pacific for several reasons. New Zealand is self-sufficient in gas, with most of its production coming from the Maui swing field. While the field is currently able to match the demand characteristics of the market, this situation is changing as the field declines. Australia is self-sufficient in gas, but because of the large distances between production and consumptions centres has developed four storage plants which account for about 5% of consumption.

The two largest gas consumers in the IEA Pacific region, Japan and Korea, are almost entirely dependent on LNG imports. Japan has 25 regasification terminals, with a total capacity equivalent to 8.6 bcm of gas, or 10% of annual gas consumption. When compared to LNG importing countries in other regions, this is a significant quantity of gas to hold in liquid form. However, this is the only means of storing gas in Japan, and is not used to manage seasonal demand swings but rather to manage the offload schedule of LNG ships. Korea has four regasification terminals with storage capacity equivalent to 2.6 bcm of gas, or 9% of annual gas consumption. Korea has the added complication of greater city-gas penetration than Japan, compared with regular industrial use. This means that Korea has much higher demand seasonality. This is met through volume flexibility on long-term import contracts, augmented by LNG purchases on the spot market.

While Spain, Korea and Japan all rely to a large degree on LNG storage, these countries are also looking at developing longer-term sites. Spain is actively developing underground gas storage, and studies are under way in Japan and Korea to investigate the practicality of using lined rock caverns.

North America has access to total underground capacity of 131.3 bcm, or 66 days average consumption, 20% more than IEA Europe. Almost 90% of total capacity is located in the US.

LAGGING INVESTMENT IS A CONCERN IN THE LONGER TERM

In terms of security of supply, the following conditions are important: well-functioning markets for gas and LNG; diversification of supply sources and delivery routes; accurate data and information (including reliable supply and demand outlook); dialogues between consumers and between consumers and producers; and proactive emergency measures.

Further examination of the roles of governments, independent or central regulators, and the IEA are necessary. Security of supply issues are different between the three IEA regions, and vary even within the specific regions. Storage infrastructure and strategic and commercial storage preparedness are different from country to country, depending on each country's historic experiences.

Nevertheless, adequate investment in production and transportation infrastructure is essential to reduce security of supply risks in the longer term. Producers are well aware of how important it is to have a reputation as a reliable supplier, if they are to maintain reliable markets for themselves.

General Trends in Gas Sector Investment

The IEA Natural Gas Market Review, the first of a new series of gas market reports, analyses investment behaviour in the gas sector with specific attention to the period 2006-2010. For this period, gas supply projects worth a total of USD 210 billion are under construction, with an additional USD 300 billion planned. This would imply possible total spending of USD 102 billion per year. In assessing the adequacy of these investments, the *IEA World Energy Investment Outlook (WEIO-2003)* can function as a useful reference, notwithstanding some definitional differences.

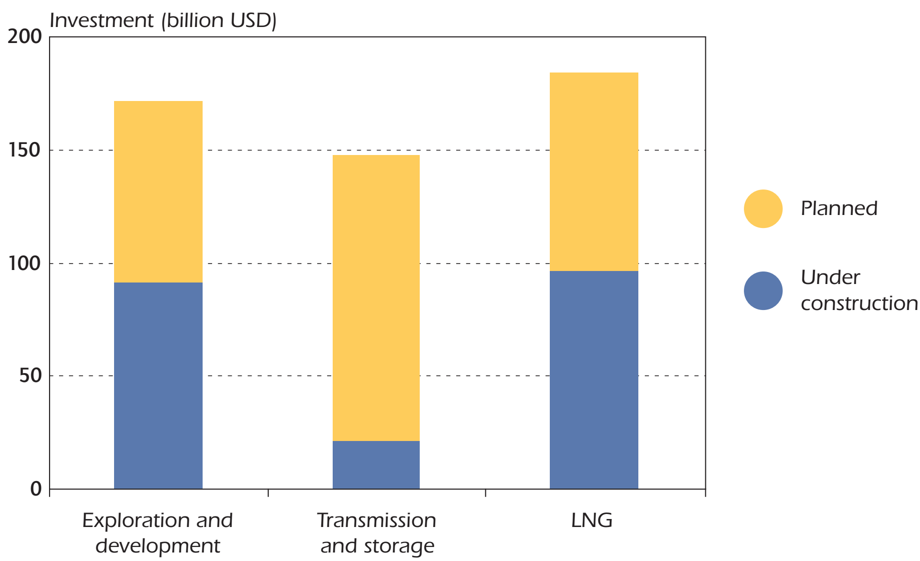
According to the *WEIO-2003*, cumulative global investment requirements in the natural gas supply chain in the period 2001-2030 are USD 3.1 trillion, or an average of USD 105 billion per year. Therefore, it would appear that current investments are broadly in line with projections, only if all planned projects proceed.

However, it is unlikely that all planned and proposed investments will be completed by the end of the decade. This is because the numbers also include some more speculative projects that will not be on stream in 2010 if the final investment decision has not been made by mid-2006. Although a five-year period is not a sufficient indication of long-term investment behaviour, there is a serious risk of underinvestment in the gas sector.

Figure 13 shows investments in projects that are currently planned or under construction in the main parts of the natural gas supply chain. USD 91 billion is under construction in exploration and development in the period 2006-2010, and that figure could double if all planned projects come to fruition. USD 21 billion is under construction in the transmission and storage part of the value chain; USD 122 billion, significantly more, is either planned or proposed. USD 96 billion is under construction in LNG projects, including liquefaction, shipping and regasification, but excluding exploration and development. A further USD 88 billion is planned in this sector.

Figure 13

Investment Focuses on LNG



Source: *Natural Gas Market Review 2006*, IEA/OECD Paris, 2006.

Of the USD 172 billion total expenditure on exploration and development, over half is attributed to gas fields supplying LNG production facilities. Given that LNG currently only constitutes 6% of total global gas consumption, its proportion of total investment is remarkable. This clearly not only shows that LNG is a rapidly growing industry, but also indicates that investment in pipelines is lagging. Of course, the pipeline industry is relatively mature, whereas LNG is a rapidly expanding industry. It is noteworthy that LNG projects are mainly backed by contracts with IEA countries.

This analysis, which is based on published sources, does not include many smaller pipeline investments which go unreported, whereas all LNG projects attract wide coverage. Notwithstanding these important caveats, the bias towards LNG investment appears quite marked, and the low level of committed transmission and storage investment is a cause for concern.

Major Pipeline Investments

A number of multi-billion-dollar pipeline projects are proposed, but few have reached positive final investment decisions. Compared with the more flexible LNG projects, pipelines create a decades-long mutual dependence between one supplying and one consuming region. Gas supply chains are becoming longer, and when international frontiers are crossed, political considerations become critical factors. This does not encourage the quick development of new projects.

Nevertheless, in many cases pipelines are still the preferred transportation method for natural gas, because of their relative high capacity, favourable geographical circumstances and straightforward design, engineering and construction. A few important projects have been recently completed (Blue Stream from Russia to Turkey; Greenstream from Libya to Italy; the West-East Gas Pipeline in China; Langeled, carrying Norwegian gas to the UK, including from the Ormen Lange gas field) and others are under construction (Balgzand-Bacton Line between the Netherlands and the United Kingdom; Baku-Tblisi-Erzurum Pipeline from Azerbaijan to Turkey; Turkey-Greece Interconnector; the Dolphin project from Qatar to Abu Dhabi, Dubai, and Oman; and West African Gas Pipeline from Nigeria to Ghana, Togo, and Benin, etc.) or under very active consideration (the subsea North European Gas Pipeline from Russia to Germany; the Nabucco pipeline from the Middle East and Caspian regions to Europe; the Rocky Mountain pipelines to the Midwestern and Eastern states in the United States; and the Alaska gas pipeline to the lower 48 states of the United States, etc.).

LNG investments

Total investment in the LNG sector in the period 2006-2010 amounts to USD 272 billion, of which USD 148 billion is under construction and another USD 124 billion is planned or proposed.

Although complete LNG value chains require multi-billion-dollar commitments, LNG investments have been requiring less time to market than many similar-sized pipeline projects. The focus and drive of international oil companies (IOCs) on LNG projects may explain this relative success. Whereas national governments or national oil companies tend to gain more and more control over the production of piped gas, IOCs still have a competitive advantage in the LNG market; hence as a sector, they are becoming more important in their business portfolio. They are more familiar with the technology, and have the skills to manage such mega-projects. They also provide considerable global market expertise and are often present in the regional markets. Thanks to their diversified supply portfolio they are a reliable partner for buyers of LNG, and thanks to their high credit ratings they are a reliable partner for banks. IOCs are responsive to strong market demands and can provide substantial equity in relatively short time frames.

Another important feature that stimulates investment in LNG is that it allows suppliers to have multiple buyers in order to spread risk. Since geographical boundaries are less of an issue *vis-à-vis* pipelines, LNG can be produced from the cheapest gas available and sold at the highest netback (when the contracts are flexible). LNG also creates possibilities for new entrants to capture a market share in former natural monopoly markets. As transport costs have fallen relative to prices, this factor becomes more significant.

Fuelled by stagnating domestic production in mature IEA Europe and North America, and backed by high gas prices in these countries, liquefaction plants are in operation or close to development in countries like Australia, Yemen, Equatorial Guinea, Egypt, Qatar, Iran, Nigeria, Angola, Norway, Russia, Peru, Indonesia, Malaysia, Algeria, Egypt, Oman, Libya, United States (Alaska) and Trinidad and Tobago, where hitherto stranded or low-value gas is found. Of these, Australia, and to a smaller extent Norway, are the only IEA countries that are likely to contribute significantly to the production of LNG in the near future. Nevertheless, most LNG projects are backed by contracts with companies in IEA countries and supply IEA markets.

COAL IN THE WORLD PRIMARY ENERGY SUPPLY

Coal meets one-quarter of the world's primary energy demand. It is used mainly for electricity generation and steel making, but its price competitiveness against oil and natural gas makes it an attractive fuel for a broad range of other applications, including cement production.

Between 1973 and 2000, coal use grew steadily by an average of 1.6% per annum. However, the last few years have seen a marked rise in coal demand, with average annual growth of 5.5% since 2000 and, by 2005, global annual production totalled 5 877.5 million tonnes (2 997.7 Mtoe). China has led this recent growth, producing 2 225.6 million tonnes in 2005; the country has few alternatives to meet the rapidly rising electricity demand of its burgeoning economy. Today, around 80% of China's electricity is generated from coal, a share that is likely to be maintained over the coming decades. After China, the USA is the world's largest coal consumer, followed by India. Across IEA countries, coal demand grew by 0.8% per annum between 2000 and 2005, and in 2005, 38% of electricity supplied in these countries came from coal-fired plants, just slightly below the share that coal-fired generation has in the global mix.

Coal is abundant and widely distributed, so that most countries have relatively easy access, either through indigenous production or through the well-developed international coal market. A recent compilation of energy reserve data[12] suggests that coal reserves would last 168 years at current production rates. Coal resources are even greater, at over 5 000 billion tonnes. There appears to be little risk of a coal shortage, although coal-exporting countries will become more important as production continues to shift away from the mature coal deposits of Western Europe and Eastern USA. A properly functioning, international market will ensure that the most economic reserves are exploited – whether in Australia, Indonesia, Vietnam, Colombia, Venezuela, Africa, Russia or elsewhere. Indeed, the international coal market has doubled in size over the last 20 years, reaching 775.2 million tonnes in 2005, an annual growth rate of 3.0% since 1981. The principal coal importers are Japan and other developed countries in the Asia-Pacific region, followed by a number of Western European countries. Most coal is traded across the oceans, shipped in dry bulk carriers, although cross-border rail transportation accounts for 9% of the world coal trade. Physical trade is backed by an evolving paper market, where producers and consumers can hedge their exposure to price risks. In practice, the paper market remains shallow, since coal is not viewed as entirely fungible, and long-term contracts are the favoured means to manage risk, although often linked to price indices and with flexible options.

In the light of renewed concerns about energy security, coal is seen as a reliable energy source, not subject to the geopolitical risks associated with oil and, increasingly, with natural gas. Fuel substitution occurs mainly in electricity generation, but there is also a growing interest in coal-to-liquids (CTL) projects, such that coal may become an important substitute for oil. CTL is well established in South Africa, China plans to produce 50 million tonnes of oil products from coal by 2020, and tax incentives are available in the USA. However, growing coal use does raise a number of issues that will need addressing by industry and governments:

PRICES

Coal consumers enjoyed a prolonged period of low prices through to mid-2003, reflecting the marginal costs of production. Since then, strong demand pushed prices to historic highs in 2004/05 (*e.g.* average CIF import costs of

12. *Reserves, Resources and Availability of Energy Resources 2004 – brief study*, Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources): Hannover, Germany, www.bgr.bund.de

USD 65.31/t for steam coal and USD 113.73/t for coking coal into OECD countries during the third and fourth quarters of 2005 respectively). Spot-market prices did moderate downwards during 2005, but have risen again in 2006. Producers are reporting healthy profits after some lean years. High oil and natural gas prices have certainly driven coal prices, but the weakening US dollar has accentuated upward price movements, since most coal trade is executed in this currency. The recent price volatility has effectively removed one of coal's traditional benefits, namely price stability. However, the trend of falling real prices over the last 25 years could not have continued indefinitely; the higher prices now cover the full cost of production and are attracting new investment into the coal sector that should ensure supply and demand balance at prices that maintain coal's competitive position. It remains to be seen whether consolidation among coal mining companies in major exporting countries and industry restructuring in developing and transition countries will bring price stability without excessive rents. Experience in Europe shows that carbon trading, under the EU Emissions Trading Scheme, and competition from natural gas do not push coal out of the fuel mix. However, commercial and political risks have become greater, and many utilities are looking at how new technologies, such as CO_2 capture and storage, can reduce these risks.

INFRASTRUCTURE

Expanding production from existing coal mines has proved to be an attractive strategy for many mining companies, especially where existing infrastructure has sufficient capacity to accommodate the increased output. Inadequate infrastructure can hamper expansion plans and is a major issue when developing new coal-mining projects. Utility supplies, local accommodation, rail links from mines, additional port capacity and new bulk carriers are long-term commitments that need to be carefully planned, often with the close involvement of governments, who may also need to regulate their operation where competition for capacity exists. Following the capacity constraints seen over the last few years, the signs in 2006 are encouraging; investment in new infrastructure is relieving the pressure points.

TRANSPORTATION

Coal consumers must compete for cargo space against consumers of other bulk commodities, such as iron ore and grain. In 2004/05, coal-importing countries experienced very high prices, partly because shipping capacity was unable to meet demand from China. Since then, the world's bulk carrier fleet has been enlarged and rates have fallen, but freight rate volatility will continue to be a risk. In the USA, coal from the massive Powder River Basin deposit is typically railed over 1 500 km to power plants once fuelled entirely by Mid-Western or Eastern coals. Rail constraints and bottlenecks limit the supply of this low-sulphur coal, and transport costs largely determine its price. In Australia and South Africa, rail and port capacity constraints have both had a detrimental impact on the ability to boost coal exports from these countries.

GREENHOUSE GAS EMISSIONS

Coal is a carbon-intensive fuel, and its growing use is incompatible with the aim of reducing greenhouse gas emissions, unless mitigation technologies are adopted. CO_2 capture and storage offers the prospect of a viable mitigation option and a number of power plant demonstration projects are proposed or under way, notably in Europe, the USA, Australia and Japan, that have the potential to lower the cost and prove the permanence of CO_2 storage. Whilst new technologies are coming forward, they add to the cost of generating electricity. New policies will be needed if CO_2 capture and storage is to become widely adopted, and these policies will have to be responsive to the additional costs.

AIR POLLUTION

In many countries, legislation is in place and enforced to ensure that emissions of air pollutants, such as sulphur dioxide, oxides of nitrogen and dust, are controlled to minimise environmental harm. The costs of pollution-control technologies have fallen considerably over the last thirty years, which has allowed their wider adoption, although this is by no means universal. Whilst, in many instances, mercury emissions from coal use are reduced significantly when other air pollutants are controlled, governments must be prepared to take further action, where necessary, as part of a wider mercury-control strategy.

The dynamics of the international coal trade over the coming years will be largely determined by the situation in China. Just a few years ago, it was anticipated that China would become a dominant coal exporter: net exports in 2001 stood at 87.5 million tonnes (excluding Hong Kong). By 2005, China's import requirement had risen substantially and net exports collapsed to 46.4 million tonnes (again, excluding Hong Kong). Since 2000, total Chinese coal consumption has grown at an average of 13.4% per annum, reaching 1 203.4 Mtoe in 2005. It requires relatively small changes in domestic demand patterns to have a large impact on China's net exports, and hence on the international coal market as a whole. The impact is felt everywhere, even in the relatively isolated coal market of the USA, where coal from the Powder River Basin swings in and out of the domestic market depending on a number of factors, including the price and availability of imported coal.

The coal industry has delivered reliable supplies of energy for many decades. However, it is not a static industry and supply patterns are changing. With rising coal demand in most regions, cross-border trade will continue to grow; this is an encouraging sign that powerful market forces are at work, driving production towards those regions where it is most economic, benefiting coal consumers everywhere. In many regions, the environmental impacts of coal use remain too high, but can be reduced by adopting the policies seen in many IEA countries which have encouraged best practices in clean coal technologies, a trend that may now extend to greenhouse gas mitigation with CO_2 capture and storage technologies.

PRODUCER-CONSUMER DIALOGUE

The Producer-Consumer Dialogue has evolved significantly since its inception in 1991 with the objective of achieving understanding and exchange of information between producing and consuming nations. Since then, it has endeavoured to bridge the gap between producing and consuming states, ensure market stability and security of supply. The dialogue has successively highlighted the importance of maintaining good working relations with key oil and gas-producing states, particularly during periods of political and economic uncertainty which have emerged throughout the world over the past decade.

The 10th International Energy Forum (IEF) was held in Doha, Qatar on 23-24 April 2006, with the participation of 59 countries and six international organisations. Under the theme "Fuelling the Future: Energy Security, a Shared Responsibility", ministers from producing and consuming countries discussed a range of global energy issues, including energy security, investment requirements to meet future energy demand and access to modern and sustainable energy.

Recognising the importance of dialogue and partnerships between governments and the energy industry, delegates interacted with CEOs of leading energy companies in the 2nd International Energy Business Forum (IEBF), with the participation of 32 major national and international energy companies.

The key outcomes of the 10th IEF can be summarised as follows:

- The IEA stressed the need for major investment throughout the energy sector, together with energy efficiency improvements along the entire energy chain, to overcome the challenges we confront in today's energy markets.
- All parties gathered in Doha agreed that prices were too high, at close to USD 75 per barrel. High oil prices represent a burden for consuming

countries, especially for developing nations. Despite the fact that current oil prices are not leading to recession, there is evidence that prices are having a negative impact on economic growth, in that the global economy is now growing more slowly than would otherwise have been the case. In the short term, there is no other way to cope with these prices apart from saving energy.

- A prolonged pattern of underinvestment in the oil sector has created constraints in the system that will take several years to resolve. Current oil price levels reflect not only geopolitics but also bottlenecks in both upstream and downstream capacities and are a risk to sustained global economic growth. Because the investment cycle takes time to bring new supplies on line, uncertainty will continue to characterise the market. Delegates also agreed that there is an urgent need for investment in exploration, production and refining, if a proper market balance is to be restored. Significant investment in refineries is coming forward (in the US, China, Korea, Saudi Arabia); however, there is the potential for a pinch point in oil and gas production if there is inadequate investment. Much of this investment will have to be made in a handful of countries in the Middle East and North Africa, which have by far the largest and least-cost oil reserves in the world.
- Peak oil is today becoming another factor of anxiety, but delegates to the IEF did not appear to lend much credence to an early peak. Nevertheless, companies highlighted that ultimate recovery is always the huge unknown. New technology may allow for recovery rates to rise to 55%, or even to 75% for some large important fields. Technological improvements in recovery rates may not lead to increased production, but decline will slow.
- In much the same way as oil-consuming countries worry about security of supply, oil-producing countries say they are worried about security of demand. Oil remains a cyclical industry, so screening values and hurdle rates for investment are still much lower than current prices. They argue that without a "road-map for demand" they cannot risk the huge investments they are being asked to make. Oil-producing countries are concerned about prospects for global oil demand because current high prices have stimulated strong support in consuming countries for measures aimed at curbing oil demand growth for economic, energy security and environmental reasons. The key message from consuming countries in Doha, led by the IEA, was that even if new policy measures are introduced, there is relatively little uncertainty about the level of supply required from the world's key oil producers over the next decade, and that it is expected that the difference between supply and demand will remain tight. Also, the current high prices are a key concern for demand security, since they threaten economic growth. Although the situation in 2030 is less certain, the investment decisions that will deliver supply at that time need not be taken until 2015 at the earliest, by which time the level of uncertainty will have decreased significantly.

- The main risks to investors around the world are those related to unstable investment conditions, or lack of access to the world's resource base. Continued underinvestment in the key producing countries would drive up prices and stimulate the development of higher-cost reserves in other parts of the world. This will ultimately benefit neither consumers nor producers. Thus, it is in everyone's interest for producer governments to communicate their long-term plans for expanding production capacity and reassure consumers that oil supplies will be forthcoming at affordable prices. Participants emphasised the importance of reliable and transparent data in all energy markets and the contribution of the IEF Joint Oil Data Initiative (JODI) in this regard. The apparent need for improving conditions to attract appropriately trained professionals in oil and gas-sector industries was also raised.
- On a broader level, producers and consumers agreed to continue working together to confront the challenges posed by energy poverty and climate change. No energy system will be sustainable without global access to modern energy services, reliable and affordable supplies, and reduction of environmental impacts.

These policy issues will be debated further at the 11th International Energy Forum that will be hosted in Rome in 2008.

ELECTRICITY

In the past year many IEA countries have pursued and made advances in the process of market liberalisation, albeit at different rates of progress. Electricity markets have been impacted by sharply increased fossil fuel prices, heightened concerns about long-term security of energy supply and volatile prices, and the introduction or implementation of key legislation and policy initiatives to address climate change issues, foster competition, and promote the use of renewables and energy efficiency. The winter period of 2006, which was characterised by very cold and dry conditions in much of Europe, also witnessed electricity prices increasing to high levels.

IEA EUROPE

The European Union is moving towards an internal electricity and gas market. The target date for full market opening is July 2007. In November 2005, the European Commission published a report titled *Progress in creating the internal electricity and gas market*, in line with requirements of the 2003 Electricity Market Directive. The report indicates that power market opening has largely been a success to date, as evidenced, for example, by lower electricity prices in real terms than in 1997 despite recent price increases for oil, gas and coal. However, a key conclusion of the report is that much more needs to be done by member states to ensure that consumers receive the full benefits of market liberalisation. The Commission urged member states to be more effective in implementing the market-opening measures required under the EU Electricity Directives.

The report also acknowledges that cross-border competition is not yet sufficiently developed to provide customers with a real alternative from the nationally established suppliers. Key indicators in this respect are the lack of price convergence across the EU and the low level of cross-border trade. The report states that insufficient interconnection between many member states prevents real competition from developing, despite the political commitment of the European Council made in 2002 to achieve an import capacity of at least 10% of internal consumption.

The Commission intends to carry out detailed country-by-country reviews of the effectiveness in practice of legislative and regulatory measures in connection with market opening, including specific additional national

Table 8

Status of Electricity Market Reform in IEA-EU Countries

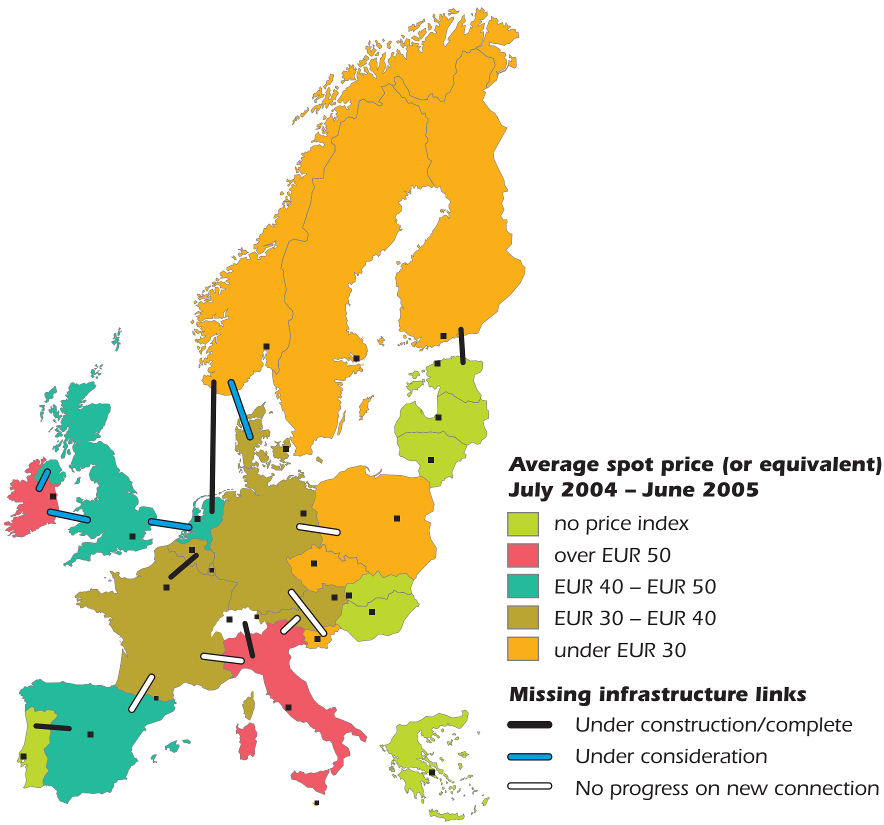
	Declared market opening (% of total)	*Large industrial users switching since market opening (% of total)*	*Medium industrial and commercial switching since market opening (% of total)*	*Electricity transmission*	*Electricity distribution Legal unbundling implemented?*
Austria	100	29	3	legal	No
Belgium	90	c.20	19	legal	Yes
Czech Republic	100	5	3.3	ownership	Yes
Denmark	100	>50	c.15	ownership	Yes
Finland	100	>50	82	ownership	Yes
France	70	15 (including medium)		legal	No
Germany	100	41	7	legal	No
Greece	62	2	0	legal	No
Hungary	67	32 (including medium)		ownership	See note
Ireland	100	56	15	legal	No
Italy	79	60 (including medium)		ownership	See note
Luxembourg	57	25	3	legal	No
Netherlands	100	-	-	ownership	Yes
Portugal	100	16	16	legal	See note
Spain	100	25	22	ownership	See note
Sweden	100	>50	-	ownership	Yes
United Kingdom	100	>50	>50	ownership	Yes

Note: In Hungary, Italy, Portugal and Spain, the distribution company is also the default supplier. However, suppliers to non-regulated customers must be legally unbundled.

Source: EU Commission, Report on progress in creating the internal gas and electricity market, Brussels, 2005.

Figure 14

Missing Electricity Links and Price Differences on the European Internal Market



Source: Report on progress in creating the internal gas and electricity market, (SEC[2005] 1448), Commission of the European Communities, Brussels, 2005.

measures. This will lead to a report by the end of 2006 and, if necessary, proposals to redress any remaining requirements.

On 8 March 2006, the Commission published a consultation document titled *Green Paper on a European Strategy for Sustainable, Competitive and Secure Energy.* As the title indicates, the Green Paper is based on three main objectives: sustainable development, competitiveness and security of supply. Among six priority areas to achieve the above objectives, the Green Paper emphasised the need to complete the internal gas and electricity markets, which guarantee security of supply and solidarity between member states. To improve transparency on the future demand/supply balance for gas and electricity, the Commission proposes to establish a European Energy Supply Observatory. The Commission will also examine whether existing forms of collaboration between national regulators and national grid operators are adequate, or whether a closer level of collaboration is needed with, for example, a European energy regulator to look at cross-border issues.

In June 2006, an energy sector inquiry into the functioning of the internal electricity market was launched under the Commission's competition powers. Preliminary findings of the competition inquiry confirm and complement the results of the Commission's report on the functioning of the European energy market. In particular, five areas of market malfunctioning are identified by responses to the energy sector inquiry:

- Electricity markets in many member states continue to be concentrated, creating scope for incumbent operators to influence prices.
- Several electricity wholesale markets are not liquid. There is also an inadequate level of unbundling of network and supply activities.
- Barriers to the cross-border supply of electricity prevent the development of integrated EU energy markets.
- A lack of transparency in the markets benefits incumbents and undermines the position of new entrants.
- Industry and consumers have little trust in the specific price formation mechanisms on energy wholesale markets, and prices have increased significantly.

As a direct result of the preliminary findings, business practices of several large European utilities are being investigated. The Commission is pursuing its competition energy sector inquiry, and identifies adequate remedies that may include action under the EC Treaty's rules on restrictive business practices, monopolies and state aids, and a possible revision of EU merger rules.

Since the EU began its efforts to create a single internal electricity market, European utilities in some countries have merged, with the objective of creating "national champions" that can compete on a wider European market. The pressure to consolidate has been escalating in the last twelve months or so. While the need for very large companies is obvious because of the need for significant investment, the recent wave of mergers among Europe's utility giants is partly driven by national politics and may therefore jeopardise the development of a single EU energy market, if not checked by vigorous competition oversight. The EU Commission's Directorate-General for Competition is very active in this field, with the aim to preserve competition.

IEA NORTH AMERICA

Canada

In Canada, the key initiatives with respect to power sector reform have been taken at the provincial level. On 13 June 2006, the Ontario Energy Minister directed the Ontario Power Authority (OPA) to proceed with its recommended 20-year electricity supply mix plan, with some revisions. The plan was designed to achieve a healthy balance by moving away from coal in favour of new nuclear power and renewable energy. The government has set targets that will double energy efficiency through conservation, and double the amount of energy from renewables by 2025.

More specifically, the government has accepted the OPA's advice that natural gas should only be used to meet peak demand in high-efficiency applications and to meet local reliability need when no alternative is available. The OPA is the agency that studies Ontario's long-term energy needs, and is responsible for carrying out the government's electricity plan, which includes the following main components:

- Ensuring adequate baseload electricity supply, while limiting the future use of nuclear power to today's installed capacity level of 14 000 megawatts.
- Directing Ontario Power Generation (OPG) to begin a feasibility study on refurbishing its existing nuclear facilities that will include a review of the economic, technological and environmental aspects of refurbishment. As part of this initiative, OPG will begin an environmental assessment on the refurbishment of the four existing units at Pickering B.
- Doubling the amount of electricity drawn from renewable sources, bringing the total to 15 700 megawatts by 2025.
- Doubling the conservation efforts suggested in the OPA's report, to reduce electricity demand by 6 300 megawatts by 2025.
- Expanding the transmission capacity from Bruce County and surrounding area to facilitate the transmission of electricity from several new wind farms and the Bruce facility to homes and businesses in Ontario.

The government is confident that the directive to the OPA meets both the core principles and the long-term energy requirements of the province to enhance the standard of living and the quality of life for all Ontarians. The directive is the basis of the Integrated Power System Plan. This 20-year plan, revised every three years, will be submitted to the independent Ontario Energy Board for review and approval.

OPG has also been directed to begin the work needed for an environmental assessment of the construction of new units at an existing nuclear facility. Nuclear is expected to remain the single-largest source for Ontario's electricity in 2025.

The government has accepted the advice of the Independent Electricity System Operator in its 9 June 2006 report that indicates the need for 2 500 to 3 000 MW of additional capacity to maintain system reliability. The government has referred the question of how best to replace coal in the earliest practical time frame to the OPA.

In Alberta, the government remains committed to the competitive retail market for all consumers. A draft discussion paper titled *Refinement Option for Alberta's Wholesale and Retail Electric Markets* was issued in March 2005. In June 2005, the government announced its decision to offer continued choice and protection to Alberta electricity consumers. A new 5-year Regulated Rate Option (RRO) for residential, farm and small commercial electricity consumers has been put into place, and is available for customers who do not choose to sign contracts for supply. The government will conduct a further review of the RRO in the autumn of 2007. Refinements to the current wholesale market design were also introduced and included. In November, the government announced the creation of a transmission advisory committee to ensure that Alberta's transmission system meets future power needs, by examining ways to speed up the process of building wires while still fulfilling the regulatory requirements.

United States

The United States adopted a key policy initiative, the *Energy Policy Act of 2005* (EPA2005), which will have far-reaching impact on the US and related energy markets. A major provision of the act addresses the issue of electric reliability. The act authorises the creation of a self-regulatory electric reliability organisation (ERO) that spans North America, with Federal Energy Regulatory Commission (FERC) oversight in the United States. The legislation makes compliance with North American Electric Reliability Council (NERC) and regional reliability standards mandatory and enforceable; this is a significant break from the current approach of voluntary compliance, and a direct consequence of the recommendations from the report into the 2003 North American blackout. The legislation respects the integrated nature of the US-Canada bulk electric system by ensuring that the ERO applies for and receives comparable recognition and approvals from government authorities in Canada.

EPA2005 grants FERC the authority to facilitate energy price transparency, and strengthens existing protections against market manipulation of energy prices. These provisions were designed to prevent future market abuses, such as those in California, Washington and Oregon from 1999 through 2001.

The energy bill repealed the Public Utilities Holding Company Act (PUHCA) of 1935 and passed PUHCA2005, a streamlined version of the law that opens the electricity and natural gas sectors to new sources of investment for necessary energy infrastructure development. This will have the effect of encouraging the construction of power lines, pipelines and underground bundled cables to meet America's future energy needs.

On 3 February 2006, FERC issued *Final Rules Concerning Certification of the Electric Reliability Organisation and Procedures for the Establishment, Approval, and Enforcement of Reliability Standards*. In accordance with the FERC rule, NERC submitted its application to FERC on 4 April 2006. At the same time, NERC submitted applications with the National Energy Board and the provinces of Alberta, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, and New Brunswick to implement comparable agreements in Canada. Approval of NERC's applications will result in the formation of an independent, international electric reliability organisation with the authority to develop and enforce reliability standards for the entire North American bulk electric system.

NERC's goal is to become certified and begin operating as the ERO by 1 January 2007.

On 18 May 2006, FERC issued a Notice of Proposed Rule (NOPR) with the aim to enhance the regulatory framework established in Order No. 888 and Order No. 889, to ensure that transmission services are provided on a non-discriminatory, just and reasonable basis. The proposal marks the first major reform of the open-access transmission tariff (OATT) enacted ten years ago.

Through the new OATT embodied in the NOPR, the Commission seeks to increase transparency and clarity in the planning and use of the transmission system, while addressing ambiguities in the original pro forma OATT. According to the Commission, the lack of specificity in the pro forma OATT creates opportunities for discrimination and makes discrimination more difficult to detect when it does occur. The NOPR retains the protection of native load customers embodied in Order No. 888, consistent with the new requirement in EPA2005 that load-serving entities be provided transmission rights to meet their service obligations. The NOPR would also maintain FERC's current approach to reciprocity for non-jurisdictional transmission owners. FERC also proposes to retain the two forms of transmission service – network and point-to-point.

In addition to providing support for energy efficiency, energy technologies and renewables, EPA2005 also provides strong support for the construction of new nuclear power plants in the US through a wide range of measures. These measures include:

- A production incentive credit of 1.8 cents/kWh of electricity produced from a qualifying advanced nuclear power facility (*e.g.* AP600, ABWR or similar) for the first eight years of operation and for the first 6 000 MW.

- A loan guarantee of up to 80% of the total project cost. There is no limit imposed on the number of projects that can obtain the loan guarantee.
- An indemnity provision for extra costs resulting from procedural or judicial delays, and procedural streamlining, with the first two projects indemnified for 100% of the extra cost, and the next four for 50%, up to USD 500 million.

As of April 2006, the District of Columbia and the following states have allowed at least some retail customers to purchase electricity directly from competitive retail suppliers: Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, and Virginia. The California energy crisis is perceived to have been a contributory factor in states' decision to restructure retail markets.

IEA PACIFIC

Australia

On 30 June 2004, all Australian state governments signed the Australian Energy Market Agreement. The two key elements of the agreed reform package relate to economic regulation and transmission. With respect to economic regulation, the Australian Energy Market Commission, with responsibility for rule making and market development, and the Australian Energy Regulator, with responsibility for market regulation and enforcement, were created. By the end of 2006, these institutions will have replaced 13, mainly state-based, entities. Regarding electricity transmission, in May 2005, the Ministerial Council on Energy announced that it would provide the Australian Energy Market Commission with rule changes it had developed to implement a new transmission planning function for the National Electricity Market (NEM), a process for assessing wholesale market regional boundaries and principles concerning the regulatory test for transmission investment.

Furthermore, all NEM jurisdictions, other than Queensland and Tasmania (which only entered the NEM in May 2005), have introduced full retail competition. Each jurisdiction maintains some form of regulated tariff and/or prices oversight. The form of the pricing regulation and its potential impact on competition differs across each jurisdiction. On 29 April 2006, Tasmania became an integral part of the NEM physically, with the commissioning of the world's longest high-voltage direct current subsea cable (360 km) linking Tasmania and Victoria.

NEM jurisdictions have agreed that where full retail contestability is operating, retail price caps should be aligned with costs, and the need for price caps should be reviewed periodically. Jurisdictions are not committed to a date for implementing reforms to retail price caps.

Japan

During the 1990s, the electricity industry in Japan began its liberalisation process. In 1995, changes in the *Electricity Utilities Industry Law* allowed competition to be introduced into the generation sector. In 1996, a wholesale electric power bidding system enabled non-electric power companies to sell electricity to electric power companies. In March 2000, retail sales of electricity were partially deregulated, allowing large end-users to choose their power supplier. In April 2005, Japan extended market liberalisation to cover, in addition to large and medium-sized industrial and commercial end-users, small industrial, commercial and air-conditioning customers. Since April 2005, the liberalised market represents about 63% of the total electric power sales in the country. As a result, a customer whose usage exceeds a certain threshold (50 kW) can now choose a service provider other than the incumbent electric power utility company. Japan expects to start considering full retail contestability by April 2007.

Lessons from Liberalised Electricity Markets

The role of government has fundamentally changed with electricity market liberalisation; the full benefits of liberalisation can only be realised if government policies adapt to reflect this new reality. This is one of the main conclusions from a recent IEA study on *Lessons from Liberalised Electricity Markets*, released in December 2005.

Modern economies are critically dependent on affordable and reliable electricity services. Over the last decade or so, IEA member countries have pursued market-based reforms to improve electricity-sector efficiency, to help strengthen its essential contribution to economic performance, international competitiveness and community prosperity.

However, recent events, including the Californian crisis of 2001, the collapse of Enron in 2002, the bursting of the power-plant investment "bubble" in North America in 2001/02, and the large-scale blackouts in 2003 and 2004 in a number of countries, have raised public concerns about these reforms. In response, government determination to implement effective electricity market reforms has weakened in some cases. In that light, IEA member countries stand at an important crossroad.

Examining the experience, it is clear that electricity market liberalisation has brought substantial benefits where reform has been comprehensively implemented, but it has required strong and ongoing government involvement and response in a fundamentally different market setting.

After up to ten years' experience with liberalised electricity markets (and even longer in some cases), important lessons can now be drawn from some pioneering countries and regions. Drawing on case studies from markets in the United Kingdom, the Nordic countries, Australia and the north-east of the United States, which have all operated with considerable success, it is evident that liberalisation has brought substantial economic benefits to these economies. Electricity sectors in these markets are performing better, and are operating more efficiently than before. In addition, consumers have been given a real choice in selecting suppliers and products. It is also evident that these results have not been achieved easily and many challenges still lie ahead. Many energy policy challenges remain unresolved. However, the higher transparency brought by successful liberalisation has improved the framework for targeted policy actions to address issues such as environmental quality and reliability.

The critical element for successful liberalisation is the presence of transparent price signals that reflect the real costs of generating, transmitting and distributing electricity. Liquid markets that allow market participants to trade and to manage risks are key features in all effective markets. Reform will only bring real economic gains if it delivers real competition in the market place. Targeted policy action is often required to achieve these outcomes.

The case studies show that when electricity markets are relatively effective, market players respond to the real needs of the sector, such as adding new investment in regions where prices are high. Interestingly, there is also emerging evidence of consumers being more involved in this market, for example by responding to the price. The traditionally strong focus on the supply side in this industry seems to become more balanced in liberalised and competitive markets, where more attention is devoted to the actual needs of the consumers.

One very clear lesson is that electricity market liberalisation is not implemented in a single event. It is a long and evolving process that requires ongoing government commitment, and it is a process that has not come to an end anywhere, as yet.

MAJOR DEVELOPMENTS IN KEY NON-MEMBER COUNTRIES

China

China has taken a gradual approach to liberalising energy markets. Experiments with power markets started in three regions, under which a portion of wholesale transaction between generators and the grid were opened up to bidding. Transactions between generators and consumers have yet to be tried. Further moves towards competitive markets include strengthening the State Electricity Regulatory Commission, updating Electricity Law, and constituting transmission system operators.

India

Implementation of the Electricity Act 2003 continues, including the notification of the National Tariff Policy in February 2006. Two key issues related to power-sector reforms are addressed, namely, setting out the formula for calculating cross-subsidy surcharge, and mandatory tariff-based competitive bidding for power purchases from private generators by distribution companies. The government proposed an Electricity Act Bill, eliminating the reference to "abolish cross-subsidies" in the Electricity Act 2003, while it maintains the objective of reducing cross-subsidies.

Russia

With respect to electricity-sector reform in Russia, although there have been certain setbacks in terms of market rules and regulations keeping pace with structural reforms, the government's reaffirmed commitment to the electricity reform process in late 2004, and again in June 2006, reflects a recognition among Russian policy makers that attracting timely and appropriate investment will remain a substantial and ongoing challenge, which can most effectively be addressed through the creation of efficient electricity markets operating in response to genuine price signals, within a robust and predictable legal and regulatory framework.

GAS

GAS PRICES

The general trend over 2005-2006 was for gas prices to increase in all major markets, although the US (4th quarter 2005) and UK (1st quarter 2006) markets have both had supply shocks which induced prices to suffer short-term peaks. These markets have both seen a decrease in prices in the run-up to winter 2006 as the market has taken account of better supply fundamentals than had been expected. This was driven by linkages to oil in continental Europe and the Pacific, or gas market fundamentals in markets such as North America and the United Kingdom. While different regions of the world use different pricing systems, interaction between these regions is increasing, creating potential friction and opportunities. New supply response to structural market tightness takes upwards of 5 years, whereas demand response tends to be more immediate. This makes all gas markets inherently volatile, whether or not the market design allows prices to reflect that volatility. Mature gas markets have developed effective ways to manage volatility, including upstream swing production, midstream gas storage, and downstream interruptability.

IEA EUROPE

Continental Europe

In continental Europe, with the linkage between gas and oil remaining, gas prices automatically follow oil price moves. This pricing system was developed when gas was introduced to these countries some decades ago. This was mainly because those first gas producers had to create a market for gas by taking market share from oil. Pricing gas on oil indices helped oil-consuming countries to diversify their energy use after the first oil shocks.

The European gas market is a mature market, and gas is now a valuable commodity in its own right, and is mostly used for power generation and heating, where oil has only a minimal market share. Indeed, the decreasing competition between oil and gas in Europe may mean that this pricing system has become a disadvantage to the efficient operation of both gas, and to a certain extent power, markets, as seen in Italy in early 2006. Oil indexation, as practised in this market, does not provide the necessary price information on short-term gas supply or demand in order to allocate the resource efficiently. This trend is set to grow, rather than recede, as gas demand increases with generating capacity.

Winter 2005/06 saw market failures in several European countries, notably Italy, as the gas price was not able to respond to gas shortages by indicating a scarcity value. With high European power prices, the economic incentive in this circumstance was to generate electricity from gas for export to the European market, while other gas users felt no price signals to curb gas demand and limited signals to augment supply. In consequence, the government intervened to manage demand and maximise supply. In this example it can be seen that the price of gas did not match supply and demand in oil-indexed markets. Meanwhile, the United Kingdom's interconnector to Belgium operated at well below capacity over the winter, despite a persistent and high price differential, because the price of gas in Europe does not reflect the balance of supply and demand. The tight situation in Italy necessitated government intervention to manage the situation; the United Kingdom situation resulted in high, volatile prices which have encouraged investment.

United Kingdom

Spot gas trading is widely developed in the United Kingdom with the virtual "National Balancing Point" (NBP), as the key trading point in the entry/exit-based system. The market has around 80 counterparties, and gas prices are set by supply and demand to clear the NBP. About half of the gas consumed in the United Kingdom is traded on spot markets, the other half is delivered according to the terms of old North Sea prices, incorporating many indices such as coal, inflation and electricity, but principally fuel oil and gas oil. In 1998, the International Petroleum Exchange of London (IPE) launched a gas futures contract, which is liquid for several years into the future. Recent long-term contracts supporting large infrastructure projects have been signed with Norwegian producers and Dutch traders, at NBP prices rather than oil prices. The same is true for recent LNG supply contracts from Qatar to the United Kingdom.

The United Kingdom is a net importer of gas but it still exports to the continent in the low-priced summer through the interconnector to Belgium. Although cheaper gas is available in the United Kingdom in summer, there is no impact on continental retail prices because of lack of competition in the European gas market. The United Kingdom's market imports the oil-indexed link to some degree from the continent through the interconnector, despite having only a minority of legacy oil-indexed contracts itself. The impact of the US Henry Hub price is likely to increase in future as the UK imports more LNG from the Atlantic basin.

IEA PACIFIC

Japan and Korea

Japan and Korea have successfully diversified their energy supplies away from oil since the 1960s by using gas as a substitute fuel for power generation and home heating. Since neither country has substantial domestic reserves to rely on, they were only able to access significant quantities of gas by importing it over substantial distances as LNG (*e.g.* from Alaska or Indonesia). In terms of pricing, both buyer and seller agreed to base the price of LNG on oil.

Beyond a certain oil price range, the rate of gas price increase and decrease with oil slows down, so that buyers and sellers are protected from exceptional oil price movements. This arrangement was called the "S curve" from the shape of the oil/LNG price graph. Over time, the "slopes" or rate of change of parts of this curve have changed, but the basic pattern remains.

This S curve imposes some interesting economics on end-consumers. It means that gas can be cheaper than oil at high oil prices, and more expensive than oil at low oil prices. In turn, this means that gas automatically gains market share (particularly from industrial users) at high oil prices, and loses market share to oil at low oil prices – this non-linear economics can cause unusual outcomes. One such example is to encourage the use of oil instead of gas when oil prices are low (as gas prices will be higher), unintentionally impacting customer choice. In the current high oil price environment, the major impact is the opposite, encouraging use of gas that is cheaper than oil.

Australia and New Zealand

Both Australia and New Zealand have small domestic gas markets in absolute size, with gas contributing around 20% of total primary energy supply. These gas markets are fully liberalised; allowing gas prices to be set by gas supply and demand. While both countries have domestic reserves of gas, New Zealand is suffering from reserves decline at its major producing field. The markets of both countries are relatively deep and liquid given the market size, and both governments intend to allow companies to solve supply and demand imbalances as they arise or are predicted.

Australia, as a major exporter of LNG, is exposed to prices in destination markets, but the major export sites are quite remote, and not linked with the domestic grid, so there is little interaction between them. Australian LNG exports are expected to become a major source of gas in the Pacific market as Indonesian exports are reduced.

IEA NORTH AMERICA

The North American market is the fusion of the United States and Canadian regional markets, united in the 1990s through the NAFTA (North American Free Trade Agreement), and to some extent also including the Mexican market. Prior to their fusion, both the US and Canadian markets operated in a similar manner to the European market of today, with oil-based contracts and pipeline companies that sold gas to customers on a long-term basis.

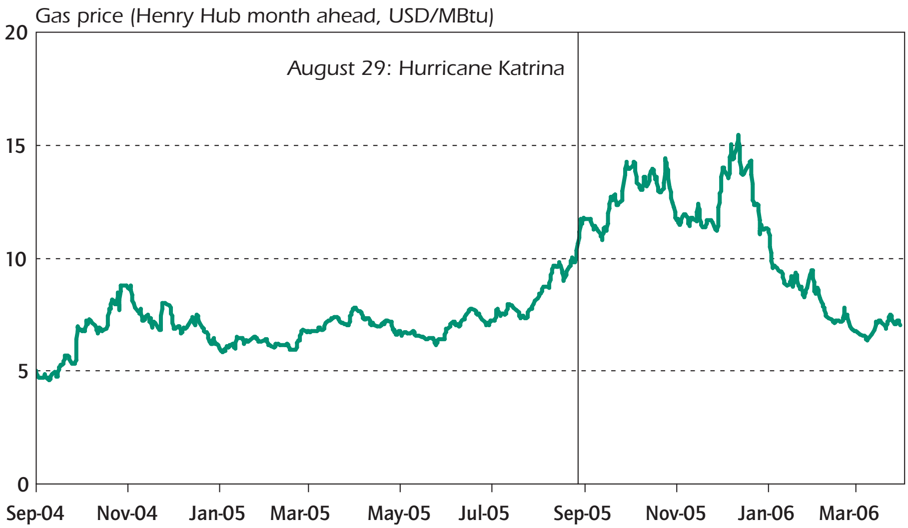
In the 1980s and 1990s, both the US and Canadian markets were liberalised, and network assets were unbundled from other functions. Long-term oil-based contracts were not suitable in an environment in which gas flows were optimised hour by hour as circumstances changed. Gas pricing was therefore based on the fundamentals of supply and demand at a given time and place.

End-consumers in North America have a range of pricing options available from which to choose. It is therefore possible for an industrial consumer to sign a supply contract at a fixed price, at daily spot prices, or in between, *e.g.* the monthly index. Some consumers index their gas purchases to power prices, coal prices, or whatever is suitable for their business, including oil prices.

When gas fundamentals determine value, rather than only oil markets, other factors are taken into account in price formation. In the North American markets, the price of gas at any time is also likely to reflect power plant availability, hydro levels, gas storage levels, oil product prices, pipeline use and availability, temperature, and the level of industrial demand. The fundamentals of gas supply and demand are complex and variable, which is why the "spot price" is volatile. This volatility can either be mitigated by demand and supply management, or acts as a signal for investment by allowing a financial return for short-term storage. In turn, the action of storage on the market helps decrease the volatility. From the perspective of the final consumer, the volatility can be managed by fixing prices over a longer term, or by active participation in the spot market.

Figure 15

Recent US Natural Gas Price Development



Source: *Natural Gas Market Review 2006*, IEA/OECD Paris, 2006.

PRICE VOLATILITY

There is an argument that liberalised gas markets result in gas price competition which is considerably more volatile than in oil-based gas markets. It is implied that liberalising gas markets is therefore worse for consumers. The fact is that most oil-based gas contracts carry an averaging period, which "smoothes" the volatility over several months. The same type of formula could be applied to natural gas spot prices instead of oil prices to achieve a "less volatile" index.

It is just as easy to create a low-volatility index from the gas spot price as it is from the oil products spot price currently used in the IEA Europe and Pacific regions. The major barrier to gas pricing is in creating an appropriate gas index. This is a more substantial challenge in Japan and Korea than in IEA Europe because there is no physical interconnectivity between countries in the Pacific, and there is no trunk pipeline system in the main gas consumer – Japan. As has been seen in Spain, however, the means to achieve gas indices through offshore LNG trade does exist. And the UK experience shows that there is no reason why the two types of pricing cannot coexist.

SUPPLY RESPONSE TO GAS PRICES

Gas supplies are currently tight in the major markets, whether in LNG markets, where there is a lack of spare liquefaction capacity, or in pipeline markets. Most long-term supply deals seen in the Pacific and European markets have built-in flexibility. This flexibility in long-term contracts is no longer required in the North American market, as consumers can always arrange the flexibility services they need by financial trade at a market hub. This financial trade is inevitably backed by physical assets somewhere in the gas system. In LNG markets, most trains are contracted below their actual maximum production, and therefore produce surplus cargoes to be sold to the highest bidder – on the spot market.

The European market has traditionally sought supply response through spare capacity on import pipelines, notably swing supplies from Russia and the North Sea. The European market has been designed to operate on contracts with a minimum delivery per day and per year from a supplier, but with a customer's option to increase that volume on demand to a maximum. This top-down approach allows large companies to match their supply to the demand of their customers, but tends to prohibit competition.

DEMAND RESPONSE TO GAS PRICES

Over time, all IEA gas consumers react to gas price movements. As prices in North America have risen steadily over the past six years, there has been a strong tendency for ammonia and methanol producers to stop producing in the high-price environment and switch production to sites near cheap sources of gas. As oil prices have risen, many industrial users in Japan and Korea have switched fuel use away from oil products and towards natural gas because the S curve effect makes gas relatively cheap.

It is over the short term that the large difference between demand response in oil-indexed and gas fundamentals-based markets is most evident. In a supply crisis, North American customers see a gas price spike, as happened after hurricanes in 2005. In a similar situation in Japan or Korea, gas prices would be unaffected, as in most of Europe. The automatic response in the

North American market is for low-value consumers to decrease consumption for a period. If they are buying spot gas, the price becomes too expensive for production. Conversely, if they buy fixed-price gas, they may be in a position to sell gas onto the market for a profit and interrupt their own production. The price signal increases supply, and higher value consumers continue to have their demand met. Conversely, in markets relying on oil indexation, gas prices do not reflect underlying gas supply issues, and therefore cannot elicit a demand response from the market.

A new challenge is posed by the increasing use of gas-fired power generation in IEA countries, in turn linked to more flexible electricity markets. This is being driven by different factors, one of which is increased flexible generation to follow increasingly variable power demand. When power demand spikes, gas-fired generation is increasingly used. This puts extra pressure on gas markets to react quickly to demands placed on it, either to produce more from gas storage/fields or to drive a demand response from other gas-consuming sectors of the economy. In non-liberalised markets, the effect is seen when governments issue decrees restricting the use of gas. In liberalised markets, this effect can be seen in the volatility of the gas price.

Governments and policy makers are increasingly aware that gas price market signals should be visible and transparent. There remain substantial challenges to ensure that these demand and supply imbalances are able to be accurately predicted by the industry with enough time to ensure adequate supply, bearing in mind that the lead time to construction for new gas supply assets is relatively long compared with other industries.

PRICE CONVERGENCE BETWEEN THE REGIONS

Whether liquefied or not, natural gas is much more difficult and costly to move from one region to another than oil, although the situation is improving as transportation costs are cheaper than ten years ago. The emerging trend is therefore one where prices in one region will influence prices in other regions through new opportunities for trade. Arbitrage possibilities sometimes exist between the various mature markets through diversion of LNG cargoes, or through pipeline/LNG swaps. Where these deals are arranged, pricing signals from one market are directly transferred to another, meaning that the price differential affects the demand/supply balance in both regions – an essential factor to bear in mind in market design.

Gas markets are no longer isolated, and events in one region will have an impact – to varying extents – on other regions. The gas market is not yet global, but policy makers and other stakeholders can no longer ignore what is happening in the other regional markets.

MARKET

There has been a continuous general trend to further liberalise gas markets across the IEA regions and in IEA countries, and this trend is spreading to countries outside the IEA.

IEA EUROPE

Europe is in the process of reform which was started in the EU with the adoption of the EC directives (passed in 1998 and 2003) on the internal gas market. The aim of the gas directives is to accelerate market opening, create a more consistent regulatory framework for the EU member states, and increase the level of integration among individual markets. However, most member states missed the deadline of 1 July 2004 for the implementation of the new directive, and some member states have not yet implemented the directives at all.

The Gas Market Directive (2003/55/EC) includes the following key provisions:

- Full market opening for all non-household customers by 1 July 2004, and for all customers by 1 July 2007.
- Legal unbundling of transmission and large and medium-sized distribution companies.
- Third-party access to transmission and distribution networks on the basis of regulated tariffs.
- Access to gas storage facilities, either on a negotiated or regulated basis.
- Strengthening of public service obligations, especially for vulnerable customers.
- Monitoring of security of supply.
- The establishment of a regulatory authority in each member state with a common minimum set of responsibilities.

Reflecting a marked increase in the amount of resources being directed towards gas market liberalisation by the EC, the Directorate-General for Competition (DG-Comp) also launched an investigation into the gas market, which reported its findings in November 2005. This investigation provided another clear analysis of the weaknesses of the current situation, stating that the European gas landscape was suffering from: market concentration, vertical foreclosure, insufficient market integration, lack of transparency and a lack of market-based prices.

In April 2006, the Director-General for Energy and Transport put 17 member governments on formal notice for failing to implement various aspects of the

European Union gas and electricity directives. A number of issues were cited, including lack of legal unbundling of gas transmission and system operators, lack of true third-party access and insufficiently transparent gas tariffs.

Recent large-scale merger activities in Europe stress the importance of a continued development of the internal EU energy market, where competition can flourish in a fully transparent market, and where gas can move easily and efficiently across borders to bring greater collective security. Further development of a regulatory framework that allows for effective competition is critical, as highlighted by the Commission early in 2006.

IEA PACIFIC

The Australian federal government, in concert with the states, has recently established a single national energy regulator, covering both electricity and gas, and replacing at least 13 provincial bodies regulating these areas.

In Japan, the government is aiming to balance maintaining gas supply security with enhancing the competitiveness of the gas utilities. In 2007, it intends to gradually expand the scope of retail liberalisation to consumers with an annual demand of at least 100 000 cubic metres, or about 50% of the gas demand. To ensure fair and transparent third-party access (TPA) to pipelines, the government proposes accounting separation and information firewalls between transportation activities and other activities of gas companies. Since negotiated TPA to regasification terminals was introduced in 2003, owners of LNG import facilities have been required to publish the amount of surplus capacity at their terminals, and give reasons for denying access to third parties who want to use that capacity.

In 1999, the Korean government signalled that it was keen for competition to develop in the gas sector, and proposed that the Korean gas company (Kogas) provide TPA to all gas infrastructures. In July 2005, POSCO (a Korean steel company) commissioned the first privately-built regasification terminal in the country.

IEA NORTH AMERICA

The North American gas industry has undergone profound structural changes over the last three decades, largely due to regulatory reforms aimed at promoting competition and improving efficiency. The North American wholesale market for gas is highly competitive. Thousands of producers, independent marketers, pipeline affiliates, local distribution companies (LDCs) and end-users compete to buy and sell gas at the wellhead and at hubs located across the region.

Table 9

Summary of Gas Customer Switching and System Operator Unbundling in the EU Member States

	Volume of gas consumption having switched by group – cumulative since market opening				Unbundling of:	
	power plants	*large and very large industrial*	*small-medium industrial and business*	*very small business and household*	*gas transmission system operators*	*gas distribution system operators*
Austria	6%	4%	Legal	Legal		
Belgium	25%	9%	Legal	Legal		
Denmark	30%	<2%	Ownership	Legal		
Finland	–	–	–	–	–	–
France	14%	0%	Legal: state overlap	No		
Germany	–	–	–	–	Partly legal	No
Greece	–	–	–	–	–	–
Ireland	100%	49%	0%	No	No	
Italy	23%	3%	1%	Ownership	Legal	
Luxembourg	–	2%	0%	0%	No	No
Netherlands	–	–	–	5%	Ownership	Legal
Portugal	–	–	–	–	–	–
Spain	60%	2%	Legal	See note		
Sweden	–	–	–	–	Ownership	No
United Kingdom	>90%	>85%	>75%	47%	Ownership	Ownership
Estonia	0%	0%	0%	0%	No	No
Latvia	0%	0%	0%	0%	No	No
Lithuania	0%	0%	0%	0%	No	No
Poland	0%	0%	0%	0%	Legal	No
Czech Republic	0%	0%	0%	0%	No	No
Slovakia	0%	0%	0%	0%	No	No
Hungary	6%		Legal	No		
Slovenia	0%	0%	0%	0%	No	No
Cyprus	–	–	–	–	–	–
Malta	–	–	–	–	–	–No

Note: In Spain, the distribution company is also the default supplier. However, suppliers to non-regulated customers must be legally unbundled.

Source: *Report on progress in creating the internal gas and electricity market,* European Commission (November 2005).

Recognising that gas supplies have recently been tight, the United States government is promoting the import of LNG. It has moved quickly to encourage the construction of LNG receiving terminals by adopting regulation, and streamlining the authorisation process. Major changes to the regulation of offshore terminals were adopted in 2002 to facilitate the construction of LNG facilities, including placing offshore terminals under exclusive Coast Guard jurisdiction and exempting owners of offshore LNG facilities from open access provisions. These moves granted owners the right to reserve for themselves all of the import and storage capacity at their facilities (proprietary access), and preceded a similar decision on onshore LNG facilities.

In August 2005, the president of the United States signed the Energy Policy Act which gave FERC (the Federal Energy Regulatory Commission) exclusive jurisdiction for location, construction, expansion, or operation of LNG terminals, but prevented open access requirements or the possibility of regulation by the rate base until January 2015. This effectively codified the FERC's earlier decision in 2002 (the "Hackberry" decision) designed to facilitate investment in LNG import terminals. It also moved to accelerate the administrative process by allowing a pre-filing process for LNG terminals. This process means that the FERC is involved in LNG projects before they are formally submitted, so it can help companies to prepare their application more effectively. In addition, Section 312 of the new act is designed to encourage investment in new gas storage facilities, seen as an essential adjunct to increasing imports. Under the section, the FERC is able to allow a company to provide storage services at market-based rates, even without the obligation to demonstrate the lack of market power.

Restructuring at the Retail Level

In 2005, participation percentages in residential customer choice programmes in the United States declined in all states except New York and Indiana, resulting in a reduction of total enrolment for the second year in a row, according to the United States Energy Information Administration. Concerns about higher and more variable natural gas prices may have reduced interest and confidence in marketer pricing options and market liberalisation.

MAJOR DEVELOPMENTS IN KEY NON-MEMBER COUNTRIES

China

China has ambitious plans to raise the proportion of natural gas in its energy mix. Judging by performance in 2005 – a rise of nearly 21% in domestic output – it appears to be succeeding, but perhaps not for long. Despite some recent success in onshore and offshore exploration, its domestic reserves are

Table 10

Status of US Natural Gas Industry Restructuring at the Retail Level by State, as of December 2005

Residential natural gas restructuring status	*States*
Statewide unbundling – 100% eligibility: Active	DC, NJ, NY, PA
Statewide unbundling – 100% eligibility: Inactive/Limited programmes	CA, MA, NM, WV
Statewide unbundling – implementation phase: > 50% eligibility	CO, GA, IL, MD, MI, OH, VA
Pilot programmes/partial unbundling	FL, IN, KY, MT, NE, SD, WY
No unbundling – considering action	IA, KS, ME, MN, NV, NH, OK, VT
No unbundling	AK, AL, AR, AZ, CT, HI, ID, LA, MS, MO, NC, ND, OR, RI, SC, TN, TX, UT, WA
Pilot programme discontinued	DE, WI

Source: EIA website: http://www.eia.doe.gov/oil_gas/natural_gas/restructure/restructure.html

not large, so greater gas use would mean sharply increasing reliance on imports. Plans for pipelines and LNG terminals have proliferated. However, recent changes in global LNG markets are now leading China to scale back its plans for LNG terminals and to focus more on making progress on pipeline deals with Russia and Central Asia. Several new pipelines have been announced, and preliminary work begun on some routes. Here, there will be direct competition with Europe for Central Asian and East Siberian gas that could flow East or West. Breakthroughs with these pipelines and significant policy efforts to promote development of gas networks, including pricing policies that allow cost recovery, will be needed if China is to maintain expansion of gas use at the rate it desires. The alternative will be continuing, even heavier, reliance on coal and oil. Already, a number of coastal power plants are being built to burn either gas or oil, and some planned gas-fired generators have been cancelled in favour of coal-fired plants. Restrictions on gas supplies will make reaching China's goal of reducing its energy consumption per unit of GDP by 20% all the more difficult, since efficiency gains in many applications depend on switching from coal to gas.

India

The *Petroleum and Natural Gas Regulatory Bill* was approved in early 2006. The act foresees the creation of a downstream regulatory authority for petroleum and natural gas that will promote competition and provide for access to pipelines on a non-discriminatory basis. However, pricing of petroleum and natural gas is excluded from the act, and will remain under government control.

The government is also in the process of finalising the *Gas pipeline policy* intended to facilitate growth of the natural gas sector and in particular to promote investment in and expansion of the pipeline infrastructure with a view to eventually create a nationwide gas grid. The policy further intends to encourage public and private investments and to protect consumer interests. A central feature of the draft pipeline policy is the common carrier proposal for third parties on open access and non-discriminatory basis and progressive unbundling of transmission and marketing activities.

Russia

Russia is and will remain an energy superpower. Over the decades, it has historically been a reliable supplier of oil and especially of natural gas, even through politically turbulent times. While the controversy relating to gas delivery between Ukraine and Russia early in 2006, which affected the stability of gas supply in Europe, was not symptomatic of imminent Russian delivery problems, it did serve to focus the world on the security of Russian gas supply. This incident has raised concerns about Russia's future ability to deliver gas, especially after several years of watching Russia's oil production growth rate decline as investors lost confidence in the stability or adequacy of Russia's investment regime. Underinvestment in Russian oil and gas production is a critical issue to world oil markets as Russia had become a key driver of non-OPEC supply growth in recent years. Creeping nationalisation in the oil sector, with Yukos and Sibneft now under state monopoly control, has raised questions about whether continued investments would be timely, especially in view of the need to develop more difficult fields in East Siberia and Northern Russia. The IEA's long-standing concerns about fiscal, legal and regulatory reform (including streamlined environmental and safety regulations) remain unchanged. More transparent and fair third-party access to oil and gas transmission systems continues to be a key need to provide for more competition, especially in the upstream natural gas sector. Such regimes will be increasingly critical to ensure an attractive environment for oil and gas company investments and to buoy Russian economic growth and global energy market stability.

MAJOR MULTINATIONAL AND SUB-NATIONAL DEVELOPMENTS OF CLIMATE CHANGE POLICIES

Regional measures proved integral to the 2005 climate change mitigation strategies of IEA member countries. Whether supra-national or sub-national in scope, regional efforts expanded the focus of climate change policy beyond the federal level to better address climate change. Around the world, IEA member states pursued regional strategies, exemplifying 2005 trends in climate change mitigation.

UNFCCC

As the largest multinational mitigation effort, the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) convened its first Meeting of the Parties (MOP) since entering into force. Held in Montreal in late 2005, COP/MOP 1 provided a forum for further negotiation of the Protocol's operation, addressing implementation of "flexible mechanisms" for emissions reductions, among other administrative and political issues. In addition, the Kyoto Parties organised two official discussions on the design of future climate change policy: the first, the Ad Hoc Working Group on Further Commitments for Annex 1 Parties under the Kyoto Protocol; the second, the UNFCCC's "Dialogue on long-term co-operative action to address climate change by enhancing implementation of the Convention". Participants in both new processes convened in May 2006 for their first formal meetings.

Delegates to the Ad Hoc Working Group (AWG) focused on the design of emissions reduction commitments for Annex 1 parties[13] – largely industrialised nations – after the Kyoto Protocol's first period ends in 2012. In formally discussing co-operative international mitigation, the AWG aims to provide some certainty to carbon-constrained investments in infrastructure and the carbon market itself. However, as noted during the debate, the AWG has no mandate to encourage participation from non-Annex 1 parties or from Protocol non-parties like the United States and Australia.

13. Annex 1 Parties to the UNFCCC include industrialised countries that were members of the OECD in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

As such, delegates to the Montreal's COP/MOP designated the UNFCCC Dialogue to explore worldwide climate change mitigation and adaptation through an "open and non-binding exchange of views, information and ideas." Participants in the Dialogue's first meeting, held two days prior to that of the Ad Hoc Working Group, discussed strategic adaptation to climate change, sustainable development, and the mitigation potential of technology and market mechanisms. Making no binding decisions, the Dialogue appears among the most informal long-term co-operation in which IEA nations participated in 2005 and 2006.

EUROPEAN UNION

As the most formal regional actor in climate change policy, the European Union addressed GHG emissions from many economic sectors, from transport to energy production. EU regional policy also targeted energy efficiency across the European economy, from the operation of buildings to the distribution of fuel. Perhaps most famously, 2005 marked the inauguration of the European Union Emissions Trading Scheme (EU-ETS), a market mechanism for emissions reduction that traded allowances for 260 million tonnes of carbon dioxide at a value of more than €5 billion in its first year alone. As governance of the European Union involves financial and judicial penalties for states not complying with Community decisions, the EU can often implement policies that are more stringent than those of many regions without central administration.

ASIA-PACIFIC PARTNERSHIP

January 2006 witnessed the inaugural meeting of the Asia-Pacific Partnership on Clean Development and Climate (AP6) between Japan, China, India, Australia, the Republic of Korea and the United States. The partnership focuses on voluntary measures by these six nations to create new investment opportunities, build local capacity, and remove barriers to the introduction of clean, more efficient technologies in the region.

SUB-NATIONAL DEVELOPMENT

In Australia, following several years of emissions trading within scattered territories, the governments of six Australian states and two territories began constructing a domestic emissions trading system, modelled on the European Union's Emissions Trading Scheme and the United States' market for sulphur dioxide. In January 2006, independent of federal mandate, the consortium of states and territories published the system's possible rules and principles for public consultation.

In the United States, in September 2005 the members of the West Coast Governors' Global Warming Initiative (Oregon, Washington and California) established a Task Force to negotiate the design of a regional emissions trading system. Once operational, the West Coast scheme will complement the Regional Greenhouse Gas Initiative (RGGI) to curb emissions of seven north-eastern American states. In tandem, these two initiatives would cover almost 20% of the United States' total CO_2 emissions.[14]

SCENARIOS

World Energy Outlook 2006

In 2005, G8 leaders and IEA Ministers asked the IEA to "advise on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future". In response to this mandate, the *World Energy Outlook 2006* puts particular emphasis on an enriched and a more detailed World Alternative Policy Scenario to 2030 that will chart a course towards a more sustainable energy future.

The Alternative Policy Scenario assumes that governments will apply the energy policies that are currently under consideration in order to increase energy efficiency and curb CO_2 emissions. The *World Energy Outlook 2004* showed that there is considerable scope for reducing energy consumption and CO_2 emissions but that decisive policy action is needed from both developed and developing countries. To deepen the analysis of developing countries' potential, the *WEO 2006* contains separate models and analysis for China, Russia, Brazil, India and Indonesia. The analysis also describes the cost implications of new policies and their impacts on energy security. Other institutions, such as the European Commission, the World Bank, the World Business Council for Sustainable Development, the US Department of Energy, the United Nations Environment Programme (UNEP) and the International Atomic Energy Agency (IAEA), have collaborated on this work.

Building on the energy investment analysis contained in the *World Energy Investment Outlook 2003*, the *WEO 2006* includes a special chapter on this subject to provide timely analysis of energy investment prospects. The chapter benchmarks against actual industry spending in order to calibrate the investment projections of the *WEO 2006*. Investment requirements for the oil (upstream and downstream), gas, coal and electricity sectors (generation,

14. As calculated with data from the US EPA Inventory of Greenhouse Gas Emissions and Sinks 1990 – 2004, California, Washington, Oregon and the seven states of the RGGI: Delaware, New York, New Hampshire, Connecticut, Vermont, New Jersey and Maine together emitted 839.1 $MtCO_2$ in 1990, 17.3% of total US emissions of 4 841 $MtCO_2$.
http://yosemite.epa.gov/oar/globalwarming.nsf/content/emissions.html

transmission and distribution) are reviewed. The chapter analyses constraints and barriers affecting energy investment (such as capital availability, resources, infrastructure, technology, regulations and environment) and their implications for the global energy market.

The *World Energy Outlook 2006* also presents a full Reference Scenario that illustrates where the energy world is headed without policy change, and includes in-depth analysis of the following issues: Investment in Energy, Nuclear Energy, and Biofuels.

Energy Technology Perspectives

In June 2006, the IEA published *Energy Technology Perspectives: Scenarios and Strategies to 2050.* This publication is part of IEA's response to the request made by the G8 leaders at the Gleneagles Summit to "advise on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future".

The publication provides a detailed review of the status and prospects of key energy technologies in electricity generation, buildings, industry and transport. It also presents scenario analysis to 2050 to demonstrate how energy technologies can make a difference. The analysis shows that by using a portfolio of current and emerging technologies, the world can enhance energy security and contain growth in CO_2 emissions. Important elements are to improve energy efficiency and further develop CO_2 capture and storage, as well as nuclear and renewables, as part of the energy mix (see Chapter 8).

INDICATORS OF ENERGY USE AND EFFICIENCY

The cross-cutting task on Energy Indicators is providing data and analytical input to all IEA tasks related to energy use and efficiency. The IEA is about to complete an update of the IEA indicator database with data through 2002/03. Based on this database, the IEA will complete a new publication to follow up analysis presented in the IEA 2004 publication *Oil Crises & Climate Challenges: 30 Years of Energy Use in IEA Countries.* The new publication will highlight energy efficiency developments and their impact on CO_2 emissions over the most recent years, covering all end-use sectors: industry, residential, commercial/services and transport, as well as power generation. The publication is planned to be completed in 2006.

Through working with the Asian Pacific Economic Co-operation, including participating in an APEC workshop in Moscow in September 2005, the IEA has already made important contributions to the discussions of how energy efficiency indicators can be expanded to non-member countries. The IEA also made good progress in discussing this topic with the World Bank. Promoting the use of common methodology for data collection and indicator development will ensure that IEA's indicator database can be updated to cover important non-member countries, such as the "Plus 5". To this end, the IEA organised two workshops on energy indicators in Paris on 24 and 25 April 2006, respectively, on *Introduction to Energy Indicators* and *Taking the Energy Indicators Work Forward.* In addition, a special session on data development procedures and methodologies, *From Macro to Micro Energy Indicators,* was held for the "Plus 5" on 26 April.

TRANSFORMING THE WAY WE USE ENERGY

As part of the IEA response to this Gleneagles work element, the Agency completed two publications before July 2006, which it prepared in advance of to the St. Petersburg Summit. They are:

- *Optimising Russian Natural Gas: Reform & Climate Policy*, a book assessing the energy savings potential of energy efficiency improvements in the Russian natural gas sector. Included are savings in distribution, transmission and flaring.

- *Light's Labour's Lost: Policy Strategies for Energy Efficient Lighting,* a book assessing: *i)* the energy significance of the lighting end use; *ii)* technologies in use and underdevelopment; *iii)* policies currently deployed and new options; and *iv)* the potential savings from the application of those technologies where a least life cycle cost condition is met. The book concludes that up to 38% could be saved cost-effectively if the appropriate measures were put in place.

The two publications are inputs into the subsequent activities carried out under the G8 request in addition to serving as stand-alone publications.

The IEA maintains a database on energy efficiency policies and measures which it is in the process of updating to account for broader policy, measures, codes and standards coverage, in addition to broader geographic coverage as "Plus 5" countries are added. This database will provide some of the information to be used in the review of codes and standards as requested in the Gleneagles Plan of Action.

Appliances

The core of the analytical effort in this area will be the updating of the 2003 IEA publication: *Cool Appliance: Policy Strategies for Energy Efficient Appliances* with new data and policy options. The expected publication of the update is December 2007. *Light's Labour's Lost* also contributes to this work on this sector. Other studies include:

- A case study on energy efficiency improvement options in Chinese air-conditioning in October 2006. Follow-on studies will include: refrigerators in China, air-conditioning and refrigerators in India.

- Two workshops in 2005 on the topic of standby power – one in Copenhagen and one in Korea.

- The energy implications of China's adoption of a 1-Watt standard for appliance standby power.

Finally, as part of the IEA's effort to facilitate the adoption of more energy-efficient policies in keeping with the Gleneagles Communiqué, the IEA initiated the Central and Eastern European Countries Appliance Project, which is now principally funded by the EU and carried out by national energy agencies in Central and Eastern Europe. The IEA continues to provide expert advice to this effort.

Buildings

Light's Labour's Lost and the forthcoming *Energy Efficiency in the Refurbishment of High-Rise Residential Buildings* are both products contributing to the buildings element. Other work under way includes:

- A study on energy efficiency options in North American building stock in late 2006.

- A paper summarising successes and failures in financing energy efficiency improvements in buildings in late 2006/early 2007. It is the initial product in a project looking at financing options in the building sector. That project is expected to generate a book on financing in the latter half of 2007.

- Policies and best practices for energy efficiency improvements in existing buildings.

- Best practices for new buildings. Zero Energy, Energy Star, Passive Houses, Low Energy Housing, Top-Runner, etc.

- Study on barriers for energy efficiency – financial, technical, practical, information and political barriers.

In addition to the report on the building sector to the 2008 G8 Summit, in the first half of 2008 the IEA expects to publish a buildings end-use assessment that will review the global and regional energy significance of the building sector, technologies currently deployed and potentially available in the short to medium term, policies and measures including future options, and an estimate of the energy savings should least life cycle cost technologies be deployed.

Industry

The industry task has so far achieved or initiated the following:

- It has established collaboration with industry through various branch organisations such as the International Aluminium Institute, the International Iron and Steel Institute, the International Fertiliser Association and the World Business Council for Sustainable Development.
- It has started collecting data for the "Plus 5" countries. It prepared and discussed a data questionnaire with Chinese and Indian government representatives.
- It has also established collaboration with the End-Use Working Party and the Industrial Energy-related Technology Systems Implementing Agreement.
- It has established collaboration with the World Bank and the international financial institutions.
- It has prepared and discussed papers on iron and steel and ammonia production with industry. It will elaborate these papers further as IEA publications.
- It held a workshop on industrial motor systems on 15-16 May 2006 in Paris.
- Together with the World Business Council for Sustainable Development, it held a workshop on energy use in cement production on 4-5 September 2006 in Paris.
- It is preparing a book on sectoral approaches to emissions reductions for publication in 2007.

Transport

The IEA held a workshop on improving the on-road energy efficiency of vehicles in November 2005. The focus of this workshop was on tyres. A second workshop on automotive air-conditioning was held in September 2006. An information paper on improving on-road performance is under way and scheduled for release in late 2006/early 2007.

Proposals for Concrete Measures to Improve Energy Efficiency

G8 Heads of State in Gleneagles reaffirmed the critical role that improved energy efficiency will play in addressing energy security, environmental and economic objectives. For example, the G8 noted in their Communiqué that they will "...promote innovation, energy efficiency, conservation,...". At the IEA Governing Board meeting at the Ministerial Level in 2005, the Ministers committed themselves to "stronger actions now to curb our growing energy import dependence... including through increased energy efficiency measures" and later put it even more plainly, "We commit to reinforcing our efficiency effort".

The IEA presented four initial concrete recommendations at St. Petersburg. These endorse international best practice, which, if adopted by G8 countries, would lead to significant energy savings and consumer benefits, and thus contribute to the actual realisation of an alternative scenario. They are based upon IEA research, workshops, and detailed discussions with experts, stakeholders and government officials. In each of the summits between 2006 and 2008, new concrete proposals will be forthcoming from IEA analyses resulting from the Gleneagles Plan of Action.

The four initial recommendations deal with:

- Limit standby power use to 1-Watt.
- Implement a fuel-efficient tyre programme.
- Minimum efficiency standards for television "set-top" boxes and digital television adaptors.
- Achieving more energy-efficient lighting.

POWERING A CLEAN ENERGY FUTURE

Cleaner Fossil Fuels

The IEA Secretariat and IEA Clean Coal Centre are focusing on Russia and the "Plus 5" countries. Work has begun on the following:

- Global database with complete information on efficiency of fossil-based electricity generation.
- Report on best practices in power plant operation.
- Series of case studies on recently constructed plants.
- Report on potential of upgrades and replacement.
- Report on potential of future developments.
- Global conference and three regional workshops.

Additionally, the Coal Industry Advisory Board and the Secretariat held a workshop in Paris on 9 November 2005 on the subject of cleaner coal-fired power in both developed and developing countries.

CO_2 Capture and Storage

The following work is being initiated:

- Workshops on Short-Term Opportunities for Carbon Dioxide Capture and Storage (CCS) – Co-ordination with Carbon Sequestration Leadership Forum Involvement of developing countries.
  - Issues Workshop (San Francisco, 22-23 August 2006).
  - Assessment Workshop (Norway, 2007).
  - Recommendations Workshop (Canada, 2007).
- Engineering/cost study on capture-ready plant (IEA Greenhouse Gas R&D Programme).
- Report on policy instruments and incentives for capture-ready plant (IEA Secretariat).

Renewable Energy

IEA continues to provide support to the Working Party on Renewable Energy Technologies and nine Implementing Agreements on renewable energy that cover the entire spectrum of renewable energy technologies and their deployment, and engages in joint projects with them. The IEA provides verified information and analysis of renewable energy policies and markets to assess the potential contribution of renewable energy technologies towards the IEA "Shared Goals", through a publicly accessible database. Furthermore, the IEA work related to renewable energy focuses on themes such as priorities for research, development and demonstration (RD&D), renewable energy heating and cooling, guidelines for bioenergy project development and contribution of renewables to energy security of supply. The IEA continues analysis of feasibility of transport fuels derived from biological sources (biofuels) which can make an important contribution to energy policy aims. A project has also been developed on fostering greater integration of renewables into electricity grids. The market and policy information collected as well as subsequent analysis are continuously being presented to international bodies, including all major technology and policy networks.

PROMOTING NETWORKS FOR RESEARCH AND DEVELOPMENT

IEA NEET Initiative (Networks of Expertise in Energy Technology)

As part of their pledge of concerted action to secure a "clean, clever and competitive energy future", G8 leaders invited IEA to help activate dynamic worldwide networks for energy technology research and development.

Building on its existing Implementing Agreement programmes, the IEA is linking with the international business, industry and financial communities, with policy makers, researchers, academics and other stakeholders in many countries. Its objective is to enhance awareness of existing research, development and deployment networks – notably IEA Implementing Agreements – and to facilitate broader participation. As part of the Dialogue, the NEET team is planning workshops and high-profile presence at major international events between mid-2006 and 2008. NEET was launched on 3 May on the margins of the 14th Session of the United Nations Commission on Sustainable Development (CSD-14) in New York.

INSTRUMENTS OF CLIMATE CHANGE MITIGATION

By definition, the climate change mitigation strategies of IEA member nations centre on reducing anthropogenic emissions of greenhouse gas. Generated by a kaleidoscope of human activities, many involving the combustion of fossil fuels, greenhouse gases require a broad range of regulatory measures if their emissions are to be stabilised or reduced. As such, IEA member countries draw from a portfolio of policies and measures to address climate change domestically and abroad. In 2005, as in years past, the policies of IEA member governments addressed a range of economic sectors, reflecting the global nature of climate change.

In this chapter, and throughout the publications of the IEA, the instruments of climate change policy are defined as catalogued in the IEA's online database of Climate Change Policies and Measures,[15] as follows.

Fiscal measures include direct subsidies, financial incentives and tax credits and exemptions. In this review, the terms "funds" and "grants" refer to a single fiscal instrument, unless further detailed as precise capital investment funds or as rebates and incentives. Fiscal measures often foster the development of nascent low-emitting technologies and energy-efficient practices. Other fiscal measures discourage fossil fuel use by directly taxing its consumption or by-products. Fiscal measures operate in several ways. Some, like grants and tax reductions, directly influence price. Other fiscal measures alter a perfectly competitive market to encourage consumers' choice of low-emission fuel, energy-efficient appliances or clean technology, not yet commercially viable. During 2005, IEA member governments implemented 61 fiscal measures.

Among all policy categories relevant to climate change, regulatory policies very often provide policy makers with the most certainty concerning the outcome of a given measure. Assuming a given jurisdiction's general

15. http://climate.iea.org/

compliance, a regulatory policy establishes a legal mandate for a precise outcome. Regulatory policies often set strict targets for appliances' minimum energy efficiency, industry's annual greenhouse gas (GHG) emissions and other easily quantified aspects of climate change mitigation. Regulatory instruments can govern the market-wide labelling of cars and air-conditioners, as exemplified this year among the 58 regulatory policies implemented.

Governments conclude voluntary agreements with actors in energy-intensive market sectors to reduce GHG emissions in a manner more flexible and often less expensive than binding regulations. A voluntary agreement requires the collaboration of public and private stakeholders. Fiscal measures often accompany voluntary agreements to encourage compliance with the agreement's target, as illustrated by the provision of tax credits for participants in a voluntary programme of emissions reduction. Outreach measures, such as publicity campaigns, also complement voluntary agreements, encouraging participants to meet their goals under public scrutiny. IEA countries established seven voluntary agreements with private actors in 2005.

Policy processes and outreach include the articulation of comprehensive mitigation strategies, and measures to gather, organise and disseminate information on climate change and energy use. Policy processes and outreach divide into formal *planning* measures of public consultation, strategic planning, and institutional development, and *outreach* measures to educate constituents. In creating new institutions, governments seek to manage or enable implementation of a given climate change strategy. As such, the establishment of regulatory agencies and government purchase programmes for clean-burning vehicles both qualify as policy processes. Outreach includes consumer awareness campaigns and programmes, and funding to aid in the implementation of other climate change policies. Policy processes and outreach often preface or complement more concrete measures. The 75 policies implemented by IEA governments in 2005 rank policy processes and outreach as the most popular means of climate change mitigation.

Many governments sponsor research and technology development to mitigate climate change, often fostering the development and commercialisation of low-emission equipment. While much economic theory supports the private sector's competence in the development of commercially viable products, some promising clean technologies require government investment during their early stages. In the absence of government intervention, nascent technology presents investors with steep risks: an indeterminate payback period on investments that is often exacerbated by uncertainty over greenhouse gas regulation. In addition, the findings of private research can be difficult to protect and commercially leverage. Government intervention aims to develop and demonstrate promising technologies on their way to commercial viability.

IEA governments also implement systems of tradeable permits to mitigate climate change. Such schemes include carbon emissions trading at the regional, domestic and supranational levels, green certificates trading to encourage renewable power production and white certificates trading to promote energy efficiency across industrial sectors. Systems of tradeable permits aim to lower the overall cost of climate change mitigation by favouring compliance where, within a regulated jurisdiction, it is least expensive. As illustrated by the European Union's scheme of carbon emissions trading, a regulatory body fixes emissions caps on individual emitters within the context of a fixed common emissions target. Flexible in their reduction strategy, installations across the European Union can then trade compliance costs in the form of emission credits, producing the least expensive compliance with a regulation's fixed target. Among the 25 tradeable permit systems established by IEA member countries in 2005, 18 correspond to the European Union's Emissions Trading Scheme.

SECTORAL CLIMATE CHANGE POLICY DEVELOPMENTS

This section considers policies and measures enacted in 2005 by IEA countries to mitigate climate change. Organised by sector – energy production, transport, industry and buildings – the policies appear in their entirety in the IEA's online database of measures and policies to address global warming. Cross-cutting policies that cover all energy sectors or outline a nation's general climate change mitigation strategy follow the sectoral summaries. These comprehensive policies include carbon funds, emissions trading schemes, and strategic planning, among other multi-sectoral measures.

ENERGY PRODUCTION

Fossil Fuels: Reducing Fuels' Carbon Intensity

In 2005, governments pursued a triple strategy to mitigate the atmospheric effects of fossil fuel combustion: encouraging the switch from carbon-intensive fuels to those of reduced CO_2 content, promoting fuels' energy-efficient distribution, and sponsoring the development of technologies to capture and store fossil fuels' GHG emissions.

Efficient Fuel Distribution and Combustion

In a GBP 40 million package of funding for investment and research into low-emission technologies, the United Kingdom's 2005 Carbon Abatement Technology Strategy included **grants** for efficiency improvements within the domestic distribution network of fossil fuels. The strategy also funded the development of equipment to remove carbon from fuels before their combustion in electricity generators.

Greenhouse Gas Capture and Storage

Greenhouse gas capture and storage addresses each fossil fuel source, from coal to gas to oil. To complement the efficient distribution and combustion of fossil fuels, the UK's Carbon Abatement Technology Strategy offered grants to develop the technology of carbon sequestration in depleted undersea oil reserves. Turkey tendered a demonstration project to research the processing of coal-bed methane to identify the best practices in mitigating methane emissions during coal extraction and subsequent energy production. Norway too funded a demonstration project to sequester the carbon produced by new national gas-fired power plants set to open before 2009. To support sequestration projects, the Norwegian state established an institution, Gassnova, for sustainable gas technologies.

Along with the United Kingdom, the European Union articulated a strategic plan to mitigate the GHG emissions of fossil-fuelled energy production. The EU's Technology Platform for Zero Emission Fossil Fuel Power Plants convenes stakeholders from the public and private sectors to develop a research strategy serving the 2050 goal of widespread zero-emission fossil-fuelled electricity production. The platform includes research into carbon capture and geological storage and low-carbon combustion. Both technologies will figure in the platform's first funded demonstration power plant, set to come on line in 2020. Funded under a European research framework programme, the Technology Platform aims to partner with the American multilateral "Zero Emission Power Plant" programme to extend its geographic scope and influence on the private sector.

Fuel switching

In theory, governments eager to protect the climate encourage power producers to switch from coal and oil to natural gas. In practice, the well-established markets and distribution systems for fossil fuels inhibit government intervention in their large-scale substitution. As such, during 2005, IEA member countries implemented no policy exclusive to the sector of energy production to promote fuel switching. Instead, fuel-switching strategy focused on the transport sector, with some auxiliary attention paid to energy production.

Renewable Energy

IEA governments use a range of policy instruments to promote the use of renewably produced energy, reflecting the fuels' highly diverse markets and production. As a group, renewable energy generally benefits from government intervention to develop its commercial viability and technological promise in a world economy still largely fuelled by fossil sources. In 2005, IEA governments supported renewable energy at all stages of its development, from technological innovation to its final sale alongside conventional fuels.

Assistance in Technological Development

The research and development of renewable energy technology often involves the formal partnership of governments and private or academic research groups. To foster the production of industrial solar power, Germany's state-funded Photovoltaic Technology Evaluation Centre provided testing facilities and equipment to solar cell and solar systems manufacturers in the process of developing new products for the competitive market. Other governments provided grants to privately managed demonstration projects, as in the United Kingdom's funding for large-scale wave and tidal power generation.

The Swedish government announced plans to fund pilot projects for wind power generation established before 2013 in an effort to create wind-power capacity in the absence of private capital investment. To complement this technological investment, the Swedish state established an institution to advise on the construction and promotion of wind power as a sustainable electricity source. Sweden also has a green certificate trading system in operation since 2003 and the system recently has been prolonged until 2030 with a more ambitious target than before. Portugal launched a comprehensive National Technology Plan to develop the technical aspects of a renewable energy market. Establishing a EUR 35 million capital investment fund for renewable energies, the plan outlines the establishment of green certificate trading among producers of renewable power to bolster their individual technological spending.

Market Intervention

To gradually shift domestic energy consumption from fossil fuels to a more renewable mix, the Republic of Korea pledged to expand renewable energy generating capacity by 21% of the 2004 level within the next seven years. Aiming to expand renewable electricity production by 344 MW by 2013, the Korean government provided funds for capital investment in the wind and solar generating capacity of nine nationalised utilities. Under the aegis of two European Union directives – the first on biofuels, the second on electricity production from renewable sources – many European states legislated the promotion of biofuelled energy production and transport, as noted in the subsequent discussion of the transport sector. The Dutch government extended direct subsidies to operators of biomass-fuelled power installations, while Spain implemented feed-in tariffs to support electricity produced from biomass combustion.

As a flexible instrument to support means of energy production that are not yet commercially viable, legislated feed-in tariffs fix a predetermined purchase rate for a power producer's renewables-generated electricity. In rewarding the production of energy, rather than investment in production capacity, feed-in tariffs encourage a fuel's commercial viability and gains in production efficiency. In many instances, governments compound the advantages of their feed-in tariffs by requiring power grid operators to grant preferential access to renewables-fuelled producers through a system of Purchase Power Agreements (PPAs).[16] Ireland initiated the Renewable Energy Feed-In Tariff (REFIT), offering a succinct explanation of the common motivation for establishing feed-in tariffs: to attract "sufficient confidence for investment finance and loan capital which may not otherwise be provided." [17] France extended eligibility for feed-in tariffs from wind farms exceeding 20 MW capacity to all wind power installations. The Czech Republic offered renewable power distributors the choice between guaranteed feed-in tariffs or the promise of a bonus on wholesale power prices for the sale of electricity produced from renewables, and the joint combustion of renewable and non-renewable sources.

Auxiliary Promotion

In an information dissemination measure involving both fossil and renewable fuels, the Finnish government mandated the publication of electricity's origin. Reinforcing a 2003 decree on the verification of electricity's fuel source, the 2005 Notification on the Origin of Electricity requires electricity vendors to notify consumers of their power's content to enable public choice of clean power sources. As noted on electricity bills or promotional material, energy's origin must be specified in terms of fossil fuel sources and peat, renewable energy sources or nuclear power. Electricity vendors must also publicise the GHG emissions and radioactive waste from electricity generation in terms of the carbon dioxide grams produced per kilowatt-hour and the volume of spent nuclear fuel relative to the total volume of electricity sold in milligrams per kilowatt-hour.

Encouraging Energy Efficiency

In the context of energy production, energy efficiency refers to the pure ratio of primary fuel to produced power. The 2005's incentives for energy-efficient power production ranged from the trade of efficiency certificates to a mandated preparation of strategic energy conservation.

White Certificates Trading

Setting an example for the French white certificates trading scheme established in 2006, the Italian government implemented a market mechanism to advance end-use energy efficiency among electricity and gas suppliers. In compliance with fixed energy conservation goals, all Italian gas and power distributors serving at least 100 000 final consumers during 2001

16. The significance of PPAs diminishes in liberalised markets where power producers enjoy relatively unfettered access to the grid. However, in vertically integrated markets controlled by few or single electricity producers, new power generators may require a government PPA to connect to the grid.
17. www.dcmnr.gov.ie/energy/renewable+energy+division/

trade certificates of energy savings. Energy service providers, subsidiaries of electricity and gas distributors and distributors themselves are obliged to trade energy efficiency certificates representing primary energy savings of one tonne of oil equivalent. Conservation-constrained distributors can earn certificates by developing proprietary conservation projects to benefit their own consumers or through the purchase of certificates.

Strategic Planning and Mandated Efficiency

Strategic planning for energy-efficient power production varied between loose affiliations of local and federal authorities to the Energy Efficiency Action Plans demanded by the European Commission of all member state governments. In February 2005, the United States Environmental Protection Agency launched a strategic partnership with the National Association of Regulatory Utility Commissioners and individual state utility agencies to design methods to conserve energy, promote renewable energy and cleanly distribute power.

In promulgating the Directive on Energy End-Use Efficiency and Energy Services, the European Union expanded the scope of energy-efficient power generation from the producing site to include efficient distribution and end use. Requiring its member state governments to prepare three national energy efficiency action plans, the directive obliges states to design methods for the public sector to exemplify energy conservation through proper investment in and maintenance of energy-efficient equipment. The directive also mandates energy suppliers to closely monitor energy consumption, to further consumer education and to develop energy efficiency measures across their supply networks.

TRANSPORT

Policies to reduce the transport sector's energy intensity ranged from voluntary agreements with car manufacturers to raise the fuel efficiency of their fleets, to binding targets on the blending of biofuels with conventional fossil fuels. Departing from past trends in the focus of policies on technical improvements to the fuel economy of conventional vehicles and consumer education, 2005's policies to reduce transport's emissions centred on renewables-produced fuels and the schematic reorganisation of transport systems.

Fossil Fuels: Reducing the Carbon Intensity of Fuel Use

Measures to reduce GHG emissions of transport fuel ranged from general strategies to discourage the use of high-emission vehicles to the promotion of specific low-emission fuels.

France levied the first of an annual vehicle pollution tax targeting passenger vans, sports utility vehicles, high-speed sports cars and high-emission luxury vehicles. The **tax** progressively penalises vehicles emitting the most carbon dioxide, taxing emissions of more than 200 grams per kilometre.

France and Italy both promoted the conversion of conventional vehicles to run on compressed or liquefied natural gas. The French state signed a **voluntary agreement** with its major domestic vehicle manufacturers and fuel distributors to develop a commercially successful market for compressed natural gas by 2010. The Italian government chose to directly **subsidise** the construction of an alternative fossil fuel infrastructure and **fund** the conversion of public buses and passenger vehicles to run on liquefied natural gas. To pay for the deployment of relatively low-emission public buses, the Italian government also levied a general tax on diesel fuels.

Renewable Energy: Alternative Fuels, Alternative-fuelled Vehicles

To encourage renewables-fuelled transport, IEA member countries addressed biofuel content in the conventional fuel supply and the construction of biofuels' market infrastructure. Biofuel blending ratios involved concrete mandates, while market development included fixed standards and strategic planning.

Biofuels

In compliance with the 2003 European Union biofuels directive, Greece and the Czech Republic both established fuel supply standards to replace 5.75% of conventional fuels with biofuels by 2010. To prepare for this 2010 fuel mix, France offered tax reductions on biofuels and mandated the blending of gasoline with at least 5% ethanol. The United Kingdom legislated the Renewable Transport Fuels Obligation, setting gradual blending standards for renewable fuels up to 2010. To educate fuel consumers, the obligation further requires fuel suppliers to publicise the avoided emissions and sustainable production of their proprietary biofuels.

Fuel Infrastructure and Vehicles

To reinforce the commercial effect of biofuel's mandated mix in the conventional fuel supply, Sweden established market standards for transport biofuels. Filling stations of a certain size must offer at least one alternative fuel by 2009. Tax exemptions on the sale of green cars and fuels will complement these market requirements, as will the concurrent exemption of biofuelled cars from congestion charging and parking fees. France implemented a vehicle emissions reduction plan, offering tax credits to buyers of vehicles powered by electricity, natural gas and hybrid fuels, and allocating 100 million euros over the next five years to fund the research on biofuelled cars.

Encouraging Energy Efficiency

IEA nations promoted efficient transport in terms of both emission-efficient use of conventional individual vehicles and the optimal organisation of the transport system.

Emission-efficient Vehicles

Both France and Portugal mandated manufacturer labelling of passenger vehicles. To educate consumers, a vehicle sold in either nation must display its fuel consumption and carbon dioxide emissions on its windshield at the point of sale. French regulation also compels manufacturers to publicise vehicles' average emissions in various driving conditions, from aggressive to leisured and from urban to motorway.

Efficient Transport

To complement its vehicle labelling scheme for conventional vehicles, France also launched a comprehensive package of aid for low-emission transport to, in part, encourage commercially viable electric passenger vehicles. Annual grants will fund the development of cleaner passenger vehicles and research on more efficient transport organisation, both on land and in the water. Italy offered bonuses to drivers turning in their conventionally fuelled vehicles to join car-sharing programmes, paying vehicle owners for the scrap metal value of their old vehicles and providing fleets of hybrid vehicles for city inhabitants' use. Spain founded the Observatory on Urban Mobility, a joint information campaign of the Ministries of Environment and Transport, and regional and municipal transport authorities, to promote public transportation as a means to reduce urban traffic, greenhouse gas emissions and pollution.

Canada's multi-faceted Freight Efficiency and Technology Initiative governed several new programmes to improve the efficiency of Canadian commercial freight, funding the purchase and installation of specific greenhouse gas reduction technologies on individual vehicles in concert with an awareness programme for freight shippers and forwarders to improve the efficiency of their shipping decisions. The Canadian Freight Sustainability Demonstration Programme funds projects that demonstrate energy efficiency through new practice or technology in the sectors of aviation, marine, rail, truck or intermodal transport. Germany adopted a different approach to encourage freight transport's optimal organisation, implementing a system of distance-based road tolls for heavy vehicles. Monitored by a combination of mobile telecommunications and satellite-based Global Positioning System, the German scheme encourages freight planners to design freight routes of optimal distance and timing.

BUILDINGS

Fossil Fuels: Reducing Fuels' Carbon Intensity

Policies to encourage fuel switching in the buildings sector revolved around consumer incentives, either for purchases of lower-emission fuel or spending on fuel-specific equipment. Government policies generally promoted fuel switching from fossil to renewable energy sources. As of 2006, Sweden will offer a 30% rebate on installation costs to households switching from fossil-fuelled heating to biofuel, solar power, heat pumps or direct heating. Within a larger campaign to improve thermal insulation and heating in residences, France began to offer tax credits for the switch from direct electric heating to heat from condensing boilers and heat pumps.

Renewable Energy

Promotion of renewable energy in buildings often involved renewables production installations of residential, rather than industrial, scale. The Greek government offered its own buildings as a demonstration project for photovoltaic energy to be used by the public offices and residences. France offered tax credits for the installation of high-performance heating systems and water heaters powered by renewable energy, including hydropower and wind. The United Kingdom's low-carbon building programme offered grants for the installation of small-scale renewable power generators such as solar panels, air source heat pumps and micro-turbines. Open to single installations and large-scale developments in the public and private sectors, the programme benefits schools, community centres and buildings and villages isolated from the electricity grid.

Encouraging Energy Efficiency

In practice, energy efficiency in the building sector entails efficient heating, cooling and lighting. Policies to encourage energy-efficient buildings targeted each stage of buildings' life cycle, offering incentives at the time of construction and retrofit credits for ageing structures. The United Kingdom and Sweden formed a partnership to share best practices in the composition of energy-efficient buildings, establishing an information campaign to educate contractors on sustainable construction. New Zealand planned to adjust the national building code to standardise construction of new houses able to maintain an internal temperature between 18 and 25 degrees Celsius without significantly drawing on external power.

Consumer Education

Recognising the decisive role of buildings' owners and managers in improving buildings' energy conservation, governments implemented several public programmes of consumer education. France, the United States and Japan launched programmes to advise consumers on home and business energy conservation techniques, from online interactive emissions and power-consumption calculators and personalised guidance on daily efficiency practices to the broadcast of public service announcements on the energy savings of better insulation. Integrating social and environmental aims, the Netherlands passed an energy-saving subsidy scheme for households with low incomes to subsidise contractors and consultants advising low-income households on residential energy savings. To complement legislation to reduce emissions from households operating off the electricity grid, the United Kingdom launched the ZeroCarbonCity campaign to sponsor events in 60 cities and educate and involve urban dwellers in climate change mitigation. Sweden has recently launched a broad information campaign on energy savings for households and property owners. The campaign will run until the end of 2007.

Building Components

Many regulations targeted specific components of a building's energy use, from windows to the appliances driving much of a structure's primary electricity demand. Both Turkey and France established standards governing buildings' legislation: the former, establishing a minimum performance for insulation, the latter, expanding existing thermal regulations to account for a given structure's environmental orientation and to encourage bioclimatic architecture. France also launched a range of tax credits to encourage efficiency investments in the components of ageing buildings.

As a building's installed appliances may account for much of a structure's electricity consumption, policies to improve energy efficiency often targeted equipment generally used in buildings. The United States' Energy Star Programme established minimum efficiency performance standards for washing machines, while Germany expanded its Blue Angel programme of emissions-efficient product labelling to include gas-powered heat pumps for residential use. Already covered by the Blue Angel label are 90 product groups meeting standards for the use of refrigerants, for efficient energy consumption, and for the emissions of nitrous oxide and carbon dioxide. Australia again raised federal standards for the minimum energy performance of electric storage water heaters, a policy affecting both residential consumers of the appliance and its industrial manufacturers.

INDUSTRY

Reducing Energy Intensity

Policies to reduce industry's energy intensity generally involve the deployment of energy efficiency practices or technology. Mandated industrial fuel switching played a minor role in the most recent legislation to reduce industry's greenhouse gas emissions. 2005 policies of industrial energy efficiency range in stringency from tax exemptions for capital investment in efficient equipment to the implementation of compulsory sector-wide energy audits. Governments promoted the use of specific technologies and the optimal organisation of industrial electricity demand to reduce sectoral energy intensity.

Emission-efficient Technology

To encourage efficient or renewables-fuelled industrial energy production, the Canadian government updated tax incentives for investment in site-specific production equipment. Under Canada's programme regarding expenses for conservation and renewable energy, the federal government allows a full deduction of eligible expenditures on technology for energy conservation and renewable energy production to meet local demand.

The European Union's Directive on the Eco-Design of Energy-Using Products sets life cycle performance standards for all European energy-using products, excluding vehicles. Illustrating the relatively free movement of manufactured goods within the European Union, the directive applies to any energy-using product sold in more than 200 000 units per year in any EU member state. Relevant to both the sectors of building and industry, the directive requires the products of industrial manufacturers to meet standards for energy and water consumption, waste generation and sustainable lifetime.

Organising Industrial Energy Use

The Greek government signed an agreement with industrial installations whose demand capacity is greater than 1 800 kW to reduce consumption during periods of peak demand. Given 24 hours' notice, large electricity consumers agree to reduce consumption by 10% during the middle of the day for any given 10 days in July. Industrial consumers fulfilling their agreed reductions receive a monthly electricity bill rebate; those who fail pay an additional power demand charge. Industrial installations not agreeing to systematically reduce demand are obliged to reduce their expected peak hour consumption by at least 10% for the entire month of July. Compliant consumers will receive a smaller rebate than those included in the voluntary reduction agreement; those failing to reduce month-long consumption will pay a smaller fine for non-compliance.

Spain levied a 0.8% tax on domestic consumers' electricity spending to finance the replacement of 2 million low-efficiency appliances, the creation of low-emission transport systems for industrial work sites, and the compulsory energy auditing of several industrial sectors. Successful audits determine the energy conservation potential of an industry's facilities and production practices.

CROSS-CUTTING POLICIES

Comprehensive Climate Change Mitigation Strategies

Domestic Strategy

Seven IEA members published broad climate change strategies in 2005, often outlining strategic policy for several energy-using sectors over the coming decades. France, Finland, Japan, the United Kingdom, the United States, Canada and the Republic of Korea announced formal climate change mitigation plans setting goals from 2008 to 2100.

Multinational Strategy

Canada's national climate change plan, "Moving Forward on Climate Change: A Plan for Honouring our Kyoto Commitment", described federal policy in terms of Canada's international climate change mitigation pledge. The United States launched several strategies of multinational strategic planning: it formed a partnership with Germany to promote energy-efficient technology, cleaner fossil fuels and general best practices in climate change mitigation; and with Japan, Australia, South Korea, China and India, the United States established the Asia-Pacific Partnership on Clean Development and Climate to foster the development of energy-efficient technology.

Energy Taxes

As promoted in previous editions of *Energy Policies of IEA Countries*, energy taxes can return the same environmental outcome as more invasive command-and-control policies at a relatively lower cost. Carbon taxes provide an ever-present obligation for market actors to reduce their carbon emissions without requiring regular government intervention. An industrial firm constrained by a carbon tax will invest in the most effective reduction technology available; a firm constrained by an efficiency standard has little incentive to invest in exceeding the fixed standard unless it is regularly strengthened to a level slightly above the best-available technology. In 2005, the Netherlands raised national energy taxes to charge industry's energy use. Though more general than a tax on only carbon dioxide, the Dutch energy tax effectively serves the same end: discouraging energy consumption and thus reducing carbon dioxide emissions.

Emissions Reporting

Japan mandated the publication of 8 000 firms' annual greenhouse gas emissions, inviting public scrutiny and establishing the institutional framework for a possible system of emissions trading. Canada established annual reporting standards for industrial emitters of greenhouse gases, while the United States revised existing standards for voluntary greenhouse gas reporting to reflect emissions and carbon sequestration from the forest and agriculture sector. Luxembourg announced emissions-verification standards in conjunction with the entry into force of the Kyoto Protocol and the growth of emissions trading within the European Union.

Emissions Trading

The regional and national use of market instruments to reduce global GHG emissions continues to drive press coverage of climate change policy and multinational negotiation of economically efficient climate change policy. As discussed previously and in subsequent sections, 2005 marked the inauguration of the European Union's Emissions Trading Scheme. Absent from the IEA's online database of strictly federal climate change policies and measures, regional schemes of emissions trading appeared in the United States and Australia. In 2005, federal policies associated with emissions trading focused on domestic practice and overseas investment in project-based mechanisms to generate emission credits.

Domestic Policies

To promote domestic investment in projects generating emissions reduction credits, Hungary offered tax credits to credit vendors paying taxes in Hungary. Any Hungarian firm realising a profit from the sale of carbon dioxide emission quotas qualifies for a reduction in corporate income tax.

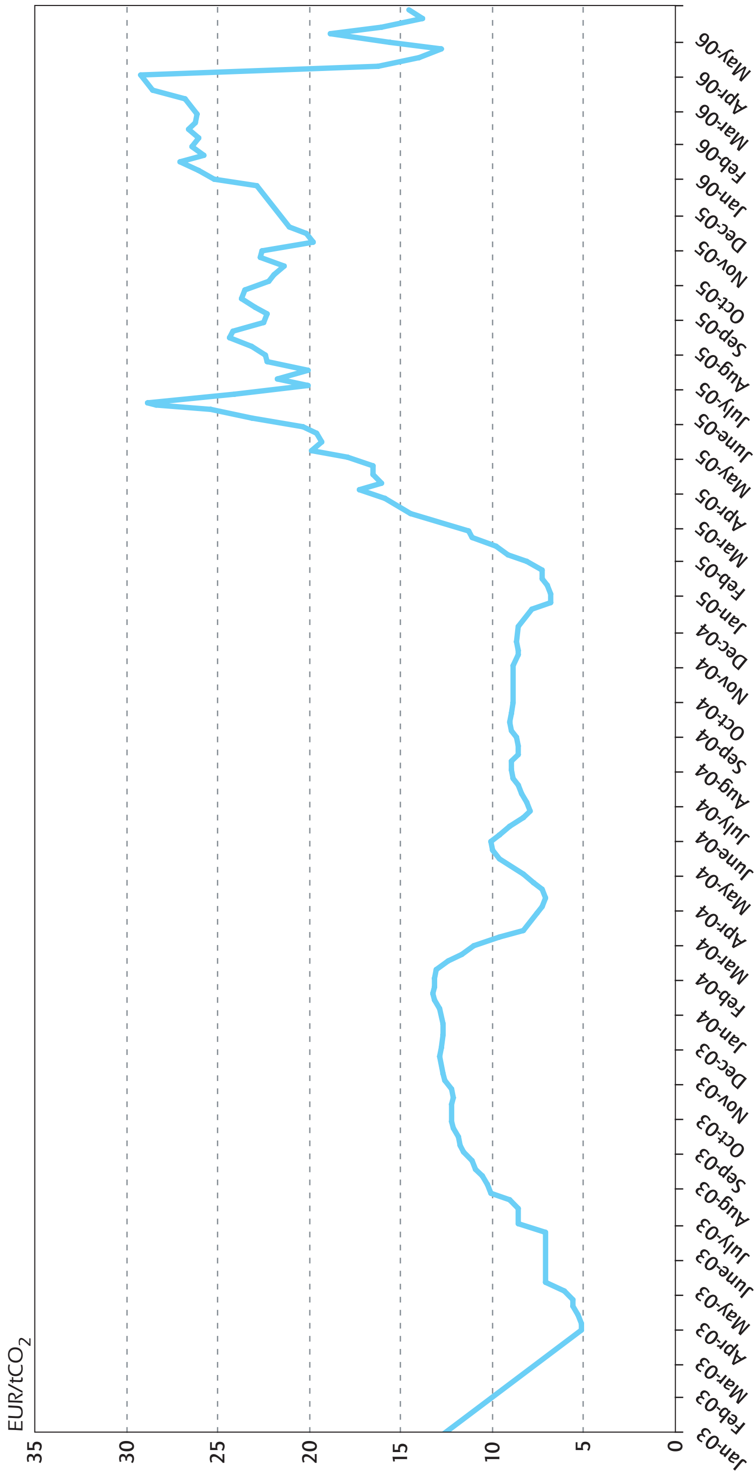
Carbon Funds

At the time of last year's *Review of Energy Policies of IEA Countries*' publication, multilateral and single-government carbon funds commanded over USD 2 billion in planned capital. Created to acquire international project-based emission credits under schemes of tradeable reductions permits, current carbon funds enable investors to trace certificates, called Certified Emissions Reductions (CERs) or Emissions Reduction Units (ERUs), to specific sites of emissions reduction. Market experts, international organisations and governments themselves predict rapid growth both in the number of government funds established to procure carbon credits through the Clean Development Mechanism[18] and in the volume and value of these traded credits. In 2005, Denmark, Japan, Canada and the Netherlands sanctioned the use of project-generated credits by establishing funds for their procurement.

18. As enumerated in the Marrakech Accords of the Kyoto Protocol, the Clean Development Mechanism and Joint Implementation are the Protocol's flexible mechanisms for carbon-constrained Annex 1 nations to lower the overall cost of their emissions reductions. The CDM enables Annex 1 investors to use credits generated by projects in non-Annex 1 nations, often developing economies, for a minority share of their compliance with the Kyoto Protocol. Governed by an Executive Board, the CDM may generate more than 1 billion Certified Emissions Reductions (CERs), each corresponding to one tonne of avoided GHG emissions, by the close of the Kyoto Protocol's first period in 2012.

Figure 16

European Union CO_2 Allowances Prices for Year-End Delivery



Source: pointcarbon.com.

DEVELOPMENTS IN EMISSIONS TRADING

EMISSIONS TRADING SCHEME DESIGN

As noted in previous years' editions of this volume, emissions trading remains an imperfect instrument of climate change mitigation. Governments choosing to regulate greenhouse gas emissions through mechanisms of emission credits trading may require auxiliary policies to correct for market failures, to foster the development of an adequately diverse energy supply and, not least, to ensure compliance with initial environmental objectives. In addition, some energy-intensive sectors prove difficult to manage with emissions trading. Thus far, the market mechanism centres on power generators and installations of energy-intensive industry. To stabilise and reduce GHG emissions over the longer term, nations must address emissions from all sectors. However, on an international scale, governments have elected to initially exclude emissions from mobile sources like airplanes, vehicles and boats.

Despite its shortcomings as an instrument for comprehensive emissions reduction, an emissions trading scheme effectively addresses fixed installations of emission-intensive industry and power production. The sectors' manageable number of fixed emission sites, access to technological means of emissions reduction and relatively large contribution to global warming all position industry and energy production for regulation by emissions trading. As such, designers of the world's most politically and economically comprehensive scheme of emissions trading, that of the European Union, established a market among the member states' 9 000 installations of industry and energy production.

18 MONTHS OF EUROPEAN UNION EMISSIONS TRADING

In compliance with the Kyoto Protocol, the European Union committed to reducing its GHG emissions by 8% relative to their level in 1990 by between 2008 and 2012. As negotiated in 1997, Article 4 of the Protocol allows the individual member states of the European Union to "share the burden" of common emissions reduction. Ranging from a 28% relative decrease for Luxembourg to a 27% increase for Portugal, member states' distinct targets reflect variant economic development and conditions of national energy use within the context of an EU-level reduction. As Parties to the Kyoto Protocol, states can use CERs and ERUs to fulfil a minority of their reduction obligations.

To facilitate this common emissions reduction, the European Parliament and the Council of the European Union adopted Directive 2003/87/EC in October 2003 to establish a Community-wide scheme of emission allowances trading. Known as the European Union Emissions Trading Scheme, or EU-ETS, the system recognised the validity of offset credits earned under the Kyoto Protocol in October 2004.[19] Although the Protocol had not yet entered into force when each decision became official, the Protocol's reduction obligations motivated nations' ratification of the trading directives.

To establish the methodology of emissions trading, the European Commission obliged each member state to prepare a National Allocation Plan, or NAP, fixing the total amount of CO_2 to be emitted by all installations and the number of emission allowances allocated to each individual installation. Largely submitted over the course of 2004, the first-round NAPs allocated 1.83 $GtCO_2$ in annual emissions rights to more than 9 000 installations across the EU. These include combustion plants, oil refineries, coke ovens, iron and steel plants; and factories making cement, glass, lime, brick, ceramics, pulp and paper that also use more than 20 MW per hour of operation, which all qualified for trading.

January 1, 2005 marked the official opening of the EU-ETS, though traders had been speculating since 2003 on forward contracts to exchange the European Union Allowances, or EUAs, each corresponding to one tonne of CO_2 (tCO_2). Until the April 2006 publication of the 2005 emissions data and concurrent apparition of surplus emission allowances, EUA prices trended upward, with periods of volatility.

CARBON PRICES

Within the EU Emissions Trading Scheme, prices for spot and forward contracts to exchange emission allowances respond to a range of influences. While single factors driving prices can be difficult to isolate, the following aspects of emissions trading have all influenced Emission Unit Allowance (EUA) supply and demand over the past 18 months of emissions trading.

Credits from Project-based Mechanisms

Less expensive than EUAs, the CERs of the Clean Development Mechanism and the ERUs of Joint Implementation attract potential buyers of EUAs. As the regulatory body of the Clean Development Mechanism approves more projects and project methodologies to generate CERs, growth in the supply and the institutional credibility of this outside credit supplier may depress EUA prices.

19. Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for GHG emission allowances trading within the Community, in respect of the Kyoto Protocol's project mechanisms, popularly known as the Linking Directive.

A similar trend may appear in the market for Joint Implementation-generated ERUs, as Russia and the Ukraine pioneer Green Investment Schemes (GIS)[20] to attract buyers for their offset credits. At present, security of a volume sufficient to meet much of the Kyoto Parties' offset demand remains forthcoming. As stipulated by the Protocol, ERUs and CERs cannot account for a majority of an installation's emissions reductions. As such, project-based mechanisms' potential can be but minor in relation to domestic or ETS-generated reductions. As tools of international social policy, they cannot be discounted, though their influence on EUA prices remains to be easily gauged.

Relative Fuel Prices

Many industrial installations, especially power generators, select fuel based largely on the relative prices of coal, oil and natural gas. The inconsistent carbon content[21] and generating efficiency of each fuel influences emission allowance prices: relatively high oil prices may encourage fuel switching to coal, driving energy producers' demand for emission credits to offset the relative excess of emissions.

Weather

As power generators receive the bulk of total EUA allocations, factors that drive power generation influence the supply of and demand for emissions offsets. Precipitation, temperature, wind and cloud cover all influence European energy consumption and production, often across borders. A severe drought during 2005 reduced Spain's hydropower production by 40%, compelling energy producers to use fossil fuels to meet consumer demand. As coal and, to a lesser extent, oil and natural gas filled the generating capacity of water, Spanish emissions rose well above the 2005 allocated cap to raise demand for 2005-vintage credits. While pronounced variations in temperature clearly drive consumer demand for heating and cooling, daily fluctuations may not sway EUA prices.

20. Several members of the former Soviet Union whose economies have shrunk over the past 15 years received a surfeit of Assigned Amount Units (AAUs) under a Kyoto Protocol allocation based on 1990 emissions volumes. As these AAUs have not been generated by policies to expressly reduce GHG emissions, some participants in international climate policy have questioned the validity of purchasing these emission offsets. In response, Russia and the Ukraine, among other nations, have explored the establishment of Green Investment Schemes (GIS), by which revenue from the sale of their AAUs will accrue to projects that provide environmental benefits. Under a GIS, earmarked revenue could be spent on projects that entail additional emissions reductions or environmental capacity building. GIS could command significant financial flows, as the market mechanisms of the Kyoto Protocol could direct several billion dollars annually to countries with economies in transition.

21. The Carbon Emission Factors (CEFs) of primary fossil fuels range from 15.3–17.2 tonnes of carbon/terajoule for natural gas to 20.2 tC/TJ for diesel oil and 26.8 tC/TJ for anthracite coal. (IEA, *CO_2 Emissions from Fuel Combustion*, 2005 Edition).

Market Administration

Administrative difficulties confounded trading between early participants in the carbon market and continue to distort the exchange of EUAs. Even in July 2006, some nations participating in the EU-ETS had yet to connect to the electronic Community International Transaction log, the trading platform allowing instantaneous exchange of allowances between counterparties' accounts. Such incomplete access compromises the EUA spot market and may inflate prices. Technical problems with domestic registries and multinational trading platforms also temporarily constrict the market.

Relative Stringency of Emission Caps

Perhaps the most visible driver of large trends in EUA pricing, the relative stringency of credits allocation drove the EUA market down by 50% in a single day in April 2006. As EU-ETS trading partners Estonia, the Czech Republic, France, the Netherlands and the Walloon region in Belgium released their emissions figures for 2005, carbon prices dropped by half at the first indication of an eventual 2005 allowance surfeit of some 44 megatonnes of carbon dioxide. The governments' initial allocation defines but part of the emission cap's stringency, as the state of the allocated economic activity also determines the degree of the carbon constraint. Sustained demand for steel construction material would drive producer demand for offset credits, just as demand for electricity-intensive products would require the energy sector to offset its emissions from expanded production.

Regulatory Factors

Several aspects of domestic regulation may influence prices. The unpredictable outcome of allowance auctions and the apparition of new entrants in the trading scheme may temporarily raise prices. Since some NAPs mandate the surrender of a closing plant's allowances, rather than their accrual to other installations managed by a common firm, such an installation would find few buyers for time-dated allowances. Firms are less likely to reduce emissions through such means, thus raising prices in a tight market.

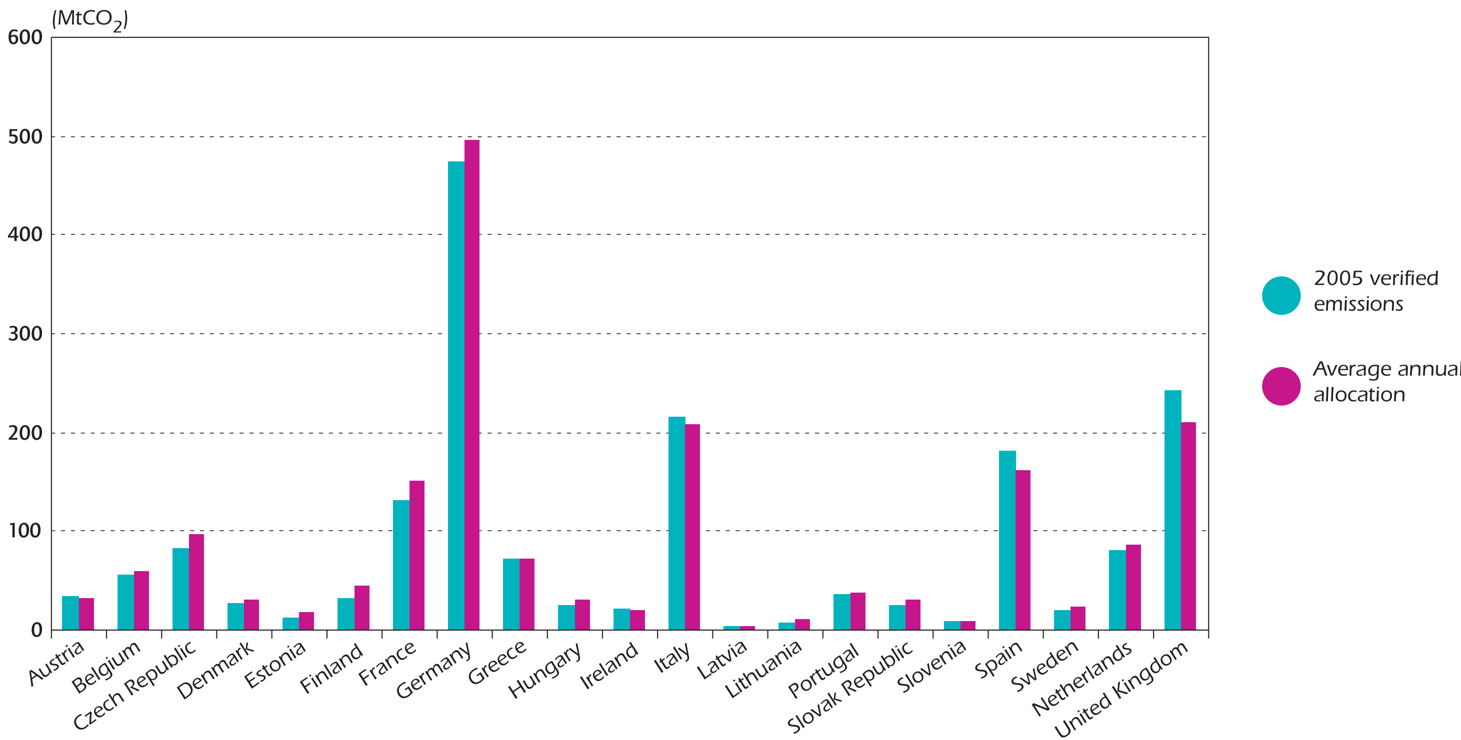
TOOLS FOR EVALUATION

Evaluation of European emissions trading should consider the correlation between the regulated emissions limit and the first period's actual emissions, as illustrated by Figure 17. Published emissions data indicate a general over-allocation of some 44 megatonnes of carbon dioxide.

Planned as a "learning-by-doing" phase to prepare European Union installations for emissions trading in conjunction with the Kyoto Protocol, the first period of the EU-ETS established a common goal to reduce emissions by 3% relative to a

Figure 17

Relative Stringency of the EU's 2005 ETS Allocations



Source: Community International Transaction Log, European Commission, http://ec.europa.eu/environment/ets/welcome.do

Business-as-Usual baseline. However, the relative stringencies illustrated by each nation's actual emissions in the context of its 2005 emissions illustrate few common aims.

The 2005 arrival of emissions trading did compel firms to reduce emissions across the EU, though the encouraging spreads between allocation and actual emissions illustrate a mild emissions constraint within several nations.

LOOKING FORWARD

The EU Emissions Trading Scheme provides a working model for complex trading schemes worldwide. Its success in dramatically curbing GHG emissions originating in the European Union remains to be gauged, even as its participating states construct the regulatory framework for subsequent rounds of trading.

Round II National Allocation Plans

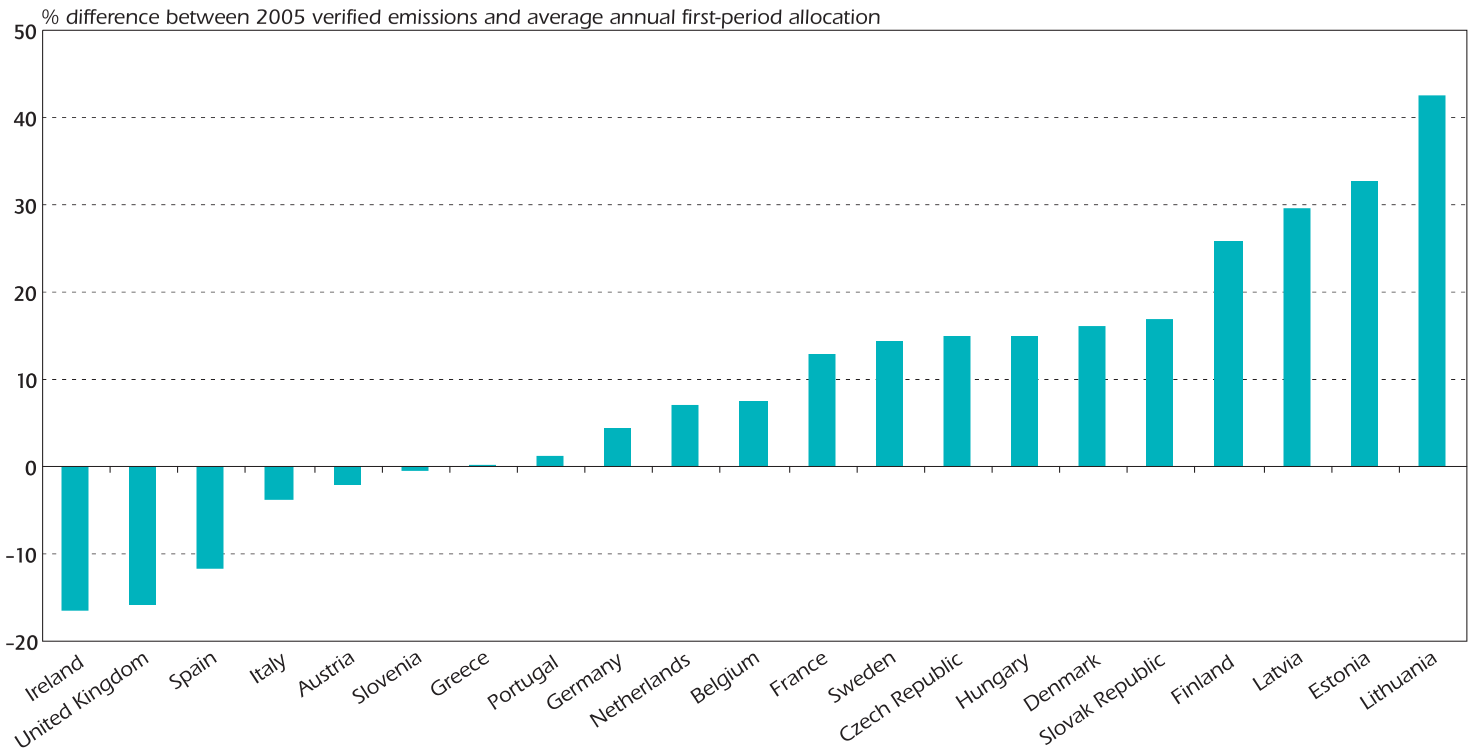
As of 30 June 2006, 11 of the 25 European Union member states had published National Allocation Plans for the second round of emissions trading set to correlate with the first period of the Kyoto Protocol. Though incomplete presentation confounds the identification of second-round trends, some nations' published allocation plans have markedly changed between rounds. As noted in the plans put forth for public comment, several nations have tightened their emission caps by including more installations under a fixed cap or by reducing the volume of this national cap. For the second round of trading, Poland has elected to expand both allocation and coverage, promising 20 million more allowances to 212 more installations than covered between 2005 and 2007.

In certain trading jurisdictions, like Belgium's Walloon region, energy production and iron and steel manufacturers may receive a relatively stringent allocation, though the plan covers the same number of installations as during the first round. On the other hand, the German government proposed to exempt certain energy-producing installations now carbon-constrained from the second round of emissions trading. The relative consensus on common coverage during the first round of emissions trade has waned.

As during the first round, some nations plan to auction allowances to fund the development of climate change mitigation technology or the infrastructure of emissions trading. The treatment of new entrants to the scheme and the repossession of allowances to closing plants remain to be enumerated in several plans, as does the cap on installations' use of credits procured through the Flexible Mechanisms of the Kyoto Protocol. At the time of writing, no trends could be discerned in either aspect of design for the second round of European emissions trading.

Figure 18

Calibration of First EU-ETS Period Allocation



Source: Community International Transaction Log, European Commission, http://ec.europa.eu/environment/ets/welcome.do

To encourage investment in the technology and infrastructure of a carbon-constrained economy, the European Commission is now considering how to afford economic operators more certainty on emissions allocations to allow for precise investment planning. The EU's further strategy includes plans to include aviation in emissions trading, among other now-exempted economic sectors. The Commission is also exploring the inclusion of nitrous oxide and other greenhouse gases in the trading scheme.

RD&D PRIORITIES: MAIN MESSAGES ON BIOENERGY AND WIND ENERGY

The development and deployment of renewable energy technologies are important components for the future of a balanced global energy economy. Renewables can make major contributions to the diversity and security of energy supply, to economic development, and to addressing local environmental pollution.

Experience over the last 30 years shows that the move towards sustainable renewable energy options depends on resource availability, technical maturity and a policy environment that is conducive to both technology improvements and commercialisation. Because of the diverse nature of renewables, each country or region needs to promote technologies and options best suited to its own resources and needs. *Renewable Energy: RD&D Priorities* is a full-scale study that looks at various types of renewable energy with the objective of better targeting renewable energy technology RD&D to ensure a higher market penetration of renewables. More detailed insights into two technologies – bioenergy and wind energy – are presented below.

BIOENERGY

Bioenergy in all its forms represents the largest current source of renewable energy and could play a major role in a low-carbon energy economy of the future. It includes traditional low technology practices in rural economies, some of which will run down as modern energy becomes available, as well as advanced technologies, such as ethanol vehicle fuels, which already play a major role. In the short term, the key challenge is to make available relatively cheap feedstock and to develop standards and norms for trading. In the medium term, there is a range of advanced conversion technologies with great potential, including biorefineries capable of simultaneously producing a range of products, including energy, as well as further development of facilities producing ethanol from lignocellulosic materials. Key technologies for the longer term include those for the production of hydrogen from biomass and the development of sustainable ways to produce large amounts of feedstock worldwide. More effort is needed on the social and environmental acceptability of large-scale bioenergy across the complete chain, *i.e.* from biofuel production to the delivery of services to the consumer.

Unique Characteristics of Bioenergy

Bioenergy has several unique characteristics that distinguish it from the other renewable energy sources (RES) that, individually, can be considered as either advantages or disadvantages. But on the whole, biomass offers good potential as an important RES of the future.

Biomass in the form of biofuels (solid, liquid or gaseous) is the only renewable energy technology that can directly replace fossil fuels (solid, liquid and gaseous), either fully or in blends of various percentages. In the latter case, the replacement can often be implemented without requiring any equipment modifications. In the case of co-utilisation with fossil fuels and subsequent carbon sequestration, bioenergy offers the only option to actually withdraw carbon from the environment.

Biomass also has the advantage, in comparison to other renewables, that it can be stored over long periods of time. On the other hand, in comparison to fossil fuels, it has the disadvantage of a relatively low energy density (energy content per unit volume and unit mass), leading to higher handling and transport cost.

However, biomass is the only renewable energy source that is not freely available; producing it requires a long chain of activities such as planting, growing, harvesting, pre-treatment (storage and drying), upgrading to a fuel, and finally mechanical, thermochemical or biological conversion to an energy carrier (power, heat or biofuels for transport). Thus, biofuels always have associated costs that must be carried by the end-user.

In contrast to the local nature of all other renewable energy sources, biomass and biofuels are traded on local, national and international markets. Although international trade in biomass fuels (solid or liquid) is still in its infancy, it is expected to play a major role in the development of a limited bioeconomy.

By its very nature, bioenergy cuts across several policy areas in addition to energy policy, including: agriculture and forestry, environment, employment, trade and market, tax policies, and regional development.

Because of limited availability of land, one can foresee a future in which biomass for energy must be balanced against the need for food, materials, biochemicals and carbon sinks. However, this point in time is beyond 2020, and depends on whether international trade in biomass fuels becomes effective; this date could well be postponed beyond 2050.

Environmental concerns associated with biomass production for food, products or fuels still need to be addressed. This must be done with an overall systems approach – rather than in an isolationist manner – allowing for comparisons to other alternatives.

Status

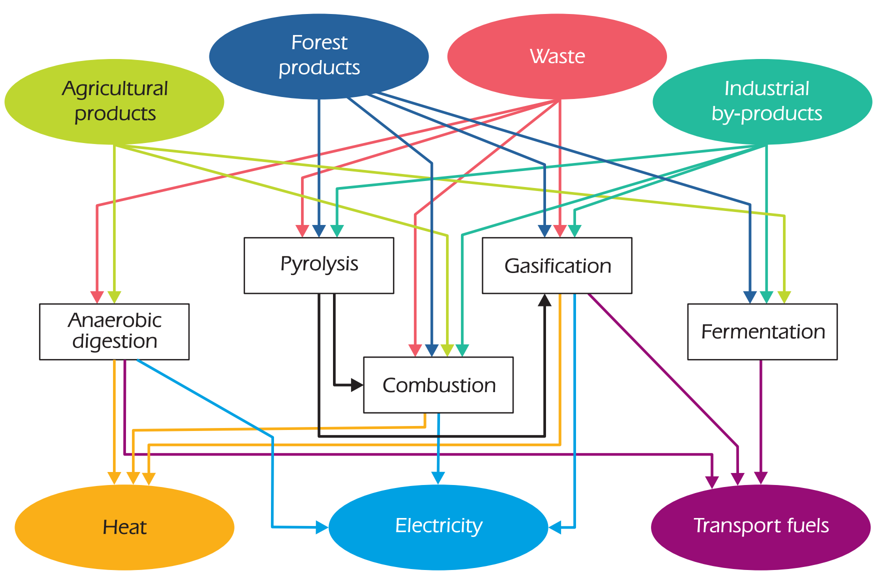
Generating bioenergy involves complex conversion processes that can follow many possible pathways from raw material to finished product, as well as a range of competing applications for various biofuels. A matrix of competing pathways further demonstrates the complexity of the sector (Figure 19).

Over the past decade, bioenergy technologies achieved significant cost reductions in several important areas including: dedicated large- and small-scale combustion and CHP; co-firing with coal, combustion of municipal solid waste; biogas generation via anaerobic digestion; and in district and individual household heating. In certain geographical areas, cost reductions were also realised in liquid biofuels such as bioethanol and biodiesel.

However, operating costs still differ significantly from country to country owing to wide variations in the cost of the biomass fuel delivered to the gate of the conversion plant. Such variations are due to two factors: *a)* the actual cost of the raw biomass; and *b)* local policies related to agriculture and forestry including: taxes; labour costs for the cultivation, production and harvesting of the resource; and labour costs for the operation of the conversion facilities. This variability makes it impossible to generalise the production costs of biomass or biomass fuels delivered to the conversion plant or, indeed, the production cost of energy generated from biomass sources.

Figure 19

Simplified Bioenergy Matrix



Source: *Renewable Energy: RD&D Priorities*, IEA/OECD Paris, 2006.

Some of the pathways shown in Figure 19, such as pyrolysis and the synthesis gas route for liquid biofuels, are still in the development phase and may require five to ten years further work before they can be considered as commercial technologies.

In an ideal scenario, all bioenergy applications should aim for polygeneration, *i.e.* the simultaneous production of heat, cooling, power and fuels, and – whenever possible – chemicals and materials. Such conditions are a prerequisite for maximising overall conversion efficiency and generating the greatest possible benefit per unit mass or unit volume of biomass. In practice, it is difficult to identify precise circumstances in which polygeneration can be applied under existing economic conditions. However, industry shows a clear tendency to advance beyond simple power generation to achieve polygeneration.

Reporting costs for bioenergy is equally complex, both for liquid biofuels and for gasification technologies (in pilot and demonstration plants). Costs for bioethanol can vary from about USD 0.25 to about USD 0.80 per litre of gasoline equivalent, subject to the location and the crop or resource used to produce the biofuel. Similarly, the cost for producing biodiesel can vary from around USD 0.40 to USD 0.90 per litre. There is good potential to further decrease production costs of both biofuels, especially bioethanol, and especially in Europe and the United States, through innovative combinations of technologies and improved utilisation of process residues. It may also be possible to use municipal wastes as a feedstock.

Gasification technologies are still in the development stage and very few reference operating plants exist, thus making it difficult to generalise about production costs. However, because of its flexibility in terms of final use of the fuel gas produced, gasification may offer significant opportunities once the sector is able to overcome remaining technical barriers, demonstrate reliability and further reduce costs.

RD&D priorities

Short-term priorities for bioenergy focus on two primary areas: *i)* availability of large quantities of relatively cheap feedstocks to support a dedicated market of biomass fuels that can be traded locally, nationally and internationally; and *ii)* further increasing conversion efficiency of basic processes while reducing their costs. To achieve the former, it is necessary to develop standards and norms on the fuel quality to be traded; the latter requires innovative approaches that may focus more on materials than on conversion technology improvements. The situation is somewhat co-dependent: a functional international market for biofuels is a prerequisite for the global development of bioenergy; for such a market to develop, large quantities of biomass fuels must be available for international trade.

Medium-term needs for bioenergy should address potential opportunities offered by biorefineries, which have the capacity to generate a variety of products (*e.g.* biopolymers, food additives, etc.) – including energy – from process residues. Such applications would significantly increase overall efficiency of the processes, increase economic benefits and promote sustainability. It may be possible to develop dedicated crops tailored to the needs of biorefineries (*e.g.* by maximising the concentration of certain chemicals, such as sugars, in the crops). The most attractive options may be found in developing successful process and business integrations of residues utilisation in food, forest and waste management areas.

In order to propose long-term RD&D priorities, it is necessary to define a long-term vision of the energy supply. This vision currently focuses on a hydrogen economy, recognising that there are several pathways to hydrogen production. It is anticipated that gaseous (biogas or biomethane) and liquid biofuels (ethanol and eventually methanol) could be used as safe carriers for hydrogen. However, in addition to considering a hydrogen economy, it is necessary to continue focusing on sustainable ways to cultivate large amounts of biomass worldwide without hampering food supply, the local ecology and biodiversity. At the same time, efforts should continue on the biorefinery approach, through which biomass for products, food and energy would become an integral part of the economy.

One area of RD&D is particularly weak; efforts must be undertaken to strengthen social and environmental integration along the entire chain, from biomass production to provision of energy services to the consumer. This issue arises in part because the advantages of bioenergy must always be balanced with its disadvantages (eventual loss of biodiversity, claim on vast areas of land, environmental emissions, and hazards and health conditions of workers).

WIND ENERGY

During the past five years, industry RD&D placed emphasis on developing larger and more effective wind energy systems, using knowledge developed from national and international generic RD&D programmes. Between 1981 and 1998, production costs of wind turbines were reduced by a factor of four, making wind energy cost-competitive with other forms of electricity generation in favourable locations, if CO_2 costs are included. Continued RD&D is essential to explore revolutionary new designs as well as for incremental improvements to provide the reductions in cost and uncertainty needed for widespread deployment. Research is needed to improve our understanding of aerodynamics and extreme wind situations, on aspects of grid integration, forecasting techniques, minimising environmental impacts, and on public attitudes to deployment.

Status

The cost of wind-generated electricity has fallen steadily over the past two decades, driven largely by technological development, increased production levels, and the use of larger machines. In many areas of the United States, the projected cost of energy for utility-scale production can be as low as USD 0.04/kWh to USD 0.06/kWh, given an excellent resource at the location and MW-plus scale turbines. The cost of energy in Norway, New Zealand, Ireland, Greece and Finland was comparable to United States values. Costs are somewhat higher in the UK, Japan and Italy. In Switzerland, the highest costs are reported as USD 0.1/kWh to USD 0.16/kWh (Figure 20). In Switzerland, however, good wind power locations are situated at altitudes starting at 800 m above sea level in a hilly or mountainous country with difficult climatic conditions (ice, cold), turbulent wind, difficult access and landscape protection problems. In a recent study carried out by the Spanish Wind Energy Association, the average cost for Spanish wind farms is around USD 0.08/kWh. German ISET reported that the average cost of a wind turbine in Germany with 2 MW power over a lifetime of 20 years is also around USD 0.08/kWh at medium wind locations.

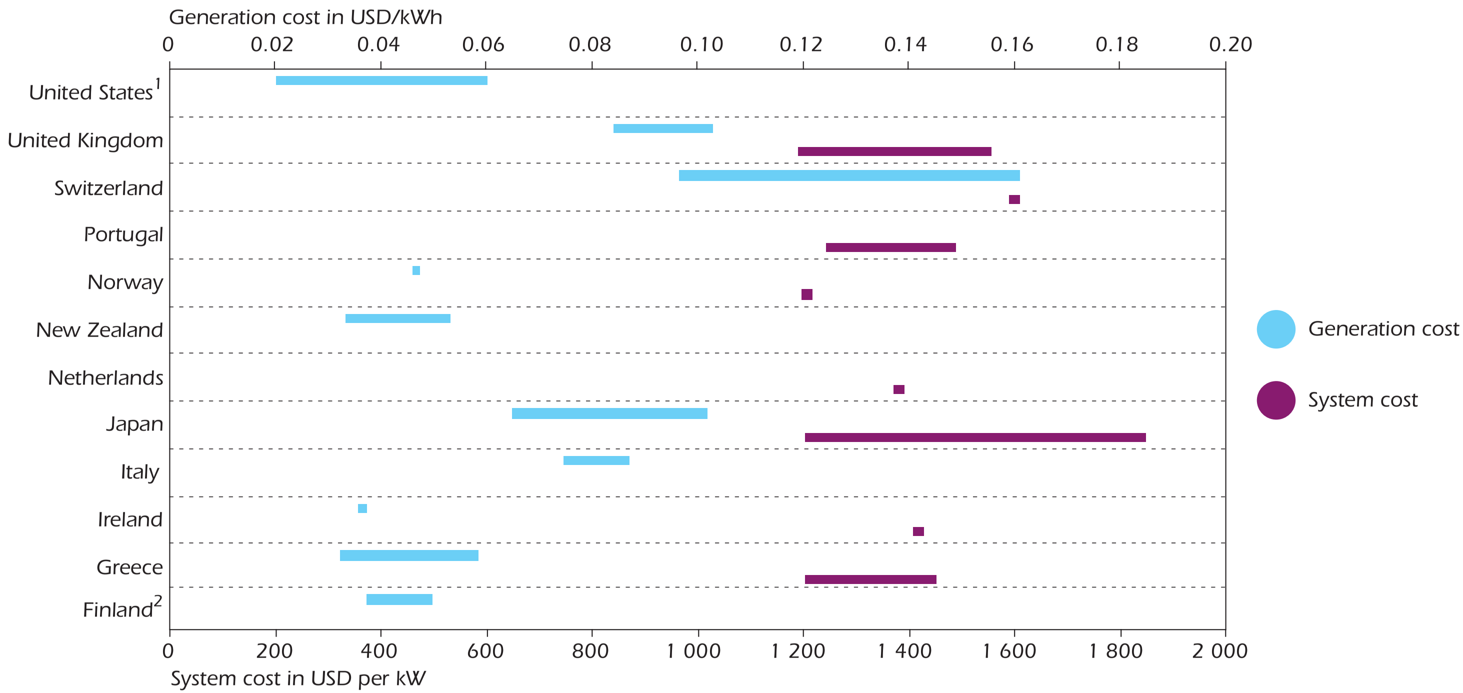
For complete wind farms, the estimates of average cost vary according to country, from USD 1 200/kW to USD 1 550/kW of installed capacity. The highest costs are reported in Japan – up to USD 1 850/kW for small installations – which reflect additional transport costs resulting from turbine imports from Europe and the United States (Figure 20). The European Wind Energy Association reported that the average cost was about USD 1 560/kW in Germany, about USD 1 180/kW in Denmark and Spain (2001-sample updated to 2004-prices). Average installation costs may also be higher because of mountainous terrain. In reality, total installation costs have a range that depends on location, project size and other factors. The cost of the turbine and tower alone can vary from USD 800/kW to USD 1 150/kW, with USD 950/kW being typical. These costs show a split of roughly 75% for the turbine (including tower) and 25% for the balance of plant (foundations, electrical infrastructure, and roads).

For the recent MW-plus machines, the installed costs per unit capacity might not be lower, but overall economics continue to improve. This is because the turbines are on taller towers, which places them in zones of higher wind speeds, thus improving energy yields.

Operating costs on turbines include servicing, repairs, site rental, insurance, and administration. A thorough study, conducted in Denmark, tracked operating costs for turbines in the size range of 150 kW to 600 kW. It shows that annual operating costs of near-contemporary turbines (500 to 600 kW) increase steadily from 1% of the investment cost in the first year to 4.5% after 15 years. These figures are consistent with Portuguese estimates of 2% to 4% and Dutch estimates of 3.4% for smaller projects. Maintenance and repair costs account for roughly one-third of total operating costs.

Figure 20

Comparison of Onshore Wind System and Generation Costs



1. Value of USD 0.02 includes available tax credits and refers to lowest bids given in tender auctions.
2. Generation costs include an investment subsidy of 30%.

Source: *Renewable Energy: RD&D Priorities*, IEA/OECD Paris, 2006.

RD&D priorities

There is strong support for continued activity in all the areas of wind energy RD&D, with no issues taking precedence over others. However, two topics are key: offshore wind development and the role of wind energy within hydrogen-based energy supply systems. Offshore wind energy, although in its infancy, is increasingly seen as a vital element of renewables development in several IEA member countries. Technology and environmental issues raised by offshore wind energy development are the subject of much research, and are likely to form an important part of future activities. In addition to using wind energy for electricity production, the technology could be applied to other energy applications in the longer term – particularly hydrogen generation.

Continue Cost Reduction

Sites with high winds are crucial for economic utilisation of wind energy. One key fact is not yet sufficiently recognised: energy production is related to mean wind speed to the power of three. In practical terms, this means that a 10% increase in wind speed will result in an energy gain of 33%. Improved site assessment and siting require better models and input from measurements. Another aspect of improving site assessment relates to finding better measures to predict extreme wind, wave and ice situations – at different types of locations and in wind farms. This may eventually make it possible to design site-specific systems that can utilise cheaper, lighter and more reliable turbines.

Wind turbines operating in the wake of another turbine are exposed to excessive loads due to wind speed deficits behind the upstream turbine. Reducing loads by improving design and adding intelligence to individual turbines in a wind farm will help optimise land use. Intelligent materials that utilise adaptive control and interact with the structure can also be used to reduce strains and/or to control aerodynamic forces. In addition, the development of new materials that can be recycled using natural processes would help decrease environmental impact – and increase the value – of wind turbines. For example, new ways to decommission glass-fibre blades are essential.

Current generator technology results in large and very heavy machines. Finding viable concepts and improving the design of direct-driven generators are two areas that show great potential for manufacturing more efficient and lighter machines. It is also important to find combined solutions for electricity generation and transmission, from low-voltage alternating current (AC) to high-voltage direct current (DC). Ideally, this would be combined with achieving an adaptable power factor and high power quality. It may be possible to reduce the cost of transmission lines by adding power plant characteristics to individual wind turbines or by utilising spinning reserve.

Specific challenges include fly-by-wire concepts, adding intelligence to the turbine, and incorporating aspects of reliability and maintainability.

Condition monitoring of components, such as blade bearings and generators, could reduce operation and maintenance (O&M) costs – an aspect that is especially interesting for remote locations both on land and offshore. New concepts could include such things as highly flexible downwind machines and diffuser-augmented turbines.

Stand-alone turbines will be built in vast numbers, but the installed total capacity may not be large. Still, the value of electricity from these machines can be of great importance, particularly in the case of remote locations where grid connection is not feasible. Integrating wind generator systems with other power sources, such as photovoltaic solar cells or diesel generating systems, is essential in small grids that require high reliability.

Increase Value and Reduce Uncertainties

The value of wind energy will increase if reliable predictions of power output can be made on different time scales, such as six to 48 hours in advance. This requires model development and strategies for online introduction of data from meteorological offices, as well as actual production figures from wind turbines in large areas.

RD&D activities in many fields of wind engineering can support background basics for standardisation work. The market-driven up-scaling and offshore applications for wind energy require better understanding of extreme environmental conditions, safety, power performance and noise. Development of international standards is essential for the successful deployment of wind energy in different countries. This will also help remove trade barriers and, indeed, facilitate free trade.

Effective storage of electricity could enhance the value and reduce the uncertainty of wind-generated electricity by making it possible to level out delivered power. This is especially important when penetration levels rise above 15% to 20%.

Enable Large-scale Use

Projections of installed capacity indicate that deployment figures will increase during the next 20 years. The contribution of wind generation will be substantial on a local and/or national level. This will put unique demands on the transmission grid and its interaction with the wind turbine generation units.

Development of tools for modelling and controlling energy supply to the electric grid will be essential to large-scale deployment of wind energy, especially in areas where the share of wind energy is high. Combined technologies for generation and transport of large quantities of electricity will need to incorporate innovations in automatic load flow controls, adaptive loads and demand-side management. Extensive use of high-capacity-power electronic devices for high-voltage DC (HVDC) links will also be required in national networks. In addition, there is a need to study concepts for storage and AC/DC concepts in co-operation with other energy sources.

Minimise Environmental Impacts

Finding suitable locations in terms of wind potential – at which there is also general acceptance for implementing wind turbines – has become increasingly complicated. Conflicting land-use goals among different interest groups is becoming more pronounced. There is clearly a need to raise public awareness of the environmental advantages of wind energy. Public attitudes towards wind energy must be incorporated into the deployment process to ensure that issues related to visual impact and interacting land-use concerns of different interest groups are adequately taken into consideration. Understanding noise generation and transportation across long distances is essential; challenges for offshore sites relate to the acoustically hard water surface. Initial estimations that wind turbines may emit more noise offshore without disturbing onshore dwellings must be studied further. Careful consideration of interaction between wind turbines and wildlife must be incorporated in the deployment process. This requires better understanding of background data and the behaviour of various species in both onshore and offshore environments.

RENEWABLE HEATING AND COOLING: FROM RD&D TO DEPLOYMENT

In the past 30 years numerous initiatives have been established worldwide to advance renewable energy technologies for electricity and biofuels production. Though the share of renewables in the energy mix is still small, spectacular market growth has been observed and there are many reasons to believe the growing trend will continue. The third energy vector, heat and/or cooling, is less publicised and seems to attract less support, both in the area of research, development and demonstration (RD&D) as well as deployment.

Heat is the largest consumer of energy, being greater than electricity or transport. Renewable heating sources (bioenergy, geothermal, solar heating and cooling) have a huge potential for growth and can replace substantial amounts of fossil fuels and electricity currently used for heating purposes. Over the last decade, energy policy focused very much on the liberalisation of the electricity markets. The heating and cooling sector seems to be missing in the policy framework.

This situation is likely to change. Given the current high prices of fossil fuels and new measures being put in place by governments, markets for domestic renewable heat equipment are growing quickly. New schemes, such as certificates and quota systems, are being launched. Renewable heat equipment begins to play an increasingly important part in the energy regulations for buildings. Targets are being established, and in the European Union the development of a renewable heat directive is being considered.

STATUS OF RENEWABLE ENERGY FOR HEATING AND COOLING

Bioenergy Heat Production

Gross heat production in IEA countries from solid biomass was 172 578 TJ in 2003, about 50% of total IEA renewable heat production. Heat production from the biodegradable part of municipal waste was 22%, the non-biodegradable part accounting for 18%, followed by heat production from waste heat and heat pumps.

In 2003, the largest producer of heat from solid biomass in the IEA was Sweden, with production of 86 182 TJ, 50% of total IEA heat production from solid biomass. Other major producers were Finland, with 30 525 TJ, the United States, with 17 932 TJ and Denmark, with 16 060 TJ.

Geothermal Heating and Cooling

At the end of 2004, total geothermal heating in IEA countries was 136 011 TJ/yr (79 217 TJ/yr from geothermal heat pumps, and 56 794 TJ/yr from individual and district heating). According to the World Geothermal Congress 2005, total annual worldwide direct use was 273 372 TJ (75 943 GWh), almost a 45% increase over 2000, growing at a compound rate of 7.5% annually. Those numbers include all direct uses (*i.e.* also for agriculture, industry, fitness centres, besides space heating). The growth rate has increased in recent years, in spite of economic downturns and other factors.

In space heating there are centralised systems like district heating networks, and smaller, decentralised geothermal heat pump (GHP) systems. Given that GHPs supplied 87 503 TJ in 2004, it is obvious that they are the greatest contributors to geothermal heating and cooling; they also contribute decisively to growth over time given the growing awareness of their capabilities, popularity and facility of use anywhere in the world.

Solar Heating and Cooling

Solar heating and cooling covers a broad spectrum of technologies, including solar water heating, active solar space heating, and passive solar heating and cooling, all of which have been commercially available for more than 30 years. The worldwide contribution of solar thermal heat to the overall energy supply is significant. An overall capacity of 92.7 GWth of solar thermal collectors was installed and IEA member countries contributed 50.1 GWth in 2003. The worldwide market for glazed solar collectors has greatly increased over the last decade to approximately 10 million m^2 installed per year. Almost all growth in this market occurred in China.

The largest producers of solar hot water technologies among the IEA countries are the United States, Japan and Turkey. Together they account for more than 77% of direct use of solar heat in IEA countries. The United States produces 59 738 TJ of heat from solar sources, Japan 26 602 TJ and Turkey 14 651 TJ. Other significant producers are Germany, Australia, Greece and Austria.

KEY ISSUES

The April 2006 Renewable Energy Working Party (REWP) Seminar "Renewable Heating and Cooling – From R&D to Deployment" was part of the IEA contribution to the discussion on technology and policy for renewable heating and cooling. For the purpose of the discussion, renewable heating and cooling includes solar energy, bioenergy, and geothermal energy.

Session 1 reviewed the current status of relevant biomass, geothermal, and solar thermal renewable energy technologies in heat and "cold" production. Heat pump technologies were included. The discussions focused on specific aspects of the technologies, such as economically recoverable resource potential, current and future costs, technology RD&D challenges, norms and standards. It was noted that heating and cooling are essential energy vectors that provide a range of services and are critical to consider from a policy perspective in moving towards a sustainable energy future.

Key findings and observations of this session can be summarised as follows:

- All of the technologies are available on the market. They are commercially viable and have been, in various forms, for many years.
- There are considerable synergies between the technologies, and they are not in competition with each other. Synergies with energy efficiency opportunities are crucial. Solar cooling matches demand with supply on sunny days.
- Industrial process heating applications will play a crucial role in global markets.
- There has been considerable technological and economic progress over the decades, but markets are still relatively small and widely diversified.
- The primary need is to move renewable heating and cooling technologies into the market by deployment on a large scale.
- All of the technologies have high potential for replacing conventional fuels.

- All technologies bring tertiary environmental benefits beyond displacing fossil fuels. A thorough and defensible cost-benefit analysis is called for. Social benefits should continue to be explored.
- Collecting statistical information is an important element in understanding and deploying all technologies, but poses a challenge in the case of widely dispersed renewable heating and cooling.
- Prices continue to decrease in certain countries, especially in niche markets, but market uptake remains irregular.
- There is a wide range of costs depending on specific applications, but in general, with good system design, the technologies show promising payback times.
- The unique and dispersed nature of the heat market needs to be accounted for, as does that for cooling.
- There are excellent opportunities for many of the technologies in developing countries.
- Combinations of technologies offer advantages (*e.g.* district heating, heat pumps).

Session 2 provided a policy review, future trends and implications for renewable heating and cooling technologies. It explored a vision of the renewable heat market and also discussed policy and regulatory framework aspects of the paradigm shift which is required to meet national and international objectives.

Conclusions

The main conclusions of the seminar are presented below:

- Renewable heating and cooling already meets a significant share of the world energy demand, although their contribution to the energy sector could be much higher.
- To exploit the full potential of renewable heating and cooling, it is necessary to invest more in RD&D to further increase their overall efficiency and reduce technology costs. The integration of systems (including storage) offers opportunities for new applications.
- Codes and standards for the technologies require additional efforts from the international community.
- Policies to encourage the wide deployment of renewable heating and cooling technologies will help increase their market share.
- Policies for renewable heating and cooling may be diverse, while policy options can be further developed within the IEA framework and best practices elaborated, for instance within the IEA Implementing Agreements.

- Collaborating with non-IEA member countries will play an important role in broadening the market base for renewable heating and cooling technologies.

Biofuels on a Global Scale

Transport fuels derived from biological sources (biofuels) can make an important contribution to energy policy aims. They can contribute to energy security by diversifying energy supply sources for transport. They can reduce GHG emissions, reduce local air pollution, and develop new industry. In developing economies, biofuels can stimulate and sustain rural development, create jobs, and save foreign exchange. The efficiency of biofuels varies significantly depending on how they are produced. Competition for arable land may limit their market penetration until a more advanced process becomes commercially competitive.

STATE OF THE ART

In 2005, about 2% of the world's gasoline market and 0.2% of the world's diesel market were supplied by biofuels, with Brazil, the United States, China and Germany the leading producers.

With current technology, the sugar cane process is much more efficient and has much greater environmental gain than processes using temperate region crops. Bioethanol from sugar cane contains eight times the amount of energy that is needed to produce it, whereas for corn bioethanol, the ratio can be much less than two to one. Sugar cane bioethanol can reduce CO_2 emissions from transport by 90%, whereas the savings with root and cereal crops are only in the region of 10-15%.

National targets for biofuels by 2010-2012, mainly in the US and the European Union, are equivalent to around 2.8% of global 2006 transport fuel demand. A 5% displacement of petroleum fuels by volume during the next 2-3 decades, as suggested in various policy debates, would require the global biofuels market to increase 2.4 times and would reduce global oil consumption by about 1.8 million barrels per day.

Most petrol engines will run on gasoline blended with up to 10% of bioethanol, and it has been demonstrated in Brazil, the US and Sweden that engines can be modified at minimal cost to accept much higher proportions.

Bioethanol can be produced from sugar cane in Brazil at a cost of USD 0.25 per litre (USD 0.94 per US gallon) – highly competitive at current oil prices. But producing ethanol from corn, sugar beet or wheat in temperate climates is much more costly, in the range of USD 0.60 to USD 0.80 per litre

(USD 2.3 to 3.0 per US gallon). Figure 21 presents a comparison between current and future prices of biofuels versus gasoline and diesel.

There is substantial potential to reduce the costs of all biofuel production processes by 2030. However, sugar cane and other tropical plants are expected to remain the most competitive source for ethanol using conventional processes. More advanced processes – particularly those for using lignocellulosic materials – are currently more expensive than conventional processes. But they may have the potential to be competitive with sugar cane, for example, in the future.

KEY ISSUES

The economic, environmental and social benefits of the current generation of biofuels vary enormously, with ethanol produced from sugar cane, biodiesel from oil palm and potential use of other tropical plants generally showing much greater benefits than ethanol from grain or beet and biodiesel from oil-seed rape in temperate regions. There is significant potential to increase sugar cane ethanol and palm oil biodiesel production in the developing world, though it is recognised that land and water use will generally compete with food and fibre crops and that any deforestation for this purpose would be environmentally counter-productive.

Some analysts claim that, if well managed, there is enough suitable land available to meet all global food and fibre needs for the growing world population as well as for energy demands up to 2100 (even with increasing energy/capita). This needs to be further researched, as the constraints of water and nutrients are not well understood at the regional level. Deforestation to produce more cropping land would, of course, represent a major environmental setback.

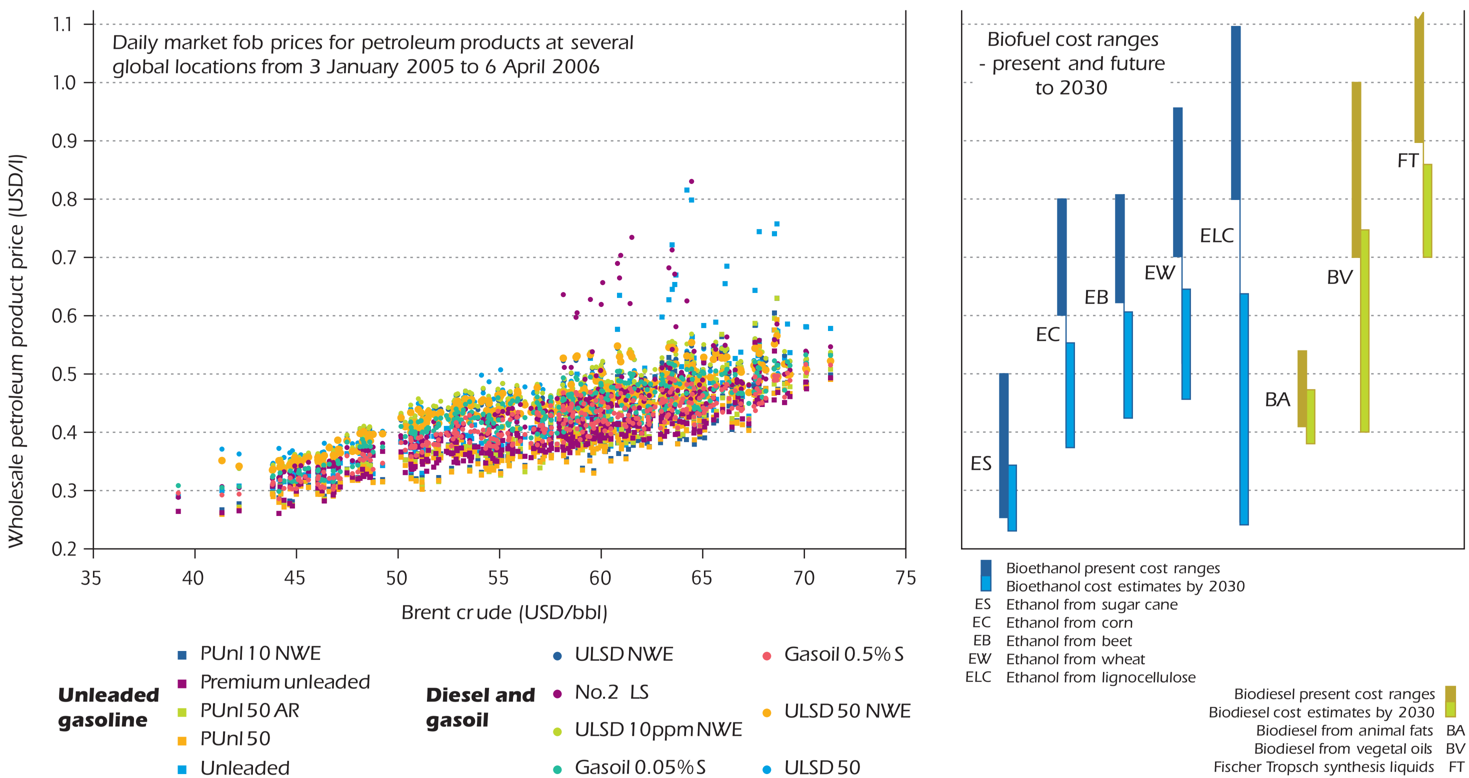
The land and water resource base necessary for biomass production needs protecting. Biofuels produced from crops grown in temperate climates remain more expensive, are less effective at reducing emissions, and hence continue to depend on financial support policies. In the US and Europe, agricultural subsidies and land use for energy and forest crops are being reviewed in relation to the possible transfer of support from food to energy products. Further analysis of the impacts of increasing biofuel production on land use change, agricultural product prices, deforestation and water use would be useful.

Technologies under development could widen the range of feedstocks and improve the economics of biofuels. These include lignocellulosic conversion which enables bioethanol to be produced from a much wider range of plant material – not just sugar and starch – so that waste products such as straw and forest residues could be utilised. Some of this biomass material is already

Figure 21

Current and Future Biofuels Prices versus Daily Gasoline and Diesel Ex-refinery

(free on board prices and related crude oil prices in US dollars)



Source: International Energy Agency, Paris.

being used to provide heat, power and biomaterials which will be competitive. In its current development stage, lignocellulosic conversion is a relatively expensive process but it has the potential to become competitive by 2030. Other technologies which could improve future competitiveness include synthesis of diesel fuels, biotechnical production of novel biofuels, and development of multi-products (polymers, biomaterials, fuels, etc.) in biorefineries, possibly linked with the co-production of electricity. Support mechanisms are needed to speed the transition to second-generation technologies.

Minimum quota policies in IEA member countries that encourage biofuel production and demand can be costly in terms of carbon emissions avoided, and do not necessarily lead to the development of new and improved technologies. Bioethanol from sugar cane and biodiesel from waste fats and oils remain cost-competitive in a high oil price environment in spite of feedstock price increases. Production of these biofuels should be encouraged in countries able to provide economic feedstocks, not only for domestic transport fuel supplies but, if in excess, also for export, since they can contribute to development as well as to energy policy objectives.

Trade barriers are restricting access to markets in many IEA member countries for the least costly biofuels and thus are constraining the growth of this industry in the developing world. Overcoming barriers to international trade in biofuels has been identified by the World Trade Organization (WTO) as necessary "to reduce or eliminate all tariff and non-tariff barriers to trade in environmental goods and services" (paragraph 31*(iii)* of the Doha Declaration). Following a clarification by the World Customs Organization in March 2005 that biodiesel is a non-agricultural product, Canada and New Zealand proposed that biodiesel be included in an agreement on environmental goods.

TECHNOLOGY, RESEARCH AND DEVELOPMENT

ENERGY TECHNOLOGY PERSPECTIVES

In 2006 the IEA's new global technology analysis – *Energy Technology Perspectives* – assessed the role technology and technology development could play up to 2050. The analysis:

- Reviews and assesses the status and prospects for key energy technologies in electricity generation, road transport, buildings and industry.
- Examines, through scenario analysis, the potential contributions that these energy technologies can make to improve energy security and reduce the environmental impacts of energy provision and use.
- Discusses strategies on how to help these technologies make this contribution.

This section presents some overall conclusions on technology and R&D, discusses the policies required and looks into recent trends in technology policies in IEA member countries. Among the conclusions drawn is that governments in IEA countries still have a major role to play in technology development and deployment.

THE OUTLOOK TO 2050 AND THE ROLE OF ENERGY TECHNOLOGY

The threat of disruptive climate change, the erosion of energy security and the growing energy needs of the developing world all pose major challenges for energy decision makers. They can only be met through innovation, the adoption of new cost-effective technologies, and a better use of existing energy-efficient technologies. The recent study mentioned above – *Energy Technology Perspectives* – presents the status and prospects for key energy technologies and assesses their potential to make a difference by 2050. It also outlines the barriers to implementing these technologies and the policy measures that can overcome such barriers.

The world is not on course for a sustainable energy future – rising oil prices, CO_2 emissions projected to more than double by 2050, to mention just two issues. But this alarming outlook can be changed. The *Energy Technology Perspectives* demonstrate that by employing technologies that already exist or are under development, the world could be brought onto a more sustainable energy path. The Accelerated Technology (ACT) scenarios show how energy-related CO_2 emissions can be returned to their current levels by 2050 and how the growth of oil demand can be moderated.

The substantial changes are grounded in:

- Strong energy efficiency gains in the transport, industry and buildings sectors.
- Electricity supply becoming significantly decarbonised as the power-generation mix shifts towards nuclear power, renewables, natural gas and coal with CO_2 capture and storage (CCS).
- Increased use of biofuels for road transport.

The costs of achieving a more sustainable energy future are not disproportionate, but they will require substantial effort and investment by both the public and private sectors. None of the technologies required are expected – when fully commercialised – to have an incremental cost of more than USD 25 per tonne of avoided CO_2 emissions in all countries, including developing countries. However, there will be significant additional transitional costs related to RD&D and deployment programmes to commercialise many of the technologies over the next couple of decades. But these will be largely levelled out by a slow-down in the increase of oil prices.

There are considerable uncertainties when looking 50 years ahead. Yet, despite all the uncertainties, two main conclusions from the analysis seem robust. First, technologies do exist that can make a difference over the next 10 to 50 years. Second, none of these technologies can make a sufficient difference on their own. Pursuing a portfolio of technologies will greatly reduce the risk, and potentially the costs, if one or more technologies fail to make the expected progress.

Implementing the ACT scenarios will require a transformation in the way power is generated; in the way homes, offices and factories are built and used; and in the technologies used for transport. In the end, it is the private sector that will have to deliver the changes required. But the market on its own will not always achieve the desired results. Governments have a major role to play in supporting innovative R&D and in helping new technologies to surmount some daunting barriers. Government, industry and consumers will have to work hard together.

TECHNOLOGY SCENARIOS

In the absence of new policies, global energy demand and CO_2 emissions will more than double by 2050. In the Baseline Scenario, global CO_2 emissions grow rapidly, oil and gas prices are high, and energy security concerns increase as imports rise. Energy use more than doubles, while CO_2 emissions rise by an unsustainable 137% from 24.5 Gt in 2003 to 58 Gt in 2050. Most of the growth in energy demand, and hence emissions, comes from developing countries.

Coal demand in 2050 is almost three times higher than in 2003; gas demand increases by 138% and crude oil demand by 65%. The carbon intensity of the world economy increases because of greater reliance on coal for power generation and an increased use of coal in the production of liquid transport fuels.

Energy technologies can bring the world's energy sector onto a more sustainable path. The five Accelerated Technology (ACT) scenarios in the *Energy Technology Perspectives* study demonstrate that the use of technologies that already exist or are under development can return global energy-related CO_2 emissions towards today's level by 2050.

The significant changes in the ACT scenarios result from strong energy efficiency gains in transport, industry and buildings; from the substantial decarbonisation of electricity supply as the power generation mix shifts towards nuclear power, renewables, natural gas, and coal with CO_2 capture and storage (CCS); and through increased use of biofuels for road transport.

Despite these changes, fossil fuels still supply between 66% and 71% of the world's energy in 2050. Demands for oil, coal (except in the scenario where CCS is not available) and natural gas are all greater in 2050 than they are today. Investment in conventional energy sources thus remains essential.

Improved energy efficiency accounts for between 31% and 53% of the CO_2 emissions reductions in the ACT scenarios; CO_2 capture and storage for between 20% and 28% (in the scenarios it is assumed to be available); fuel switching for between 11% and 16%; the use of renewables in power generation for between 5% and 16%; nuclear for between 2% and 10%; biofuels in transport for about 6%; and other options for between 1% and 3%.

The ACT scenarios show that more energy-efficient end-use technologies can reduce total global energy consumption by 24% by 2050 compared to the Baseline Scenario. Electricity demand is reduced by one-third below the baseline level in 2050, which halves electricity demand growth between 2003 and 2050. Savings of oil are equivalent to more than half of today's global oil consumption, offsetting 56% of the growth in oil product demand expected in the Baseline Scenario. The growth in oil demand is moderated by improved efficiency, the increased use of biofuels in the transport sector, and fuel switching in buildings and industry sectors.

A sixth scenario, TECH Plus, is based on more optimistic assumptions on the rate of progress for renewable and nuclear electricity generation technologies, for advanced biofuels, and for hydrogen fuel cells. Given these assumptions,

CO_2 emissions could fall by about 16% below current levels in 2050. Hydrogen and biofuels provide 34% of total final transport energy demand in 2050, returning primary oil demand in 2050 to about today's level. Global CO_2 emissions in the scenarios are summarised in Figure 22.

Bringing global CO_2 emission levels in 2050 back to current levels, as illustrated by the ACT scenarios, could offer a pathway to eventually stabilise CO_2 concentrations in the atmosphere. However, the trend of declining CO_2 emissions achieved by 2050 would have to continue in the second half of this century. In approximate terms, the ACT scenarios show how electricity generation can be substantially decarbonised by 2050. Decarbonising transport, which is more difficult, would need to be achieved in the following decades.

The more radical changes in the TECH Plus scenario could be regarded as providing an indication of the trends that may develop more strongly and perhaps with more certainty, in the second half of the century.

Barriers to Technology Uptake

The Accelerated Technology scenarios demonstrate that employing technologies that exist today or are under development can shift the world onto a path towards a more sustainable energy future. Most, perhaps all, of the energy technologies considered face barriers they must overcome before their full potential can be harvested. These barriers can be classified under three broad headings: technical barriers; cost barriers; and other barriers not primarily related to costs and technical issues.

Technical Barriers

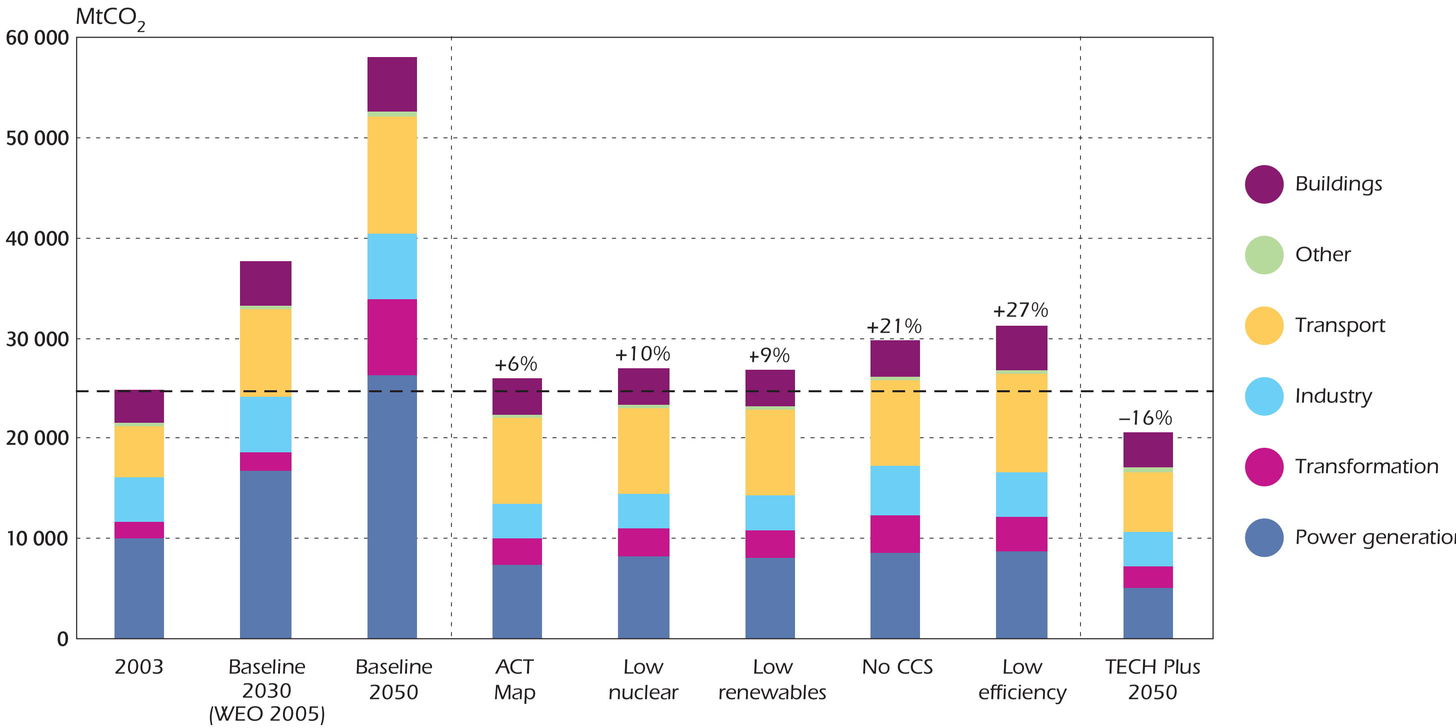
Some energy technologies are not yet ready for the market. Further research and development (R&D) may be needed to resolve technical problems. Typically, government funding is essential in the early phase of a technology's development, while industry's engagement increases as the technology gets closer to market introduction. When a technology is technically proven, demonstration projects may be required to show that it works on a commercial scale and under relevant operating conditions.

Cost Barriers

Most new energy technologies initially have higher costs than the incumbent technologies. Costs can be reduced by further R&D and usually fall, sometimes significantly, as a result of the "technology learning" effect. Deployment programmes may be needed to achieve these cost reductions. Although the costs of the technologies will be reduced by R&D and learning, some technologies, like CO_2 capture and storage, can only be cost-competitive if credit is given for the CO_2 emissions reductions or in specific cases where CO_2 can get credits for being used for enhanced oil recovery.

Figure 22

Global CO_2 Emissions in the Baseline Scenario, ACT Scenarios and TECH Plus Scenario



Source: Country submissions.

Table 11

The Main Barriers Faced by Key Technologies in the ACT and TECH Plus Scenarios and Policy Instruments to Overcome Them

		Technical barriers		*Cost barriers*		*Cost-effective, but facing other barriers*
	Policy instruments	*R&D*	*Demonstration*	*Deployment*	*CO_2 reduction incentive*	*Regulation/ Information/ other*
Sector	**Technologies**					
Transport - vehicles	Vehicle fuel economy improvements				x	X
	Hybrid vehicles	x		X	x	
	Ethanol flex-fuel vehicles				X	
	Hydrogen fuel cell vehicles	X	X	X	X	
	Non-engine technologies				x	X
Transport - fuels	Biodiesel				X	
	Ethanol (grain/starch)				X	x
	Ethanol (sugar)				X	x
	Ethanol (cellulosic)	X	X	x	X	
	Hydrogen	X	X	X	X	
Industry	Co-generation technologies				x	x
	Motor systems					X
	Steam systems				x	X
	Energy efficiency in existing basic materials production processes				x	x
	Process innovation in basic materials production processes	X	X	x	x	
	Fuel substitution in basic materials production processes				X	
	Materials/product efficiency	x	X	x		X
	Feedstock substitution	X	X	x	x	
	CO_2 capture and storage	X	X	x	X	
Buildings & appliances	Heating and cooling technologies	x			x	X
	District heating and cooling systems				x	X
	Building energy management systems	x	x	x	x	X
	Lighting systems	x	x	x	x	X
	Electric appliances			x	x	X

Table 11 *(continued)*

The Main Barriers Faced by Key Technologies in the ACT and TECH Plus Scenario and Policy Instruments to Overcome Them

		Technical barriers		*Cost barriers*		*Cost-effective, but facing other barriers*
	Policy instruments	*R&D*	*Demons-tration*	*Deploy-ment*	*CO_2 reduction incentive*	*Regulation/ Information/ other*
Sector	**Technologies**					
Buildings & appliances	Reduce stand-by losses		x			X
	Building shell measures	x	x	x	x	X
	Solar heating and cooling		x	x	X	X
Power generation	Hydro (small & large)				X	X
	Biomass	x	x	x	X	
	Geothermal	x	x	x	X	
	Wind (onshore & offshore)		x	X	X	X
	Solar photovoltaics	X	X	X	X	
	Concentrating solar power	x	X	X	X	
	Ocean energy	X	X	X	X	
	Combined cycle (natural gas)*				X	
	Advanced steam cycles (coal)*		x	x	X	
	IGCC (coal)*	x	X	X	X	
	Fuel cells	X	X	X	X	
	CCS advanced steam cycle w/flue-gas separation (coal)	x	X		X	
	CCS advanced steam cycle w/oxyfuelling (coal)	X	X		X	
	CCS integrated gasification Combined cycle (coal)	X	X	X	X	
	CCS chemical absorption flue-gas separation (natural gas)	x	X		X	
	Nuclear generation II and III	x	x	x	X	X
	Nuclear generation IV		X	X	x	X

*Importance of incentives to reduce CO_2 emissions reflects a situation where these efficient fossil fuel-based generation technologies compete with less efficient alternatives, not when they compete with carbon-free options.

General note to the table: X denotes a barrier that is important today, while x denotes a barrier that is less important but still significant. The absence of a cross does not necessarily mean that the barrier is not relevant for the technology – for example there are technologies within almost all categories that would benefit from more R&D – but rather that it is less important overall compared to the barriers that are identified in the table.

Another group of technologies, on the demand side, are those that have higher capital costs than less efficient incumbent technologies, but which have significantly lower life cycle costs due to their lower energy bills. These technologies face a "first cost" barrier to market acceptance, which is partly associated with a lack of information and awareness of their life cycle cost-benefits. The energy performance of these technologies is usually of secondary importance in the purchase decision. This lowers the probability that the market will gravitate to the least-cost option. The likelihood of market actors trying to minimise energy costs is further weakened by numerous split incentives. For example, a large proportion of buildings and energy-using capital equipment is often not purchased by those who will be paying the energy bill. Priority is therefore usually given to minimising the initial capital investment, rather than the energy or life cycle costs.

A new energy technology will typically go through several stages to overcome technical and cost barriers before it becomes cost-competitive. Even if a technology is technically proven after the R&D and demonstration stage, costs may still be too high for the market. This is often referred to as the "valley of death" that new technologies face on the way to full commercialisation. Programmes aimed at taking the technology through the deployment phase can require considerably more resources than the R&D phase. In some cases, prolonging the R&D phase to reduce the market entry cost for the technology may lead to reduced overall costs, as long as the increased R&D expenses are lower than the reduction in deployment costs.

While governments play an important role in stimulating deployment, the costs of the programmes are often borne by the private sector. For example, governments may establish codes or minimum standards that require the market to invest in certain technologies, often at a higher initial cost, but which will result in the reduced cost of the technologies as their deployment increases. The expectation of large future markets stimulated by deployment programmes may also have the important benefit of activating additional R&D by private industry. With a market in sight, industry will step up its efforts, set research priorities and find ways to cut costs.

Other Barriers

There are a range of other barriers that can delay or prevent the market deployment of technologies. These include such diverse factors as public acceptance, planning and licensing, financing, lack of information, structure and split incentives. These barriers, and the policies to overcome them, are described in more depth in the *Energy Technology Perspectives*.

Table 11 illustrates, for each group of technologies included in the ACT and TECH Plus scenarios, the main barriers facing the technology today and the policy instruments that are the most crucial to stimulate its market uptake at this time. It should be noted that the table focuses on the most important barriers/policy instruments and is *not* an exhaustive list. Many technologies for which R&D is not listed as a key barrier could still benefit from further research. Similarly, technologies for which cost is not listed as a main barrier may well achieve further cost reductions. The table represents broad categories of technologies for which cost is an issue across many different markets. Typically, the barriers and their relative importance vary depending on specific market conditions. They also vary among different technologies within a category (*e.g.* compact fluorescent lighting systems are proven and available to the market, while advanced light-emitting diode-based lighting systems would benefit from more R&D). The column representing technologies that are cost-effective, but are facing other barriers, illustrates the situation of today's commercially available technologies. Technologies that may become cost-effective in the future, if they overcome technical and cost barriers, may still face other barriers to their market uptake.

TECHNOLOGY STRATEGIES FOR A MORE SUSTAINABLE FUTURE

Well-focused R&D Programmes are Essential

There is an acute need to stabilise declining budgets for energy-related R&D and then increase them. More R&D in the private sector is critical. Some forward-looking companies are increasing their commitments, but this trend needs to continue and broaden. For technologies that are already commercial, the private sector is best placed to tailor ongoing research and development to the market's needs.

Nevertheless, government–funded R&D will remain essential, especially for promising technologies that are not yet commercial. Government R&D budgets in IEA countries are well below the levels that they reached in response to the oil price shocks of the 1970s and have been static or in decline over the past decade.

Budgets for energy R&D and deployment programmes need to be reviewed if the results in the *Energy Technology Perspectives* scenarios are to be realised. Some of the areas with the greatest potential include advanced biofuels, hydrogen and fuel cells, energy storage and advanced renewables. There are also some interesting areas of basic science – especially biotechnologies, nano-technologies and materials – which could have far-reaching implications for energy in the long term.

The Transition from R&D to Technology Deployment is Critical

The deployment phase can require considerably more resources than the R&D phase. Several new technologies that are already on the market need government backing if they are to be mass deployed. Many renewable energy technologies are in this position. The "valley of death" that new technologies face on the way to full commercialisation must be bridged. Experience shows that new technologies benefit from cost reductions through "technology learning" as deployment increases. Governmental deployment programmes can also activate R&D by private industry by creating expectations of future markets for the new technology.

There is a particularly urgent need to commercialise advanced coal-fired power plants with CO_2 capture and storage. If this is done, coal can continue to play a major role in the energy mix to 2050, significantly reducing the costs of shifting to a more sustainable energy future. To accelerate the introduction of CCS, at least ten full-scale integrated coal-fired power plants with CCS are needed by 2015 for demonstration. These plants will cost between USD 500 million and USD 1 billion each. The projects can only be accomplished if governments strengthen their commitment to CCS development and deployment and work closely with the private sector. Involvement of developing countries with large coal reserves, such as China, will be crucial in this process. Similar initiatives will be needed to commercialise generation IV nuclear technology.

Non-economic Barriers Must also Receive Attention

There are a range of barriers other than economic or technical that can delay or prevent innovation and market deployment of new energy technologies. These barriers can take many forms, including planning and licensing rules, lack of information and education, health and safety regulations, and lack of co-ordination across different sectors. All these need attention if the potential of promising technologies is to be realised.

Collaboration between Developed and Developing Countries Will be Needed

By 2050, most of the world's energy will be consumed in developing countries, many of which are experiencing rapid growth in all energy-consuming sectors. Developing countries will therefore also need to consider energy security and CO_2 abatement policies. A significant transformation of the global energy economy is required to meet the legitimate aspirations of developing countries' citizens for energy services, to secure supplies and to ensure sustainability. Developed countries have an important role to play in helping developing economies to leapfrog the technology development process and to employ efficient equipment and practices through technology transfer, capacity building and collaborative RD&D efforts. Fast-growing developing countries offer opportunities to accelerate technology learning and bring down the costs of technologies, such as energy-efficient equipment.

RECENT TRENDS IN R&D FUNDING IN IEA MEMBER COUNTRIES

Despite the critical role to be played by energy technologies, the current level of energy R&D, in both the public and private sectors, is a serious cause for concern. After a significant increase from the mid-1970s to early 1980s, government energy R&D budgets in member countries have declined, and stayed on a relatively stable, low level since the late 1990s. It is unlikely that the technological challenges facing the energy sector can be addressed without significant increases to R&D budgets in IEA member countries.

GOVERNMENT BUDGETS FOR ENERGY R&D

Total government expenditures of IEA member countries on energy R&D decreased from some USD 9.6 billion at 2005 prices and exchange rates in 1992 to USD 8.6 billion in 1998.[22] This decline represents a continuation, albeit less dramatic, of the trend already established in the 1980s, and is largely associated with the difficulties of the nuclear industry and, since 1985, with the decrease in oil prices. From 1998, government expenditures have slightly recovered and were estimated to be USD 9.5 billion in 2005.

As Figure 23 shows, government budgets for energy R&D in Europe decreased by 28% from 1992 to 2005, while the IEA North America budgets decreased from 1992 to 1998 and then rose again to the same level as in 1992. The budget for the Pacific region has increased over the period. Between 1992 and 2005, two countries (Japan and the United States) accounted for more than 70% of total R&D government budgets in IEA countries. In 1990, the shares of total IEA spending for these two countries were nearly the same, with 29% for the United States and 34% for Japan, while a large group of European countries' R&D budgets have significantly decreased in real terms in two areas: nuclear research (fusion and fission) and technologies related to fossil fuel extraction and transformation.

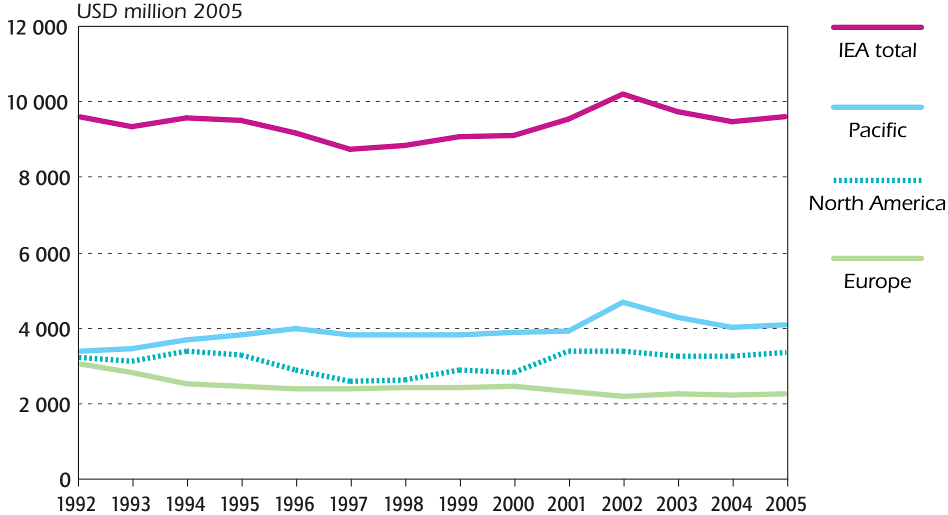
Taking inflation into account, government expenditures for energy R&D have declined even more. The development in energy R&D budgets as a percentage of GDP for selected countries is illustrated in Figure 24. Only Japan has

22. The analysis in this section is largely based on the data collected by the IEA statistical office from the governments of member countries on public spending in energy R&D. Considerations on quantitative trends are based on a smaller data set than the one actually available to the IEA because the government budget information is not available for all IEA countries for all years considered (1992-2005). In order to have a consistent data set, data from the following countries have been used:
- For the North America region: United States and Canada.
- For Europe: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and Turkey.
- For the Pacific region: Japan, Australia and New Zealand.

Finally, while considering the trends described here, the reader should be reminded of possible distortions introduced by the use of exchange rates to convert budgetary figures into euros.
Comment: as the figures in the section are given in dollars, this reference to converting into euros is unclear.

Figure 23

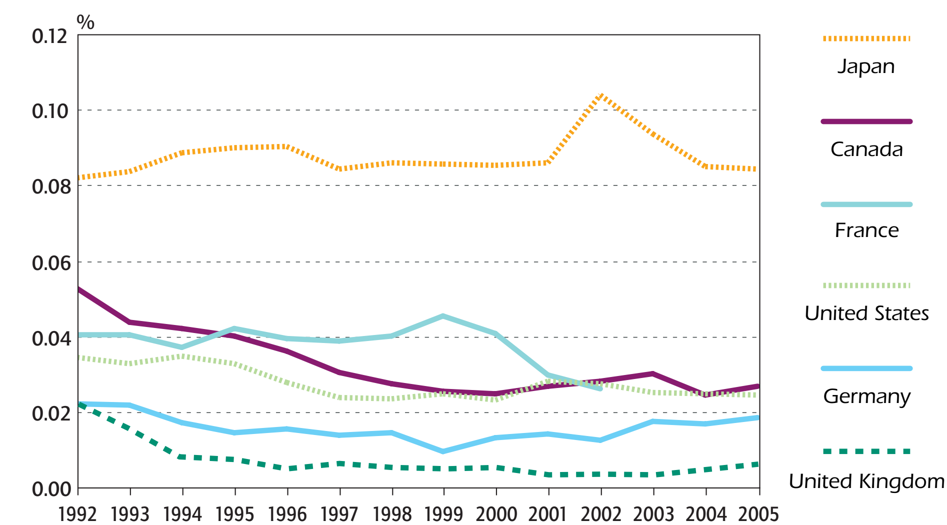
Government Energy R&D Budgets in IEA Countries by Region and Total



Note: excluding the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.
Source: Country submissions.

Figure 24

Nominal R&D Budget as a Percentage of Nominal GDP in Selected IEA Countries



Note: data not available for France from 2003 to 2005.
Source: Country submissions.

maintained a relatively high level, whereas the R&D budget relative to GDP has declined in the US, Canada and particularly in several European countries. In Japan, energy R&D was 0.08% of GDP in 2005, but in most other IEA countries it was below 0.03%. Several IEA countries have signed up to the Barcelona Convention with the aim of increasing total public and private research and development budgets to 3% of GDP.

GOVERNMENT EXPENDITURES ON INDIVIDUAL TECHNOLOGIES

Nuclear technologies still remain at the core of public R&D spending in some of the largest IEA member countries – see Figure 25. But between 1992 and 2005, the relative share of nuclear technologies decreased from 52.5% to 40.5%. Government support for both fusion and fission has decreased, and fission R&D has shifted focus from light-water and other reactors to nuclear supporting technology and fuel cycle research.

Government expenditure for fossil fuel research experienced the largest drop in share – from 13.2% in 1992 to 10.5% in 2005. Fossil fuel research has recovered slightly from a share of only 7.6% in 1999. In percentage terms, research expenditures on oil and gas did not suffer a visible reduction, while the brunt of the reduction fell on coal research, in particular expenditures related to coal and lignite exploration and production techniques. Although this reduction may be related to the decline in coal production in industrial countries, the use of coal for electricity generation is expected to increase in both developed and developing countries. Therefore, research activities on coal combustion (in particular, high-efficiency technologies for power generation), on carbon capture and storage, and on efficient conversion remain important.

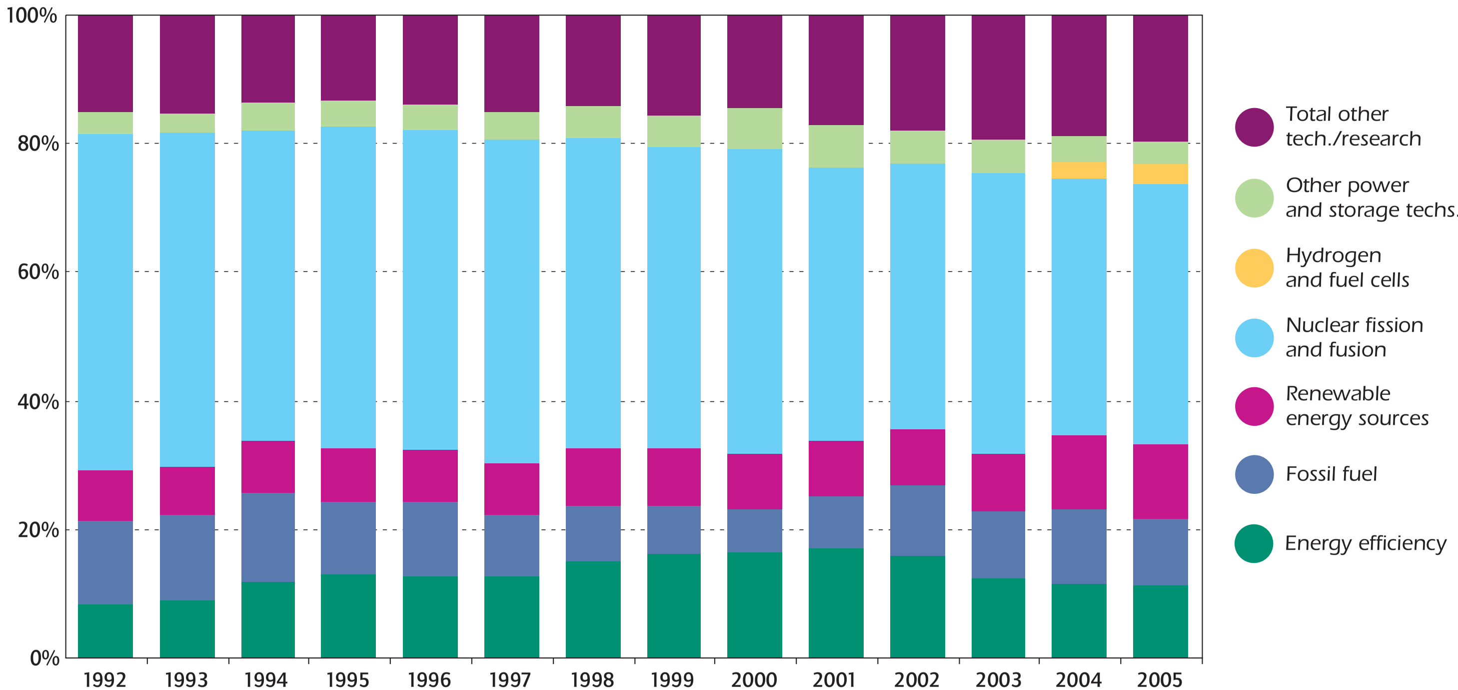
The share of renewable energy in government R&D budgets of IEA countries grew slightly from 7.6% in 1992 to 11.6% in 2005. Favoured options in the allocation of funds were solar heating and cooling, photovoltaic, biomass and wind. Energy efficiency received more government support in 2005 than in 1992, with its share increasing from 8.2% to 11.5% of the total R&D budget. Public resources for power and storage technologies increased from 3.3 % in 1992 to 3.6% in 2005, and expenditure on other technologies and research areas grew from 15.2% in 1992 to 19.7% in 2005.

PRIVATE-SECTOR R&D

It is increasingly important to involve the private sector in R&D activities to facilitate the process of technology development. For countries where public R&D budgets are limited, co-operation with private-sector partners could be

Figure 25

Government Energy R&D Budgets in IEA Countries: Technology Shares



Sources: Country submissions and IEA Secretariat estimates.

an effective option. On the other hand, it is also a challenging task to clarify the respective roles of government and industry to facilitate the efficient deployment of new technologies. Furthermore, with market liberalisation where private-sector R&D becomes more focused on short-term and applied research, governments also need to redefine their roles and improve their policy measures to stimulate private initiatives more effectively.

The private sector may be replacing the decreased involvement of government, but this is difficult to confirm. Very little information is available on private industry R&D budgets for energy technologies. There is evidence that, following the process of market liberalisation, many electric utilities have reduced their involvement in R&D. Research in the energy-system manufacturing industries, on the other hand, may still be important, but only in the most visionary cases does it look beyond a short-term horizon. In fact, as industry has increasingly focused on shorter-term R&D, government collaboration with industry has had the effect of shifting some government funding away from longer-term R&D, focusing funds on the stage immediately before commercialisation.

Some member governments have encouraged private R&D spending through increased use of fiscal incentives (tax breaks, etc.), but these measures are not likely to induce a major shift in industry towards longer-term research. Although government energy R&D budgets have recently increased in the United States – and to a lesser extent in Europe – there remains a concern that insufficient resources have been allocated for medium- and long-term options to meet energy policy objectives, including global climate change mitigation. Some IEA consultative bodies have been suggesting that IEA governments should find a more balanced R&D budget mix that focuses on the longer-term policy objective of sustainable development.

ENERGY POLICIES IN KEY NON-MEMBER COUNTRIES

CHINA

China was active in a wide range of energy policy areas from 2005 to early 2006. The electricity shortages that began in 2003 and which led to a massive spurt of growth in generating capacity, raising demand (and prices) for coal, but also pushing oil demand to unexpectedly high levels in 2004, helped spur activity on both the supply and the demand sides. Work on a comprehensive energy law was launched, as were efforts to draft or revise laws on oil and natural gas, coal, and energy efficiency, and a new law on renewable energy came into force. The 11th Five-Year Plan (FYP), announced in March 2006, which is intended to guide socioeconomic policy from 2006 to 2010, featured an ambitious goal of reducing the country's energy intensity (energy consumed per unit of GDP) by 20% in 2010 compared to 2005. In addition to the emphasis on energy efficiency, the major objectives targeting energy policy in the FYP are: improvement of the ways in which coal is used (even as it remains the dominant fuel); diversification of energy sources to include *inter alia* more renewables, natural gas, nuclear, coal-bed methane; "optimisation" of energy supply (*e.g.* by promoting improved extraction and generation technologies, limiting the adverse impacts of hydroelectric projects, closing down small, dangerous coal mines and inefficient power plants, etc.); and the development of a secure and economic energy system. The drafting of energy legislation and specification of programmes to achieve the targets set by the 11th Five-Year Plan are proceeding in tandem.

The regulatory landscape continued to evolve, with the creation of a cabinet-level National Energy Leading Group, and a permanently staffed office to carry out its day-to-day duties. The Energy Bureau under the National Development and Reform Commission (NDRC), the country's leading executive agency, began to expand its staff. Within the Energy Bureau, the National Oil Reserve Office took a leading role in co-ordinating the creation of a national strategic oil reserve, a process that continues. Responsibility for key aspects of energy policy – efficiency, renewables, prices, and taxes – remained under the control of other NDRC departments and other government agencies. The relatively new State Electricity Regulatory Commission took steps towards becoming an independent regulator, for instance, overseeing the creation of pilot wholesale electricity markets in three regions.

ENERGY SECURITY

China's moves to secure its oil supplies have included encouraging its national oil companies to acquire overseas resources and to establish a strategic reserve. The latter appears to be a loosely co-ordinated set of diplomatic agreements bracketing commercial activities, supported in some cases by aid and construction programmes to target countries. Talks with Saudi Arabia have concerned, among other things, joint investment in a strategic reserve on Chinese soil as well as supplies of oil to fill a strategic reserve, but few details are available. China began releasing a USD 3 billion loan to Angola, its largest foreign oil supplier. In 2006, President Hu Jintao, Prime Minister Wen Jiabao, and Foreign Minister Li Zhaoxing each visited sub-Saharan Africa. The government has also supported activity in Central Asia and Russia, including PetroChina/CNPC's acquisition of PetroKazakhstan in 2005, construction of oil and gas pipelines from Kazakhstan to China, and Sinopec's purchase of an interest in Russia's Udmurtneft, an oil-producing subsidiary of TNK BP.

Establishment of a strategic reserve, on the other hand, has involved creating new organisations and writing new rules and regulations. The National Development and Reform Commission (NDRC) houses within its Energy Bureau the National Oil Reserve Office (NORO), which was set up in 2003, when China began planning the four strategic petroleum reserve sites now under construction (Zhenhai, to be completed in August 2006, Zhoushan in Zhejiang, Dalian in Liaoning, and Huangdao in Shandong). A variety of sites are being considered for the second phase of construction of SPR sites. Meanwhile, NORO is now overseeing the creation of a National Oil Reserve Centre (NORC), which will be responsible for managing strategic reserves. Determination of NORC duties and its relation to other organisations (including national oil companies), selection of staff, and writing of rules for ordinary operations and emergency response, and other preparations are under way. Meanwhile, the government is studying the experiences of other countries to inform its deliberations. An emergency workshop will be held in China in late 2006, and Chinese statisticians have undergone training at the IEA.

Substitutes for oil from biomass and coal have received growing policy and programmatic support from the central and some local governments. Ethanol from corn, wheat, potatoes and sugar cane is already blended into gasoline in several provinces, and more is expected. Plans for producing substantial amounts of biodiesel have been put forward. Coal-to-liquids projects in coal-producing regions and in Shanghai have received government policy and financial support to move forward, though most projects have been moving slowly.

ENERGY MARKETS

China remains loyal to its gradual approach to liberalising energy markets. Prices for and trade in oil products remain tightly controlled, even as price-setting mechanisms have been made somewhat more responsive to market conditions. Oil prices increased once in 2005 and, in May 2006, another rise in domestic oil product prices was permitted, but they still remain below international levels.

By keeping product prices low while crude oil prices are high, the government effectively requires state-owned refiners, which fulfil about 90% of demand, to subsidise consumers and mitigate the impacts of higher fuel and feedstock costs. There are some direct subsidies to consumers. Starting in early 2006, some local governments began granting small fuel subsidies to poor residents, financed in part by an 8.5 billion yuan (UDS 1 billion) fund from the central government. The central government also grants occasional lump-sum payments to refiners to offset their forced losses, and in late 2005, it gave Sinopec, the country's largest refiner, 10 billion yuan (about USD 1.2 billion). China National Petroleum Company/PetroChina, China's largest oil company and one with a much larger share of its business in upstream oil – which remains profitable – received no such subsidy. In fact, the upstream oil business has been subjected to a new windfall profits tax. In March 2006, a "petroleum special profits tax" was imposed on all domestic and foreign-invested enterprises that extract crude oil from Chinese territory. The tax rate is progressive according to the domestic market price of crude oil, starting at 2.2% when the price of domestically produced crude oil exceeds USD 46 per barrel, and reaching a maximum of 9.2% when oil is USD 60 or higher per barrel.

Controls on coal prices were lifted long before electricity prices began to rise, and recent imbalances in coal supply and demand have led to rising coal prices, squeezing generators that have had only intermittent success in pressuring the government to raise wholesale and retail power prices. Tariff increases were allowed in May 2005, mainly to allow generators to pass the increased fuel costs on to consumers. Difficulties in reaching agreement on fuel prices between coal suppliers and utilities (many of which are now investing heavily in coal production) spurred the government in January 2006 to threaten penalties against any party found to be recalcitrant in signing contracts. In June 2006, retail and wholesale electricity prices were again allowed to rise. This time, surcharges to feed-in tariffs applicable to various types of generators were included to provide incentives for hydropower and other renewable energy projects, as well as installation of desulphurisation equipment. This is an important, though small step towards incorporating all financial and environmental costs in power prices, sending signals to investors to finance cleaner power plants, and to consumers to use electricity more wisely.

Experiments with power markets were begun in three regions, under which a portion of wholesale transactions between generators and the grid were opened up to bidding. Transactions between generators and consumers have yet to be tried, in part because grid pricing remains rolled up in overall power prices, even though reforms of the past several years have gone most of the way towards separating generation from transmission and distribution. Further moves towards competitive markets await the strengthening of a number of institutions like the State Electricity Regulatory Commission, and the constitution of transmission system operators that can handle sophisticated power market transactions. Other needed developments include an update to the Electricity Law (now under way), and strengthening of strategic planning methods so that demand-side resources are considered along with supply. The IEA Study *China's Power Sector Reforms: Where to next?*, published in 2006, outlined the main challenges and potential solutions to the power sector in China.

ENERGY EFFICIENCY

As mentioned above, the 11th Five-Year Plan has a strong theme of conservation of resources, including energy. The elements that appear in the FYP are mostly reiterations of directives and programmes that have appeared before; most of the specific initiatives derive from the 2005 Ten Energy Conservation Priority Projects, which in turn were selected from among the items in the 2004 Medium- and Long-Term Energy Conservation Plan. These include:

- Upgrading coal-burning industrial boilers and kilns.
- Promoting co-generation for district heating.
- Utilising waste heat and pressure.
- Conserving oil and using substitutes (biofuels, liquids from coal).
- Improving efficiency of electric motors systems.
- "rationalising" the structure of the energy system.
- Improving energy use in buildings, *e.g.* through enforcement of building energy codes.
- Promoting efficient lighting.
- Establishing programmes to conserve energy in government departments.
- Strengthening the energy monitoring and technical service system.

There are, however, some other new initiatives, *e.g.* the Top 1 000 Enterprises Energy Conservation Action Plan (Top 1 000 programme), led by NDRC. Conceptual and practical elements of policies and programmes that have been used in China and elsewhere have been adapted and combined to create a programme to promote greater efficiency in the largest industrial and energy facilities, together accounting for nearly one-third of the country's energy use (excluding biomass). Details of implementation are still being worked out, but it appears that each enterprise will have its energy use monitored, and it will agree to a plan to improve energy efficiency with quantitative targets. Positive incentive policies will be offered to encourage enterprises to meet and exceed their targets, but negative incentives, other than publicity for failure to reach targets, seem to be lacking. Considerable interagency co-ordination will be involved in this effort. The main responsibility for implementation will lie at the provincial and municipal levels. Some local governments have already announced programmes that widen the scope to include many more enterprises than the national programme.

While industry will remain the largest energy user for some time to come, the fast-growing buildings and transport sectors are receiving attention. In late 2005, for instance, the State Council announced the "Notice on Encouraging the Development of Energy – Saving and Environment – Friendly Small-Engine Vehicles". In this notice, the State Council asked governments at different levels to formulate industrial policies and consumption policies encouraging the development and use of small-engine vehicles. Other areas of activity include energy standards and labels for household appliances, lighting equipment and office equipment, as well as developing implementation guidelines to help construction firms to comply with buildings energy codes. The government continues to support public awareness campaigns, including an annual "Energy Conservation Week", marked by public events for television and other media, exhibitions, and workshops. The existing Energy Conservation Law, which has had little impact since its promulgation in 1998, is currently being reviewed, and its revisions would presumably help to support this programme and the others mentioned above.

While technical improvements in efficiency will help towards the 20% energy-intensity reduction target, policy statements clearly indicate that China will rely on changes to the structure of the energy system – towards fuels that are more efficient in end uses, like natural gas – and, more importantly, on structural change in the economy. Both of these change only slowly, however, and have proven resistant to past government initiatives.

RENEWABLE ENERGY

China's new Renewable Energy Law went into effect in January 2006. Like all laws in China, however, its impact will depend on the specific provisions of the implementing regulations now under consideration and on how assiduously they are applied. Wind power developers, for instance, are disappointed that the law does not stipulate that regional grids be required to pay feed-in tariffs that would make wind-generated electricity competitive with the country's ubiquitous and often very cheap coal-fired power.

ENERGY R&D

Policies on structural reforms in the energy industry were indicated in the Interim Regulation and the *Guiding Catalogue for Adjustment of Industrial*

Structure, released at the end of December 2005. The Interim Regulation has classified a variety of industries into three categories of "encouraged", "restricted", and "to-be-eliminated". Regarding the energy industry, these categories have 47, 6 and 18 items depicted, respectively. Among the "encouraged" are exploration and development of natural gas hydrates, construction of supercritical and ultra-supercritical power plants with a single unit output of at least 600 000 kW. On the other hand, policies include "restrictions" on mining business with coal mines failing to reach the established standards in size, and on ordinary coal-fired thermal power plants with a single unit output of 300 000 kW or less (except for those in small-scale power grids in Tibet and other areas). The "to-be-eliminated" category includes oil refineries with annual production capacity of 1 million tonnes or less, among others. The Interim Regulation and the *Guiding Catalogue* may be used as a reference for studying future investment plans, project approvals and taxation systems.

INDIA

Energy security remains central to India's public policy debate. In his Independence Day Address on 15 August 2005, India's President set 2020 as the target year for achieving energy security and 2030 for energy independence. President Kalam argued that the "strategic goals for energy independence by 2030 would call for a shift in the structure of energy sources". Specifically, he highlighted the need to minimise fossil fuel imports and secure access to them; to maximise the hydro and nuclear potential and, most importantly, to increase power generation from renewable energy technologies to 25% against 5% in 2005. Attaining energy independence would require a major shift from fossil fuels to renewable energy sources. In a second speech delivered in April 2006, India's President outlined his vision towards meeting this strategic goal. Recent Indian energy policy developments therefore have to be considered within this context.

ENERGY POLICY

India's long-awaited draft Integrated Energy Policy was released by the Planning Commission in December 2005. The draft policy document stresses the need to promote competitive and transparent energy markets and to have independent regulation for areas where market forces alone cannot deliver the policy objectives. The importance of establishing relative pricing to allow for efficient choice across fuels is also recognised. The draft policy places great emphasis on energy efficiency and demand-side management and identifies a 25% potential for improvement in energy intensity. However, these potentials will not be realised in the absence of adequate policies and implementation measures. It is also unclear to what extent strong and consistent energy efficiency policies can be implemented under the current supply-oriented and diverse ministerial structure for energy policies.

While recognising the practical problems resulting from the current administrative set-up of India's energy sector, the draft policy falls short of forcefully promoting a comprehensive reorganisation. India's energy policy is currently established under a complicated multi-ministerial structure. The continuation of this multi-layer structure calls into question the status and authority the integrated energy policy will eventually have in setting a unified energy policy. The draft policy advocates the creation of an "Apex Body on Energy" under the chairmanship of the Prime Minister; however, it does not clearly define responsibilities and authorities of the Apex Body in implementing the integrated policy.

Such an Apex Body does already exist today in the form of the "Energy Co-ordination Committee" (ECC) created by the Prime Minister in 2005 to guide the country's energy policy. The ECC has since evolved into a regular body. It takes a systematic and co-ordinated approach to policy formulation and decision-making in the area of energy planning and security, covering energy-related issues across the coal, power, petroleum and natural gas sectors. Since its inception, the EEC has held regular meetings and has discussed various policy issues, including price increases for petroleum products and natural gas; LNG supplies and fuel supplies for power plants.

The Indian government reaffirmed its commitment to the creation of strategic oil stocks in early 2006. In order to speed up construction of the storage facilities, the Indian Strategic Petroleum Reserves Limited (ISPRL) was made a subsidiary of the Oil Industry Development Board. The draft integrated energy policy includes a recommendation that India should aim to extend its strategic oil reserve beyond the level already approved by the government.

Under the 5th round of the New Exploration Licensing Policy (NELP V) in 2005, 20 blocks were offered and 18 blocks awarded. The road show for NELP VI was launched in early 2006, indicating that India is now more aggressively pursuing exploration of its hydrocarbon potential in response to energy-security concerns. This approach is also shored up by the 21 oil and gas discoveries made during 2005 – over half of which were by private companies and/or joint ventures. At the same time, Indian public companies continued their overseas expansion into the upstream oil and gas sector and acquired acreages and/or participating interests in 23 blocks in seven countries.

Limited progress has been made with the three regional gas pipeline projects that India officially announced in early 2005. Progress on the Iran-Pakistan-India pipeline is halted by outstanding agreements on the pricing of gas and the appropriate project structure. The Myanmar-Bangladesh-India pipeline is now likely to circumvent Bangladesh and is supposed to connect directly from

Myanmar into India's north-eastern states. In May 2006, India officially joined the Turkmenistan-Afghanistan-Pakistan (TAP) pipeline project, though questions of quantity and price of gas delivery remain to be negotiated.

ELECTRICITY

Implementation of the Electricity Act 2003 continues, and several legislative and policy initiatives were undertaken. The National Tariff Policy was notified in February 2006 and addresses, among others, two key issues in relation to power sector reforms. The first is the formula for calculating a cross-subsidy surcharge to compensate for the introduction of open access in distribution by 2008 for large industrial consumers. The tariff policy sets out a uniform formula to be applied by all state electricity regulatory commissions for calculation of the open access surcharge. However, the regulators expressed the view that one formula does not sufficiently reflect the different conditions in each state and requested the policy to be amended accordingly. The Ministry of Power has signalled its agreement to consider amending the policy to include a provision that would let the state electricity regulatory commissions set the surcharge in their respective states.

The second issue relates to the mandatory tariff-based competitive bidding for power purchases from private generators by distribution licensees and public distribution companies. Government-owned generation companies, at central and state level, will be exempted from this provision for five years. In effect, private generators will thus be disadvantaged in comparison to public generators, and this might impact negatively on attracting private investment in generation. This provision of the national tariff policy is rather contentious, and the Ministry of Power has already clarified that those private investors with cleared power purchase agreements or who applied to the regulatory commissions before the policy became effective will not be affected by the new provision.

The government reviewed the Electricity Act 2003 and proposed an Electricity Act (Amendment) Bill that would, among others, eliminate the reference to "abolish cross-subsidies" as this is not envisaged by the government in the foreseeable future. However, reduction of cross-subsidies remains a policy objective of the government. The rural electrification policy was finalised in March 2006 upon extensive consultations, but details of the policy are not available.

In spring 2005, the government launched the Rajiv Gandhi Grameen Vidhyutikaran Yojana scheme. The aim of the scheme is to provide electricity to all villages and habitations within four years and to provide access to electricity to all rural households. According to the Ministry of Power, almost 120 000 villages were un-electrified as of December 2005, out of a total of about 480 000 villages. In terms of households, only about 44% of all rural households on a country-wide basis have access to electricity.

OIL AND GAS

The Petroleum and Natural Gas Regulatory Bill was approved in early 2006. The act foresees the creation of a downstream regulatory authority for petroleum and natural gas that will promote competition and provide for access to pipelines on a non-discriminatory basis. However, pricing of petroleum and natural gas is excluded from the act and will remain under government control.

The government is also in the process of finalising the Gas Pipeline Policy intended to facilitate growth of the natural gas sector and in particular to promote investment in and expansion of the pipeline infrastructure with a view to the eventual creation of a nationwide gas grid. The policy further intends to encourage public and private investments and to protect consumer interests. A central feature of the draft pipeline policy is the common carrier proposal for third parties on open access and non-discriminatory basis and progressive unbundling of transmission and marketing activities.

Natural gas produced by public-sector companies is sold under the "administered pricing system" (APM) and retail prices had been kept unchanged since 1998. In 2005, the government raised prices and limited the provision of APM gas to the public power and fertiliser sectors. This move became necessary as the production of APM gas is in constant decline while demand is increasing. On the other hand, the gas production of private companies and joint ventures is continuously increasing. Non-APM gas is sold at market-based prices, which nevertheless also need approval from the government. Prices of non-APM gas were also increased, thus the dual pricing structure of domestic Indian gas remained. The government has not yet spelled out a clear gas-pricing policy, and the continuation of the dualistic gas-pricing system can possibly impact negatively on developing the gas potential in India.

On the petroleum side, prices of the four major products (kerosene, LPG, diesel and petrol) are also controlled by the government and are held below cost of supply. Retail prices for LPG and kerosene have not been adjusted since November 2004 and June 2002 respectively, while prices for diesel and petrol were increased in September 2005 and in June 2006. The differential between retail price and actual cost is being carried primarily by the public-sector oil and natural gas companies, which are consequently suffering losses. As a result, India's largest upstream company, ONGC, which is required to carry a share of the so-called "under recovery", has announced a downward revision of its planned overseas investments in upstream oil and gas. In 2005, the government set up a committee to advise a new regime of petroleum product pricing. One of the recommendations made in its report, shifting pricing of petroleum products from import parity pricing to trade parity, was adopted by the government. In effect, this shifts part of the burden of controlled retail prices from downstream to upstream and refining companies. The report also proposes changes to the tax structure of petroleum products which have been partially adopted by the government; various taxes and duties account for up to almost 50% of retail prices. However, the suggestions made in the report are not far-reaching enough to address the overall problem of petroleum product taxation and pricing, and would leave the public oil companies with substantial financial responsibilities for the government's economic policy.

India's National Auto Fuel Policy was announced in 2003 and is being gradually implemented according to the road map spelled out in the policy document. Sale of Euro III standard equivalent fuels in India's largest cities commenced in April 2005, while the rest of the country is being supplied with Euro II standard equivalent fuels as of October 2005. The policy foresees the introduction of Euro IV standards in India's eleven largest cities by 2010.

ENERGY EFFICIENCY

The potential benefits of energy efficiency programmes are increasingly recognised by the government. The draft Integrated Energy Policy identifies a 25% potential for improvements in energy intensity. The National Energy Labelling Programme for electrical items was launched in May 2006. Under the programme, six electrical appliances have been selected and labelling will be launched successively for those. Labels will become mandatory within six months of the launch of labelling for each appliance. The programme will start with frost-free refrigerators and fluorescent lights and will be expanded within one year to include direct cool refrigerators, air-conditioners, electric motors and ceiling fans.

India's construction industry is booming and consequently the energy efficiency of buildings is another priority area for the government. Several of India's states that are witnessing substantial construction activity have launched initiatives in this area, and several think-tanks and industry representations have also started to expand their activities on buildings efficiency A draft building code was issued by the Bureau of Energy Efficiency in December 2005.

The Bureau of Energy Efficiency is also pursuing a programme to promote energy efficiency in 15 key industrial sectors. The key sectors were prioritised on the basis of their current energy consumption and savings potential. BEE's chosen approach for improving energy conservation in the industrial sector is to combine various policy measures with voluntary efforts. Eventually, specific energy consumption norms for the key industrial sectors will be developed.

NON-CONVENTIONAL ENERGY SOURCES

The government prepared a second draft of the New and Renewable Energy Policy Statement in 2005, providing a strategic vision up to 2100 for new and renewable energy sources in India. The draft policy statement identified key development areas on which activities should be focused, including alternative fuels for transport and power; electric hybrid vehicles; energy recovery from waste; hydrogen, biomass and wind and solar power. The government has high hopes for hydrogen technology and has set up a National Hydrogen Energy Board tasked with the development and implementation of a hydrogen energy road-map. For the necessary R&D activities, the policy statement promotes domestic public-private partnership. International co-operation would be pursued on a case-by-case basis if deemed beneficial.

Because of the lack of raw material, the government had to suspend its ambitious mandatory biofuel policy in 2004. However, the policy was re-launched in 2006 with the aim of a country-wide 10% mix by 2009. The total volume required to be purchased in 2006 is about 400 million litres and contracts have already been finalised for almost 250 million litres. Effective as from 1 January 2006, a mandatory national biodiesel purchase policy was launched with a fixed price per litre. To ensure nationwide quality standards, twenty outlets were officially designated as purchase centres, and priority is given to those producers who use non-edible tree-grown oil as feedstock. India's biofuels policy is aimed at combining the need to diversify energy sources with the promotion of rural development and employment creation.

SOUTH-EAST ASIA

Although a region of almost 600 million people, the emerging economies of South-East Asia have a strong export trade focus and their growth is impacted by external factors. However, while growth in the US and European markets in 2006 has slowed, and oil prices have continued at a sustained high level, growth in the Japanese and Chinese economies has been strong and has helped to mitigate these downward effects.

In 2004, GDP growth in the Association of South-East Asian Nations (ASEAN) averaged 6.3% and, in 2005, slowed somewhat to 5.5%. However, in 2006, the Asian Development Bank (ADB) forecasts that the external economic environment will be largely supportive of the ASEAN economies and their GDP is expected to continue at 5.5%. This can be contrasted with the ASEAN average of 4.8% per annum since 1999.

The impact of high oil prices is being largely felt by the major oil import-dependent ASEAN economies of Singapore, Thailand and the Philippines, and, more recently, by Indonesia and Malaysia. Indonesia became a net oil importer in 2004, and both Indonesia and Malaysia have had large retail petroleum subsidies.

The sustained oil price increase is having a further impact on economic growth of the ASEAN economies. These are heavily dependent on foreign and domestic investment to finance their development, and interest rate rises brought about by authorities to limit oil price-driven inflation could have an impact on the capital flows that are necessary to drive this development.

The smooth leadership transition in Malaysia and the smooth elections in the region's major economy, Indonesia, in 2004, plus the ongoing more settled government of Indonesia over 2005-2006, has encouraged greater investor confidence. Additionally, ASEAN economies continue their development towards more open economies with progress in several Free Trade Agreements and the region's evolution towards the ASEAN single Economic Community (ASC) by 2020. The ASC envisions a Euro-style integration with a freer flow of goods, services, capital, and investment. Discussions have started to bring forward the implementation of the ASC to 2015.

The IEA is also involved in the ASEAN energy policy discussions. Mr. Mandil participated in the ASEAN summit of 2006, and an in-depth review of Indonesian energy policies by the IEA is currently planned for 2007.

THE IMPACT OF SUSTAINED HIGH OIL PRICES

As a relatively less energy-efficient region that is quickly becoming a net oil-importing region, ASEAN countries are vulnerable to sustained high oil prices. With their fast-increasing energy demand and their burgeoning transport sectors, the sustained high oil price has forced ASEAN countries to confront their vulnerability and the need for reform, particularly in relation to petroleum fuel subsidies and petroleum price controls.

With a jump of more than 50% in the global price of crude in 2005, stresses began to show: regional inflation crept up, the Indonesian rupiah declined by 10%, fuel subsidies cast a major fiscal shadow, and fuel price controls caused major losses for some state-owned companies. Additionally, the petroleum subsidies of various ASEAN economies placed a heavy financial burden on national governments and diverted public funds away from more targeted spending.

Countries adjusted by

- Cutting fuel subsidies.
- Malaysia recently instituted a managed float of the ringgit (previously pegged to the US dollar since the Asian "financial crisis").
- Dropping price controls.
- Allowing increased private-sector competition in oil markets.
- Focusing on development of urban transport, alternative fuels and fuel extenders, and energy efficiency policies and programmes.

Attempting to institute such reforms is not new for South-East Asia. But winding back subsidies and state monopolies, dropping price controls, and imposing additional taxes are politically charged and difficult. In Indonesia, moves on fuel subsidies contributed partly to the downfall of President Suharto in 1998. However, although a double-edged sword, the current sustained high oil price has provided a much-needed political impetus to bring about policy reform, particularly of the budget impacting retail fuel subsidies.

For Indonesia, the focus has been on reforming its petroleum subsidies and its oil and gas upstream investment regime. For example, in October 2005, President Yudhoyono instituted an average 125% increase in the retail prices of gasoline, diesel, kerosene and LPG. He also passed responsibility for future retail price increases (to an international par) to a selected committee of ministers, thereby taking some of the political "steam" out of winding back the subsidies.

For Malaysia, the Philippines and Thailand, the primary focus has been on reforming their petroleum subsidies, but with a strong push to establish a biofuel petroleum-extender industry. In Thailand and the Philippines, the focus is on ethanol as a gasoline extender and Malaysia's focus is on palm oil as a diesel fuel extender.

Singapore's lack of overt policy response to the high oil prices does not indicate an energy sector that is immune to movement in international prices. Singapore's energy sector has achieved maturity with sufficient deregulation, adequate information flows, sector skills, and flow of financial signals not to require a major "hands-on" policy response from government. For Singapore, it is time to review frameworks to find cheaper and more efficient fuel alternatives that encourage consumers' more efficient use of energy on the one hand, and investment on the other.

Governments throughout ASEAN have been urgently pursuing a range of national voluntary and compulsory energy-saving measures, but these appear to have had considerably less impact when compared with the vast amounts being spent on supporting petroleum subsidies.

In late 2005 and early 2006, as global price increases and governments' efficiency and conservation measures began to flow more strongly through to ASEAN consumers, there has been an impact on consumption levels.

RECENT ENERGY POLICY DEVELOPMENTS

To address region-wide energy issues, the ASEAN Senior Officials Meeting on Energy (SOME) and the ASEAN Ministers of Energy Meeting (AMEM) are held annually to review progress of policy and programmes in place and to provide direction for future regional policy and programmes.

Energy Security

Recognising its fast-increasing dependence on oil imports, the ASEAN countries have been revising a mechanism known as the ASEAN Petroleum Security Agreement (APSA) for regional consultation and co-ordination during a petroleum supply shortage and emergency. However, the APSA and its annexed Coordinated Emergency Response Mechanism (CERM) have been under active revision since 2002 and remain to be agreed.

Under the auspices of the ASEAN Centre for Energy (ACE) and with the assistance of the government of Japan, ACE has installed an Energy Security Communication System supporting information and oil data dissemination to assist ASEAN countries in analysing and co-ordinating oil security issues.

Trans-ASEAN Energy Network

To address issues of longer-term security, energy mix and source diversification, sectoral efficiency, and environmental sustainability, ASEAN policy makers emphasise policy and infrastructure aimed at enhancing market reform and cross-border energy trade. This is known as the Trans-ASEAN Energy Network, made up of the ASEAN Power Grid (APG) and the Trans-ASEAN Gas Pipeline (TAGP).

The TAGP project continues its development, most recently in 2005, with natural gas flowing via two new fields from an offshore Malaysia-Thailand joint development area into Thailand and Malaysia. Three additional projects, in the Philippines and Indonesia, have also been identified.

The ASCOPE Gas Centre (AGC), Kuala Lumpur, continues its implementation of a number of regional initiatives focusing on maritime pipeline transportation, technical standardisation, harmonisation, and cross-border and transit issues.

The APG project continues the development of five cross-border electricity interconnection projects between ASEAN countries. The Council of the Heads of ASEAN Power Utilities and Authorities (HAPUA) has initiated the formulation of a common ASEAN policy and framework for cross-border electricity interconnection and trade.

Coal

This is an area that has had limited regional attention. The ASEAN Forum on Coal has determined key policy strategies for analysis over the next three years, including clean coal technologies, promoting privat-sector investment, promoting intra-ASEAN coal trade, and environmental assessment of coal projects.

Energy Efficiency and Conservation

While governments throughout ASEAN have been urgently pursuing a range of national voluntary and compulsory energy-saving measures, ASEAN regional co-operation continues the implementation of various projects, including the ASEAN energy benchmarking system for buildings and an ASEAN Standards and Labelling System. The ASEAN Energy Management Accreditation System (AEMAS) has been established by the ASEAN Centre for Energy (ACE).

Renewable Energy

ASEAN countries, as emerging economies with a high renewable energy (RE) potential, continue to pursue a greater share of RE in the power generation mix. High oil prices, fast-growing oil import dependence, and the strong impact on transport fuels are giving added impetus to RE substitution for stationary applications and the development of biofuel extenders and substitutes for the transport sector. Thailand, Malaysia, the Philippines, and, more recently, Indonesia, are taking the lead in biofuels, with tax and financial incentives focusing on RE and rural development.

Regional Energy Policy and Planning

ASEAN countries, under ACE's Energy Supply Security Planning programme, are focusing on country data and information collection and dissemination as an aid to enhanced transparency and co-ordination. These data and information include energy databases on prices, energy outlook development, statistics publication, and capacity building.

LATIN AMERICA

Latin America faces a year of momentous change as presidential elections will have taken place in thirteen countries between November 2005 and the end of 2006. Except for Honduras, all recent elections have given way to leftleaning governments (Chile, Bolivia, Haiti, Costa Rica, and Peru), ranging from strong anti-private-sector positions to more moderate trends. The remaining major elections: Mexico (July 2006), Brazil (October 2006) and Venezuela (November/December 2006) will be decisive in shaping the overall political balance of the region. Importantly, the results of these elections have already influenced and will continue to dramatically influence the direction of Latin American countries' energy policies.

In addition, several ambitious regional integration projects have been proposed across South America, such as the great pipeline of the south, which would reach from Caracas, Venezuela, to Buenos Aires, Argentina, via Brazil, with links to Bolivia, Paraguay and Uruguay, stretching for a total of 8 000 km for an estimated cost of USD 20 billion. Such regional integration projects with questionable economic rationale highlight growing concerns about energy security and some governments' regional ambitions.

BOLIVIA

Bolivia's reserves of natural gas are the largest in South America after Venezuela's. Large deposits were discovered in the 1990s after the oil industry was re-privatised. Foreign companies, including Petrobras, Total, BP, BG and Repsol invested an estimated USD 4 billion to develop these reserves, notably by developing the Bolivia-Brazil gas pipeline (Gasbol) for a total cost of USD 2.1 billion.

On 1 May 2006, Bolivian troops seized gas fields and installations after the Bolivian government promulgated the so-called "hydrocarbon nationalisation" under Supreme Decree No. 28701. This decree transferred the ownership of oil and gas resources and the control of Chaco, Andina, Transrede, Compañia de Logistica de Hidrocarburos Boliviana, and Petrobras – the Brazilian state oil and gas company – to the Bolivian state-owned oil company Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) and imposed a government take of up to 82% on oil and gas production in the major fields of the country. Beyond the expansion of the terms set by the new hydrocarbon law in May 2005, this decision by the Bolivian government marks a clear departure from the negotiation process that was being developed with Brazil and Argentina to establish new prices for natural gas exports as well as the possibility of further investment by private companies operating in Bolivia.

The Supreme Decree which is currently on hold would negatively affect the countries and companies on which Bolivia depends to expand its export market, which is vital to its economy as hydrocarbons (including gas and natural gas liquids) represent 38% of the country's total export income. Some analysts link Bolivia's nationalisation move to Venezuela's promotion of resource nationalism. In the short term, current players' negotiation period will delay investment decisions and most likely put a hold on investment (except from Venezuela) for several years.

BRAZIL

Brazil is currently the 10th-greatest energy-consuming country, accounting for about 2.1% of the world's annual total energy consumption and the fourth-largest non-IEA energy consumer after China, India and Russia.[23] Brazil's proven oil reserves are estimated (as of January 2006) at about 13 billion barrels, second-largest in South America (after Venezuela). The *World Energy Outlook 2006* is devoting a special chapter to Brazil, in recognition of the importance of the country.

On 21 April 2006, President Lula claimed the country's self-sufficiency in oil. A near-doubling in Brazilian crude supply since the late 1990s has largely been achieved by the national oil company Petrobras. According to Petrobras, the symbolic start of commercial operations at the 180 000 b/d P-50 platform at the Albacore Este field in the deep-water Campos basin on 21 April will enable the company, which accounts for over 90% of Brazil's oil output, to produce 1.9 mb/d of crude oil this year. Total crude production reached 2.09 mb/d in May 2006.[24] Crude supply will continue to grow in 2006 as five offshore developments in the Campos, Sergipe and Espirito Santo basins are brought into production.

Self-sufficiency will help to protect Brazil from international energy crises and contribute to managing excessive volatility in the world commodity market. However, although it will produce the same volume of oil as it consumes, Brazil will still depend on light oil imports because the country's refining profile is unable to process all of the domestically produced heavy oil. Reaching the milestone of net self-sufficiency in crude oil will therefore push the government to redefine its policies for the oil sector in order to stretch self-sufficiency as long as possible by attracting investment in exploration and production (E&P) and by developing a strategy for expanding refining capacity. Petrobras expects domestic production to continue growing at an average 6% per year until 2010, with planned investments in E&P of USD 28 billion until 2010, while other international companies are expected to invest an additional USD 7.4 billion. On the other hand, Petrobras plans to invest USD 8 billion through 2010 to expand and modernise its refining park and to add value to its products.

Gas currently accounts for 9.1% of Brazil's primary energy supply. Between 1999 and 2004, natural gas demand grew by a remarkable 20% per year. In 2004 and 2005, natural gas demand continued to grow rapidly, and was set to reach 100 million cubic metres (mcm)/day in 2010, growing at an average annual demand of 14%. To face this rapidly growing demand, Brazil was hoping to double the capacity of the Gasbol pipeline from the current

23. *IEA Energy Statistics of Non-OECD Countries*, 2005.
24. Oil Market Report, 13 June 2006.

30 mcm/d, and at a minimum was planning to expand the capacity of the pipeline by 15 mcm/d over the next four years. This growing demand was the result of an explicit government policy aimed at diversifying energy sources in all sectors, including thermal generation. Government energy planning relied on gas-fired generation as an alternative, to stabilise seasonal changes in power supply due to rainfall variations and manage prudently the level of reservoirs.

Current total gas supply (excluding Petrobras's own consumption and losses) in Brazil amounts to 56.2 mcm/d. Bolivian imports currently account for 42% of total gas supply in Brazil. Excluding Petrobras's consumption for its refineries (11.7 mcm/d), Bolivia represents 58% of commercial gas supply in Brazil. The main end-user of gas is the industrial sector, which consumes 60% of commercial supply, and in particular the chemical and petrochemical sector, the iron and steel sector, the cement sector, as well as other energy-intensive industries such as glass, ceramics, food, paper and pulp. Thermal generation is the second-largest consumer, with 22.5%, and the transport sector, where the use of vehicular natural gas dramatically increased in the last few years, consumes about 14% of commercial gas. After Bolivia's nationalisation of its hydrocarbons sector, the current challenge is for Petrobras to supply at a reasonable price sufficient quantities to ensure continuous economic growth, especially given the country's industrial sector's heavy reliance on gas. According to the Gas Supply Agreement between Brazil and Bolivia, prices are set in US dollars and indexed to a basket of international fuel oil prices, but cannot be renegotiated until 2009.

In the short run, gas imports from Bolivia will not increase, since all investment plans for further expansion have been cancelled by Petrobras. Those end-users that can use more than one fuel will "switch back" to either fuel oil or diesel. In this category, Petrobras's refineries, which consume 7 mcm/d, could switch to fuel oil in a few months, the supply of which is abundant. Some thermal generation plants could do the same, as well as some industries for which energy costs are not too high. In the medium term, Petrobras will have more alternatives, and it recently announced an "Anticipated Production Plan" aiming to increase natural gas production by 24.2 mcm/d by 2009, equivalent to the current level of gas imports from Bolivia. The objective is to increase production at the Espírito Santo basin more than tenfold by 2009, to 16.7 mcm/d from the current 1.4 mcm/d, as well as from the Campos basin, where Petrobras will increase production by 6 mcm/d from the current 22.8 mcm/d, and by 1.5 mcm/d from productive fields in the Santos basin. Current production in the Santos basin is around 1 mcm/d. The new gas reserves in the Santos basin, mainly the 419 bcm Mexilhão giant field, are currently under development but cannot be included in the Anticipated Production Plan because of lack of equipment on the international oil market. The production of non-associated gas at Mexilhão field is only expected to start in 2009.

ECUADOR

Although Ecuador is only South America's fifth-largest oil producer, the oil sector plays a vital role in the economy as oil export revenues account for over 30% of state income. Ecuador's state oil company Petroecuador continues to suffer from lack of investment in exploration and production. The country's crude production has levelled off and may decline in the future unless new investment is forthcoming. New bidding rounds, including areas for new development, marginal fields, are repeatedly delayed.

Ecuador's political instability, sporadic production interruptions caused by indigenous protests, and the recent series of legal disputes related to the reimbursement of VAT payments and contract terms have frozen private investment. The termination of Occidental's contract for Block 15, owing to its transfer of a 40% stake in its Block 15 concession to EnCana without previous government approval, and the seizure of its assets have placed an added burden on Petroecuador, which is already struggling to finance operations at its own fields. Petroproducción previously said that maintaining operations at Block 15 required at least USD 30 million per month. The Ministry of Economy has been slow to transfer resources to Petroecuador to run the field, and the company has been forced to use funds reserved for its own operations.[25] Private companies are also preparing for the possible renegotiation of their contracts after President Alfredo Palacio's call to increase the state's share of production and profits from 20% to 50%.

Concern is also growing about Ecuador's ability to meet its rapid increase in demand for refined products. Refining capacity constraints are amplifying imports at a time of high international prices, and could further deteriorate Ecuador's precarious trade balance. Addressing fuel theft would be one of the options to tackle the problem, as 24 perforations were reported in the Shushufindi-Quito refined product pipeline in 2005.

MEXICO

Mexico is the world's fifth-largest oil producer and the largest in Latin America; it is one of the main suppliers of crude oil to the United States. It is the fifth-largest oil exporter in the world and the second-largest oil exporter in Latin America behind Venezuela. While Mexico is one of the world's major natural gas producers and the second-largest in Latin America behind Argentina, it still imports around 20% of its total demand from the United States at relatively high prices.

In the context of the Presidential elections on 2 July, energy policy was high on the agenda, and emerged as a significant campaign topic for the candidates of

25. *Global Insight*, Ecuador: Petroecuador President Resigns, Thursday 22 June.

the three main parties, owing to the very high energy price environment and its harmful effect on the country's industrial sector in particular.

Mexico's proven reserves have declined in recent years. According to state-owned Pemex, Mexico's reserves/production ratio (based on previous year production levels) fell from 20 years in 2002 to 10 years in 2005.[26] However, under the administration of President Vicente Fox, Pemex has seen steady increases in its exploration budget. Official production data from Pemex showed a rise of 20 thousand barrels/day (kb/d) for crude and 10 kb/d for natural gas liquids (NGL) in 2005, reaching 3.37 mb/d and 440 kb/d respectively. However, the Oil Market Report has trimmed expectations for crude production in 2006 overall by 30 kb/d, to 3.27 mb/d. It is increasingly difficult to see offsets for declining Cantarell field production before 2007.

There appears to be a broad consensus from Mexico's main political parties on the need for greater investment in the oil sector even though they firmly differ on the means to achieve this objective. The reversal of production decline and falling reserves are expected to require tax reform in order to boost Pemex's budget, and an opening of the upstream sector to foreign company participation in deep-water hydrocarbon developments.[27] One of the central energy issues under debate is therefore the role that the private sector should play in the industry's expansion. Heavy budgetary constraints combined with a monopolistic structure limit the ability of the two large state-owned enterprises (Pemex and CFE) to fulfil increasing demand and investment requirements. However, the private sector's role in the energy field continues to be a divisive issue among politicians and in society at large.

Although the power sector in general suffers from underinvestment and inadequate pricing, non-distribution losses further jeopardise the financial viability of the two state-owned electricity distribution companies operating in Mexico: the CFE, which supplies approximately 90% of the electricity consumed in Mexico, and the LFC. LFC recently announced that it stands to lose some USD 1 billion in 2006 from power theft, which represents 31% of the company's total annual revenues. The company distributes to the federal district of Mexico City, where it has identified some 1.4 million customers who either do not pay or connect illegally to the network.[28]

VENEZUELA

The Venezuelan government continues to promote energy projects to build regional political alliances through the Petroamerica and PetroCaribe

26. Energy Information Administration, Country Analysis Brief: Mexico. EIA website (2006).
27. Oil Market Report, 12 April 2006.
28. *Business News America*, Power theft to cost LFC US$1bn in 2006 – Mexico, Wednesday, 7 June 2006.

initiatives, which provide price discounts, financing, and exchange of oil supplies for agricultural products, technical assistance, and medical assistance with many Caribbean and Latin American countries, and even for low-income households in the United States. This strategy also involves refining capacity joint projects, such as the USD 3 billion Pernambuco refinery project with Petrobras in Brazil. Venezuela is also promoting regional energy integration projects, including a proposed gas pipeline to Colombia and another reaching Argentina through Brazil, which should now include Bolivia, revealing the project's political nature. This oil diplomacy is enabled by high international oil prices that have resulted in outstanding GDP real growth close to 9% in 2005.

The new constitution, which makes all upstream operations the exclusive responsibility of the Venezuela state through PDVSA, the state oil company, as well as the new Hydrocarbons Law, have raised questions about Venezuela's ability to finance and maintain current levels of oil production in fields that deplete at 25% annually.[29] By the end of the 2005 official deadline, all private companies operating in Venezuela's upstream oil sector had converted their Oil Supply Agreements to joint venture companies with PDVSA, with the exception of ExxonMobil which sold its stake to majority partner Repsol YPF.

The conversion of these contracts represents a dramatic change for PDVSA, which has not yet recovered from the dismissal of a significant number of its staff in the midst of the 2004 oils strikes, as the company now assumes a predominant role, with implications in terms of financial resources, decision-making, operational and technical know-how. For the private sector, these new contracts put into practice the new Hydrocarbons Law, which states that the private sector can only participate as a minority partner in upstream activities. It also raises uncertainties for investment in the gas sector at large, where the private sector is still free to participate with no restriction.

RUSSIA

Russia is and will remain an energy superpower. Its reserves of oil and gas are already huge and are very likely underdefined. Russia has been a reliable supplier of oil, and especially of gas, over decades of politically turbulent times. In this respect, it is most apt that Russia, during its year as G8 President, chose energy security as a key focus for discussion. Given this focus, the International Energy Agency has been more vigilant than in the past – not in questioning Russia's intent to remain a reliable energy supplier, but in raising the question of Russia's ability to do so. The IEA Secretariat's concern is that

29. *Global Insight*, Country Report: Venezuela.

Gazprom has focused its capital expenditures on acquiring ownership or control of strategic downstream assets over the past few years, rather than investing in upstream gas infrastructure and productive capacity. Russia has relied on relatively cheap, captive Central Asian gas to fill its growing export commitments.

While the controversy relating to gas delivery between Ukraine and Russia early in 2006, which affected the stability of gas supply in Europe, was not symptomatic of imminent Russian delivery problems, it did serve to focus the world on the security of Russian gas supply. This incident has raised concerns about Russia's future ability to deliver gas, especially after several years of decline in the country's oil production growth rate as investors lost confidence in the stability or adequacy of Russia's investment regime. Underinvestment in Russian oil and gas production is a critical issue to world oil markets as Russia had become a key driver of non-OPEC supply growth in recent years. Creeping nationalisation in the oil sector, with Yukos and Sibneft now under state monopoly control and the disputes over Shell's Sakhalin development, has raised questions about whether continued investments would be timely, especially in view of the need to develop more difficult fields in East Siberia and Northern Russia. The IEA's long-standing concerns about fiscal, legal and regulatory reform (including streamlined environmental and safety regulations) remain unchanged. More transparent and fair third-party access to oil and gas transmission systems continues to be a key need to provide for more competition, especially in the upstream natural gas sector. Such regimes will be increasingly critical to ensure an attractive environment for oil and gas company investments and to buoy Russian economic growth and global energy market stability.

Nonetheless the issues of the hour, Europe is a natural market for Russia's energy commodities, and will long remain Russia's primary energy export destination. The interdependence is clear and must be sustained, but European governments are increasingly concerned that what has up to now been a mutually beneficial state of symbiosis could evolve into vulnerability.

Russia is currently facing major investment decisions in its upstream oil and gas sector as well as in its electricity sector. Timely development of Eastern Siberia is increasingly a priority across all relevant ministries, Gazprom, Transneft and Russian and foreign investors. Yet given the events of the last year with the State's tightening grip on production and exports, there is reason for concern that investments will not keep pace with the exploration and production challenges ahead. The fiscal and regulatory systems are still unclear and can in no way attract or sustain the needed investment levels – especially in frontier areas with no infrastructure. Increases in 2005 oil production and export taxes, uncertainty over the soon-to-be-enacted Subsoil Law, the recent clamp-down on transfer pricing and greater enforcement of compliance with existing production licences are all issues. Until these measures are clarified, Russian producers may indeed curb investment with a consequent slow-down in production growth.

OIL

The downward trend in Russian oil production growth over the 2004-2005 period seems to have come to an end in early 2006. With the nationalisation of key Yukos assets and Sibneft completed, the focus on producing these oil assets is being re-established. The underlying question still remains, however, as to the efficiency of state companies versus private ones, given their different drivers and interests. Russia's oil production averaged 9.7 million barrels a day (mb/d) in October 2006. The first 10 months of 2006 saw output reach 9.7 mb/d, up 2.4% over 2005 levels. This is in line with the IEA's outlook for annual growth in Russian oil production for 2006 of 2% – more conservative than Russian-based outlooks due to factoring in of delays at the Sakhalin-1 PSA project. Rosneft was among the strongest growth elements in October, up 9.5% year-on-year due to Yuganskneftegaz production growth. Lagging behind the industry average was Gazprom Neft (formerly Sibneft), down 1.7% year-on-year. The IEA outlook for production growth over 2007 is in the order of 2.9% assuming "normal" weather in the first quarter (1Q) (compared to 1Q 2006 which saw oil production hit by exceptional cold weather) and build towards capacity of Sakhalin-1.

An issue still unresolved is the implication of Gazprom's supervisory role over Eastern Siberian energy developments and how this will impact TNK-BP activities or assets. TNK-BP's 1Q output was 1.47 mb/d, reflecting a decline of 2.4% year-on-year, well below the Russian industry average.

In February 2006, a new draft of the important Subsoil Law was submitted for discussion. By late 2006 no further progress had been achieved on this, leaving key issues and concerns unresolved. These include:

- The bidding process for subsoil rights needing to be done in a transparent and competitive way (auction as opposed to tenders) and to provide a level playing field.
- Production rights in the event of a discovery (right of first refusal) which are essential if investors are to have the incentive to spend millions of dollars on risky exploration programmes.
- Termination of rights needing to be clearly defined in the law and easily understood. The current draft reintroduces discretionary powers to the Russian State.
- Stabilisation mechanism and reference to pre-existing production-sharing agreements (PSAs) needed for current investors.

- Assignment/pledging of rights which are important elements in a developed market economy and could help promote commercial activity and economic growth.
- Arbitration mechanisms (including international arbitration).
- Restrictions on foreign investors which are internally contradictory and vague needing clarification.

Clarification on restrictions on foreign investors is especially important, given the conflicting signals on this issue from various Russian officials. The issue of "strategic fields" and limiting foreign investor access to this changing list of Russian oil and gas assets is having a destabilising impact on the investment environment – at a time when increasingly difficult investment prospects are looming.

The Russian government's increasing focus on fiscal reforms for the oil and gas sector is a very positive sign. It includes amendments to the taxation of natural resources to enhance the investment environment in difficult-to-develop areas, clearly with a view of enhancing the attractiveness of virgin regions such as East Siberia. This is critical for the economics of pipeline infrastructure to the East, which in turn is critical for Russia in terms of opening up new export markets beyond its traditional European ones. Although not as profi-sensitive a system as originally intended by reformers and perhaps not attractive enough to enter into greenfield developments in East Siberia, according to some investors, this system is more easily administered and reduces the threat of loopholes being used against the spirit of the law. It is to be put into effect as of January 2007.

Another extremely positive step is the possible declassification of oil reserves, which are to date considered as state secrets. This is considered a long-overdue change, necessary to improve transparency, stability and predictability of global oil markets. It is also an opportunity to increase the capitalisation of a number of companies and the Russian stock market as a whole.

GAS

Russia produced 641 bcm of natural gas in 2005, 85% of which by Gazprom, Russia's majority state-owned gas company. An estimated 26% of the world's natural gas reserves remain in Russia's super-giant fields and in smaller fields adjacent to the super-giants. Gazprom holds 60% of Russia's reserves, owns and operates the mainline gas transmission system, and monopolises the lucrative gas export trade. In July 2006, the law on "Gas Exports" gave Gazprom a monopoly on gas exports. Supporters of the law argued that this will protect national energy security and the state's fiscal interest. The law perpetuates Gazprom's *de facto* monopoly hold over gas exports – including future LNG exports – and strengthens Gazprom's position vis-à-vis independent gas producers, at least until such time as domestic gas prices are in line with export market prices. Raising domestic prices faster would also reduce internal consumption and free up gas volumes for exports without the need to invest in developing new fileds and/or additional infrastructure.

The lack of competition in Russia's upstream gas sector is increasingly disconcerting given the tension in gas supplies to European customers already apparent during the extraordinarily cold weather in early 2006. This reflects the technical limits of Russian gas production and its transport capacity. With Gazprom's major fields in decline, and its unwillingness to undertake or authorise other domestic options, Russia relies on Central Asian gas to meet the growth in its contracts with Europe. But is there sufficient investment in Central Asian gas? Current IEA projections suggest that Gazprom could face a gradually increasing supply shortfall against its existing contracts beginning in the next few years if timely investment in new fields is not made. With a lack of convincing information from Gazprom to the contrary, the IEA projects an average 20 bcm/year natural decline in Gazprom's production reflecting historic decline rates in its three big gas fields. At this rate, by 2015, almost 200 bcm will need to be produced from new Gazprom fields, if it is to maintain production at current levels – let alone meet its new strategic goals of increasing production to 560 bcm in 2010 and 590 bcm in 2020.

Gazprom recognises that to maintain its position as a key gas supplier, it would need to focus increasingly on reserve replacement and exploration. Gazprom will have to increase its annual reserve replacement in the order of 700 bcm/year to 2015 and 750-800 bcm/year for the period 2016-2030. This is 36% more than the 2002 reserve replacement level, the last time in almost a decade when reserve replacement was anywhere near production. Gazprom's reserve replacement dropped to 79% in 2003, 69% in 2004, and just over 100% in 2005. The major problem Gazprom faces today is the decline of the three jewels in its current production portfolio – the Medvezhe, Urengoye and Yamburg fields which together account for about two-thirds of Gazprom's production. Zapolyarnoye – which reached its peak plateau of 100 bcm/year in 2005 – is expected to match the decline at other fields for the next 3-4 years. It is considered the last relatively cheap gas in Russia. The Russian Energy Strategy presents estimates for development of the Yamal fields on the order of USD 30/thousand cubic metres which does not include investments needed for the related new transportation infrastructure this project will demand.

Until recently, an important aspect of Gazprom's strategy has been its apparent focus on Central Asian gas reserves, relative to that of developing its own reserves or that of Russian independent gas producers. Since early 2003, Gazprom's strategy to engage Central Asian states – especially Turkmenistan, where it has contracted up to 80-90 bcm per year of imports by 2009 – raises concern about Gazprom's approach to increasing production from its own reserves. While there is a certain logic in this approach, there is reason to question the advisability of relying on long-term contracts between Russia and Turkmenistan to meet future increases in Russian and European gas demand. This is of particular concern since the increase in import prices Turkmenistan imposed on Ukraine, and the ongoing price negotiations between Turkmenistan and Russia over 2006. A troubling sign lending more weight to the IEA's concerns about lack of investment in Central Asia's gas sector came in early September 2006, when Gazprom and Turkmenistan finalised negotiations on gas price increases from USD 65 to USD 100/tcm for 2007-2009 for 50 bcm per year. This is a dramatic decrease in volumes compared to the originally agreed 80-90 bcm per year back in 2003 for imports from 2007 to 2029. This clearly tightens the gas balance the IEA has pointed to over the past year. To add to this uncertainty, over the past year there continues to be little evidence of investment in the refurbishment of the Turkmen part of the Central Asia-Centre (CAC) pipeline infrastructure or upstream gas facilities, whether by Gazprom or by other parties.

In early October 2006, Gazprom's management announced their decision to start the investment phase of development of the Bovanenskoye field in the Yamal Peninsula as well as the construction of a trunk pipeline to support it (Bovanensky-Ukta). First gas is expected in the 3Q 2011 with production of 15 bcm per year. Peak production is expected in the order of 140 bcm per year. Gazprom also announced that it planned to develop the Shtokman field with a focus on European gas markets through the Nordstream pipeline (as opposed to an earlier focus on LNG from this field). Some experts take the Shtokman announcement to mean the field will be shelved for a few years, given Gazprom has stated it would develop the field without foreign partners. The IEA will watch with interest the development of these huge gas resources, key to helping meet incremental gas demand by customers in European markets and possibly other world markets.

Given the growing number of non-Gazprom gas producers of both associated and non-associated gas and the efficiency gains possible from more competition in Russia's upstream sector, it is not clear that Gazprom's mega-project approach or its Central Asian one will produce the most efficiently priced gas. Ultimately, consumers will pay the higher price for a pipeline built before its time – as will the shareholders of the companies involved. The Russian Energy Strategy projects non-Gazprom production at between 105 and 115 bcm in 2010 and between 140 and 160 bcm in 2020. However, prospects for independent production will depend heavily on the transparent and reliable access to Gazprom's gas-processing capacity and transmission system. At Gazprom's Board of Directors meeting in early February 2006, the role of independents in domestic market supplies and their contribution to Gazprom's export portfolio was discussed. Gazprom's is said to have favoured closer co-operation with independents. What this means is not yet clear given that in mid-2006, it acquired 19.4% of Novatek, the largest of the independent gas producers. Meanwhile, the Russian government is promoting policies to enhance regulations to ensure non-discriminatory third-party access to Russia's natural gas transportation network. A new draft Order and Regulation was submitted by the Antimonopoly Service to relevant ministries, including provisions for auctions for access to gas pipelines, new terms for gas transportation contracts and better access to information on spare pipeline capacities.

For well over two decades, Russia has been a major supplier of gas to Europe, through pipelines which transit the Ukraine (covering about 80% of exports), Belarus, and directly to Turkey and Finland. In 2004, gas exports totalled 140 bcm to Western Europe, with an additional 52.5 bcm to the former Soviet Union republics. Some smaller European states are almost 100% dependent on Russian gas supplies; even large users such as Germany and Italy are respectively 40% and 30% dependent on Russian gas supplies. Gazprom is likely to have strong profits in 2006, on the back of increasing gas export prices indexed to oil prices. However, in common with a number of energy entities worldwide, it is unclear to what extent these increased profits are being directed at key upstream and mid-stream activities. Given the issues with Turkmenistan described above, increased shipments may be delayed.

Gazprom has recently taken an interest in Russia's other potential gas regions in East Siberia: the Far East and Sakhalin. In July 2005 Gazprom and Shell signed a Memorandum of Understanding whereby Gazprom would acquire up to 25% plus one share in the Sakhalin II venture, and Shell would acquire a 50% interest in the Zapolyarnoye Neocomian field in West Siberia.[30] Gazprom, as supervisor of the development in East Siberia and the Far East, has asserted its intention to participate in all natural gas developments in the region to ensure its control of export routes and volumes. Gazprom's intentions seem to indicate that Kovykta and Sakhalin gas resources belong to international consortia in which Gazprom has only a share – presumably these consortia will determine the markets for their gas.

The Russian government is intent on developing this sparsely populated vast region. Russia has a long-standing declaration of intent to co-operate with China given the East Siberian oil and gas resources and China's interest in importing increasing volumes from its neighbour. This was discussed at the highest levels in spring 2006 when intergovernmental framework agreements were signed by President Putin of Russia and President Hu Jintao of China. President Putin stated that Russia could potentially supply an annual total of 60-80 bcm of gas to China using eastern and western routes which would each supply 30-40 bcm. Gazprom stated that the planned USD 10 billion 3 000 km Altai pipeline system (the western route, for which construction has

30. The transaction was expected to be finalised in 2006. However, shortly after the Memorandum was signed, Shell announced that the costs of the second phase of the Sakhalin II project had risen from USD 12 to USD 22 billion. This gave Gazprom grounds to renegotiate the terms of the asset swap and discussions are ongoing.

begun) would pump the first Russian gas to China as early as 2011. Gazprom's president also said that the Kovykta field in the Irkutsk region of East Siberia could be a possible export source – but that gas from Sakhalin or West Siberia was still being considered. These political statements made in spring 2006 are very ambitious, especially with Gazprom's increasing assertion of control in this region over recent years, which has done little to spur on development by private investors in the region.[31] This begs the question as to the intent behind these statements. Clearly there is a political will – but is the timing of these statements more a reflection of concerns being raised in Europe on Russian export markets?

Gazprom total annual investments, including non-infrastructure investment, have been in the order of USD 7 to 8 billion since 2003. In 2005, Gazprom's management board approved a more than 40% increase in its investment programme to USD 10.8 billion, much of the increase being directed to the North European gas pipeline project (or NordStream). In autumn 2006 Gazprom's investment budget was increased yet again to over USD 13 billion (capital costs of NordStream subsequently increased to USD 18 billion). IEA estimates *(WEO 2006)* of investment needs in Russia's gas sector are in the order of USD 16 billion per year solely to bring on new sources of gas and to upgrade and maintain gas infrastructure. Although largely in line with projections given other investments by independent gas producers and oil companies, the IEA is concerned about the priority Gazprom seems to be placing on foreign acquisitions and export infrastructure as opposed to its domestic network and upstream.

While investments to diversify its energy holdings and secure markets downstream may seem a natural investment strategy to many observers, it raises the issue of adequacy and timeliness of traditional gas production and transport investment. The recent tightness in gas supplies to European customers over January and February 2006, driven by extraordinarily cold weather, highlighted the technical limits of the Russian gas production and transport capacity. While the exceptionally cold conditions would have stretched any gas supply system (especially one that makes such an important contribution to power generation), some observers see these events as a possible early warning of underinvestment, and that in the absence of a rapid turnaround, such shortages may occur at times of less extreme demand.

In summary, monopoly factors (by no means unique to Russia) are certainly one reason for underinvestment in Russian gas infrastructure. While Russia is not alone in facing such policy problems, their consequences seem much more significant in this case. With its major fields in decline and unwilling to undertake or authorise other domestic options, Russia relies now on Central

31. These intentions seem to set aside that Kovykta and Sakhalin gas resources belong to international consortia on which Gazprom has only a share. Presumably these consortia will determine the markets for their gas.

Asian gas to meet the growth in its contracts with Europe. However, investment in Central Asia appears to be inadequate. Assuming a continuing decline of about 20 bcm/year in its Big-3 producing areas and stagnant imports from Central Asia, current projections suggest a supply shortfall against existing contracts that could reach 50 bcm by 2010 if no major new Gazprom fields are commissioned. Timely investments in major new fields and infrastructure – owned by Gazprom or independently held – supported by market opening policy changes, have the potential to reverse this trend.

ELECTRICITY

The Russian government embarked on a highly ambitious programme of electricity reform which moved into its active phase in spring 2003. By mid-2006, most of the structural transformations of the sector had been undertaken, given the momentum of RAO UES and its interest to unbundle and restructure competitive parts of the sector (7 planned wholesale thermal generation companies (gencos), the 4 planned inter-regional distribution grid companies, and 13 of 14 territorial gencos had been established while unbundling by activity type was completed in 57 of 72 regional energy companies) away from the natural monopoly parts (Federal Grid Company and System Operator). Although there have been certain set-backs since that time in terms of the market rules and regulations keeping pace with the structural reforms, the government's reaffirmed commitment to the electricity reform process in late 2004 and again in June 2006 reflects a recognition among Russian policy makers that attracting timely and appropriate investment will remain a substantial and ongoing challenge, which can most effectively be addressed through the creation of efficient electricity markets operating in response to genuine price signals, within a robust and predictable legal and regulatory framework.

Only such markets can attract the new investment that the industry will need, especially in order to ensure security of electricity supply beyond 2010. In early June 2006, the Russian government approved the attraction of private investment into power generation by way of additional emissions of shares to newly created wholesale and regional generation companies.

At the end of October 2006, Wholesale Genco #5 was the first company to offer 5.1 billion additional shares, or 14.4% of increased charter capital and attracted USD 459 million. The Russian government aims to attract about USD 80 billion of investment into generation and transmission over the next five years. Anatoly Chubais, the head of RAO UES, stated in September 2006 that the company's outlook for new generating capacity by 2010 is in the order of 21 GW, more than 10% of Russia's current installed capacity. This is much less than the 55 GW capacity gap RAO UES predicted two years ago. Perhaps this is due to the ambitious plans of the nuclear industry to build 2 GW/year from 2012 to 2025. In August 2006, the Russian government approved the investment plan for the electricity sector for 2007 in the framework of a 3-year plan for the sector to 2009. Investments in 2007 are expected to more than double those in 2006 to 160 billion roubles (about USD 6 billion). Another USD 2 billion is expected to be invested in Russia's nuclear sector.

IEA's assessment, described in *Russian Electricity Reform: Emerging Challenges and Opportunities* (2005) places the capacity crunch well into the next decade. Much depends on how much generating capacity which was mothballed over the 1990s can be effectively reconnected and used. The IEA's outlook points to the fact that load factors of the thermal generating plants (accounting for almost 70% of Russia's generating capacity) dropped by about 15% since 1990 (pre-crisis/economic transition benchmark) from levels of over 60% to 47% in 2003. This will mean the difference between major new investments being needed in the sector or an ability to limit investment needs through refurbishment of existing capacity.

A key to the success of competitive markets in electricity, and eventually other parts of Russia's energy sector, will be strong, well-resourced, well-trained and independent regulators that can rise to the challenge of establishing access to network and other monopoly products and services on fair and reasonable terms for all market players. The IEA continues to be concerned about the lack of resources and independence of Russian regulatory bodies, given the critical role they will need to play to ensure against market power abuses in the face of powerful vested interests and dominant players such as Gazprom.

Clearly, if Russia is concerned about security of gas supplies in the coming years, a competitive electricity sector (which consumes almost 40% of domestically supplied gas) would go a long way in enhancing efficient energy/natural gas use in an effort by private companies to reduce costs and become more competitive.

The recognition by the Russian government that tariff rebalancing – particularly the removal of cross-subsidies – is a necessary precondition for successful introduction of market reforms, is reassuring. Cost-reflectivity has been recognised as a principal objective of the reforms. The regime of vesting contracts now proposed for all users provides a means for dealing with this critical issue while at the same time allowing competitive wholesale and retail markets to be progressively introduced over the remainder of the decade. In its book, *Russian Electricity Reform: Emerging Challenges and Opportunities* (2005), the IEA commends the Russian government's plan to use this period to gradually raise regulated end-user tariffs to levels consistent with the delivered price of electricity sourced through the competitive wholesale and retail market. Such rebalancing would allow customer choice to be extended progressively through the life of the vesting arrangements and ultimately to all users at the end of the vesting contract period if desired.

ENERGY EFFICIENCY AND ENVIRONMENT

President Putin focused on energy efficiency in his State of the Nation Address in early May 2006.

> *"...Unfortunately, a large part of the technological equipment used by Russian industry today lags not just years but decades behind the most advanced technology the world can offer. Even allowing for the climate conditions in Russia, our energy use is many times less efficient than that of our direct competitors. Yes, we know that this is the legacy of the way our economy and our industry developed during the Soviet period, but it is not enough just to know. We have to take concrete steps to change the situation. We must take serious measures to encourage investment in production infrastructure and innovative development while at the same time maintaining the financial stability we have achieved...*

This is a positive sign and very much in line with the IEA's work on promoting energy efficiency in Russia and other countries of the Commonwealth of Independent States. IEA analysis shows that just increasing the level of combined heat and power in transition economies' district heating systems could save the equivalent of 80 bcm of gas per year – more than half of this in Russia alone. Even greater potential savings are available in distribution systems and buildings. In its book, *Optimising Russian Gas: Reform and Climate Policy*, the IEA examines the potential to reduce gas losses and GHG emissions in the Russian natural gas sector and to limit natural gas flaring by oil companies. This is increasingly important given the era of "cheap" gas coming to an end for Gazprom. A clear win-win option to reduce pressure on gas deliverability is a strategy to slow rising domestic gas demand as the Russian economy grows, through intensifying energy-efficiency programmes and more market-based gas pricing.

The IEA estimates that at least 30 billion cubic metres – a fifth of the country's exports to European OECD countries – could be saved annually by the introduction of more advanced, available technology and the implementation of energy efficiency measures. Such investments would be all the more attractive as they would also generate reductions equivalent to 150 million tonnes of CO_2 that could also be sold on the emerging carbon markets. Russia's ability to identify concrete projects that deliver GHG savings would furthermore be attractive to OECD countries seeking carbon-trading opportunities.

As the third-largest contributor to global energy-related CO_2 emissions, Russia plays an important role in global GHG emissions. With Russia's ratification of the Kyoto Protocol at the end of 2004 and the subsequent entry into force of the Protocol in February 2005, Russia has the potential to play a key role in global GHG markets as well. Through the market mechanisms created under the Kyoto Protocol (*e.g.* emissions trading and Joint Implementation), Russia may be in a position to attract greater foreign investments in its economy and to reduce GHG emissions at the same time. This is very much in the interest of the Russian government. In addition to working on meeting the institutional requirements to participate effectively in the Kyoto Protocol's flexible mechanisms, Russian officials are also developing their participation strategy. They are aware of the reluctance of many Parties to purchase Russia's "surplus" assigned amount units that would be seen as not contributing to the global environment.

CASPIAN AND CENTRAL ASIA

Baku-Tbilisi-Ceyhan (BTC) pipeline, transporting Caspian oil to the western markets via the Ceyhan terminal at the Mediterranean coast of Turkey, has become operational in June 2006. The BTC pipeline will reach the capacity of 50 million tonnes of oil per year. The Baku-Tbilisi-Erzurum (BTE) pipeline that will connect the Azeri gas to the transmission grid of Turkey is to become operational by the end of 2006. The BTE pipeline will have an initial annual capacity of 7-8 bcm per year, which can be extented to 20 bcm per year in the medium term.

EURASIAN MARKET ACCESS & INVESTMENT POLICY

The government of Georgia and the IEA co-hosted a round table under the auspices of President Mikheil Saakashvili in Tbilisi on the 19th to 21st of June 2006. The conference was dedicated to evaluating progress to date in South Caucasus oil and gas transportation and prospects for the future. Senior government representatives from regional oil and gas producers and transit and consuming countries joined industry and key international organisations (European Commission, European Bank for Reconstruction and Development, EU Council, Organisation for Security and Co-operation in Europe, Energy Charter Secretariat and United Nations Economic Commission for Europe) to review investment policies and practices, hear from the corporations and to examine prospects for additional oil and gas infrastructure. Discussions focused on identifying opportunities and obstacles to strengthening the link between the vast oil and gas potential of the region and world markets.

KEY FINDINGS

Diversity

South Caucasus, Caspian and Central Asian oil and gas are essential to reinforcing energy market security both by enhancing the diversity of world supplies of these commodities, but also by providing Central Asian producers a greater diversity of customers. New oil and gas infrastructure provides valuable complementarity to existing systems.

Stakeholders have reason to be quite pleased with progress to date, but much work remains to be done to extract maximum benefit from the opportunities offered by the region. This means enhancing market access to Central Asian gas supplies and strengthening conditions for investment in upstream reserves, transport infrastructure and opportunities for adding value to oil and gas. These may include new trans-Caspian routes for oil and eventually gas, South Caucasian routes and reinforced shipments into South-East European systems. This is in addition to the rehabilitation and effective management of existing pipelines.

Transparency

Conference participants emphasised the need for greater transparency throughout the oil and gas sectors. More and better data are needed on oil and gas reserves, production and transport capacity, as well as on pricing mechanisms. Clear information on the development of legal and regulatory systems throughout the Eurasian area is essential to strengthen investor and consumer confidence and to shape overall energy market security. Public policy decisions in the sector should be informed by best practices in international energy policy and a more robust producer-consumer dialogue should inform the public on decisions affecting their welfare. Coherence and clarity in energy market policies and public governance must be strengthened throughout the region to enable market access to new entrants, whether customers, producers or transit service providers.

Investment and Governance

Governments are responsible for establishing the framework conditions within which competitive markets can flourish. They set the tone for the quality and consistency of business practices demanded by consumers. Public and private partnerships, the strength of civil society, co-operation with international institutions and visibility to the public can boost investor confidence and lower the costs of large infrastructure projects. Practices established in promoting the South Caucasus oil and gas transport systems already in place testify to this and should inspire the reinforcement of best practices and facilitate the new transport systems that can bring value to producers, consumers and everyone along the way.

Next Steps

Interdependent producers, consumers and transit countries all have a stake in promoting a robust energy market and all need to sustain a vigorous dialogue to be sure their interests are transparent and well-understood. Regional co-operation in energy market development and sound governance can be strengthened by continuing the Tbilisi initiative to “Forge the Links” between Central Asian countries and the rest of the world with all stakeholders, public and private.

CENTRAL AND SOUTH-EASTERN EUROPE

Over the past few years, most countries in Central Europe and the Baltics have developed long-term policies and strategies for energy security and efficiency and created the appropriate institutions to implement sustainable reforms of energy markets. This process has been slower in South-Eastern Europe, particularly in the Western Balkans. Countries in the Western Balkans still need to develop robust energy strategies and reliable data systems in order to reach market fundamentals.

The eight new members of the European Union (EU-8)[32] now apply the EU directives and take part in elaborating EU energy policy and legislation. The Slovak Republic and Poland are expected to join the IEA in 2007. Both countries are very close to complying with IEA standards for oil security systems (stockpiling and emergency plans). They have adopted national laws on emergency situations and oil stocks and have set up National Emergency Sharing Organisation (NESO)-type bodies. By mid-2006, the Slovak Republic had developed 110 days oil stocks and Poland 79 days stocks. Poland is expected to pass some additional legislation on oil stocks. The Slovak Republic will undergo an Emergency Response Review in the autumn of 2006 and Poland in late 2006 or early 2007.

In October 2005, the EU and nine countries of South-East Europe[33] signed the Energy Community Treaty, which aims to create the legal framework for an integrated European market for electricity and gas. Norway is already a participant in the internal energy market of the EU through the Agreement on the European Economic Area. In order to maintain the homogeneity of the internal market and avoid fragmentation in the future, a legal link needs to be established between Norway and the Energy Community. Norway has therefore presented interest in acceding to the Energy Community Treaty as a party. Negotiations with Turkey are ongoing for joining the treaty at a later stage. Moldova, Ukraine also applied to join.[34] The Energy Community Treaty calls on the South-East European countries to create a regional energy market designed to fit into the framework of the EU's Internal Energy Market. This means that the relevant *acquis communautaire* on energy, environment and competition will be implemented in the Balkan peninsula as well. This will enhance market opening, investment guarantees and firm regulatory control of the energy sectors. This treaty is the first legally binding agreement signed by the South-East European states and territories since the wars of the 1990s.

32. Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia. The Czech Republic and Hungary are members of the IEA.
33. Croatia, Bosnia and Herzegovina, Serbia, Montenegro, the former Yugoslav Republic of Macedonia, Albania, Romania, Bulgaria and UNMIK on behalf of Kosovo.
34. European Commission Directorate-General for Energy and Transport (2005) "South-East Europe connects the internal market for electricity and gas" (Memo).

The treaty will create a policy framework for international donors to support infrastructure investments. It will also provide the framework for the expansion of the natural gas system to create an intermediate gas market between the Caspian Sea and the European Union. The treaty will also address the specific energy and environment concerns of South-East Europe, such as increased mortality rates from winter cold and environmental degradation from emissions in old power stations, the use of wood for domestic heating that results in deforestation and the unsustainable development of wetlands and watercourses for hydroelectric power. The expected short-term results of the initiative would be new investments in the mining and metallurgy sectors. In the longer term, the stabilisation of the energy sector will assist the macro-economic revival of the region, contributing to lower emigration rates, economic growth and peace.[35]

SUB-SAHARAN AFRICA

ANGOLA

Angola is Africa's second-largest oil producer after Nigeria, producing approximately 1.46 mb/d in 2006,[36] and the sixth-largest supplier of oil to the US. Most benefits to the country from oil production, which is almost entirely offshore, accrue in the form of export revenues. These are currently critical to the Angolan economy, representing over 80% of the government's budget and 52% of GDP in 2004. (The government's share of oil revenues that year was approximately USD 5.7 billion, or about 45%).[37] The IEA published its in-depth review of Angolan energy policies, *Angola – Towards an Energy Strategy*, in October 2006.

Crude oil has been commercially exploited in Angola since its discovery onshore in 1955. Commencement of production offshore the coastal enclave of Cabinda followed shortly afterwards. The sector has grown rapidly since then, especially after 1980, facilitated by the successful attraction of large foreign investments and technological expertise from the major international oil companies. Production is expected to come increasingly from deep-water offshore fields, with higher production costs and more challenging technological requirements, as shallower, more mature fields closer to shore gradually decline.

Angola's upstream potential is likely to remain promising throughout the next decade, thanks to its favourable geology and reserve base, recent exploration successes, and relatively attractive fiscal terms, as well as recent and anticipated advances in deep-water production technology. Along with

35. http://ec.europa.eu/energy/
36. *Oil Market Report* data, 13 June 2006
37. IEA, *Energy Policy Review of Angola,* 2006.

heightened competition for scarce hydrocarbon resources internationally, these factors have helped renew interest in the Gulf of Guinea as a major oil supply source, and are likely to ensure that Angola becomes an increasingly important exporter to international markets, particularly the United States and China. In 2004, a new petroleum law came into force that seeks to standardise future production-sharing agreements and further clarify the roles of the Ministry of Petroleum, Sonangol and the operating companies, in an effort to attract more private and foreign investment.

Until recently, Angola's one refinery covered most of the country's domestic consumption. Since the 2002 cease-fire, both consumption and imports of key products such as gasoline, diesel and jet fuel have increased substantially. While Angola is nominally a net exporter of oil products, this is mostly due to exports of fuel oil. Most domestic oil product prices in Angola are subsidised. Over the past few years, the government has been raising prices gradually in an effort to eventually eliminate subsidies, but has had to contend with dramatically rising world oil prices that "move the goalposts". Prices that are fixed below cost and are uniform throughout the country give few incentives to private companies to engage in distribution and sales of oil products, especially outside Luanda. The few exceptions benefit from subsidised wholesale prices from Sonangol. The government plans to create a competitive distribution market within the next few years, include unbundling Sonangol logistics and storage from its service stations, but has yet to fully clarify the details and regulatory framework. Efficient distribution is also severely hindered by the poor conditions of roads and railroads. Angola's one refinery, located near Luanda, is inefficient and its output subsidised. Sonangol plans to build a new export-oriented refinery in Lobito to process the deep-water sour crudes that are forming an increasing share of the country's oil output, though it has yet to find a strategic partner.

Almost all gas reserves and production in Angola are associated with oil. Approximately 70-80% of associated gas is flared. The government has declared that all new fields must be zero-flare and that routine flaring should cease at existing fields by 2010. Flaring reduction plans have generally focused on reinjection and on a proposed project to build an onshore liquefaction plant in Soyo for LNG exports.

There is currently no gas infrastructure or gas use, with the exception of LPG for cooking. Projects to use gas domestically could be developed as spin-offs to the LNG scheme, but would likely be limited to the area around Soyo, some 300 kilometres away from the main potential demand centre of Luanda. Other barriers to an eventual gas industry include lack of a clear government strategy and regulatory framework for onshore gas transportation and marketing, as well as lack of ownership rights to the gas by the oil companies that produce it.

ENERGY BALANCES AND KEY STATISTICAL DATA OF IEA COUNTRIES

AUSTRALIA

AUSTRIA

BELGIUM

CANADA

CZECH REPUBLIC

DENMARK

FINLAND

FRANCE

GERMANY

GREECE

HUNGARY

IRELAND

ITALY

JAPAN

KOREA

LUXEMBOURG

NETHERLANDS

NEW ZEALAND

NORWAY

PORTUGAL

SPAIN

SWEDEN

SWITZERLAND

TURKEY

UNITED KINGDOM

UNITED STATES

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**68.0**	**157.5**	**253.7**	**261.8**	**344.0**	**452.9**	**532.4**
Coal[1]		40.3	106.1	185.2	192.6	248.2	314.9	371.6
Oil		19.8	29.0	30.7	30.6	30.6	29.0	29.2
Gas		3.4	17.1	31.3	32.0	57.7	99.7	119.4
Comb. Renewables & Waste[2]		3.5	4.0	5.0	5.0	5.7	7.2	9.7
Nuclear		–	–	–	–	–	–	–
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	1.6
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.1	0.2	0.1	0.4	0.6	0.8
TOTAL NET IMPORTS[4]		**-10.3**	**-65.3**	**-139.5**	**-144.6**	**-210.2**	**-288.0**	**-334.6**
Coal[1]	Exports	17.6	67.3	135.5	141.7	195.3	252.9	301.6
	Imports	–	–	–	–	–	–	–
	Net Imports	-17.6	-67.3	-135.5	-141.7	-195.3	-252.9	-301.6
Oil	Exports	3.4	9.3	22.1	20.9	23.7	21.7	21.5
	Imports	12.5	14.2	28.0	28.1	34.9	45.6	58.0
	Bunkers	1.8	0.6	0.7	0.8	1.0	1.0	1.1
	Net Imports	7.4	4.3	5.1	6.4	10.2	22.8	35.4
Gas	Exports	–	2.3	9.1	9.3	25.1	61.1	80.0
	Imports	–	–	–	–	–	3.1	11.6
	Net Imports	–	-2.3	-9.1	-9.3	-25.1	-58.0	-68.4
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**-0.1**	**-4.7**	**-1.3**	**-1.4**	**10.2**	**9.9**	**9.7**
TOTAL SUPPLY (TPES)		**57.6**	**87.5**	**112.9**	**115.8**	**144.1**	**174.8**	**207.5**
Coal[1]		22.6	35.0	48.3	49.5	57.2	66.2	74.2
Oil		27.1	32.5	35.9	37.0	46.7	57.5	70.2
Gas		3.4	14.8	22.2	22.7	32.7	41.7	51.0
Comb. Renewables & Waste[2]		3.5	4.0	5.0	5.0	5.7	7.2	9.7
Nuclear		–	–	–	–	–	–	–
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	1.6
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.1	0.2	0.1	0.4	0.6	0.8
Electricity Trade[5]		–	–	–	–	–	–	–
Shares (%)								
Coal		*39.2*	*40.0*	*42.8*	*42.7*	*39.7*	*37.9*	*35.7*
Oil		*47.1*	*37.1*	*31.8*	*32.0*	*32.4*	*32.9*	*33.9*
Gas		*5.9*	*16.9*	*19.6*	*19.6*	*22.7*	*23.9*	*24.6*
Comb. Renewables & Waste		*6.1*	*4.5*	*4.4*	*4.3*	*3.9*	*4.1*	*4.7*
Nuclear		–	–	–	–	–	–	–
Hydro		*1.7*	*1.4*	*1.2*	*1.2*	*1.0*	*0.8*	*0.7*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	*0.1*	*0.1*	*0.1*	*0.3*	*0.3*	*0.4*
Electricity Trade		–	–	–	–	–	–	–

0 is negligible, – is nil, .. is not available.

Please note: All data except GDP and population refer to the fiscal year July to June.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**40,0**	**58.1**	**72.3**	**73.9**	**89.4**	**109.4**	**132.4**
Coal[1]	4.9	4.3	2.7	3.3	3.0	3.1	3.1
Oil	24.7	30.5	37.3	37.5	43.9	54.2	66.7
Gas	2.4	8.8	11.5	11.8	18.8	22.9	27.4
Comb. Renewables & Waste[2]	3.5	3.3	4.3	4.1	3.9	4.4	4.9
Geothermal	-	–	–	–	–	–	–
Solar/Wind/Other	–	0.1	0.1	0.1	0.1	0.1	0.1
Electricity	4.5	11.1	16.4	17.1	19.8	24.6	30.2
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*12.3*	*7.4*	*3.8*	*4.5*	*3.3*	*2.8*	*2.4*
Oil	*61.7*	*52.6*	*51.6*	*50.7*	*49.1*	*49.5*	*50.3*
Gas	*5.9*	*15.2*	*15.9*	*16.0*	*21.0*	*21.0*	*20.7*
Comb. Renewables & Waste	*8.7*	*5.6*	*5.9*	*5.6*	*4.4*	*4.1*	*3.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Electricity	*11.3*	*19.1*	*22.6*	*23.1*	*22.1*	*22.5*	*22.8*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[6]	**17.6**	**23.1**	**25.8**	**27.0**	**37.6**	**45.9**	**55.8**
Coal[1]	4.6	4.1	2.6	3.2	2.8	3.0	3.0
Oil	7.7	6.3	6.0	5.9	9.9	12.7	16.7
Gas	1.8	6.1	7.5	7.7	13.5	16.5	19.8
Comb. Renewables & Waste[2]	1.5	1.5	2.4	2.5	2.3	2.8	3.3
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	2.0	5.1	7.3	7.7	9.1	11.0	13.0
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*26.4*	*17.6*	*10.2*	*11.7*	*7.5*	*6.5*	*5.3*
Oil	*43.8*	*27.4*	*23.2*	*21.8*	*26.2*	*27.6*	*29.9*
Gas	*10.0*	*26.5*	*29.2*	*28.6*	*35.8*	*35.9*	*35.4*
Comb. Renewables & Waste	*8.5*	*6.4*	*9.2*	*9.4*	*6.2*	*6.1*	*6.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.3*	*22.0*	*28.3*	*28.4*	*24.3*	*23.9*	*23.3*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**13.5**	**22.7**	**29.2**	**29.3**	**33.8**	**41.1**	**49.2**
TOTAL OTHER SECTORS[8]	**8.9**	**12.3**	**17.3**	**17.6**	**18.1**	**22.4**	**27.4**
Coal[1]	0.3	0.1	0.1	0.1	0.0	0.0	0.0
Oil	3.5	1.8	2.7	2.8	1.1	1.3	1.6
Gas	0.6	2.7	3.7	3.8	4.8	5.9	7.2
Comb. Renewables & Waste[2]	2.0	1.8	1.9	1.6	1.6	1.6	1.6
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.1	0.1	0.1	0.1	0.1	0.1
Electricity	2.5	5.9	8.9	9.2	10.5	13.4	16.9
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*3.2*	*1.1*	*0.4*	*0.5*	*0.2*	*0.1*	*0.1*
Oil	*39.7*	*14.2*	*15.8*	*16.2*	*5.9*	*5.8*	*5.8*
Gas	*7.0*	*21.8*	*21.2*	*21.5*	*26.7*	*26.4*	*26.1*
Comb. Renewables & Waste	*22.5*	*14.4*	*10.8*	*9.1*	*8.9*	*7.2*	*5.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.7*	*0.5*	*0.4*	*0.4*	*0.4*	*0.4*
Electricity	*27.7*	*47.7*	*51.3*	*52.4*	*58.0*	*60.0*	*61.7*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**16.0**	**35.1**	**54.6**	**55.3**	**64.7**	**77.3**	**91.0**
OUTPUT (Mtoe)	**5.5**	**13.3**	**19.6**	**20.6**	**23.0**	**28.7**	**35.2**
(TWh gross)	64.4	154.3	227.8	239.3	267.9	333.7	409.1
Output Shares (%)							
Coal	*74.9*	*77.1*	*77.2*	*79.3*	*73.8*	*72.1*	*68.8*
Oil	*2.6*	*2.7*	*1.0*	*0.7*	*1.2*	*1.1*	*1.0*
Gas	*4.3*	*10.6*	*13.8*	*12.3*	*16.3*	*18.4*	*21.8*
Comb. Renewables & Waste	*0.5*	*0.4*	*0.6*	*0.6*	*1.0*	*1.4*	*2.1*
Nuclear	–	–	–	–	–	–	–
Hydro	*17.7*	*9.2*	*7.0*	*6.8*	*6.3*	*5.2*	*4.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.3*	*0.3*	*1.4*	*1.8*	*1.9*
TOTAL LOSSES	**17.8**	**29.3**	**46.2**	**46.9**	**54.6**	**65.4**	**75.1**
of which:							
Electricity and Heat Generation[10]	10.5	21.7	35.0	34.7	41.7	48.6	55.8
Other Transformation	5.5	0.6	2.6	3.0	4.2	4.8	5.4
Own Use and Losses[11]	1.7	7.0	8.6	9.1	8.8	12.0	13.8
Statistical Differences	**-0.1**	**0.2**	**-5.6**	**-5.0**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	172.80	280.50	445.20	455.60	558.30	769.86	1 040.48
Population (millions)	13.61	17.18	19.98	20.21	21.33	23.19	24.78
TPES/GDP[12]	0.33	0.31	0.25	0.25	0.26	0.23	0.20
Energy Production/TPES	1.18	1.80	2.25	2.26	2.39	2.59	2.57
Per Capita TPES[13]	4.23	5.10	5.65	5.73	6.75	7.54	8.37
Oil Supply/GDP[12]	0.16	0.12	0.08	0.08	0.08	0.07	0.07
TFC/GDP[12]	0.23	0.21	0.16	0.16	0.16	0.14	0.13
Per Capita TFC[13]	2.94	3.38	3.62	3.66	4.19	4.72	5.34
Energy-related CO_2 Emissions (Mt CO_2)[14]	157.9	259.7	348.1	354.4	414.4	499.6	586.4
CO_2 Emissions from Bunkers (Mt CO_2)	7.3	6.3	9.2	9.6	11.5	15.0	19.3

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	3.0	2.2	2.0	2.5	3.7	1.9	1.7
Coal	1.5	3.2	2.5	2.4	2.5	1.5	1.1
Oil	2.9	0.1	0.8	3.1	3.9	2.1	2.0
Gas	12.7	7.1	3.2	2.6	6.2	2.5	2.0
Comb. Renewables & Waste	0.1	1.0	1.8	-0.1	2.2	2.4	3.0
Nuclear	–	–	–	–	–	–	–
Hydro	5.1	-0.7	1.0	1.4	0.7	0.1	0.5
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	17.3	4.9	-18.0	21.5	4.5	2.6
TFC	2.5	2.1	1.7	2.3	3.2	2.0	1.9
Electricity Consumption	6.3	5.0	3.0	4.4	2.5	2.2	2.1
Energy Production	3.9	5.7	3.7	3.2	4.7	2.8	1.6
Net Oil Imports	4.2	-6.9	1.4	24.5	8.1	8.4	4.5
GDP	2.6	3.0	3.6	2.3	3.4	3.3	3.1
Growth in the TPES/GDP Ratio	0.4	-0.8	-1.6	0.2	0.3	-1.3	-1.3
Growth in the TFC/GDP Ratio	-0.1	-0.9	-1.9	-0.1	-0.2	-1.2	-1.1

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**7.9**	**8.1**	**9.7**	**9.9**	**10.8**	**11.1**	**..**
Coal[1]		1.0	0.6	0.3	0.1	0.0	0.1	..
Oil		2.7	1.2	1.0	1.1	0.9	0.6	..
Gas		2.0	1.1	1.8	1.7	1.6	1.3	..
Comb. Renewables & Waste[2]		0.7	2.4	3.7	3.8	4.7	5.6	..
Nuclear		–	–	–	–	–	–	..
Hydro		1.6	2.7	2.8	3.1	3.1	3.0	..
Geothermal		–	0.0	0.0	0.0	0.0	0.0	..
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.4	0.5	..
TOTAL NET IMPORTS[4]		**14.0**	**17.2**	**23.2**	**23.6**	**23.5**	**25.0**	**..**
Coal[1]	Exports	0.1	0.0	0.0	0.0	–	–	..
	Imports	3.1	3.2	3.5	3.8	4.0	4.8	..
	Net Imports	3.0	3.2	3.5	3.8	4.0	4.8	..
Oil	Exports	0.1	0.6	1.5	1.6	1.7	1.7	..
	Imports	9.9	10.2	14.8	15.2	14.6	15.1	..
	Bunkers	–	–	–	–	–	–	..
	Net Imports	9.7	9.6	13.3	13.5	13.0	13.4	..
Gas	Exports	–	–	0.9	1.1	0.9	0.9	..
	Imports	1.3	4.4	6.8	7.1	7.1	7.7	..
	Net Imports	1.3	4.4	5.9	6.0	6.3	6.8	..
Electricity	Exports	0.4	0.6	1.2	1.2	1.1	1.1	..
	Imports	0.3	0.6	1.6	1.4	1.4	2.0	..
	Net Imports	-0.1	-0.0	0.5	0.3	0.2	0.9	..
TOTAL STOCK CHANGES		**-0.3**	**-0.3**	**0.1**	**-0.3**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**21.7**	**25.0**	**33.0**	**33.2**	**34.3**	**36.1**	**..**
Coal[1]		3.9	4.1	4.1	4.0	4.1	4.9	..
Oil		12.3	10.6	14.2	14.3	13.8	14.0	..
Gas		3.3	5.2	7.6	7.6	7.9	8.1	..
Comb. Renewables & Waste[2]		0.7	2.5	3.7	3.7	4.7	4.7	..
Nuclear		–	–	–	–	–	–	..
Hydro		1.6	2.7	2.8	3.1	3.1	3.0	..
Geothermal		–	0.0	0.0	0.0	0.0	0.0	..
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.4	0.5	..
Electricity Trade[5]		-0.1	-0.0	0.5	0.3	0.2	0.9	..
Shares (%)								
Coal		*17.9*	*16.4*	*12.4*	*11.9*	*11.8*	*13.5*	..
Oil		*56.7*	*42.3*	*43.1*	*43.0*	*40.3*	*38.6*	..
Gas		*15.3*	*20.7*	*22.9*	*23.0*	*23.0*	*22.5*	..
Comb. Renewables & Waste		*3.3*	*9.9*	*11.1*	*11.3*	*13.8*	*13.1*	..
Nuclear		–	–	–	–	–	–	..
Hydro		*7.5*	*10.8*	*8.6*	*9.4*	*9.2*	*8.3*	..
Geothermal		–	–	*0.1*	*0.1*	*0.1*	*0.1*	..
Solar/Wind/Other		–	*0.1*	*0.3*	*0.5*	*1.2*	*1.3*	..
Electricity Trade		*-0.6*	*-0.2*	*1.5*	*0.8*	*0.7*	*2.5*	..

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**16.8**	**20.0**	**27.4**	**27.6**	**30.1**	**32.7**	**..**
Coal[1]	2.0	1.3	0.7	0.6	1.9	1.9	..
Oil	10.2	9.2	13.1	13.0	12.4	12.3	..
Gas	1.8	3.1	4.6	4.9	5.1	5.8	..
Comb. Renewables & Waste[2]	0.7	2.2	2.7	2.7	3.3	3.0	..
Geothermal	–	0.0	0.0	0.0	0.0	0.0	..
Solar/Wind/Other	–	0.0	0.1	0.1	–	–	..
Electricity	2.2	3.7	4.9	5.0	5.9	7.7	..
Heat	–	0.6	1.3	1.3	1.5	1.9	..
Shares (%)							
Coal	*11.8*	*6.4*	*2.7*	*2.3*	*6.3*	*5.7*	..
Oil	*60.4*	*46.0*	*47.9*	*47.1*	*41.2*	*37.7*	..
Gas	*10.7*	*15.3*	*16.8*	*17.8*	*17.1*	*17.8*	..
Comb. Renewables & Waste	*4.1*	*10.8*	*9.8*	*9.6*	*10.9*	*9.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.1*	*0.3*	*0.3*	–	–	..
Electricity	*12.9*	*18.4*	*17.8*	*18.1*	*19.5*	*23.7*	..
Heat	–	*3.1*	*4.8*	*4.7*	*5.0*	*5.9*	..
TOTAL INDUSTRY[6]	**6.5**	**6.9**	**8.7**	**8.8**	**10.6**	**11.2**	**..**
Coal[1]	0.7	0.6	0.5	0.5	1.8	1.8	..
Oil	3.3	2.1	2.8	2.8	2.7	2.7	..
Gas	1.3	2.0	2.4	2.7	2.8	3.3	..
Comb. Renewables & Waste[2]	0.0	0.6	0.9	0.8	1.1	0.9	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	1.0	1.5	1.8	1.9	2.1	2.3	..
Heat	–	0.1	0.2	0.2	0.2	0.2	..
Shares (%)							
Coal	*11.5*	*8.5*	*6.1*	*5.6*	*16.7*	*16.2*	..
Oil	*51.7*	*30.2*	*32.4*	*31.5*	*25.2*	*24.0*	..
Gas	*20.2*	*28.8*	*27.6*	*30.3*	*26.1*	*29.6*	..
Comb. Renewables & Waste	*0.5*	*8.8*	*10.6*	*9.1*	*9.9*	*7.6*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*16.1*	*22.5*	*21.1*	*21.6*	*20.0*	*20.4*	..
Heat	–	*1.1*	*2.2*	*2.0*	*2.0*	*2.1*	..
TRANSPORT[7]	**4.0**	**4.9**	**7.9**	**8.2**	**7.8**	**7.9**	**..**
TOTAL OTHER SECTORS[8]	**6.3**	**8.2**	**10.8**	**10.7**	**11.6**	**13.6**	**..**
Coal[1]	1.1	0.7	0.2	0.2	0.1	0.1	..
Oil	3.1	2.6	3.0	2.6	2.7	2.3	..
Gas	0.5	1.0	2.0	2.0	2.1	2.2	..
Comb. Renewables & Waste[2]	0.7	1.6	1.7	1.8	2.0	2.1	..
Geothermal	–	0.0	0.0	0.0	0.0	0.0	..
Solar/Wind/Other	–	0.0	0.1	0.1	–	–	..
Electricity	1.0	1.9	2.7	2.8	3.4	5.1	..
Heat	–	0.5	1.1	1.1	1.3	1.7	..
Shares (%)							
Coal	*17.9*	*8.3*	*1.9*	*1.5*	*1.0*	*0.4*	..
Oil	*48.6*	*31.2*	*27.3*	*24.8*	*23.0*	*16.9*	..
Gas	*7.6*	*11.8*	*18.3*	*18.7*	*18.4*	*16.5*	..
Comb. Renewables & Waste	*10.3*	*18.9*	*16.1*	*17.2*	*16.8*	*15.8*	..
Geothermal	–	–	*0.1*	*0.1*	*0.1*	*0.1*	..
Solar/Wind/Other	–	*0.2*	*0.7*	*0.8*	–	–	..
Electricity	*15.6*	*23.0*	*25.3*	*26.5*	*29.7*	*37.8*	..
Heat	–	*6.5*	*10.3*	*10.5*	*11.1*	*12.5*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.9**	**7.1**	**8.9**	**9.2**	**10.5**	**12.6**	..
OUTPUT (Mtoe)	**2.7**	**4.2**	**5.0**	**5.3**	**6.3**	**7.7**	..
(TWh gross)	30.9	49.3	57.7	61.6	73.4	89.4	..
Output Shares (%)							
Coal	*10.3*	*14.2*	*16.4*	*14.8*	*12.3*	*19.0*	..
Oil	*14.1*	*3.8*	*3.0*	*3.0*	*0.8*	*0.6*	..
Gas	*14.3*	*15.7*	*19.4*	*17.8*	*27.2*	*27.4*	..
Comb. Renewables & Waste	*0.7*	*2.4*	*3.5*	*3.8*	*3.4*	*7.8*	..
Nuclear	–	–	–	–	–	–	..
Hydro	*60.6*	*63.9*	*57.0*	*59.1*	*49.8*	*39.1*	..
Geothermal	–	–	*0.0*	*0.0*	*0.0*	*0.0*	..
Solar/Wind/Other	–	–	*0.7*	*1.5*	*6.4*	*6.0*	..
TOTAL LOSSES	**4.7**	**5.0**	**5.5**	**5.4**	**5.1**	**6.1**	..
of which:							
Electricity and Heat Generation[10]	2.2	2.2	2.6	2.6	2.6	2.9	..
Other Transformation	1.3	0.7	0.8	0.8	0.1	0.1	..
Own Use and Losses[11]	1.2	2.1	2.1	2.1	2.4	3.0	..
Statistical Differences	**0.1**	**0.0**	**0.2**	**0.2**	**-0.9**	**-2.6**	..

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	99.00	150.70	200.10	205.00	230.86	281.42	..
Population (millions)	7.59	7.68	8.12	8.18	8.20	8.28	..
TPES/GDP[12]	0.22	0.17	0.17	0.16	0.15	0.13	..
Energy Production/TPES	0.37	0.32	0.29	0.30	0.32	0.31	..
Per Capita TPES[13]	2.85	3.26	4.07	4.06	4.19	4.36	..
Oil Supply/GDP[12]	0.12	0.07	0.07	0.07	0.06	0.05	..
TFC/GDP[12]	0.17	0.13	0.14	0.13	0.13	0.12	..
Per Capita TFC[13]	2.22	2.60	3.38	3.38	3.67	3.94	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	54.3	57.6	75.4	75.1	75.5	79.7	..
CO_2 Emissions from Bunkers (Mt CO_2)	0.3	0.9	1.3	1.5	1.7	2.1	..

GROWTH RATES (% per year)	73-79	79-90	90-03	03-04	04-10	10-20	20-30
TPES	1.7	0.4	2.2	0.5	0.6	0.5	..
Coal	-1.1	1.1	0.0	-3.6	0.4	1.9	..
Oil	0.8	-1.8	2.3	0.2	-0.5	0.1	..
Gas	4.6	1.7	2.9	0.9	0.6	0.3	..
Comb. Renewables & Waste	6.3	8.2	3.1	2.0	3.9	0.0	..
Nuclear	–	–	–	–	–	–	..
Hydro	6.7	1.2	0.3	10.7	0.1	-0.5	..
Geothermal	–	–	17.9	-2.9	-2.7	3.9	..
Solar/Wind/Other	–	–	16.6	48.6	16.2	1.3	..
TFC	2.2	0.4	2.5	0.8	1.4	0.8	..
Electricity Consumption	3.9	2.7	2.2	2.8	2.7	2.8	..
Energy Production	0.2	0.1	1.4	1.5	1.6	0.2	..
Net Oil Imports	2.7	-1.6	2.5	1.7	-0.7	0.3	..
GDP	3.0	2.2	2.2	2.4	2.0	2.0	..
Growth in the TPES/GDP Ratio	-1.3	-1.8	-0.0	-1.9	-1.4	-1.5	..
Growth in the TFC/GDP Ratio	-0.8	-1.8	0.2	-1.6	-0.6	-1.1	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**6.5**	**13.1**	**13.4**	**13.5**	**13.7**	**11.2**	**2.4**
Coal[1]		6.4	1.2	0.1	0.1	..	..	..
Oil		–	–	–	–	–	–	–
Gas		0.0	0.0	–	–	–	–	–
Comb. Renewables & Waste[2]		0.0	0.7	1.0	1.1	1.6	1.9	2.1
Nuclear		0.0	11.1	12.3	12.3	12.1	9.2	–
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geothermal		–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Wind/Other[3]		–	0.0	0.0	0.0	0.1	0.1	0.3
TOTAL NET IMPORTS[4]		**39.8**	**36.0**	**45.8**	**44.3**	**47.8**	**51.9**	**59.0**
Coal[1]	Exports	0.8	1.1	0.7	0.9	..	..	..
	Imports	5.3	10.8	6.5	6.7	..	..	..
	Net Imports	4.6	9.7	5.8	5.9	4.2	3.1	10.0
Oil	Exports	15.1	19.2	23.8	25.8	..	..	..
	Imports	46.4	41.7	55.8	56.5	..	..	..
	Bunkers	3.1	4.1	6.9	7.8	5.8	6.2	6.7
	Net Imports	28.2	18.4	25.0	23.0	23.2	24.0	24.1
Gas	Exports	–	–	–	–	–	–	–
	Imports	7.1	8.2	14.2	14.6	20.0	24.4	24.6
	Net Imports	7.1	8.2	14.2	14.6	20.0	24.4	24.6
Electricity	Exports	0.2	0.7	0.7	0.6	..	..	..
	Imports	0.1	0.4	1.3	1.3	..	..	..
	Net Imports	-0.1	-0.3	0.6	0.7	0.4	0.4	0.4
TOTAL STOCK CHANGES		**-0.0**	**0.1**	**-0.0**	**-0.1**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**46.3**	**49.1**	**59.2**	**57.7**	**61.5**	**63.1**	**61.4**
Coal[1]		11.2	10.7	5.9	5.8	4.2	3.1	10.0
Oil		28.0	18.7	24.8	23.0	23.2	24.0	24.1
Gas		7.1	8.2	14.4	14.6	20.0	24.4	24.6
Comb. Renewables & Waste[2]		0.0	0.7	1.2	1.3	1.6	1.9	2.1
Nuclear		0.0	11.1	12.3	12.3	12.1	9.2	–
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geothermal		–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Wind/Other[3]		–	0.0	0.0	0.0	0.1	0.1	0.3
Electricity Trade[5]		-0.1	-0.3	0.6	0.7	0.4	0.4	0.4
Shares (%)								
Coal		*24.1*	*21.7*	*10.0*	*10.0*	*6.8*	*5.0*	*16.2*
Oil		*60.5*	*38.2*	*41.8*	*39.9*	*37.7*	*38.0*	*39.1*
Gas		*15.4*	*16.6*	*24.3*	*25.2*	*32.6*	*38.6*	*40.1*
Comb. Renewables & Waste		–	*1.4*	*2.0*	*2.2*	*2.6*	*3.0*	*3.4*
Nuclear		–	*22.7*	*20.9*	*21.4*	*19.6*	*14.6*	–
Hydro		–	–	–	–	*0.1*	*0.1*	*0.1*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	–	–	*0.1*	*0.1*	*0.5*
Electricity Trade		*-0.1*	*-0.7*	*0.9*	*1.2*	*0.6*	*0.6*	*0.6*

0 is negligible, – is nil, .. is not available.
Please note: All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**34.6**	**33.2**	**42.6**	**41.3**	**45.4**	**47.8**	**49.1**
Coal[1]	5.7	3.5	1.8	1.6	1.7	1.4	1.2
Oil	21.0	17.3	22.6	20.9	21.6	22.4	22.4
Gas	4.6	6.8	10.5	10.8	12.7	13.2	13.6
Comb. Renewables & Waste[2]	–	0.3	0.4	0.5	0.7	0.9	1.0
Geothermal	–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Wind/Other	–	0.0	0.0	0.0	0.0	0.0	0.1
Electricity	2.9	5.0	6.9	6.9	7.7	8.8	9.6
Heat	0.3	0.2	0.5	0.5	0.9	1.1	1.2
Shares (%)							
Coal	*16.5*	*10.6*	*4.2*	*3.8*	*3.6*	*2.8*	*2.4*
Oil	*60.7*	*52.2*	*52.9*	*50.7*	*47.6*	*46.8*	*45.7*
Gas	*13.3*	*20.5*	*24.6*	*26.2*	*28.1*	*27.6*	*27.7*
Comb. Renewables & Waste	–	*1.0*	*1.1*	*1.2*	*1.6*	*1.9*	*2.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	*0.1*	*0.2*
Electricity	*8.5*	*15.0*	*16.1*	*16.8*	*17.1*	*18.4*	*19.5*
Heat	*0.9*	*0.7*	*1.2*	*1.3*	*2.0*	*2.4*	*2.5*
TOTAL INDUSTRY[6]	**16.8**	**13.6**	**17.0**	**15.9**	**20.7**	**21.5**	**21.2**
Coal[1]	3.5	3.0	1.6	1.4	1.6	1.3	1.2
Oil	7.9	4.3	6.0	5.0	7.1	7.5	7.5
Gas	3.2	3.3	5.2	5.3	6.8	6.9	6.8
Comb. Renewables & Waste[2]	–	0.1	0.3	0.3	0.2	0.2	0.2
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.9	2.6	3.4	3.5	4.1	4.4	4.3
Heat	0.3	0.2	0.4	0.4	0.9	1.1	1.1
Shares (%)							
Coal	*21.1*	*22.2*	*9.5*	*8.9*	*7.8*	*6.3*	*5.4*
Oil	*46.8*	*31.8*	*35.3*	*31.6*	*34.5*	*35.1*	*35.6*
Gas	*18.7*	*24.3*	*30.8*	*33.2*	*32.8*	*32.1*	*32.3*
Comb. Renewables & Waste	–	*1.0*	*1.5*	*1.9*	*0.9*	*1.0*	*1.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.5*	*19.3*	*20.3*	*21.9*	*19.9*	*20.6*	*20.3*
Heat	*1.9*	*1.4*	*2.6*	*2.5*	*4.1*	*4.9*	*5.4*
TRANSPORT[7]	**5.0**	**7.9**	**10.4**	**10.5**	**10.7**	**11.6**	**12.3**
TOTAL OTHER SECTORS[8]	**12.7**	**11.7**	**15.3**	**14.9**	**14.0**	**14.7**	**15.6**
Coal[1]	2.2	0.5	0.1	0.2	0.0	0.0	0.0
Oil	8.1	5.2	6.3	5.6	4.2	3.9	3.5
Gas	1.5	3.5	5.3	5.5	6.0	6.3	6.8
Comb. Renewables & Waste[2]	–	0.2	0.2	0.2	0.2	0.2	0.1
Geothermal	–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Wind/Other	–	0.0	0.0	0.0	0.0	0.0	0.1
Electricity	0.9	2.3	3.3	3.3	3.5	4.2	5.1
Heat	–	0.0	0.1	0.1	0.1	0.1	0.1
Shares (%)							
Coal	*17.0*	*4.5*	*1.0*	*1.1*	*0.2*	*0.1*	–
Oil	*64.2*	*44.5*	*41.4*	*37.5*	*30.4*	*26.6*	*22.2*
Gas	*11.4*	*30.0*	*34.5*	*37.0*	*42.6*	*42.7*	*43.2*
Comb. Renewables & Waste	–	*1.6*	*1.3*	*1.3*	*1.2*	*1.1*	*0.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	*0.1*	*0.2*	*0.4*
Electricity	*7.4*	*19.2*	*21.5*	*22.3*	*25.0*	*28.9*	*32.9*
Heat	–	*0.3*	*0.4*	*0.8*	*0.5*	*0.5*	*0.4*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**10.0**	**17.7**	**19.9**	**20.1**	**21.2**	**21.7**	**19.7**
OUTPUT (Mtoe)	**3.5**	**6.0**	**7.2**	**7.3**	**8.3**	**9.5**	**10.3**
(TWh gross)	40.6	70.3	83.6	84.4	96.5	110.0	120.0
Output Shares (%)							
Coal	*21.7*	*28.2*	*13.9*	*13.6*	*4.5*	*1.8*	*37.4*
Oil	*53.7*	*1.9*	*1.2*	*2.0*	*0.2*	*0.0*	*0.0*
Gas	*23.7*	*7.7*	*25.9*	*25.5*	*43.9*	*62.9*	*58.1*
Comb. Renewables & Waste	*0.3*	*1.0*	*1.9*	*2.3*	*2.5*	*2.3*	*2.0*
Nuclear	*0.2*	*60.8*	*56.7*	*56.1*	*47.9*	*32.2*	–
Hydro	*0.4*	*0.4*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.0*	*0.1*	*0.2*	*0.5*	*0.5*	*2.1*
TOTAL LOSSES	**12.6**	**16.2**	**16.7**	**16.6**	**16.2**	**15.3**	**12.3**
of which:							
Electricity and Heat Generation[10]	6.2	11.4	12.2	12.3	11.9	11.0	8.1
Other Transformation	5.0	2.1	1.7	1.7	1.6	1.5	1.4
Own Use and Losses[11]	1.4	2.7	2.8	2.7	2.7	2.8	2.9
Statistical Differences	**-0.9**	**-0.3**	**-0.1**	**-0.2**	**–**	**–**	**–**

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	128.10	187.90	240.10	246.30	289.16	344.62	405.10
Population (millions)	9.73	9.97	10.37	10.42	10.51	10.70	10.88
TPES/GDP[12]	0.36	0.26	0.25	0.23	0.21	0.18	0.15
Energy Production/TPES	0.14	0.27	0.23	0.23	0.22	0.18	0.04
Per Capita TPES[13]	4.76	4.93	5.71	5.54	5.85	5.90	5.65
Oil Supply/GDP[12]	0.22	0.10	0.10	0.09	0.08	0.07	0.06
TFC/GDP[12]	0.27	0.18	0.18	0.17	0.16	0.14	0.12
Per Capita TFC[13]	3.55	3.33	4.11	3.96	4.32	4.46	4.51
Energy-related CO_2 Emissions (Mt CO_2)[14]	133.6	108.5	119.6	116.1	123.3	131.4	158.3
CO_2 Emissions from Bunkers (Mt CO_2)	11.3	16.0	26.6	29.0	23.4	25.8	28.3

GROWTH RATES (% per year)	73–79	79–90	90–03	03–04	04–10	10–20	20–30
TPES	1.0	-0.0	1.4	-2.5	1.1	0.3	-0.3
Coal	0.3	-0.6	-4.4	-2.7	-5.3	-2.8	12.3
Oil	-1.5	-2.8	2.2	-7.0	0.1	0.3	0.0
Gas	4.5	-1.2	4.5	1.2	5.5	2.0	0.1
Comb. Renewables & Waste	41.7	22.8	3.9	9.6	3.7	1.8	0.9
Nuclear	130.2	12.8	0.8	-0.1	-0.4	-2.6	–
Hydro	4.9	1.3	-0.7	28.6	7.2	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	19.4	50.0	23.8	3.6	14.0
TFC	0.5	-0.6	1.9	-3.2	1.6	0.5	0.3
Electricity Consumption	4.2	2.6	2.5	1.1	1.9	1.3	0.8
Energy Production	2.7	5.0	0.2	0.6	0.2	-2.0	-14.3
Net Oil Imports	-0.8	-3.4	2.4	-8.2	0.2	0.3	0.0
GDP	2.4	2.2	1.9	2.6	2.7	1.8	1.6
Growth in the TPES/GDP Ratio	-1.3	-2.2	-0.4	-5.0	-1.6	-1.5	-1.9
Growth in the TFC/GDP Ratio	-1.9	-2.8	0.0	-5.7	-1.1	-1.2	-1.3

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

	1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION	**198.0**	**273.7**	**385.8**	**397.5**	**593.9**	**607.1**	**..**
Coal[1]	11.7	37.9	30.3	32.3	39.9	38.7	..
Oil	96.3	94.1	144.2	149.6	263.2	220.4	..
Gas	61.4	88.6	151.1	150.7	216.2	271.1	..
Comb. Renewables & Waste[2]	7.8	8.2	11.6	11.9	17.0	19.0	..
Nuclear	4.1	19.4	19.5	23.6	23.9	22.7	..
Hydro	16.7	25.5	29.0	29.3	33.3	34.6	..
Geothermal	–	–	–	–	0.4	0.4	..
Solar/Wind/Other[3]	–	0.0	0.1	0.1	0.1	0.1	..
TOTAL NET IMPORTS[4]	**-36.6**	**-60.3**	**-127.4**	**-134.6**	**-286.4**	**-256.6**	**..**
Coal[1] Exports	7.6	21.4	14.9	15.4	23.1	23.1	..
Imports	10.5	9.5	13.3	11.5	8.7	2.1	..
Net Imports	2.8	-11.9	-1.7	-3.9	-14.4	-21.0	..
Oil Exports	63.1	49.7	106.3	111.3	219.1	171.6	..
Imports	48.8	34.8	57.0	59.4	54.2	60.0	..
Bunkers	1.1	0.9	0.5	0.6	0.7	0.8	..
Net Imports	-15.4	-15.9	-49.8	-52.5	-165.6	-112.4	..
Gas Exports	23.1	33.0	83.3	86.3	105.4	122.8	..
Imports	0.3	0.5	7.9	8.9	1.0	1.0	..
Net Imports	-22.8	-32.5	-75.4	-77.4	-104.4	-121.7	..
Electricity Exports	1.4	1.6	2.7	2.9	5.4	4.7	..
Imports	0.2	1.5	2.1	2.0	3.4	3.3	..
Net Imports	-1.2	-0.0	-0.6	-0.9	-2.0	-1.4	..
TOTAL STOCK CHANGES	-1.6	-4.0	4.1	6.2	–	–	..
TOTAL SUPPLY (TPES)	**159.8**	**209.4**	**262.6**	**269.0**	**307.5**	**350.5**	**..**
Coal[1]	15.3	24.3	30.3	28.7	25.5	17.7	..
Oil	79.9	77.3	92.8	98.2	97.6	108.0	..
Gas	37.3	54.7	79.7	78.0	111.8	149.4	..
Comb. Renewables & Waste[2]	7.8	8.2	11.7	12.0	17.0	19.0	..
Nuclear	4.1	19.4	19.5	23.6	23.9	22.7	..
Hydro	16.7	25.5	29.0	29.3	33.3	34.6	..
Geothermal	–	–	–	–	0.4	0.4	..
Solar/Wind/Other[3]	–	0.0	0.1	0.1	0.1	0.1	..
Electricity Trade[5]	-1.2	-0.0	-0.6	-0.9	-2.0	-1.4	..
Shares (%)							
Coal	*9.5*	*11.6*	*11.6*	*10.7*	*8.3*	*5.1*	..
Oil	*50.0*	*36.9*	*35.4*	*36.5*	*31.7*	*30.8*	..
Gas	*23.3*	*26.1*	*30.4*	*29.0*	*36.4*	*42.6*	..
Comb. Renewables & Waste	*4.9*	*3.9*	*4.5*	*4.4*	*5.5*	*5.4*	..
Nuclear	*2.5*	*9.3*	*7.4*	*8.8*	*7.8*	*6.5*	..
Hydro	*10.5*	*12.2*	*11.1*	*10.9*	*10.8*	*9.9*	..
Geothermal –	–	–	–	*0.1*	*0.1*	..	
Solar/Wind/Other –	–	–	–	–	–	..	
Electricity Trade	*-0.8*	–	*-0.2*	*-0.3*	*-0.7*	*-0.4*	..

0 is negligible, – is nil, .. is not available.

Please note: All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**132.1**	**160.1**	**197.3**	**201.7**	**219.8**	**248.1**	**..**
Coal[1]	5.2	3.1	3.2	3.5	2.9	2.2	..
Oil	76.5	69.9	87.4	91.4	86.8	98.2	..
Gas	23.7	43.3	53.1	52.7	63.5	72.4	..
Comb. Renewables & Waste[2]	7.6	7.3	9.6	9.9	15.6	17.5	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	18.9	36.0	43.1	43.3	50.3	57.0	..
Heat	0.1	0.6	0.9	1.0	0.7	0.9	..
Shares (%)							
Coal	*4.0*	*1.9*	*1.6*	*1.7*	*1.3*	*0.9*	..
Oil	*57.9*	*43.6*	*44.3*	*45.3*	*39.5*	*39.6*	..
Gas	*18.0*	*27.0*	*26.9*	*26.1*	*28.9*	*29.2*	..
Comb. Renewables & Waste	*5.8*	*4.5*	*4.9*	*4.9*	*7.1*	*7.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*14.3*	*22.5*	*21.8*	*21.4*	*22.9*	*23.0*	..
Heat	*0.1*	*0.4*	*0.5*	*0.5*	*0.3*	*0.3*	..
TOTAL INDUSTRY[6]	**52.8**	**62.0**	**77.0**	**79.9**	**95.7**	**107.9**	**..**
Coal[1]	4.7	3.0	3.2	3.5	2.8	2.2	..
Oil	21.4	18.0	24.4	26.4	24.9	27.6	..
Gas	11.9	20.2	23.1	23.6	31.2	36.2	..
Comb. Renewables & Waste[2]	5.7	5.7	7.6	8.0	13.6	15.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	9.1	14.4	17.8	17.6	22.4	25.8	..
Heat	0.1	0.6	0.9	1.0	0.7	0.9	..
Shares (%)							
Coal	*8.9*	*4.9*	*4.2*	*4.4*	*3.0*	*2.0*	..
Oil	*40.4*	*29.0*	*31.7*	*33.0*	*26.0*	*25.6*	..
Gas	*22.5*	*32.7*	*30.0*	*29.5*	*32.6*	*33.6*	..
Comb. Renewables & Waste	*10.8*	*9.1*	*9.9*	*9.9*	*14.2*	*14.2*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*17.2*	*23.3*	*23.1*	*22.0*	*23.4*	*23.9*	..
Heat	*0.2*	*1.0*	*1.2*	*1.2*	*0.8*	*0.8*	..
TRANSPORT[7]	**34.2**	**44.2**	**53.9**	**55.6**	**64.5**	**75.4**	**..**
TOTAL OTHER SECTORS[8]	**45.1**	**54.0**	**66.4**	**66.2**	**59.7**	**64.8**	**..**
Coal[1]	0.4	0.1	0.0	0.0	0.1	0.1	..
Oil	21.3	10.9	13.4	13.4	6.5	6.9	..
Gas	11.9	20.2	26.2	25.5	24.5	25.7	..
Comb. Renewables & Waste[2]	1.9	1.6	1.8	1.8	2.0	2.2	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	9.5	21.2	24.9	25.4	26.7	30.0	..
Heat	–	0.0	0.0	0.0	–	–	..
Shares (%)							
Coal	*0.9*	*0.1*	–	–	*0.1*	*0.1*	..
Oil	*47.4*	*20.2*	*20.2*	*20.3*	*10.8*	*10.7*	..
Gas	*26.3*	*37.4*	*39.4*	*38.5*	*41.0*	*39.6*	..
Comb. Renewables & Waste	*4.2*	*3.0*	*2.8*	*2.8*	*3.3*	*3.3*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*21.2*	*39.3*	*37.5*	*38.3*	*44.7*	*46.2*	..
Heat	–	–	–	–	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**36.1**	**71.4**	**89.2**	**90.9**	**97.6**	**103.1**	**..**
OUTPUT (Mtoe)	**23.2**	**41.4**	**50.7**	**51.5**	**60.5**	**67.4**	**..**
(TWh gross)	270.1	481.9	589.9	598.4	703.6	783.5	..
Output Shares (%)		..					
Coal	*12.9*	*17.1*	*19.2*	*17.2*	*14.2*	*10.5*	..
Oil	*3.4*	*3.4*	*3.7*	*3.6*	*2.1*	*1.9*	..
Gas	*6.0*	*2.0*	*5.6*	*5.4*	*13.7*	*23.2*	..
Comb. Renewables & Waste	–	*0.8*	*1.5*	*1.5*	*2.1*	*2.1*	..
Nuclear	*5.6*	*15.1*	*12.7*	*15.1*	*12.7*	*10.8*	..
Hydro	*72.1*	*61.6*	*57.2*	*57.0*	*55.0*	*51.3*	..
Geothermal	–	–	–	–	*0.1*	*0.1*	..
Solar/Wind/Other	–	*0.0*	*0.1*	*0.2*	*0.1*	*0.1*	..
TOTAL LOSSES	**31.2**	**49.2**	**63.6**	**64.5**	**87.7**	**102.3**	**..**
of which:							
Electricity and Heat Generation[10]	12.8	29.4	37.5	38.5	36.3	34.8	..
Other Transformation	1.9	–1.3	-6.2	–4.7	–5.0	–2.7	..
Own Use and Losses[11]	16.5	21.1	32.3	30.8	56.3	70.2	..
Statistical Differences	**-3.5**	**0.1**	**1.7**	**2.8**	**–**	**–**	**..**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	323.10	535.60	764.30	786.70	938.81	1 161.34	..
Population (millions)	22.49	27.70	31.66	31.95	33.20	35.30	..
TPES/GDP[12]	0.49	0.39	0.34	0.34	0.33	0.30	..
Energy Production/TPES	1.24	1.31	1.47	1.48	1.93	1.73	..
Per Capita TPES[13]	7.11	7.56	8.29	8.42	9.26	9.93	..
Oil Supply/GDP[12]	0.25	0.14	0.12	0.12	0.10	0.09	..
TFC/GDP[12]	0.41	0.30	0.26	0.26	0.23	0.21	..
Per Capita TFC[13]	5.87	5.78	6.23	6.32	6.62	7.03	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	376.3	428.6	556.4	550.9	619.6	697.9	..
CO_2 Emissions from Bunkers (Mt CO_2)	5.2	5.6	3.7	4.6	4.5	4.6	..

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	3.0	0.9	1.8	2.5	2.3	1.3	..
Coal	4.4	1.9	1.7	-5.4	-1.9	-3.6	..
Oil	2.4	-1.6	1.4	5.8	-0.1	1.0	..
Gas	2.7	2.1	2.9	-2.1	6.2	2.9	..
Comb. Renewables & Waste	-1.6	1.2	2.8	2.3	6.0	1.2	..
Nuclear	15.7	6.4	0.0	20.7	0.2	-0.5	..
Hydro	3.8	1.8	1.0	1.0	2.1	0.4	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	32.3	61.8	-11.3	–	..
TFC	2.6	0.4	1.6	2.2	1.4	1.2	..
Electricity Consumption	4.7	3.4	1.4	0.4	2.5	1.3	..
Energy Production	1.0	2.4	2.7	3.0	6.9	0.2	..
Net Oil Imports	–	–	9.2	5.3	21.1	-3.8	..
GDP	3.6	2.7	2.8	2.9	3.0	2.1	..
Growth in the TPES/GDP Ratio	-0.6	-1.8	-1.0	-0.5	-0.7	-0.8	..
Growth in the TFC/GDP Ratio	-1.0	-2.3	-1.1	-0.7	-1.5	-0.9	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**38.51**	**40.10**	**33.00**	**34.24**	**25.68**	**21.50**	**19.41**
Coal[1]		38.01	36.31	24.33	24.84	17.00	12.00	9.60
Oil		0.04	0.21	0.47	0.57	0.40	0.40	0.40
Gas		0.36	0.20	0.13	0.16	0.10	0.30	0.30
Comb. Renewables & Waste[2]		–	–	1.21	1.63	1.30	1.90	2.20
Nuclear		–	3.28	6.74	6.86	6.70	6.70	6.70
Hydro		0.09	0.10	0.12	0.17	0.16	0.17	0.17
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	–	0.00	0.02	0.03	0.04
TOTAL NET IMPORTS[4]		**6.99**	**7.63**	**11.32**	**11.71**	**16.40**	**22.50**	**24.20**
Coal[1]	Exports	2.56	7.26	4.92	4.70	4.10	1.10	0.90
	Imports	0.15	1.57	1.56	1.80	1.20	1.40	1.60
	Net Imports	-2.41	-5.69	-3.36	-2.90	-2.90	0.30	0.70
Oil	Exports	0.04	6.56	1.28	0.98	1.60	1.60	1.70
	Imports	8.91	15.16	9.70	10.00	10.20	10.60	11.00
	Bunkers	–	–	–	–	–	–	–
	Net Imports	8.87	8.60	8.42	9.02	8.60	9.00	9.30
Gas	Exports	0.01	–	0.04	0.07	–	–	–
	Imports	0.73	4.78	7.74	7.16	11.00	13.00	14.00
	Net Imports	0.72	4.78	7.70	7.09	11.00	13.00	14.00
Electricity	Exports	0.44	0.76	2.26	2.19	0.70	0.40	0.60
	Imports	0.25	0.70	0.87	0.84	0.40	0.60	0.80
	Net Imports	-0.19	-0.06	-1.40	-1.35	-0.30	0.20	0.20
TOTAL STOCK CHANGES		**-0,08**	**1,26**	**-0,10**	**-0,43**	**-**	**-**	**-**
TOTAL SUPPLY (TPES)		**45.42**	**48.99**	**44.22**	**45.53**	**42.08**	**44.00**	**43.61**
Coal[1]		35.59	31.46	20.97	20.96	14.10	12.30	10.30
Oil		8.91	8.96	8.77	9.62	9.00	9.40	9.70
Gas		1.01	5.26	7.84	7.79	11.10	13.30	14.30
Comb. Renewables & Waste[2]		–	–	1.17	1.49	1.30	1.90	2.20
Nuclear		–	3.28	6.74	6.86	6.70	6.70	6.70
Hydro		0.09	0.10	0.12	0.17	0.16	0.17	0.17
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	–	–	–	0.02	0.03	0.04
Electricity Trade[5]		-0.19	-0.06	-1.39	-1.35	-0.30	0.20	0.20
Shares (%)								
Coal		*78.4*	*64.2*	*47.4*	*46.0*	*33.5*	*28.0*	*23.6*
Oil		*19.6*	*18.3*	*19.8*	*21.1*	*21.4*	*21.4*	*22.2*
Gas		*2.2*	*10.7*	*17.7*	*17.1*	*26.4*	*30.2*	*32.8*
Comb. Renewables & Waste		–	–	*2.6*	*3.3*	*3.1*	*4.3*	*5.0*
Nuclear		–	*6.7*	*15.2*	*15.1*	*15.9*	*15.2*	*15.4*
Hydro		*0.2*	*0.2*	*0.3*	*0.4*	*0.4*	*0.4*	*0.4*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	–	–	–	*0.1*	*0.1*
Electricity Trade		*-0.4*	*-0.1*	*-3.2*	*-3.0*	*-0.7*	*0.5*	*0.5*

0 is negligible, - is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**31.66**	**33.79**	**26.66**	**27.65**	**28.58**	**30.44**	**31.04**
Coal[1]	19.25	13.35	3.92	3.86	2.70	2.30	1.60
Oil	8.06	8.54	8.39	9.40	8.30	8.40	8.70
Gas	1.81	4.80	6.32	6.21	8.70	9.70	10.70
Comb. Renewables & Waste[2]	–	–	0.87	0.92	0.70	1.00	1.20
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	0.00	0.01	0.02	0.02
Electricity	2.54	4.14	4.51	4.63	4.87	5.67	5.52
Heat	–	2.96	2.65	2.62	3.30	3.35	3.30
Shares (%)							
Coal	*60.8*	*39.5*	*14.7*	*14.0*	*9.4*	*7.6*	*5.2*
Oil	*25.5*	*25.3*	*31.5*	*34.0*	*29.0*	*27.6*	*28.0*
Gas	*5.7*	*14.2*	*23.7*	*22.5*	*30.4*	*31.9*	*34.5*
Comb. Renewables & Waste	–	–	*3.3*	*3.3*	*2.4*	*3.3*	*3.9*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	*0.1*
Electricity	*8.0*	*12.3*	*16.9*	*16.7*	*17.0*	*18.6*	*17.8*
Heat	–	*8.8*	*9.9*	*9.5*	*11.5*	*11.0*	*10.6*
TOTAL INDUSTRY[6]	**18.80**	**17.66**	**10.73**	**11.63**	**12.52**	**13.12**	**13.02**
Coal[1]	11.44	6.93	2.91	2.83	1.80	1.60	1.10
Oil	5.30	4.68	2.47	3.24	3.40	3.30	3.40
Gas	0.46	2.65	2.52	2.48	4.20	4.70	5.10
Comb. Renewables & Waste[2]	–	–	0.27	0.35	0.10	0.30	0.30
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.61	2.32	1.77	1.92	1.72	1.87	1.82
Heat	–	1.08	0.78	0.81	1.30	1.35	1.30
Shares (%)							
Coal	*60.8*	*39.3*	*27.1*	*24.3*	*14.4*	*12.2*	*8.5*
Oil	*28.2*	*26.5*	*23.1*	*27.9*	*27.2*	*25.2*	*26.1*
Gas	*2.4*	*15.0*	*23.5*	*21.3*	*33.5*	*35.8*	*39.2*
Comb. Renewables & Waste	–	–	*2.5*	*3.0*	*0.8*	*2.3*	*2.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.6*	*13.1*	*16.5*	*16.5*	*13.7*	*14.3*	*14.0*
Heat	–	*6.1*	*7.3*	*7.0*	*10.4*	*10.3*	*10.0*
TRANSPORT[7]	**2.45**	**2.86**	**6.02**	**6.34**	**5.12**	**5.43**	**5.64**
TOTAL OTHER SECTORS[8]	**10.42**	**13.28**	**9.92**	**9.68**	**10.94**	**11.88**	**12.38**
Coal[1]	7.70	6.42	1.01	1.03	0.90	0.70	0.50
Oil	0.60	1.27	0.20	0.09	0.60	0.70	0.70
Gas	1.35	2.15	3.76	3.69	4.30	4.60	5.20
Comb. Renewables & Waste[2]	–	–	0.53	0.54	0.58	0.67	0.86
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	0.00	0.01	0.02	0.02
Electricity	0.76	1.56	2.55	2.52	2.55	3.20	3.10
Heat	–	1.88	1.87	1.81	2.00	2.00	2.00
Shares (%)							
Coal	*73.9*	*48.3*	*10.2*	*10.6*	*8.2*	*5.9*	*4.0*
Oil	*5.8*	*9.6*	*2.0*	*0.9*	*5.5*	*5.9*	*5.7*
Gas	*13.0*	*16.2*	*37.9*	*38.1*	*39.3*	*38.7*	*42.0*
Comb. Renewables & Waste	–	–	*5.4*	*5.6*	*5.3*	*5.6*	*7.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	*0.1*	*0.1*	*0.2*
Electricity	*7.3*	*11.7*	*25.7*	*26.0*	*23.3*	*26.9*	*25.0*
Heat	–	*14.2*	*18.8*	*18.7*	*18.3*	*16.8*	*16.2*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**9.70**	**19.58**	**23.44**	**23.92**	**21.18**	**21.58**	**20.49**
OUTPUT (Mtoe)	**3.54**	**5.36**	**7.12**	**7.21**	**6.07**	**6.37**	**6.32**
(TWh gross)	41.17	62.27	82.82	83.79	70.59	74.05	73.47
Output Shares (%)							
Coal	*85.1*	*76.4*	*61.5*	*60.3*	*47.5*	*40.5*	*39.3*
Oil	*11.3*	*0.9*	*0.4*	*0.4*	*2.0*	*2.6*	*2.7*
Gas	*0.9*	*0.6*	*4.5*	*4.6*	*9.9*	*17.1*	*17.3*
Comb. Renewables & Waste	–	–	*0.6*	*0.9*	*1.3*	*2.3*	*2.9*
Nuclear	–	*20.2*	*31.2*	*31.4*	*36.7*	*34.9*	*35.2*
Hydro	*2.6*	*1.9*	*1.7*	*2.4*	*2.6*	*2.6*	*2.6*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*
TOTAL LOSSES	**15.07**	**15.00**	**16.96**	**17.46**	**13.61**	**13.56**	**12.57**
of which:							
Electricity and Heat Generation[10]	6.16	10.53	12.80	13.26	11.33	11.36	10.37
Other Transformation	7.34	1.64	1.08	1.19	0.40	0.20	0.10
Own Use and Losses[11]	1.57	2.83	3.08	3.02	1.88	2.00	2.10
Statistical Differences	**-1.31**	**0.20**	**0.60**	**0.42**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	40.37	54.40	59.90	62.70	84.02	136.87	222.94
Population (millions)	9.92	10.36	10.20	10.21	10.20	10.20	10.10
TPES/GDP[12]	1.13	0.90	0.74	0.73	0.50	0.32	0.20
Energy Production/TPES	0.85	0.82	0.75	0.75	0.61	0.49	0.45
Per Capita TPES[13]	4.58	4.73	4.33	4.46	4.13	4.31	4.32
Oil Supply/GDP[12]	0.22	0.16	0.15	0.15	0.11	0.07	0.04
TFC/GDP[12]	0.78	0.62	0.45	0.44	0.34	0.22	0.14
Per Capita TFC[13]	3.19	3.26	2.61	2.71	2.80	2.98	3.07
Energy-related CO_2 Emissions (Mt CO_2)[14]	147.3	154.0	117.5	118.8	101.9	101.6	97.1
CO_2 Emissions from Bunkers (Mt CO_2)	0.7	0.7	0.6	0.9	1.2	1.9	3.2

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	1.2	0.1	-0.8	3.0	-1.3	0.4	-0.1
Coal	-0.3	-1.0	-3.1	-0.1	-6.4	-1.4	-1.8
Oil	4.2	-2.2	-0.2	9.6	-1.1	0.4	0.3
Gas	14.3	8.0	3.1	-0.7	6.1	1.8	0.7
Comb. Renewables & Waste	–	–	–	27.2	-2.2	3.9	1.5
Nuclear	–	–	5.7	1.8	-0.4	–	–
Hydro	13.3	-6.0	1.3	46.2	-1.4	0.3	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	37.2	4.1	2.9
TFC	2.8	-0.9	-1.8	3.7	0.6	0.6	0.2
Electricity Consumption	3.4	2.6	0.6	2.7	0.8	1.5	-0.3
Energy Production	2.0	-0.7	-1.5	3.8	-4.7	-1.8	-1.0
Net Oil Imports	3.9	-2.4	-0.2	7.1	-0.8	0.5	0.3
GDP	2.5	1.4	0.7	4.7	5.0	5.0	5.0
Growth in the TPES/GDP Ratio	-1.3	-1.3	-1.5	-1.6	-6.0	-4.3	-4.8
Growth in the TFC/GDP Ratio	0.3	-2.2	-2.5	-0.9	-4.2	-4.2	-4.6

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**0.43**	**10.04**	**28.41**	**31.01**	**33.47**	**21.91**	**21.07**
Coal[1]		–	–	–	–	–	–	–
Oil		0.07	6.07	18.63	19.78	19.96	13.29	12.36
Gas		–	2.77	7.20	8.49	10.17	4.81	4.69
Comb. Renewables & Waste[2]		0.35	1.14	2.08	2.16	2.46	2.81	2.83
Nuclear		–	–	–	–	–	–	–
Hydro		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Geothermal		–	0.00	0.00	0.00	0.03	0.02	–
Solar/Wind/Other[3]		–	0.06	0.49	0.58	0.85	0.97	1.19
TOTAL NET IMPORTS[4]		**19.85**	**7.69**	**-7.91**	**-10.83**	**-12.21**	**-0.56**	**0.54**
Coal[1]	Exports	0.04	0.03	0.09	0.09	–	–	–
	Imports	1.91	6.25	5.66	4.52	3.91	2.71	1.69
	Net Imports	1.87	6.22	5.57	4.42	3.91	2.71	1.69
Oil	Exports	2.89	5.84	17.80	19.56	10.46	3.37	2.18
	Imports	21.58	8.58	8.50	8.86	–	–	–
	Bunkers	0.69	0.96	0.99	0.80	0.80	0.80	0.80
	Net Imports	18.00	1.79	-10.29	-11.50	-11.26	-4.17	-2.98
Gas	Exports	–	0.93	2.59	3.69	4.53	–	–
	Imports	–	–	–	–	–	0.95	2.15
	Net Imports	–	-0.93	-2.59	-3.69	-4.53	0.95	2.15
Electricity	Exports	0.11	0.42	1.34	0.99	0.33	0.05	0.33
	Imports	0.09	1.03	0.60	0.75	–	–	–
	Net Imports	-0.02	0.61	-0.74	-0.25	-0.33	-0.05	-0.33
TOTAL STOCK CHANGES		**-0.44**	**0.17**	**0.18**	**-0.11**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**19.83**	**17.89**	**20.69**	**20.07**	**21.26**	**21.35**	**21.61**
Coal[1]		1.93	6.09	5.67	4.36	3.91	2.71	1.69
Oil		17.57	8.17	8.38	8.40	8.70	9.13	9.38
Gas		–	1.82	4.66	4.63	5.64	5.76	6.85
Comb. Renewables & Waste[2]		0.35	1.14	2.21	2.35	2.46	2.81	2.83
Nuclear		–	–	–	–	–	–	–
Hydro		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Geothermal		–	0.00	0.00	0.00	0.03	0.02	–
Solar/Wind/Other[3]		–	0.06	0.50	0.58	0.85	0.97	1.19
Electricity Trade[5]		-0.02	0.61	-0.74	-0.25	-0.33	-0.05	-0.33
Shares (%)								
Coal		*9.7*	*34.0*	*27.4*	*21.7*	*18.4*	*12.7*	*7.8*
Oil		*88.6*	*45.7*	*40.5*	*41.8*	*40.9*	*42.7*	*43.4*
Gas		–	*10.2*	*22.5*	*23.1*	*26.5*	*27.0*	*31.7*
Comb. Renewables & Waste		*1.8*	*6.4*	*10.7*	*11.7*	*11.5*	*13.2*	*13.1*
Nuclear		–	–	–	–	–	–	–
Hydro		–	–	–	–	–	–	–
Geothermal		–	–	–	–	*0.1*	*0.1*	–
Solar/Wind/Other		–	*0.3*	*2.4*	*2.9*	*4.0*	*4.5*	*5.5*
Electricity Trade		*-0.1*	*3.4*	*-3.6*	*-1.2*	*-1.5*	*-0.2*	*-1.5*

0 is negligible, – is nil, .. is not available.

Please note: TPES for a given year strongly depends on the amount of net import of electricity. which may vary substantially from year to year. For forecast years. electricity exports may be lower when the CO_2 quota system is taken into account.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**16.26**	**13.87**	**15.38**	**15.62**	**16.20**	**16.43**	**16.81**
Coal[1]	0.34	0.40	0.23	0.26	0.22	0.23	0.24
Oil	14.26	7.55	7.43	7.64	7.73	8.03	8.34
Gas	0.12	1.16	1.75	1.71	1.82	1.72	1.69
Comb. Renewables & Waste[2]	0.16	0.56	0.72	0.72	0.80	0.79	0.81
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.00	0.01	0.01	0.01	0.01	0.01
Electricity	1.39	2.44	2.78	2.84	2.97	3.17	3.36
Heat	–	1.76	2.46	2.45	2.67	2.48	2.36
Shares (%)							
Coal	*2.1*	*2.9*	*1.5*	*1.7*	*1.3*	*1.4*	*1.4*
Oil	*87.7*	*54.5*	*48.3*	*48.9*	*47.7*	*48.9*	*49.6*
Gas	*0.7*	*8.3*	*11.3*	*11.0*	*11.2*	*10.4*	*10.0*
Comb. Renewables & Waste	*1.0*	*4.1*	*4.7*	*4.6*	*4.9*	*4.8*	*4.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	–	–	–
Electricity	*8.5*	*17.6*	*18.1*	*18.2*	*18.3*	*19.3*	*20.0*
Heat	–	*12.7*	*16.0*	*15.7*	*16.5*	*15.1*	*14.1*
TOTAL INDUSTRY[6]	**4.10**	**3.00**	**3.13**	**3.22**	**3.28**	**3.34**	**3.45**
Coal[1]	0.21	0.32	0.20	0.24	0.18	0.19	0.20
Oil	3.41	1.23	1.05	1.10	1.07	1.09	1.12
Gas	0.02	0.54	0.75	0.73	0.81	0.78	0.78
Comb. Renewables & Waste[2]	0.06	0.11	0.11	0.11	0.16	0.16	0.16
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.40	0.73	0.84	0.86	0.87	0.94	1.01
Heat	–	0.07	0.18	0.18	0.19	0.19	0.18
Shares (%)							
Coal	*5.2*	*10.7*	*6.5*	*7.4*	*5.4*	*5.6*	*5.7*
Oil	*83.4*	*40.9*	*33.6*	*34.2*	*32.6*	*32.6*	*32.5*
Gas	*0.4*	*17.9*	*24.0*	*22.7*	*24.7*	*23.2*	*22.5*
Comb. Renewables & Waste	*1.4*	*3.8*	*3.5*	*3.5*	*4.9*	*4.8*	*4.6*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*9.7*	*24.2*	*26.7*	*26.8*	*26.6*	*28.1*	*29.4*
Heat	–	*2.5*	*5.7*	*5.5*	*5.9*	*5.7*	*5.3*
TRANSPORT[7]	**3.52**	**4.11**	**5.02**	**5.26**	**5.39**	**5.78**	**6.12**
TOTAL OTHER SECTORS[8]	**8.65**	**6.77**	**7.23**	**7.14**	**7.54**	**7.31**	**7.25**
Coal[1]	0.13	0.08	0.03	0.02	0.04	0.04	0.04
Oil	7.34	2.24	1.39	1.31	1.29	1.18	1.13
Gas	0.10	0.62	0.99	0.98	1.01	0.94	0.91
Comb. Renewables & Waste[2]	0.10	0.45	0.61	0.60	0.64	0.63	0.65
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.00	0.01	0.01	0.01	0.01	0.01
Electricity	0.98	1.70	1.92	1.94	2.07	2.21	2.33
Heat	–	1.68	2.29	2.28	2.47	2.29	2.18
Shares (%)							
Coal	*1.4*	*1.2*	*0.4*	*0.3*	*0.5*	*0.6*	*0.6*
Oil	*84.9*	*33.1*	*19.3*	*18.3*	*17.2*	*16.2*	*15.6*
Gas	*1.2*	*9.2*	*13.7*	*13.7*	*13.4*	*12.9*	*12.5*
Comb. Renewables & Waste	*1.2*	*6.7*	*8.4*	*8.4*	*8.4*	*8.7*	*9.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Electricity	*11.3*	*25.1*	*26.5*	*27.2*	*27.5*	*30.3*	*32.1*
Heat	–	*24.9*	*31.6*	*31.9*	*32.8*	*31.3*	*30.1*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.60**	**7.09**	**10.38**	**9.05**	**8.88**	**8.42**	**8.64**
OUTPUT (Mtoe)	**1.64**	**2.23**	**3.97**	**3.48**	**3.51**	**3.46**	**3.94**
(TWh gross)	19.12	25.98	46.17	40.48	40.84	40.21	45.76
Output Shares (%)							
Coal	*35.8*	*90.7*	*54.8*	*46.1*	*42.0*	*30.6*	*17.7*
Oil	*64.1*	*3.4*	*5.1*	*4.0*	*2.4*	*3.2*	*2.0*
Gas	–	*2.7*	*21.2*	*24.7*	*21.7*	*26.3*	*37.9*
Comb. Renewables & Waste	–	*0.8*	*6.8*	*8.8*	*12.7*	*15.0*	*14.9*
Nuclear	–	–	–	–	–	–	–
Hydro	*0.1*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*2.3*	*12.1*	*16.3*	*21.3*	*24.9*	*27.5*
TOTAL LOSSES	**3.66**	**4.02**	**5.37**	**4.52**	**5.06**	**4.92**	**4.80**
of which:							
Electricity and Heat Generation[10]	2.96	2.65	3.31	2.48	2.04	1.88	1.78
Other Transformation	0.44	-0.03	-0.00	0.01	0.08	0.08	0.08
Own Use and Losses[11]	0.26	1.40	2.06	2.03	2.93	2.96	2.93
Statistical Differences	**-0.08**	**-0.01**	**-0.06**	**-0.07**	–	–	–

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	97.30	123.90	163.00	166.40	186.18	215.22	237.04
Population (millions)	5.02	5.14	5.39	5.40	5.43	5.41	5.38
TPES/GDP[12]	0.20	0.14	0.13	0.12	0.11	0.10	0.09
Energy Production/TPES	0.02	0.56	1.37	1.55	1.57	1.03	0.98
Per Capita TPES[13]	3.95	3.48	3.84	3.72	3.92	3.95	4.02
Oil Supply/GDP[12]	0.18	0.07	0.05	0.05	0.05	0.04	0.04
TFC/GDP[12]	0.17	0.11	0.09	0.09	0.09	0.08	0.07
Per Capita TFC[13]	3.24	2.70	2.85	2.89	2.99	3.04	3.12
Energy-related CO_2 Emissions (Mt CO_2)[14]	56.6	50.7	56.5	50.9	52.3	49.2	48.5
CO_2 Emissions from Bunkers (Mt CO_2)	4.5	4.8	5.3	5.0	5.3	5.8	6.1

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	1.2	-1.6	1.1	-3.0	1.0	0.0	0.1
Coal	14.4	3.1	-0.6	-23.1	-1.8	-3.6	-4.6
Oil	-1.4	-6.0	0.2	0.2	0.6	0.5	0.3
Gas	–	–	7.5	-0.6	3.3	0.2	1.7
Comb. Renewables & Waste	6.9	7.3	5.2	6.0	0.8	1.4	0.0
Nuclear	–	–	–	–	–	–	–
Hydro	–	–	–	–	7.0	–	–
Geothermal	–	–	5.5	–	36.6	-2.1	–
Solar/Wind/Other	–	44.0	18.3	18.3	6.7	1.3	2.1
TFC	0.7	-1.8	0.8	1.6	0.6	0.1	0.2
Electricity Consumption	4.9	2.5	1.0	1.9	0.7	0.7	0.6
Energy Production	14.7	23.6	8.3	9.2	1.3	-4.1	-0.4
Net Oil Imports	-2.6	-17.8	–	11.8	-0.3	–	-3.3
GDP	1.5	1.4	2.1	2.1	1.9	1.5	1.0
Growth in the TPES/GDP Ratio	-0.3	-2.9	-1.0	-4.9	-0.9	-1.4	-0.8
Growth in the TFC/GDP Ratio	-0.9	-3.1	-1.3	-0.5	-1.3	-1.3	-0.7

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**4.9**	**12.1**	**16.0**	**15.9**	**18.2**	**19.8**	**..**
Coal[1]		–	–	–	–	–	–	..
Peat		0.1	1.8	1.8	0.8	1.8	2.0	..
Oil		–	–	0.1	0.1	–	–	..
Gas		–	–	–	–	–	–	..
Comb. Renewables & Waste[2]		3.9	4.3	7.4	7.8	7.1	7.5	..
Nuclear		–	5.0	5.9	5.9	8.1	9.0	..
Hydro		0.9	0.9	0.8	1.3	1.1	1.2	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.1	..
TOTAL NET IMPORTS[4]		**16.6**	**17.7**	**22.0**	**20.7**	**19.4**	**20.1**	**..**
Coal[1]	Exports	0.0	0.0	–	–	..	..	..
	Imports	2.4	4.4	6.6	5.5	4.3	5.2	..
	Net Imports	2.4	4.4	6.6	5.5	4.3	5.2	..
Peat	Exports	–	–	0.0	0.0	..	..	..
	Imports	–	–	–	–	–	–	..
	Net Imports	–	–	-0.0	-0.0	..	..	..
Oil	Exports	0.2	1.7	5.7	5.8	..	..	..
	Imports	14.0	12.5	17.3	17.1	9.2	8.9	..
	Bunkers	0.1	0.6	0.6	0.5	..	..	..
	Net Imports	13.8	10.2	11.0	10.9	9.2	8.9	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	–	2.2	4.1	3.9	4.8	5.2	..
	Net Imports	–	2.2	4.1	3.9	4.8	5.2	..
Electricity	Exports	0.0	0.0	0.6	0.6	0.4	0.7	..
	Imports	0.4	0.9	1.0	1.0	1.1	1.1	..
	Net Imports	0.4	0.9	0.4	0.4	0.7	0.4	..
TOTAL STOCK CHANGES		**-0.1**	**-0.6**	**-0.4**	**1.5**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**21.3**	**29.2**	**37.7**	**38.1**	**37.7**	**39.9**	**..**
Coal[1]		2.5	4.1	5.9	5.4	4.3	5.2	..
Peat		0.0	1.2	2.4	2.1	1.8	2.0	..
Oil		13.6	10.3	10.7	11.2	9.2	8.9	..
Gas		–	2.2	4.1	3.9	4.8	5.2	..
Comb. Renewables & Waste[2]		3.9	4.6	7.3	7.7	7.5	7.9	..
Nuclear		–	5.0	5.9	5.9	8.1	9.0	..
Hydro		0.9	0.9	0.8	1.3	1.1	1.2	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.0	0.0	0.0	0.1	..
Electricity Trade[5]		0.4	0.9	0.4	0.4	0.7	0.4	..
Shares (%)								
Coal		*11.8*	*14.1*	*15.6*	*14.2*	*11.4*	*13.0*	..
Peat		*0.2*	*4.2*	*6.5*	*5.6*	*4.8*	*5.0*	..
Oil		*63.6*	*35.1*	*28.5*	*29.4*	*24.5*	*22.4*	..
Gas		–	*7.5*	*10.8*	*10.4*	*12.8*	*13.0*	..
Comb. Renewables & Waste		*18.5*	*15.6*	*19.5*	*20.3*	*20.0*	*19.8*	..
Nuclear		–	*17.2*	*15.7*	*15.5*	*21.5*	*22.6*	..
Hydro		*4.2*	*3.2*	*2.2*	*3.4*	*3.0*	*3.0*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	–	*0.1*	*0.1*	*0.2*	..
Electricity Trade		*1.7*	*3.1*	*1.1*	*1.1*	*1.8*	*1.1*	..

0 is negligible, – is nil, .. is not available.
Please note: All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**19.4**	**22.7**	**26.6**	**27.2**	**28.8**	**29.9**	**..**
Coal[1]	1.0	1.2	0.8	0.8	1.0	1.1	..
Peat	0.0	0.4	0.3	0.3	0.4	0.4	..
Oil	11.5	9.7	9.0	9.1	8.9	8.6	..
Gas	0.0	1.0	1.0	0.9	2.0	2.1	..
Comb. Renewables & Waste[2]	3.9	3.5	4.8	5.3	5.7	5.9	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	2.3	5.1	7.0	7.2	7.9	8.7	..
Heat	0.6	1.9	3.8	3.6	2.8	3.1	..
Shares (%)							
Coal	*5.3*	*5.1*	*3.0*	*2.9*	*3.5*	*3.5*	..
Peat	*0.1*	*1.8*	*1.0*	*1.0*	*1.4*	*1.4*	..
Oil	*59.2*	*42.5*	*33.8*	*33.6*	*30.9*	*28.9*	..
Gas	*0.1*	*4.3*	*3.7*	*3.4*	*7.0*	*6.9*	..
Comb. Renewables & Waste	*20.3*	*15.5*	*18.0*	*19.7*	*19.8*	*19.7*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*11.9*	*22.3*	*26.2*	*26.3*	*27.5*	*29.1*	..
Heat	*3.1*	*8.4*	*14.3*	*13.1*	*9.8*	*10.3*	..
TOTAL INDUSTRY[6]	**7.6**	**10.5**	**12.9**	**13.6**	**15.4**	**16.2**	**..**
Coal[1]	0.9	1.2	0.8	0.8	1.0	1.1	..
Peat	0.0	0.4	0.2	0.3	0.4	0.4	..
Oil	5.0	2.6	2.3	2.4	2.7	2.7	..
Gas	0.0	0.9	0.9	0.8	1.9	2.0	..
Comb. Renewables & Waste[2]	–	2.5	3.6	4.2	4.5	4.7	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	1.6	2.8	3.8	4.0	4.5	5.1	..
Heat	0.1	0.2	1.3	1.2	0.3	0.3	..
Shares (%)							
Coal	*12.1*	*11.0*	*6.1*	*5.8*	*6.6*	*6.5*	..
Peat	*0.2*	*3.6*	*1.9*	*1.9*	*2.5*	*2.6*	..
Oil	*66.2*	*24.7*	*17.7*	*17.3*	*17.7*	*16.3*	..
Gas	*0.1*	*9.0*	*6.7*	*6.2*	*12.6*	*12.1*	..
Comb. Renewables & Waste	–	*23.4*	*27.9*	*30.7*	*29.3*	*28.9*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*20.4*	*26.6*	*29.4*	*29.2*	*29.5*	*31.6*	..
Heat	*1.0*	*1.7*	*10.2*	*8.9*	*1.8*	*2.0*	..
TRANSPORT[7]	**2.6**	**4.4**	**4.8**	**4.9**	**4.5**	**4.4**	**..**
TOTAL OTHER SECTORS[8]	**9.3**	**7.9**	**8.8**	**8.7**	**9.0**	**9.2**	**..**
Coal[1]	0.1	0.0	0.0	0.0	0.0	0.0	..
Peat	0.0	0.0	0.0	0.0	0.0	0.0	..
Oil	3.9	2.7	2.0	1.9	1.8	1.7	..
Gas	0.0	0.0	0.1	0.1	0.1	0.1	..
Comb. Renewables & Waste[2]	3.9	1.1	1.2	1.2	1.2	1.2	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.8	2.2	3.1	3.1	3.3	3.5	..
Heat	0.5	1.7	2.5	2.4	2.6	2.7	..
Shares (%)							
Coal	*1.1*	*0.1*	-	-	-	-	..
Peat	*0.1*	*0.2*	*0.3*	*0.3*	*0.1*	*0.1*	..
Oil	*42.3*	*35.0*	*22.8*	*22.2*	*20.4*	*18.2*	..
Gas	-	*0.5*	*0.8*	*0.8*	*0.7*	*0.6*	..
Comb. Renewables & Waste	*42.6*	*13.6*	*13.2*	*13.4*	*13.2*	*13.0*	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	-	-	-	-	-	..
Electricity	*8.2*	*28.5*	*34.9*	*36.1*	*37.1*	*38.2*	..
Heat	*5.7*	*22.1*	*27.9*	*27.2*	*28.4*	*29.8*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.5**	**11.9**	**19.6**	**18.7**	**18.9**	**21.4**	..
OUTPUT (Mtoe)	**2.2**	**4.7**	**7.2**	**7.4**	**7.5**	**8.6**	..
(TWh gross)	26.1	54.4	84.2	85.8	87.5	99.7	..
Output Shares (%)							
Coal	*18.7*	*18.5*	*23.1*	*19.9*	*13.1*	*15.4*	..
Peat	*9.4*	*14.6*	*8.7*	*7.6*	*5.7*	*5.6*	..
Oil	*31.6*	*3.1*	*1.1*	*0.7*	*0.8*	*0.7*	..
Gas	–	*8.6*	*16.6*	*14.9*	*16.5*	*16.5*	..
Comb. Renewables & Waste	–	–	*12.1*	*12.5*	*12.6*	*12.4*	..
Nuclear	–	*35.3*	*27.0*	*26.5*	*35.6*	*34.7*	..
Hydro	*40.3*	*20.0*	*11.4*	*17.6*	*15.1*	*13.8*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.5*	*1.1*	..
TOTAL LOSSES	**2.0**	**7.1**	**11.0**	**10.2**	**8.9**	**10.0**	..
of which:							
Electricity and Heat Generation[10]	0.6	5.1	8.2	7.6	8.3	9.5	..
Other Transformation	0.5	0.6	0.9	0.8	..	..	..
Own Use and Losses[11]	0.9	1.4	1.9	1.8	0.5	0.6	..
Statistical Differences	**-0.07**	**-0.70**	**0.17**	**0.68**	**–**	**–**	..

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	61.20	100.40	127.50	132.10	154.89	195.09	..
Population (millions)	4.67	4.99	5.21	5.23	5.27	5.32	..
TPES/GDP[12]	0.35	0.29	0.30	0.29	0.24	0.20	..
Energy Production/TPES	0.23	0.41	0.43	0.42	0.48	0.50	..
Per Capita TPES[13]	4.57	5.85	7.23	7.29	7.15	7.50	..
Oil Supply/GDP[12]	0.22	0.10	0.08	0.08	0.06	0.05	..
TFC/GDP[12]	0.32	0.23	0.21	0.21	0.19	0.15	..
Per Capita TFC[13]	4.16	4.56	5.09	5.20	5.47	5.61	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	48.4	55.0	73.0	68.9	62.8	67.0	..
CO_2 Emissions from Bunkers (Mt CO_2)	0.5	2.8	3.1	2.9	..	..	..

GROWTH RATES (% per year)	73–79	79–90	90–03	03–04	04–10	10–20	20–30
TPES	2.3	1.6	2.0	1.1	-0.2	0.6	..
Coal	7.4	0.6	2.8	-8.2	-3.7	1.8	..
Peat	48.1	10.6	5.5	-13.1	-2.5	1.0	..
Oil	-0.5	-2.3	0.4	4.3	-3.2	-0.3	..
Gas	–	9.4	4.9	-3.3	3.4	0.7	..
Comb. Renewables & Waste	-2.4	2.7	3.7	5.0	-0.4	0.5	..
Nuclear	–	10.0	1.3	-0.1	5.4	1.1	..
Hydro	0.6	-0.0	-1.0	57.1	-2.1	0.4	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	75.0	19.1	9.4	..
TFC	0.4	1.2	1.2	2.3	1.0	0.4	..
Electricity Consumption	4.7	4.7	2.5	2.8	1.7	0.9	..
Energy Production	4.7	5.9	2.2	-1.0	2.3	0.8	..
Net Oil Imports	1.1	-3.3	0.5	-0.8	-2.7	-0.3	..
GDP	2.5	3.2	1.9	3.6	2.7	2.3	..
Growth in the TPES/GDP Ratio	-0.2	-1.5	0.1	-2.4	-2.8	-1.7	..
Growth in the TFC/GDP Ratio	-2.0	-1.9	-0.6	-1.3	-1.7	-1.9	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**44.2**	**111.9**	**136.2**	**137.4**	**142.0**	**146.0**	**138.7**
Coal[1]		18.0	8.2	1.4	0.5	0.5	0.4	-
Oil		2.1	3.5	1.5	1.5	-	-	-
Gas		6.3	2.5	1.3	1.1	-	-	-
Comb. Renewables & Waste[2]		9.8	11.0	11.8	12.0	14.7	18.5	22.5
Nuclear		3.8	81.9	114.9	116.8	120.3	117.8	106.6
Hydro		4.1	4.6	5.1	5.1	5.9	5.9	5.9
Geothermal		0.0	0.1	0.1	0.1	..	..	..
Solar/Wind/Other[3]		0.0	0.1	0.1	0.1	0.6	3.3	3.7
TOTAL NET IMPORTS[4]		**142.8**	**117.1**	**134.6**	**137.2**	**156.8**	**173.9**	**198.9**
Coal[1]	Exports	1.3	0.6	0.3	0.6	-	-	-
	Imports	10.8	13.7	12.1	13.9	9.8	11.2	21.4
	Net Imports	9.5	13.0	11.8	13.3	9.8	11.2	21.4
Oil	Exports	13.7	14.8	22.9	24.3	13.3	14.6	16.1
	Imports	145.1	100.9	116.7	118.2	120.3	124.3	126.6
	Bunkers	5.3	2.5	2.8	3.2	3.0	3.0	3.0
	Net Imports	126.0	83.6	91.0	90.7	104.0	106.7	107.5
Gas	Exports	0.1	0.3	0.8	1.2	-	-	-
	Imports	7.6	24.7	38.4	39.9	47.3	59.0	70.0
	Net Imports	7.6	24.4	37.6	38.7	47.3	59.0	70.0
Electricity	Exports	0.6	4.5	6.3	5.9	4.3	3.0	-
	Imports	0.4	0.6	0.6	0.6	-	-	-
	Net Imports	-0.2	-3.9	-5.7	-5.3	-4.3	-3.0	–
TOTAL STOCK CHANGES		**-2.4**	**-1.7**	**0.4**	**0.5**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**184.7**	**227.3**	**271.1**	**275.2**	**298.8**	**319.9**	**337.6**
Coal[1]		29.2	20.2	14.4	14.1	10.3	11.6	21.4
Oil		124.3	87.3	91.1	92.1	104.0	106.7	107.5
Gas		13.6	26.0	39.4	40.2	47.3	59.0	70.0
Comb. Renewables & Waste[2]		9.8	11.0	11.7	12.0	14.7	18.5	22.5
Nuclear		3.8	81.9	114.9	116.8	120.3	117.8	106.6
Hydro		4.1	4.6	5.1	5.1	5.9	5.9	5.9
Geothermal		0.0	0.1	0.1	0.1	..	..	..
Solar/Wind/Other[3]		0.0	0.1	0.1	0.1	0.6	3.3	3.7
Electricity Trade[5]		-0.2	-3.9	-5.7	-5.3	-4.3	-3.0	–
Shares (%)								
Coal		*15.8*	*8.9*	*5.3*	*5.1*	*3.4*	*3.6*	*6.3*
Oil		*67.3*	*38.4*	*33.6*	*33.5*	*34.8*	*33.4*	*31.8*
Gas		*7.3*	*11.5*	*14.5*	*14.6*	*15.8*	*18.4*	*20.7*
Comb. Renewables & Waste		*5.3*	*4.8*	*4.3*	*4.3*	*4.9*	*5.8*	*6.7*
Nuclear		*2.1*	*36.0*	*42.4*	*42.5*	*40.3*	*36.8*	*31.6*
Hydro		*2.2*	*2.0*	*1.9*	*1.9*	*2.0*	*1.9*	*1.8*
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other		–	–	–	–	*0.2*	*1.0*	*1.1*
Electricity Trade		*-0.1*	*-1.7*	*-2.1*	*-1.9*	*-1.4*	*-0.9*	–

0 is negligible.,– is nil, .. is not available.

Please note: All forecasts are based on the 2003 submission. Forecast data for solar/wind/other include geothermal.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**145.6**	**147.1**	**172.4**	**172.3**	**196.1**	**213.3**	**228.2**
Coal[1]	13.1	7.5	3.6	3.4	7.2	6.9	7.2
Oil	99.4	79.5	88.2	88.5	95.1	97.3	97.8
Gas	11.2	23.9	35.2	34.0	40.9	46.7	51.1
Comb. Renewables & Waste[2]	8.9	9.6	9.6	9.8	13.9	16.1	19.6
Geothermal	0.0	0.1	0.1	0.1	..	..	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	–
Electricity	12.8	26.0	35.1	35.8	39.0	46.3	52.5
Heat	0.3	0.5	0.7	0.6	..	..	..
Shares (%)							
Coal	*9.0*	*5.1*	*2.1*	*2.0*	*3.7*	*3.2*	*3.2*
Oil	*68.3*	*54.1*	*51.1*	*51.4*	*48.5*	*45.6*	*42.8*
Gas	*7.7*	*16.3*	*20.4*	*19.7*	*20.9*	*21.9*	*22.4*
Comb. Renewables & Waste	*6.1*	*6.5*	*5.6*	*5.7*	*7.1*	*7.6*	*8.6*
Geothermal	–	*0.1*	*0.1*	*0.1*	..	..	..
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.8*	*17.7*	*20.4*	*20.8*	*19.9*	*21.7*	*23.0*
Heat	*0.2*	*0.3*	*0.4*	*0.4*	..	..	..
TOTAL INDUSTRY[6]	**56.6**	**46.1**	**50.1**	**51.6**	**62.2**	**67.3**	**71.8**
Coal[1]	7.2	5.9	3.2	3.0	5.6	5.1	5.0
Oil	35.3	18.0	19.2	19.6	22.2	22.1	22.6
Gas	5.8	11.1	14.8	16.1	16.3	18.5	20.0
Comb. Renewables & Waste[2]	1.2	1.3	1.3	1.4	4.8	6.0	6.5
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	7.2	9.9	11.5	11.5	13.3	15.6	17.7
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*12.7*	*12.7*	*6.3*	*5.9*	*9.0*	*7.6*	*7.0*
Oil	*62.3*	*38.9*	*38.4*	*38.0*	*35.7*	*32.9*	*31.5*
Gas	*10.2*	*24.1*	*29.7*	*31.2*	*26.2*	*27.5*	*27.9*
Comb. Renewables & Waste	*2.1*	*2.9*	*2.7*	*2.7*	*7.7*	*8.9*	*9.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*12.8*	*21.4*	*23.0*	*22.3*	*21.4*	*23.2*	*24.7*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**27.1**	**42.4**	**51.6**	**51.9**	**56.4**	**62.2**	**68.3**
TOTAL OTHER SECTORS[8]	**61.9**	**58.6**	**70.7**	**68.7**	**77.5**	**83.9**	**88.1**
Coal[1]	5.8	1.7	0.4	0.4	1.6	1.8	2.2
Oil	37.6	19.9	18.8	18.4	18.1	15.4	10.4
Gas	5.4	12.8	20.3	17.8	24.6	28.2	31.1
Comb. Renewables & Waste[2]	7.7	8.2	7.9	8.1	8.5	9.0	11.1
Geothermal	0.0	0.1	0.1	0.1	..	..	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	–
Electricity	5.0	15.3	22.6	23.2	24.7	29.5	33.3
Heat	0.3	0.5	0.7	0.6	..	..	..
Shares (%)							
Coal	*9.4*	*2.8*	*0.6*	*0.6*	*2.1*	*2.1*	*2.5*
Oil	*60.8*	*34.0*	*26.5*	*26.8*	*23.4*	*18.4*	*11.8*
Gas	*8.7*	*21.9*	*28.7*	*26.0*	*31.7*	*33.6*	*35.3*
Comb. Renewables & Waste	*12.5*	*14.0*	*11.2*	*11.7*	*11.0*	*10.7*	*12.6*
Geothermal	–	*0.2*	*0.2*	*0.2*	..	..	..
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.1*	*26.2*	*31.9*	*33.8*	*31.9*	*35.2*	*37.8*
Heat	*0.4*	*0.8*	*0.9*	*0.9*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**36.8**	**98.6**	**134.0**	**137.6**	**138.3**	**147.9**	**153.2**
OUTPUT (Mtoe)	**15.7**	**35.9**	**48.3**	**48.8**	**51.0**	**57.0**	**60.9**
(TWh gross)	182.5	417.2	561.8	567.1	593.0	663.2	708.3
Output Shares (%)							
Coal	*19.7*	*8.5*	*5.5*	*5.0*	*1.9*	*2.8*	*8.7*
Oil	*40.2*	*2.1*	*1.2*	*1.0*	*0.9*	*0.3*	*0.2*
Gas	*5.5*	*0.7*	*3.2*	*3.2*	*6.0*	*11.3*	*16.2*
Comb. Renewables & Waste	*0.1*	*0.4*	*0.9*	*0.9*	*0.5*	*1.2*	*1.4*
Nuclear	*8.1*	*75.3*	*78.5*	*79.0*	*77.8*	*68.1*	*57.8*
Hydro	*26.1*	*12.9*	*10.5*	*10.5*	*11.6*	*10.4*	*9.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	*0.3*	*0.1*	*0.2*	*0.2*	*1.2*	*5.8*	*6.1*
TOTAL LOSSES	**39.3**	**75.6**	**99.0**	**102.6**	**102.7**	**106.5**	**109.4**
of which:							
Electricity and Heat Generation[10]	20.8	62.2	85.0	88.2	87.3	90.9	92.3
Other Transformation	6.4	1.6	0.6	0.8	0.3	0.4	0.4
Own Use and Losses[11]	12.0	11.8	13.5	13.7	15.1	15.2	16.7
Statistical Differences	**-0.2**	**4.5**	**-0.3**	**0.3**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	698.10	1 078.90	1 382.80	1 414.80	1 621.62	2 035.66	2 555.42
Population (millions)	53.30	58.17	61.80	62.18	62.54	64.17	65.40
TPES/GDP[12]	0.26	0.21	0.20	0.19	0.18	0.16	0.13
Energy Production/TPES	0.24	0.49	0.50	0.50	0.48	0.46	0.41
Per Capita TPES[13]	3.46	3.91	4.39	4.43	4.78	4.98	5.16
Oil Supply/GDP[12]	0.18	0.08	0.07	0.07	0.06	0.05	0.04
TFC/GDP[12]	0.21	0.14	0.12	0.12	0.12	0.10	0.09
Per Capita TFC[13]	2.73	2.53	2.79	2.77	3.14	3.32	3.49
Energy-related CO_2 Emissions (Mt CO_2)[14]	489.0	355.3	388.1	386.9	421.0	461.0	526.4
CO_2 Emissions from Bunkers (Mt CO_2)	22.7	17.7	24.5	26.6	28.5	33.4	39.5

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	0.8	1.5	1.4	1.5	1.4	0.7	0.5
Coal	1.7	-4.2	-2.6	-2.1	-5.0	1.2	6.3
Oil	-1.4	-2.4	0.3	1.1	2.0	0.3	0.1
Gas	7.4	2.0	3.2	2.0	2.8	2.2	1.7
Comb. Renewables & Waste	-0.5	1.4	0.5	2.0	3.5	2.3	2.0
Nuclear	18.1	20.6	2.6	1.6	0.5	-0.2	-1.0
Hydro	5.7	-1.9	0.7	0.9	2.4	0.0	–
Geothermal	46.8	24.4	1.2	0.8	–	–	–
Solar/Wind/Other	-1.8	4.4	2.7	15.3	32.6	18.3	1.2
TFC	0.5	-0.2	1.2	-0.1	2.2	0.8	0.7
Electricity Consumption	5.4	3.7	2.3	1.9	1.5	1.7	1.3
Energy Production	1.3	8.0	1.5	0.9	0.6	0.3	-0.5
Net Oil Imports	-1.4	-2.9	0.6	-0.3	2.3	0.3	0.1
GDP	2.8	2.5	1.9	2.3	2.3	2.3	2.3
Growth in the TPES/GDP Ratio	-1.9	-1.0	-0.6	-0.8	-0.9	-1.6	-1.7
Growth in the TFC/GDP Ratio	-2.2	-2.6	-0.7	-2.4	-0.1	-1.4	-1.6

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**171.7**	**186.2**	**134.6**	**136.0**	**123.4**	**94.9**	**86.9**
Coal[1]		141.4	121.8	57.7	58.3	51.5	45.2	41.8
Oil		6.8	4.7	4.4	4.4	3.0	1.8	0.6
Gas		16.4	13.5	15.9	14.7	15.3	13.8	11.4
Comb. Renewables & Waste[2]		2.5	4.8	9.8	10.6	13.2	15.8	17.2
Nuclear		3.2	39.8	43.0	43.5	33.9	8.3	–
Hydro		1.3	1.5	1.7	1.8	2.0	2.1	2.1
Geothermal		–	0.0	0.1	0.1	0.2	1.1	4.3
Solar/Wind/Other[3]		–	0.0	1.9	2.5	4.3	6.7	9.5
TOTAL NET IMPORTS[4]		**167.3**	**165.4**	**211.2**	**213.1**	**214.0**	**213.8**	**200.2**
Coal[1]	Exports	18.3	8.2	0.6	0.6	–	–	–
	Imports	15.2	11.5	25.7	28.3	23.9	24.8	13.8
	Net Imports	-3.1	3.3	25.1	27.7	23.9	24.8	13.8
Oil	Exports	9.9	10.2	19.8	25.3	3.7	3.9	2.8
	Imports	171.1	132.9	146.1	147.8	131.6	124.2	116.8
	Bunkers	4.1	2.5	2.6	2.7	3.0	3.6	4.4
	Net Imports	157.1	120.2	123.7	119.8	124.9	116.7	109.5
Gas	Exports	0.1	0.9	6.1	7.0	–	–	–
	Imports	12.4	42.7	68.5	72.8	67.2	72.4	77.2
	Net Imports	12.3	41.7	62.4	65.9	67.2	72.4	77.2
Electricity	Exports	0.7	2.6	4.1	4.4	3.8	3.8	4.0
	Imports	1.7	2.7	4.0	4.1	1.8	3.7	3.8
	Net Imports	1.0	0.1	-0.0	-0.2	-2.0	-0.1	-0.2
TOTAL STOCK CHANGES		**-1.1**	**4.7**	**1.3**	**-1.1**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**337.9**	**356.2**	**347.1**	**348.0**	**337.4**	**308.6**	**287.2**
Coal[1]		139.4	128.5	85.0	85.8	75.4	69.9	55.5
Oil		161.9	126.5	126.5	125.2	127.9	118.5	110.1
Gas		28.7	55.0	79.1	78.7	82.6	86.3	88.5
Comb. Renewables & Waste[2]		2.5	4.8	9.8	10.6	13.2	15.8	17.2
Nuclear		3.2	39.8	43.0	43.5	33.9	8.3	–
Hydro		1.3	1.5	1.7	1.8	2.0	2.1	2.1
Geothermal		–	0.0	0.1	0.1	0.2	1.1	4.3
Solar/Wind/Other[3]		–	0.0	1.9	2.5	4.3	6.7	9.5
Electricity Trade[5]		1.0	0.1	-0.0	-0.2	-2.0	-0.1	-0.2
Shares (%)								
Coal		*41.2*	*36.1*	*24.5*	*24.7*	*22.3*	*22.7*	*19.3*
Oil		*47.9*	*35.5*	*36.4*	*36.0*	*37.9*	*38.4*	*38.4*
Gas		*8.5*	*15.4*	*22.8*	*22.6*	*24.5*	*27.9*	*30.8*
Comb. Renewables & Waste		*0.7*	*1.3*	*2.8*	*3.0*	*3.9*	*5.1*	*6.0*
Nuclear		*0.9*	*11.2*	*12.4*	*12.5*	*10.0*	*2.7*	–
Hydro		*0.4*	*0.4*	*0.5*	*0.5*	*0.6*	*0.7*	*0.7*
Geothermal		–	–	–	–	*0.1*	*0.4*	*1.5*
Solar/Wind/Other		–	–	*0.5*	*0.7*	*1.3*	*2.2*	*3.3*
Electricity Trade		*0.3*	–	–	*-0.1*	*-0.6*	–	*-0.1*

0 is negligible, – is nil, .. is not available.

Please note: Forecasts are based on studies by the Institute of Energy Economics at the University of Cologne (EWI) and Prognos AG/Baselof. They are not official forecasts of the German government.

All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**246.6**	**247.3**	**244.0**	**251.7**	**248.7**	**240.1**	**229.8**
Coal[1]	53.1	37.3	8.4	9.0	12.3	10.7	10.0
Oil	138.2	117.7	116.8	115.6	117.8	109.4	101.9
Gas	21.1	41.0	61.0	62.4	59.0	58.3	56.2
Comb. Renewables & Waste[2]	1.7	3.0	5.3	5.6	6.1	8.0	9.2
Geothermal	–	0.0	0.1	0.1	–	–	–
Solar/Wind/Other	–	0.0	0.2	0.2	0.5	0.9	1.1
Electricity	26.9	39.1	43.8	44.1	45.3	45.8	45.3
Heat	5.5	9.1	8.4	14.6	7.6	7.1	6.3
Shares (%)							
Coal	*21.5*	*15.1*	*3.4*	*3.6*	*5.0*	*4.5*	*4.3*
Oil	*56.0*	*47.6*	*47.9*	*45.9*	*47.4*	*45.6*	*44.3*
Gas	*8.6*	*16.6*	*25.0*	*24.8*	*23.7*	*24.3*	*24.4*
Comb. Renewables & Waste	*0.7*	*1.2*	*2.2*	*2.2*	*2.5*	*3.3*	*4.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.2*	*0.4*	*0.5*
Electricity	*10.9*	*15.8*	*17.9*	*17.5*	*18.2*	*19.1*	*19.7*
Heat	*2.2*	*3.7*	*3.5*	*5.8*	*3.1*	*2.9*	*2.7*
TOTAL INDUSTRY[6]	**105.9**	**89.5**	**76.8**	**78.7**	**81.4**	**81.1**	**79.6**
Coal[1]	28.7	20.7	7.3	8.1	11.9	10.5	9.8
Oil	46.9	27.3	27.1	27.4	27.5	28.0	27.0
Gas	13.3	19.7	21.3	21.1	21.2	21.6	21.3
Comb. Renewables & Waste[2]	0.0	0.8	–	–	0.5	0.5	0.6
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	0.0	0.0	0.1
Electricity	15.3	18.6	19.9	20.1	19.0	19.4	19.9
Heat	1.6	2.4	1.1	1.9	1.3	1.2	1.0
Shares (%)							
Coal	*27.1*	*23.1*	*9.5*	*10.3*	*14.6*	*13.0*	*12.3*
Oil	*44.3*	*30.5*	*35.3*	*34.8*	*33.8*	*34.5*	*33.9*
Gas	*12.6*	*22.0*	*27.8*	*26.8*	*26.1*	*26.6*	*26.8*
Comb. Renewables & Waste	–	*0.9*	–	–	*0.6*	*0.6*	*0.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	*0.1*	*0.1*
Electricity	*14.5*	*20.8*	*25.9*	*25.6*	*23.3*	*23.9*	*24.9*
Heat	*1.5*	*2.7*	*1.5*	*2.4*	*1.6*	*1.4*	*1.2*
TRANSPORT[7]	**39.7**	**60.0**	**63.0**	**64.5**	**64.1**	**62.6**	**61.5**
TOTAL OTHER SECTORS[8]	**101.0**	**97.8**	**104.2**	**108.6**	**103.1**	**96.4**	**88.7**
Coal[1]	22.7	16.6	1.1	0.9	0.4	0.2	0.2
Oil	54.2	31.6	28.8	26.1	29.2	24.7	21.4
Gas	7.8	21.3	39.7	41.3	37.7	36.0	33.3
Comb. Renewables & Waste[2]	1.7	2.2	4.5	4.6	4.1	4.1	4.0
Geothermal	–	0.0	0.1	0.1	–	–	–
Solar/Wind/Other	–	0.0	0.2	0.2	0.5	0.8	1.0
Electricity	10.7	19.3	22.5	22.6	24.9	24.7	23.6
Heat	3.9	6.7	7.3	12.7	6.3	5.9	5.3
Shares (%)							
Coal	*22.5*	*16.9*	*1.0*	*0.8*	*0.4*	*0.2*	*0.2*
Oil	*53.6*	*32.3*	*27.6*	*24.1*	*28.3*	*25.6*	*24.1*
Gas	*7.7*	*21.8*	*38.1*	*38.1*	*36.6*	*37.3*	*37.5*
Comb. Renewables & Waste	*1.7*	*2.2*	*4.4*	*4.2*	*4.0*	*4.2*	*4.5*
Geothermal	–	–	*0.1*	*0.1*	–	–	–
Solar/Wind/Other	–	–	*0.2*	*0.2*	*0.5*	*0.8*	*1.1*
Electricity	*10.6*	*19.8*	*21.6*	*20.9*	*24.1*	*25.6*	*26.6*
Heat	*3.9*	*6.9*	*7.0*	*11.7*	*6.1*	*6.1*	*6.0*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**98.6**	**141.2**	**141.3**	**144.1**	**133.3**	**112.2**	**100.6**
OUTPUT (Mtoe)	**32.2**	**47.1**	**51.2**	**52.5**	**53.5**	**51.6**	**50.7**
(TWh gross)	374.4	547.7	595.6	610.0	622.5	600.0	589.5
Output Shares (%)							
Coal	*69.0*	*58.8*	*52.8*	*50.5*	*47.0*	*48.6*	*39.4*
Oil	*12.0*	*1.9*	*0.8*	*1.7*	*0.7*	*0.7*	*0.6*
Gas	*10.9*	*7.4*	*9.8*	*10.1*	*16.3*	*24.7*	*33.1*
Comb. Renewables & Waste	*0.8*	*0.9*	*2.5*	*2.6*	*4.2*	*4.9*	*5.4*
Nuclear	*3.2*	*27.8*	*27.7*	*27.4*	*20.9*	*5.3*	*–*
Hydro	*4.1*	*3.2*	*3.2*	*3.5*	*3.7*	*4.2*	*4.2*
Geothermal	*–*	*–*	*–*	*–*	*0.0*	*0.2*	*0.9*
Solar/Wind/Other	*–*	*0.0*	*3.2*	*4.3*	*7.1*	*11.4*	*16.5*
TOTAL LOSSES	**90.7**	**112.0**	**104.6**	**100.0**	**88.7**	**68.5**	**57.3**
of which:							
Electricity and Heat Generation[10]	60.0	83.4	80.7	76.8	71.0	52.5	42.8
Other Transformation	7.0	8.0	6.0	5.6	1.4	1.4	1.3
Own Use and Losses[11]	23.7	20.5	17.8	17.6	16.3	14.7	13.3
Statistical Differences	**0.5**	**-3.0**	**-1.5**	**-3.7**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	1 052.30	1 543.40	1 921.30	1 952.70	2 135.17	2 502.47	2 847.50
Population (millions)	78.96	79.36	82.52	82.50	82.40	81.30	79.30
TPES/GDP[12]	0.32	0.23	0.18	0.18	0.16	0.12	0.10
Energy Production/TPES	0.51	0.52	0.39	0.39	0.37	0.31	0.30
Per Capita TPES[13]	4.28	4.49	4.21	4.22	4.09	3.80	3.62
Oil Supply/GDP[12]	0.15	0.08	0.07	0.06	0.06	0.05	0.04
TFC/GDP[12]	0.23	0.16	0.13	0.13	0.12	0.10	0.08
Per Capita TFC[13]	3.12	3.12	2.96	3.05	3.02	2.95	2.90
Energy-related CO_2 Emissions (Mt CO_2)[14]	1 058.7	966.4	844.6	848.6	808.3	770.0	695.8
CO_2 Emissions from Bunkers (Mt CO_2)	21.8	22.1	29.6	31.7	34.9	41.3	48.0

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	1.5	-0.3	-0.2	0.3	-0.5	-0.9	-0.7
Coal	-0.2	-0.6	-3.1	0.9	-2.1	-0.7	-2.3
Oil	-0.1	-2.2	0.0	-1.0	0.4	-0.8	-0.7
Gas	10.2	0.6	2.8	-0.5	0.8	0.4	0.3
Comb. Renewables & Waste	6.2	2.7	5.7	7.5	3.7	1.8	0.9
Nuclear	27.5	10.3	0.6	1.2	-4.1	-13.1	–
Hydro	3.2	-0.5	0.8	9.4	1.5	0.8	0.0
Geothermal	–	–	26.0	2.1	5.2	19.1	14.5
Solar/Wind/Other	–	–	43.5	32.3	9.9	4.5	3.4
TFC	1.2	-0.6	-0.1	3.2	-0.2	-0.3	-0.4
Electricity Consumption	3.8	1.4	0.9	0.8	0.4	0.1	-0.1
Energy Production	1.0	0.2	-2.5	1.1	-1.6	-2.6	-0.9
Net Oil Imports	0.2	-2.5	0.2	-3.2	0.7	-0.7	-0.6
GDP	2.4	2.2	1.7	1.6	1.5	1.6	1.3
Growth in the TPES/GDP Ratio	-0.9	-2.5	-1.9	-1.3	-2.0	-2.4	-2.0
Growth in the TFC/GDP Ratio	-1.1	-2.8	-1.8	1.5	-1.7	-1.9	-1.7

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**2.33**	**9.20**	**9.92**	**10.29**	**11.88**	**14.70**	**16.20**
Coal[1]		1.69	7.12	8.18	8.55	9.85	12.27	13.54
Oil		–	0.84	0.13	0.12	–	–	–
Gas		–	0.14	0.03	0.03	0.05	0.05	0.05
Comb. Renewables & Waste[2]		0.45	0.89	0.98	0.99	0.93	1.00	1.10
Nuclear		–	–	–	–	–	–	–
Hydro		0.19	0.15	0.41	0.40	0.55	0.67	0.67
Geothermal		–	0.00	0.00	0.00	0.06	0.17	0.28
Solar/Wind/Other[3]		–	0.06	0.19	0.20	0.45	0.54	0.55
TOTAL NET IMPORTS[4]		**11.12**	**12.74**	**19.08**	**21.18**	**23.75**	**26.97**	**31.51**
Coal[1]	Exports	0.02	–	0.07	0.04	..	..	..
	Imports	0.47	0.92	0.49	0.50	0.79	0.78	2.34
	Net Imports	0.45	0.92	0.42	0.46	0.79	0.78	2.34
Oil	Exports	4.95	7.56	6.04	5.79	..	..	..
	Imports	16.51	21.87	25.72	27.32	..	..	..
	Bunkers	0.89	2.55	3.20	3.23	3.88	4.51	5.23
	Net Imports	10.67	11.76	16.48	18.30	18.50	21.32	22.59
Gas	Exports	–	–	–	–	..	..	..
	Imports	–	–	2.00	2.17	4.11	4.52	6.24
	Net Imports	–	–	2.00	2.17	4.11	4.52	6.24
Electricity	Exports	0.00	0.05	0.18	0.18	..	..	..
	Imports	0.01	0.11	0.36	0.42	..	..	..
	Net Imports	0.00	0.06	0.18	0.24	0.35	0.35	0.35
TOTAL STOCK CHANGES		**-1.10**	**0.24**	**0.89**	**-1.00**	**-**	**-**	**-**
TOTAL SUPPLY (TPES)		**12.36**	**22.18**	**29.89**	**30.47**	**35.63**	**41.67**	**47.70**
Coal[1]		2.10	8.07	8.91	9.11	10.64	13.05	15.88
Oil		9.61	12.81	17.19	17.30	18.50	21.32	22.59
Gas		–	0.14	2.03	2.23	4.16	4.57	6.28
Comb. Renewables & Waste[2]		0.45	0.89	0.98	0.99	0.93	1.00	1.10
Nuclear		–	–	–	–	–	–	–
Hydro		0.19	0.15	0.41	0.40	0.55	0.67	0.67
Geothermal		–	0.00	0.00	0.00	0.06	0.17	0.28
Solar/Wind/Other[3]		–	0.06	0.19	0.20	0.45	0.54	0.55
Electricity Trade[5]		0.00	0.06	0.18	0.24	0.35	0.35	0.35
Shares (%)								
Coal		*17.0*	*36.4*	*29.8*	*29.9*	*29.8*	*31.3*	*33.3*
Oil		*77.7*	*57.8*	*57.5*	*56.8*	*51.9*	*51.2*	*47.3*
Gas		–	*0.6*	*6.8*	*7.3*	*11.7*	*11.0*	*13.2*
Comb. Renewables & Waste		*3.6*	*4.0*	*3.3*	*3.2*	*2.6*	*2.4*	*2.3*
Nuclear		–	–	–	–	–	–	–
Hydro		*1.5*	*0.7*	*1.4*	*1.3*	*1.5*	*1.6*	*1.4*
Geothermal		–	–	–	–	*0.2*	*0.4*	*0.6*
Solar/Wind/Other		–	*0.3*	*0.6*	*0.7*	*1.3*	*1.3*	*1.2*
Electricity Trade		–	*0.3*	*0.6*	*0.8*	*1.0*	*0.8*	*0.7*

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**9.21**	**15.47**	**21.61**	**21.43**	**24.27**	**27.75**	**30.95**
Coal[1]	0.52	1.20	0.60	0.56	0.83	0.79	0.80
Oil	7.15	10.75	15.26	14.93	15.44	16.94	17.48
Gas	0.00	0.11	0.51	0.59	1.69	2.02	2.55
Comb. Renewables & Waste[2]	0.45	0.89	0.91	0.92	0.90	0.90	1.00
Geothermal	–	0.00	0.00	0.00	–	–	–
Solar/Wind/Other	–	0.06	0.11	0.11	0.10	0.11	0.12
Electricity	1.09	2.45	4.18	4.28	5.28	6.95	8.94
Heat	–	–	0.05	0.04	0.03	0.04	0.06
Shares (%)							
Coal	*5.6*	*7.8*	*2.8*	*2.6*	*3.4*	*2.8*	*2.6*
Oil	*77.6*	*69.5*	*70.6*	*69.7*	*63.6*	*61.1*	*56.5*
Gas	–	*0.7*	*2.4*	*2.8*	*7.0*	*7.3*	*8.2*
Comb. Renewables & Waste	*4.9*	*5.8*	*4.2*	*4.3*	*3.7*	*3.2*	*3.2*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.4*	*0.5*	*0.5*	*0.4*	*0.4*	*0.4*
Electricity	*11.9*	*15.8*	*19.3*	*20.0*	*21.8*	*25.0*	*28.9*
Heat	–	–	*0.2*	*0.2*	*0.1*	*0.2*	*0.2*
TOTAL INDUSTRY[6]	**3.49**	**4.70**	**5.15**	**4.95**	**4.97**	**5.28**	**5.97**
Coal[1]	0.46	1.18	0.60	0.55	0.83	0.79	0.80
Oil	2.39	2.18	2.69	2.48	1.71	2.08	2.26
Gas	–	0.11	0.45	0.50	0.80	0.60	0.88
Comb. Renewables & Waste[2]	–	0.19	0.20	0.21	0.20	0.20	0.20
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.63	1.04	1.22	1.20	1.43	1.62	1.83
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*13.1*	*25.0*	*11.6*	*11.2*	*16.7*	*14.9*	*13.4*
Oil	*68.7*	*46.5*	*52.1*	*50.1*	*34.5*	*39.4*	*37.9*
Gas	–	*2.2*	*8.8*	*10.2*	*16.1*	*11.4*	*14.7*
Comb. Renewables & Waste	–	*4.1*	*3.9*	*4.2*	*4.0*	*3.8*	*3.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*18.2*	*22.2*	*23.6*	*24.3*	*28.7*	*30.6*	*30.6*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**2.70**	**5.95**	**7.98**	**8.14**	**9.74**	**11.45**	**12.54**
TOTAL OTHER SECTORS[8]	**3.03**	**4.82**	**8.48**	**8.35**	**9.55**	**11.02**	**12.44**
Coal[1]	0.04	0.03	0.01	0.01	–	–	–
Oil	2.08	2.63	4.63	4.34	4.14	3.58	2.87
Gas	0.00	0.01	0.05	0.08	0.78	1.32	1.59
Comb. Renewables & Waste[2]	0.45	0.70	0.71	0.71	0.70	0.70	0.80
Geothermal	–	0.00	0.00	0.00	–	–	–
Solar/Wind/Other	–	0.06	0.11	0.11	0.10	0.11	0.12
Electricity	0.46	1.40	2.94	3.05	3.80	5.26	7.01
Heat	–	–	0.05	0.04	0.03	0.04	0.06
Shares (%)							
Coal	*1.4*	*0.5*	*0.1*	*0.1*	–	–	–
Oil	*68.6*	*54.5*	*54.5*	*52.0*	*43.3*	*32.5*	*23.0*
Gas	*0.1*	*0.1*	*0.5*	*0.9*	*8.1*	*12.0*	*12.8*
Comb. Renewables & Waste	*14.9*	*14.6*	*8.4*	*8.6*	*7.4*	*6.4*	*6.4*
Geothermal	–	*0.1*	–	–	–	–	–
Solar/Wind/Other	–	*1.2*	*1.2*	*1.3*	*1.0*	*1.0*	*0.9*
Electricity	*15.0*	*29.0*	*34.7*	*36.6*	*39.8*	*47.7*	*56.4*
Heat	–	–	*0.5*	*0.5*	*0.3*	*0.4*	*0.4*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.34**	**8.90**	**12.57**	**12.87**	**14.81**	**18.72**	**23.53**
OUTPUT (Mtoe)	**1.27**	**2.99**	**4.98**	**5.06**	**6.07**	**8.09**	**10.44**
(TWh gross)	14.82	34.78	57.91	58.81	70.64	94.02	121.39
Output Shares (%)							
Coal	*35.5*	*72.4*	*60.7*	*60.2*	*54.7*	*55.6*	*54.8*
Oil	*49.5*	*22.3*	*15.0*	*14.3*	*13.8*	*16.9*	*16.4*
Gas	–	*0.3*	*13.8*	*15.3*	*16.2*	*13.5*	*17.8*
Comb. Renewables & Waste	–	–	*0.4*	*0.4*	*0.2*	*0.1*	*0.1*
Nuclear	–	–	–	–	–	–	–
Hydro	*15.0*	*5.1*	*8.2*	*7.9*	*9.1*	*8.3*	*6.4*
Geothermal	–	–	–	–	*0.1*	*0.2*	*0.3*
Solar/Wind/Other	–	*0.0*	*1.8*	*1.9*	*5.8*	*5.4*	*4.2*
TOTAL LOSSES	**3.14**	**7.00**	**8.78**	**9.16**	**11.37**	**13.92**	**16.76**
of which:							
Electricity and Heat Generation[10]	2.07	5.91	7.54	7.77	8.71	10.59	13.03
Other Transformation	0.44	-0.23	-0.75	-0.62	0.38	0.58	0.60
Own Use and Losses[11]	0.64	1.31	1.99	2.01	2.28	2.75	3.13
Statistical Differences	**0.00**	**-0.28**	**-0.51**	**-0.12**	–	–	–

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	68.90	90.00	129.00	135.00	161.20	216.64	291.14
Population (millions)	9.08	10.34	11.02	11.06	11.21	11.50	11.79
TPES/GDP[12]	0.18	0.25	0.23	0.23	0.22	0.19	0.16
Energy Production/TPES	0.19	0.41	0.33	0.34	0.33	0.35	0.34
Per Capita TPES[13]	1.36	2.15	2.71	2.76	3.18	3.62	4.05
Oil Supply/GDP[12]	0.14	0.14	0.13	0.13	0.11	0.10	0.08
TFC/GDP[12]	0.13	0.17	0.17	0.16	0.15	0.13	0.11
Per Capita TFC[13]	1.01	1.50	1.96	1.94	2.16	2.41	2.63
Energy-related CO_2 Emissions (Mt CO_2)[14]	34.4	70.6	94.1	93.9	104.8	123.7	143.1
CO_2 Emissions from Bunkers (Mt CO_2)	4.5	10.5	12.5	12.7	15.2	18.2	21.9

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	4.4	3.0	2.3	2.0	2.6	1.6	1.4
Coal	8.7	8.0	0.8	2.2	2.6	2.1	2.0
Oil	3.5	0.7	2.3	0.6	1.1	1.4	0.6
Gas	–	–	23.0	10.0	11.0	0.9	3.2
Comb. Renewables & Waste	–	6.4	0.7	1.0	-1.1	0.8	1.0
Nuclear	–	–	–	–	–	–	–
Hydro	8.2	-6.2	7.9	-2.0	5.4	2.0	-0.0
Geothermal	–	–	-8.1	–	96.2	11.5	5.3
Solar/Wind/Other	–	–	9.8	5.7	14.2	1.9	0.1
TFC	4.0	2.6	2.6	-0.8	2.1	1.4	1.1
Electricity Consumption	7.0	3.7	4.2	2.3	3.6	2.8	2.6
Energy Production	8.3	8.5	0.6	3.8	2.4	2.2	1.0
Net Oil Imports	2.5	-0.4	2.6	11.0	0.2	1.4	0.6
GDP	3.3	0.7	2.8	4.7	3.0	3.0	3.0
Growth in the TPES/GDP Ratio	1.2	2.3	-0.5	-2.6	-0.3	-1.4	-1.6
Growth in the TFC/GDP Ratio	0.7	1.9	-0.2	-5.3	-0.9	-1.6	-1.8

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**12.70**	**14.33**	**10.41**	**10.24**	**9.72**	**9.13**	**8.66**
Coal[1]		6.05	4.14	2.71	2.18	2.00	1.80	1.60
Oil		2.02	2.27	1.61	1.59	1.00	0.80	0.70
Gas		4.03	3.81	2.29	2.37	1.80	1.40	1.00
Comb. Renewables & Waste[2]		0.59	0.42	0.82	0.87	1.00	1.20	1.40
Nuclear		–	3.58	2.89	3.12	3.79	3.79	3.79
Hydro		0.01	0.02	0.02	0.02	0.02	0.02	0.02
Geothermal		–	0.09	0.09	0.09	0.10	0.10	0.10
Solar/Wind/Other[3]		–	–	0.00	0.00	0.01	0.03	0.05
TOTAL NET IMPORTS[4]		**8.66**	**14.17**	**16.35**	**16.01**	**17.40**	**21.44**	**22.81**
Coal[1]	Exports	0.11	–	0.05	0.08	–	–	–
	Imports	1.74	1.63	1.05	1.21	0.32	0.32	0.32
	Net Imports	1.63	1.63	1.00	1.13	0.32	0.32	0.32
Oil	Exports	0.92	1.52	2.51	2.86	1.50	1.50	1.50
	Imports	7.39	7.96	7.32	7.82	7.74	8.14	8.84
	Bunkers	–	–	–	–	–	–	–
	Net Imports	6.48	6.44	4.81	4.96	6.24	6.64	7.34
Gas	Exports	0.01	0.02	–	–	–	–	–
	Imports	0.17	5.19	9.94	9.28	10.68	14.16	14.95
	Net Imports	0.15	5.17	9.94	9.28	10.68	14.16	14.95
Electricity	Exports	0.09	0.19	0.61	0.26	0.16	0.16	0.15
	Imports	0.49	1.14	1.21	0.91	0.31	0.47	0.35
	Net Imports	0.40	0.96	0.60	0.64	0.16	0.31	0.20
TOTAL STOCK CHANGES		**-0.02**	**0.07**	**-0.42**	**0.11**	**-**	**-**	**-**
TOTAL SUPPLY (TPES)		**21.33**	**28.56**	**26.34**	**26.36**	**27.11**	**30.57**	**31.47**
Coal[1]		7.91	6.12	3.75	3.50	2.32	2.12	1.92
Oil		8.21	8.51	6.30	6.41	7.24	7.44	8.04
Gas		4.17	8.91	11.88	11.71	12.48	15.56	15.95
Comb. Renewables & Waste[2]		0.64	0.38	0.82	0.87	1.00	1.20	1.40
Nuclear		–	3.58	2.89	3.12	3.79	3.79	3.79
Hydro		0.01	0.02	0.02	0.02	0.02	0.02	0.02
Geothermal		–	0.09	0.09	0.09	0.10	0.10	0.10
Solar/Wind/Other[3]		–	–	0.00	0.00	0.01	0.03	0.05
Electricity Trade[5]		0.40	0.96	0.60	0.64	0.16	0.31	0.20
Shares (%)								
Coal		*37.1*	*21.4*	*14.2*	*13.3*	*8.6*	*6.9*	*6.1*
Oil		*38.5*	*29.8*	*23.9*	*24.3*	*26.7*	*24.3*	*25.6*
Gas		*19.6*	*31.2*	*45.1*	*44.4*	*46.0*	*50.9*	*50.7*
Comb. Renewables & Waste		*3.0*	*1.3*	*3.1*	*3.3*	*3.7*	*3.9*	*4.4*
Nuclear		–	*12.5*	*11.0*	*11.8*	*14.0*	*12.4*	*12.0*
Hydro		–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Geothermal		–	*0.3*	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*
Solar/Wind/Other		–	–	–	–	–	*0.1*	*0.2*
Electricity Trade		*1.9*	*3.4*	*2.3*	*2.4*	*0.6*	*1.0*	*0.6*

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**17.14**	**21.02**	**19.00**	**19.14**	**19.59**	**21.66**	**21.95**
Coal[1]	4.17	2.68	0.66	0.66	0.72	0.52	0.52
Oil	6.71	7.41	5.72	6.11	6.00	6.20	6.80
Gas	3.08	6.20	7.73	7.75	8.13	10.61	10.40
Comb. Renewables & Waste[2]	0.62	0.34	0.75	0.63	0.50	0.60	0.90
Geothermal	–	0.09	0.08	0.08	0.09	0.09	0.09
Solar/Wind/Other	–	–	0.00	0.00	–	–	–
Electricity	1.51	2.72	2.70	2.74	2.78	2.20	1.80
Heat	1.06	1.59	1.37	1.18	1.37	1.44	1.44
Shares (%)							
Coal	*24.3*	*12.7*	*3.5*	*3.4*	*3.7*	*2.4*	*2.4*
Oil	*39.1*	*35.2*	*30.1*	*31.9*	*30.6*	*28.6*	*31.0*
Gas	*17.9*	*29.5*	*40.7*	*40.5*	*41.5*	*49.0*	*47.4*
Comb. Renewables & Waste	*3.6*	*1.6*	*3.9*	*3.3*	*2.6*	*2.8*	*4.1*
Geothermal	–	*0.4*	*0.4*	*0.4*	*0.5*	*0.4*	*0.4*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*8.8*	*12.9*	*14.2*	*14.3*	*14.2*	*10.2*	*8.2*
Heat	*6.2*	*7.6*	*7.2*	*6.1*	*7.0*	*6.6*	*6.5*
TOTAL INDUSTRY[6]	**7.90**	**8.08**	**4.87**	**4.99**	**5.13**	**5.86**	**5.90**
Coal[1]	1.87	0.80	0.38	0.41	0.52	0.32	0.32
Oil	2.34	2.11	1.42	1.66	1.38	1.27	1.41
Gas	2.29	3.76	1.69	1.56	2.01	3.11	3.11
Comb. Renewables & Waste[2]	0.02	0.00	0.08	0.07	–	–	–
Geothermal	–	–	0.00	0.00	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.92	1.18	0.82	0.82	0.82	0.74	0.63
Heat	0.46	0.23	0.48	0.47	0.40	0.43	0.43
Shares (%)							
Coal	*23.6*	*9.9*	*7.8*	*8.2*	*10.1*	*5.5*	*5.4*
Oil	*29.6*	*26.1*	*29.2*	*33.3*	*27.0*	*21.7*	*23.9*
Gas	*29.0*	*46.5*	*34.6*	*31.3*	*39.1*	*53.0*	*52.7*
Comb. Renewables & Waste	*0.2*	–	*1.6*	*1.4*	–	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.7*	*14.6*	*16.9*	*16.4*	*16.0*	*12.6*	*10.7*
Heat	*5.9*	*2.8*	*9.8*	*9.4*	*7.8*	*7.3*	*7.2*
TRANSPORT[7]	**2.37**	**3.15**	**3.82**	**3.99**	**4.05**	**4.51**	**4.94**
TOTAL OTHER SECTORS[8]	**6.88**	**9.79**	**10.30**	**10.17**	**10.41**	**11.29**	**11.10**
Coal[1]	1.93	1.88	0.27	0.25	0.20	0.20	0.20
Oil	2.45	2.25	0.57	0.56	0.65	0.49	0.50
Gas	0.78	2.44	6.04	6.18	6.12	7.51	7.29
Comb. Renewables & Waste[2]	0.60	0.34	0.67	0.56	0.50	0.60	0.90
Geothermal	–	0.09	0.08	0.08	0.09	0.09	0.09
Solar/Wind/Other	–	–	0.00	0.00	–	–	–
Electricity	0.52	1.43	1.79	1.83	1.88	1.40	1.11
Heat	0.60	1.36	0.89	0.71	0.97	1.01	1.01
Shares (%)							
Coal	*28.1*	*19.2*	*2.6*	*2.4*	*1.9*	*1.8*	*1.8*
Oil	*35.7*	*22.9*	*5.5*	*5.5*	*6.2*	*4.3*	*4.5*
Gas	*11.4*	*25.0*	*58.6*	*60.8*	*58.8*	*66.5*	*65.6*
Comb. Renewables & Waste	*8.7*	*3.4*	*6.5*	*5.5*	*4.8*	*5.3*	*8.1*
Geothermal	–	*0.9*	*0.8*	*0.8*	*0.9*	*0.8*	*0.8*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*7.5*	*14.6*	*17.3*	*18.0*	*18.1*	*12.4*	*10.0*
Heat	*8.7*	*13.9*	*8.6*	*7.0*	*9.3*	*8.9*	*9.1*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**6.37**	**10.23**	**9.77**	**9.51**	**10.73**	**11.44**	**11.76**
OUTPUT (Mtoe)	**1.52**	**2.45**	**2.94**	**2.90**	**3.20**	**3.56**	**4.07**
(TWh gross)	17.64	28.44	34.15	33.71	37.18	41.44	47.34
Output Shares (%)							
Coal	*66.0*	*30.5*	*27.1*	*24.7*	*13.4*	*10.9*	*8.5*
Oil	*17.2*	*4.8*	*4.8*	*2.3*	*6.7*	*8.4*	*7.4*
Gas	*16.2*	*15.7*	*34.8*	*34.8*	*37.7*	*42.2*	*49.6*
Comb. Renewables & Waste	–	*0.1*	*0.6*	*2.2*	*2.4*	*2.4*	*2.3*
Nuclear	–	*48.3*	*32.3*	*35.3*	*39.0*	*35.0*	*30.6*
Hydro	*0.6*	*0.6*	*0.5*	*0.6*	*0.5*	*0.4*	*0.4*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.0*	*0.0*	*0.2*	*0.6*	*1.2*
TOTAL LOSSES	**4.87**	**7.99**	**7.17**	**7.10**	**7.52**	**8.91**	**9.52**
of which:							
Electricity and Heat Generation[10]	3.67	6.03	5.30	5.24	6.04	6.32	6.14
Other Transformation	0.21	-0.05	0.09	0.06	0.18	0.18	0.19
Own Use and Losses[11]	0.99	2.02	1.78	1.80	1.31	2.40	3.19
Statistical Differences	**-0.68**	**-0.45**	**0.18**	**0.11**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	30.46	43.70	52.70	55.10	69.72	108.27	168.14
Population (millions)	10.43	10.37	10.13	10.11	9.94	9.68	9.42
TPES/GDP[12]	0.70	0.65	0.50	0.48	0.39	0.28	0.19
Energy Production/TPES	0.60	0.50	0.40	0.39	0.36	0.30	0.28
Per Capita TPES[13]	2.05	2.76	2.60	2.61	2.73	3.16	3.34
Oil Supply/GDP[12]	0.27	0.19	0.12	0.12	0.10	0.07	0.05
TFC/GDP[12]	0.56	0.48	0.36	0.35	0.28	0.20	0.13
Per Capita TFC[13]	1.64	2.03	1.88	1.89	1.97	2.24	2.33
Energy-related CO_2 Emissions (Mt CO_2)[14]	68.4	70.6	57.7	56.8	55.7	62.6	64.2
CO_2 Emissions from Bunkers (Mt CO_2)	0.2	0.5	0.6	0.7	0.9	1.3	2.1

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	4.9	0.1	-0.6	0.1	0.5	1.2	0.3
Coal	1.2	-3.0	-3.7	-6.6	-6.6	-0.9	-1.0
Oil	5.6	-2.6	-2.3	1.6	2.1	0.3	0.8
Gas	10.0	1.7	2.2	-1.5	1.1	2.2	0.2
Comb. Renewables & Waste	-2.6	-3.3	6.2	6.0	2.3	1.8	1.6
Nuclear	–	–	-1.6	8.1	3.3	–	–
Hydro	6.3	1.3	–	20.0	-1.9	–	–
Geothermal	–	–	–	–	2.5	–	–
Solar/Wind/Other	–	–	–	–	30.8	9.6	7.2
TFC	4.5	-0.5	-0.8	0.8	0.4	1.0	0.1
Electricity Consumption	6.0	2.2	-0.0	1.3	0.3	-2.3	-2.0
Energy Production	2.4	-0.2	-2.4	-1.7	-0.9	-0.6	-0.5
Net Oil Imports	7.1	-3.8	-2.2	3.1	3.9	0.6	1.0
GDP	4.3	1.0	1.5	4.6	4.0	4.5	4.5
Growth in the TPES/GDP Ratio	0.6	-0.9	-2.0	-4.3	-3.4	-3.2	-4.0
Growth in the TFC/GDP Ratio	0.2	-1.5	-2.2	-3.6	-3.5	-3.3	-4.2

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**1.120**	**3.467**	**1.915**	**1.902**	**3.156**	**3.908**	**..**
Coal[1]		0.045	0.016	–	–	0.835	0.567	..
Peat		1.020	1.411	1.096	0.890	–	–	..
Oil		–	–	–	–	–	–	..
Gas		–	1.872	0.544	0.688	1.840	2.703	..
Comb. Renewables & Waste[2]		–	0.108	0.185	0.214	0.288	0.284	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.055	0.060	0.051	0.054	0.070	0.070	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.039	0.057	0.123	0.284	..
TOTAL NET IMPORTS[4]		**5.901**	**7.134**	**13.437**	**13.737**	**15.350**	**17.844**	**..**
Coal[1]	Exports	0.073	0.022	0.018	0.018	–	–	..
	Imports	0.578	2.066	1.682	1.827	2.268	0.930	..
	Net Imports	0.505	2.044	1.664	1.809	2.268	0.930	..
Peat	Exports	–	–	–	–	–	–	..
	Imports	–	–	–	–	–	–	..
	Net Imports	–	–	–	–	–	–	..
Oil	Exports	0.472	0.680	1.592	1.301	–	–	..
	Imports	5.956	5.788	10.305	10.286	..	..	..
	Bunkers	0.092	0.018	0.172	0.152	..	..	..
	Net Imports	5.392	5.090	8.541	8.833	9.454	11.647	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	–	–	3.133	2.959	3.493	5.132	..
	Net Imports	–	–	3.133	2.959	3.493	5.132	..
Electricity	Exports	0.002	–	0.001	–	–	–	..
	Imports	0.006	–	0.101	0.135	0.135	0.135	..
	Net Imports	0.004	–	0.100	0.135	0.135	0.135	..
TOTAL STOCK CHANGES		**0.168**	**-0.192**	**-0.281**	**-0.433**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**7.189**	**10.409**	**15.072**	**15.206**	**18.506**	**21.752**	**..**
Coal[1]		0.565	2.139	1.720	1.765	3.103	1.497	..
Peat		1.020	1.358	0.834	0.517	–	–	..
Oil		5.545	4.871	8.490	8.820	9.454	11.647	..
Gas		–	1.872	3.652	3.644	5.333	7.835	..
Comb. Renewables & Waste[2]		–	0.108	0.185	0.214	0.288	0.284	..
Nuclear		–	–	–	–	–	–	..
Hydro		0.055	0.060	0.051	0.054	0.070	0.070	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	–	0.039	0.057	0.123	0.284	..
Electricity Trade[5]		0.004	–	0.100	0.135	0.135	0.135	..
Shares (%)								
Coal		*7.9*	*20.5*	*11.4*	*11.6*	*16.8*	*6.9*	..
Peat		*14.2*	*13.0*	*5.5*	*3.4*	–	–	..
Oil		*77.1*	*46.8*	*56.3*	*58.0*	*51.1*	*53.5*	..
Gas		–	*18.0*	*24.2*	*24.0*	*28.8*	*36.0*	..
Comb. Renewables & Waste		–	*1.0*	*1.2*	*1.4*	*1.6*	*1.3*	..
Nuclear		–	–	–	–	–	–	..
Hydro		*0.8*	*0.6*	*0.3*	*0.4*	*0.4*	*0.3*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	*0.3*	*0.4*	*0.7*	*1.3*	..
Electricity Trade		*0.1*	–	*0.7*	*0.9*	*0.7*	*0.6*	..

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**5.416**	**7.823**	**11.703**	**11.976**	**14.590**	**17.961**	**..**
Coal[1]	0.520	1.053	0.397	0.379	0.614	0.397	..
Peat	0.408	0.495	0.124	0.125	–	–	..
Oil	3.856	4.149	7.799	7.975	9.322	11.516	..
Gas	0.103	0.998	1.277	1.324	1.933	2.662	..
Comb. Renewables & Waste[2]	–	0.108	0.167	0.189	0.187	0.181	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.529	1.021	1.939	1.982	2.534	3.205	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*9.6*	*13.5*	*3.4*	*3.2*	*4.2*	*2.2*	..
Peat	*7.5*	*6.3*	*1.1*	*1.0*	–	–	..
Oil	*71.2*	*53.0*	*66.6*	*66.6*	*63.9*	*64.1*	..
Gas	*1.9*	*12.8*	*10.9*	*11.1*	*13.2*	*14.8*	..
Comb. Renewables & Waste	–	*1.4*	*1.4*	*1.6*	*1.3*	*1.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*9.8*	*13.1*	*16.6*	*16.5*	*17.4*	*17.8*	..
Heat	–	–	–	–	–	–	..
TOTAL INDUSTRY[6]	**1.920**	**2.385**	**2.403**	**2.419**	**2.499**	**3.129**	**..**
Coal[1]	0.044	0.271	0.042	0.037	0.225	0.166	..
Peat	–	–	–	–	–	–	..
Oil	1.662	0.879	1.193	1.216	0.866	1.282	..
Gas	0.025	0.788	0.436	0.433	0.561	0.721	..
Comb. Renewables & Waste[2]	–	0.063	0.121	0.143	0.146	0.146	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.189	0.386	0.610	0.590	0.701	0.814	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*2.3*	*11.4*	*1.7*	*1.5*	*9.0*	*5.3*	..
Peat	–	–	–	–	–	–	..
Oil	*86.6*	*36.9*	*49.6*	*50.3*	*34.7*	*41.0*	..
Gas	*1.3*	*33.0*	*18.1*	*17.9*	*22.4*	*23.0*	..
Comb. Renewables & Waste	–	*2.6*	*5.0*	*5.9*	*5.8*	*4.7*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*9.8*	*16.2*	*25.4*	*24.4*	*28.1*	*26.0*	..
Heat	–	–	–	–	–	–	..
TRANSPORT[7]	**1.406**	**2.031**	**4.532**	**4.718**	**6.278**	**7.605**	**..**
TOTAL OTHER SECTORS[8]	**2.090**	**3.406**	**4.767**	**4.839**	**5.813**	**7.227**	**..**
Coal[1]	0.476	0.782	0.355	0.342	0.389	0.231	..
Peat	0.408	0.495	0.124	0.125	–	–	..
Oil	0.788	1.240	2.075	2.055	2.191	2.642	..
Gas	0.078	0.211	0.840	0.891	1.372	1.941	..
Comb. Renewables & Waste[2]	–	0.045	0.046	0.046	0.041	0.035	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	0.340	0.634	1.326	1.380	1.820	2.378	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*22.8*	*23.0*	*7.4*	*7.1*	*6.7*	*3.2*	..
Peat	*19.5*	*14.5*	*2.6*	*2.6*	–	–	..
Oil	*37.7*	*36.4*	*43.5*	*42.5*	*37.7*	*36.6*	..
Gas	*3.7*	*6.2*	*17.6*	*18.4*	*23.6*	*26.9*	..
Comb. Renewables & Waste	–	*1.3*	*1.0*	*1.0*	*0.7*	*0.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*16.3*	*18.6*	*27.8*	*28.5*	*31.3*	*32.9*	..
Heat	–	–	–	–	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**1.766**	**3.121**	**4.882**	**4.848**	**6.103**	**6.637**	..
OUTPUT (Mtoe)	**0.632**	**1.224**	**2.138**	**2.168**	**2.790**	**3.507**	..
(TWh gross)	7.348	14.229	24.861	25.215	32.447	40.776	..
Output Shares (%)							
Coal	*1.0*	*41.6*	*25.0*	*24.7*	*27.8*	*10.1*	..
Peat	*23.9*	*15.8*	*8.2*	*5.9*	–	–	..
Oil	*66.3*	*10.0*	*9.9*	*12.7*	*0.0*	*0.0*	..
Gas	–	*27.7*	*52.4*	*51.1*	*64.1*	*78.9*	..
Comb. Renewables & Waste	–	–	*0.3*	*0.4*	*1.1*	*0.9*	..
Nuclear	–	–	–	–	–	–	..
Hydro	*8.8*	*4.9*	*2.4*	*2.5*	*2.5*	*2.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*1.8*	*2.6*	*4.4*	*8.1*	..
TOTAL LOSSES	**1.649**	**2.307**	**3.390**	**3.362**	**3.915**	**3.791**	..
of which:							
Electricity and Heat Generation[10]	1.134	1.897	2.743	2.680	3.313	3.130	..
Other Transformation	0.329	0.098	0.129	0.152	–	–	..
Own Use and Losses[11]	0.186	0.312	0.518	0.530	0.602	0.661	..
Statistical Differences	**0.12**	**0.28**	**-0.02**	**-0.13**	**–**	**–**	..

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	24.60	48.30	113.20	118.20	153.93	206.87	..
Population (millions)	3.07	3.51	3.99	4.06	4.17	4.51	..
TPES/GDP[12]	0.29	0.22	0.13	0.13	0.12	0.11	..
Energy Production/TPES	0.16	0.33	0.13	0.13	0.17	0.18	..
Per Capita TPES[13]	2.34	2.97	3.78	3.75	4.44	4.83	..
Oil Supply/GDP[12]	0.23	0.10	0.08	0.07	0.06	0.06	..
TFC/GDP[12]	0.22	0.16	0.10	0.10	0.09	0.09	..
Per Capita TFC[13]	1.76	2.23	2.93	2.95	3.50	3.99	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	21.0	30.2	41.1	41.4	50.6	56.6	..
CO_2 Emissions from Bunkers (Mt CO_2)	1.1	1.1	2.8	2.6	..	..	..

GROWTH RATES (% per year)	73-79	79-90	90-03	03-04	04-10	10-20	20-30
TPES	3.6	1.5	2.9	0.9	3.3	1.6	..
Coal	6.9	8.8	-1.7	2.6	9.9	-7.0	..
Peat	2.1	1.5	-3.7	-38.0	–	–	..
Oil	2.3	-2.4	4.4	3.9	1.2	2.1	..
Gas	–	13.6	5.3	-0.2	6.6	3.9	..
Comb. Renewables & Waste	–	–	4.2	15.7	5.1	-0.1	..
Nuclear	–	–	–	–	–	–	..
Hydro	4.3	-1.5	-1.2	5.9	4.4	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	46.2	13.7	8.7	..
TFC	4.3	1.1	3.1	2.3	3.3	2.1	..
Electricity Consumption	5.8	2.9	5.1	2.2	4.2	2.4	..
Energy Production	4.6	8.1	-4.5	-0.7	8.8	2.2	..
Net Oil Imports	2.9	-2.0	4.1	3.4	1.1	2.1	..
GDP	4.9	3.6	6.8	4.4	4.5	3.0	..
Growth in the TPES/GDP Ratio	-1.3	-2.0	-3.6	-3.4	-1.1	-1.3	..
Growth in the TFC/GDP Ratio	-0.6	-2.4	-3.4	-2.0	-1.1	-0.9	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**20.5**	**25.3**	**27.6**	**30.1**	**29.0**	**30.5**	**35.4**
Coal[1]		0.3	0.3	0.2	0.1	0.1	0.1	0.1
Oil		1.1	4.5	5.8	5.6	5.7	5.0	5.0
Gas		12.6	14.0	11.4	10.6	8.5	6.0	6.0
Comb. Renewables & Waste[2]		0.2	0.8	2.4	5.4	5.0	6.5	8.6
Nuclear		0.8	–	–	–	–	–	–
Hydro		3.2	2.7	2.9	3.4	4.0	4.5	4.6
Geothermal		2.1	3.0	4.8	4.9	5.0	7.0	8.3
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.7	1.4	2.8
TOTAL NET IMPORTS[4]		**109.3**	**124.5**	**151.4**	**154.6**	**167.8**	**193.2**	**207.0**
Coal[1]	Exports	0.4	0.1	0.1	0.2	0.1	0.1	–
	Imports	8.2	13.9	14.6	17.0	16.4	17.1	18.5
	Net Imports	7.7	13.7	14.5	16.8	16.3	17.0	18.5
Oil	Exports	29.4	19.9	24.5	26.2	24.0	25.0	25.0
	Imports	136.4	105.0	108.4	107.5	99.7	107.3	111.2
	Bunkers	7.1	2.7	3.2	3.4	3.6	4.5	5.0
	Net Imports	99.9	82.4	80.7	77.9	72.1	77.8	81.2
Gas	Exports	–	0.0	0.3	0.3	0.1	0.1	0.1
	Imports	1.6	25.3	51.4	55.6	73.3	91.9	100.6
	Net Imports	1.6	25.3	51.1	55.3	73.2	91.8	100.5
Electricity	Exports	0.2	0.1	0.0	0.1	0.3	0.4	0.4
	Imports	0.3	3.1	4.4	4.0	5.9	6.5	6.5
	Net Imports	0.1	3.0	4.4	3.9	5.6	6.1	6.1
TOTAL STOCK CHANGES		**-0.9**	**-1.8**	**2.3**	**-0.2**	**-**	**-**	**-**
TOTAL SUPPLY (TPES)		**128.9**	**148.0**	**181.3**	**184.5**	**196.8**	**223.7**	**242.4**
Coal[1]		8.1	14.6	14.9	16.6	16.4	17.1	18.6
Oil		100.1	84.8	87.4	83.5	77.8	82.8	86.2
Gas		14.2	39.0	63.6	66.0	81.7	97.8	106.5
Comb. Renewables & Waste[2]		0.2	0.9	3.1	6.0	5.6	7.0	9.3
Nuclear		0.8	–	–	–	–	–	–
Hydro		3.2	2.7	2.9	3.4	4.0	4.5	4.6
Geothermal		2.1	3.0	4.8	4.9	5.0	7.0	8.3
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.7	1.4	2.8
Electricity Trade[5]		0.1	3.0	4.4	3.9	5.6	6.1	6.1
Shares (%)								
Coal		*6.3*	*9.9*	*8.2*	*9.0*	*8.3*	*7.6*	*7.7*
Oil		*77.6*	*57.3*	*48.2*	*45.3*	*39.5*	*37.0*	*35.6*
Gas		*11.0*	*26.3*	*35.1*	*35.8*	*41.5*	*43.7*	*43.9*
Comb. Renewables & Waste		*0.2*	*0.6*	*1.7*	*3.3*	*2.8*	*3.1*	*3.8*
Nuclear		*0.6*	–	–	–	–	–	–
Hydro		*2.5*	*1.8*	*1.6*	*1.8*	*2.0*	*2.0*	*1.9*
Geothermal		*1.7*	*2.0*	*2.7*	*2.6*	*2.5*	*3.1*	*3.4*
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.4*	*0.6*	*1.2*
Electricity Trade		*0.1*	*2.0*	*2.4*	*2.1*	*2.8*	*2.7*	*2.5*

0 is negligible, – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**98.7**	**117.6**	**139.4**	**144.8**	**148.2**	**172.4**	**187.8**
Coal[1]	3.3	3.4	2.7	3.0	4.8	5.5	5.6
Oil	72.1	64.2	67.9	68.2	66.7	73.3	78.1
Gas	12.8	30.6	41.9	41.6	44.6	51.4	56.1
Comb. Renewables & Waste[2]	–	0.9	1.6	1.8	2.3	3.0	4.3
Geothermal	–	0.2	0.2	0.2	0.6	1.0	1.0
Solar/Wind/Other	–	0.0	0.0	0.0	0.1	0.2	0.8
Electricity	10.6	18.5	25.1	25.4	29.1	38.0	41.9
Heat	–	–	–	4.5	–	–	–
Shares (%)							
Coal	*3.3*	*2.9*	*2.0*	*2.1*	*3.2*	*3.2*	*3.0*
Oil	*73.0*	*54.5*	*48.7*	*47.1*	*45.0*	*42.5*	*41.6*
Gas	*12.9*	*26.0*	*30.1*	*28.7*	*30.1*	*29.8*	*29.9*
Comb. Renewables & Waste	–	*0.7*	*1.1*	*1.2*	*1.6*	*1.7*	*2.3*
Geothermal	–	*0.2*	*0.2*	*0.1*	*0.4*	*0.6*	*0.5*
Solar/Wind/Other	–	–	–	–	*0.1*	*0.1*	*0.4*
Electricity	*10.7*	*15.7*	*18.0*	*17.6*	*19.6*	*22.0*	*22.3*
Heat	–	–	–	*3.1*	–	–	–
TOTAL INDUSTRY[6]	**47.6**	**44.6**	**48.5**	**49.1**	**47.1**	**53.8**	**58.7**
Coal[1]	2.6	3.3	2.7	3.0	4.8	5.5	5.6
Oil	29.7	16.9	15.2	15.5	12.1	12.2	11.9
Gas	8.7	14.6	17.9	17.9	16.5	19.5	22.2
Comb. Renewables & Waste[2]	–	0.2	0.3	0.3	0.4	0.6	1.0
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	6.6	9.5	12.4	12.4	13.3	16.0	18.0
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*5.6*	*7.4*	*5.6*	*6.2*	*10.2*	*10.2*	*9.5*
Oil	*62.3*	*37.9*	*31.3*	*31.5*	*25.7*	*22.7*	*20.3*
Gas	*18.2*	*32.9*	*36.9*	*36.5*	*35.0*	*36.2*	*37.8*
Comb. Renewables & Waste	–	*0.5*	*0.6*	*0.6*	*0.8*	*1.1*	*1.7*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*13.9*	*21.4*	*25.6*	*25.2*	*28.2*	*29.7*	*30.7*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**20.5**	**35.3**	**44.1**	**44.9**	**48.7**	**56.7**	**63.1**
TOTAL OTHER SECTORS[8]	**30.6**	**37.8**	**46.7**	**50.8**	**52.4**	**61.9**	**66.0**
Coal[1]	0.5	0.1	0.0	0.0	–	–	–
Oil	22.5	12.8	9.8	9.2	8.4	8.6	8.3
Gas	4.0	15.7	23.6	23.3	27.2	29.9	31.4
Comb. Renewables & Waste[2]	–	0.6	1.3	1.3	1.2	1.4	1.8
Geothermal	–	0.2	0.2	0.2	0.6	1.0	1.0
Solar/Wind/Other	–	0.0	0.0	0.0	0.1	0.2	0.8
Electricity	3.6	8.3	11.8	12.2	14.9	20.8	22.7
Heat	–	–	–	4.5	–	–	–
Shares (%)							
Coal	*1.5*	*0.3*	–	–	–	–	–
Oil	*73.5*	*33.8*	*20.9*	*18.2*	*16.0*	*13.9*	*12.6*
Gas	*13.1*	*41.6*	*50.6*	*45.8*	*51.9*	*48.3*	*47.6*
Comb. Renewables & Waste	–	*1.7*	*2.7*	*2.6*	*2.3*	*2.3*	*2.7*
Geothermal	–	*0.5*	*0.5*	*0.4*	*1.1*	*1.6*	*1.5*
Solar/Wind/Other	–	–	–	–	*0.2*	*0.3*	*1.2*
Electricity	*11.8*	*22.1*	*25.3*	*24.0*	*28.4*	*33.6*	*34.4*
Heat	–	–	–	*8.9*	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**28.0**	**43.1**	**56.6**	**59.4**	**64.9**	**75.9**	**82.3**
OUTPUT (Mtoe)	**12.4**	**18.3**	**24.4**	**25.2**	**29.8**	**37.1**	**41.0**
(TWh gross)	143.9	213.1	283.4	293.0	346.1	431.0	476.8
Output Shares (%)							
Coal	*3.6*	*16.8*	*15.6*	*17.4*	*15.0*	*12.3*	*12.6*
Oil	*62.4*	*48.2*	*26.8*	*16.1*	*6.9*	*3.8*	*1.4*
Gas	*3.1*	*18.6*	*41.4*	*44.3*	*57.8*	*63.1*	*63.9*
Comb. Renewables & Waste	*0.9*	*0.0*	*1.6*	*5.9*	*3.3*	*3.7*	*4.2*
Nuclear	*2.2*	*–*	*–*	*–*	*–*	*–*	*–*
Hydro	*26.1*	*14.8*	*11.9*	*13.5*	*13.4*	*12.2*	*11.2*
Geothermal	*1.7*	*1.5*	*1.9*	*1.9*	*1.5*	*1.6*	*1.8*
Solar/Wind/Other	*–*	*0.0*	*0.8*	*1.0*	*2.0*	*3.2*	*4.9*
TOTAL LOSSES	**29.9**	**30.4**	**41.7**	**39.7**	**48.6**	**51.3**	**54.6**
of which:							
Electricity and Heat Generation[10]	15.6	24.8	32.2	29.6	35.1	38.9	41.3
Other Transformation	6.0	-3.5	-0.1	0.2	-0.5	-0.5	-0.3
Own Use and Losses[11]	8.3	9.1	9.6	9.9	14.0	13.0	13.6
Statistical Differences	**0.3**	**-0.0**	**0.2**	**-0.1**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	576.30	917.50	1 100.70	1 114.20	1 232.79	1 502.76	1 923.66
Population (millions)	54.75	56.72	58.05	58.13	58.50	58.00	57.00
TPES/GDP[12]	0.22	0.16	0.16	0.17	0.16	0.15	0.13
Energy Production/TPES	0.16	0.17	0.15	0.16	0.15	0.14	0.15
Per Capita TPES[13]	2.35	2.61	3.12	3.17	3.36	3.86	4.25
Oil Supply/GDP[12]	0.17	0.09	0.08	0.07	0.06	0.06	0.04
TFC/GDP[12]	0.17	0.13	0.13	0.13	0.12	0.11	0.10
Per Capita TFC[13]	1.80	2.07	2.40	2.49	2.53	2.97	3.29
Energy-related CO_2 Emissions (Mt CO_2)[14]	333.8	398.4	452.8	462.3	482.8	537.7	572.8
CO_2 Emissions from Bunkers (Mt CO_2)	26.3	15.0	21.2	21.5	23.4	28.9	34.6

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	0.5	1.0	1.6	1.8	1.1	1.3	0.8
Coal	4.3	3.1	0.1	11.6	-0.2	0.4	0.8
Oil	-1.5	-0.7	0.2	-4.5	-1.2	0.6	0.4
Gas	8.1	5.1	3.8	3.8	3.6	1.8	0.9
Comb. Renewables & Waste	23.4	0.8	9.6	93.5	-1.1	2.3	2.9
Nuclear	-2.9	–	–	–	–	–	–
Hydro	3.4	-3.3	0.5	17.2	2.7	1.2	0.2
Geothermal	0.1	3.0	3.8	1.6	0.4	3.4	1.7
Solar/Wind/Other	–	–	29.1	30.4	25.4	7.2	7.2
TFC	1.3	0.9	1.3	3.9	0.4	1.5	0.9
Electricity Consumption	4.0	3.0	2.4	1.4	2.3	2.7	1.0
Energy Production	0.1	1.9	0.7	9.3	-0.6	0.5	1.5
Net Oil Imports	-1.8	-0.7	-0.2	-3.5	-1.3	0.8	0.4
GDP	3.5	2.4	1.4	1.2	1.7	2.0	2.5
Growth in the TPES/GDP Ratio	-2.9	-1.3	0.2	0.5	-0.6	-0.7	-1.7
Growth in the TFC/GDP Ratio	-2.1	-1.5	-0.1	2.7	-1.3	-0.5	-1.6

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**29.5**	**76.8**	**85.5**	**96.8**	**134.8**	**..**	**148.9**
Coal[1]		17.9	4.5	-	–	–	..	–
Oil		0.8	2.1	2.2	2.3	–	..	–
Gas		2.3	1.9	2.6	2.7	–	..	–
Comb. Renewables & Waste[2]		–	5.1	6.0	6.2	21.9	..	24.6
Nuclear		2.5	52.7	62.5	73.6	100.9	..	112.5
Hydro		5.7	7.7	8.1	8.1	9.1	..	8.9
Geothermal		0.2	1.6	3.2	3.1	2.9	..	2.9
Solar/Wind/Other[3]		–	1.2	0.7	0.7	–	..	–
TOTAL NET IMPORTS[4]		**300.7**	**372.7**	**430.1**	**435.5**	**401.1**	**..**	**434.6**
Coal[1]	Exports	0.4	1.4	1.9	1.5	–	..	–
	Imports	41.3	73.8	107.9	117.6	93.4	..	97.8
	Net Imports	40.9	72.4	106.0	116.1	93.4	..	97.8
Oil	Exports	2.9	3.6	3.9	4.5	–	..	–
	Imports	276.7	266.6	264.4	261.4	237.8	..	241.4
	Bunkers	16.8	5.3	5.0	5.2	4.6	..	4.7
	Net Imports	257.0	257.8	255.5	251.6	233.2	..	236.7
Gas	Exports	–	–	–	–	–	..	–
	Imports	2.8	42.5	68.6	67.8	74.5	..	100.2
	Net Imports	2.8	42.5	68.6	67.8	74.5	..	100.2
Electricity	Exports	–	–	–	–	–	..	–
	Imports	–	–	–	–	–	..	–
	Net Imports	–	–	–	–	–	..	–
TOTAL STOCK CHANGES		**-6.6**	**-3.5**	**0.6**	**0.9**	**–**	**..**	**–**
TOTAL SUPPLY (TPES)		**323.6**	**446.0**	**516.1**	**533.2**	**535.9**	**..**	**583.5**
Coal[1]		57.9	77.0	106.0	116.1	93.4	..	97.8
Oil		252.2	256.4	258.3	255.0	233.2	..	236.7
Gas		5.1	44.3	71.2	70.3	74.5	..	100.2
Comb. Renewables & Waste[2]		–	5.1	6.0	6.2	21.9	..	24.6
Nuclear		2.5	52.7	62.5	73.6	100.9	..	112.5
Hydro		5.7	7.7	8.1	8.1	9.1	..	8.9
Geothermal		0.2	1.6	3.2	3.1	2.9	..	2.9
Solar/Wind/Other[3]		–	1.2	0.7	0.7	–	..	–
Electricity Trade[5]		–	–	–	–	–	..	–
Shares (%)								
Coal		*17.9*	*17.3*	*20.5*	*21.8*	*17.4*	..	*16.8*
Oil		*77.9*	*57.5*	*50.0*	*47.8*	*43.5*	..	*40.6*
Gas		*1.6*	*9.9*	*13.8*	*13.2*	*13.9*	..	*17.2*
Comb. Renewables & Waste		–	*1.1*	*1.2*	*1.2*	*4.1*	..	*4.2*
Nuclear		*0.8*	*11.8*	*12.1*	*13.8*	*18.8*	..	*19.3*
Hydro		*1.8*	*1.7*	*1.6*	*1.5*	*1.7*	..	*1.5*
Geothermal		*0.1*	*0.4*	*0.6*	*0.6*	*0.5*	..	*0.5*
Solar/Wind/Other		–	*0.3*	*0.1*	*0.1*	–	..	–
Electricity Trade		–	–	–	–	–	..	–

0 is negligible, – is nil, .. is not available

Please note: Only partial information is available for 2010 and 2030. Forecast data for combustible renewables & waste include solar. wind. etc.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**234.4**	**305.6**	**349.3**	**354.3**	**376.9**	**..**	**400.6**
Coal[1]	20.2	32.2	25.7	27.0	39.8	..	38.0
Oil	171.5	189.3	213.6	213.8	209.4	..	208.6
Gas	7.0	15.4	25.5	26.7	28.7	..	38.4
Comb. Renewables & Waste[2]	–	2.6	2.3	2.4	10.4	..	8.7
Geothermal	–	0.1	0.2	0.2	0.1	..	0.1
Solar/Wind/Other	–	1.2	0.6	0.6	–	..	–
Electricity	35.7	64.7	80.8	83.1	87.1	..	105.1
Heat	0.0	0.2	0.5	0.6	1.4	..	1.6
Shares (%)							
Coal	*8.6*	*10.5*	*7.4*	*7.6*	*10.6*	..	*9.5*
Oil	*73.2*	*61.9*	*61.2*	*60.3*	*55.6*	..	*52.1*
Gas	*3.0*	*5.0*	*7.3*	*7.5*	*7.6*	..	*9.6*
Comb. Renewables & Waste	–	*0.9*	*0.6*	*0.7*	*2.8*	..	*2.2*
Geothermal	–	–	*0.1*	*0.1*	–	..	–
Solar/Wind/Other	–	*0.4*	*0.2*	*0.2*	–	..	–
Electricity	*15.2*	*21.2*	*23.1*	*23.5*	*23.1*	..	*26.2*
Heat	–	*0.1*	*0.2*	*0.2*	*0.4*	..	*0.4*
TOTAL INDUSTRY[6]	**140.2**	**140.5**	**141.9**	**145.3**	**..**	**..**	**..**
Coal[1]	18.2	31.8	25.7	27.0	..	..	..
Oil	94.9	69.7	70.2	71.0	..	..	..
Gas	2.1	4.7	10.1	11.2	..	..	..
Comb. Renewables & Waste[2]	–	2.5	2.2	2.3	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	25.1	31.9	33.6	33.9	..	..	..
Heat	–	–	–	–	..	..	..
Shares (%)							
Coal	*13.0*	*22.6*	*18.1*	*18.6*	..	..	..
Oil	*67.7*	*49.6*	*49.5*	*48.8*	..	..	..
Gas	*1.5*	*3.3*	*7.1*	*7.7*	..	..	..
Comb. Renewables & Waste	–	*1.8*	*1.6*	*1.6*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*17.9*	*22.7*	*23.7*	*23.3*	..	..	..
Heat	–	–	–	–	..	..	..
TRANSPORT[7]	**42.6**	**75.7**	**93.5**	**94.1**	**..**	**..**	**..**
TOTAL OTHER SECTORS[8]	**51.6**	**89.4**	**113.9**	**114.9**	**..**	**..**	**..**
Coal[1]	1.8	0.4	–	–	..	..	..
Oil	35.3	45.4	51.5	50.3	..	..	..
Gas	5.0	10.7	15.4	15.5	..	..	..
Comb. Renewables & Waste[2]	–	0.1	0.0	0.0	..	..	..
Geothermal	–	0.1	0.2	0.2	..	..	..
Solar/Wind/Other	–	1.2	0.6	0.6	..	..	..
Electricity	9.5	31.4	45.6	47.6	..	..	..
Heat	0.0	0.2	0.5	0.6	..	..	..
Shares (%)							
Coal	*3.4*	*0.4*	–	–	..	..	..
Oil	*68.5*	*50.8*	*45.2*	*43.8*	..	..	..
Gas	*9.6*	*12.0*	*13.5*	*13.5*	..	..	..
Comb. Renewables & Waste	–	*0.1*	–	–	..	..	..
Geothermal	–	*0.1*	*0.2*	*0.2*	..	..	..
Solar/Wind/Other	–	*1.3*	*0.6*	*0.5*	..	..	..
Electricity	*18.4*	*35.1*	*40.0*	*41.4*	..	..	..
Heat	*0.1*	*0.2*	*0.5*	*0.5*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**90.6**	**171.2**	**210.5**	**219.2**	**242.5**	..	**283.8**
OUTPUT (Mtoe)	**40.0**	**72.1**	**89.6**	**92.1**	**96.1**	..	**115.1**
(TWh gross)	465.4	838.2	1 041.6	1 071.0	1 116.9	..	1 337.9
Output Shares (%)							
Coal	*8.0*	*13.9*	*27.4*	*27.5*	*18.3*	..	*18.2*
Oil	*73.2*	*29.9*	*13.8*	*12.4*	*9.3*	..	*8.6*
Gas	*2.3*	*19.8*	*24.5*	*22.8*	*23.3*	..	*28.8*
Comb. Renewables & Waste	–	*1.4*	*1.7*	*1.7*	*4.6*	..	*4.1*
Nuclear	*2.1*	*24.1*	*23.0*	*26.4*	*34.7*	..	*32.3*
Hydro	*14.3*	*10.7*	*9.1*	*8.8*	*9.5*	..	*7.8*
Geothermal	*0.1*	*0.2*	*0.3*	*0.3*	*0.3*	..	*0.2*
Solar/Wind/Other	–	*0.0*	*0.1*	*0.1*	–	..	–
TOTAL LOSSES	**94.6**	**140.4**	**166.6**	**173.4**	**159.0**	..	**182.8**
of which:							
Electricity and Heat Generation[10]	50.5	99.0	120.5	126.6	145.0	..	167.2
Other Transformation	25.1	22.1	24.9	25.4	5.1	..	5.8
Own Use and Losses[11]	19.0	19.3	21.2	21.4	8.9	..	9.9
Statistical Differences	**-5.4**	**-0.0**	**0.2**	**5.5**	**–**	..	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	2 223.70	4 130.40	4 803.20	4 932.50	5 554.80	..	7 407.69
Population (millions)	108.66	123.54	127.62	127.69	127.47	..	117.58
TPES/GDP[12]	0.15	0.11	0.11	0.11	0.10	..	0.08
Energy Production/TPES	0.09	0.17	0.17	0.18	0.25	..	0.26
Per Capita TPES[13]	2.98	3.61	4.04	4.18	4.20	..	4.96
Oil Supply/GDP[12]	0.11	0.06	0.05	0.05	0.04	..	0.03
TFC/GDP[12]	0.11	0.07	0.07	0.07	0.07	..	0.05
Per Capita TFC[13]	2.16	2.47	2.74	2.77	2.96	..	3.41
Energy-related CO_2 Emissions (Mt CO_2)[14]	891.2	1 058.0	1 214.5	1 215.0	1 081.0	..	1 165.1
CO_2 Emissions from Bunkers (Mt CO_2)	58.6	30.1	36.5	37.9	38.8	..	47.0

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–30**
TPES	1.5	2.1	1.1	3.3	0.1	0.4
Coal	-2.0	3.8	2.5	9.5	-3.6	0.2
Oil	0.4	-0.1	0.1	-1.3	-1.5	0.1
Gas	24.2	8.2	3.7	-1.2	1.0	1.5
Comb. Renewables & Waste	–	–	1.3	3.9	23.3	0.6
Nuclear	39.1	10.1	1.3	17.7	5.4	0.5
Hydro	3.2	0.9	0.4	-0.6	2.0	-0.1
Geothermal	22.3	6.7	5.7	-3.1	-1.5	0.0
Solar/Wind/Other	–	–	-3.8	-2.3	–	–
TFC	1.0	1.9	1.0	1.4	1.0	0.3
Electricity Consumption	3.9	3.4	1.7	2.8	0.8	0.9
Energy Production	4.9	6.3	0.8	13.2	5.7	0.5
Net Oil Imports	0.5	-0.2	-0.1	-1.5	-1.3	0.1
GDP	3.5	3.8	1.2	2.7	2.0	1.4
Growth in the TPES/GDP Ratio	-1.9	-1.7	-0.0	0.6	-1.9	-1.0
Growth in the TFC/GDP Ratio	-2.4	-1.9	-0.1	-1.2	-0.9	-1.1

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**6.76**	**21.91**	**37.89**	**38.03**	**51.52**	**79.94**	**108.49**
Coal[1]		6.65	7.58	1.41	1.37	-	-	-
Oil		–	–	0.50	0.44	–	–	–
Gas		–	–	–	–	–	–	–
Comb. Renewables & Waste[2]		–	–	1.73	1.75	6.80	12.77	19.43
Nuclear		–	13.78	33.79	34.07	44.27	66.67	88.39
Hydro		0.11	0.55	0.42	0.37	0.45	0.50	0.66
Geothermal		–	–	–	0.00	–	–	–
Solar/Wind/Other[3]		–	0.00	0.04	0.04	..	..	..
TOTAL NET IMPORTS[4]		**13.03**	**68.51**	**170.55**	**177.07**	**209.03**	**249.83**	**298.33**
Coal[1]	Exports	0.12	–	–	–	–	–	–
	Imports	0.45	15.73	45.42	50.25	65.01	73.64	92.23
	Net Imports	0.34	15.73	45.42	50.25	65.01	73.64	92.23
Oil	Exports	1.04	3.73	28.57	32.14	–	–	–
	Imports	14.28	55.41	137.26	139.98	116.45	131.80	150.76
	Bunkers	0.56	1.58	6.32	6.96	6.00	6.00	6.00
	Net Imports	12.69	50.10	102.37	100.88	110.45	125.80	144.76
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	2.68	22.73	25.91	33.57	50.39	61.35
	Net Imports	–	2.68	22.73	25.91	33.57	50.39	61.35
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**1.86**	**2.24**	**-2.14**	**-2.05**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**21.64**	**92.65**	**206.30**	**213.05**	**260.55**	**329.76**	**406.82**
Coal[1]		8.13	25.56	47.09	50.09	65.01	73.64	92.23
Oil		13.40	50.04	101.20	101.43	110.45	125.80	144.76
Gas		–	2.72	22.00	25.28	33.57	50.39	61.35
Comb. Renewables & Waste[2]		–	–	1.76	1.77	6.80	12.77	19.43
Nuclear		–	13.78	33.79	34.07	44.27	66.67	88.39
Hydro		0.11	0.55	0.42	0.37	0.45	0.50	0.66
Geothermal		–	–	–	0.00	–	–	–
Solar/Wind/Other[3]		–	0.00	0.04	0.04	..	..	..
Electricity Trade[5]		–	–	–	–	–	–	–
Shares (%)								
Coal		*37.6*	*27.6*	*22.8*	*23.5*	*25.0*	*22.3*	*22.7*
Oil		*61.9*	*54.0*	*49.1*	*47.6*	*42.4*	*38.1*	*35.6*
Gas		–	*2.9*	*10.7*	*11.9*	*12.9*	*15.3*	*15.1*
Comb. Renewables & Waste		–	–	*0.9*	*0.8*	*2.6*	*3.9*	*4.8*
Nuclear		–	*14.9*	*16.4*	*16.0*	*17.0*	*20.2*	*21.7*
Hydro		*0.5*	*0.6*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	–	–	..	..	..
Electricity Trade		–	–	–	–	–	–	–

0 is negligible, – is nil, .. is not available.

Forecast data for combustible renewables and waste include solar. wind and other.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**17.40**	**63.99**	**141.72**	**143.69**	**192.81**	**238.35**	**286.34**
Coal[1]	6.49	11.37	8.16	7.51	22.58	24.95	27.67
Oil	9.81	43.82	87.74	86.79	104.46	121.05	138.94
Gas	–	0.67	14.01	14.51	22.08	28.95	33.76
Comb. Renewables & Waste[2]	–	–	1.06	1.45	6.80	12.77	19.43
Geothermal	–	–	–	0.00	–	–	–
Solar/Wind/Other	–	0.00	0.03	0.04	..	..	..
Electricity	1.10	8.12	27.35	29.06	34.55	47.49	63.04
Heat	–	–	3.37	4.33	2.34	3.14	3.50
Shares (%)							
Coal	*37.3*	*17.8*	*5.8*	*5.2*	*11.7*	*10.5*	*9.7*
Oil	*56.4*	*68.5*	*61.9*	*60.4*	*54.2*	*50.8*	*48.5*
Gas	–	*1.1*	*9.9*	*10.1*	*11.5*	*12.1*	*11.8*
Comb. Renewables & Waste	–	–	*0.7*	*1.0*	*3.5*	*5.4*	*6.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*6.3*	*12.7*	*19.3*	*20.2*	*17.9*	*19.9*	*22.0*
Heat	–	–	*2.4*	*3.0*	*1.2*	*1.3*	*1.2*
TOTAL INDUSTRY[6]	**7.37**	**25.17**	**67.68**	**69.92**	**104.84**	**129.68**	**156.88**
Coal[1]	0.39	2.71	7.60	6.85	21.97	24.59	27.56
Oil	6.22	17.42	38.95	39.87	55.00	64.60	74.04
Gas	–	0.07	3.74	3.94	5.32	6.63	7.97
Comb. Renewables & Waste[2]	–	–	0.94	1.13	5.92	11.65	18.08
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	0.76	4.97	14.49	15.25	16.63	22.22	29.23
Heat	–	–	1.96	2.89	–	–	–
Shares (%)							
Coal	*5.3*	*10.8*	*11.2*	*9.8*	*21.0*	*19.0*	*17.6*
Oil	*84.4*	*69.2*	*57.5*	*57.0*	*52.5*	*49.8*	*47.2*
Gas	–	*0.3*	*5.5*	*5.6*	*5.1*	*5.1*	*5.1*
Comb. Renewables & Waste	–	–	*1.4*	*1.6*	*5.6*	*9.0*	*11.5*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*10.3*	*19.7*	*21.4*	*21.8*	*15.9*	*17.1*	*18.6*
Heat	–	–	*2.9*	*4.1*	–	–	–
TRANSPORT[7]	**2.60**	**14.93**	**34.16**	**34.25**	**41.48**	**51.12**	**60.23**
TOTAL OTHER SECTORS[8]	**7.43**	**23.89**	**39.88**	**39.52**	**46.49**	**57.56**	**69.23**
Coal[1]	6.08	8.67	0.56	0.66	0.61	0.36	0.11
Oil	1.02	11.56	14.96	13.12	9.22	7.80	7.42
Gas	–	0.60	10.14	10.34	15.77	20.16	23.40
Comb. Renewables & Waste[2]	–	–	0.12	0.31	0.88	1.13	1.35
Geothermal	–	–	–	0.00	–	–	–
Solar/Wind/Other	–	0.00	0.03	0.04	..	..	..
Electricity	0.33	3.06	12.66	13.60	17.67	24.97	33.44
Heat	–	–	1.40	1.45	2.34	3.14	3.50
Shares (%)							
Coal	*81.9*	*36.3*	*1.4*	*1.7*	*1.3*	*0.6*	*0.2*
Oil	*13.7*	*48.4*	*37.5*	*33.2*	*19.8*	*13.5*	*10.7*
Gas	–	*2.5*	*25.4*	*26.2*	*33.9*	*35.0*	*33.8*
Comb. Renewables & Waste	–	–	*0.3*	*0.8*	*1.9*	*2.0*	*2.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	..	..	..
Electricity	*4.5*	*12.8*	*31.8*	*34.4*	*38.0*	*43.4*	*48.3*
Heat	–	–	*3.5*	*3.7*	*5.0*	*5.5*	*5.1*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.30**	**26.60**	**79.30**	**84.10**	**96.06**	**132.03**	**173.85**
OUTPUT (Mtoe)	**1.27**	**9.06**	**29.66**	**31.53**	**37.76**	**51.85**	**68.74**
(TWh gross)	14.83	105.37	344.85	366.61	439.04	602.91	799.35
Output Shares (%)							
Coal	*9.0*	*16.8*	*38.9*	*38.8*	*39.1*	*36.8*	*36.8*
Oil	*82.3*	*17.9*	*9.2*	*8.0*	*9.0*	*3.9*	*4.0*
Gas	–	*9.1*	*12.3*	*16.2*	*12.0*	*15.9*	*15.9*
Comb. Renewables & Waste	–	–	*0.6*	*0.1*	..	..	..
Nuclear	–	*50.2*	*37.6*	*35.7*	*38.7*	*42.4*	*42.4*
Hydro	*8.7*	*6.0*	*1.4*	*1.2*	*1.2*	*1.0*	*1.0*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.0*	*0.0*	..	..	..
TOTAL LOSSES	**4.13**	**28.58**	**63.52**	**65.00**	**67.74**	**91.41**	**120.48**
of which:							
Electricity and Heat Generation[10]	2.03	17.53	46.16	48.15	55.90	76.99	101.56
Other Transformation	1.09	6.64	8.45	7.45	7.85	9.01	11.95
Own Use and Losses[11]	1.01	4.41	8.90	9.40	3.98	5.41	6.97
Statistical Differences	**0.11**	**0.09**	**1.06**	**4.35**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	77.30	283.60	585.90	613.10	798.42	1 181.85	1 667.12
Population (millions)	34.10	42.87	47.85	48.08	49.22	49.96	49.33
TPES/GDP[12]	0.28	0.33	0.35	0.35	0.33	0.28	0.24
Energy Production/TPES	0.31	0.24	0.18	0.18	0.20	0.24	0.27
Per Capita TPES[13]	0.63	2.16	4.31	4.43	5.29	6.60	8.25
Oil Supply/GDP[12]	0.17	0.18	0.17	0.17	0.14	0.11	0.09
TFC/GDP[12]	0.23	0.23	0.24	0.23	0.24	0.20	0.17
Per Capita TFC[13]	0.51	1.49	2.96	2.99	3.92	4.77	5.80
Energy-related CO_2 Emissions (Mt CO_2)[14]	65.8	225.9	452.4	462.1	554.7	658.1	792.2
CO_2 Emissions from Bunkers (Mt CO_2)	2.1	5.9	23.8	26.1	24.3	26.7	29.8

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	10.8	7.9	6.4	3.3	3.4	2.4	2.1
Coal	6.9	7.0	4.8	6.4	4.4	1.3	2.3
Oil	12.3	5.8	5.6	0.2	1.4	1.3	1.4
Gas	–	–	17.4	14.9	4.8	4.1	2.0
Comb. Renewables & Waste	–	–	–	0.9	25.1	6.5	4.3
Nuclear	–	29.2	7.1	0.8	4.5	4.2	2.9
Hydro	10.5	9.6	-2.0	-11.8	3.1	1.1	2.9
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	20.8	17.1	–	–	–
TFC	9.8	7.0	6.3	1.4	5.0	2.1	1.9
Electricity Consumption	15.9	10.6	9.8	6.3	2.9	3.2	2.9
Energy Production	4.9	8.4	4.3	0.4	5.2	4.5	3.1
Net Oil Imports	13.3	5.8	5.7	-1.5	1.5	1.3	1.4
GDP	8.3	7.8	5.7	4.6	4.5	4.0	3.5
Growth in the TPES/GDP Ratio	2.3	0.2	0.6	-1.3	-1.0	-1.6	-1.3
Growth in the TFC/GDP Ratio	1.4	-0.7	0.5	-3.1	0.5	-1.8	-1.6

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**0.00**	**0.03**	**0.06**	**0.07**	**..**	**..**	**..**
Coal[1]		–	–	–	–	..	..	..
Oil		–	–	–	–	..	..	..
Gas		–	–	–	–	..	..	..
Comb. Renewables & Waste[2]		–	0.03	0.05	0.06	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		0.00	0.01	0.01	0.01	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	–	0.00	0.00	..	..	..
TOTAL NET IMPORTS[4]		**4.51**	**3.55**	**4.21**	**4.66**	**..**	**..**	**..**
Coal[1]	Exports	–	–	–	–	..	..	..
	Imports	2.44	1.13	0.08	0.09	..	..	..
	Net Imports	2.44	1.13	0.08	0.09	..	..	..
Oil	Exports	0.01	0.01	0.01	0.02	..	..	..
	Imports	1.69	1.67	2.76	3.10	..	..	..
	Bunkers	–	–	–	–	..	..	..
	Net Imports	1.67	1.65	2.75	3.08	..	..	..
Gas	Exports	–	–	–	–	..	..	..
	Imports	0.22	0.43	1.06	1.20	..	..	..
	Net Imports	0.22	0.43	1.06	1.20	..	..	..
Electricity	Exports	0.07	0.06	0.24	0.27	..	..	..
	Imports	0.24	0.40	0.56	0.56	..	..	..
	Net Imports	0.18	0.34	0.32	0.29	..	..	..
TOTAL STOCK CHANGES		**-0.01**	**-0.01**	**-0.01**	**0.01**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**4.51**	**3.57**	**4.26**	**4.75**	**..**	**..**	**..**
Coal[1]		2.44	1.13	0.08	0.09	..	..	..
Oil		1.67	1.64	2.74	3.10	..	..	..
Gas		0.22	0.43	1.06	1.20	..	..	..
Comb. Renewables & Waste[2]		–	0.03	0.05	0.06	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		0.00	0.01	0.01	0.01	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	–	0.00	0.00	..	..	..
Electricity Trade[5]		0.18	0.34	0.32	0.29	..	..	..
Shares (%)								
Coal		*54.1*	*31.7*	*1.8*	*2.0*	..	..	..
Oil		*37.1*	*46.0*	*64.3*	*65.1*	..	..	..
Gas		*4.9*	*12.0*	*25.0*	*25.2*	..	..	..
Comb. Renewables & Waste		–	*0.7*	*1.2*	*1.2*	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		*0.1*	*0.2*	*0.2*	*0.2*	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other		–	–	–	*0.1*	..	..	..
Electricity Trade		*3.9*	*9.5*	*7.5*	*6.1*	..	..	..

0 is negligible, – is nil, .. is not available.

Please note: Forecasts are not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**2.94**	**2.96**	**4.04**	**4.49**	**..**	**..**	**..**
Blast Furnace Gas	0.74	0.20	–	–	–	–	–
Other Coal[1]	0.24	0.35	0.08	0.09	..	..	..
Oil	1.54	1.64	2.74	3.10	..	..	..
Gas	0.18	0.42	0.63	0.68	..	..	..
Comb. Renewables & Waste[2]	–	–	0.02	0.02	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	0.26	0.36	0.52	0.55	..	..	..
Heat	–	–	0.05	0.05	..	..	..
Shares (%)							
Blast Furnace Gas	*25.1*	*6.8*	–	–	..	..	..
Other Coal	*8.1*	*11.7*	*1.9*	*2.1*	..	..	..
Oil	*52.1*	*55.3*	*68.0*	*69.0*	..	..	..
Gas	*6.0*	*14.2*	*15.7*	*15.1*	..	..	..
Comb. Renewables & Waste	–	–	*0.4*	*0.4*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*8.7*	*12.0*	*12.8*	*12.2*	..	..	..
Heat	–	–	*1.2*	*1.1*	..	..	..
TOTAL INDUSTRY[6]	**2.09**	**1.34**	**0.90**	**0.98**	**..**	**..**	**..**
Blast Furnace Gas	0.74	0.20	–	–	..	..	..
Other Coal[1]	0.20	0.34	0.08	0.09	..	..	..
Oil	0.81	0.30	0.06	0.07	..	..	..
Gas	0.14	0.28	0.40	0.43	..	..	..
Comb. Renewables & Waste[2]	–	–	–	–	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	0.20	0.23	0.34	0.36	..	..	..
Heat	–	–	0.02	0.03	..	..	..
Shares (%)							
Blast Furnace Gas	*35.4*	*15.1*	–	–	..	..	..
Other Coal	*9.7*	*25.3*	*8.6*	*9.6*	..	..	..
Oil	*38.6*	*22.0*	*7.0*	*7.2*	..	..	..
Gas	*6.6*	*20.8*	*43.9*	*43.7*	..	..	..
Comb. Renewables & Waste	–	–	–	–	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*9.7*	*16.8*	*37.8*	*36.8*	..	..	..
Heat	–	–	*2.5*	*2.7*	..	..	..
TRANSPORT[7]	**0.29**	**1.03**	**2.39**	**2.71**	**..**	**..**	**..**
TOTAL OTHER SECTORS[8]	**0.56**	**0.59**	**0.74**	**0.80**	**..**	**..**	**..**
Coal[1]	0.03	0.01	–	–	..	..	..
Oil	0.44	0.31	0.30	0.33	..	..	..
Gas	0.04	0.14	0.24	0.25	..	..	..
Comb. Renewables & Waste[2]	–	–	0.02	0.02	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	0.05	0.13	0.17	0.18	..	..	..
Heat	–	–	0.02	0.03	..	..	..
Shares (%)							
Coal	*6.1*	*1.0*	–	–	..	..	..
Oil	*78.4*	*53.6*	*40.6*	*40.9*	..	..	..
Gas	*6.8*	*24.1*	*31.8*	*31.5*	..	..	..
Comb. Renewables & Waste	–	–	*2.0*	*1.9*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*8.8*	*21.3*	*22.4*	*22.3*	..	..	..
Heat	–	–	*3.1*	*3.2*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**0.44**	**0.20**	**0.48**	**0.58**	..	..	..
OUTPUT (Mtoe)	**0.12**	**0.05**	**0.24**	**0.29**	..	..	..
(TWh gross)	1.39	0.62	2.78	3.38	..	..	..
Output Shares (%)							
Blast Furnace Gas	–	*76.4*	–	–	..	..	..
Other Coal	*58.8*	–	–	–	..	..	..
Oil	*27.6*	*1.4*	–	–	..	..	..
Gas	*10.2*	*5.4*	*93.9*	*92.8*	..	..	..
Comb. Renewables & Waste	–	*5.4*	*2.3*	*2.8*	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	*3.4*	*11.2*	*2.8*	*3.0*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	*1.0*	*1.4*	..	..	..
TOTAL LOSSES	**1.54**	**0.61**	**0.23**	**0.27**	..	..	..
of which:							
Electricity and Heat Generation[10]	0.32	0.14	0.19	0.23	..	..	..
Other Transformation	1.08	0.41	–	–	..	..	..
Own Use and Losses[11]	0.14	0.06	0.04	0.03	..	..	..
Statistical Differences	**0.02**	**0.00**	**-0.00**	–	–	–	–

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	6.50	11.50	21.00	21.90	..	..	..
Population (millions)	0.35	0.38	0.45	0.45	..	..	..
TPES/GDP[12]	0.69	0.31	0.20	0.22	..	..	..
Energy Production/TPES	0.00	0.01	0.01	0.02	..	..	..
Per Capita TPES[13]	12.83	9.35	9.47	10.51	..	..	..
Oil Supply/GDP[12]	0.26	0.14	0.13	0.14	..	..	..
TFC/GDP[12]	0.45	0.26	0.19	0.20	..	..	..
Per Capita TFC[13]	8.39	7.74	8.97	9.92	..	..	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	16.5	10.5	9.9	11.3	..	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	0.2	0.4	1.2	1.3	..	..	..

GROWTH RATES (% per year)	73–79	79–90	90–03	03–04	04–10	10–20	20–30
TPES	-2.5	-0.8	1.4	11.5	..	..	..
Coal	-4.6	-4.3	-18.6	20.5	..	..	..
Oil	-4.0	2.1	4.0	12.9	..	..	..
Gas	13.6	-0.8	7.2	12.7	..	..	..
Comb. Renewables & Waste	–	3.0	5.6	15.7	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	12.2	-2.6	1.2	28.6	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	100.0	..	..	..
TFC	-0.1	0.1	2.4	11.2	..	..	..
Electricity Consumption	2.7	1.6	2.9	6.0	..	..	..
Energy Production	36.6	1.6	5.2	20.0	..	..	..
Net Oil Imports	-3.5	1.8	4.0	12.2	..	..	..
GDP	1.2	4.6	4.7	4.3	..	..	..
Growth in the TPES/GDP Ratio	-3.6	-5.1	-3.2	6.9	..	..	..
Growth in the TFC/GDP Ratio	-1.3	-4.3	-2.2	6.6	..	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**56.8**	**60.5**	**58.5**	**67.9**	**57.3**	**48.4**	**36.2**
Coal[1]		1.1	–	–	–	–	–	–
Oil		1.6	4.1	3.2	3.0	1.7	1.3	0.3
Gas		53.7	54.6	52.2	61.6	51.4	40.1	32.5
Comb Renewables & Waste[2]		–	0.9	1.9	2.2	2.7	3.8	1.9
Nuclear		0.3	0.9	1.0	1.0	1.0	1.0	0.5
Hydro		–	0.0	0.0	0.0	0.0	0.0	0.0
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.6	2.2	1.1
TOTAL NET IMPORTS[4]		**6.0**	**6.4**	**22.2**	**15.0**	**24.4**	**43.5**	**68.8**
Coal[1]	Exports	1.4	2.3	4.9	6.0	5.9	4.9	7.4
	Imports	2.9	11.7	14.1	14.6	15.1	16.3	26.4
	Net Imports	1.5	9.5	9.2	8.6	9.3	11.4	19.0
Oil	Exports	42.4	60.2	69.2	74.1	117.5	123.0	83.0
	Imports	83.8	91.1	110.5	118.7	162.2	176.7	144.7
	Bunkers	11.6	10.9	13.5	14.7	16.2	18.6	21.4
	Net Imports	29.8	19.9	27.7	29.8	28.6	35.1	40.3
Gas	Exports	25.3	25.8	34.5	38.4	45.2	43.7	37.7
	Imports	–	2.0	18.3	13.5	30.4	40.5	47.3
	Net Imports	-25.3	-23.8	-16.2	-24.9	-14.8	-3.2	9.6
Electricity	Exports	0.1	0.0	0.3	0.4	0.7	1.2	0.8
	Imports	0.0	0.8	1.8	1.8	2.0	1.5	0.8
	Net Imports	-0.1	0.8	1.5	1.4	1.3	0.3	-0.1
TOTAL STOCK CHANGES		**-0.3**	**-0.2**	**0.2**	**-0.7**	**-**	**-**	**-**
TOTAL SUPPLY (TPES)		**62.4**	**66.7**	**80.9**	**82.1**	**81.7**	**91.9**	**105.0**
Coal[1]		2.9	8.9	8.8	8.7	9.3	11.4	19.0
Oil		30.9	24.3	31.5	32.0	30.3	36.4	40.6
Gas		28.5	30.8	36.0	36.7	36.6	36.8	42.1
Comb Renewables & Waste[2]		–	0.9	1.9	2.2	2.7	3.8	1.9
Nuclear		0.3	0.9	1.0	1.0	1.0	1.0	0.5
Hydro		–	0.0	0.0	0.0	0.0	0.0	0.0
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other[3]		–	0.0	0.1	0.2	0.6	2.2	1.1
Electricity Trade[5]		-0.1	0.8	1.5	1.4	1.3	0.3	-0.1
Shares (%)								
Coal		*4.6*	*13.4*	*10.9*	*10.6*	*11.4*	*12.4*	*18.1*
Oil		*49.5*	*36.5*	*39.0*	*38.9*	*37.1*	*39.6*	*38.6*
Gas		*45.6*	*46.2*	*44.5*	*44.7*	*44.8*	*40.1*	*40.1*
Comb Renewables & Waste		–	*1.4*	*2.4*	*2.6*	*3.3*	*4.1*	*1.8*
Nuclear		*0.5*	*1.4*	*1.3*	*1.2*	*1.2*	*1.1*	*0.4*
Hydro		–	–	–	–	–	–	–
Geothermal		–	–	–	–	–	–	–
Solar/Wind/Other		–	–	*0.2*	*0.2*	*0.7*	*2.4*	*1.0*
Electricity Trade		*-0.2*	*1.2*	*1.8*	*1.7*	*1.6*	*0.3*	*-0.1*

0 is negligible, – is nil, .. is not available.

Please note: Forecasts for 2030 have no official status All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**48.8**	**51.3**	**62.3**	**63.3**	**62.8**	**70.2**	**79.4**
Coal[1]	1.1	1.4	0.9	1.0	1.0	1.2	1.4
Oil	24.7	19.9	26.8	27.2	25.8	31.0	33.2
Gas	19.3	23.0	23.3	23.3	21.9	21.7	27.3
Comb. Renewables & Waste[2]	–	0.4	0.4	0.4	0.2	0.2	0.2
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.0	0.0	0.0	0.0	0.1	0.0
Electricity	3.8	6.3	8.6	8.9	10.0	12.0	13.5
Heat	–	0.3	2.3	2.6	3.8	4.0	3.6
Shares (%)							
Coal	*2.2*	*2.7*	*1.4*	*1.5*	*1.6*	*1.6*	*1.8*
Oil	*50.5*	*38.8*	*43.0*	*43.0*	*41.1*	*44.2*	*41.8*
Gas	*39.5*	*44.8*	*37.5*	*36.8*	*34.8*	*30.9*	*34.4*
Comb. Renewables & Waste	–	*0.7*	*0.6*	*0.6*	*0.4*	*0.4*	*0.3*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	*0.1*	*0.1*
Electricity	*7.8*	*12.3*	*13.9*	*14.0*	*15.9*	*17.1*	*17.0*
Heat	–	*0.6*	*3.7*	*4.0*	*6.1*	*5.8*	*4.6*
TOTAL INDUSTRY[6]	**21.2**	**21.3**	**24.7**	**25.2**	**27.8**	**31.5**	**36.0**
Coal[1]	0.8	1.3	0.8	0.9	1.0	1.2	1.4
Oil	10.4	8.2	11.0	11.0	12.9	15.4	17.8
Gas	8.1	8.8	8.0	8.1	7.1	7.4	9.4
Comb. Renewables & Waste[2]	–	0.1	0.1	0.1	0.0	0.0	0.0
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	2.0	2.9	3.5	3.6	3.6	4.1	4.7
Heat	–	–	1.2	1.4	3.2	3.4	2.6
Shares (%)							
Coal	*3.6*	*6.2*	*3.4*	*3.7*	*3.7*	*3.7*	*3.9*
Oil	*48.8*	*38.7*	*44.6*	*43.7*	*46.4*	*49.0*	*49.5*
Gas	*38.4*	*41.3*	*32.6*	*32.3*	*25.6*	*23.6*	*26.2*
Comb. Renewables & Waste	–	*0.3*	*0.4*	*0.5*	*0.1*	*0.1*	*0.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*9.2*	*13.4*	*14.2*	*14.1*	*12.7*	*12.9*	*13.0*
Heat	–	–	*4.9*	*5.7*	*11.5*	*10.8*	*7.3*
TRANSPORT[7]	**7.5**	**10.6**	**15.0**	**15.4**	**12.0**	**14.6**	**14.3**
TOTAL OTHER SECTORS[8]	**20.2**	**19.4**	**22.6**	**22.6**	**22.9**	**24.1**	**29.1**
Coal[1]	0.3	0.1	0.0	0.0	–	–	–
Oil	6.9	1.2	0.9	0.9	1.0	1.1	1.2
Gas	11.1	14.2	15.3	15.2	14.7	14.2	17.9
Comb. Renewables & Waste[2]	–	0.3	0.3	0.3	0.2	0.2	0.2
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	0.0	0.0	0.0	0.0	0.1	0.0
Electricity	1.8	3.4	5.0	5.2	6.3	7.8	8.7
Heat	–	0.3	1.1	1.1	0.6	0.6	1.0
Shares (%)							
Coal	*1.6*	*0.3*	*0.1*	*0.1*	–	–	–
Oil	*34.2*	*6.2*	*3.9*	*3.9*	*4.3*	*4.6*	*4.2*
Gas	*55.3*	*73.1*	*67.7*	*66.9*	*64.3*	*59.2*	*61.6*
Comb. Renewables & Waste	–	*1.6*	*1.2*	*1.2*	*1.0*	*0.9*	*0.8*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.1*	*0.3*	*0.1*
Electricity	*8.8*	*17.3*	*22.1*	*22.8*	*27.5*	*32.4*	*29.8*
Heat	–	*1.6*	*4.9*	*5.0*	*2.8*	*2.6*	*3.5*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**12.0**	**15.4**	**21.2**	**21.6**	**25.1**	**30.6**	**34.2**
OUTPUT (Mtoe)	**4.5**	**6.2**	**8.3**	**8.7**	**9.8**	**13.2**	**15.2**
(TWh gross)	52.6	71.9	96.8	100.8	114.1	153.7	177.3
Output Shares (%)							
Coal	*6.0*	*38.3*	*28.4*	*26.0*	*25.2*	*24.9*	*43.9*
Oil	*12.3*	*4.3*	*3.0*	*2.8*	*3.2*	*1.8*	*4.0*
Gas	*79.5*	*50.9*	*58.7*	*60.5*	*56.2*	*45.9*	*42.2*
Comb Renewables & Waste	–	*1.5*	*4.1*	*4.6*	*6.6*	*8.5*	*2.2*
Nuclear	*2.1*	*4.9*	*4.2*	*3.8*	*3.3*	*2.4*	*1.0*
Hydro	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.1*	*1.6*	*2.1*	*5.4*	*16.5*	*6.6*
TOTAL LOSSES	**14.3**	**15.6**	**18.6**	**18.7**	**18.9**	**21.7**	**25.6**
of which:							
Electricity and Heat Generation[10]	7.5	8.9	10.1	9.9	10.9	12.5	14.5
Other Transformation	1.6	0.8	1.7	1.7	2.1	2.3	2.6
Own Use and Losses[11]	5.2	6.0	6.8	7.1	5.8	6.9	8.5
Statistical Differences	**-0.7**	**-0.2**	**-0.0**	**0.1**	**-**	**-**	**-**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	196.20	290.20	391.80	398.50	473.61	623.21	774.96
Population (millions)	13.44	14.95	16.22	16.27	16.83	17.88	18.89
TPES/GDP[12]	0.32	0.23	0.21	0.21	0.17	0.15	0.14
Energy Production/TPES	0.91	0.91	0.72	0.83	0.70	0.53	0.34
Per Capita TPES[13]	4.65	4.47	4.99	5.05	4.86	5.14	5.56
Oil Supply/GDP[12]	0.16	0.08	0.08	0.08	0.06	0.06	0.05
TFC/GDP[12]	0.25	0.18	0.16	0.16	0.13	0.11	0.10
Per Capita TFC[13]	3.64	3.43	3.84	3.89	3.73	3.93	4.20
Energy-related CO_2 Emissions (Mt CO_2)[14]	153.8	158.1	185.1	185.8	185.8	206.7	255.7
CO_2 Emissions from Bunkers (Mt CO_2)	39.3	39.0	53.1	57.4	64.2	75.8	89.0

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	1.7	-0.3	1.5	1.5	-0.1	1.2	1.3
Coal	2.4	9.5	-0.1	-1.5	1.1	2.0	5.3
Oil	0.4	-2.4	2.0	1.4	-0.9	1.8	1.1
Gas	2.4	-0.6	1.2	2.1	-0.1	0.1	1.4
Comb Renewables & Waste	–	13.0	5.7	12.2	3.5	3.6	-6.8
Nuclear	21.0	0.0	1.1	-4.9	-0.4	–	-7.2
Hydro	–	–	-1.2	33.3	8.4	–	–
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	25.3	37.1	20.4	15.1	-7.3
TFC	2.0	-0.6	1.5	1.6	-0.1	1.1	1.2
Electricity Consumption	4.4	2.3	2.4	2.6	2.0	1.8	1.2
Energy Production	4.4	-1.8	-0.3	16.1	-2.8	-1.7	-2.9
Net Oil Imports	1.0	-4.1	2.6	7.6	-0.7	2.1	1.4
GDP	2.6	2.2	2.3	1.7	2.9	2.8	2.2
Growth in the TPES/GDP Ratio	-0.9	-2.4	-0.8	-0.2	-2.9	-1.6	-0.8
Growth in the TFC/GDP Ratio	-0.6	-2.8	-0.8	-0.1	-3.0	-1.6	-0.9

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**4.05**	**12.01**	**13.11**	**12.98**	**16.72**	**19.26**	**21.68**
Coal[1]		1.29	1.39	3.09	3.10	3.52	4.79	4.99
Oil		0.18	1.96	1.30	1.15	1.21	1.01	1.25
Gas		0.28	3.90	3.86	3.45	3.38	2.82	3.48
Comb. Renewables & Waste[2]		–	0.55	0.84	0.89	2.20	3.00	4.09
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.04	2.32	2.15	2.16	2.16
Geothermal		1.07	2.21	1.97	2.03	4.15	5.01	5.13
Solar/Wind/Other[3]		–	–	0.02	0.04	0.13	0.47	0.58
TOTAL NET IMPORTS[4]		**4.27**	**1.79**	**3.87**	**5.05**	**5.23**	**6.61**	**7.81**
Coal[1]	Exports	0.02	0.23	1.60	1.38	1.80	2.00	2.00
	Imports	–	0.01	–	0.45	–	–	–
	Net Imports	-0.02	-0.22	-1.60	-0.93	-1.80	-2.00	-2.00
Oil	Exports	–	1.47	1.02	0.82	0.86	0.71	0.88
	Imports	4.60	3.80	6.75	7.02	8.28	9.76	11.25
	Bunkers	0.31	0.32	0.26	0.23	0.39	0.43	0.56
	Net Imports	4.29	2.01	5.47	5.97	7.03	8.61	9.81
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**-0.05**	**-0.04**	**0.29**	**-0.38**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**8.27**	**13.76**	**17.28**	**17.64**	**21.96**	**25.87**	**29.48**
Coal[1]		1.26	1.13	1.81	1.89	1.72	2.79	2.99
Oil		4.42	3.96	6.74	7.03	8.24	9.62	11.05
Gas		0.28	3.90	3.86	3.45	3.38	2.82	3.48
Comb. Renewables & Waste[2]		–	0.55	0.84	0.89	2.20	3.00	4.09
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.04	2.32	2.15	2.16	2.16
Geothermal		1.07	2.21	1.97	2.03	4.15	5.01	5.13
Solar/Wind/Other[3]		–	–	0.02	0.04	0.13	0.47	0.58
Electricity Trade[5]		–	–	–	–	–	–	–
Shares (%)								
Coal		*15.3*	*8.2*	*10.5*	*10.7*	*7.8*	*10.8*	*10.1*
Oil		*53.5*	*28.8*	*39.0*	*39.9*	*37.5*	*37.2*	*37.5*
Gas		*3.4*	*28.3*	*22.3*	*19.6*	*15.4*	*10.9*	*11.8*
Comb. Renewables & Waste		–	*4.0*	*4.8*	*5.0*	*10.0*	*11.6*	*13.9*
Nuclear		–	–	–	–	–	–	–
Hydro		*14.9*	*14.6*	*11.8*	*13.2*	*9.8*	*8.3*	*7.3*
Geothermal		*12.9*	*16.1*	*11.4*	*11.5*	*18.9*	*19.4*	*17.4*
Solar/Wind/Other		–	–	*0.1*	*0.2*	*0.6*	*1.8*	*2.0*
Electricity Trade		–	–	–	–	–	–	–

0 is negligible, – is nil, .. is not available.

Please note: Forecast data. except GDP and population. refer to the fiscal year.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**6.05**	**9.84**	**13.61**	**13.95**	**15.23**	**17.87**	**20.40**
Coal[1]	0.87	1.00	1.06	0.91	1.10	1.17	1.24
Oil	3.67	4.43	6.68	6.93	7.74	9.11	10.54
Gas	0.14	1.30	1.86	2.00	1.71	2.02	1.99
Comb. Renewables & Waste[2]	–	0.45	0.67	0.71	1.21	1.65	2.25
Geothermal	–	0.27	0.32	0.35	0.31	0.31	0.31
Solar/Wind/Other	–	–	0.01	0.01	–	–	–
Electricity	1.37	2.39	3.02	3.04	3.17	3.61	4.07
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*14.4*	*10.1*	*7.8*	*6.5*	*7.2*	*6.5*	*6.1*
Oil	*60.6*	*45.1*	*49.1*	*49.7*	*50.8*	*51.0*	*51.7*
Gas	*2.4*	*13.2*	*13.7*	*14.3*	*11.2*	*11.3*	*9.8*
Comb. Renewables & Waste	–	*4.6*	*4.9*	*5.1*	*7.9*	*9.2*	*11.0*
Geothermal	–	*2.8*	*2.4*	*2.5*	*2.0*	*1.7*	*1.5*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.6*	*24.3*	*22.2*	*21.8*	*20.8*	*20.2*	*20.0*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[6]	**2.18**	**4.08**	**5.08**	**5.23**	**5.65**	**6.58**	**7.36**
Coal[1]	0.69	0.87	0.93	0.73	1.09	1.16	1.24
Oil	0.96	0.59	0.58	0.69	0.41	0.40	0.39
Gas	0.05	1.06	1.50	1.66	1.39	1.65	1.62
Comb. Renewables & Waste[2]	–	0.39	0.61	0.65	1.10	1.51	2.05
Geothermal	–	0.22	0.27	0.29	0.25	0.25	0.25
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.48	0.96	1.19	1.20	1.41	1.61	1.82
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*31.5*	*21.3*	*18.4*	*14.0*	*19.2*	*17.7*	*16.8*
Oil	*43.9*	*14.4*	*11.4*	*13.2*	*7.3*	*6.1*	*5.3*
Gas	*2.4*	*25.9*	*29.5*	*31.8*	*24.6*	*25.0*	*22.0*
Comb. Renewables & Waste	–	*9.5*	*12.0*	*12.3*	*19.5*	*22.9*	*27.9*
Geothermal	–	*5.4*	*5.3*	*5.6*	*4.4*	*3.8*	*3.4*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.2*	*23.6*	*23.4*	*23.0*	*25.0*	*24.5*	*24.7*
Heat	–	–	–	–	–	–	–
TRANSPORT[7]	**2.15**	**3.54**	**5.63**	**5.82**	**7.02**	**8.41**	**9.86**
TOTAL OTHER SECTORS[8]	**1.72**	**2.22**	**2.90**	**2.90**	**2.56**	**2.89**	**3.18**
Coal[1]	0.19	0.13	0.13	0.18	0.01	0.00	0.00
Oil	0.57	0.37	0.50	0.47	0.35	0.35	0.35
Gas	0.09	0.18	0.35	0.33	0.31	0.37	0.37
Comb. Renewables & Waste[2]	–	0.06	0.07	0.06	0.10	0.14	0.19
Geothermal	–	0.05	0.05	0.06	0.06	0.06	0.06
Solar/Wind/Other	–	–	0.01	0.01	–	–	–
Electricity	0.88	1.42	1.79	1.80	1.72	1.96	2.21
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*10.7*	*5.7*	*4.3*	*6.2*	*0.5*	*0.1*	–
Oil	*32.8*	*16.6*	*17.4*	*16.1*	*13.7*	*12.1*	*11.0*
Gas	*5.3*	*8.1*	*12.2*	*11.5*	*12.2*	*12.9*	*11.5*
Comb. Renewables & Waste	–	*2.9*	*2.2*	*2.2*	*4.1*	*4.9*	*6.1*
Geothermal	–	*2.4*	*1.8*	*1.9*	*2.3*	*2.1*	*1.9*
Solar/Wind/Other	–	–	*0.2*	*0.2*	–	–	–
Electricity	*51.2*	*64.3*	*61.9*	*62.0*	*67.2*	*67.9*	*69.5*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**3.16**	**5.27**	**6.36**	**6.35**	**8.91**	**10.64**	**12.10**
OUTPUT (Mtoe)	**1.59**	**2.76**	**3.48**	**3.60**	**3.76**	**4.28**	**4.83**
(TWh gross)	18.53	32.15	40.44	41.81	43.70	49.77	56.11
Output Shares (%)							
Coal	*8.5*	*1.5*	*8.2*	*9.9*	*6.1*	*14.0*	*13.4*
Oil	*6.1*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.0*
Gas	*1.4*	*17.7*	*24.6*	*16.7*	*18.2*	*7.6*	*12.8*
Comb. Renewables & Waste	–	*1.3*	*1.3*	*1.3*	*4.9*	*5.9*	*7.1*
Nuclear	–	–	–	–	–	–	–
Hydro	*77.3*	*72.6*	*58.6*	*64.6*	*57.1*	*50.5*	*44.8*
Geothermal	*6.7*	*6.9*	*6.8*	*6.5*	*10.2*	*11.0*	*10.0*
Solar/Wind/Other	–	–	*0.4*	*0.9*	*3.5*	*11.0*	*11.9*
TOTAL LOSSES	**2.35**	**4.01**	**3.97**	**3.86**	**6.73**	**8.00**	**9.08**
of which:							
Electricity and Heat Generation[10]	1.57	2.51	2.88	2.76	5.15	6.36	7.28
Other Transformation	0.36	0.60	-0.04	-0.13	0.30	0.30	0.30
Own Use and Losses[11]	0.43	0.90	1.13	1.23	1.27	1.33	1.50
Statistical Differences	**-0.13**	**-0.09**	**-0.30**	**-0.16**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	32.70	39.80	59.10	61.70	71.55	91.59	117.25
Population (millions)	2.97	3.41	4.04	4.08	4.50	5.00	5.50
TPES/GDP[12]	0.25	0.35	0.29	0.29	0.31	0.28	0.25
Energy Production/TPES	0.49	0.87	0.76	0.74	0.76	0.74	0.74
Per Capita TPES[13]	2.78	4.03	4.28	4.32	4.88	5.17	5.36
Oil Supply/GDP[12]	0.14	0.10	0.11	0.11	0.12	0.11	0.09
TFC/GDP[12]	0.19	0.25	0.23	0.23	0.21	0.20	0.17
Per Capita TFC[13]	2.04	2.88	3.37	3.41	3.38	3.57	3.71
Energy-related CO_2 Emissions (Mt CO_2)[14]	17.0	22.0	33.2	32.8	35.0	41.9	48.4
CO_2 Emissions from Bunkers (Mt CO_2)	1.6	2.4	3.1	3.3	4.2	5.2	6.7

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	1.5	3.9	1.8	2.1	3.7	1.7	1.3
Coal	-4.5	1.5	3.7	4.1	-1.6	5.0	0.7
Oil	-0.9	-0.5	4.2	4.3	2.7	1.6	1.4
Gas	20.3	14.7	-0.1	-10.5	-0.4	-1.8	2.1
Comb. Renewables & Waste	–	1.3	3.3	5.7	16.4	3.2	3.1
Nuclear	–	–	–	–	–	–	–
Hydro	4.6	2.0	0.1	14.0	-1.3	0.1	–
Geothermal	-2.2	8.1	-0.9	2.8	12.6	1.9	0.2
Solar/Wind/Other	–	–	–	111.8	24.0	13.6	2.1
TFC	2.0	3.4	2.5	2.5	1.5	1.6	1.3
Electricity Consumption	3.0	3.5	1.8	0.6	0.7	1.3	1.2
Energy Production	4.5	7.8	0.7	-1.0	4.3	1.4	1.2
Net Oil Imports	-2.5	-5.4	8.0	9.1	2.8	2.0	1.3
GDP	0.1	1.8	3.1	4.4	2.5	2.5	2.5
Growth in the TPES/GDP Ratio	1.4	2.1	-1.3	-2.2	1.2	-0.8	-1.2
Growth in the TFC/GDP Ratio	2.0	1.6	-0.5	-1.8	-1.0	-0.9	-1.1

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**8.08**	**120.30**	**235.63**	**238.63**	**..**	**..**	**..**
Coal[1]		0.29	0.20	1.98	1.95	..	..	..
Oil		1.52	84.51	157.01	155.58	..	..	..
Gas		–	24.14	66.25	70.40	..	..	..
Comb. Renewables & Waste[2]		–	1.03	1.29	1.32	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		6.27	10.42	9.08	9.35	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	0.00	0.03	0.03	..	..	..
TOTAL NET IMPORTS[4]		**6.15**	**-96.94**	**-207.41**	**-211.36**	**..**	**..**	**..**
Coal[1]	Exports	0.09	0.17	1.81	1.84	..	..	..
	Imports	0.67	0.84	0.71	0.83	..	..	..
	Net Imports	0.58	0.67	-1.10	-1.02	..	..	..
Oil	Exports	3.58	78.10	149.97	149.34	..	..	..
	Imports	10.23	4.47	4.43	4.44	..	..	..
	Bunkers	0.64	0.45	0.57	0.52	..	..	..
	Net Imports	6.01	-74.08	-146.11	-145.41	..	..	..
Gas	Exports	–	22.17	60.93	65.95	..	..	..
	Imports	–	–	–	–	..	..	..
	Net Imports	–	-22.17	-60.93	-65.95	..	..	..
Electricity	Exports	0.45	1.40	0.48	0.33	..	..	..
	Imports	0.01	0.03	1.15	1.31	..	..	..
	Net Imports	-0.45	-1.37	0.68	0.98	..	..	..
TOTAL STOCK CHANGES		**0.41**	**-1.87**	**-1.08**	**0.39**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**14.63**	**21.49**	**27.15**	**27.66**	**..**	**..**	**..**
Coal[1]		0.91	0.86	0.79	0.92	..	..	..
Oil		7.90	8.57	9.91	10.58	..	..	..
Gas		–	1.98	5.32	4.45	..	..	..
Comb. Renewables & Waste[2]		–	1.03	1.35	1.35	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		6.27	10.42	9.08	9.35	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other[3]		–	0.00	0.03	0.03	..	..	..
Electricity Trade[5]		-0.45	-1.37	0.68	0.98	..	..	..
Shares (%)								
Coal		*6.2*	*4.0*	*2.9*	*3.3*	..	..	..
Oil		*54.0*	*39.9*	*36.5*	*38.2*	..	..	..
Gas		–	*9.2*	*19.6*	*16.1*	..	..	..
Comb. Renewables & Waste		–	*4.8*	*5.0*	*4.9*	..	..	..
Nuclear		–	–	–	–	..	..	..
Hydro		*42.8*	*48.5*	*33.5*	*33.8*	..	..	..
Geothermal		–	–	–	–	..	..	..
Solar/Wind/Other		–	–	*0.1*	*0.1*	..	..	..
Electricity Trade		*-3.1*	*-6.4*	*2.5*	*3.6*	..	..	..

0 is negligible, – is nil, .. is not available.

Please note: Forecasts are not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**13.73**	**18.03**	**20.76**	**21.24**	**..**	**..**	**..**
Coal[1]	0.81	0.78	0.70	0.79	..	..	..
Oil	7.68	7.96	9.20	8.92	..	..	..
Gas	0.01	–	0.70	0.80	..	..	..
Comb. Renewables & Waste[2]	–	0.90	1.09	1.08	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	5.23	8.33	8.87	9.45	..	..	..
Heat	–	0.07	0.19	0.21	..	..	..
Shares (%)							
Coal	*5.9*	*4.3*	*3.4*	*3.7*	..	..	..
Oil	*55.9*	*44.1*	*44.3*	*42.0*	..	..	..
Gas	*0.1*	–	*3.4*	*3.8*	..	..	..
Comb. Renewables & Waste	–	*5.0*	*5.3*	*5.1*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*38.1*	*46.2*	*42.7*	*44.5*	..	..	..
Heat	–	*0.4*	*0.9*	*1.0*	..	..	..
TOTAL INDUSTRY[6]	**6.96**	**7.89**	**9.02**	**9.15**	**..**	**..**	**..**
Coal[1]	0.76	0.77	0.70	0.79	..	..	..
Oil	3.01	2.79	3.10	2.76	..	..	..
Gas	0.00	–	0.69	0.78	..	..	..
Comb. Renewables & Waste[2]	–	0.38	0.40	0.38	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	3.20	3.94	4.11	4.40	..	..	..
Heat	–	0.02	0.03	0.03	..	..	..
Shares (%)							
Coal	*10.9*	*9.7*	*7.7*	*8.6*	..	..	..
Oil	*43.2*	*35.4*	*34.3*	*30.2*	..	..	..
Gas	–	–	*7.6*	*8.5*	..	..	..
Comb. Renewables & Waste	–	*4.8*	*4.4*	*4.2*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*45.9*	*49.9*	*45.5*	*48.1*	..	..	..
Heat	–	*0.2*	*0.3*	*0.3*	..	..	..
TRANSPORT[7]	**2.62**	**4.22**	**4.78**	**4.98**	**..**	**..**	**..**
TOTAL OTHER SECTORS[8]	**4.15**	**5.92**	**6.95**	**7.12**	**..**	**..**	**..**
Coal[1]	0.06	0.01	0.00	0.00	..	..	..
Oil	2.10	1.02	1.47	1.34	..	..	..
Gas	0.01	–	0.01	0.02	..	..	..
Comb. Renewables & Waste[2]	–	0.52	0.69	0.70	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	1.98	4.31	4.62	4.90	..	..	..
Heat	–	0.06	0.16	0.18	..	..	..
Shares (%)							
Coal	*1.3*	*0.2*	–	–	..	..	..
Oil	*50.6*	*17.2*	*21.2*	*18.8*	..	..	..
Gas	*0.2*	–	*0.1*	*0.2*	..	..	..
Comb. Renewables & Waste	–	*8.7*	*9.9*	*9.8*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	–	..	..	..
Electricity	*47.8*	*72.9*	*66.5*	*68.8*	..	..	..
Heat	–	*1.0*	*2.3*	*2.5*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**6.31**	**10.58**	**9.48**	**9.74**	..	..	..
OUTPUT (Mtoe)	**6.28**	**10.46**	**9.18**	**9.47**	..	..	..
(TWh gross)	73.03	121.61	106.80	110.08	..	..	..
Output Shares (%)							
Coal	*0.0*	*0.1*	*0.1*	*0.1*	..	..	..
Oil	*0.2*	*0.0*	*0.0*	*0.0*	..	..	..
Gas	–	–	*0.3*	*0.3*	..	..	..
Comb. Renewables & Waste	–	*0.2*	*0.4*	*0.4*	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	*99.8*	*99.6*	*98.9*	*98.8*	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	*0.2*	*0.2*	..	..	..
TOTAL LOSSES	**0.86**	**3.67**	**4.44**	**4.58**	..	..	..
of which:							
Electricity and Heat Generation[10]	0.03	0.05	0.07	0.07	..	..	..
Other Transformation	0.09	-0.03	-0.50	-0.52	..	..	..
Own Use and Losses[11]	0.73	3.65	4.87	5.02	..	..	..
Statistical Differences	**0.05**	**-0.20**	**1.95**	**1.84**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	66.30	115.80	175.30	180.20	..	..	..
Population (millions)	3.96	4.24	4.57	4.59	..	..	..
TPES/GDP[12]	0.22	0.19	0.15	0.15	..	..	..
Energy Production/TPES	0.55	5.60	8.68	8.63	..	..	..
Per Capita TPES[13]	3.70	5.07	5.95	6.03	..	..	..
Oil Supply/GDP[12]	0.12	0.07	0.06	0.06	..	..	..
TFC/GDP[12]	0.21	0.16	0.12	0.12	..	..	..
Per Capita TFC[13]	3.47	4.25	4.55	4.63	..	..	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	24.2	28.7	35.7	36.3	..	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	2.8	2.7	2.4	2.4	..	..	..

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	4.0	1.4	1.8	1.9	..	..	..
Coal	1.4	-1.3	-0.7	16.7	..	..	..
Oil	2.2	-0.4	1.1	6.8	..	..	..
Gas	–	9.8	7.9	-16.4	..	..	..
Comb. Renewables & Waste	–	5.6	2.1	0.2	..	..	..
Nuclear	–	–	–	–	..	..	..
Hydro	3.3	2.9	-1.0	3.0	..	..	..
Geothermal	–	–	–	–	..	..	..
Solar/Wind/Other	–	–	–	15.8	..	..	..
TFC	3.5	0.6	1.1	2.3	..	..	..
Electricity Consumption	3.6	2.3	0.5	6.5	..	..	..
Energy Production	33.7	9.1	5.3	1.3	..	..	..
Net Oil Imports	–	20.4	5.4	-0.5	..	..	..
GDP	4.6	2.7	3.2	2.8	..	..	..
Growth in the TPES/GDP Ratio	-0.6	-1.2	-1.4	-0.9	..	..	..
Growth in the TFC/GDP Ratio	-1.1	-2.0	-2.1	-0.4	..	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**1.40**	**3.39**	**4.34**	**3.90**	**5.64**	**..**	**..**
Coal[1]		0.13	0.12	-	–	–	..	..
Oil		–	–	–	–	–	..	..
Gas		–	–	–	–	–	..	..
Comb. Renewables & Waste[2]		0.64	2.48	2.85	2.88	3.79	..	..
Nuclear		–	–	–	–	–	..	..
Hydro		0.63	0.79	1.35	0.85	1.11	..	..
Geothermal		–	0.00	0.08	0.08	0.07	..	..
Solar/Wind/Other[3]		–	0.01	0.06	0.09	0.67	..	..
TOTAL NET IMPORTS[4]		**5.69**	**14.82**	**21.94**	**22.14**	**24.34**	**..**	**..**
Coal[1]	Exports	0.01	0.01	–	–	–	..	..
	Imports	0.28	3.00	3.27	3.21	3.07	..	..
	Net Imports	0.27	2.99	3.27	3.21	3.07	..	..
Oil	Exports	0.23	2.50	1.72	2.03	..	..	..
	Imports	6.44	14.93	18.08	17.75	17.51	..	..
	Bunkers	0.80	0.61	0.58	0.66	1.36	..	..
	Net Imports	5.42	11.82	15.79	15.07	16.15	..	..
Gas	Exports	–	–	–	–	–	..	..
	Imports	–	–	2.64	3.30	5.12	..	..
	Net Imports	–	–	2.64	3.30	5.12	..	..
Electricity	Exports	0.01	0.15	0.27	0.18	–	..	..
	Imports	0.01	0.15	0.51	0.74	–	..	..
	Net Imports	-0.00	0.00	0.24	0.56	–	..	..
TOTAL STOCK CHANGES		**0.14**	**-0.47**	**-0.50**	**0.51**	**–**	**..**	**..**
TOTAL SUPPLY (TPES)		**7.23**	**17.75**	**25.78**	**26.55**	**29.98**	**..**	**..**
Coal[1]		0.51	2.76	3.28	3.37	3.07	..	..
Oil		5.45	11.71	15.28	15.42	16.15	..	..
Gas		–	–	2.64	3.30	5.12	..	..
Comb. Renewables & Waste[2]		0.64	2.48	2.85	2.88	3.79	..	..
Nuclear		–	–	–	–	–	..	..
Hydro		0.63	0.79	1.35	0.85	1.11	..	..
Geothermal		–	0.00	0.08	0.08	0.07	..	..
Solar/Wind/Other[3]		–	0.01	0.06	0.09	0.67	..	..
Electricity Trade[5]		-0.00	0.00	0.24	0.56	–	..	..
Shares (%)								
Coal		*7.0*	*15.5*	*12.7*	*12.7*	*10.2*	..	..
Oil		*75.4*	*66.0*	*59.3*	*58.1*	*53.9*	..	..
Gas		–	–	*10.2*	*12.4*	*17.1*	..	..
Comb. Renewables & Waste		*8.8*	*14.0*	*11.0*	*10.9*	*12.6*	..	..
Nuclear		–	–	–	–	–	..	..
Hydro		*8.7*	*4.4*	*5.2*	*3.2*	*3.7*	..	..
Geothermal		–	–	*0.3*	*0.3*	*0.2*	..	..
Solar/Wind/Other		–	*0.1*	*0.2*	*0.3*	*2.2*	..	..
Electricity Trade		–	–	*0.9*	*2.1*	–	..	..

0 is negligible, – is nil, .. is not available.

Please note: All forecasts are based on the 2003 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**6.11**	**14.00**	**20.86**	**21.34**	**23.81**	**..**	**..**
Coal[1]	0.19	0.59	0.14	0.09	0.17	..	..
Oil	4.59	8.97	13.09	13.37	14.33	..	..
Gas	0.05	0.05	1.21	1.28	1.72	..	..
Comb. Renewables & Waste[2]	0.58	2.33	2.47	2.48	2.55	..	..
Geothermal	–	–	0.00	0.00	–	..	..
Solar/Wind/Other	–	0.01	0.02	0.02	0.06	..	..
Electricity	0.70	2.03	3.71	3.84	4.54	..	..
Heat	–	0.03	0.23	0.26	0.44	..	..
Shares (%)							
Coal	*3.1*	*4.2*	*0.7*	*0.4*	*0.7*	..	..
Oil	*75.1*	*64.0*	*62.7*	*62.7*	*60.2*	..	..
Gas	*0.8*	*0.4*	*5.8*	*6.0*	*7.2*	..	..
Comb. Renewables & Waste	*9.5*	*16.6*	*11.8*	*11.6*	*10.7*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	*0.1*	*0.1*	*0.1*	*0.3*	..	..
Electricity	*11.5*	*14.5*	*17.8*	*18.0*	*19.1*	..	..
Heat	–	*0.2*	*1.1*	*1.2*	*1.9*	..	..
TOTAL INDUSTRY[6]	**2.71**	**6.81**	**8.16**	**8.20**	**9.39**	**..**	**..**
Coal[1]	0.14	0.59	0.14	0.09	0.17	..	..
Oil	1.81	3.96	4.12	4.14	4.26	..	..
Gas	0.00	–	0.92	0.95	1.20	..	..
Comb. Renewables & Waste[2]	0.32	1.18	1.32	1.32	1.40	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	–	–	–	..	..
Electricity	0.44	1.05	1.45	1.47	1.93	..	..
Heat	–	0.03	0.21	0.24	0.42	..	..
Shares (%)							
Coal	*5.1*	*8.7*	*1.7*	*1.1*	*1.8*	..	..
Oil	*66.9*	*58.2*	*50.5*	*50.4*	*45.4*	..	..
Gas	*0.1*	–	*11.3*	*11.5*	*12.8*	..	..
Comb. Renewables & Waste	*11.8*	*17.3*	*16.2*	*16.1*	*14.9*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	–	–	–	..	..
Electricity	*16.2*	*15.4*	*17.7*	*17.9*	*20.6*	..	..
Heat	–	*0.4*	*2.6*	*3.0*	*4.5*	..	..
TRANSPORT[7]	**1.95**	**3.82**	**7.26**	**7.45**	**8.27**	**..**	**..**
TOTAL OTHER SECTORS[8]	**1.46**	**3.37**	**5.45**	**5.68**	**6.16**	**..**	**..**
Coal[1]	0.04	0.00	–	–	–	..	..
Oil	0.87	1.21	1.76	1.83	1.85	..	..
Gas	0.05	0.05	0.28	0.33	0.52	..	..
Comb. Renewables & Waste[2]	0.26	1.15	1.15	1.16	1.15	..	..
Geothermal	–	–	0.00	0.00	–	..	..
Solar/Wind/Other	–	0.01	0.02	0.02	0.06	..	..
Electricity	0.25	0.95	2.23	2.33	2.56	..	..
Heat	–	–	0.01	0.02	0.02	..	..
Shares (%)							
Coal	*2.4*	–	–	–	–	..	..
Oil	*59.7*	*35.9*	*32.2*	*32.2*	*30.1*	..	..
Gas	*3.2*	*1.5*	*5.1*	*5.7*	*8.4*	..	..
Comb. Renewables & Waste	*17.9*	*34.1*	*21.1*	*20.4*	*18.7*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	*0.3*	*0.4*	*0.4*	*1.0*	..	..
Electricity	*16.8*	*28.1*	*40.9*	*41.0*	*41.6*	..	..
Heat	–	–	*0.2*	*0.3*	*0.3*	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**1.33**	**5.10**	**7.78**	**7.86**	**10.49**	..	..
OUTPUT (Mtoe)	**0.84**	**2.44**	**4.00**	**3.86**	**5.18**	..	..
(TWh gross)	9.79	28.36	46.52	44.83	60.20	..	..
Output Shares (%)							
Coal	*3.9*	*32.1*	*31.2*	*33.1*	*21.8*	..	..
Oil	*19.2*	*33.1*	*13.5*	*12.7*	*7.9*	..	..
Gas	–	–	*16.6*	*26.1*	*33.8*	..	..
Comb. Renewables & Waste	*2.0*	*2.4*	*3.6*	*4.0*	*3.0*	..	..
Nuclear	–	–	–	–	–	..	..
Hydro	*74.8*	*32.3*	*33.8*	*22.0*	*21.5*	..	..
Geothermal	–	*0.0*	*0.2*	*0.2*	*0.1*	..	..
Solar/Wind/Other	–	*0.0*	*1.1*	*1.8*	*11.8*	..	..
TOTAL LOSSES	**1.26**	**3.21**	**4.87**	**5.05**	**6.17**	..	..
of which:							
Electricity and Heat Generation[10]	0.49	2.63	3.55	3.75	4.69	..	..
Other Transformation	0.27	-0.38	-0.08	-0.05	–	..	..
Own Use and Losses[11]	0.51	0.96	1.40	1.35	1.48	..	..
Statistical Differences	**-0.15**	**0.53**	**0.05**	**0.17**	**–**	..	..

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	47.40	81.00	107.50	108.50	126.17	..	..
Population (millions)	8.72	10.00	10.44	10.52	10.62	..	..
TPES/GDP[12]	0.15	0.22	0.24	0.24	0.24	..	..
Energy Production/TPES	0.19	0.19	0.17	0.15	0.19	..	..
Per Capita TPES[13]	0.83	1.78	2.47	2.52	2.82	..	..
Oil Supply/GDP[12]	0.12	0.14	0.14	0.14	0.13	..	..
TFC/GDP[12]	0.13	0.17	0.19	0.20	0.19	..	..
Per Capita TFC[13]	0.70	1.40	2.00	2.03	2.24	..	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	16.4	39.6	58.9	60.3	65.8	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	3.5	3.5	3.8	4.2	6.8	..	..

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	5.5	5.4	2.9	3.0	2.0	..	..
Coal	-2.4	18.2	1.3	2.8	-1.6	..	..
Oil	6.1	3.8	2.1	0.9	0.8	..	..
Gas	–	–	–	25.3	7.6	..	..
Comb. Renewables & Waste	3.2	11.2	1.1	1.3	4.7	..	..
Nuclear	–	–	–	–	–	..	..
Hydro	7.3	-1.8	4.2	-37.2	4.6	..	..
Geothermal	–	–	28.5	-1.3	-1.8	..	..
Solar/Wind/Other	–	–	14.4	44.4	39.5	..	..
TFC	4.7	5.2	3.1	2.3	1.8	..	..
Electricity Consumption	8.5	5.3	4.8	3.5	2.8	..	..
Energy Production	4.4	5.9	1.9	-10.1	6.3	..	..
Net Oil Imports	8.1	2.9	2.2	-4.6	1.2	..	..
GDP	2.9	3.4	2.2	0.9	2.5	..	..
Growth in the TPES/GDP Ratio	2.5	1.9	0.7	2.0	-0.5	..	..
Growth in the TFC/GDP Ratio	1.8	1.7	0.9	1.3	-0.7	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**11.3**	**34.6**	**33.0**	**32.5**	**..**	**..**	**..**
Coal[1]		6.5	11.7	7.0	6.5	..	..	..
Oil		0.7	1.2	0.3	0.3	..	..	..
Gas		0.0	1.3	0.2	0.3	..	..	..
Comb. Renewables & Waste[2]		0.0	4.1	4.7	4.8	..	..	..
Nuclear		1.7	14.1	16.1	16.6	..	..	..
Hydro		2.5	2.2	3.5	2.7	..	..	..
Geothermal		–	–	0.0	0.0	..	..	..
Solar/Wind/Other[3]		–	0.0	1.1	1.4	..	..	..
TOTAL NET IMPORTS[4]		**42.5**	**56.6**	**102.7**	**108.8**	**..**	**..**	**..**
Coal[1]	Exports	0.0	0.0	0.5	0.7	..	..	..
	Imports	2.2	7.1	13.3	14.9	..	..	..
	Net Imports	2.2	7.1	12.7	14.1	..	..	..
Oil	Exports	4.3	12.3	7.0	8.2	..	..	..
	Imports	45.3	61.8	82.7	85.6	..	..	..
	Bunkers	1.4	3.7	7.0	7.2	..	..	..
	Net Imports	39.6	45.9	68.7	70.3	..	..	..
Gas	Exports	–	–	–	–	..	..	..
	Imports	0.9	3.7	21.2	24.6	..	..	..
	Net Imports	0.9	3.7	21.2	24.6	..	..	..
Electricity	Exports	0.2	0.3	0.7	1.0	..	..	..
	Imports	0.0	0.3	0.8	0.7	..	..	..
	Net Imports	-0.2	-0.0	0.1	-0.3	..	..	..
TOTAL STOCK CHANGES		**-1.5**	**-0.1**	**0.4**	**0.9**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**52.4**	**91.1**	**136.1**	**142.2**	**158.2**	**..**	**..**
Coal[1]		9.0	19.3	20.1	21.0	13.9	..	..
Oil		38.4	46.5	69.0	70.8	73.8	..	..
Gas		0.9	5.0	21.3	25.2	36.9	..	..
Comb. Renewables & Waste[2]		0.0	4.1	4.7	4.8	11.5	..	..
Nuclear		1.7	14.1	16.1	16.6	14.8	..	..
Hydro		2.5	2.2	3.5	2.7	3.3	..	..
Geothermal		–	–	0.0	0.0	–	..	..
Solar/Wind/Other[3]		–	0.0	1.1	1.4	4.1	..	..
Electricity Trade[5]		-0.2	-0.0	0.1	-0.3	–	..	..
Shares (%)								
Coal		*17.2*	*21.2*	*14.8*	*14.8*	*8.8*	..	..
Oil		*73.3*	*51.0*	*50.7*	*49.8*	*46.7*	..	..
Gas		*1.8*	*5.5*	*15.7*	*17.7*	*23.3*	..	..
Comb. Renewables & Waste		–	*4.5*	*3.5*	*3.4*	*7.3*	..	..
Nuclear		*3.3*	*15.5*	*11.9*	*11.7*	*9.3*	..	..
Hydro		*4.7*	*2.4*	*2.6*	*1.9*	*2.1*	..	..
Geothermal		–	–	–	–	–	..	..
Solar/Wind/Other		–	–	*0.8*	*1.0*	*2.6*	..	..
Electricity Trade		*-0.3*	–	*0.1*	*-0.2*	–	..	..

0 is negligible, – is nil, .. is not available.

Please note: The forecast data for 2010 have been estimated by the IEA Secretariat based on the official 2011 Spanish forecasts assuming linear growth between 2004 and 2011.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**39.9**	**62.5**	**99.9**	**103.5**	**121.5**	**..**	**..**
Coal[1]	4.0	3.2	1.6	1.6	2.1	..	..
Oil	30.1	39.9	59.9	61.5	66.3	..	..
Gas	0.7	4.6	15.8	16.8	22.2	..	..
Comb. Renewables & Waste[2]	–	3.9	3.8	3.7	6.7	..	..
Geothermal	–	–	0.0	0.0	–	..	..
Solar/Wind/Other	–	–	0.0	0.1	0.2	..	..
Electricity	5.1	10.8	18.7	19.8	24.0	..	..
Heat	–	0.0	–	–	–	..	..
Shares (%)							
Coal	*9.9*	*5.2*	*1.6*	*1.6*	*1.7*	..	..
Oil	*75.6*	*63.9*	*60.0*	*59.4*	*54.6*	..	..
Gas	*1.8*	*7.4*	*15.8*	*16.3*	*18.2*	..	..
Comb. Renewables & Waste	–	*6.3*	*3.8*	*3.5*	*5.5*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	–	*0.1*	*0.2*	..	..
Electricity	*12.7*	*17.3*	*18.8*	*19.2*	*19.8*	..	..
Heat	–	–	–	–	–	..	..
TOTAL INDUSTRY[6]	**20.7**	**25.3**	**38.4**	**38.4**	**43.5**	**..**	**..**
Coal[1]	3.6	2.9	1.5	1.4	2.0	..	..
Oil	13.4	11.3	15.0	14.1	14.8	..	..
Gas	0.4	3.8	12.1	12.8	15.2	..	..
Comb. Renewables & Waste[2]	–	1.8	1.5	1.4	2.5	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	0.0	0.0	–	..	..
Electricity	3.3	5.4	8.3	8.7	8.9	..	..
Heat	–	–	–	–	–	..	..
Shares (%)							
Coal	*17.5*	*11.6*	*3.9*	*3.8*	*4.6*	..	..
Oil	*64.7*	*44.6*	*39.1*	*36.7*	*34.1*	..	..
Gas	*2.0*	*14.9*	*31.5*	*33.3*	*35.0*	..	..
Comb. Renewables & Waste	–	*7.3*	*4.0*	*3.5*	*5.8*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	–	–	–	..	..
Electricity	*15.8*	*21.5*	*21.6*	*22.7*	*20.5*	..	..
Heat	–	–	–	–	–	..	..
TRANSPORT[7]	**11.9**	**22.8**	**37.3**	**39.1**	**45.6**	**..**	**..**
TOTAL OTHER SECTORS[8]	**7.2**	**14.4**	**24.2**	**26.0**	**32.4**	**..**	**..**
Coal[1]	0.3	0.3	0.1	0.2	0.1	..	..
Oil	4.9	6.1	8.2	9.0	9.2	..	..
Gas	0.3	0.8	3.7	4.1	6.9	..	..
Comb. Renewables & Waste[2]	–	2.1	2.1	2.1	2.3	..	..
Geothermal	–	–	0.0	0.0	–	..	..
Solar/Wind/Other	–	–	0.0	0.1	0.2	..	..
Electricity	1.7	5.1	10.0	10.7	13.7	..	..
Heat	–	0.0	–	–	–	..	..
Shares (%)							
Coal	*4.3*	*2.1*	*0.3*	*0.6*	*0.3*	..	..
Oil	*68.2*	*42.4*	*34.0*	*34.5*	*28.3*	..	..
Gas	*4.1*	*5.8*	*15.4*	*15.6*	*21.4*	..	..
Comb. Renewables & Waste	–	*14.4*	*8.5*	*8.1*	*7.0*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	*0.2*	*0.2*	*0.7*	..	..
Electricity	*23.4*	*35.2*	*41.4*	*41.0*	*42.4*	..	..
Heat	–	–	–	–	–	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**12.6**	**33.1**	**49.4**	**52.3**	**56.1**	..	..
OUTPUT (Mtoe)	**6.5**	**13.0**	**22.2**	**23.8**	**27.7**	..	..
(TWh gross)	75.7	151.2	257.9	277.1	322.6	..	..
Output Shares (%)							
Coal	*18.9*	*40.1*	*29.5*	*29.0*	*15.9*	..	..
Oil	*33.2*	*5.7*	*9.3*	*8.6*	*4.8*	..	..
Gas	*1.0*	*1.0*	*15.3*	*20.0*	*31.8*	..	..
Comb. Renewables & Waste	*0.1*	*0.4*	*1.4*	*2.4*	*4.3*	..	..
Nuclear	*8.7*	*35.9*	*24.0*	*23.0*	*17.5*	..	..
Hydro	*38.2*	*16.8*	*15.9*	*11.4*	*11.7*	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	*0.0*	*4.7*	*5.6*	*14.0*	..	..
TOTAL LOSSES	**13.4**	**28.5**	**36.7**	**38.4**	**36.7**	..	..
of which:							
Electricity and Heat Generation[10]	6.1	20.1	27.2	28.5	28.3	..	..
Other Transformation	3.6	2.3	1.3	1.3	4.0	..	..
Own Use and Losses[11]	3.7	6.1	8.2	8.6	4.4	..	..
Statistical Differences	**-0.9**	**0.0**	**-0.5**	**0.3**	**–**	..	..

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	281.90	440.60	635.90	655.60	781.78	..	..
Population (millions)	34.96	39.01	42.01	42.69	46.33	..	..
TPES/GDP[12]	0.19	0.21	0.21	0.22	0.20	..	..
Energy Production/TPES	0.22	0.38	0.24	0.23	..	..	..
Per Capita TPES[13]	1.50	2.33	3.24	3.33	3.41	..	..
Oil Supply/GDP[12]	0.14	0.11	0.11	0.11	0.09	..	..
TFC/GDP[12]	0.14	0.14	0.16	0.16	0.16	..	..
Per Capita TFC[13]	1.14	1.60	2.38	2.42	2.62	..	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	141.6	207.4	312.3	329.8	340.2	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	7.0	15.0	30.8	32.4	11.3	..	..

GROWTH RATES (% per year)	**73–79**	**79–90**	**90–03**	**03–04**	**04–10**	**10–20**	**20–30**
TPES	4.1	2.9	3.1	4.5	1.8	..	..
Coal	3.0	5.4	0.3	4.5	-6.7	..	..
Oil	4.1	-0.5	3.1	2.5	0.7	..	..
Gas	6.7	12.3	11.9	17.9	6.6	..	..
Comb. Renewables & Waste	24.8	49.4	1.1	2.3	15.6	..	..
Nuclear	0.4	20.9	1.0	2.8	-1.9	..	..
Hydro	8.2	-5.3	3.8	-23.1	3.1	..	..
Geothermal	–	–	–	–	–	..	..
Solar/Wind/Other	–	–	62.3	28.8	19.6	..	..
TFC	4.1	1.9	3.7	3.6	2.7	..	..
Electricity Consumption	6.4	3.6	4.3	5.9	3.3	..	..
Energy Production	5.5	7.5	-0.4	-1.3	–	..	..
Net Oil Imports	3.2	-0.4	3.2	2.2	–	..	..
GDP	2.3	2.9	2.9	3.1	3.0	..	..
Growth in the TPES/GDP Ratio	1.8	-0.0	0.3	1.4	-1.2	..	..
Growth in the TFC/GDP Ratio	1.8	-0.9	0.8	0.5	-0.3	..	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**9.3**	**29.8**	**31.6**	**35.1**	**34.2**	**30.4**	**..**
Coal[1]		0.0	0.0	–	–	–	–	..
Peat		–	0.2	0.3	0.4	0.6	0.6	..
Oil		–	0.0	–	–	–	–	..
Gas		–	–	–	–	–	–	..
Comb. Renewables & Waste[2]		3.5	5.5	8.7	8.9	9.6	11.0	..
Nuclear		0.6	17.8	17.6	20.2	17.3	11.6	..
Hydro		5.1	6.2	4.6	5.2	6.0	6.0	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	0.0	0.4	0.4	0.7	1.3	..
TOTAL NET IMPORTS[4]		**29.6**	**17.6**	**21.1**	**18.4**	**13.5**	**15.2**	**..**
Coal[1]	Exports	0.0	0.0	0.0	0.0	0.0	0.0	..
	Imports	1.7	2.6	2.5	2.5	2.2	2.2	..
	Net Imports	1.7	2.6	2.5	2.5	2.2	2.2	..
Peat	Exports	–	–	–	–	–	..	..
	Imports	–	–	–	–	–	..	..
	Net Imports	–	–	–	–	–	..	..
Oil	Exports	1.4	8.7	10.2	11.2	11.6	11.6	..
	Imports	30.4	24.0	28.5	28.2	24.1	24.1	..
	Bunkers	1.1	0.7	1.6	1.9	2.0	2.0	..
	Net Imports	27.8	14.6	16.6	15.1	10.5	10.5	..
Gas	Exports	–	–	–	–	–	–	..
	Imports	–	0.6	0.9	0.9	0.9	2.4	..
	Net Imports	–	0.6	0.9	0.9	0.9	2.4	..
Electricity	Exports	0.4	1.3	1.0	1.5	1.5	–	..
	Imports	0.5	1.1	2.1	1.3	1.3	–	..
	Net Imports	0.1	-0.2	1.1	-0.2	-0.2	–	..
TOTAL STOCK CHANGES		**0.5**	**0.2**	**-1.0**	**0.4**	**1.4**	**1.4**	**..**
TOTAL SUPPLY (TPES)		**39.3**	**47.6**	**51.7**	**53.9**	**49.1**	**47.0**	**..**
Coal[1]		1.6	2.7	2.3	2.6	2.5	2.5	..
Peat		–	0.2	0.3	0.4	0.6	0.6	..
Oil		28.4	14.7	15.7	15.5	11.6	11.6	..
Gas		–	0.6	0.9	0.9	0.9	2.4	..
Comb. Renewables & Waste[2]		3.5	5.5	8.7	9.0	9.6	11.0	..
Nuclear		0.6	17.8	17.6	20.2	17.3	11.6	..
Hydro		5.1	6.2	4.6	5.2	6.0	6.0	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other[3]		–	0.0	0.4	0.4	0.7	1.3	..
Electricity Trade[5]		0.1	-0.2	1.1	-0.2	-0.2	–	..
Shares (%)								
Coal		*4.1*	*5.7*	*4.5*	*4.8*	*5.1*	*5.3*	..
Peat		–	*0.5*	*0.7*	*0.7*	*1.1*	*1.2*	..
Oil		*72.2*	*30.8*	*30.5*	*28.7*	*23.6*	*24.7*	..
Gas		–	*1.2*	*1.7*	*1.6*	*1.8*	*5.2*	..
Comb. Renewables & Waste		*9.0*	*11.6*	*16.9*	*16.7*	*19.6*	*23.4*	..
Nuclear		*1.4*	*37.4*	*34.0*	*37.4*	*35.3*	*24.7*	..
Hydro		*13.1*	*13.1*	*8.9*	*9.6*	*12.2*	*12.8*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	*0.7*	*0.7*	*1.5*	*2.7*	..
Electricity Trade		*0.2*	*-0.3*	*2.1*	*-0.3*	*-0.4*	–	..

0 is negligible, – is nil, .. is not available

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**35.3**	**32.1**	**35.9**	**35.7**	**36.0**	**37.3**	**..**
Coal[1]	0.9	1.0	0.8	0.8	0.9	0.9	..
Peat	–	0.0	0.0	0.0	0.0	0.0	..
Oil	24.8	14.0	14.3	13.9	12.6	12.7	..
Gas	0.1	0.4	0.5	0.5	0.6	0.9	..
Comb. Renewables & Waste[2]	3.5	4.6	5.1	5.2	6.2	6.9	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	..
Electricity	6.0	10.4	11.1	11.2	11.7	11.5	..
Heat	–	1.7	4.1	4.1	4.0	4.4	..
Shares (%)							
Coal	*2.6*	*3.2*	*2.2*	*2.2*	*2.4*	*2.4*	..
Peat	–	–	–	–	*0.1*	*0.1*	..
Oil	*70.4*	*43.7*	*39.8*	*38.8*	*34.9*	*33.9*	..
Gas	*0.3*	*1.1*	*1.5*	*1.4*	*1.7*	*2.5*	..
Comb. Renewables & Waste	*9.8*	*14.4*	*14.1*	*14.7*	*17.2*	*18.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*16.9*	*32.2*	*31.0*	*31.4*	*32.5*	*30.9*	..
Heat	–	*5.3*	*11.3*	*11.5*	*11.2*	*11.8*	..
TOTAL INDUSTRY[6]	**15.5**	**13.3**	**14.6**	**14.6**	**15.0**	**15.1**	**..**
Coal[1]	0.9	1.0	0.8	0.8	0.9	0.9	..
Peat	–	0.0	0.0	0.0	0.0	0.0	..
Oil	8.3	3.5	4.0	4.0	3.1	2.8	..
Gas	0.0	0.3	0.3	0.3	0.4	0.6	..
Comb. Renewables & Waste[2]	2.9	3.7	4.2	4.2	5.0	5.6	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	3.4	4.6	4.8	4.9	5.1	4.6	..
Heat	–	0.2	0.4	0.4	0.5	0.6	..
Shares (%)							
Coal	*5.7*	*7.5*	*5.4*	*5.3*	*5.8*	*5.9*	..
Peat	–	–	*0.1*	*0.1*	*0.1*	*0.1*	..
Oil	*53.4*	*26.5*	*27.8*	*27.6*	*21.0*	*18.4*	..
Gas	*0.1*	*1.9*	*2.3*	*2.2*	*2.7*	*4.2*	..
Comb. Renewables & Waste	*18.9*	*27.7*	*28.6*	*28.4*	*33.4*	*37.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*21.9*	*35.0*	*33.2*	*33.7*	*33.9*	*30.7*	..
Heat	–	*1.3*	*2.6*	*2.8*	*3.0*	*3.7*	..
TRANSPORT[7]	**5.5**	**7.4**	**8.3**	**8.6**	**8.6**	**9.4**	**..**
TOTAL OTHER SECTORS[8]	**14.3**	**11.5**	**13.0**	**12.5**	**12.5**	**12.9**	**..**
Coal[1]	0.0	0.0	–	–	–	..	..
Peat	–	–	–	–	–	..	..
Oil	11.2	3.3	2.2	1.7	1.2	0.8	..
Gas	0.1	0.1	0.2	0.2	0.2	0.3	..
Comb. Renewables & Waste[2]	0.5	1.0	0.9	0.9	1.2	1.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	..
Electricity	2.4	5.5	6.1	6.0	6.3	6.6	..
Heat	–	1.5	3.7	3.7	3.6	3.9	..
Shares (%)							
Coal	*0.3*	*0.4*	–	–	–	..	..
Peat	–	–	–	–	–	..	..
Oil	*78.7*	*28.9*	*17.1*	*13.6*	*9.3*	*6.5*	..
Gas	*0.7*	*0.9*	*1.4*	*1.5*	*1.6*	*2.0*	..
Comb. Renewables & Waste	*3.6*	*8.4*	*6.8*	*7.4*	*9.4*	*10.3*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*16.6*	*47.9*	*46.5*	*48.1*	*50.9*	*51.2*	..
Heat	–	*13.4*	*28.2*	*29.4*	*28.8*	*29.9*	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**8.2**	**26.7**	**28.2**	**31.2**	**29.1**	**25.4**	..
OUTPUT (Mtoe)	**6.7**	**12.6**	**11.6**	**13.0**	**13.4**	**13.0**	..
(TWh gross)	78.1	146.0	135.4	151.7	156.0	150.7	..
Output Shares (%)							
Coal	*0.6*	*1.1*	*3.1*	*1.2*	*2.2*	*1.7*	..
Peat	–	*0.0*	*0.1*	*0.5*	*0.2*	*0.2*	..
Oil	*19.4*	*0.9*	*2.9*	*1.3*	*1.7*	*1.0*	..
Gas	–	*0.3*	*0.5*	*0.5*	*0.6*	*5.8*	..
Comb. Renewables & Waste	*0.5*	*1.4*	*3.6*	*5.3*	*5.5*	*8.5*	..
Nuclear	*2.7*	*46.7*	*49.8*	*51.1*	*42.6*	*29.5*	..
Hydro	*76.7*	*49.7*	*39.5*	*39.6*	*44.6*	*46.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*0.5*	*0.6*	*2.6*	*6.6*	..
TOTAL LOSSES	**3.4**	**16.1**	**16.9**	**18.9**	**16.4**	**13.0**	..
of which:							
Electricity and Heat Generation[10]	1.5	12.2	12.8	14.4	11.9	8.2	..
Other Transformation	1.0	1.1	1.9	2.0	2.6	2.9	..
Own Use and Losses[11]	1.0	2.8	2.2	2.5	1.9	1.9	..
Statistical Differences	**0.60**	**-0.68**	**-1.07**	**-0.70**	**-3.32**	**-3.39**	..

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	142.10	199.60	253.70	263.20	296.98	363.19	..
Population (millions)	8.14	8.56	8.96	8.99	9.18	9.51	..
TPES/GDP[12]	0.28	0.24	0.20	0.20	0.17	0.13	..
Energy Production/TPES	0.24	0.63	0.61	0.65	0.70	0.65	..
Per Capita TPES[13]	4.83	5.56	5.77	6.00	5.34	4.94	..
Oil Supply/GDP[12]	0.20	0.07	0.06	0.06	0.04	0.03	..
TFC/GDP[12]	0.25	0.16	0.14	0.14	0.12	0.10	..
Per Capita TFC[13]	4.34	3.75	4.00	3.97	3.92	3.93	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	84.9	51.9	54.5	52.2	43.2	46.8	..
CO_2 Emissions from Bunkers (Mt CO_2)	3.9	3.2	6.7	7.9	8.5	8.9	..

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	1.8	0.8	0.6	4.3	-1.6	-0.4	..
Coal	1.6	3.9	-1.2	10.0	-0.4	–	..
Peat	–	–	3.0	10.8	6.7	–	..
Oil	-0.8	-5.4	0.5	-1.6	-4.7	–	..
Gas	–	–	3.4	-0.5	0.2	10.5	..
Comb. Renewables & Waste	1.8	3.1	3.6	3.3	1.1	1.3	..
Nuclear	46.7	11.3	-0.1	14.9	-2.5	-3.9	..
Hydro	0.3	1.6	-2.3	12.3	2.5	0.1	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	23.6	23.8	28.1	9.6	..
TFC	0.4	-1.1	0.8	-0.5	0.1	0.4	..
Electricity Consumption	3.5	3.2	0.6	0.7	0.7	-0.2	..
Energy Production	8.0	6.6	0.5	10.9	-0.4	-1.2	..
Net Oil Imports	0.3	-5.8	1.0	-9.1	-5.8	–	..
GDP	1.8	2.1	1.9	3.7	2.0	2.0	..
Growth in the TPES/GDP Ratio	-0.0	-1.3	-1.2	0.5	-3.5	-2.4	..
Growth in the TFC/GDP Ratio	-1.3	-3.2	-1.0	-4.0	-1.9	-1.6	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**4.28**	**9.72**	**11.79**	**11.82**	**11.21**	**10.50**	**9.01**
Coal[1]		–	–	–	–	–	–	–
Oil		–	–	–	–	–	–	–
Gas		–	0.00	–	–	–	–	–
Comb. Renewables & Waste[2]		0.24	0.90	1.47	1.72	2.03	2.10	2.03
Nuclear		1.64	6.18	7.19	7.05	6.29	5.52	4.10
Hydro		2.40	2.56	2.99	2.90	2.88	2.88	2.88
Geothermal		–	0.06	0.12	0.12	–	–	–
Solar/Wind/Other[3]		–	0.01	0.02	0.03	0.00	0.01	0.01
TOTAL NET IMPORTS[4]		**15.23**	**15.16**	**14.93**	**15.34**	**15.87**	**16.20**	**16.47**
Coal[1]	Exports	0.02	0.01	–	–	–	–	–
	Imports	0.24	0.35	0.08	0.13	0.10	0.10	0.10
	Net Imports	0.22	0.34	0.08	0.13	0.10	0.10	0.10
Oil	Exports	0.23	0.16	0.65	0.60	–	–	–
	Imports	15.38	13.54	13.15	13.16	13.04	12.94	12.63
	Bunkers	–	0.02	0.01	0.01	–	–	–
	Net Imports	15.16	13.36	12.49	12.56	13.04	12.94	12.63
Gas	Exports	–	–	–	–	–	–	–
	Imports	0.15	1.63	2.63	2.71	2.85	2.99	3.13
	Net Imports	0.15	1.63	2.63	2.71	2.85	2.99	3.13
Electricity	Exports	0.90	1.97	2.86	2.39	0.12	..	..
	Imports	0.60	1.79	2.59	2.33	..	0.17	0.61
	Net Imports	-0.30	-0.18	-0.27	-0.06	-0.12	0.17	0.61
TOTAL STOCK CHANGES		**0.22**	**0.12**	**0.15**	**-0.03**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**19.72**	**24.99**	**26.87**	**27.13**	**27.08**	**26.70**	**25.48**
Coal[1]		0.33	0.36	0.14	0.13	0.10	0.10	0.10
Oil		15.26	13.46	12.58	12.53	13.04	12.94	12.63
Gas		0.15	1.63	2.63	2.71	2.85	2.99	3.13
Comb. Renewables & Waste[2]		0.24	0.92	1.47	1.71	2.03	2.10	2.03
Nuclear		1.64	6.18	7.19	7.05	6.29	5.52	4.10
Hydro		2.40	2.56	2.99	2.90	2.88	2.88	2.88
Geothermal		–	0.06	0.12	0.12	–	–	–
Solar/Wind/Other[3]		–	0.01	0.02	0.03	0.00	0.01	0.01
Electricity Trade[5]		-0.30	-0.18	-0.27	-0.06	-0.12	0.17	0.61
Shares (%)								
Coal		*1.7*	*1.4*	*0.5*	*0.5*	*0.4*	*0.4*	*0.4*
Oil		*77.4*	*53.8*	*46.8*	*46.2*	*48.2*	*48.5*	*49.6*
Gas		*0.8*	*6.5*	*9.8*	*10.0*	*10.5*	*11.2*	*12.3*
Comb. Renewables & Waste		*1.2*	*3.7*	*5.5*	*6.3*	*7.5*	*7.9*	*8.0*
Nuclear		*8.3*	*24.7*	*26.8*	*26.0*	*23.2*	*20.7*	*16.1*
Hydro		*12.2*	*10.3*	*11.1*	*10.7*	*10.6*	*10.8*	*11.3*
Geothermal		–	*0.2*	*0.4*	*0.5*	–	–	–
Solar/Wind/Other		–	–	*0.1*	*0.1*	–	–	–
Electricity Trade		*-1.5*	*-0.7*	*-1.0*	*-0.2*	*-0.5*	*0.6*	*2.4*

0 is negligible, – is nil, .. is not available.

Please note: All forecast data are based on the 2002 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**17.57**	**19.65**	**21.63**	**21.98**	**21.76**	**21.89**	**21.69**
Coal[1]	0.29	0.35	0.14	0.13	0.10	0.10	0.10
Oil	14.30	12.85	12.90	12.85	12.65	12.56	12.26
Gas	0.24	1.52	2.40	2.48	2.68	2.77	2.85
Comb. Renewables & Waste[2]	0.24	0.59	0.95	1.17	1.31	1.38	1.39
Geothermal	–	0.06	0.12	0.12	–	–	–
Solar/Wind/Other	–	0.01	0.02	0.02	–	–	–
Electricity	2.50	4.04	4.74	4.83	4.76	4.83	4.83
Heat	–	0.25	0.35	0.37	0.27	0.26	0.26
Shares (%)							
Coal	*1.6*	*1.8*	*0.6*	*0.6*	*0.5*	*0.4*	*0.5*
Oil	*81.4*	*65.4*	*59.6*	*58.4*	*58.1*	*57.4*	*56.5*
Gas	*1.3*	*7.7*	*11.1*	*11.3*	*12.3*	*12.6*	*13.1*
Comb. Renewables & Waste	*1.4*	*3.0*	*4.4*	*5.3*	*6.0*	*6.3*	*6.4*
Geothermal	–	*0.3*	*0.6*	*0.6*	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	–	–	–
Electricity	*14.2*	*20.6*	*21.9*	*22.0*	*21.9*	*22.1*	*22.3*
Heat	–	*1.3*	*1.6*	*1.7*	*1.2*	*1.2*	*1.2*
TOTAL INDUSTRY[6]	**4.78**	**3.93**	**4.59**	**4.72**	**4.85**	**4.89**	**5.03**
Coal[1]	0.08	0.33	0.13	0.13	0.10	0.10	0.10
Oil	3.70	1.31	1.51	1.55	1.42	1.38	1.39
Gas	0.05	0.59	0.79	0.82	1.14	1.14	1.19
Comb. Renewables & Waste[2]	–	0.16	0.44	0.48	0.49	0.51	0.50
Geothermal	–	–	0.01	0.01	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.95	1.48	1.57	1.60	1.63	1.69	1.77
Heat	–	0.05	0.14	0.14	0.08	0.07	0.07
Shares (%)							
Coal	*1.6*	*8.4*	*2.9*	*2.7*	*2.0*	*2.0*	*2.0*
Oil	*77.4*	*33.4*	*32.9*	*32.8*	*29.3*	*28.3*	*27.7*
Gas	*1.1*	*15.1*	*17.2*	*17.3*	*23.4*	*23.3*	*23.7*
Comb. Renewables & Waste	–	*4.1*	*9.5*	*10.1*	*10.2*	*10.5*	*9.9*
Geothermal	–	–	*0.2*	*0.2*	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*19.9*	*37.7*	*34.2*	*34.0*	*33.5*	*34.5*	*35.3*
Heat	–	*1.2*	*3.1*	*2.9*	*1.6*	*1.4*	*1.4*
TRANSPORT[7]	**4.29**	**6.29**	**7.00**	**6.97**	**7.10**	**7.43**	**7.47**
TOTAL OTHER SECTORS[8]	**8.49**	**9.43**	**10.03**	**10.30**	**9.81**	**9.58**	**9.20**
Coal[1]	0.21	0.02	0.01	0.01	0.00	0.00	0.00
Oil	6.48	5.47	4.64	4.59	4.43	4.06	3.72
Gas	0.19	0.92	1.62	1.67	1.54	1.63	1.66
Comb. Renewables & Waste[2]	0.24	0.43	0.51	0.70	0.82	0.87	0.89
Geothermal	–	0.06	0.11	0.12	–	–	–
Solar/Wind/Other	–	0.01	0.02	0.02	–	–	–
Electricity	1.37	2.34	2.91	2.98	2.83	2.83	2.74
Heat	–	0.20	0.21	0.23	0.19	0.19	0.19
Shares (%)							
Coal	*2.5*	*0.2*	*0.1*	*0.1*	–	–	–
Oil	*76.3*	*57.9*	*46.3*	*44.5*	*45.2*	*42.4*	*40.4*
Gas	*2.2*	*9.8*	*16.1*	*16.2*	*15.7*	*17.0*	*18.0*
Comb. Renewables & Waste	*2.8*	*4.5*	*5.1*	*6.8*	*8.4*	*9.1*	*9.7*
Geothermal	–	*0.6*	*1.1*	*1.1*	–	–	–
Solar/Wind/Other	–	*0.1*	*0.2*	*0.2*	–	–	–
Electricity	*16.1*	*24.8*	*29.0*	*28.9*	*28.8*	*29.5*	*29.8*
Heat	–	*2.1*	*2.1*	*2.2*	*1.9*	*2.0*	*2.1*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**4.48**	**9.30**	**10.94**	**10.74**	**10.07**	**9.35**	**7.91**
OUTPUT (Mtoe)	**3.17**	**4.72**	**5.60**	**5.47**	**5.22**	**5.00**	**4.56**
(TWh gross)	36.82	54.88	65.12	63.58	60.73	58.18	53.03
Output Shares (%)							
Coal	–	*0.1*	–	–	–	–	–
Oil	*7.1*	*0.7*	*0.4*	*0.3*	*0.1*	*0.1*	*0.2*
Gas	–	*0.6*	*1.4*	*1.5*	*1.7*	*2.2*	*2.7*
Comb. Renewables & Waste	–	*1.3*	*2.5*	*2.7*	*3.2*	*3.6*	*4.2*
Nuclear	*17.1*	*43.1*	*42.2*	*42.4*	*39.8*	*36.4*	*29.6*
Hydro	*75.8*	*54.3*	*53.5*	*53.1*	*55.2*	*57.6*	*63.2*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*
TOTAL LOSSES	**2.17**	**5.00**	**5.83**	**5.81**	**5.31**	**4.81**	**3.80**
of which:							
Electricity and Heat Generation[10]	1.32	4.31	4.96	4.87	4.55	4.06	3.05
Other Transformation	0.14	0.01	-0.02	-0.03	0.00	–	–
Own Use and Losses[11]	0.72	0.68	0.89	0.97	0.76	0.75	0.74
Statistical Differences	**-0.02**	**0.34**	**-0.58**	**-0.65**	**–**	**–**	**–**

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	174.30	221.70	248.70	253.80	289.20	329.07	374.44
Population (millions)	6.44	6.80	7.41	7.48	7.50	7.40	7.40
TPES/GDP[12]	0.11	0.11	0.11	0.11	0.09	0.08	0.07
Energy Production/TPES	0.22	0.39	0.44	0.44	0.41	0.39	0.35
Per Capita TPES[13]	3.06	3.68	3.63	3.63	3.61	3.61	3.44
Oil Supply/GDP[12]	0.09	0.06	0.05	0.05	0.05	0.04	0.03
TFC/GDP[12]	0.10	0.09	0.09	0.09	0.08	0.07	0.06
Per Capita TFC[13]	2.73	2.89	2.92	2.94	2.90	2.96	2.93
Energy-related CO_2 Emissions (Mt CO_2)[14]	43.6	41.3	43.7	44.6	44.3	44.4	43.8
CO_2 Emissions from Bunkers (Mt CO_2)	2.1	3.2	3.7	3.6	4.0	4.6	5.2

GROWTH RATES (% per year)	73-79	79-90	90-03	03-04	04-10	10-20	20-30
TPES	0.2	2.1	0.6	1.0	-0.0	-0.1	-0.5
Coal	-6.3	4.5	-7.0	-4.3	-5.1	–	0.3
Oil	-2.2	0.1	-0.5	-0.4	0.7	-0.1	-0.2
Gas	31.0	7.2	3.7	3.2	0.8	0.5	0.5
Comb. Renewables & Waste	11.2	6.6	3.7	16.9	2.9	0.3	-0.3
Nuclear	11.0	6.5	1.2	-1.9	-1.9	-1.3	-2.9
Hydro	2.1	-0.5	1.2	-3.1	-0.1	–	–
Geothermal	–	–	5.3	4.2	–	–	–
Solar/Wind/Other	–	–	8.8	8.3	-30.2	5.2	1.8
TFC	-0.6	1.4	0.7	1.6	-0.2	0.1	-0.1
Electricity Consumption	2.6	3.0	1.2	1.9	-0.3	0.2	0.0
Energy Production	6.5	4.1	1.5	0.2	-0.9	-0.6	-1.5
Net Oil Imports	-1.6	-0.3	-0.5	0.5	0.6	-0.1	-0.2
GDP	-0.4	2.4	0.9	2.1	2.2	1.3	1.3
Growth in the TPES/GDP Ratio	0.6	-0.4	-0.3	-1.1	-2.2	-1.4	-1.7
Growth in the TFC/GDP Ratio	-0.3	-1.0	-0.1	-0.4	-2.3	-1.2	-1.4

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**15.52**	**25.82**	**23.59**	**24.11**	**36.74**	**65.69**	**..**
Coal[1]		5.21	12.37	10.77	10.53	22.71	36.80	..
Oil		3.59	3.61	2.32	2.22	1.57	0.69	..
Gas		–	0.18	0.46	0.57	0.24	0.23	..
Comb. Renewables & Waste[2]		6.45	7.21	5.78	5.56	4.42	3.93	..
Nuclear		–	–	–	–	–	8.23	..
Hydro		0.22	1.99	3.04	3.96	4.90	9.42	..
Geothermal		0.05	0.43	0.86	0.89	1.98	4.81	..
Solar/Wind/Other[3]		–	0.03	0.36	0.38	0.92	1.58	..
TOTAL NET IMPORTS[4]		**8.74**	**27.99**	**55.92**	**57.20**	**88.86**	**156.43**	**..**
Coal[1]	Exports	–	–	0.00	–	–	–	..
	Imports	0.01	4.21	10.90	11.20	12.29	43.50	..
	Net Imports	0.01	4.21	10.90	11.20	12.29	43.50	..
Oil	Exports	0.86	1.90	4.39	5.29	–	–	..
	Imports	9.68	23.18	32.71	34.23	39.61	60.23	..
	Bunkers	0.09	0.12	0.63	1.01	–	–	..
	Net Imports	8.73	21.16	27.70	27.94	39.61	60.23	..
Gas	Exports	–	–	–	–	0.67	0.67	..
	Imports	–	2.68	17.28	18.12	37.63	51.98	..
	Net Imports	–	2.68	17.28	18.12	36.96	51.31	..
Electricity	Exports	–	0.08	0.05	0.10	–	–	..
	Imports	–	0.02	0.10	0.04	–	1.40	..
	Net Imports	–	-0.06	0.05	-0.06	–	1.40	..
TOTAL STOCK CHANGES		**0.11**	**-0.83**	**-0.72**	**0.60**	**–**	**–**	**..**
TOTAL SUPPLY (TPES)		**24.37**	**52.97**	**78.79**	**81.91**	**125.59**	**222.12**	**..**
Coal[1]		5.15	16.91	21.22	22.38	35.00	80.30	..
Oil		12.50	23.61	29.77	30.09	41.18	60.92	..
Gas		–	2.86	17.72	18.70	37.19	51.54	..
Comb. Renewables & Waste[2]		6.45	7.21	5.78	5.56	4.42	3.93	..
Nuclear		–	–	–	–	–	8.23	..
Hydro		0.22	1.99	3.04	3.96	4.90	9.42	..
Geothermal		0.05	0.43	0.86	0.89	1.98	4.81	..
Solar/Wind/Other[3]		–	0.03	0.36	0.38	0.92	1.58	..
Electricity Trade[5]		–	-0.06	0.05	-0.06	–	1.40	..
Shares (%)								
Coal		*21.1*	*31.9*	*26.9*	*27.3*	*27.9*	*36.2*	..
Oil		*51.3*	*44.6*	*37.8*	*36.7*	*32.8*	*27.4*	..
Gas		–	*5.4*	*22.5*	*22.8*	*29.6*	*23.2*	..
Comb. Renewables & Waste		*26.5*	*13.6*	*7.3*	*6.8*	*3.5*	*1.8*	..
Nuclear		–	–	–	–	–	*3.7*	..
Hydro		*0.9*	*3.8*	*3.9*	*4.8*	*3.9*	*4.2*	..
Geothermal		*0.2*	*0.8*	*1.1*	*1.1*	*1.6*	*2.2*	..
Solar/Wind/Other		–	*0.1*	*0.5*	*0.5*	*0.7*	*0.7*	..
Electricity Trade		–	*-0.1*	*0.1*	*-0.1*	–	*0.6*	..

0 is negligible, – is nil, .. is not available

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**20.03**	**40.50**	**60.42**	**62.96**	**97.36**	**167.83**	**..**
Coal[1]	2.93	7.52	10.44	10.77	17.89	41.73	..
Oil	9.70	20.80	26.59	27.15	36.04	54.77	..
Gas	0.04	0.72	6.65	7.59	19.62	24.79	..
Comb. Renewables & Waste[2]	6.45	7.21	5.75	5.53	4.42	3.93	..
Geothermal	0.05	0.36	0.78	0.81	1.65	4.48	..
Solar/Wind/Other	–	0.03	0.35	0.38	0.50	0.86	..
Electricity	0.85	3.87	9.49	10.29	17.25	37.28	..
Heat	–	–	0.37	0.45	–	–	..
Shares (%)							
Coal	*14.6*	*18.6*	*17.3*	*17.1*	*18.4*	*24.9*	..
Oil	*48.5*	*51.4*	*44.0*	*43.1*	*37.0*	*32.6*	..
Gas	*0.2*	*1.8*	*11.0*	*12.1*	*20.2*	*14.8*	..
Comb. Renewables & Waste	*32.2*	*17.8*	*9.5*	*8.8*	*4.5*	*2.3*	..
Geothermal	*0.2*	*0.9*	*1.3*	*1.3*	*1.7*	*2.7*	..
Solar/Wind/Other	–	*0.1*	*0.6*	*0.6*	*0.5*	*0.5*	..
Electricity	*4.3*	*9.5*	*15.7*	*16.3*	*17.7*	*22.2*	..
Heat	–	–	*0.6*	*0.7*	–	–	..
TOTAL INDUSTRY[6]	**4.30**	**13.69**	**23.60**	**24.30**	**44.06**	**79.49**	**..**
Coal[1]	1.14	4.50	8.37	8.36	13.98	33.93	..
Oil	2.60	6.16	8.26	8.21	9.55	12.17	..
Gas	0.00	0.67	2.23	2.61	11.79	13.65	..
Comb. Renewables & Waste[2]	–	–	–	–	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	0.01	0.12	0.12	0.17	0.26	..
Electricity	0.55	2.35	4.62	4.99	8.58	19.49	..
Heat	–	–	–	–	–	–	..
Shares (%)							
Coal	*26.5*	*32.9*	*35.5*	*34.4*	*31.7*	*42.7*	..
Oil	*60.5*	*45.0*	*35.0*	*33.8*	*21.7*	*15.3*	..
Gas	*0.1*	*4.9*	*9.5*	*10.7*	*26.8*	*17.2*	..
Comb. Renewables & Waste	–	–	–	–	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.1*	*0.5*	*0.5*	*0.4*	*0.3*	..
Electricity	*12.9*	*17.2*	*19.6*	*20.5*	*19.5*	*24.5*	..
Heat	–	–	–	–	–	–	..
TRANSPORT[7]	**4.49**	**9.58**	**12.95**	**13.25**	**19.92**	**34.04**	**..**
TOTAL OTHER SECTORS[8]	**11.25**	**17.23**	**23.87**	**25.42**	**33.39**	**54.30**	**..**
Coal[1]	1.27	3.00	2.07	2.41	3.91	7.81	..
Oil	3.15	5.11	5.49	5.86	6.74	8.92	..
Gas	0.04	0.05	4.36	4.88	7.82	11.12	..
Comb. Renewables & Waste[2]	6.45	7.21	5.75	5.53	4.42	3.93	..
Geothermal	0.05	0.36	0.78	0.81	1.65	4.48	..
Solar/Wind/Other	–	0.02	0.23	0.25	0.33	0.61	..
Electricity	0.29	1.49	4.81	5.23	8.52	17.44	..
Heat	–	–	0.37	0.45	–	–	..
Shares (%)							
Coal	*11.2*	*17.4*	*8.7*	*9.5*	*11.7*	*14.4*	..
Oil	*28.0*	*29.6*	*23.0*	*23.0*	*20.2*	*16.4*	..
Gas	*0.3*	*0.3*	*18.3*	*19.2*	*23.4*	*20.5*	..
Comb. Renewables & Waste	*57.4*	*41.8*	*24.1*	*21.8*	*13.2*	*7.2*	..
Geothermal	*0.4*	*2.1*	*3.3*	*3.2*	*4.9*	*8.3*	..
Solar/Wind/Other	–	*0.1*	*1.0*	*1.0*	*1.0*	*1.1*	..
Electricity	*2.6*	*8.6*	*20.2*	*20.6*	*25.5*	*32.1*	..
Heat	–	–	*1.5*	*1.8*	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**2.77**	**11.08**	**25.01**	**26.27**	**41.21**	**84.48**	..
OUTPUT (Mtoe)	**1.07**	**4.95**	**12.09**	**12.96**	**20.81**	**41.56**	..
(TWh gross)	12.43	57.54	140.58	150.70	242.02	483.24	..
Output Shares (%)							
Coal	*26.1*	*35.1*	*22.9*	*22.9*	*27.3*	*33.2*	..
Oil	*51.4*	*6.9*	*6.5*	*5.1*	*2.9*	*1.3*	..
Gas	–	*17.7*	*45.2*	*41.3*	*44.1*	*34.5*	..
Comb. Renewables & Waste	*1.6*	–	*0.1*	*0.1*	–	–	..
Nuclear	–	–	–	–	–	*6.5*	..
Hydro	*20.9*	*40.2*	*25.1*	*30.6*	*23.6*	*22.7*	..
Geothermal	–	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	..
Solar/Wind/Other	–	–	*0.0*	*0.0*	*2.0*	*1.7*	..
TOTAL LOSSES	**4.04**	**11.57**	**18.57**	**19.07**	**28.23**	**54.29**	..
of which:							
Electricity and Heat Generation[10]	1.70	6.13	12.55	12.86	20.40	42.93	..
Other Transformation	1.34	2.88	1.25	1.44	2.35	2.93	..
Own Use and Losses[11]	0.99	2.56	4.77	4.77	5.48	8.43	..
Statistical Differences	**0.30**	**0.90**	**-0.19**	**-0.13**	–	–	..

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	66.30	140.20	210.50	229.30	314.38	584.61	..
Population (millions)	38.45	56.20	70.71	71.79	78.46	87.76	..
TPES/GDP[12]	0.37	0.38	0.37	0.36	0.40	0.38	..
Energy Production/TPES	0.64	0.49	0.30	0.29	0.29	0.30	..
Per Capita TPES[13]	0.63	0.94	1.11	1.14	1.60	2.53	..
Oil Supply/GDP[12]	0.19	0.17	0.14	0.13	0.13	0.10	..
TFC/GDP[12]	0.30	0.29	0.29	0.27	0.31	0.29	..
Per Capita TFC[13]	0.52	0.72	0.85	0.88	1.24	1.91	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	52.7	128.6	203.8	209.5	328.6	593.3	..
CO_2 Emissions from Bunkers (Mt CO_2)	0.4	0.9	4.7	6.1	4.1	7.6	..

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	3.7	5.2	3.1	3.9	7.4	5.9	..
Coal	4.1	9.0	1.8	5.4	7.7	8.7	..
Oil	3.1	4.2	1.8	1.1	5.4	4.0	..
Gas	–	–	15.1	5.6	12.1	3.3	..
Comb. Renewables & Waste	3.1	-0.7	-1.7	-3.8	-3.8	-1.2	..
Nuclear	–	–	–	–	–	–	..
Hydro	25.7	7.6	3.3	30.4	3.6	6.7	..
Geothermal	3.8	19.7	5.4	3.6	14.2	9.3	..
Solar/Wind/Other	–	–	21.6	7.0	15.8	5.6	..
TFC	4.1	4.3	3.1	4.2	7.5	5.6	..
Electricity Consumption	11.3	8.2	7.2	8.4	9.0	8.0	..
Energy Production	1.9	3.6	-0.7	2.2	7.3	6.0	..
Net Oil Imports	5.1	5.5	2.1	0.9	6.0	4.3	..
GDP	4.5	4.5	3.2	8.9	5.4	6.4	..
Growth in the TPES/GDP Ratio	-0.8	0.7	-0.1	-4.6	1.9	-0.5	..
Growth in the TFC/GDP Ratio	-0.4	-0.2	-0.0	-4.3	2.0	-0.8	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		**108.5**	**208.0**	**246.4**	**225.2**	**..**	**..**	**..**
Coal[1]		75.9	53.6	16.8	14.9	..	..	..
Oil		0.5	95.2	110.7	99.6	..	..	..
Gas		24.4	40.9	92.6	86.4	..	..	..
Comb. Renewables & Waste[2]		–	0.6	2.8	2.9	8.9	12.9	..
Nuclear		7.3	17.1	23.1	20.8	18.2	7.7	..
Hydro		0.3	0.4	0.3	0.4	0.5	0.7	..
Geothermal		–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other[3]		–	0.0	0.1	0.2	1.0	1.5	..
TOTAL NET IMPORTS[4]		**110.4**	**2.1**	**-16.4**	**9.6**	**..**	**..**	**..**
Coal[1]	Exports	2.0	1.8	0.5	0.6	..	..	..
	Imports	1.1	10.3	20.5	23.2	..	..	..
	Net Imports	-0.9	8.5	20.0	22.6	..	..	..
Oil	Exports	20.9	76.5	101.6	97.9	..	..	..
	Imports	136.9	65.4	73.9	84.7	..	..	..
	Bunkers	5.4	2.5	1.8	2.1	..	..	..
	Net Imports	110.6	-13.6	-29.5	-15.3	..	..	..
Gas	Exports	–	–	13.7	8.8	..	..	..
	Imports	0.7	6.2	6.7	10.3	..	..	..
	Net Imports	0.7	6.2	-7.0	1.5	..	..	..
Electricity	Exports	0.0	0.0	0.3	0.2	–	–	..
	Imports	0.0	1.0	0.4	0.8	0.7	0.7	..
	Net Imports	0.0	1.0	0.2	0.6	0.7	0.7	..
TOTAL STOCK CHANGES		**1.8**	**2.1**	**2.2**	**-1.1**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**220.7**	**212.2**	**232.3**	**233.7**	**238.6**	**246.4**	**..**
Coal[1]		76.4	63.1	38.1	37.5	37.6	29.9	..
Oil		111.6	82.6	81.8	83.7	86.9	95.9	..
Gas		25.1	47.2	85.9	87.4	84.8	97.1	..
Comb. Renewables & Waste[2]		–	0.6	2.8	3.1	8.9	12.9	..
Nuclear		7.3	17.1	23.1	20.8	18.2	7.7	..
Hydro		0.3	0.4	0.3	0.4	0.5	0.7	..
Geothermal		–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other[3]		–	0.0	0.1	0.2	1.0	1.5	..
Electricity Trade[5]		0.0	1.0	0.2	0.6	0.7	0.7	..
Shares (%)								
Coal		*34.6*	*29.7*	*16.4*	*16.0*	*15.8*	*12.1*	..
Oil		*50.5*	*38.9*	*35.2*	*35.8*	*36.4*	*38.9*	..
Gas		*11.4*	*22.2*	*37.0*	*37.4*	*35.5*	*39.4*	..
Comb. Renewables & Waste		–	*0.3*	*1.2*	*1.3*	*3.7*	*5.2*	..
Nuclear		*3.3*	*8.1*	*10.0*	*8.9*	*7.6*	*3.1*	..
Hydro		*0.2*	*0.2*	*0.1*	*0.2*	*0.2*	*0.3*	..
Geothermal		–	–	–	–	–	–	..
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.4*	*0.6*	..
Electricity Trade		–	*0.5*	*0.1*	*0.3*	*0.3*	*0.3*	..

0 is negligible, – is nil, .. is not available.

Please note: In the course of preparing UK energy projections. some off-model adjustments to take account of prospective measures in the UK's Climate Change Programme have not necessarily been fully included in the CO_2 emissions projections. All forecasts are based on the 2004 submission.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**147.1**	**145.4**	**161.1**	**163.7**	**169.5**	**185.2**	**..**
Coal[1]	26.5	10.8	2.6	3.0	6.3	6.3	..
Oil	77.0	68.8	75.1	77.3	80.6	89.8	..
Gas	23.6	41.8	51.8	51.2	52.4	56.3	..
Comb. Renewables & Waste[2]	–	0.4	0.7	0.7	–	–	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	..
Electricity	20.0	23.6	29.0	29.2	30.2	32.8	..
Heat	–	–	1.9	2.2	..	..	..
Shares (%)							
Coal	*18.0*	*7.4*	*1.6*	*1.9*	*3.7*	*3.4*	..
Oil	*52.3*	*47.3*	*46.6*	*47.2*	*47.6*	*48.5*	..
Gas	*16.1*	*28.7*	*32.1*	*31.3*	*30.9*	*30.4*	..
Comb. Renewables & Waste	–	*0.3*	*0.4*	*0.4*	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*13.6*	*16.2*	*18.0*	*17.9*	*17.8*	*17.7*	..
Heat	–	–	*1.2*	*1.3*	..	..	..
TOTAL INDUSTRY[6]	**65.0**	**42.8**	**44.2**	**44.2**	**48.8**	**52.2**	**..**
Coal[1]	13.3	6.4	1.6	2.0	6.1	6.0	..
Oil	33.7	15.7	17.7	18.7	17.1	16.9	..
Gas	10.1	12.0	13.6	12.0	15.4	17.6	..
Comb. Renewables & Waste[2]	–	0.1	0.3	0.3	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	7.8	8.7	9.8	10.1	10.2	11.7	..
Heat	–	–	1.1	1.2	..	..	..
Shares (%)							
Coal	*20.5*	*14.9*	*3.6*	*4.4*	*12.5*	*11.5*	..
Oil	*51.8*	*36.8*	*40.0*	*42.2*	*35.0*	*32.4*	..
Gas	*15.6*	*27.9*	*30.9*	*27.2*	*31.6*	*33.7*	..
Comb. Renewables & Waste	–	*0.2*	*0.6*	*0.6*	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*12.1*	*20.2*	*22.3*	*22.8*	*20.9*	*22.4*	..
Heat	–	–	*2.6*	*2.8*	..	..	..
TRANSPORT[7]	**31.0**	**46.5**	**53.5**	**54.8**	**59.4**	**68.2**	**..**
TOTAL OTHER SECTORS[8]	**51.2**	**56.1**	**63.4**	**64.6**	**61.3**	**64.8**	**..**
Coal[1]	13.1	4.4	1.0	1.1	0.2	0.3	..
Oil	12.6	7.0	4.6	4.5	4.9	5.5	..
Gas	13.5	29.8	38.1	39.2	37.0	38.7	..
Comb. Renewables & Waste[2]	–	0.3	0.4	0.4	–	–	..
Geothermal	–	0.0	0.0	0.0	–	–	..
Solar/Wind/Other	–	0.0	0.0	0.0	–	–	..
Electricity	12.0	14.5	18.5	18.5	19.2	20.3	..
Heat	–	–	0.8	1.0	..	..	..
Shares (%)							
Coal	*25.5*	*7.8*	*1.6*	*1.7*	*0.3*	*0.5*	..
Oil	*24.7*	*12.5*	*7.3*	*6.9*	*8.0*	*8.5*	..
Gas	*26.4*	*53.2*	*60.1*	*60.7*	*60.4*	*59.7*	..
Comb. Renewables & Waste	–	*0.6*	*0.7*	*0.6*	–	–	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*23.4*	*25.8*	*29.1*	*28.6*	*31.3*	*31.3*	..
Heat	–	–	*1.2*	*1.5*	..	..	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**72.5**	**74.4**	**85.3**	**84.3**	**81.6**	**79.2**	..
OUTPUT (Mtoe)	**24.2**	**27.3**	**34.1**	**33.8**	**34.4**	**37.1**	..
(TWh gross)	281.4	317.8	395.9	393.2	400.4	432.0	..
Output Shares (%)							
Coal	*62.1*	*65.0*	*35.4*	*34.1*	*25.7*	*17.0*	..
Oil	*25.6*	*10.9*	*1.2*	*1.2*	*2.3*	*2.1*	..
Gas	*1.0*	*1.6*	*38.2*	*40.6*	*44.4*	*60.6*	..
Comb. Renewables & Waste	–	*0.2*	*1.7*	*2.0*	*5.7*	*7.5*	..
Nuclear	*10.0*	*20.7*	*22.4*	*20.3*	*17.5*	*6.8*	..
Hydro	*1.4*	*1.6*	*0.8*	*1.3*	*1.4*	*1.9*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*0.3*	*0.5*	*3.0*	*4.1*	..
TOTAL LOSSES	**75.2**	**67.5**	**71.0**	**70.0**	**69.1**	**61.2**	..
of which:							
Electricity and Heat Generation[10]	48.3	47.1	49.4	48.3	47.2	42.0	..
Other Transformation	9.7	4.1	2.6	2.5	6.8	6.7	..
Own Use and Losses[11]	17.3	16.3	19.1	19.1	15.1	12.5	..
Statistical Differences	**-1.7**	**-0.7**	**0.2**	**0.0**	–	–	..

INDICATORS	1973	1990	2003	2004	2010	2020	2030
GDP (billion 2000 USD)	813.40	1 130.90	1 542.20	1 591.10	1 899.86	2 431.98	..
Population (millions)	56.22	57.24	59.55	59.84	61.40	63.80	..
TPES/GDP[12]	0.27	0.19	0.15	0.15	0.13	0.10	..
Energy Production/TPES	0.49	0.98	1.06	0.96	..	..	..
Per Capita TPES[13]	3.93	3.71	3.90	3.91	3.89	3.86	..
Oil Supply/GDP[12]	0.14	0.07	0.05	0.05	0.05	0.04	..
TFC/GDP[12]	0.18	0.13	0.10	0.10	0.09	0.08	..
Per Capita TFC[13]	2.62	2.54	2.71	2.74	2.76	2.90	..
Energy-related CO_2 Emissions (Mt CO_2)[14]	640.1	557.6	534.3	537.1	541.3	561.4	..
CO_2 Emissions from Bunkers (Mt CO_2)	25.4	23.6	35.3	39.4	..	..	..

GROWTH RATES (% per year)	73-79	79-90	90-03	03-04	04-10	10-20	20-30
TPES	-0.1	-0.3	0.7	0.6	0.3	0.3	..
Coal	-0.5	-1.5	-3.8	-1.6	0.1	-2.3	..
Oil	-2.6	-1.3	-0.1	2.2	0.6	1.0	..
Gas	8.3	1.4	4.7	1.8	-0.5	1.4	..
Comb. Renewables & Waste	–	–	12.1	10.8	19.4	3.8	..
Nuclear	5.4	5.0	2.3	-9.8	-2.2	-8.3	..
Hydro	1.6	1.9	-3.6	52.5	2.0	3.8	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	21.0	45.8	32.7	3.8	..
TFC	0.1	-0.2	0.8	1.6	0.6	0.9	..
Electricity Consumption	0.9	1.0	1.6	0.8	0.5	0.8	..
Energy Production	10.1	0.7	1.3	-8.6	–	–	..
Net Oil Imports	-27.1	–	6.1	-48.0	–	–	..
GDP	1.5	2.2	2.4	3.2	3.0	2.5	..
Growth in the TPES/GDP Ratio	-1.6	-2.5	-1.7	-2.5	-2.6	-2.1	..
Growth in the TFC/GDP Ratio	-1.4	-2.3	-1.6	-1.5	-2.3	-1.6	..

Please note: Rounding may cause totals to differ from the sum of the elements.

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004	2010	2020	2030
TOTAL PRODUCTION		1 455	1 650	1 633	1 641	1 900	2 075	2 214
Coal[1]		333	539	526	547	650	688	859
Oil		534	433	351	339	400	413	369
Gas		503	419	448	438	484	559	543
Comb. Renewables & Waste[2]		37	62	68	70	95	110	120
Nuclear		23	159	205	212	223	241	240
Hydro		23	23	24	23	26	26	26
Geothermal		2	14	9	9	16	31	48
Solar/Wind/Other[3]		–	0	2	3	6	7	8
TOTAL NET IMPORTS[4]		289	315	643	690	744	904	1 100
Coal[1]	Exports	31	67	26	28	26	12	10
	Imports	1	2	17	20	9	33	60
	Net Imports	-30	-65	-9	-7	-17	21	50
Oil	Exports	11	39	51	52	54	57	58
	Imports	316	413	645	693	715	822	978
	Bunkers	9	29	19	24	14	14	14
	Net Imports	296	346	575	617	647	752	905
Gas	Exports	2	2	16	20	14	17	25
	Imports	24	35	92	99	126	147	169
	Net Imports	22	33	76	80	112	130	144
Electricity	Exports	0	2	2	2	2	1	1
	Imports	1	2	3	3	4	3	2
	Net Imports	1	0	1	1	2	1	1
TOTAL STOCK CHANGES		-8	-38	5	-5	–	–	–
TOTAL SUPPLY (TPES)		1 736	1 928	2 281	2 326	2 645	2 979	3 314
Coal[1]		311	458	531	545	633	709	909
Oil		824	770	921	947	1 047	1 165	1 274
Gas		515	439	520	515	596	688	687
Comb. Renewables & Waste[2]		37	62	68	71	95	110	120
Nuclear		23	159	205	212	223	241	240
Hydro		23	23	24	23	26	26	26
Geothermal		2	14	9	9	16	31	48
Solar/Wind/Other[3]		–	0	2	3	6	7	8
Electricity Trade[5]		1	0	1	1	2	1	1
Shares (%)								
Coal		*17.9*	*23.8*	*23.3*	*23.4*	*23.9*	*23.8*	*27.4*
Oil		*47.5*	*40.0*	*40.4*	*40.7*	*39.6*	*39.1*	*38.5*
Gas		*29.6*	*22.8*	*22.8*	*22.1*	*22.6*	*23.1*	*20.7*
Comb. Renewables & Waste		*2.2*	*3.2*	*3.0*	*3.0*	*3.6*	*3.7*	*3.6*
Nuclear		*1.3*	*8.3*	*9.0*	*9.1*	*8.4*	*8.1*	*7.3*
Hydro		*1.3*	*1.2*	*1.1*	*1.0*	*1.0*	*0.9*	*0.8*
Geothermal		*0.1*	*0.7*	*0.4*	*0.4*	*0.6*	*1.0*	*1.4*
Solar/Wind/Other		–	–	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*
Electricity Trade		*0.1*	–	–	–	*0.1*	–	–

0 is negligible, – is nil, .. is not available.

Please note: Care should be taken when evaluating consumption by sector since inputs of fuel to autoproducers are included in final consumption for some years and not for others.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004	2010	2020	2030
TFC	**1 323**	**1 307**	**1 570**	**1 601**	**1 767**	**1 959**	**2 155**
Coal[1]	74	54	32	34	29	17	30
Oil	701	698	837	866	947	1 053	1 148
Gas	367	303	342	335	374	410	436
Comb. Renewables & Waste[2]	37	23	44	47	61	73	78
Geothermal	–	0	1	1	–	–	–
Solar/Wind/Other	–	–	1	1	1	2	2
Electricity	143	226	308	313	339	394	455
Heat	–	2	5	3	14	10	6
Shares (%)							
Coal	*5.6*	*4.2*	*2.0*	*2.1*	*1.7*	*0.9*	*1.4*
Oil	*53.0*	*53.4*	*53.3*	*54.1*	*53.6*	*53.8*	*53.3*
Gas	*27.8*	*23.2*	*21.8*	*20.9*	*21.2*	*20.9*	*20.2*
Comb. Renewables & Waste	*2.8*	*1.7*	*2.8*	*2.9*	*3.5*	*3.7*	*3.6*
Geothermal	–	–	*0.1*	*0.1*	–	–	–
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Electricity	*10.8*	*17.3*	*19.6*	*19.6*	*19.2*	*20.1*	*21.1*
Heat	–	*0.2*	*0.3*	*0.2*	*0.8*	*0.5*	*0.3*
TOTAL INDUSTRY[6]	**483**	**401**	**444**	**464**	**487**	**497**	**547**
Coal[1]	60	45	29	31	27	15	28
Oil	161	149	166	183	175	179	192
Gas	177	124	135	135	153	164	177
Comb. Renewables & Waste[2]	29	9	28	31	33	37	41
Geothermal	–	–	0	0	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	56	75	80	81	88	95	104
Heat	–	–	4	2	12	8	5
Shares (%)							
Coal	*12.5*	*11.2*	*6.6*	*6.7*	*5.6*	*3.0*	*5.0*
Oil	*33.4*	*37.1*	*37.4*	*39.5*	*35.8*	*36.0*	*35.0*
Gas	*36.7*	*30.9*	*30.5*	*29.2*	*31.5*	*33.0*	*32.4*
Comb. Renewables & Waste	*5.9*	*2.3*	*6.4*	*6.6*	*6.7*	*7.4*	*7.5*
Geothermal	–	–	–	–	–	–	–
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*11.5*	*18.6*	*18.1*	*17.5*	*18.0*	*19.0*	*19.0*
Heat	–	–	*0.9*	*0.5*	*2.4*	*1.6*	*0.9*
TRANSPORT[7]	**420**	**502**	**630**	**639**	**751**	**867**	**952**
TOTAL OTHER SECTORS[8]	**420**	**404**	**497**	**497**	**528**	**595**	**655**
Coal[1]	14	10	2	3	2	2	2
Oil	137	63	62	65	58	57	55
Gas	173	164	193	186	203	223	236
Comb. Renewables & Waste[2]	9	14	10	9	12	12	11
Geothermal	–	0	1	1	–	–	–
Solar/Wind/Other	–	–	1	1	1	2	2
Electricity	87	152	227	231	249	297	348
Heat	–	2	1	1	3	2	1
Shares (%)							
Coal	*3.2*	*2.4*	*0.5*	*0.6*	*0.4*	*0.4*	*0.3*
Oil	*32.6*	*15.6*	*12.4*	*13.1*	*10.9*	*9.6*	*8.3*
Gas	*41.2*	*40.6*	*38.8*	*37.4*	*38.5*	*37.5*	*36.0*
Comb. Renewables & Waste	*2.1*	*3.4*	*2.0*	*1.9*	*2.3*	*2.0*	*1.8*
Geothermal	–	*0.1*	*0.2*	*0.2*	–	–	–
Solar/Wind/Other	–	–	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
Electricity	*20.8*	*37.5*	*45.7*	*46.5*	*47.1*	*49.9*	*53.1*
Heat	–	*0.5*	*0.2*	*0.1*	*0.6*	*0.3*	*0.2*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004	2010	2020	2030
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**430**	**745**	**924**	**944**	**1 093**	**1 252**	**1 427**
OUTPUT (Mtoe)	**169**	**275**	**349**	**357**	**402**	**468**	**543**
(TWh gross)	1 966	3 203	4 054	4 148	4 674	5 442	6 315
Output Shares (%)							
Coal	*46.2*	*53.1*	*51.4*	*50.4*	*50.8*	*49.2*	*57.3*
Oil	*17.1*	*4.1*	*3.4*	*3.4*	*2.7*	*2.3*	*2.2*
Gas	*18.6*	*11.9*	*16.5*	*17.6*	*17.7*	*21.7*	*16.8*
Comb. Renewables & Waste	*0.0*	*2.7*	*1.7*	*1.7*	*2.4*	*2.3*	*2.3*
Nuclear	*4.5*	*19.1*	*19.4*	*19.6*	*18.3*	*17.0*	*14.6*
Hydro	*13.5*	*8.5*	*6.9*	*6.5*	*6.5*	*5.6*	*4.9*
Geothermal	*0.1*	*0.5*	*0.4*	*0.4*	*0.4*	*0.7*	*0.9*
Solar/Wind/Other	*–*	*0.1*	*0.3*	*0.4*	*1.1*	*1.2*	*1.1*
TOTAL LOSSES	**429**	**629**	**705**	**719**	**878**	**1 021**	**1 160**
of which:							
Electricity and Heat Generation[10]	261	467	566	582	670	769	874
Other Transformation	7	13	-2	-3	42	50	74
Own Use and Losses[11]	160	149	140	140	166	201	211
Statistical Differences	**-15**	**-9**	**6**	**6**	**–**	**–**	**–**

INDICATORS	**1973**	**1990**	**2003**	**2004**	**2010**	**2020**	**2030**
GDP (billion 2000 USD)	4 304.80	7 055.00	10 269.30	10 703.90	12 979.94	17 456.20	23 000.99
Population (millions)	211.94	250.18	291.09	293.95	310.12	336.99	364.79
TPES/GDP[12]	0.40	0.27	0.22	0.22	0.20	0.17	0.14
Energy Production/TPES	0.84	0.86	0.72	0.71	0.72	0.70	0.67
Per Capita TPES[13]	8.19	7.70	7.84	7.91	8.53	8.84	9.09
Oil Supply/GDP[12]	0.19	0.11	0.09	0.09	0.08	0.07	0.06
TFC/GDP[12]	0.31	0.19	0.15	0.15	0.14	0.11	0.09
Per Capita TFC[13]	6.24	5.22	5.39	5.45	5.70	5.81	5.91
Energy-related CO_2 Emissions (Mt CO_2)[14]	4 703.9	4 841.7	5 713.3	5 800.0	6 520.0	7 315.3	8 284.8
CO_2 Emissions from Bunkers (Mt CO_2)	45.2	129.8	110.3	127.6	105.3	127.0	153.7

GROWTH RATES (% per year)	**73-79**	**79-90**	**90-03**	**03-04**	**04-10**	**10-20**	**20-30**
TPES	1.3	0.2	1.3	2.0	2.2	1.2	1.1
Coal	2.8	2.0	1.1	2.7	2.5	1.1	2.5
Oil	1.2	-1.2	1.4	2.8	1.7	1.1	0.9
Gas	-1.3	-0.7	1.3	-1.0	2.5	1.4	-0.0
Comb. Renewables & Waste	5.9	1.5	0.6	4.5	5.1	1.5	0.9
Nuclear	20.3	7.7	2.0	3.2	0.9	0.7	-0.0
Hydro	1.1	-0.3	0.2	-2.7	1.9	0.0	0.0
Geothermal	9.0	13.4	-3.8	3.0	10.4	6.9	4.5
Solar/Wind/Other	–	–	16.7	10.1	14.7	1.7	1.1
TFC	0.7	-0.5	1.4	2.0	1.7	1.0	1.0
Electricity Consumption	3.1	2.5	2.4	1.6	1.3	1.5	1.4
Energy Production	0.8	0.7	-0.1	0.5	2.5	0.9	0.6
Net Oil Imports	5.1	-1.3	4.0	7.2	0.8	1.5	1.9
GDP	3.0	2.9	2.9	4.2	3.3	3.0	2.8
Growth in the TPES/GDP Ratio	-1.6	-2.6	-1.6	-2.2	-1.1	-1.8	-1.7
Growth in the TFC/GDP Ratio	-2.2	-3.3	-1.5	-2.2	-1.6	-1.9	-1.8

Please note: Rounding may cause totals to differ from the sum of the elements.

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

1 Includes lignite and peat, except for Finland, Ireland and Sweden. In these three cases, peat is shown separately.

2 Comprises solid biomass, liquid biomass, biogas, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.

3 Other includes tide, wave and ambient heat used in heat pumps.

4 Total net imports include combustible renewables and waste.

5 Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.

6 Includes non-energy use.

7 Includes less than 1% non-oil fuels.

8 Includes residential, commercial, public service and agricultural sectors.

9 Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.

10 Losses arising in the production of electricity and heat at main activity producer utilities (formerly known as public) and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.

11 Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.

12 Toe per thousand US dollars at 2000 prices and exchange rates.

13 Toe per person.

14 "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2004 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX A

ENERGY POLICIES OF IEA COUNTRIES

Table A1

GDP Growth Rates for IEA Countries[1]

(annual average percentage change)

	1973-1979	2000	2001	2002	2003	2004	2005
Canada	3.6	5.3	1.8	3.1	2.0	2.9	2.9
United States	3.0	3.7	0.8	1.6	2.7	4.2	3.5
North America	**3.0**	**3.8**	**0.8**	**1.7**	**2.7**	**4.1**	**3.5**
Australia	2.6	1.9	3.8	3.3	4.0	2.3	2.6
Japan	3.5	2.4	0.2	-0.3	1.3	2.7	2.7
Korea	8.3	8.5	3.8	7.0	3.1	4.6	4.0
New Zealand	0.1	2.3	3.4	4.6	3.7	4.4	1.6
Pacific	**3.5**	**2.9**	**0.8**	**0.7**	**1.7**	**2.9**	**2.8**
Austria	3.0	3.4	0.8	1.0	1.4	2.4	1.9
Belgium	2.4	3.9	1.1	1.5	0.9	2.6	1.3
Czech Republic	2.5	3.9	2.7	1.4	3.3	4.7	5.9
Denmark	1.5	3.6	0.7	0.5	0.6	2.1	2.9
Finland	2.5	5.1	1.0	2.2	2.4	3.6	2.1
France	2.8	4.1	2.0	1.2	0.8	2.3	1.5
Germany	2.4	3.2	1.2	0.1	-0.2	1.6	0.9
Greece	3.3	4.5	4.6	3.9	4.6	4.7	3.7
Hungary	4.3	5.4	3.8	3.9	3.5	4.6	4.2
Ireland	4.9	9.2	6.1	6.2	4.4	4.4	4.7
Italy	3.5	3.0	1.8	0.4	0.3	1.2	-0.0
Luxembourg	1.2	8.9	1.5	2.5	2.9	4.3	4.1
Netherlands	2.6	3.5	1.4	0.1	-0.1	1.7	1.1
Norway	4.6	2.8	2.8	1.1	1.1	2.8	2.6
Portugal	2.9	3.4	1.7	0.4	-1.1	0.9	0.4
Spain	2.3	5.0	3.5	2.7	3.0	3.1	3.4
Sweden	1.8	4.3	1.1	2.0	1.7	3.7	2.7
Switzerland	-0.4	3.6	1.1	0.3	-0.3	2.1	1.9
Turkey	4.5	7.4	-7.5	8.0	5.8	8.9	7.4
United Kingdom	1.5	4.0	2.2	2.0	2.5	3.2	1.8
IEA Europe	**2.4**	**3.9**	**1.7**	**1.3**	**1.2**	**2.5**	**1.7**
IEA Total	**2.9**	**3.6**	**1.1**	**1.3**	**1.9**	**3.3**	**2.7**

1. Data are in 2000 dollars at 2000 prices.

Source: *National Accounts of OECD Countries, Volume 1*, OECD Paris. 2006.

Table A2

TPES/GDP Ratios for IEA Countries[1]

	1973	1979	2003	2004	2005[2]	Average Annual Growth Rates (%) 1993-1998	Average Annual Growth Rates (%) 1999-2004
Canada	0.49	0.48	0.34	0.34	0.33	-1.8	-1.2
United States	0.40	0.37	0.22	0.22	0.21	-2.2	-1.8
North America	**0.41**	**0.37**	**0.23**	**0.23**	**0.22**	**-2.2**	**-1.7**
Australia	0.33	0.34	0.25	0.25	0.26	-1.6	-1.7
Japan	0.15	0.13	0.11	0.11	0.11	0.7	-0.9
Korea	0.28	0.32	0.35	0.35	0.35	1.0	-1.7
New Zealand	0.25	0.28	0.29	0.29	0.28	-0.5	-3.6
Pacific	**0.16**	**0.15**	**0.14**	**0.15**	**0.14**	**1.0**	**-0.6**
Austria	0.22	0.20	0.17	0.16	0.17	-0.1	0.8
Belgium	0.36	0.33	0.25	0.23	0.23	0.4	-2.2
Czech Republic	1.13	1.04	0.74	0.73	0.68	-2.4	0.3
Denmark	0.20	0.20	0.13	0.12	0.11	-2.0	-1.3
Finland	0.35	0.34	0.30	0.29	0.26	-1.6	-0.1
France	0.26	0.24	0.20	0.19	0.19	-1.1	-0.6
Germany	0.32	0.30	0.18	0.18	0.18	-1.3	-0.8
Greece	0.18	0.19	0.23	0.23	0.22	0.4	-1.6
Hungary	0.70	0.72	0.50	0.48	0.48	-3.0	-3.3
Ireland	0.29	0.27	0.13	0.13	0.13	-3.8	-4.0
Italy	0.22	0.19	0.16	0.17	0.17	0.2	0.3
Luxembourg	0.69	0.55	0.20	0.22	0.21	-7.5	2.3
Netherlands	0.32	0.30	0.21	0.21	0.20	-2.3	0.9
Norway	0.22	0.21	0.15	0.15	0.16	-3.1	-1.5
Portugal	0.15	0.18	0.24	0.24	0.25	0.8	0.1
Spain	0.19	0.21	0.21	0.22	0.21	0.8	0.2
Sweden	0.28	0.28	0.20	0.20	0.19	-1.1	-1.5
Switzerland	0.11	0.12	0.11	0.11	0.10	-0.2	-0.8
Turkey	0.37	0.35	0.37	0.36	0.35	1.0	-1.4
United Kingdom	0.27	0.25	0.15	0.15	0.14	-2.4	-2.5
IEA Europe	**0.28**	**0.26**	**0.19**	**0.19**	**0.19**	**-1.0**	**-0.7**
IEA Total	**0.30**	**0.28**	**0.20**	**0.19**	**0.19**	**-1.1**	**-1.2**

1. Measured in toe per USD 1 000 of GDP at 2000 prices and exchange rates; changes in energy intensity reflect the combined effects of efficiency improvements, structural changes, fuel substitution and exchange rates.

2. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006 and *National Accounts of OECD Countries, Volume 1*, OECD Paris, 2006.

Table A3

TPES per Inhabitant for IEA Countries

(toe per capita)

	1973	1979	2003	2004	2005[1]	Average Annual Growth Rates (%) 1993-1998	1999-2004
Canada	7.11	7.88	8.29	8.42	8.30	0.6	0.7
United States	8.19	8.36	7.84	7.91	7.82	0.35	-0.3
North America	**8.09**	**8.31**	**7.88**	**7.96**	**7.87**	**0.38**	**-0.2**
Australia	4.23	4.70	5.65	5.73	5.89	1.59	0.1
Japan	2.98	3.06	4.04	4.18	4.17	1.8	0.1
Korea	0.63	1.07	4.31	4.43	4.59	4.4	3.0
New Zealand	2.78	2.88	4.28	4.32	4.21	1.16	-1.3
Pacific	**2.58**	**2.76**	**4.27**	**4.40**	**4.45**	**2.28**	**0.8**
Austria	2.85	3.17	4.07	4.06	4.23	2.2	2.2
Belgium	4.76	5.01	5.71	5.54	5.58	2.6	-0.6
Czech Republic	4.58	4.73	4.33	4.46	4.40	-0.3	3.6
Denmark	3.95	4.16	3.84	3.72	3.60	0.8	-0.2
Finland	4.57	5.12	7.23	7.29	6.65	2.5	2.4
France	3.46	3.54	4.39	4.43	4.42	0.8	0.9
Germany	4.28	4.73	4.21	4.22	4.20	0.3	0.3
Greece	1.36	1.65	2.71	2.76	2.80	2.6	2.4
Hungary	2.05	2.65	2.60	2.61	2.75	-0.0	1.0
Ireland	2.34	2.63	3.78	3.75	3.89	3.8	0.2
Italy	2.35	2.36	3.12	3.17	3.22	2.0	1.4
Luxembourg	12.83	10.69	9.47	10.51	10.67	-4.4	5.4
Netherlands	4.65	4.91	4.99	5.05	5.03	0.5	1.6
Norway	3.70	4.54	5.95	6.03	6.50	0.7	0.0
Portugal	0.83	1.02	2.47	2.52	2.59	4.0	0.5
Spain	1.50	1.79	3.24	3.33	3.37	3.8	2.3
Sweden	4.83	5.27	5.77	6.00	5.66	1.6	0.7
Switzerland	3.06	3.15	3.63	3.63	3.62	0.8	-0.3
Turkey	0.63	0.70	1.11	1.14	1.19	3.0	1.1
United Kingdom	3.93	3.91	3.90	3.91	3.84	0.6	-0.2
IEA Europe	**3.10**	**3.25**	**3.55**	**3.58**	**3.58**	**1.11**	**0.7**
IEA Total	**4.44**	**4.63**	**5.08**	**5.15**	**5.13**	**1.06**	**0.4**

1. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006 and *National Accounts of OECD Countries. Volume 1*, OECD Paris, 2006.

Table A4

TFC/GDP Ratios for IEA Countries[1]

	1973	1979	2002	2003	2004	Average Annual Growth Rates (%) 1993-1998	1999-2004
Canada	0.41	0.39	0.25	0.26	0.26	-1.8	-1.4
United States	0.31	0.27	0.15	0.15	0.15	-2.1	-1.4
North America	**0.31**	**0.28**	**0.16**	**0.16**	**0.16**	**-2.0**	**-1.4**
Australia	0.23	0.23	0.17	0.16	0.16	-1.7	-1.9
Japan	0.11	0.09	0.07	0.07	0.07	0.1	-0.9
Korea	0.23	0.24	0.24	0.24	0.23	-0.1	-1.7
New Zealand	0.19	0.21	0.24	0.23	0.23	0.2	-2.3
Pacific	**0.12**	**0.11**	**0.10**	**0.10**	**0.10**	**0.4**	**-0.6**
Austria	0.17	0.16	0.13	0.14	0.13	-0.2	1.1
Belgium	0.27	0.24	0.17	0.18	0.17	0.8	-2.0
Czech Republic	0.78	0.80	0.43	0.45	0.44	-3.2	-0.7
Denmark	0.17	0.16	0.09	0.09	0.09	-2.6	-1.2
Finland	0.32	0.28	0.21	0.21	0.21	-2.4	-1.0
France	0.21	0.18	0.12	0.12	0.12	-0.9	-1.6
Germany	0.23	0.22	0.12	0.13	0.13	-1.3	-0.4
Greece	0.13	0.14	0.17	0.17	0.16	1.2	-1.9
Hungary	0.56	0.57	0.36	0.36	0.35	-2.7	-1.9
Ireland	0.22	0.21	0.11	0.10	0.10	-3.8	-3.3
Italy	0.17	0.15	0.12	0.13	0.13	-0.5	0.5
Luxembourg	0.45	0.42	0.19	0.19	0.20	-4.8	1.4
Netherlands	0.25	0.24	0.15	0.16	0.16	-2.4	0.8
Norway	0.21	0.19	0.12	0.12	0.12	-2.3	-1.3
Portugal	0.13	0.14	0.19	0.19	0.20	1.3	1.0
Spain	0.14	0.16	0.15	0.16	0.16	1.4	0.9
Sweden	0.25	0.23	0.14	0.14	0.14	-1.8	-2.4
Switzerland	0.10	0.10	0.08	0.09	0.09	-0.3	-0.8
Turkey	0.30	0.30	0.29	0.29	0.27	-0.3	-0.6
United Kingdom	0.18	0.17	0.11	0.10	0.10	-2.4	-2.4
IEA Europe	**0.21**	**0.19**	**0.13**	**0.14**	**0.14**	**-1.1**	**-0.7**
IEA Total	**0.23**	**0.21**	**0.14**	**0.14**	**0.14**	**-1.2**	**-0.9**

1. Measured in toe per USD 1 000 of GDP at 2000 prices and exchange rates.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006 and *National Accounts of OECD Countries, Volume 1*, OECD Paris, 2006.

Table A5

Total Energy Demand in IEA Countries

(Mtoe and %)

	1973						1979					
	TPES	Shares of TPES					TPES	Shares of TPES				
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %
Canada	159.8	9.5	50.0	23.3	2.5	14.6	190.8	10.4	48.2	22.9	5.1	13.4
United States	1736.4	17.9	47.5	29.6	1.3	3.7	1881.2	19.5	47.0	25.4	3.7	4.4
North America	**1896.3**	**17.2**	**47.7**	**29.1**	**1.4**	**4.6**	**2072.0**	**18.7**	**47.1**	**25.1**	**3.9**	**5.2**
Australia	57.6	39.2	47.1	5.9	-	7.8	68.7	36.0	46.8	10.1	-	7.1
Japan	323.6	17.9	77.9	1.6	0.8	1.8	354.6	14.4	73.0	5.2	5.2	2.2
Korea	21.6	37.6	61.9	-	-	0.5	40.0	30.2	67.2	-	2.1	0.5
New Zealand	8.3	15.3	53.5	3.4	-	27.8	9.0	10.6	46.5	9.5	-	33.4
Pacific	**411.1**	**21.9**	**72.3**	**2.1**	**0.6**	**3.1**	**472.4**	**18.8**	**68.2**	**5.6**	**4.1**	**3.3**
Austria	21.7	17.9	56.7	15.3	-	10.1	23.9	15.2	53.9	18.1	-	12.9
Belgium	46.3	24.1	60.5	15.4	0.0	-0.1	49.3	23.1	52.0	18.9	6.0	-0.0
Czech Republic	45.4	78.4	19.6	2.2	-	-0.2	48.7	71.9	23.5	4.6	-	0.0
Denmark	19.8	9.7	88.6	-	-	1.7	21.3	20.3	75.9	-	-	3.7
Finland	21.3	12.0	63.6	-	-	24.4	24.4	17.4	54.0	3.3	7.2	18.0
France	184.7	15.8	67.3	7.3	2.1	7.4	193.9	16.7	59.0	10.7	5.4	8.1
Germany	337.9	41.2	47.9	8.5	0.9	1.4	369.6	37.4	43.6	13.9	3.7	1.4
Greece	12.4	17.0	77.7	-	-	5.2	16.0	21.6	73.6	-	-	4.8
Hungary	21.3	37.1	38.5	19.6	-	4.9	28.4	30.0	40.2	26.0	-	3.8
Ireland	7.2	22.0	77.1	-	-	0.8	8.9	22.5	71.5	5.2	-	0.8
Italy	128.9	6.3	77.6	11.0	0.6	4.4	132.8	7.9	69.0	17.1	0.5	5.6
Luxembourg	4.5	54.1	37.1	4.9	-	4.0	3.9	47.4	33.8	12.1	-	6.6
Netherlands	62.4	4.6	49.5	45.6	0.5	-0.2	68.9	4.8	45.9	47.6	1.3	0.4
Norway	14.6	6.2	54.0	-	-	39.8	18.5	5.4	48.7	3.8	-	42.1
Portugal	7.2	7.0	75.4	-	-	17.5	10.0	4.4	78.3	-	-	17.3
Spain	52.4	17.2	73.3	1.8	3.3	4.4	66.8	16.1	73.3	2.1	2.6	5.9
Sweden	39.3	4.1	72.2	-	1.4	22.3	43.7	4.1	62.1	-	12.5	21.3
Switzerland	19.7	1.7	77.4	0.8	8.3	11.9	20.0	1.1	66.9	3.8	15.4	12.8
Turkey	24.4	21.1	51.3	-	-	27.6	30.3	21.6	49.5	-	-	28.9
United Kingdom	220.7	34.6	50.5	11.4	3.3	0.2	220.0	33.7	43.2	18.4	4.5	0.2
IEA Europe	**1292.2**	**26.5**	**57.4**	**9.8**	**1.5**	**4.7**	**1399.2**	**25.3**	**51.8**	**14.0**	**3.6**	**5.3**
IEA Total	**3599.7**	**21.1**	**54.0**	**19.1**	**1.4**	**4.5**	**3943.6**	**21.0**	**51.3**	**18.8**	**3.8**	**5.0**

1. Includes hydro, geothermal, combustible renewables, waste, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A5 *(continued)*

Total Energy Demand in IEA Countries

(Mtoe and %)

	2004						2005[1]						2004-2005
	TPES	Shares of TPES					TPES	Shares of TPES					Change in TPES
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[2] %	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[2] %	%
Canada	269.0	10.7	36.5	29.0	8.8	15.1	266.8	10.6	36.2	28.8	9.0	15.5	-0.8
United States	2325.9	23.4	40.7	22.1	9.1	4.6	2319.2	23.8	40.6	21.9	9.1	4.5	-0.3
North America	**2594.9**	**22.1**	**40.3**	**22.8**	**9.1**	**5.7**	**2586.0**	**22.5**	**40.2**	**22.6**	**9.1**	**5.7**	**-0.3**
Australia	115.8	42.7	32.0	19.6	-	5.6	120.2	43.6	32.2	18.9	-	5.3	3.8
Japan	533.2	21.8	47.8	13.2	13.8	3.4	532.2	21.4	48.0	13.3	14.3	3.0	-0.2
Korea	213.0	23.5	47.6	11.9	16.0	1.0	221.5	23.7	45.5	12.5	17.3	1.0	4.0
New Zealand	17.6	10.7	39.9	19.6	-	29.9	17.5	11.9	40.2	18.7	-	29.1	-1.0
Pacific	**879.7**	**24.7**	**45.5**	**13.8**	**12.2**	**3.7**	**891.4**	**24.8**	**45.1**	**13.9**	**12.9**	**3.3**	**1.3**
Austria	33.2	11.9	43.0	23.0	-	22.1	34.6	11.5	42.2	23.6	-	22.7	4.4
Belgium	57.7	10.0	39.9	25.2	21.4	3.4	58.2	8.9	39.2	26.2	21.3	4.4	0.9
Czech Republic	45.5	46.0	21.1	17.1	15.1	0.7	44.9	45.2	22.2	17.1	14.4	1.2	-1.4
Denmark	20.1	21.7	41.8	23.1	-	13.4	19.5	19.2	41.9	22.6	-	16.3	-3.0
Finland	38.1	19.8	29.4	10.4	15.5	24.9	34.8	13.9	30.7	10.3	17.4	27.7	-8.6
France	275.2	5.1	33.5	14.6	42.5	4.4	274.8	5.2	32.9	14.9	42.8	4.2	-0.1
Germany	348.0	24.7	36.0	22.6	12.5	4.2	346.8	23.7	35.5	23.3	12.2	5.2	-0.4
Greece	30.5	29.9	56.8	7.3	-	6.0	31.0	29.4	56.8	7.6	-	6.2	1.7
Hungary	26.4	13.3	24.3	44.4	11.8	6.1	27.7	11.2	25.4	43.6	13.1	6.7	5.2
Ireland	15.2	15.0	58.0	24.0	-	3.0	15.9	16.4	58.3	21.9	..	3.4	4.3
Italy	184.5	9.0	45.3	35.8	-	10.0	187.5	8.7	43.7	37.6	-	10.0	1.7
Luxembourg	4.8	2.0	65.1	25.2	-	7.6	4.8	1.7	66.8	24.3	-	7.3	1.9
Netherlands	82.1	10.6	38.9	44.7	1.2	4.6	82.3	10.1	40.2	43.1	1.3	5.4	0.1
Norway	27.7	3.3	38.2	16.1	-	42.4	30.0	2.5	38.0	19.4	-	40.1	8.3
Portugal	26.5	12.7	58.1	12.4	-	16.8	27.3	12.3	58.7	13.7	-	15.3	2.8
Spain	142.2	14.8	49.8	17.7	11.7	6.1	145.6	14.3	48.9	20.5	10.3	6.0	2.4
Sweden	53.9	5.5	28.7	1.6	37.4	26.7	51.1	5.1	29.1	1.6	36.8	27.2	-5.3
Switzerland	27.1	0.5	46.2	10.0	26.0	17.3	27.1	0.6	47.1	10.3	22.5	19.5	-0.0
Turkey	81.9	27.3	36.7	22.8	-	13.1	86.4	28.4	33.5	26.4	-	11.7	5.5
United Kingdom	233.7	16.0	35.8	37.4	8.9	1.9	230.8	16.7	35.2	36.8	9.2	2.1	-1.3
IEA Europe	**1754.2**	**15.4**	**38.4**	**24.0**	**14.5**	**7.6**	**1761.1**	**15.0**	**38.0**	**24.8**	**14.2**	**8.0**	**0.4**
IEA Total	**5228.8**	**20.3**	**40.5**	**21.7**	**11.4**	**6.0**	**5238.5**	**20.4**	**40.3**	**21.9**	**11.5**	**6.0**	**0.2**

1. Preliminary data. 2. Includes hydro, geothermal, combustible renewables, waste, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A5 *(continued)*

Total Energy Demand in IEA Countries

(Mtoe and %)

	2010						2020						2010-2020
	TPES	Shares of TPES					TPES	Shares of TPES					Change in TPES
	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %	Mtoe	Coal %	Oil %	Natural Gas %	Nuclear %	Other[1] %	%
Canada	307.5	8.3	31.7	36.4	7.8	15.8	350.5	5.1	30.8	42.6	6.5	15.0	14.0
United States	2644.5	23.9	39.6	22.6	8.4	5.5	2979.2	23.8	39.1	23.1	8.1	5.9	12.7
North America	**2952.0**	**22.3**	**38.8**	**24.0**	**8.4**	**6.6**	**3329.7**	**21.8**	**38.2**	**25.2**	**7.9**	**6.9**	**12.8**
Australia	144.1	39.7	32.4	22.7	-	5.2	174.8	37.9	32.9	23.9	-	5.3	21.3
Japan	535.9	17.4	43.5	13.9	18.8	6.3	..	..	..	..	..	..	..
Korea	260.5	25.0	42.4	12.9	17.0	2.8	329.8	22.3	38.1	15.3	20.2	4.0	26.6
New Zealand	22.0	7.8	37.5	15.4	-	39.3	25.9	10.8	37.2	10.9	-	41.1	17.8
Pacific	**962.5**	**22.6**	**41.4**	**15.0**	**15.1**	**6.0**	..	..	..	..	..	..	..
Austria	34.3	11.8	40.3	23.0	-	24.9	36.1	13.5	38.6	22.5	-	25.4	5.3
Belgium	61.5	6.8	37.7	32.6	19.6	3.4	63.1	5.0	38.0	38.6	14.6	3.8	2.6
Czech Republic	42.1	33.5	21.4	26.4	15.9	2.8	44.0	28.0	21.4	30.2	15.2	5.2	4.6
Denmark	21.3	18.4	40.9	26.5	-	14.2	21.4	12.7	42.7	27.0	-	17.6	0.4
Finland	37.7	16.3	24.5	12.8	21.5	24.9	39.9	18.0	22.4	13.0	22.6	24.0	5.9
France	298.8	3.4	34.8	15.8	40.3	5.7	319.9	3.6	33.4	18.4	36.8	7.7	7.0
Germany	337.4	22.3	37.9	24.5	10.0	5.2	308.6	22.7	38.4	27.9	2.7	8.3	-8.5
Greece	35.6	29.8	51.9	11.7	-	6.5	41.7	31.3	51.2	11.0	-	6.6	17.0
Hungary	27.1	8.6	26.7	46.0	14.0	4.7	30.6	6.9	24.3	50.9	12.4	5.4	12.7
Ireland	18.5	16.8	51.1	28.8	-	3.3	21.8	6.9	53.5	36.0	-	3.6	17.5
Italy	196.8	8.3	39.5	41.5	-	10.6	223.7	7.6	37.0	43.7	-	11.6	13.7
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	81.7	11.4	37.1	44.8	1.2	5.6	91.9	12.4	39.6	40.1	1.1	6.9	12.5
Norway	..	..	..	..	..	..	..	..	..	..	..	..	..
Portugal	30.0	10.2	53.9	17.1	-	18.8	..	..	..	..	..	..	..
Spain	158.2	8.8	46.7	23.3	9.3	11.9	..	..	..	..	..	..	..
Sweden	49.1	6.3	23.6	1.8	35.3	32.9	47.0	6.5	24.7	5.2	24.7	38.9	-4.3
Switzerland	27.1	0.4	48.2	10.5	23.2	17.7	26.7	0.4	48.5	11.2	20.7	19.3	-1.4
Turkey	125.6	27.9	32.8	29.6	-	9.7	222.1	36.2	27.4	23.2	3.7	9.5	76.9
United Kingdom	238.6	15.8	36.4	35.5	7.6	4.7	246.4	12.1	38.9	39.4	3.1	6.4	3.2
IEA Europe	..	..	..	..	..	..	..	..	..	..	..	..	..
IEA Total	..	..	..	..	..	..	..	..	..	..	..	..	..

1. Includes hydro, geothermal, combustible renewables, waste, solar, wind, tide, wave, ambient heat used in heat pumps, and electricity and heat trade.

Note: The IEA Secretariat has estimated data for certain countries. Please see Energy Balances and Key Statistical Data for details.

Source: Country submissions.

Table A6

Development of IEA Energy Self-sufficiency by Product

(Mtoe and %)

	1973			1979			2003			2004			2005[1]		
	TPES	Production	%	TPES	Production	%	TPES	Production	%	TPES	Production	%	TPES	Production	%
North America															
Coal	326.3	345.1	105.7	386.8	443.6	114.7	561.5	556.4	99.1	574.1	578.8	100.8	581.2	588.9	101.3
Oil	903.9	630.2	69.7	975.6	581.7	59.6	1 014.3	495.0	48.8	1 045.7	488.7	46.7	1 038.6	466.4	44.9
Natural Gas	551.8	564.0	102.2	520.6	521.8	100.2	599.7	599.2	99.9	592.8	589.0	99.4	584.4	578.4	99.0
Total	**1 896.3**	**1 653.5**	**87.2**	**2 072.0**	**1 736.1**	**83.8**	**2 543.5**	**2 018.5**	**79.4**	**2 594.9**	**2 038.5**	**78.6**	**2 586.0**	**2 015.6**	**77.9**
Pacific															
Coal	89.8	66.1	73.6	89.0	70.3	79.0	203.2	189.7	93.4	217.5	197.1	90.6	221.0	206.7	93.6
Oil	297.2	20.8	7.0	322.0	23.8	7.4	402.1	34.7	8.6	400.5	34.5	8.6	402.1	31.3	7.8
Natural Gas	8.7	6.0	68.1	26.4	9.9	37.6	119.2	37.8	31.7	121.8	38.1	31.3	124.3	41.5	33.4
Total	**411.1**	**108.3**	**26.3**	**472.4**	**139.0**	**29.4**	**852.6**	**390.2**	**45.8**	**879.7**	**409.5**	**46.6**	**891.4**	**423.7**	**47.5**
IEA Europe															
Coal	342.7	303.2	88.5	353.6	296.7	83.9	269.7	134.6	49.9	271.0	130.6	48.2	264.9	126.7	47.8
Oil	742.0	22.8	3.1	725.3	117.9	16.3	672.4	307.1	45.7	673.4	295.4	43.9	668.5	269.3	40.3
Natural Gas	127.0	119.9	94.4	195.9	167.2	85.3	411.6	252.2	61.3	421.5	259.1	61.5	436.6	251.6	57.6
Total	**1 292.2**	**525.9**	**40.7**	**1 399.2**	**705.3**	**50.4**	**1 729.4**	**1 066.2**	**61.6**	**1 754.2**	**1 069.8**	**61.0**	**1 761.1**	**1 034.6**	**58.7**
IEA Total															
Coal	758.9	714.4	94.1	829.4	810.7	97.7	1 034.4	880.8	85.1	1 062.6	906.5	85.3	1 067.1	922.2	86.4
Oil	1 943.1	673.7	34.7	2 023.0	723.3	35.8	2 088.8	836.8	40.1	2 119.7	818.7	38.6	2 109.1	767.1	36.4
Natural Gas	687.5	689.8	100.3	743.0	698.9	94.1	1 130.5	889.2	78.7	1 136.2	886.3	78.0	1 145.3	871.6	76.1
Total	**3 599.7**	**2 287.6**	**63.6**	**3 943.6**	**2 580.4**	**65.4**	**5 125.5**	**3 474.9**	**67.8**	**5 228.8**	**3 517.9**	**67.3**	**5 238.5**	**3 473.8**	**66.3**

1. Preliminary data.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A7

Indigenous Production/Primary Energy Supply in IEA Countries, 2004

	Total Energy[1]	Coal[1]	Oil[1]	Gas[1]	Electricity[2]
Canada	1.477	1.124	1.523	1.931	1.019
United States	0.706	1.002	0.358	0.852	0.997
North America	**0.786**	**1.008**	**0.467**	**0.994**	**1.000**
Australia	2.261	3.894	0.827	1.407	1.000
Japan	0.181	–	0.009	0.038	0.999
Korea	0.179	0.027	0.004	–	1.000
New Zealand	0.736	1.644	0.164	1.000	0.984
Pacific	**0.466**	**0.906**	**0.086**	**0.313**	**0.999**
Austria	0.298	0.014	0.076	0.219	0.952
Belgium	0.235	0.016	–	–	0.916
Czech Republic	0.752	1.186	0.060	0.021	1.231
Denmark	1.545	–	2.356	1.833	1.076
Finland	0.417	0.104	0.006	–	0.946
France	0.499	0.039	0.017	0.028	1.123
Germany	0.391	0.680	0.035	0.187	1.004
Greece	0.338	0.938	0.007	0.013	0.954
Hungary	0.388	0.623	0.248	0.202	0.819
Ireland	0.125	0.390	–	0.189	0.947
Italy	0.163	0.004	0.067	0.161	0.865
Luxembourg	0.015	–	–	–	0.501
Netherlands	0.827	–	0.093	1.676	0.861
Norway	8.627	2.116	14.709	15.831	0.906
Portugal	0.147	–	–	–	0.874
Spain	0.229	0.307	0.004	0.012	1.011
Sweden	0.651	0.129	–	–	1.014
Switzerland	0.436	–	–	–	1.011
Turkey	0.294	0.471	0.074	0.030	1.005
United Kingdom	0.964	0.398	1.190	0.989	0.981
IEA Europe	**0.610**	**0.482**	**0.439**	**0.615**	**0.991**
IEA Total	**0.673**	**0.853**	**0.386**	**0.780**	**0.997**

1. Calculated as production divided by primary energy supply.
2. Calculated as the ratio between domestic generation and total apparent consumption, or TFC plus own-use in the energy sector and distribution losses. Includes CHP units.

Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2006.

Table A8

Recent Energy and Oil Supply Trends for IEA Countries

(Mtoe and %)

	TPES					Oil Supply					Net Oil Imports[1]				
	2003	2004	% Chg.	2005[2]	% Chg.	2003	2004	% Chg.	2005[2]	% Chg.	2003	2004	% Chg.	2005[2]	% Chg.
Canada	262.6	269.0	2.5	266.8	-0.8	92.8	98.2	5.8	96.5	-1.7	-49.8	-52.5	5.3	-48.3	-7.9
United States	2280.9	2325.9	2.0	2319.2	-0.3	921.4	947.5	2.8	942.1	-0.6	575.5	616.7	7.2	626.7	1.6
North America	**2543.5**	**2594.9**	**2.0**	**2586.0**	**-0.3**	**1014.3**	**1045.7**	**3.1**	**1038.6**	**-0.7**	**525.7**	**564.2**	**7.3**	**578.4**	**2.5**
Australia	112.9	115.8	2.5	120.2	3.8	35.9	37.0	3.1	38.7	4.4	5.1	6.4	24.5	11.3	77.7
Japan	516.1	533.2	3.3	532.2	-0.2	258.3	255.0	-1.3	255.5	0.2	255.5	251.6	-1.5	255.1	1.4
Korea	206.3	213.0	3.3	221.5	4.0	101.2	101.4	0.2	100.8	-0.6	102.4	100.9	-1.5	98.0	-2.8
New Zealand	17.3	17.6	2.1	17.5	-1.0	6.7	7.0	4.3	7.0	-0.1	5.5	6.0	9.1	5.9	-1.6
Pacific	**852.6**	**879.7**	**3.2**	**891.4**	**1.3**	**402.1**	**400.5**	**-0.4**	**402.1**	**0.4**	**368.5**	**364.9**	**-1.0**	**370.3**	**1.5**
Austria	33.0	33.2	0.5	34.6	4.4	14.2	14.3	0.2	14.6	2.5	13.3	13.5	1.7	13.4	-1.0
Belgium	59.2	57.7	-2.5	58.2	0.9	24.8	23.0	-7.0	22.8	-0.9	25.0	23.0	-8.2	23.1	0.4
Czech Republic	44.2	45.5	3.0	44.9	-1.4	8.8	9.6	9.6	10.0	3.6	8.4	9.0	7.1	9.7	7.9
Denmark	20.7	20.1	-3.0	19.5	-3.0	8.4	8.4	0.2	8.2	-2.9	-10.3	-11.5	11.8	-10.3	-10.4
Finland	37.7	38.1	1.1	34.8	-8.6	10.7	11.2	4.3	10.7	-4.7	11.0	10.9	-0.8	10.7	-1.7
France	271.1	275.2	1.5	274.8	-0.1	91.1	92.1	1.1	90.3	-2.0	91.0	90.7	-0.3	90.2	-0.6
Germany	347.1	348.0	0.3	346.8	-0.4	126.5	125.2	-1.0	123.2	-1.6	123.7	119.8	-3.2	120.9	1.0
Greece	29.9	30.5	2.0	31.0	1.7	17.2	17.3	0.6	17.6	1.8	16.5	18.3	11.0	17.2	-6.2
Hungary	26.3	26.4	0.1	27.7	5.2	6.3	6.4	1.6	7.0	9.8	4.8	5.0	3.1	5.8	16.6
Ireland	15.1	15.2	0.9	15.9	4.3	8.5	8.8	3.9	9.2	4.8	8.5	8.8	3.4	9.2	4.0
Italy	181.3	184.5	1.8	187.5	1.7	87.4	83.5	-4.5	82.0	-1.8	80.7	77.9	-3.5	75.2	-3.5
Luxembourg	4.3	4.8	11.5	4.8	1.9	2.7	3.1	12.9	3.2	4.5	2.7	3.1	12.2	3.2	4.2
Netherlands	80.9	82.1	1.5	82.3	0.1	31.5	32.0	1.4	33.1	3.4	27.7	29.8	7.6	31.6	5.9
Norway	27.1	27.7	1.9	30.0	8.3	9.9	10.6	6.8	11.4	7.6	-146.1	-145.4	-0.5	-130.3	-10.4
Portugal	25.8	26.5	3.0	27.3	2.8	15.3	15.4	0.9	16.0	3.9	15.8	15.1	-4.6	16.3	8.4
Spain	136.1	142.2	4.5	145.6	2.4	69.0	70.8	2.5	71.3	0.7	68.7	70.3	2.2	72.3	2.8
Sweden	51.7	53.9	4.3	51.1	-5.3	15.7	15.5	-1.6	14.9	-3.9	16.6	15.1	-9.1	15.5	2.7
Switzerland	26.9	27.1	1.0	27.1	-0.0	12.6	12.5	-0.4	12.8	2.1	12.5	12.6	0.5	13.0	3.5
Turkey	78.8	81.9	3.9	86.4	5.5	29.8	30.1	1.1	29.0	-3.8	27.7	27.9	0.9	26.1	-6.5
United Kingdom	232.3	233.7	0.6	230.8	-1.3	81.8	83.7	2.2	81.3	-2.9	-29.5	-15.3	-48.0	-8.3	-46.2
IEA Europe	**1729.4**	**1754.2**	**1.4**	**1761.1**	**0.4**	**672.4**	**673.4**	**0.2**	**668.5**	**-0.7**	**368.9**	**378.5**	**2.6**	**404.5**	**6.9**
IEA Total	**5125.5**	**5228.8**	**2.0**	**5238.5**	**0.2**	**2088.8**	**2119.7**	**1.5**	**2109.1**	**-0.5**	**1263.0**	**1307.6**	**3.5**	**1353.2**	**3.5**

1. Includes requirements for marine bunkers. 2. Preliminary data.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A9

Share of Oil Use by Sector in IEA Countries

(%)

	TFC				Industry[1]				Residential/Commercial[2]				Transport			
	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
Canada	57.9	53.3	44.3	45.3	40.4	37.3	31.7	33.0	47.4	35.4	20.2	20.3	98.8	95.2	91.9	92.6
United States	53.0	54.6	53.3	54.1	33.4	41.4	37.4	39.5	32.6	25.0	12.4	13.1	95.9	96.9	96.8	96.7
North America	**53.4**	**54.5**	**52.3**	**53.1**	**34.1**	**40.9**	**36.6**	**38.6**	**34.0**	**26.1**	**13.4**	**13.9**	**96.1**	**96.7**	**96.4**	**96.4**
Australia	61.7	59.7	51.6	50.7	43.8	40.6	23.2	21.8	39.7	26.7	15.8	16.2	99.4	99.6	98.1	98.0
Japan	73.2	70.3	61.2	60.3	67.7	62.2	49.5	48.8	68.5	63.6	45.2	43.8	96.9	97.6	98.3	98.3
Korea	56.4	62.0	61.9	60.4	84.4	77.7	57.5	57.0	13.7	25.1	37.5	33.2	99.1	99.4	99.0	98.7
New Zealand	60.6	55.2	49.1	49.7	43.9	35.2	11.4	13.2	32.8	22.8	17.4	16.1	99.9	99.9	99.3	99.3
Pacific	**70.4**	**67.8**	**59.9**	**58.9**	**65.6**	**60.5**	**48.1**	**47.4**	**58.1**	**53.2**	**40.0**	**38.2**	**97.6**	**98.2**	**98.5**	**98.3**
Austria	60.4	54.9	47.9	47.1	51.7	40.1	32.4	31.5	48.6	44.7	27.3	24.8	92.9	94.8	93.3	93.2
Belgium	60.7	56.4	52.9	50.7	46.8	38.3	35.3	31.6	64.2	57.4	41.4	37.5	98.4	98.6	98.8	98.8
Czech Republic	25.5	25.9	31.5	34.0	28.2	26.9	23.1	27.9	5.8	9.4	2.0	0.9	88.5	89.1	95.1	95.9
Denmark	87.7	80.2	48.3	48.9	83.4	70.5	33.6	34.2	84.9	76.2	19.3	18.3	99.7	99.7	99.4	99.4
Finland	59.2	54.8	33.8	33.6	66.2	54.3	17.7	17.3	42.3	41.1	22.8	22.2	99.3	99.5	98.2	98.3
France	68.3	64.0	51.1	51.4	62.3	58.6	38.4	38.0	60.8	50.7	26.5	26.8	97.7	98.1	97.3	97.2
Germany	56.0	53.2	47.9	45.9	44.3	39.4	35.3	34.8	53.6	47.8	27.6	24.1	93.5	97.1	96.7	96.3
Greece	77.6	77.4	70.6	69.7	68.7	69.4	52.1	50.1	68.6	61.6	54.5	52.0	99.2	99.7	99.6	99.6
Hungary	39.1	42.2	30.1	31.9	29.6	32.7	29.2	33.3	35.7	36.5	5.5	5.5	81.2	90.6	97.5	97.5
Ireland	71.2	64.5	66.6	66.6	86.6	73.8	49.6	50.3	37.7	30.7	43.5	42.5	100.0	100.0	100.0	99.7
Italy	73.0	65.1	48.7	47.1	62.3	52.1	31.3	31.5	73.5	58.5	20.9	18.2	97.1	97.3	97.3	96.9
Luxembourg	52.1	43.8	68.0	69.0	38.6	19.9	7.0	7.2	78.4	67.8	40.6	40.9	99.0	99.2	99.6	99.6
Netherlands	50.5	42.6	43.0	43.0	48.8	46.7	44.6	43.7	34.2	16.8	3.9	3.9	99.0	99.0	99.1	99.1
Norway	55.9	52.6	44.3	42.0	43.2	43.3	34.3	30.2	50.6	37.3	21.2	18.8	98.3	98.3	96.9	96.8
Portugal	75.1	73.7	62.7	62.7	66.9	66.9	50.5	50.4	59.7	52.9	32.2	32.2	98.0	99.0	99.4	99.3
Spain	75.6	78.6	60.0	59.4	64.7	70.0	39.1	36.7	68.2	64.4	34.0	34.5	98.8	99.1	98.4	98.3
Sweden	70.4	62.8	39.8	38.8	53.4	48.1	27.8	27.6	78.7	62.6	17.1	13.6	96.8	96.9	96.8	94.9
Switzerland	81.4	75.3	59.6	58.4	77.4	64.0	32.9	32.8	76.3	70.7	46.3	44.5	95.9	95.8	96.3	96.3
Turkey	48.5	49.4	44.0	43.1	60.5	56.7	35.0	33.8	28.0	23.8	23.0	23.0	88.1	96.3	99.1	98.7
United Kingdom	52.3	48.5	46.6	47.2	51.8	45.6	40.0	42.2	24.7	21.6	7.3	6.9	99.1	99.1	98.6	98.7
IEA Europe	**60.3**	**56.4**	**48.9**	**48.2**	**52.5**	**47.6**	**35.8**	**35.4**	**51.5**	**43.7**	**22.9**	**21.4**	**96.5**	**97.8**	**97.7**	**97.5**
IEA Total	**57.7**	**56.7**	**52.3**	**52.4**	**45.7**	**46.2**	**38.7**	**39.3**	**43.0**	**35.9**	**20.9**	**20.3**	**96.3**	**97.2**	**97.1**	**97.0**

1. Includes non-energy use.

2. Includes commercial/public services and agricultural use.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A10

Historical and Projected Oil Production in IEA Countries

(Mtoe)

	1973	1979	2004	2005[1]	2010	2020	2030
Canada	96.3	86.6	149.6	147.3	263.2	220.4	..
United States	533.8	495.1	339.1	319.2	399.9	413.4	369.1
North America	**630.2**	**581.7**	**488.7**	**466.4**	**663.1**	**633.9**	**..**
Australia	19.8	22.7	30.6	27.5	30.6	29.0	29.2
Japan	0.8	0.6	2.3	2.3	-	..	–
Korea	–	–	0.4	0.5	–	–	–
New Zealand	0.2	0.4	1.2	1.0	1.2	1.0	1.2
Pacific	**20.8**	**23.8**	**34.5**	**31.3**	**31.8**	**..**	**30.5**
Austria	2.7	1.8	1.1	0.9	0.9	0.6	..
Belgium	–	–	–	–	–	–	–
Czech Republic	0.0	0.3	0.6	0.6	0.4	0.4	0.4
Denmark	0.1	0.4	19.8	19.0	20.0	13.3	12.4
Finland	–	–	0.1	0.1	–	–	..
France	2.1	2.0	1.5	1.3	–	–	–
Germany	6.8	4.9	4.4	4.3	3.0	1.8	0.6
Greece	–	–	0.1	0.1	–	–	–
Hungary	2.0	2.4	1.6	1.4	1.0	0.8	0.7
Ireland	–	–	–	–	–	–	..
Italy	1.1	1.6	5.6	6.3	5.7	5.0	5.0
Luxembourg	–	–	–	–	..	..	..
Netherlands	1.6	1.6	3.0	2.3	1.7	1.3	0.3
Norway	1.5	18.6	155.6	142.3	..	..	..
Portugal	–	–	–	–	–	..	..
Spain	0.7	1.4	0.3	0.2	..	..	..
Sweden	–	0.0	–	–	–	–	..
Switzerland	–	–	–	–	–	–	–
Turkey	3.6	2.9	2.2	2.2	1.6	0.7	..
United Kingdom	0.5	79.9	99.6	88.3	..	..	..
IEA Europe	**22.8**	**117.9**	**295.4**	**269.3**	**..**	**..**	**..**
IEA Total	**673.7**	**723.3**	**818.7**	**767.1**	**..**	**..**	**..**

1. Preliminary data.

Sources: *Energy Balances of OECD Countries,* Paris IEA/OECD, 2006, for 1973, 1979 and 2004; and country submissions for 2010, 2020 and 2030.

Table A11

Historical and Projected Net Oil Imports of IEA Countries[1]

(Mtoe)

	1979	2003	2004	2005[2]	2010	2020	2030
Canada	6.3	-49.8	-52.5	-48.3	-165.6	-112.4	..
United States	399.2	575.5	616.7	626.7	646.7	751.8	905.3
North America	**405.5**	**525.7**	**564.2**	**578.4**	**481.1**	**639.3**	**..**
Australia	9.5	5.1	6.4	11.3	10.2	22.8	35.4
Japan	264.4	255.5	251.6	255.1	233.2 e	..	236.7 e
Korea	26.9	102.4	100.9	98.0	110.5 e	125.8 e	144.8 e
New Zealand	3.7	5.5	6.0	5.9	7.0	8.6	9.8
Pacific	**304.4**	**368.5**	**364.9**	**370.3**	**360.9**	**..**	**426.7**
Austria	11.4	13.3	13.5	13.4	13.0	13.4	..
Belgium	27.0	25.0	23.0	23.1	23.2	24.0	24.1
Czech Republic	11.2	8.4	9.0	9.7	8.6	9.0	9.3
Denmark	15.3	-10.3	-11.5	-10.3	-11.3	-4.2	-3.0
Finland	14.7	11.0	10.9	10.7	9.2	8.9	..
France	115.9	91.0	90.7	90.2	104.0	106.7	107.5
Germany	159.3	123.7	119.8	120.9	124.9	116.7	109.5
Greece	12.4	16.5	18.3	17.2	18.5	21.3	22.6
Hungary	9.8	4.8	5.0	5.8	6.2	6.6	7.3
Ireland	6.4	8.5	8.8	9.2	9.5	11.6	..
Italy	89.4	80.7	77.9	75.2	72.1	77.8	81.2
Luxembourg	1.4	2.7	3.1	3.2	..	..	..
Netherlands	31.7	27.7	29.8	31.6	28.6	35.1	40.3
Norway	-9.6	-146.1	-145.4	-130.3	..	..	..
Portugal	8.6	15.8	15.1	16.3	16.2	..	..
Spain	47.8	68.7	70.3	72.3	..	..	..
Sweden	28.3	16.6	15.1	15.5	10.5	10.5	..
Switzerland	13.8	12.5	12.6	13.0	13.0	12.9	12.6
Turkey	11.7	27.7	27.9	26.1	39.6	60.2	..
United Kingdom	16.6	-29.5	-15.3	-8.3	..	..	..
IEA Europe	**623.2**	**368.9**	**378.5**	**404.5**	**..**	**..**	**..**
IEA Total	**1 333.1**	**1 263.0**	**1 307.6**	**1 353.2**	**..**	**..**	**..**

1. Includes requirements for marine bunkers.

2. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006, for 1979, 2003 and 2004; and country submissions for 2010. 2020 and 2030.

Table A12

Total IEA Electricity Generation by Fuel

(TWh and %)

	1973		1979		2004		2005[1]	
	Output TWh	Share %	Output TWh	Share %	Output TWh	Share %	Output TWh	Share %
Coal	1 607.1	*37.2*	2 020.2	*37.8*	3 668.5	*37.8*	3 757.2	*37.9*
Oil	1 105.7	*25.6*	1 052.3	*19.7*	454.0	*4.7*	455.2	*4.6*
Natural Gas	512.9	*11.9*	598.5	*11.2*	1 760.9	*18.1*	1 843.3	*18.6*
Comb. Renewables & Waste	6.3	*0.1*	11.2	*0.2*	191.9	*2.0*	191.9	*1.9*
Nuclear	188.3	*4.4*	573.4	*10.7*	2 292.3	*23.6*	2 304.0	*23.3*
Hydro	891.2	*20.6*	1 073.7	*20.1*	1 228.8	*12.7*	1 231.2	*12.4*
Geothermal	6.4	*0.1*	8.6	*0.2*	27.2	*0.3*	28.3	*0.3*
Solar/Wind	0.6	*0.0*	0.5	*0.0*	80.1	*0.8*	93.4	*0.9*
Total	**4 318.4**	***100.0***	**5 338.4**	***100.0***	**9 704.0**	***100.0***	**9 905.1**	***100.0***

1. Preliminary data.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A13

Electricity Generation in IEA Countries, 2004

	Energy Inputs[1] (Mtoe)	Electricity Output in TWh	Shares of Fuel in Electricity Generation (%)					
			Coal	Oil	Gas	Nuclear	Hydro	Other[2]
Canada	90.9 e	598.4	17.2	3.6	5.4	15.1	57.0	1.7
United States	944.2	4 147.7	50.4	3.4	17.6	19.6	6.5	2.5
North America	**1 035.1**	**4 746.1**	**46.2**	**3.4**	**16.1**	**19.0**	**12.9**	**2.4**
Australia	55.3	239.3	79.3	0.7	12.3	–	6.8	0.9
Japan	219.2	1 071.0	27.5	12.4	22.8	26.4	8.8	2.2
Korea	84.1	366.6	38.8	8.0	16.2	35.7	1.2	0.1
New Zealand	6.4	41.8	9.9	0.1	16.7	–	64.6	8.7
Pacific	**365.0**	**1 718.8**	**36.7**	**9.6**	**19.8**	**24.0**	**8.2**	**1.7**
Austria	9.2 e	61.6	14.8	3.0	17.8	–	59.1	5.4
Belgium	20.1 e	84.4	13.6	2.0	25.5	56.1	0.4	2.5
Czech Republic	23.9 e	83.8	60.3	0.4	4.6	31.4	2.4	0.9
Denmark	9.1 e	40.5	46.1	4.0	24.7	–	0.1	25.1
Finland	18.7	85.8	27.5	0.7	14.9	26.5	17.6	12.6
France	137.6 e	567.1	5.0	1.0	3.2	79.0	10.5	1.1
Germany	144.1 e	610.0	50.5	1.7	10.1	27.4	3.5	6.9
Greece	12.9 e	58.8	60.2	14.3	15.3	–	7.9	2.4
Hungary	9.5	33.7	24.7	2.3	34.8	35.3	0.6	2
Ireland	4.8	25.2	30.6	12.7	51.1	–	2.5	3.0
Italy	59.4 e	293.0	17.4	16.1	44.3	–	13.5	8.8
Luxembourg	0.6	3.4	..	..	92.8	–	3.0	4.3
Netherlands	21.6	100.8	26.0	2.8	60.5	3.8	0.1	6.7
Norway	9.7	110.1	0.1	0.0	0.3	–	98.8	0.6
Portugal	7.9	44.8	33.1	12.7	26.1	–	22.0	6.1
Spain	52.3 e	277.1	29.0	8.6	20.0	23.0	11.4	8.1
Sweden	31.2 e	151.7	1.7	1.3	0.5	51.1	39.6	5.8
Switzerland	10.7 e	63.6	–	0.3	1.5	42.4	53.1	2.7
Turkey	26.3 e	150.7	22.9	5.1	41.3	–	30.6	0.2
United Kingdom	84.3	393.2	34.1	1.2	40.6	20.3	1.3	2.5
IEA Europe	**694.0**	**3 239.2**	**26.1**	**4.0**	**20.3**	**30.1**	**14.7**	**4.9**
IEA Total	**2 094.1**	**9 704.0**	**37.8**	**4.7**	**18.1**	**23.6**	**12.7**	**3.1**

1. Includes CHP and heat-only plants.
2. Includes combustible renewables, waste, geothermal, solar, wind, tide and wave.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006.

Table A14

Electricity Intensity of IEA Countries[1]

	1973	1979	2003	2004	2005[2]	Average Annual Growth Rates (%) 1993-1998	1999-2004
Canada	0.79	0.82	0.76	0.75	0.74	-2.3	-1.6
United States	0.46	0.46	0.4	0.39	0.39	-1.4	-1.3
North America	**0.48**	**0.49**	**0.42**	**0.42**	**0.41**	**-1.6**	**-1.3**
Australia	0.38	0.45	0.51	0.53	0.53	-0.7	0.3
Japan	0.21	0.22	0.22	0.22	0.21	1.4	-0.5
Korea	0.19	0.29	0.59	0.6	0.62	4	3.6
New Zealand	0.57	0.67	0.68	0.68	0.67	-2	-1.5
Pacific	**0.23**	**0.24**	**0.28**	**0.29**	**0.28**	**1.8**	**0.8**
Austria	0.3	0.31	0.33	0.33	0.33	-0.5	1
Belgium	0.31	0.35	0.38	0.38	0.37	0.6	-0.2
Czech Republic	0.97	1.05	1.12	1.09	1.05	-0.1	-0.9
Denmark	0.19	0.24	0.23	0.23	0.22	-2.4	-0.9
Finland	0.5	0.56	0.7	0.69	0.65	-1.4	-0.4
France	0.26	0.3	0.36	0.36	0.36	-0.3	-0.1
Germany	0.37	0.39	0.31	0.31	0.31	-0.8	0.8
Greece	0.22	0.27	0.47	0.46	0.46	1.4	0.1
Hungary	0.73	0.78	0.78	0.75	0.73	-1.6	-3
Ireland	0.3	0.34	0.23	0.23	0.23	-3.2	-1.9
Italy	0.25	0.26	0.31	0.31	0.32	0.7	1.2
Luxembourg	0.65	0.58	0.35	0.34	0.32	0.7	-1.3
Netherlands	0.26	0.28	0.29	0.29	0.29	0	0.8
Norway	1.02	0.97	0.66	0.68	0.68	-3	-1.9
Portugal	0.21	0.28	0.46	0.48	0.49	1.1	2.9
Spain	0.26	0.32	0.41	0.42	0.43	1.5	1.7
Sweden	0.55	0.61	0.58	0.57	0.56	-2.5	-2.2
Switzerland	0.2	0.23	0.26	0.25	0.25	-0.3	0.4
Turkey	0.19	0.27	0.67	0.65	0.65	5.2	0.5
United Kingdom	0.35	0.34	0.26	0.25	0.25	-1.2	-1.7
IEA Europe	**0.33**	**0.35**	**0.36**	**0.36**	**0.35**	**-0.3**	**0.2**
IEA Total	**0.37**	**0.38**	**0.37**	**0.37**	**0.36**	**-0.4**	**-0.4**

1. Calculated as production plus net imports divided by GDP and measured in kWh per dollar of GDP at 2000 prices and exchange rates; includes CHP units.

2. Preliminary data.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006 and *National Accounts of OECD Countries, Volume 1*, OECD Paris, 2006.

Table A15

Electricity Generating Capacity in IEA Countries, 2004

(GW net)

	Total Capacity						
	Coal	Oil	Natural Gas	Nuclear	Hydro	Other	Total
Canada	..	..	..	10.62	70.86	0.48	118.61
United States[1]	313.97	34.90	397.36	99.60	99.05	20.07	964.94
North America	**..**	**..**	**..**	**110.21**	**169.91**	**20.55**	**1 083.55**
Australia	28.66	1.17	10.93	–	9.27	0.76	50.78
Japan[2, 3]	37.48	43.33	59.93	47.12	45.34	0.50	233.71
Korea	19.12 e	8.17 e	16.55 e	16.72	3.88	0.10	64.53
New Zealand	0.80	0.16	1.74	–	5.35	0.84	8.87
Pacific	**86.05**	**52.83**	**89.15**	**63.84**	**63.84**	**2.20**	**357.90**
Austria	2.19 e	0.54	3.24	–	14.09	0.85	20.89
Belgium	–	2.67	5.36	5.76	1.43	0.44	15.65
Czech Republic	10.43	0.06	0.76	3.76	2.16	0.27	17.43
Denmark	4.71	1.98	2.69	–	0.01	3.98	13.37
Finland	5.49	2.50	2.91	2.67	3.00	0.09	16.66
France	..	..	..	63.36	25.24	0.61	116.59
Germany	53.73	5.56	19.12	20.55	8.25	17.34	124.55
Greece	4.64	2.37	1.81	–	3.10	0.53	12.44
Hungary	1.78	0.45	4.27	1.87	0.05	0.22	8.63
Ireland[2]	1.11	1.02	2.79	–	0.53	0.39	5.84
Italy	13.70	13.93	30.18	–	20.75	2.78	81.34
Luxembourg	–	–	0.46	–	1.14	0.06	1.66
Netherlands	..	..	..	0.45	0.04	1.38	22.02
Norway	0.06 e	0.01 e	0.05	–	28.08	0.26	28.46
Portugal	1.78	2.97	2.46	–	4.85	0.66	12.71
Spain	12.21	8.09	13.74	7.58	18.12	9.70	69.43
Sweden	1.77	4.50	0.35	9.47	16.35	1.26	33.70
Switzerland	–	0.15	0.38	3.22	14.97	0.45	19.16
Turkey	8.30	3.22	12.61	–	12.65	0.06	36.82
United Kingdom	26.56	6.18	29.25	11.85	4.25	2.28	80.37
IEA Europe	**..**	**..**	**..**	**130.54**	**179.02**	**43.59**	**737.71**
IEA Total	**..**	**..**	**..**	**304.59**	**412.77**	**66.34**	**2 179.15**

1. Capacity is net summer capacity.
2. Only gross capacity data are available.
3. Does not include autoproducer capacity.
Source: Country submissions.

Table A16

Percentage Change in Real Energy Prices for End-users in IEA Countries, 2004-2005

	Total Energy		Oil Products		Electricity		Gas		Coal	
	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial	Industry	Residential/ Commercial
Canada	15.5	8.4	22.5	11.6	6.7	0.5	21.0	8.6	..	..
United States	**18.2**	**13.3**	**27.4**	**18.5**	**0.2**	**1.6**	**22.4**	**15.4**	**21.1**	**..**
Australia	1.8	7.5	13.1	11.9	-5.6	-2.6	3.7	7.0	..	..
Japan	4.8	5.3	17.9	12.3	-4.3	-2.2	-1.2	1.1	43.0	..
Korea	7.9	2.3	14.4	3.7	-3.0	-2.5	..	..	7.0	..
New Zealand	**11.0**	**8.0**	**18.5**	**10.1**	**-2.6**	**4.8**	**20.1**	**7.9**	**..**	**..**
Austria	7.1	4.9	9.0	11.2	4.0	-3.7	4.1	3.9	0.4	-1.0
Belgium	9.3	7.5	15.2	17.0	1.2	-3.0	5.9	6.1	-14.8	-0.7
Czech Republic	12.7	4.6	11.2	4.8	11.2	-0.2	22.9	11.4	14.9	0.8
Denmark	3.1	6.7	11.2	7.6	-16.7	2.4	..	17.1	-4.5	..
Finland	3.9	4.4	14.6	8.8	-5.0	-2.4	8.6	9.8	17.7	..
France	13.4	5.8	14.6	11.8	-1.7	-1.7	23.8	6.6	33.3	-1.7
Germany	10.1	9.1	12.2	9.9	7.1	8.2	7.3	8.1	..	..
Greece	10.5	8.4	13.6	10.1	0.2	1.4	27.5	13.2	..	..
Hungary	8.5	5.2	12.0	5.0	-2.8	6.5	13.3	3.8	..	-1.2
Ireland	16.5	9.4	19.2	7.5	4.0	12.3	28.4	12.6	..	..
Italy	5.9	5.1	13.9	7.3	-3.9	-2.0	4.4	6.5	26.9	..
Luxembourg	6.4	10.5	13.2	13.5	-7.5	-2.4	-7.5	-2.4	..	..
Netherlands	5.9	8.6	7.4	6.2	0.6	5.0	10.4	15.3	..	..
Norway	-1.7	3.0	6.2	7.3	-10.1	-2.8	..	..	..	..
Portugal	11.8	5.1	15.0	8.5	1.9	0.0	..	..	1.2	..
Spain	17.0	4.1	13.3	8.7	32.6	-2.0	12.3	3.0	..	..
Sweden	11.2	7.7	18.5	10.0	1.5	4.8	..	..	..	..
Switzerland	9.1	9.4	17.3	14.0	-2.7	-3.4	13.7	8.4	-0.6	..
Turkey	9.6	7.5	20.1	17.3	-7.7	-9.4	14.8	18.6	6.6	0.2
United Kingdom	**14.9**	**6.7**	**9.3**	**5.1**	**26.4**	**6.0**	**44.5**	**11.6**	**12.6**	**6.7**

Source: *Energy Prices and Taxes, Third Quarter 2006*, IEA/OECD Paris, 2006.

Table A17

Tax as a Percentage of Oil Product Prices in IEA Countries

	High-sulphur Fuel Oil Industry				Heating Oil Residential				Diesel Commercial Transport				Premium Unleaded Gasoline (95 RON)[1] Transport			
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Canada	..	..	..	..	10.2	10.2	10.2	10.2	34.5	32.4	30.0	25.8	42.4	40.7	37.5	33.8
United States	4.9	4.9	4.9	4.9	6.5	5.5	4.8	3.6	33.9	29.9	25.1	18.9	24.6	21.7	18.9	15.8
Australia	..	..	..	..	..	..	..	..	..	..	..	..	53.6	51.7	48.2	43.1
Japan	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	53.3	51.6	48.4	42.1	56.4	55.4	52.7	48.0
Korea	10.7	11.6	12.2	12.6	32.8	34.1	33.9	32.1	..	..	..	..	67.7	66.5	63.6	61.2
New Zealand	..	..	..	..	..	..	..	..	0.6	0.7	0.6	0.4	47.4	47.9	45.5	44.6
Austria	..	..	..	..	36.6	36.2	38.9	34.2	48.3	50.4	51.6	48.1	64.1	63.8	61.5	57.7
Belgium	10.9	..	..	..	22.0	21.6	22.2	20.9	50.8	47.0	45.0	40.7	69.2	67.2	66.0	63.3
Czech Republic	..	..	11.0	9.5	31.6	30.9	31.4	28.0	45.8	45.4	47.9	42.5	62.1	61.7	60.8	57.5
Denmark	..	..	..	..	57.4	56.8	54.9	49.4	50.6	50.7	50.4	44.5	69.7	69.5	68.5	64.6
Finland	..	..	..	..	36.5	36.1	33.9	30.2	47.3	48.2	45.9	40.2	70.0	71.7	69.6	66.5
France	10.0	10.0	10.6	7.6	29.8	30.9	28.9	26.1	59.4	59.1	56.4	48.8	73.7	74.3	71.9	67.1
Germany	..	..	..	..	31.3	31.2	29.5	25.5	60.8	61.5	58.2	51.1	73.4	73.7	71.5	67.4
Greece	..	8.9	9.4	7.2	40.7	42.6	39.2	34.3	46.5	45.4	39.1	33.1	55.5	55.3	51.7	49.0
Hungary	..	..	..	..	..	..	..	..	51.3	50.6	48.5	43.0	64.1	64.5	63.2	60.0
Ireland	5.2	5.1	5.1	4.0	22.1	22.3	21.3	19.4	47.5	49.8	50.5	43.0	64.2	63.8	63.8	59.6
Italy	27.2	..	..	..	65.0	64.1	61.1	55.2	56.5	55.1	51.5	44.6	68.4	67.8	66.3	62.9
Luxembourg	..	..	..	..	12.4	12.3	13.5	12.8	46.1	45.6	42.2	36.2	58.8	58.5	59.6	56.3
Netherlands	..	..	..	..	50.5	49.7	47.4	42.3	51.8	51.5	48.6	43.2	70.9	71.0	69.2	66.0
Norway	..	..	..	..	37.7	35.8	35.1	33.1	49.6	49.2	48.4	43.7	70.0	68.9	66.6	64.5
Portugal	11.6	..	..	..	..	..	28.6	25.5	53.4	53.1	51.1	45.4	68.9	68.1	66.5	62.8
Spain	7.4	7.1	..	..	36.7	35.7	33.4	29.1	49.5	49.2	45.2	38.2	62.4	62.3	59.4	55.3
Sweden	..	..	..	..	60.6	62.4	62.3	56.2	46.5	49.0	48.7	44.0	69.6	70.1	68.1	65.3
Switzerland	..	..	..	..	9.3	9.1	8.9	8.1	69.2	66.9	62.0	54.2	64.3	63.3	59.6	55.2
Turkey	34.4	36.3	41.0	27.7	63.1	64.8	61.8	56.6	64.3	65.5	62.4	57.9	70.1	71.2	68.4	69.0
United Kingdom	20.5	..	..	..	24.4	26.0	24.4	21.9	71.3	69.5	67.6	60.9	77.4	75.5	73.6	69.2

1. Regular unleaded gasoline for Australia, Canada, Japan and Korea, 2002 to 2005.

Source: *Energy Prices and Taxes, Third Quarter 2006*, IEA/OECD Paris, 2006.

Table A18

Energy Balances and Key Statistical Data for IEA and Regions

		IEA Total				IEA North America				IEA Pacific				IEA Europe			
		1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
SUPPLY																	Unit: Mtoe
TOTAL PRODUCTION		**2287.6**	**2580.4**	**3474.9**	**3517.9**	**1653.5**	**1736.1**	**2018.5**	**2038.5**	**108.3**	**139.0**	**390.2**	**409.5**	**525.9**	**705.3**	**1066.2**	**1069.8**
Coal[1]		714.4	810.7	880.8	906.5	345.1	443.6	556.4	578.8	66.1	70.3	189.7	197.1	303.2	296.7	134.6	130.6
Oil		673.7	723.3	836.8	818.7	630.2	581.7	495.0	488.7	20.8	23.8	34.7	34.5	22.8	117.9	307.1	295.4
Gas		689.8	698.9	889.2	886.3	564.0	521.8	599.2	589.0	6.0	9.9	37.8	38.1	119.9	167.2	252.2	259.1
Comb. Renewables & Waste[2]		78.3	97.6	163.7	172.9	45.3	59.9	79.2	82.2	3.5	4.0	13.6	13.9	29.4	33.7	71.0	76.8
Nuclear		49.2	150.0	572.1	597.4	27.3	80.3	224.8	235.5	2.5	19.2	96.3	107.7	19.3	50.6	250.9	254.2
Hydro		76.6	92.3	103.8	105.7	39.6	45.3	53.0	52.6	8.1	10.1	12.0	12.2	29.0	37.0	38.8	40.9
Geothermal		5.6	7.5	20.0	20.3	2.1	3.5	8.5	8.8	1.3	1.7	5.2	5.2	2.2	2.2	6.3	6.4
Solar/Wind/Other[3]		0.0	0.1	8.5	10.2	-	-	2.5	2.8	-	0.0	0.9	0.9	0.0	0.0	5.2	6.5
TOTAL NET IMPORTS[4]		**1331.5**	**1418.6**	**1640.6**	**1713.6**	**252.6**	**374.4**	**515.8**	**555.5**	**307.7**	**338.7**	**465.0**	**473.1**	**771.2**	**705.5**	**659.8**	**685.0**
Coal[1]	Exports	84.1	113.5	194.1	203.9	38.7	51.5	40.5	43.0	18.2	26.7	139.0	144.5	27.2	35.2	14.7	16.4
	Imports	114.4	145.5	328.1	355.7	11.2	15.5	29.8	31.8	41.8	44.4	153.3	168.2	61.4	85.6	145.0	155.7
	Net Imports	30.3	32.0	134.0	151.7	-27.5	-36.1	-10.6	-11.3	23.6	17.7	14.4	23.7	34.2	50.4	130.3	139.3
Oil	Exports	233.1	251.9	684.7	710.1	74.1	40.4	156.9	163.4	7.3	4.2	55.6	58.4	151.6	207.3	472.2	488.3
	Imports	1596.3	1659.0	2025.9	2105.6	365.3	471.9	702.3	752.6	308.1	323.1	436.4	436.5	923.0	864.0	887.3	916.5
	Bunkers	72.1	74.0	78.2	87.9	10.4	26.0	19.7	25.0	19.4	14.5	12.3	13.2	42.3	33.6	46.2	49.7
	Net Imports	1291.1	1333.1	1263.0	1307.6	280.8	405.5	525.7	564.2	281.3	304.4	368.5	364.9	729.0	623.2	368.9	378.5
Gas	Exports	50.3	82.5	227.8	241.6	24.9	24.0	98.8	105.8	-	-	9.1	9.3	25.5	58.5	119.8	126.5
	Imports	60.0	135.3	467.7	491.9	24.2	29.0	99.6	108.0	2.8	16.7	91.3	93.7	33.0	89.6	276.9	290.2
	Net Imports	9.7	52.8	239.9	250.3	-0.7	5.0	0.7	2.2	2.8	16.7	82.1	84.5	7.5	31.1	157.1	163.6
Electricity	Exports	6.7	10.3	28.2	27.5	1.6	2.9	4.8	4.8	-	-	-	-	5.0	7.4	23.4	22.7
	Imports	7.1	10.9	30.9	30.0	1.6	2.9	4.7	4.9	-	-	-	-	5.4	8.1	26.2	25.1
	Net Imports	0.4	0.6	2.7	2.5	0.0	-0.0	-0.0	0.1	-	-	-	-	0.4	0.7	2.7	2.5
TOTAL STOCK CHANGES		**-19.5**	**-55.4**	**10.1**	**-2.6**	**-9.8**	**-38.5**	**9.2**	**0.9**	**-4.8**	**-5.3**	**-2.6**	**-3.0**	**-4.8**	**-11.6**	**3.5**	**-0.6**
TOTAL SUPPLY (TPES)		**3599.7**	**3943.6**	**5125.5**	**5228.8**	**1896.3**	**2072.0**	**2543.5**	**2594.9**	**411.1**	**472.4**	**852.6**	**879.7**	**1292.2**	**1399.2**	**1729.4**	**1754.2**
Coal[1]		758.9	829.4	1034.4	1062.6	326.3	386.8	561.5	574.1	89.8	89.0	203.2	217.5	342.7	353.6	269.7	271.0
Oil		1943.1	2023.0	2088.8	2119.7	903.9	975.6	1014.3	1045.7	297.2	322.0	402.1	400.5	742.0	725.3	672.4	673.4
Gas		687.5	743.0	1130.5	1136.2	551.8	520.6	599.7	592.8	8.7	26.4	119.2	121.8	127.0	195.9	411.6	421.5
Comb. Renewables & Waste[2]		78.4	97.7	164.7	174.3	45.3	59.9	79.2	82.6	3.5	4.0	13.6	13.9	29.5	33.8	71.9	77.8
Nuclear		49.2	150.0	572.1	597.4	27.3	80.3	224.8	235.5	2.5	19.2	96.3	107.7	19.3	50.6	250.9	254.2
Hydro		76.6	92.3	103.8	105.7	39.6	45.3	53.0	52.6	8.1	10.1	12.0	12.2	29.0	37.0	38.8	40.9
Geothermal		5.6	7.5	20.0	20.3	2.1	3.5	8.5	8.8	1.3	1.7	5.2	5.2	2.2	2.2	6.3	6.4
Solar/Wind/Other[3]		0.0	0.1	8.5	10.2	-	-	2.5	2.8	-	0.0	0.9	0.9	0.0	0.0	5.2	6.5
Electricity Trade[5]		0.4	0.7	2.7	2.5	0.0	-0.0	-0.0	0.1	-	-	-	-	0.4	0.7	2.7	2.4

Table A18 *(continued)*

Energy Balances and Key Statistical Data for IEA and Regions

	IEA Total				IEA North America				IEA Pacific				IEA Europe			
	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
SUPPLY																Unit: Mtoe
Fuel Shares (%)																
Coal	*21.1*	*21.0*	*20.2*	*20.3*	*17.2*	*18.7*	*22.1*	*22.1*	*21.9*	*18.8*	*23.8*	*24.7*	*26.5*	*25.3*	*15.6*	*15.4*
Oil	*54.0*	*51.3*	*40.8*	*40.5*	*47.7*	*47.1*	*39.9*	*40.3*	*72.3*	*68.2*	*47.2*	*45.5*	*57.4*	*51.8*	*38.9*	*38.4*
Gas	*19.1*	*18.8*	*22.1*	*21.7*	*29.1*	*25.1*	*23.6*	*22.8*	*2.1*	*5.6*	*14.0*	*13.8*	*9.8*	*14.0*	*23.8*	*24.0*
Comb. Renewables & Waste	*2.2*	*2.5*	*3.2*	*3.3*	*2.4*	*2.9*	*3.1*	*3.2*	*0.9*	*0.9*	*1.6*	*1.6*	*2.3*	*2.4*	*4.2*	*4.4*
Nuclear	*1.4*	*3.8*	*11.2*	*11.4*	*1.4*	*3.9*	*8.8*	*9.1*	*0.6*	*4.1*	*11.3*	*12.2*	*1.5*	*3.6*	*14.5*	*14.5*
Hydro	*2.1*	*2.3*	*2.0*	*2.0*	*2.1*	*2.2*	*2.1*	*2.0*	*2.0*	*2.1*	*1.4*	*1.4*	*2.2*	*2.6*	*2.2*	*2.3*
Geothermal	*0.2*	*0.2*	*0.4*	*0.4*	*0.1*	*0.2*	*0.3*	*0.3*	*0.3*	*0.4*	*0.6*	*0.6*	*0.2*	*0.2*	*0.4*	*0.4*
Solar/Wind/Other	–	–	*0.2*	*0.2*	–	–	*0.1*	*0.1*	–	–	*0.1*	*0.1*	–	–	*0.3*	*0.4*
Electricity Trade	–	–	*0.1*	–	–	–	–	–	–	–	–	–	–	–	*0.2*	*0.1*
DEMAND																Unit: Mtoe
FINAL CONSUMPTION BY SECTOR																
TFC	**2725.8**	**2917.7**	**3578.0**	**3647.2**	**1455.0**	**1533.1**	**1767.4**	**1802.5**	**297.8**	**332.1**	**577.0**	**585.9**	**972.9**	**1052.5**	**1233.7**	**1258.8**
Coal[1]	252.5	226.3	114.2	119.4	79.0	72.0	34.9	37.7	32.5	33.1	37.7	38.7	141.1	121.2	41.6	42.9
Oil	1574.0	1654.6	1872.7	1909.3	777.5	835.7	924.6	957.8	209.6	225.1	345.4	345.0	586.8	593.9	602.7	606.6
Gas	501.4	539.8	723.0	719.6	391.0	368.0	395.3	387.6	9.5	14.3	52.9	55.1	100.8	157.5	274.8	276.9
Comb. Renewables & Waste[2]	75.8	93.1	109.7	114.8	45.0	59.6	53.6	56.8	3.5	3.8	8.2	8.7	27.3	29.7	47.9	49.3
Geothermal	0.0	0.1	2.9	3.0	–	–	0.9	1.0	–	–	0.6	0.6	0.0	0.1	1.5	1.5
Solar/Wind/Other	–	0.0	3.0	2.9	–	–	1.3	1.3	–	0.0	0.8	0.7	–	0.0	0.9	1.0
Electricity	314.2	389.3	712.3	727.6	162.3	196.8	351.1	356.3	42.7	55.7	127.5	132.3	109.2	136.9	233.6	239.0
Heat	7.9	14.4	40.3	50.6	0.1	1.0	5.7	4.1	0.0	0.1	3.9	4.9	7.7	13.3	30.7	41.6
Fuel Shares (%)																
Coal	*9.3*	*7.8*	*3.2*	*3.3*	*5.4*	*4.7*	*2.0*	*2.1*	*10.9*	*10.0*	*6.5*	*6.6*	*14.5*	*11.5*	*3.4*	*3.4*
Oil	*57.7*	*56.7*	*52.3*	*52.4*	*53.4*	*54.5*	*52.3*	*53.1*	*70.4*	*67.8*	*59.9*	*58.9*	*60.3*	*56.4*	*48.9*	*48.2*
Gas	*18.4*	*18.5*	*20.2*	*19.7*	*26.9*	*24.0*	*22.4*	*21.5*	*3.2*	*4.3*	*9.2*	*9.4*	*10.4*	*15.0*	*22.3*	*22.0*
Comb. Renewables & Waste	*2.8*	*3.2*	*3.1*	*3.1*	*3.1*	*3.9*	*3.0*	*3.2*	*1.2*	*1.2*	*1.4*	*1.5*	*2.8*	*2.8*	*3.9*	*3.9*
Geothermal	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*
Solar/Wind/Other	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*	-	-	*0.1*	*0.1*
Electricity	*11.5*	*13.3*	*19.9*	*19.9*	*11.2*	*12.8*	*19.9*	*19.8*	*14.3*	*16.8*	*22.1*	*22.6*	*11.2*	*13.0*	*18.9*	*19.0*
Heat	*0.3*	*0.5*	*1.1*	*1.4*	-	*0.1*	*0.3*	*0.2*	-	-	*0.7*	*0.8*	*0.8*	*1.3*	*2.5*	*3.3*

Table A18 *(continued)*

Energy Balances and Key Statistical Data for IEA and Regions

	IEA Total				IEA North America				IEA Pacific				IEA Europe			
	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
DEMAND																Unit: Mtoe
TOTAL INDUSTRY[6]	**1123.3**	**1157.3**	**1169.4**	**1206.3**	**535.4**	**561.3**	**520.6**	**544.1**	**167.4**	**167.9**	**240.5**	**247.5**	**420.6**	**428.0**	**408.4**	**414.7**
Coal[1]	168.2	151.7	104.1	108.3	64.8	57.5	32.5	34.7	23.9	24.0	36.9	37.7	79.4	70.1	34.7	35.8
Oil	513.1	535.1	452.3	474.1	182.4	229.7	190.3	209.8	109.8	101.6	115.7	117.4	221.0	203.7	146.2	146.9
Gas	246.9	238.9	288.9	291.9	189.2	156.4	158.5	158.9	3.9	6.0	22.8	24.5	53.9	76.5	107.6	108.5
Comb. Renewables & Waste[2]	40.3	47.1	57.6	61.1	34.3	39.5	36.0	38.6	1.5	2.1	6.1	6.7	4.6	5.5	15.4	15.9
Geothermal	-	-	0.4	0.4	-	-	0.1	0.1	-	-	0.3	0.3	-	-	0.0	0.0
Solar/Wind/Other	-	-	0.1	0.1	-	-	-	-	-	-	-	-	-	-	0.1	0.1
Electricity	152.2	180.2	251.6	255.4	64.6	77.2	98.3	98.6	28.3	34.2	56.6	58.0	59.3	68.9	96.7	98.9
Heat	2.5	4.4	14.4	15.0	0.1	1.0	4.7	3.4	-	-	2.0	2.9	2.5	3.4	7.7	8.7
Fuel Shares (%)																
Coal	*15.0*	*13.1*	*8.9*	*9.0*	*12.1*	*10.3*	*6.3*	*6.4*	*14.3*	*14.3*	*15.3*	*15.3*	*18.9*	*16.4*	*8.5*	*8.6*
Oil	*45.7*	*46.2*	*38.7*	*39.3*	*34.1*	*40.9*	*36.6*	*38.6*	*65.6*	*60.5*	*48.1*	*47.4*	*52.5*	*47.6*	*35.8*	*35.4*
Gas	*22.0*	*20.6*	*24.7*	*24.2*	*35.3*	*27.9*	*30.4*	*29.2*	*2.3*	*3.6*	*9.5*	*9.9*	*12.8*	*17.9*	*26.3*	*26.2*
Comb. Renewables & Waste	*3.6*	*4.1*	*4.9*	*5.1*	*6.4*	*7.0*	*6.9*	*7.1*	*0.9*	*1.3*	*2.6*	*2.7*	*1.1*	*1.3*	*3.8*	*3.8*
Geothermal	-	-	-	-	-	-	-	-	-	-	*0.1*	*0.1*	-	-	-	-
Solar/Wind/Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity	*13.6*	*15.6*	*21.5*	*21.2*	*12.1*	*13.7*	*18.9*	*18.1*	*16.9*	*20.3*	*23.5*	*23.4*	*14.1*	*16.1*	*23.7*	*23.8*
Heat	*0.2*	*0.4*	*1.2*	*1.2*	-	*0.2*	*0.9*	*0.6*	-	-	*0.8*	*1.2*	*0.6*	*0.8*	*1.9*	*2.1*
TRANSPORT[7]	**696.4**	**796.0**	**1203.7**	**1224.9**	**454.6**	**498.7**	**683.6**	**694.8**	**60.9**	**80.3**	**162.5**	**163.5**	**180.9**	**217.0**	**357.6**	**366.5**
TOTAL OTHER SECTORS[8]	**906.1**	**964.4**	**1205.0**	**1216.1**	**464.9**	**473.1**	**563.3**	**563.6**	**69.6**	**83.9**	**174.0**	**174.9**	**371.5**	**407.4**	**467.7**	**477.5**
Coal[1]	80.7	73.7	10.0	11.1	14.0	14.5	2.4	3.0	8.3	9.1	0.7	0.9	58.4	50.2	6.9	7.1
Oil	390.0	346.2	252.1	247.4	158.1	123.6	75.3	78.5	40.5	44.6	69.7	66.8	191.4	178.0	107.1	102.2
Gas	237.5	284.7	414.7	408.9	185.0	195.7	218.7	211.3	5.7	8.3	29.6	30.0	46.8	80.7	166.4	167.6
Comb. Renewables & Waste[2]	35.4	46.0	45.2	44.7	10.8	20.1	11.9	11.2	2.0	1.7	2.1	2.0	22.7	24.2	31.2	31.4
Geothermal	0.0	0.1	2.5	2.6	-	-	0.8	0.8	-	-	0.3	0.3	0.0	0.1	1.5	1.5
Solar/Wind/Other	-	0.0	2.8	2.8	-	-	1.3	1.3	-	0.0	0.8	0.7	-	0.0	0.8	0.9
Electricity	157.1	203.7	451.6	463.0	97.0	119.2	251.9	256.8	13.2	20.1	68.9	72.2	46.8	64.5	130.8	134.0
Heat	5.3	10.0	26.0	35.6	-	0.0	1.0	0.6	0.0	0.1	2.0	2.0	5.3	9.9	23.1	32.9

Table A18 *(continued)*

Energy Balances and Key Statistical Data for IEA and Regions

	IEA Total				IEA North America				IEA Pacific				IEA Europe			
	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
DEMAND																Unit: Mtoe
Fuel Shares (%)																
Coal	*8.9*	*7.6*	*0.8*	*0.9*	*3.0*	*3.1*	*0.4*	*0.5*	*11.9*	*10.8*	*0.4*	*0.5*	*15.7*	*12.3*	*1.5*	*1.5*
Oil	*43.0*	*35.9*	*20.9*	*20.3*	*34.0*	*26.1*	*13.4*	*13.9*	*58.1*	*53.2*	*40.0*	*38.2*	*51.5*	*43.7*	*22.9*	*21.4*
Gas	*26.2*	*29.5*	*34.4*	*33.6*	*39.8*	*41.4*	*38.8*	*37.5*	*8.1*	*9.9*	*17.0*	*17.1*	*12.6*	*19.8*	*35.6*	*35.1*
Comb. Renewables & Waste	*3.9*	*4.8*	*3.7*	*3.7*	*2.3*	*4.3*	*2.1*	*2.0*	*2.9*	*2.0*	*1.2*	*1.1*	*6.1*	*5.9*	*6.7*	*6.6*
Geothermal	–	–	*0.2*	*0.2*	–	–	*0.1*	*0.1*	–	–	*0.2*	*0.2*	–	–	*0.3*	*0.3*
Solar/Wind/Other	–	–	*0.2*	*0.2*	–	–	*0.2*	*0.2*	–	–	*0.4*	*0.4*	–	–	*0.2*	*0.2*
Electricity	*17.3*	*21.1*	*37.5*	*38.1*	*20.9*	*25.2*	*44.7*	*45.6*	*18.9*	*24.0*	*39.6*	*41.3*	*12.6*	*15.8*	*28.0*	*28.1*
Heat	*0.6*	*1.0*	*2.2*	*2.9*	–	–	*0.2*	*0.1*	–	*0.1*	*1.1*	*1.2*	1.4	2.4	4.9	6.9
ENERGY TRANSFORMATION AND LOSSES																
ELECTRICITY GENERATION[9]																
INPUT (Mtoe)	**907.5**	**1136.4**	**2042.8**	**2094.1**	**466.3**	**577.3**	**1013.1**	**1035.1**	**113.1**	**152.5**	**350.7**	**365.0**	**328.1**	**406.6**	**679.1**	**694.0**
OUTPUT (Mtoe)	**371.4**	**459.1**	**813.5**	**834.5**	**192.3**	**233.8**	**399.4**	**408.2**	**48.4**	**63.1**	**142.3**	**147.8**	**130.7**	**162.2**	**271.8**	**278.6**
(TWh gross)	4318.4	5338.4	9458.9	9704.0	2235.6	2718.8	4644.2	4746.1	563.2	733.7	1654.7	1718.8	1519.7	1885.9	3160.0	3239.2
Output Shares (%)																
Coal	*37.2*	*37.8*	*38.7*	*37.8*	*42.1*	*43.3*	*47.3*	*46.2*	*15.7*	*15.7*	*36.2*	*36.7*	*37.9*	*38.6*	*27.2*	*26.1*
Oil	*25.6*	*19.7*	*5.2*	*4.7*	*15.4*	*12.5*	*3.4*	*3.4*	*63.2*	*46.9*	*10.7*	*9.6*	*26.6*	*19.5*	*5.0*	*4.0*
Gas	*11.9*	*11.2*	*17.5*	*18.1*	*17.0*	*13.4*	*15.1*	*16.1*	*2.4*	*11.0*	*20.5*	*19.8*	*7.8*	*8.2*	*19.3*	*20.3*
Comb. Renewables & Waste	*0.1*	*0.2*	*1.8*	*2.0*	*0.0*	*0.1*	*1.7*	*1.7*	*0.1*	*0.1*	*1.3*	*1.2*	*0.4*	*0.5*	*2.1*	*2.8*
Nuclear	*4.4*	*10.7*	*23.2*	*23.6*	*4.7*	*11.2*	*18.6*	*19.0*	*1.7*	*10.0*	*22.3*	*24.0*	*4.9*	*10.3*	*30.5*	*30.1*
Hydro	*20.6*	*20.1*	*12.8*	*12.7*	*20.6*	*19.4*	*13.3*	*12.9*	*16.7*	*16.0*	*8.4*	*8.2*	*22.2*	*22.8*	*14.3*	*14.7*
Geothermal	*0.1*	*0.2*	*0.3*	*0.3*	*0.1*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.4*	*0.4*	*0.2*	*0.1*	*0.2*	*0.2*
Solar/Wind/Other	*0.0*	*0.0*	*0.6*	*0.8*	–	–	*0.3*	*0.3*	–	–	*0.1*	*0.1*	*0.0*	*0.0*	*1.5*	*1.9*
TOTAL LOSSES (Mtoe)	**902.7**	**1025.3**	**1546.0**	**1569.6**	**460.0**	**533.3**	**768.5**	**783.5**	**118.8**	**142.2**	**280.3**	**289.1**	**323.9**	**349.9**	**497.3**	**497.0**
of which:																
Electricity and Heat Generation[10]	527.1	661.4	1182.0	1204.1	274.0	342.5	604.0	620.3	64.6	89.2	204.5	212.3	188.6	229.8	373.6	371.5
Other Transformation	95.0	90.2	46.1	47.0	9.1	33.4	–8.2	–7.7	32.1	25.0	35.9	35.7	53.8	31.9	18.4	18.9
Own Use and Losses[11]	280.6	273.7	317.9	318.6	176.9	157.4	172.7	170.9	22.2	28.1	39.9	41.1	81.5	88.2	105.3	106.6
Statistical Differences	**–28.7**	**0.5**	**1.4**	**12.0**	**–18.6**	**5.6**	**7.6**	**8.9**	**–5.5**	**–2.0**	**–4.6**	**4.7**	**–4.6**	**–3.1**	**–1.5**	**–1.6**

Table A18 *(continued)*

Energy Balances and Key Statistical Data for IEA and Regions

	IEA Total				IEA North America				IEA Pacific				IEA Europe			
	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004	1973	1979	2003	2004
INDICATORS																
GDP (billion 2000 USD)	11805	14028	26004	26858	4628	5540	11034	11491	2507	3088	5893	6063	4671	5400	9077	9305
Population (millions)	811	851	1009	1016	234	249	323	326	159	171	199	200	417	430	487	490
TPES/GDP[12]	0.30	0.28	0.20	0.19	0.41	0.37	0.23	0.23	0.16	0.15	0.14	0.15	0.28	0.26	0.19	0.19
Energy Production/TPES	0.64	0.65	0.68	0.67	0.87	0.84	0.79	0.79	0.26	0.29	0.46	0.47	0.41	0.50	0.62	0.61
Per Capita TPES[13]	4.44	4.63	5.08	5.15	8.09	8.31	7.88	7.96	2.58	2.76	4.27	4.40	3.10	3.25	3.55	3.58
Oil Supply/GDP[12]	0.16	0.14	0.08	0.08	0.20	0.18	0.09	0.09	0.12	0.10	0.07	0.07	0.16	0.13	0.07	0.07
TFC/GDP[12]	0.23	0.21	0.14	0.14	0.31	0.28	0.16	0.16	0.12	0.11	0.10	0.10	0.21	0.19	0.14	0.14
Per Capita TFC[13]	3.36	3.43	3.54	3.59	6.21	6.15	5.48	5.53	1.87	1.94	2.89	2.93	2.33	2.44	2.53	2.57
Energy-related CO_2 Emissions (Mt CO_2)[14]	9831.5	10364.0	12076.4	12201.6	5080.2	5298.8	6269.6	6350.8	1131.9	1249.3	2048.2	2064.3	3619.4	3815.9	3758.6	3786.4
CO_2 Emissions from Bunkers (Mt CO_2)	298.3	313.0	456.2	498.9	50.4	105.2	114.0	132.2	69.6	53.3	72.5	76.9	178.3	154.5	269.6	289.9
GROWTH RATES (% per year)																
	73-79	**79-90**	**90-03**	**03-04**	**73-79**	**79-90**	**90-03**	**03-04**	**73-79**	**79-90**	**90-03**	**03-04**	**73-79**	**79-90**	**90-03**	**03-04**
TPES	**1.5**	**0.7**	**1.4**	**2.0**	**1.5**	**0.3**	**1.3**	**2.0**	**2.3**	**2.8**	**2.2**	**3.2**	**1.3**	**0.6**	**1.1**	**1.4**
Coal	1.5	1.5	0.4	2.7	2.9	2.0	1.2	2.2	-0.2	4.1	3.0	7.1	0.5	0.0	-2.1	0.5
Oil	0.7	-1.1	1.2	1.5	1.3	-1.3	1.4	3.1	1.3	0.6	1.2	-0.4	-0.4	-1.6	0.8	0.2
Gas	1.3	0.7	2.7	0.5	-1.0	-0.5	1.5	-1.1	20.3	8.6	4.7	2.2	7.5	2.0	4.1	2.4
Comb. Renewables & Waste	3.7	2.6	1.8	5.8	4.8	1.5	0.9	4.2	2.2	8.3	2.7	2.2	2.3	3.6	2.9	8.3
Nuclear	20.4	10.4	1.9	4.4	19.7	7.6	1.8	4.8	40.1	12.0	2.9	11.8	17.4	13.4	1.7	1.3
Hydro	3.2	0.5	0.4	1.8	2.3	0.7	0.6	-0.6	3.8	1.2	0.3	1.7	4.1	0.1	0.3	5.3
Geothermal	4.9	10.1	-0.6	1.6	9.0	13.4	-3.8	3.0	4.7	7.5	2.5	-0.9	0.3	4.7	4.2	1.8
Solar/Wind/Other	3.2	37.1	12.1	19.6	-	-	17.0	11.6	-	50.5	-2.4	-2.0	-1.4	18.7	24.1	27.8
TFC	**1.1**	**0.2**	**1.4**	**1.9**	**0.9**	**-0.4**	**1.4**	**2.0**	**1.8**	**2.5**	**2.2**	**1.5**	**1.3**	**0.1**	**1.1**	**2.0**
Electricity Consumption	3.6	2.8	2.3	2.2	3.3	2.7	2.3	1.5	4.5	4.1	3.0	3.7	3.8	2.5	2.0	2.3
Energy Production	2.0	1.7	0.8	1.2	0.8	0.9	0.4	1.0	4.3	6.2	2.9	5.0	5.0	2.5	1.1	0.3
Net Oil Imports	0.5	-2.2	1.5	3.5	6.3	-1.8	3.6	7.3	1.3	0.3	1.2	-1.0	-2.6	-4.0	-0.6	2.6
GDP	2.9	2.9	2.3	3.3	3.0	2.9	2.9	4.1	3.5	4.0	1.7	2.9	2.4	2.3	2.1	2.5
Growth in the TPES/GDP Ratio	-1.3	-2.1	-0.9	-1.2	-1.5	-2.5	-1.5	-2.0	-1.2	-1.1	0.5	0.3	-1.1	-1.7	-0.9	-1.0
Growth in the TFC/GDP Ratio	-1.7	-2.7	-0.9	-1.3	-2.1	-3.2	-1.4	-2.1	-1.6	-1.4	0.4	-1.3	-1.1	-2.2	-0.9	-0.5

Table A18 (Footnotes)

1. Includes lignite and peat, except for Finland, Ireland and Sweden. In these three cases, peat is shown separately.
2. Comprises solid biomass, liquid biomass, biogas, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
3. Other includes tide, wave and ambient heat used in heat pumps.
4. Total net imports include combustible renewables and waste.
5. Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.
6. Includes non-energy use.
7. Includes less than 1% non-oil fuels.
8. Includes residential, commercial, public service and agricultural sectors.
9. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
10. Losses arising in the production of electricity and heat at main activity producer utilities (formerly known as public) and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.
11. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
12. Toe per thousand US dollars at 2000 prices and exchange rates.
13. Toe per person.
14. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2004 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX B

GOVERNMENT ENERGY R&D BUDGETS

Table B1

IEA Government R&D Budgets in National Currencies

(millions except for Japanese and Korean currencies, which are in billions)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	322.0	322.0	300.6	265.9	249.6	248.6	266.5	293.2	321.2	364.0	313.6	362.3
United States	2 441.6	2 409.1	2 149.9	1 965.7	2 024.6	2 293.8	2 266.7	2 814.4	2 847.3	2 750.0	2 888.5	3 017.8
Australia	..	116.3	..	157.6	..	136.5	..	155.5	..	151.7	..	..
Japan	433.9	445.7	459.1	437.7	441.8	433.2	436.3	433.5	516.7	464.8	428.4	430.0
Korea	..	..	..	..	..	..	..	..	110.3	..	365.9	422.8
New Zealand	3.8	4.4	5.3	5.1	6.4	6.1	6.4	8.9	10.1	11.5	13.4	13.3
Austria	23.6	24.1	24.3	25.7	27.4	26.5	23.3	29.9	29.2	25.0	33.5	..
Belgium	41.4	43.8	56.4	54.5	70.4	49.7	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	178.4	..	..
Denmark	259.0	245.1	217.6	258.3	316.2	312.6	327.1	328.0	167.9	177.2	346.9	453.2
Finland	48.2	58.2	56.1	79.4	81.9	77.9	65.5	62.7	70.5	53.6	..	..
France	424.3	501.9	483.2	488.2	527.1	617.1	586.7	441.6	403.5	..	..	..
Germany	300.0	262.2	285.0	259.2	280.1	187.7	268.6	292.5	264.5	377.6	369.6	413.2
Greece	3.3	6.1	7.5	14.3	..	..	5.7	7.0	8.8	..	..	..
Hungary	..	..	..	..	..	..	584.6	562.9	788.6	688.7	830.4	882.4
Ireland	..	..	..	..	..	..	..	..	3.9	7.0	10.0	10.9
Italy	225.4	243.8	237.8	221.9	222.1	..	262.7	283.0	300.1	291.3	285.0	258.0
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	165.9	121.2	127.1	146.2	140.1	140.7	126.4	159.3	140.2	128.2	..	..
Norway	355.7	304.4	288.3	281.8	277.4	371.6	370.0	384.5	392.9	384.3	474.2	553.3
Portugal	2.7	1.4	1.7	1.2	1.6	2.0	1.5	1.0	2.0	2.6	3.0	1.3
Spain	64.1	60.0	59.3	60.3	47.4	50.0	49.3	49.7	45.7	55.5	43.9	47.1
Sweden	598.0	452.9	413.1	467.0	440.0	590.0	647.0	763.0	853.0	870.6	924.6	447.9
Switzerland	220.8	215.1	206.7	196.9	182.6	179.9	166.8	172.8	179.4	183.8	187.5	194.0
Turkey	0.0	0.2	0.3	1.6	1.4	1.4	2.2	3.7	4.1	5.1	1.4	1.7
United Kingdom	50.9	52.9	36.4	49.3	43.8	42.8	48.0	30.4	35.3	34.2	48.6	71.4
European Commission[2]	..	..	..	..	..	..	..	..	..	..	..	..

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. No information on R&D budgets has been provided by the European Commission.
Note: Budgets provided for recent years by some countries may have been estimated.
Source: Country submissions.

Table B2

IEA Government R&D Budgets in 2005 National Currencies

(millions except for Japanese and Korean currencies, which are in billions)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	398.6	389.9	358.1	313.0	295.0	288.9	297.3	323.4	350.7	385.0	321.8	362.3
United States	3 031.1	2 932.2	2 566.6	2 309.8	2 351.9	2 626.5	2 541.0	3 081.0	3 063.1	2 900.1	2 968.0	3 017.8
Australia	..	150.4	..	196.2	..	168.4	..	177.7	..	163.9	..	..
Japan	391.4	404.3	419.8	399.0	403.2	400.7	409.7	412.4	498.1	454.6	423.9	430.0
Korea	..	..	..	..	..	..	..	..	116.3	..	365.9	422.8
New Zealand	4.7	5.3	6.3	6.0	7.4	7.1	7.3	9.7	10.9	12.3	13.7	13.3
Austria	27.1	27.2	27.1	28.7	30.5	29.3	25.4	32.0	30.9	26.1	34.3	..
Belgium	48.9	51.1	65.5	62.5	79.3	55.6	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	184.3	..	..
Denmark	319.4	298.6	259.9	302.4	365.9	355.7	361.4	353.6	178.2	184.0	353.0	453.2
Finland	58.2	67.1	64.9	89.9	89.6	85.4	69.9	64.6	71.9	54.9	..	..
France	491.7	573.2	542.6	543.2	579.9	680.4	637.2	471.1	421.3	..	..	..
Germany	324.7	278.6	301.3	273.3	293.8	196.1	282.5	304.1	270.9	383.1	372.1	413.2
Greece	5.6	9.4	10.7	19.1	..	..	6.8	8.0	9.8	..	..	..
Hungary	..	..	..	..	..	..	783.9	695.1	898.5	735.9	848.1	882.4
Ireland	..	..	..	..	..	..	..	..	4.1	7.4	10.2	10.9
Italy	312.1	321.4	297.7	271.3	264.4	..	301.3	316.1	325.3	306.9	292.5	258.0
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	215.0	153.9	159.6	180.1	169.6	167.8	145.0	173.6	147.2	131.2	..	..
Norway	548.8	456.8	415.8	395.0	391.7	492.0	423.1	434.5	451.0	430.8	505.9	553.3
Portugal	3.9	1.9	2.3	1.5	2.0	2.4	1.7	1.1	2.1	2.7	3.0	1.3
Spain	94.5	84.4	80.6	80.1	61.4	63.0	60.1	58.2	51.3	59.8	45.5	47.1
Sweden	708.9	519.9	468.7	522.8	488.5	649.1	703.3	811.6	892.5	892.8	935.8	447.9
Switzerland	235.9	227.9	219.0	209.1	194.2	190.2	174.9	180.0	184.0	186.3	189.1	194.0
Turkey	3.4	8.1	6.6	21.3	10.5	6.8	7.0	7.6	5.9	6.0	1.5	1.7
United Kingdom	66.8	67.7	44.9	59.2	51.2	48.9	54.2	33.5	37.8	35.6	49.5	71.4
European Commission[2]	..	..	..	..	..	..	..	..	..	..	..	..

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. No information on R&D budgets has been provided by the European Commission.
Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B3

IEA Government R&D Budgets

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e	2005 exch. rates Unit per $
Canada[1]	328.9	321.7	295.4	258.3	243.4	238.4	245.3	266.8	289.4	317.6	265.5	298.9	1.212
United States	3 031.1	2 932.2	2 566.6	2 309.8	2 351.9	2 626.5	2 541.0	3 081.0	3 063.1	2 900.1	2 968.0	3 017.8	1.0
Australia	..	114.5	..	149.4	..	128.2	..	135.4	..	124.8	..	..	1.313
Japan	3 555.1	3 672.4	3 812.5	3 624.1	3 662.1	3 639.8	3 721.3	3 746.0	4 524.3	4 129.1	3 850.1	3 905.3	110.10
Korea	..	..	..	..	..	..	..	..	113.6	..	357.3	412.9	1 024.0
New Zealand	3.3	3.7	4.4	4.3	5.2	5.0	5.1	6.8	7.7	8.6	9.7	9.4	1.421
Austria	33.7	33.8	33.7	35.7	37.9	36.4	31.6	39.7	38.3	32.4	42.6	..	0.805
Belgium	60.7	63.4	81.4	77.7	98.5	69.1	..	..	..	..	..	..	0.805
Czech Republic	..	..	..	..	..	..	..	..	..	7.7	..	..	23.95
Denmark	53.3	49.8	43.4	50.4	61.0	59.3	60.3	59.0	29.7	30.7	58.9	75.6	5.996
Finland	72.3	83.4	80.7	111.7	111.3	106.1	86.8	80.2	89.4	68.2	..	..	0.805
France	610.8	712.0	674.1	674.8	720.4	845.2	791.5	585.2	523.4	..	..	..	0.805
Germany	403.4	346.1	374.3	339.4	364.9	243.6	351.0	377.7	336.6	475.9	462.2	513.2	0.805
Greece	7.0	11.7	13.3	23.7	..	..	8.5	10.0	12.2	..	..	..	0.805
Hungary	..	..	..	..	..	..	3.9	3.5	4.5	3.7	4.3	4.4	199.5
Ireland	..	..	..	..	..	..	..	..	5.1	9.1	12.7	13.6	0.805
Italy	387.7	399.2	369.8	337.0	328.5	..	374.3	392.7	404.1	381.2	363.4	320.5	0.805
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..	0.805
Netherlands	267.0	191.2	198.2	223.7	210.7	208.4	180.1	215.6	182.9	163.0	..	..	0.805
Norway	85.2	70.9	64.6	61.3	60.8	76.4	65.7	67.5	70.0	66.9	78.5	85.9	6.441
Portugal	4.8	2.3	2.9	1.9	2.5	3.0	2.1	1.3	2.7	3.4	3.8	1.6	0.805
Spain	117.4	104.8	100.1	99.5	76.2	78.3	74.7	72.2	63.7	74.3	56.6	58.5	0.805
Sweden	94.9	69.6	62.7	70.0	65.4	86.9	94.1	108.6	119.4	119.5	125.2	59.9	7.47
Switzerland	189.0	182.6	175.5	167.5	155.6	152.4	140.2	144.2	147.4	149.3	151.5	155.4	1.248
Turkey	2.5	6.0	4.9	15.9	7.8	5.1	5.2	5.7	4.4	4.5	1.1	1.3	1.340
United Kingdom	121.5	123.0	81.6	107.6	93.1	88.9	98.5	60.9	68.7	64.6	90.1	129.9	0.550
Estimated IEA Total [2]	9 532.6	9 482.9	9 152.8	8 719.9	8 793.7	9 026.5	9 070.2	9 515.7	10 165.8	9 699.6	9 429.5	9 586.3	
European Commission [3]	..	..	..	..	..	..	..	..	..	..	..	..	0.805

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.
3. No information on R&D budgets has been provided by the European Commission.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B4

IEA Government Budgets on Energy R&D

(per thousand units of GDP)

	R&D/GDP including nuclear research								
	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	0.30	0.27	0.25	0.25	0.26	0.28	0.30	0.24	0.27
United States	0.24	0.23	0.25	0.23	0.28	0.27	0.25	0.25	0.24
Australia	0.29	..	0.23	..	0.23	..	0.19	..	..
Japan	0.84	0.86	0.85	0.85	0.86	1.04	0.93	0.85	0.84
Korea	..	..	..	..	..	0.16	..	0.47	0.52
New Zealand	0.05	0.06	0.06	0.06	0.07	0.08	0.09	0.09	0.09
Austria	0.14	0.14	0.13	0.11	0.14	0.13	0.11	0.14	..
Belgium	0.25	0.31	0.21	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	0.07	..	..
Denmark	0.23	0.27	0.26	0.25	0.25	0.12	0.13	0.24	0.30
Finland	0.74	0.70	0.64	0.50	0.46	0.50	0.37	..	..
France	0.38	0.40	0.45	0.41	0.29	0.26	..	..	..
Germany	0.14	0.14	0.09	0.13	0.14	0.12	0.17	0.17	0.18
Greece	0.15	..	..	0.05	0.05	0.06	..	..	..
Hungary	..	..	..	0.04	0.04	0.05	0.04	0.04	0.04
Ireland	..	..	..	..	..	0.03	0.05	0.07	0.07
Italy	0.22	0.21	..	0.23	0.23	0.24	0.22	0.21	0.19
Luxembourg	..	..	..	..	..	..	..	..	..
Netherlands	0.42	0.38	0.36	0.30	0.36	0.30	0.27	..	..
Norway	0.25	0.25	0.30	0.25	0.25	0.26	0.25	0.28	0.30
Portugal	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01
Spain	0.12	0.09	0.09	0.08	0.07	0.06	0.07	0.05	0.05
Sweden	0.25	0.22	0.28	0.29	0.34	0.36	0.36	0.36	0.17
Switzerland	0.52	0.47	0.45	0.40	0.41	0.42	0.42	0.42	0.43
Turkey	0.06	0.03	0.02	0.02	0.02	0.01	0.01	0.00	0.00
United Kingdom	0.06	0.05	0.05	0.05	0.03	0.03	0.03	0.04	0.06
	R&D/GDP excluding nuclear research								
	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	0.17	0.16	0.17	0.18	0.21	0.22	0.25	0.19	0.19
United States	0.20	0.20	0.22	0.20	0.25	0.24	0.22	0.21	0.21
Australia	0.29	..	0.22	..	0.22	..	0.19	..	..
Japan	0.21	0.25	0.24	0.25	0.26	0.37	0.29	0.30	0.30
Korea	..	..	..	..	..	0.12	..	0.18	0.23
New Zealand	0.05	0.06	0.06	0.06	0.07	0.08	0.09	0.09	0.09
Austria	0.13	0.13	0.12	0.10	0.12	0.12	0.10	0.13	..
Belgium	0.08	0.09	0.04	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	0.04	..	..
Denmark	0.23	0.24	0.23	0.23	0.23	0.11	0.11	0.22	0.28
Finland	0.66	0.63	0.56	0.44	0.41	0.45	0.34	..	..
France	0.03	0.03	0.04	0.04	0.05	0.06	..	..	..
Germany	0.06	0.06	0.05	0.06	0.08	0.07	0.11	0.10	0.12
Greece	0.14	..	..	0.04	0.05	0.05	..	..	..
Hungary	..	..	..	0.03	0.02	0.03	0.02	0.04	0.04
Ireland	..	..	..	..	..	0.03	0.05	0.07	0.07
Italy	0.12	0.12	..	0.13	0.14	0.16	0.15	0.15	0.13
Luxembourg	..	..	..	..	..	..	..	..	..
Netherlands	0.37	0.34	0.32	0.25	0.31	0.26	0.23	..	..
Norway	0.21	0.19	0.25	0.21	0.21	0.22	0.21	0.24	0.26
Portugal	0.01	0.02	0.02	0.01	0.01	0.01	0.00	0.02	0.01
Spain	0.06	0.05	0.05	0.04	0.04	0.03	0.04	0.04	0.03
Sweden	0.22	0.20	0.26	0.27	0.32	0.34	0.34	0.34	0.15
Switzerland	0.36	0.33	0.34	0.27	0.29	0.29	0.30	0.30	0.31
Turkey	0.05	0.02	0.02	0.02	0.02	0.01	0.01	0.00	0.00
United Kingdom	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.04

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B5

IEA Government R&D Budgets for Energy Efficiency

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	53.6	52.4	53.7	51.8	52.8	56.0	43.7	55.5	84.2	84.9	45.2	46.7
United States	531.2	616.1	493.2	455.6	489.4	550.0	604.0	636.7	621.9	413.2	390.8	366.1
Australia	..	13.7	..	9.6	..	8.9	..	11.9	..	11.1	..	..
Japan	232.0	247.5	282.6	275.1	444.1	540.5	585.5	622.5	643.9	481.4	442.8	464.7
Korea	..	..	..	..	..	..	..	..	21.4	..	24.6	38.5
New Zealand	0.6	0.9	0.8	0.7	0.4	0.8	0.8	0.5	0.6	1.2	1.8	1.8
Austria	13.5	12.3	12.4	11.8	9.5	10.5	9.7	12.2	10.4	6.6	12.5	..
Belgium	12.3	11.2	14.4	12.7	18.6	5.6	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	–	..	..
Denmark	7.4	6.4	6.7	10.2	11.6	13.0	17.7	13.8	0.5	1.4	5.2	6.1
Finland	21.5	29.7	28.8	47.8	57.8	48.1	36.2	32.0	34.0	17.3	..	..
France	10.4	10.1	9.1	5.9	8.3	15.9	16.1	15.6	24.5	..	..	..
Germany	16.4	18.8	27.5	17.9	16.3	15.0	11.8	30.5	19.7	21.7	25.7	24.3
Greece	1.9	2.2	2.9	7.1	..	..	0.7	0.8	2.0	..	..	..
Hungary	..	–	–	..	–	..	1.3	0.2	0.3	–	–	–
Ireland	..	..	..	..	..	..	..	..	3.4	6.2	6.9	8.4
Italy	70.0	73.9	74.9	69.3	69.1	..	32.9	34.7	33.7	30.8	28.1	29.8
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	66.6	70.5	81.1	84.5	84.5	85.4	55.2	76.6	55.4	37.8	..	..
Norway	12.4	2.9	2.7	2.5	2.4	2.3	2.3	2.1	2.7	2.9	2.5	3.4
Portugal	0.6	1.1	0.9	0.9	0.1	0.3	0.3	0.4	0.1	0.1	1.4	0.2
Spain	11.4	8.8	5.4	5.3	10.0	4.7	6.1	3.4	2.7	5.4	3.1	3.7
Sweden	27.8	25.3	29.4	21.9	18.4	27.5	34.0	43.9	54.8	56.3	38.4	18.8
Switzerland	36.0	34.4	32.3	25.5	24.3	26.9	20.9	21.8	19.7	20.5	17.0	18.4
Turkey	0.1	0.3	0.3	0.1	0.3	0.3	0.7	2.2	0.5	0.4	0.2	0.3
United Kingdom	5.5	3.4	2.9	2.2	1.1	1.5	3.0	–	–	–	–	–
Estimated IEA Total [2]	**1 138.8**	**1 239.7**	**1 170.4**	**1 111.3**	**1 328.3**	**1 460.9**	**1 496.7**	**1 622.6**	**1 627.0**	**1 215.9**	**1 094.3**	**1 075.0**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B6

IEA Government R&D Budgets for Oil and Gas

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	55.8	51.6	60.8	50.9	52.1	52.5	48.2	58.8	53.3	59.6	51.8	61.9
United States	121.8	134.8	92.5	80.1	84.9	83.7	97.0	122.5	110.3	91.6	78.0	78.8
Australia	..	39.8	..	83.0	..	58.3	..	49.8	..	36.1	..	..
Japan	120.3	137.2	135.7	131.6	99.1	33.6	26.6	34.2	285.8	237.9	219.2	213.4
Korea	..	..	..	..	..	..	..	..	1.1	1.3	6.5	6.0
New Zealand	0.7	0.7	0.8	0.8	0.9	0.9	0.9	2.4	3.5	3.1	2.5	2.4
Austria	0.3	0.4	0.8	0.3	0.3	0.2	–	0.4	0.2	0.1	0.3	..
Belgium	–	–	0.1	0.1	–	0.3	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	0.4	..	..
Denmark	4.3	4.5	3.7	3.3	2.7	3.4	2.5	2.4	–	–	–	5.1
Finland	–	–	–	2.8	3.1	3.5	1.7	3.4	3.5	0.5	..	..
France	42.6	40.9	40.2	39.8	39.4	39.5	41.1	44.8	36.8	..	..	..
Germany	3.4	0.9	–	–	–	–	–	–	–	–	–	–
Greece	0.9	1.5	1.6	2.5	..	..	..	..	..	..	..	..
Hungary	..	–	–	..	–	0.1	0.7	0.2	0.2	0.3	0.3	0.5
Ireland	..	..	..	..	..	..	..	..	0.3	0.4	0.2	0.2
Italy	–	–	–	–	–	..	–	–	2.7	2.6	2.6	2.5
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	17.2	12.2	12.3	13.7	11.4	10.9	12.0	10.4	20.8	13.8	..	..
Norway	37.9	35.3	31.1	29.6	28.3	45.8	35.5	33.1	26.5	32.0	39.4	41.4
Portugal	0.4	0.2	0.1	0.1	0.1	0.2	0.1	–	–	0.2	0.7	0.2
Spain	–	–	–	–	–	0.1	2.2	–	–	–	–	–
Sweden	–	–	–	–	–	–	–	–	–	–	–	–
Switzerland	14.5	13.8	10.8	11.8	10.3	9.8	9.0	9.2	12.5	11.9	11.7	12.0
Turkey	0.1	4.1	2.9	6.0	1.1	0.2	0.1	0.1	0.2	0.5	0.1	0.1
United Kingdom	6.4	13.9	6.5	9.6	7.7	5.1	5.8	4.3	1.7	1.7	–	–
Estimated IEA Total [2]	**470.6**	**490.4**	**451.9**	**463.7**	**414.8**	**347.9**	**340.6**	**376.2**	**603.6**	**525.8**	**500.6**	**506.2**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.

2. IEA totals include estimates where data are not available. Because of missing data. the following countries have not been included in the total: the Czech Republic. Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B7

IEA Government R&D Budgets for Coal

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	11.1	13.9	10.1	3.4	5.6	7.2	4.2	4.4	4.8	7.4	7.8	9.3
United States	480.9	232.7	318.0	113.4	121.3	144.9	135.5	263.7	346.3	347.0	324.4	211.0
Australia	..	19.5	..	24.7	..	25.4	..	32.5	..	31.9	..	..
Japan	254.7	235.3	210.1	186.2	169.1	130.3	82.2	43.4	63.4	59.6	113.6	135.1
Korea	..	..	..	..	..	..	..	..	13.3	13.7	0.6	0.6
New Zealand	0.5	0.4	0.5	0.5	0.6	0.5	0.5	0.3	0.3	–	–	–
Austria	0.9	0.7	1.6	2.0	0.5	0.7	0.6	0.5	0.4	0.5	0.2	..
Belgium	2.2	1.8	2.0	2.9	0.6	0.8	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	3.0	..	..
Denmark	6.2	3.6	1.1	–	0.1	0.1	–	–	–	–	–	–
Finland	4.9	4.2	4.6	4.5	3.8	3.9	3.5	2.8	3.2	0.3	..	..
France	7.0	7.1	6.6	6.5	0.1	–	–	–	–	..	..	..
Germany	22.2	16.0	4.4	1.7	1.6	12.9	12.0	22.6	17.2	10.1	6.7	9.9
Greece	0.6	1.0	1.0	3.0	..	..	..	..	..	..	..	..
Hungary	..	–	–	..	–	..	..	0.3	0.3	–	–	–
Ireland	..	..	..	..	..	..	..	..	–	–	–	–
Italy	–	–	–	–	–	..	–	–	15.5	15.1	14.7	14.3
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	17.8	4.7	4.7	3.9	2.7	1.1	0.2	0.1	3.1	2.8	..	..
Norway	–	–	–	–	–	–	–	–	–	–	..	–
Portugal	–	–	–	–	0.2	0.3	0.4	0.2	0.8	0.2	–	0.1
Spain	6.2	7.0	6.1	5.7	3.9	7.5	2.5	6.3	3.5	3.9	6.7	5.6
Sweden	0.9	0.6	0.3	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.1	–
Switzerland	0.4	0.5	–	–	–	–	–	–	–	–	–	–
Turkey	0.2	0.3	0.1	4.7	2.4	1.9	0.6	0.9	0.3	0.8	0.1	0.1
United Kingdom	7.7	11.4	10.8	5.3	2.8	1.3	3.4	7.4	5.9	3.9	–	–
Estimated IEA Total [2]	**842.6**	**559.8**	**607.0**	**365.6**	**337.0**	**338.8**	**271.6**	**386.1**	**495.5**	**484.9**	**520.1**	**430.1**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B8

IEA Government R&D Budgets for Conventional Nuclear[1]

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[2]	161.6	158.1	120.1	116.2	97.1	73.9	65.1	54.5	55.8	47.4	56.8	80.2
United States	118.2	102.6	46.7	66.4	23.2	25.8	39.0	51.8	53.0	137.1	131.1	170.6
Australia	..	7.7	..	1.1	..	..	..	..	..	..	..	..
Japan	1 930.3	2 115.7	2 234.9	2 144.3	2 106.7	2 138.1	2 027.1	2 123.2	2 658.8	2 595.8	2 230.7	2 257.1
Korea	..	..	..	..	..	..	..	..	31.6	36.5	212.0	230.7
New Zealand	–	–	–	–	–	–	–	–	–	–	–	–
Austria	0.8	0.7	1.1	0.8	–	0.5	–	0.3	0.2	–	0.2	..
Belgium	23.4	30.9	45.6	46.7	62.9	48.7	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	3.5	..	..
Denmark	1.0	0.7	0.7	0.7	3.9	3.8	3.6	3.2	2.5	2.3	2.0	1.7
Finland	9.2	7.8	9.9	9.0	9.5	10.4	8.1	7.4	5.0	5.7	..	..
France	450.8	579.6	545.3	556.5	598.2	705.5	651.6	443.9	351.5	..	..	..
Germany	88.1	86.6	68.2	48.5	46.6	26.2	30.2	21.2	37.4	30.5	30.3	27.6
Greece	0.2	0.4	0.4	0.3	..	..	..	..	..	..	..	..
Hungary	..	–	–	..	0.3	0.5	1.3	1.3	1.3	1.5	0.5	0.5
Ireland	..	..	..	..	..	..	..	..	–	–	0.2	–
Italy	71.9	57.2	51.6	51.0	45.8	..	66.1	64.4	62.6	59.5	58.0	49.7
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	17.4	16.5	14.6	16.1	9.9	10.6	19.6	19.2	11.7	9.8	..	..
Norway	12.0	12.3	11.6	11.3	12.7	11.9	10.8	10.5	10.7	10.4	11.3	10.7
Portugal	3.1	0.1	0.2	0.1	–	–	–	–	–	–	–	–
Spain	26.6	25.0	25.0	24.6	11.5	7.4	20.2	20.7	19.1	19.4	8.0	7.5
Sweden	1.8	1.6	1.4	5.2	5.2	5.2	5.1	5.0	5.4	5.3	5.3	5.2
Switzerland	29.7	28.7	25.0	25.6	24.0	17.5	23.9	22.3	24.7	25.3	24.2	24.0
Turkey	1.4	1.0	1.1	1.8	1.2	0.2	0.2	0.3	–	0.4	–	–
United Kingdom	19.1	17.0	9.0	2.2	4.2	–	–	–	–	0.4	4.3	4.2
Estimated IEA Total [3]	**2 963.6**	**3 249.8**	**3 215.1**	**3 124.1**	**3 060.9**	**3 140.4**	**3 019.3**	**2 893.8**	**3 346.8**	**3 352.8**	**2 928.8**	**3 017.8**

1. Conventional Nuclear refers to Total Nuclear Fission minus Nuclear Breeder.
2. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
3. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B9

IEA Government R&D Budgets for Nuclear Breeders

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	–	–	–	–	0.2	0.6	0.5	0.6	0.6	0.5	0.4	0.5
United States	–	–	–	–	–	–	–	–	–	–	–	–
Australia	..	–	..	–	..	..	..	..	..	..	..	..
Japan	434.4	339.3	314.1	270.0	233.2	215.5	365.9	301.6	136.0	139.4	127.7	140.9
Korea	..	..	..	..	..	..	..	..	–	–	–	–
New Zealand	–	–	–	–	–	–	–	–	–	–	–	–
Austria	–	–	–	–	–	–	–	–	–	–	–	..
Belgium	..	–	–	–	–	–	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	–	..	..
Denmark	–	–	–	–	–	–	–	–	–	–	–	–
Finland	–	1.1	–	–	–	–	–	–	–	–	..	..
France	46.8	19.9	19.1	15.4	28.1	26.1	14.8	–	5.2	..	..	..
Germany	–	–	–	–	–	–	–	–	–	–	–	–
Greece	–	–	–	–	..	..	..	..	..	..	..	..
Hungary	..	–	–	..	–	–	..	–	–	–	–	–
Ireland	..	..	..	..	..	..	..	..	–	–	–	–
Italy	–	–	–	–	–	..	–	–	–	–	–	–
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	30.7	–	–	–	–	–	–	–	4.8	4.6	..	..
Norway	–	–	–	–	–	–	–	–	–	–	–	–
Portugal	–	–	–	–	–	–	–	–	–	–	–	–
Spain	–	–	–	–	–	–	1.2	–	–	–	–	–
Sweden	5.4	4.9	4.3	..	..	..	..	..	..	–	–	–
Switzerland	0.6	1.1	1.2	0.4	0.1	0.1	0.1	0.1	–	–	–	–
Turkey	–	–	–	–	–	–	–	–	–	–	–	–
United Kingdom	2.4	0.3	–	–	–	–	–	–	–	–	..	..
Estimated IEA Total [2]	**526.0**	**366.6**	**338.7**	**289.7**	**265.6**	**246.1**	**386.4**	**306.0**	**150.6**	**149.7**	**136.7**	**150.2**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B10

IEA Government R&D Budgets for Nuclear Fusion

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	8.6	8.4	9.3	–	3.4	0.2	1.1	1.1	1.1	0.5	0.3	0.4
United States	408.0	448.4	285.3	257.9	252.4	252.6	267.1	272.0	259.4	253.8	262.9	273.9
Australia	..	–	..	–	..	..	..	..	..	..	..	..
Japan	292.0	300.4	333.5	311.1	252.0	248.1	238.4	205.6	128.4	123.0	111.7	109.9
Korea	..	..	..	..	..	..	..	..	–	–	5.9	2.9
New Zealand	–	–	–	–	–	–	–	–	–	–	–	–
Austria	1.5	1.5	0.8	1.5	3.3	3.5	3.7	4.1	4.3	3.8	3.9	..
Belgium	11.8	4.6	6.3	6.7	6.9	7.7	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	–	..	..
Denmark	–	–	–	–	2.4	2.5	2.5	1.7	1.7	1.3	1.3	1.4
Finland	–	–	1.2	2.0	1.3	3.2	1.9	1.5	4.2	–	..	..
France	46.5	47.8	47.4	46.8	41.0	41.1	39.1	42.4	49.3	..	..	..
Germany	140.4	120.4	129.4	142.1	159.2	80.2	159.8	142.3	112.0	145.3	144.9	142.9
Greece	–	–	–	–	..	..	..	..	..	..	..	..
Hungary	..	–	–	..	–	–	..	–	–	–	–	–
Ireland	..	..	..	..	..	..	..	..	–	–	–	–
Italy	94.5	95.5	104.0	102.0	97.8	..	86.4	84.1	67.2	58.9	51.0	49.7
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	22.2	9.7	8.2	11.1	10.3	11.2	12.6	10.0	7.0	9.2	..	..
Norway	–	–	–	–	–	–	–	–	–	–	–	–
Portugal	–	–	–	–	–	–	–	–	–	2.6	–	–
Spain	24.3	23.1	23.2	23.0	21.3	23.9	15.0	14.9	14.7	14.1	8.8	12.1
Sweden	12.2	2.2	2.0	1.6	1.7	1.5	1.5	1.4	1.5	1.5	1.5	1.5
Switzerland	24.1	21.4	25.1	26.0	21.1	21.4	20.3	20.2	19.2	18.5	18.6	18.4
Turkey	–	–	–	–	–	–	–	–	–	–	–	–
United Kingdom	38.2	36.9	27.0	37.1	27.6	30.0	35.0	29.4	30.4	30.3	29.0	35.5
Estimated IEA Total [2]	**1 124.1**	**1 120.3**	**1 002.8**	**968.9**	**901.7**	**819.3**	**892.7**	**838.6**	**707.1**	**719.6**	**698.0**	**715.2**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B11

IEA Government R&D Budgets for Renewables

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	15.5	15.2	15.1	11.7	12.0	14.6	27.0	23.9	26.5	40.7	27.9	33.8
United States	274.4	332.3	245.0	231.5	284.3	296.3	236.2	274.1	266.1	255.9	249.6	242.8
Australia	..	5.3	..	7.8	..	12.6	..	13.5	..	13.2	..	..
Japan	107.4	108.1	110.1	109.2	121.0	128.8	154.1	140.0	176.9	144.5	311.3	285.4
Korea	..	..	..	..	..	..	..	..	12.5	15.1	37.5	53.0
New Zealand	1.3	1.5	1.9	1.9	2.2	1.5	1.6	2.8	2.0	2.8	3.1	3.0
Austria	9.3	11.0	8.5	10.3	13.6	12.7	8.8	10.5	12.7	12.8	12.1	..
Belgium	3.2	5.2	3.8	4.3	1.8	1.4	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	0.8	..	..
Denmark	23.7	22.2	18.0	23.2	25.5	22.1	22.3	24.9	12.8	12.6	29.3	29.9
Finland	7.4	7.5	9.5	15.3	11.1	12.5	11.5	10.6	12.5	21.8	..	..
France	6.8	6.7	6.3	3.9	5.2	17.1	17.7	23.9	30.7	..	..	..
Germany	105.2	93.1	116.0	91.3	102.9	90.7	95.5	91.0	96.1	87.3	70.9	123.5
Greece	2.6	4.6	4.3	9.0	..	..	2.6	3.8	4.5	..	..	..
Hungary	..	0.6	0.1	..	–	–	0.6	1.4	2.4	1.8	3.5	3.4
Ireland	..	..	..	..	..	..	..	..	0.8	2.0	3.6	3.0
Italy	42.5	57.9	54.1	49.8	46.4	..	31.8	52.4	70.0	66.2	64.8	61.5
Luxembourg	0.1	–	0.1	0.5	0.2	0.7	0.5	..	..	..	..	..
Netherlands	35.4	31.7	38.2	50.7	55.7	57.9	43.4	55.5	57.3	61.6	..	..
Norway	11.0	7.2	6.7	6.6	7.8	7.7	7.7	6.0	5.7	5.1	5.6	5.4
Portugal	0.8	0.8	1.6	0.8	1.7	1.9	1.1	0.5	1.7	0.3	1.6	1.0
Spain	21.7	21.0	21.0	21.0	26.1	22.4	24.3	22.7	22.3	27.4	28.0	27.6
Sweden	20.3	15.7	10.0	10.3	16.7	16.3	31.7	34.1	32.0	26.1	42.7	15.2
Switzerland	46.1	45.2	43.2	45.7	44.5	45.7	33.2	32.3	34.2	35.9	38.4	40.1
Turkey	0.5	0.1	0.2	3.0	2.4	1.6	1.8	0.7	1.4	0.9	0.5	0.4
United Kingdom	21.7	21.2	13.9	9.4	6.9	9.6	9.0	12.2	20.4	22.0	36.4	66.5
Estimated IEA Total [2]	**761.8**	**808.6**	**729.5**	**707.4**	**797.7**	**811.9**	**773.2**	**833.4**	**896.3**	**868.6**	**1 082.3**	**1 113.2**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B12

IEA Government R&D Budgets for Power and Storage (including Hydrogen and Fuel Cells)

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[1]	11.9	11.6	9.9	5.5	5.9	6.1	20.8	26.5	31.3	45.6	41.3	42.1
United States	144.0	160.2	144.4	147.6	146.7	145.7	138.8	148.1	155.9	172.8	269.9	292.1
Australia	..	6.6	..	6.1	..	11.1	..	7.2	..	5.1	..	..
Japan	69.7	69.8	72.8	74.9	129.0	134.3	165.9	190.5	77.0	39.8	56.7	50.6
Korea	..	..	..	..	..	..	..	..	20.0	29.2	69.0	80.1
New Zealand	–	0.1	0.4	0.4	0.3	0.9	0.9	0.7	0.8	..	1.9	1.8
Austria	5.9	5.0	5.8	5.1	5.8	4.2	4.4	6.1	5.0	5.1	9.5	..
Belgium	5.4	7.4	7.4	2.4	6.3	3.7	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	..	..	..
Denmark	5.3	5.1	5.6	5.6	5.7	5.3	4.8	5.2	4.6	4.9	14.2	23.1
Finland	21.1	20.8	16.0	21.6	19.5	19.6	16.8	17.3	18.2	15.9	..	..
France	..	..	..	..	..	..	0.9	2.7	5.8	..	..	..
Germany	3.8	2.6	15.0	26.2	27.9	10.0	27.5	53.8	44.2	41.7	39.0	30.9
Greece	0.1	0.1	0.1	0.3	..	..	3.1	3.3	3.5	..	..	..
Hungary	..	..	..	..	0.2	–	..	..	..	0.1	–	–
Ireland	..	..	..	..	..	..	..	..	0.6	0.2	0.5	0.6
Italy	27.3	21.7	22.2	20.5	21.4	..	111.4	108.5	105.3	102.3	99.7	82.0
Luxembourg	–	–	–	0.7	–	–	–	..	..	..	..	..
Netherlands	49.5	21.1	23.9	24.4	16.7	13.9	13.2	11.8	12.6	13.5	..	..
Norway	4.4	5.5	4.1	3.7	3.3	2.8	8.0	3.9	5.5	5.3	7.0	13.1
Portugal	..	–	–	–	0.1	–	–	0.1	–	..	–	–
Spain	..	0.5	0.5	0.5	0.5	1.8	2.3	1.3	..	0.7	–	–
Sweden	11.3	5.3	1.3	13.0	9.2	19.1	9.8	11.9	12.4	14.9	17.8	11.0
Switzerland	22.7	22.9	24.5	19.2	21.2	20.6	22.5	26.1	24.4	22.4	26.7	27.2
Turkey	0.1	..	..	0.2	0.2	0.7	1.7	1.1	1.4	0.9	0.1	0.3
United Kingdom	8.9	7.1	2.5	2.4	2.5	2.9	3.5	3.2	8.4	5.7	11.0	11.8
Estimated IEA Total [2]	**398.8**	**373.5**	**362.6**	**379.4**	**430.5**	**451.7**	**566.7**	**631.1**	**523.1**	**506.4**	**627.0**	**624.3**

1. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
2. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B12a

IEA Government R&D Budgets for Other Cross-cutting Technologies or Research[1]

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
Canada[2]	10.7	10.5	16.4	18.9	14.3	27.2	34.6	41.6	31.8	31.1	33.8	24.1
United States	952.7	905.0	941.5	957.4	949.7	1 127.6	1 023.4	1 312.1	1 250.3	1 228.7	1 261.2	1 382.5
Australia	..	21.9	..	17.1	..	8.5	..	16.8	..	26.3	..	..
Japan	114.3	118.9	118.8	121.7	107.8	70.5	75.6	85.0	354.2	307.8	236.2	248.1
Korea	..	..	..	..	..	..	..	..	13.7	22.5	1.2	1.1
New Zealand	0.3	0.2	0.1	..	0.9	0.4	0.5	0.2	0.4	1.5	0.4	0.4
Austria	1.6	2.3	2.7	3.8	5.0	4.1	4.4	5.6	5.1	3.5	3.8	..
Belgium	2.5	2.5	1.6	2.0	1.4	0.8	..	..	..	..	..	..
Czech Republic	..	..	..	..	..	..	..	..	..	..	..	..
Denmark	5.3	7.2	7.6	7.5	9.1	9.3	6.9	7.8	7.7	8.2	6.9	8.2
Finland	8.3	12.4	10.7	8.6	5.2	5.0	7.2	5.2	8.8	6.7	..	..
France	..	..	..	..	..	..	10.1	11.9	19.5	..	..	..
Germany[3]	23.8	7.6	13.8	11.6	10.4	8.6	14.2	16.3	10.1	139.3	144.8	154.2
Greece	0.8	1.9	3.1	1.5	..	..	..	..	..	..	..	..
Hungary	..	..	..	..	0.4	..	..	..	..	0.1	–	–
Ireland	..	..	..	..	..	..	..	..	0.1	0.4	1.3	1.4
Italy	81.5	93.1	63.0	44.4	47.9	..	45.7	48.6	47.1	45.8	44.6	31.1
Luxembourg	..	..	..	..	..	..	..	..	..	..	..	..
Netherlands	10.4	24.7	15.3	19.3	19.5	17.3	24.0	32.0	10.3	10.0	..	..
Norway	7.4	7.6	8.2	7.6	6.3	5.9	1.4	11.8	18.9	11.2	12.8	12.0
Portugal	–	–	–	–	0.2	0.3	0.3	–	..	–	–	–
Spain	27.1	19.4	19.0	19.4	2.9	10.6	0.8	3.0	1.5	3.4	2.0	1.9
Sweden	15.3	13.8	13.9	17.8	14.1	17.3	11.9	12.1	13.2	15.2	19.5	8.2
Switzerland	14.9	14.7	13.3	13.2	10.1	10.4	10.2	12.2	12.6	14.8	15.0	15.2
Turkey	0.1	0.4	0.3	0.2	0.1	0.2	0.1	0.4	0.6	0.5	0.1	0.1
United Kingdom	11.5	11.9	9.1	39.4	40.1	38.6	38.9	4.4	1.9	0.8	9.3	11.9
Estimated IEA Total [4]	**1 306.3**	**1 274.2**	**1 274.7**	**1 309.9**	**1 257.1**	**1 409.4**	**1 322.9**	**1 627.8**	**1 815.8**	**1 875.9**	**1 841.6**	**1 954.2**

1. Includes CO_2 Capture and Storage.
2. All data refer to the fiscal year, April 2005 to March 2006 for 2005.
3. For 2003, 2004 and 2005 data include the institutionally financed R&D activities of the Helmholtz centres, which were not considered in the last years and cannot be allocated to a specific technology area.
4. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been included in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.

Note: Budgets provided for recent years by some countries may have been estimated.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B13

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	Australia				Austria			
	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
GROUP 1: ENERGY EFFICIENCY	..	..	..	..	**12.48**	**29.30**	..	..
I.1 Industry	..	..	..	..	1.00	2.36	..	..
I.2 Residential/Commercial	..	..	..	..	3.64	8.55	..	..
I.3 Transport	..	..	..	..	6.72	15.78	..	..
I.4 Other Conservation	..	..	..	..	1.11	2.61	..	..
GROUP II: FOSSIL FUELS	..	..	..	..	**0.57**	**1.34**	..	..
II.1 Total Oil and Gas	..	..	..	..	0.34	0.81	..	..
II.1.1 Enhanced Oil and Gas Production	..	..	..	..	–	–	..	..
II.1.2 Refining. Transp. and Stor. of Oil and Gas	..	..	..	..	0.20	0.47	..	..
II.1.3 Non-Conventional Oil and Gas Production	..	..	..	..	–	–	..	..
II.1.4 Oil and Gas Combustion	..	..	..	..	–	–	..	..
II.1.5 Oil and Gas Conversion	..	..	..	..	–	–	..	..
II.1.6 Other Oil and Gas	..	..	..	..	0.14	0.34	..	..
II.2 Total Coal	..	..	..	..	0.23	0.54	..	..
II.2.1 Coal Prod., Prep., and Trans.	..	..	..	..	–	–	..	..
II.2.2 Coal Combustion	..	..	..	..	0.12	0.28	..	..
II.2.3 Coal Conversion (excl. IGCC)	..	..	..	..	–	–	..	..
II.2.4 Other Coal	..	..	..	..	0.11	0.27	..	..
II.3 Total CO_2 Capture and Storage	..	..	..	..	–	–	..	..
GROUP III: RENEWABLE ENERGY SOURCES	..	..	..	..	**12.12**	**28.46**	..	..
III.1 Total Solar Energy	..	..	..	..	1.75	4.11	..	..
III.1.1 Solar Heating and Cooling (incl. Daylighting)	..	..	..	..	1.01	2.38	..	..
III.1.2 Photovoltaics	..	..	..	..	0.49	1.15	..	..
III.1.3 Solar Thermal Power and High Temp. Apps	..	..	..	..	0.25	0.58	..	..
III.2 Wind Energy	..	..	..	..	0.53	1.26	..	..
III.3 Ocean Energy	..	..	..	..	–	–	..	..
III.4 Total Bioenergy	..	..	..	..	9.14	21.46	..	..
III.4.1 Prod. of Transport Biofuels incl. from Wastes	..	..	..	..	–	–	..	..
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	..	..	..	..	–	–	..	..
III.4.3 Applications for Heat and Electricity	..	..	..	..	–	–	..	..
III.4.4 Other Bioenergy	..	..	..	..	9.14	21.46	..	..
III.5 Geothermal Energy	..	..	..	..	0.36	0.84	..	..
III.6 Total Hydropower	..	..	..	..	0.34	0.80	..	..
III.6.1 Large Hydropower (capacity >10 MW)	..	..	..	..	–	–	..	..
III.6.2 Small Hydropower (capacity <10 MW)	..	..	..	..	0.34	0.80	..	..
III.7 Other Renewables	..	..	..	..	–	–	..	..
GROUP IV: NUCLEAR FISSION and FUSION	..	..	..	..	**4.10**	**9.63**	..	..
IV.1 Total Nuclear Fission	..	..	..	..	0.23	0.55	..	..
IV.1.1 Light-Water Reactors (LWRs)	..	..	..	..	–	–	..	..
IV.1.2 Other Converter Reactors	..	..	..	..	–	–	..	..
IV.1.3 Fuel Cycle	..	..	..	..	–	–	..	..
IV.1.4 Nuclear Supporting Technology	..	..	..	..	0.23	0.55	..	..
IV.1.5 Nuclear Breeder	..	..	..	..	–	–	..	..
IV.1.6 Other Nuclear Fission	..	..	..	..	–	–	..	..
IV.2 Nuclear Fusion	..	..	..	..	3.87	9.07	..	..
GROUP V: HYDROGEN and FUEL CELLS	..	..	..	..	**–**	**–**	..	..
V.1 Total Hydrogen	..	..	..	..	–	–	..	..
V.1.1 Hydrogen Production	..	..	..	..	–	–	..	..
V.1.2 Hydrogen Storage[1]	..	..	..	..	–	–	..	..
V.1.5 Hydrogen End Uses incl. Comb; excl. Fuel Cells	..	..	..	..	–	–	..	..
V.2 Total Fuel Cells	..	..	..	..	–	–	..	..
V.2.1 Stationary Applications	..	..	..	..	–	–	..	..
V.2.2 Mobile Applications	..	..	..	..	–	–	..	..
V.2.3 Other Applications	..	..	..	..	–	–	..	..
GROUP VI: OTHER POWER AND STORAGE TECHS	..	..	..	..	**9.55**	**22.42**	..	..
VI.1 Electric Power Conversion	..	..	..	..	5.79	13.60	..	..
VI.2 Electricity Transm., and Distr.	..	..	..	..	2.58	6.05	..	..
VI.3 Energy Storage	..	..	..	..	1.18	2.77	..	..
GROUP VII: TOTAL OTHER TECH./RESEARCH	..	..	..	..	**3.77**	**8.85**	..	..
VII.1 Energy System Analysis	..	..	..	..	2.17	5.10	..	..
VII.2 Other	..	..	..	..	1.60	3.75	..	..
TOTAL ENERGY RD&D	..	..	..	..	**42.60**	**100.00**	..	..

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
2. All data refer to the fiscal year, April 2005 to March 2006 for 2005.

Belgium				Canada[2]				Czech Republic			
2004		2005e		2004		2005e		2004		2005e	
USD	%	USD	%	USD	%	USD	%	USD	%	USD	%
..	..	..	..	**45.23**	**17.04**	**46.67**	**15.62**	..	..	..	..
..	..	..	..	14.60	5.50	14.35	4.80	..	..	..	..
..	..	..	..	17.19	6.48	15.88	5.31	..	..	..	..
..	..	..	..	8.32	3.13	8.99	3.01	..	..	..	..
..	..	..	..	5.12	1.93	7.46	2.49	..	..	..	..
..	..	..	..	**74.50**	**28.06**	**83.87**	**28.06**	..	..	..	..
..	..	..	..	51.84	19.53	61.94	20.72	..	..	..	..
..	..	..	..	6.37	2.40	7.45	2.49	..	..	..	..
..	..	..	..	4.79	1.80	5.31	1.78	..	..	..	..
..	..	..	..	17.64	6.64	22.66	7.58	..	..	..	..
..	..	..	..	0.83	0.31	1.25	0.42	..	..	..	..
..	..	..	..	2.63	0.99	1.04	0.35	..	..	..	..
..	..	..	..	19.60	7.38	24.22	8.10	..	..	..	..
..	..	..	..	7.82	2.95	9.30	3.11	..	..	..	..
..	..	..	..	0.14	0.05	0.15	0.05	..	..	..	..
..	..	..	..	3.68	1.39	4.55	1.52	..	..	..	..
..	..	..	..	2.11	0.79	3.26	1.09	..	..	..	..
..	..	..	..	1.89	0.71	1.34	0.45	..	..	..	..
..	..	..	..	14.84	5.59	12.64	4.23	..	..	..	..
..	..	..	..	**27.92**	**10.51**	**33.79**	**11.30**	..	..	..	..
..	..	..	..	8.73	3.29	8.63	2.89	..	..	..	..
..	..	..	..	4.00	1.51	4.41	1.48	..	..	..	..
..	..	..	..	4.73	1.78	4.22	1.41	..	..	..	..
..	..	..	..	–	–	–	–	..	..	..	..
..	..	..	..	3.22	1.21	4.38	1.47	..	..	..	..
..	..	..	..	–	–	0.29	0.10	..	..	..	..
..	..	..	..	12.00	4.52	16.60	5.55	..	..	..	..
..	..	..	..	5.57	2.10	7.16	2.40	..	..	..	..
..	..	..	..	1.08	0.41	3.23	1.08	..	..	..	..
..	..	..	..	3.42	1.29	4.16	1.39	..	..	..	..
..	..	..	..	1.94	0.73	2.05	0.69	..	..	..	..
..	..	..	..	1.15	0.43	0.52	0.17	..	..	..	..
..	..	..	..	2.63	0.99	3.20	1.07	..	..	..	..
..	..	..	..	0.66	0.25	0.77	0.26	..	..	..	..
..	..	..	..	1.97	0.74	2.42	0.81	..	..	..	..
..	..	..	..	0.17	0.06	0.18	0.06	..	..	..	..
..	..	..	..	**57.60**	**21.69**	**81.02**	**27.11**	..	..	..	..
..	..	..	..	57.26	21.57	80.66	26.99	..	..	..	..
..	..	..	..	0.43	0.16	0.45	0.15	..	..	..	..
..	..	..	..	55.03	20.73	66.01	22.08	..	..	..	..
..	..	..	..	0.45	0.17	0.45	0.15	..	..	..	..
..	..	..	..	0.47	0.18	0.45	0.15	..	..	..	..
..	..	..	..	0.43	0.16	0.45	0.15	..	..	..	..
..	..	..	..	0.43	0.16	12.84	4.30	..	..	..	..
..	..	..	..	0.34	0.13	0.36	0.12	..	..	..	..
..	..	..	..	**32.40**	**12.20**	**33.35**	**11.16**	..	..	..	..
..	..	..	..	16.07	6.05	14.91	4.99	..	..	..	..
..	..	..	..	2.36	0.89	2.93	0.98	..	..	..	..
..	..	..	..	13.19	4.97	11.32	3.79	..	..	..	..
..	..	..	..	0.52	0.20	0.66	0.22	..	..	..	..
..	..	..	..	16.32	6.15	18.44	6.17	..	..	..	..
..	..	..	..	4.35	1.64	5.86	1.96	..	..	..	..
..	..	..	..	9.30	3.50	9.86	3.30	..	..	..	..
..	..	..	..	2.68	1.01	2.72	0.91	..	..	..	..
..	..	..	..	**8.88**	**3.34**	**8.75**	**2.93**	..	..	..	..
..	..	..	..	1.29	0.48	1.23	0.41	..	..	..	
..	..	..	..	3.52	1.32	3.79	1.27	..	..	..	..
..	..	..	..	4.07	1.53	3.73	1.25	..	..	..	..
..	..	..	..	**18.98**	**7.15**	**11.44**	**3.83**	..	..	..	..
..	..	..	..	5.14	1.94	7.37	2.47	..	..	..	..
..	..	..	..	13.84	5.21	4.07	1.36	..	..	..	..
..	..	..	..	**265.50**	**100.00**	**298.89**	**100.00**	..	..	..	..

Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B13 *(continued)*

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	Denmark				Finland			
	2004		2005e		2004		2005e	
	USD	%	USD	%	USD	%	USD	%
GROUP 1: ENERGY EFFICIENCY	**5.20**	**8.84**	**6.14**	**8.12**	..	..	..	..
I.1 Industry	1.89	3.21	2.12	2.80	..	..	..	..
I.2 Residential/Commercial	2.19	3.73	2.67	3.53	..	..	..	..
I.3 Transport	–	–	–	–	..	..	..	..
I.4 Other Conservation	1.12	1.90	1.35	1.79	..	..	..	..
GROUP II: FOSSIL FUELS	**–**	**–**	**5.43**	**7.18**	..	..	..	..
II.1 Total Oil and Gas	–	–	5.09	6.74	..	..	..	..
II.1.1 Enhanced Oil and Gas Production	–	–	4.30	5.69	..	..	..	..
II.1.2 Refining. Transp. and Stor. of Oil and Gas	–	–	–	–	..	..	..	..
II.1.3 Non-Conventional Oil and Gas Production	–	–	–	–	..	..	..	..
II.1.4 Oil and Gas Combustion	–	–	0.79	1.05	..	..	..	..
II.1.5 Oil and Gas Conversion	–	–	–	–	..	..	..	..
II.1.6 Other Oil and Gas	–	–	–	–	..	..	..	..
II.2 Total Coal	–	–	–	–	..	..	..	..
II.2.1 Coal Prod. Prep. and Trans.	–	–	–	–	..	..	..	..
II.2.2 Coal Combustion	–	–	–	–	..	..	..	..
II.2.3 Coal Conversion (excl. IGCC)	–	–	–	–	..	..	..	..
II.2.4 Other Coal	–	–	–	–	..	..	..	..
II.3 Total CO_2 Capture and Storage	–	–	0.33	0.44	..	..	..	..
GROUP III: RENEWABLE ENERGY SOURCES	**29.27**	**49.72**	**29.89**	**39.55**	..	..	..	..
III.1 Total Solar Energy	3.23	5.49	3.82	5.06	..	..	..	..
III.1.1 Solar Heating and Cooling (incl. Daylighting)	0.41	0.70	–	–	..	..	..	..
III.1.2 Photovoltaics	2.82	4.79	3.82	5.06	..	..	..	..
III.1.3 Solar Thermal Power and High Temp. Apps	–	–	–	–	..	..	..	..
III.2 Wind Energy	13.76	23.37	11.87	15.71	..	..	..	..
III.3 Ocean Energy	0.17	0.29	1.56	2.06	..	..	..	..
III.4 Total Bioenergy	12.11	20.57	12.64	16.72	..	..	..	..
III.4.1 Prod. of Transport Biofuels incl. from Wastes	2.01	3.41	4.09	5.41	..	..	..	..
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	1.32	2.25	1.47	1.95	..	..	..	..
III.4.3 Applications for Heat and Electricity	8.58	14.57	7.03	9.30	..	..	..	..
III.4.4 Other Bioenergy	0.20	0.34	0.05	0.06	..	..	..	..
III.5 Geothermal Energy	–	–	–	–	..	..	..	..
III.6 Total Hydropower	–	–	–	–	..	..	..	..
III.6.1 Large Hydropower (capacity >10 MW)	–	–	–	–	..	..	..	..
III.6.2 Small Hydropower (capacity <10 MW)	–	–	–	–	..	..	..	..
III.7 Other Renewables	–	–	–	–	..	..	..	..
GROUP IV: NUCLEAR FISSION AND FUSION	**3.26**	**5.53**	**3.12**	**4.13**	..	..	..	..
IV.1 Total Nuclear Fission	1.95	3.32	1.73	2.29	..	..	..	..
IV.1.1 Light-Water Reactors (LWRs)	–	–	–	–	..	..	..	..
IV.1.2 Other Converter Reactors	–	–	–	–	..	..	..	..
IV.1.3 Fuel Cycle	–	–	–	–	..	..	..	..
IV.1.4 Nuclear Supporting Technology	1.95	3.32	1.73	2.29	..	..	..	..
IV.1.5 Nuclear Breeder	–	–	–	–	..	..	..	..
IV.1.6 Other Nuclear Fission	–	–	–	–	..	..	..	..
IV.2 Nuclear Fusion	1.31	2.22	1.38	1.83	..	..	..	..
GROUP V: HYDROGEN AND FUEL CELLS	**10.81**	**18.37**	**19.85**	**26.26**	..	..	..	..
V.1 Total Hydrogen	0.68	1.15	2.47	3.27	..	..	..	..
V.1.1 Hydrogen Production	0.61	1.04	0.11	0.14	..	..	..	..
V.1.2 Hydrogen Storage[1]	0.07	0.11	2.03	2.69	..	..	..	..
V.1.5 Hydrogen End Uses incl. Comb; excl. Fuel Cells	–	–	0.33	0.44	..	..	..	..
V.2 Total Fuel Cells	10.13	17.22	17.38	22.99	..	..	..	..
V.2.1 Stationary Applications	9.54	16.21	16.21	21.45	..	..	..	..
V.2.2 Mobile Applications	0.59	1.01	1.16	1.54	..	..	..	..
V.2.3 Other Applications	–	–	–	–	..	..	..	..
GROUP VI: OTHER POWER and STORAGE TECHS	**3.38**	**5.74**	**3.27**	**4.33**	..	..	..	..
VI.1 Electric Power Conversion	–	–	–	–	..	..	..	..
VI.2 Electricity Transm. and Distr.	–	–	–	–	..	..	..	..
VI.3 Energy Storage	3.38	5.74	3.27	4.33	..	..	..	..
GROUP VII: TOTAL OTHER TECH./RESEARCH	**6.95**	**11.80**	**7.90**	**10.45**	..	..	..	..
VII.1 Energy System Analysis	3.46	5.87	4.94	6.54	..	..	..	..
VII.2 Other	3.49	5.93	2.96	3.91	..	..	..	..
TOTAL ENERGY RD&D	**58.87**	**100.00**	**75.59**	**100.00**	..	..	..	..

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
2. All data refer to the fiscal year, April 2005 to March 2006 for 2005.

	France				Germany[2]				Greece			
	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
	..	..	..	..	**25.71**	**5.56**	**24.33**	**4.74**	..	..	..	..
	..	..	..	..	5.53	1.20	6.29	1.23	..	..	..	..
	..	..	..	..	17.47	3.78	14.77	2.88	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	2.71	0.59	3.27	0.64	..	..	..	..
	..	..	..	..	**12.31**	**2.66**	**14.31**	**2.79**	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	6.70	1.45	9.93	1.93	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	6.70	1.45	9.93	1.93	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	5.61	1.21	4.38	0.85	..	..	..	..
	..	..	..	..	**70.91**	**15.34**	**123.51**	**24.06**	..	..	..	..
	..	..	..	..	49.27	10.66	72.35	14.10	..	..	..	..
	..	..	..	..	13.88	3.00	15.25	2.97	..	..	..	..
	..	..	..	..	30.51	6.60	50.94	9.92	..	..	..	..
	..	..	..	..	4.88	1.06	6.16	1.20	..	..	..	..
	..	..	..	..	9.25	2.00	21.27	4.14	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	5.00	1.08	14.72	2.87	..	..	..	..
	..	..	..	..	1.25	0.27	3.65	0.71	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	2.89	0.62	5.33	1.04	..	..	..	..
	..	..	..	..	0.86	0.19	5.74	1.12	..	..	..	..
	..	..	..	..	7.38	1.60	15.18	2.96	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	**175.16**	**37.89**	**170.43**	**33.21**	..	..	..	..
	..	..	..	..	30.26	6.55	27.58	5.37	..	..	..	..
	..	..	..	..	21.01	4.55	18.63	3.63	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	9.25	2.00	8.94	1.74	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	144.90	31.35	142.86	27.83	..	..	..	..
	..	..	..	..	**32.79**	**7.09**	**26.74**	**5.21**	..	..	..	..
	..	..	..	..	–	–	0.35	0.07	..	..	..	..
	..	..	..	..	–	–	0.35	0.07	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	32.79	7.09	26.40	5.14	..	..	..	..
	..	..	..	..	29.51	6.38	24.02	4.68	..	..	..	..
	..	..	..	..	2.95	0.64	1.58	0.31	..	..	..	..
	..	..	..	..	0.33	0.07	0.79	0.15	..	..	..	..
	..	..	..	..	**6.19**	**1.34**	**4.13**	**0.80**	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	–	–	–	–	..	..	..	..
	..	..	..	..	6.19	1.34	4.13	0.80	..	..	..	..
	..	..	..	..	**139.16**	**30.11**	**149.79**	**29.19**	..	..	..	..
	..	..	..	..	0.41	0.09	1.41	0.27	..	..	..	..
	..	..	..	..	138.75	30.02	148.38	28.91	..	..	..	..
	..	..	..	..	**462.22**	**100.00**	**513.25**	**100.00**	..	..	..	..

Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B13 *(continued)*

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	Hungary				Ireland			
	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
GROUP 1: ENERGY EFFICIENCY	**–**	**–**	**–**	**–**	**6.88**	**54.35**	**8.39**	**61.82**
I.1 Industry	–	–	–	–	0.95	7.52	0.75	5.50
I.2 Residential/Commercial	–	–	–	–	5.93	46.83	7.64	56.32
I.3 Transport	–	–	–	–	–	–	–	–
I.4 Other Conservation	–	–	–	–	–	–	–	–
GROUP II: FOSSIL FUELS	**0.26**	**6.02**	**0.50**	**11.33**	**0.17**	**1.33**	**0.25**	**1.83**
II.1 Total Oil and Gas	0.26	6.02	0.50	11.33	0.17	1.33	0.25	1.83
II.1.1 Enhanced Oil and Gas Production	0.26	6.02	0.50	11.33	0.17	1.33	0.25	1.83
II.1.2 Refining. Transp. and Stor. of Oil and Gas	–	–	–	–	–	–	–	–
II.1.3 Non-Conventional Oil and Gas Production	–	–	–	–	–	–	–	–
II.1.4 Oil and Gas Combustion	–	–	–	–	–	–	–	–
II.1.5 Oil and Gas Conversion	–	–	–	–	–	–	–	–
II.1.6 Other Oil and Gas	–	–	–	–	–	–	–	–
II.2 Total Coal	–	–	–	–	–	–	–	–
II.2.1 Coal Prod. Prep. and Trans.	–	–	–	–	–	–	–	–
II.2.2 Coal Combustion	–	–	–	–	–	–	–	–
II.2.3 Coal Conversion (excl. IGCC)	–	–	–	–	–	–	–	–
II.2.4 Other Coal	–	–	–	–	–	–	–	–
II.3 Total CO_2 Capture and Storage	–	–	–	–	–	–	–	–
GROUP III: RENEWABLE ENERGY SOURCES	**3.47**	**81.65**	**3.41**	**77.06**	**3.63**	**28.65**	**3.00**	**22.15**
III.1 Total Solar Energy	–	–	–	–	0.11	0.83	0.04	0.30
III.1.1 Solar Heating and Cooling (incl. Daylighting)	–	–	–	–	0.06	0.46	–	–
III.1.2 Photovoltaics	–	–	–	–	0.05	0.37	0.04	0.30
III.1.3 Solar Thermal Power and High Temp. Apps	–	–	–	–	–	–	–	–
III.2 Wind Energy	0.09	2.17	0.10	2.27	1.10	8.65	1.17	8.63
III.3 Ocean Energy	–	–	–	–	0.26	2.07	0.20	1.44
III.4 Total Bioenergy	3.38	79.48	3.31	74.80	1.70	13.46	1.27	9.34
III.4.1 Prod. of Transport Biofuels incl. from Wastes	–	–	–	–	0.13	0.99	0.08	0.58
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	3.17	74.66	3.11	70.26	0.58	4.61	0.45	3.32
III.4.3 Applications for Heat and Electricity	0.20	4.82	0.20	4.53	0.99	7.85	0.74	5.44
III.4.4 Other Bioenergy	–	–	–	–	–	–	–	–
III.5 Geothermal Energy	–	–	–	–	0.20	1.57	0.03	0.25
III.6 Total Hydropower	–	–	–	–	0.26	2.07	0.30	2.20
III.6.1 Large Hydropower (capacity >10 MW)	–	–	–	–	–	–	–	–
III.6.2 Small Hydropower (capacity <10 MW)	–	–	–	–	0.26	2.07	0.30	2.20
III.7 Other Renewables	–	–	–	–	–	–	–	–
GROUP IV: NUCLEAR FISSION and FUSION	**0.52**	**12.33**	**0.51**	**11.60**	**0.16**	**1.25**	**–**	**–**
IV.1 Total Nuclear Fission	0.52	12.33	0.51	11.60	0.16	1.25	–	–
IV.1.1 Light-Water Reactors (LWRs)	–	–	–	–	–	–	–	–
IV.1.2 Other Converter Reactors	–	–	–	–	–	–	–	–
IV.1.3 Fuel Cycle	–	–	–	–	–	–	–	–
IV.1.4 Nuclear Supporting Technology	0.52	12.33	0.51	11.60	0.16	1.25	–	–
IV.1.5 Nuclear Breeder	–	–	–	–	–	–	–	–
IV.1.6 Other Nuclear Fission	–	–	–	–	–	–	–	–
IV.2 Nuclear Fusion	–	–	–	–	–	–	–	–
GROUP V: HYDROGEN and FUEL CELLS	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
V.1 Total Hydrogen	–	–	–	–	–	–	–	–
V.1.1 Hydrogen Production	–	–	–	–	–	–	–	–
V.1.2 Hydrogen Storage[1]	–	–	–	–	–	–	–	–
V.1.5 Hydrogen End Uses incl. Comb; Excl. Fuel Cells	–	–	–	–	–	–	–	–
V.2 Total Fuel Cells	–	–	–	–	–	–	–	–
V.2.1 Stationary Applications	–	–	–	–	–	–	–	–
V.2.2 Mobile Applications	–	–	–	–	–	–	–	–
V.2.3 Other Applications	–	–	–	–	–	–	–	–
GROUP VI: OTHER POWER and STORAGE TECHS	**–**	**–**	**–**	**–**	**0.50**	**3.95**	**0.56**	**4.12**
VI.1 Electric Power Conversion	–	–	–	–	–	–	–	–
VI.2 Electricity Transm. and Distr.	–	–	–	–	0.33	2.62	0.37	2.75
VI.3 Energy Storage	–	–	–	–	0.17	1.33	0.19	1.37
GROUP VII: TOTAL OTHER TECH./RESEARCH	**–**	**–**	**–**	**–**	**1.33**	**10.47**	**1.37**	**10.07**
VII.1 Energy System Analysis	–	–	–	–	–	–	–	–
VII.2 Other	–	–	–	–	1.33	10.47	1.37	10.07
TOTAL ENERGY RD&D	**4.25**	**100.00**	**4.42**	**100.00**	**12.67**	**100.00**	**13.56**	**100.00**

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Italy				Japan				Korea			
2004		2005e		2004		2005e		2004		2005e	
USD	%	USD	%	USD	%	USD	%	USD	%	USD	%
28.05	**7.72**	**29.81**	**9.30**	**442.79**	**11.50**	**464.73**	**11.90**	**24.61**	**6.89**	**38.52**	**9.33**
8.93	2.46	7.45	2.33	–	–	–	–	17.96	5.03	28.12	6.81
17.85	4.91	19.88	6.20	–	–	–	–	5.91	1.65	9.25	2.24
1.28	0.35	1.24	0.39	–	–	–	–	0.74	0.21	1.16	0.28
–	–	1.24	0.39	442.79	11.50	464.73	11.90	–	–	–	–
17.21	**4.74**	**16.77**	**5.23**	**332.89**	**8.65**	**348.47**	**8.92**	**8.38**	**2.34**	**7.71**	**1.87**
2.55	0.70	2.48	0.78	219.24	5.69	213.35	5.46	6.53	1.83	6.01	1.46
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	159.01	4.13	177.20	4.54	1.06	0.30	0.97	0.24
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	4.24	1.19	3.91	0.95
–	–	–	–	–	–	–	–	1.04	0.29	0.96	0.23
2.55	0.70	2.48	0.78	60.22	1.56	36.15	0.93	0.19	0.05	0.17	0.04
14.66	4.04	14.29	4.46	113.65	2.95	135.11	3.46	0.61	0.17	0.56	0.14
–	–	–	–	2.68	0.07	2.54	0.07	0.09	0.02	0.08	0.02
4.46	1.23	4.35	1.36	42.72	1.11	74.40	1.91	0.52	0.15	0.48	0.12
5.10	1.40	4.97	1.55	68.25	1.77	58.17	1.49	–	–	–	–
5.10	1.40	4.97	1.55	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	1.23	0.35	1.14	0.28
64.78	**17.82**	**61.49**	**19.19**	**311.33**	**8.09**	**285.41**	**7.31**	**37.51**	**10.50**	**52.96**	**12.83**
61.46	16.91	58.88	18.37	177.48	4.61	145.53	3.73	10.77	3.01	16.50	4.00
5.23	1.44	5.09	1.59	–	–	4.54	0.12	1.21	0.34	1.33	0.32
13.13	3.61	12.80	3.99	177.48	4.61	140.99	3.61	9.01	2.52	14.65	3.55
43.10	11.86	40.99	12.79	–	–	–	–	0.55	0.15	0.51	0.12
0.13	0.04	0.12	0.04	12.09	0.31	11.27	0.29	8.12	2.27	10.63	2.57
–	–	–	–	–	–	–	–	0.20	0.05	0.55	0.13
3.19	0.88	2.48	0.78	64.62	1.68	74.57	1.91	4.13	1.16	4.11	1.00
–	–	–	–	–	–	–	–	1.24	0.35	1.24	0.30
–	–	–	–	64.62	1.68	74.57	1.91	0.33	0.09	0.43	0.10
3.19	0.88	2.48	0.78	–	–	–	–	1.49	0.42	1.51	0.36
–	–	–	–	–	–	–	–	1.07	0.30	0.93	0.23
–	–	–	–	–	–	–	–	2.14	0.60	2.09	0.51
–	–	–	–	–	–	–	–	0.69	0.19	0.91	0.22
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	0.69	0.19	0.91	0.22
–	–	–	–	57.15	1.48	54.04	1.38	11.46	3.21	18.17	4.40
109.02	**30.00**	**99.38**	**31.01**	**2 470.13**	**64.16**	**2 507.93**	**64.22**	**217.87**	**60.97**	**233.59**	**56.58**
58.02	15.96	49.69	15.50	2 358.39	61.26	2 398.03	61.40	212.01	59.33	230.66	55.87
–	–	–	–	33.43	0.87	45.05	1.15	19.74	5.52	28.62	6.93
–	–	–	–	61.40	1.59	55.49	1.42	0.68	0.19	0.37	0.09
58.02	15.96	49.69	15.50	811.25	21.07	761.37	19.50	23.83	6.67	23.79	5.76
–	–	–	–	1 324.59	34.40	1 395.19	35.73	94.78	26.52	105.57	25.57
–	–	–	–	127.72	3.32	140.94	3.61	–	–	–	–
–	–	–	–	–	–	–	–	72.98	20.42	72.30	17.51
51.01	14.04	49.69	15.50	111.74	2.90	109.90	2.81	5.86	1.64	2.93	0.71
–	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**27.91**	**7.81**	**30.08**	**7.28**
–	–	–	–	–	–	–	–	6.29	1.76	7.35	1.78
–	–	–	–	–	–	–	–	1.01	0.28	0.83	0.20
–	–	–	–	–	–	–	–	3.45	0.96	4.82	1.17
–	–	–	–	–	–	–	–	1.83	0.51	1.71	0.41
–	–	–	–	–	–	–	–	21.61	6.05	22.73	5.50
–	–	–	–	–	–	–	–	12.58	3.52	7.56	1.83
–	–	–	–	–	–	–	–	7.19	2.01	11.82	2.86
–	–	–	–	–	–	–	–	1.85	0.52	3.35	0.81
99.72	**27.44**	**81.99**	**25.58**	**56.73**	**1.47**	**50.64**	**1.30**	**41.06**	**11.49**	**50.00**	**12.11**
38.25	10.53	31.06	9.69	–	–	–	–	24.27	6.79	25.29	6.13
45.90	12.63	37.27	11.63	56.73	1.47	50.64	1.30	13.42	3.76	19.99	4.84
15.56	4.28	13.66	4.26	–	–	–	–	3.37	0.94	4.73	1.14
44.63	**12.28**	**31.06**	**9.69**	**236.19**	**6.13**	**248.11**	**6.35**	**–**	**–**	**–**	**–**
12.75	3.51	6.21	1.94	–	–	–	–	–	–	–	–
31.88	8.77	24.84	7.75	236.19	6.13	248.11	6.35	–	–	–	–
363.41	**100.00**	**320.50**	**100.00**	**3 850.06**	**100.00**	**3 905.29**	**100.00**	**357.33**	**100.00**	**412.87**	**100.00**

Table B13 *(continued)*

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	Luxembourg				Netherlands			
	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
GROUP 1: ENERGY EFFICIENCY	..	..	..	..	..	..	..	..
I.1 Industry	..	..	..	..	..	..	..	..
I.2 Residential/Commercial	..	..	..	..	..	..	..	..
I.3 Transport	..	..	..	..	..	..	..	..
I.4 Other Conservation	..	..	..	..	..	..	..	..
GROUP II: FOSSIL FUELS	..	..	..	..	..	..	..	..
II.1 Total Oil and Gas	..	..	..	..	..	..	..	..
II.1.1 Enhanced Oil and Gas Production	..	..	..	..	..	..	..	..
II.1.2 Refining. Transp. and Stor. of Oil and Gas	..	..	..	..	..	..	..	..
II.1.3 Non-Conventional Oil and Gas Production	..	..	..	..	..	..	..	..
II.1.4 Oil and Gas Combustion	..	..	..	..	..	..	..	..
II.1.5 Oil and Gas Conversion	..	..	..	..	..	..	..	..
II.1.6 Other Oil and Gas	..	..	..	..	..	..	..	..
II.2 Total Coal	..	..	..	..	..	..	..	..
II.2.1 Coal Prod. Prep. and Trans.	..	..	..	..	..	..	..	..
II.2.2 Coal Combustion	..	..	..	..	..	..	..	..
II.2.3 Coal Conversion (excl. IGCC)	..	..	..	..	..	..	..	..
II.2.4 Other Coal	..	..	..	..	..	..	..	..
II.3 Total CO_2 Capture and Storage	..	..	..	..	..	..	..	..
GROUP III: RENEWABLE ENERGY SOURCES	..	..	..	..	..	..	..	..
III.1 Total Solar Energy	..	..	..	..	..	..	..	..
III.1.1 Solar Heating and Cooling (incl. Daylighting)	..	..	..	..	..	..	..	..
III.1.2 Photovoltaics	..	..	..	..	..	..	..	..
III.1.3 Solar Thermal Power and High Temp. Apps	..	..	..	..	..	..	..	..
III.2 Wind Energy	..	..	..	..	..	..	..	..
III.3 Ocean Energy	..	..	..	..	..	..	..	..
III.4 Total Bioenergy	..	..	..	..	..	..	..	..
III.4.1 Prod. of Transport Biofuels incl. from Wastes	..	..	..	..	..	..	..	..
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	..	..	..	..	..	..	..	..
III.4.3 Applications for Heat and Electricity	..	..	..	..	..	..	..	..
III.4.4 Other Bioenergy	..	..	..	..	..	..	..	..
III.5 Geothermal Energy	..	..	..	..	..	..	..	..
III.6 Total Hydropower	..	..	..	..	..	..	..	..
III.6.1 Large Hydropower (capacity >10 MW)	..	..	..	..	..	..	..	..
III.6.2 Small Hydropower (capacity <10 MW)	..	..	..	..	..	..	..	..
III.7 Other Renewables	..	..	..	..	..	..	..	..
GROUP IV: NUCLEAR FISSION and FUSION	..	..	..	..	..	..	..	..
IV.1 Total Nuclear Fission	..	..	..	..	..	..	..	..
IV.1.1 Light-Water Reactors (LWRs)	..	..	..	..	..	..	..	..
IV.1.2 Other Converter Reactors	..	..	..	..	..	..	..	..
IV.1.3 Fuel Cycle	..	..	..	..	..	..	..	..
IV.1.4 Nuclear Supporting Technology	..	..	..	..	..	..	..	..
IV.1.5 Nuclear Breeder	..	..	..	..	..	..	..	..
IV.1.6 Other Nuclear Fission	..	..	..	..	..	..	..	..
IV.2 Nuclear Fusion	..	..	..	..	..	..	..	..
GROUP V: HYDROGEN and FUEL CELLS	..	..	..	..	..	..	..	..
V.1 Total Hydrogen	..	..	..	..	..	..	..	..
V.1.1 Hydrogen Production	..	..	..	..	..	..	..	..
V.1.2 Hydrogen Storage[1]	..	..	..	..	..	..	..	..
V.1.5 Hydrogen End Uses incl. Comb; excl. Fuel Cells	..	..	..	..	..	..	..	..
V.2 Total Fuel Cells	..	..	..	..	..	..	..	..
V.2.1 Stationary Applications	..	..	..	..	..	..	..	..
V.2.2 Mobile Applications	..	..	..	..	..	..	..	..
V.2.3 Other Applications	..	..	..	..	..	..	..	..
GROUP VI: OTHER POWER AND STORAGE TECHS	..	..	..	..	..	..	..	..
VI.1 Electric Power Conversion	..	..	..	..	..	..	..	..
VI.2 Electricity Transm. and Distr.	..	..	..	..	..	..	..	..
VI.3 Energy Storage	..	..	..	..	..	..	..	..
GROUP VII: TOTAL OTHER TECH./RESEARCH	..	..	..	..	..	..	..	..
VII.1 Energy System Analysis	..	..	..	..	..	..	..	..
VII.2 Other	..	..	..	..	..	..	..	..
TOTAL ENERGY RD&D	..	..	..	..	..	..	..	..

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

New Zealand				Norway				Portugal			
2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
1.84	**19.06**	**1.80**	**19.14**	**2.45**	**3.12**	**3.37**	**3.92**	**1.41**	**37.49**	**0.23**	**14.76**
0.20	2.05	0.19	2.06	0.30	0.38	0.84	0.98	1.41	37.49	0.23	14.76
0.36	3.69	0.25	2.62	2.15	2.74	2.53	2.95	-	-	-	-
0.39	4.03	0.38	4.05	-	-	-	-	-	-	-	-
0.90	9.29	0.98	10.40	-	-	-	-	-	-	-	-
2.51	**26.03**	**2.49**	**26.50**	**47.64**	**60.65**	**49.18**	**57.26**	**0.78**	**20.85**	**0.33**	**21.23**
2.45	25.40	2.43	25.87	39.36	50.11	41.42	48.22	0.75	19.97	0.24	15.24
2.42	25.11	2.40	25.58	8.78	11.18	6.74	7.84	-	-	-	-
–	–	–	–	3.30	4.20	4.13	4.81	–	–	–	–
–	–	–	–	–	–	–	–	0.75	19.97	0.24	15.24
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	0.85	0.99	–	–	–	–
0.03	0.28	0.03	0.28	27.28	34.73	29.70	34.58	–	–	–	–
–	–	–	–	–	–	–	–	0.03	0.88	0.09	5.99
–	–	–	–	–	–	–	–	–	–	0.00	0.24
–	–	–	–	–	–	–	–	0.01	0.34	–	–
–	–	–	–	–	–	–	–	–	–	0.05	3.11
–	–	–	–	–	–	–	–	0.02	0.54	0.04	2.63
0.06	0.63	0.06	0.64	8.28	10.54	7.76	9.04	–	–	–	–
3.09	**31.99**	**3.01**	**32.11**	**5.63**	**7.17**	**5.37**	**6.25**	**1.56**	**41.66**	**1.00**	**64.01**
–	–	–	–	1.52	1.94	1.43	1.66	0.85	22.70	0.81	52.19
–	–	–	–	0.20	0.25	0.13	0.15	0.84	22.43	0.81	52.19
–	–	–	– 1.33	1.69	1.30	1.51	0.01	0.27	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	1.57	2.00	1.38	1.60	–	–	–	–
–	–	–	–	0.12	0.15	0.29	0.33	0.05	1.28	0.02	1.60
1.10	11.39	1.07	11.43	0.98	1.24	1.23	1.43	0.66	17.65	0.16	10.30
–	–	–	–	–	–	0.23	0.27	0.59	15.80	0.14	8.86
0.58	5.98	0.56	6.00	–	–	–	–	–	–	–	–
0.20	2.02	0.19	2.03	0.98	1.24	1.00	1.16	0.07	1.82	0.02	1.44
0.33	3.38	0.32	3.40	–	–	–	–	0.00	0.03	–	–
0.79	8.21	0.77	8.24	–	–	–	–	–	–	–	–
1.20	12.40	1.17	12.44	1.44	1.83	1.05	1.22	–	–	–	–
1.20	12.40	1.17	12.44	1.44	1.83	0.82	0.95	–	–	–	–
–	–	–	–	–	–	0.23	0.27	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	**–**	**–**	**–**	**11.26**	**14.34**	**10.71**	**12.47**	**–**	**–**	**–**	**–**
–	–	–	–	11.26	14.34	10.71	12.47	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	5.38	6.85	5.05	5.87	–	–	–	–
–	–	–	–	5.88	7.49	5.67	6.60	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
1.69	**17.54**	**1.58**	**16.86**	**3.78**	**4.81**	**9.38**	**10.92**	**–**	**–**	**–**	**–**
1.14	11.78	1.04	11.07	3.36	4.28	8.03	9.35	–	–	–	–
0.70	7.30	0.69	7.32	2.15	2.74	1.21	1.41	–	–	–	–
0.43	4.48	0.35	3.75	1.14	1.46	6.54	7.62	–	–	–	–
–	–	–	–	0.07	0.08	0.29	0.33	–	–	–	–
0.56	5.76	0.54	5.79	0.41	0.53	1.34	1.56	–	–	–	–
0.56	5.76	0.54	5.79	0.41	0.53	1.01	1.17	–	–	–	–
–	–	–	–	–	–	0.34	0.39	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
0.17	**1.79**	**0.17**	**1.80**	**3.21**	**4.09**	**3.69**	**4.30**	**–**	**–**	**–**	**–**
–	–	–	–	–	–	–	–	–	–	–	–
0.17	1.79	0.17	1.80	2.87	3.65	3.69	4.30	–	–	–	–
–	–	–	–	0.35	0.44	–	–	–	–	–	–
0.35	**3.58**	**0.34**	**3.60**	**4.57**	**5.81**	**4.19**	**4.88**	**–**	**–**	**–**	**–**
–	–	–	–	2.62	3.33	1.47	1.71	–	–	–	–
0.35	3.58	0.34	3.60	1.95	2.48	2.72	3.17	–	–	–	–
9.66	**100.00**	**9.39**	**100.00**	**78.54**	**100.00**	**85.90**	**100.00**	**3.75**	**100.00**	**1.56**	**100.00**

Table B13 *(continued)*

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	Spain				Sweden			
	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
GROUP 1: ENERGY EFFICIENCY	**3.07**	**5.43**	**3.72**	**6.36**	**38.39**	**30.65**	**18.77**	**31.30**
I.1 Industry	0.09	0.16	0.11	0.18	15.39	12.29	8.91	14.86
I.2 Residential/Commercial	2.11	3.72	2.60	4.45	4.55	3.63	2.11	3.53
I.3 Transport	0.87	1.54	1.01	1.73	15.75	12.58	6.19	10.32
I.4 Other Conservation	–	–	–	–	2.69	2.15	1.56	2.60
GROUP II: FOSSIL FUELS	**6.75**	**11.92**	**5.62**	**9.62**	**0.11**	**0.09**	**0.02**	**0.03**
II.1 Total Oil and Gas	–	–	–	–	–	–	–	–
II.1.1 Enhanced Oil and Gas Production	–	–	–	–	–	–	–	–
II.1.2 Refining, Transp. and Stor. of Oil and Gas	–	–	–	–	–	–	–	–
II.1.3 Non-Conventional Oil and Gas Production	–	–	–	–	–	–	–	–
II.1.4 Oil and Gas Combustion	–	–	–	–	–	–	–	–
II.1.5 Oil and Gas Conversion	–	–	–	–	–	–	–	–
II.1.6 Other Oil and Gas	–	–	–	–	–	–	–	–
II.2 Total Coal	6.75	11.92	5.62	9.62	0.11	0.09	0.02	0.03
II.2.1 Coal Prod., Prep., and Trans.	–	–	–	–	–	–	–	–
II.2.2 Coal Combustion	0.93	1.65	0.91	1.56	–	–	–	–
II.2.3 Coal Conversion (excl. IGCC)	–	–	–	–	–	–	–	–
II.2.4 Other Coal	5.81	10.27	4.71	8.06	0.11	0.09	0.02	0.03
II.3 Total CO_2 Capture and Storage	–	–	–	–	–	–	–	–
GROUP III: RENEWABLE ENERGY SOURCES	**27.99**	**49.46**	**27.61**	**47.24**	**42.67**	**34.07**	**15.24**	**25.42**
III.1 Total Solar Energy	13.14	23.22	13.63	23.31	5.38	4.30	0.83	1.39
III.1.1 Solar Heating and Cooling (incl. Daylighting)	0.63	1.11	0.63	1.08	1.01	0.81	0.43	0.71
III.1.2 Photovoltaics	2.00	3.54	2.01	3.44	4.37	3.49	0.41	0.68
III.1.3 Solar Thermal Power and High Temp. Apps	10.51	18.57	10.98	18.79	–	–	–	–
III.2 Wind Energy	9.55	16.88	9.04	15.46	4.30	3.44	0.27	0.46
III.3 Ocean Energy	–	–	–	–	–	–	0.27	0.45
III.4 Total Bioenergy	4.63	8.18	4.28	7.32	31.37	25.05	13.17	21.97
III.4.1 Prod. of Transport Biofuels incl. from Wastes	–	–	–	–	13.68	10.92	8.11	13.53
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	–	–	–	–	10.80	8.62	3.79	6.32
III.4.3 Applications for Heat and Electricity	–	–	–	–	3.21	2.57	0.51	0.85
III.4.4 Other Bioenergy	4.63	8.18	4.28	7.32	3.68	2.94	0.76	1.27
III.5 Geothermal Energy	–	–	–	–	0.07	0.06	–	–
III.6 Total Hydropower	0.67	1.18	0.67	1.15	1.01	0.81	0.69	1.16
III.6.1 Large Hydropower (capacity >10 MW)	–	–	–	–	–	–	–	–
III.6.2 Small Hydropower (capacity <10 MW)	0.67	1.18	0.67	1.15	1.01	0.81	0.69	1.16
III.7 Other Renewables	–	–	–	–	0.53	0.43	–	–
GROUP IV: NUCLEAR FISSION AND FUSION	**16.77**	**29.63**	**19.56**	**33.45**	**6.77**	**5.41**	**6.69**	**11.16**
IV.1 Total Nuclear Fission	7.99	14.12	7.49	12.82	5.28	4.22	5.22	8.71
IV.1.1 Light-Water Reactors (LWRs)	–	–	–	–	5.28	4.22	5.22	8.71
IV.1.2 Other Converter Reactors	–	–	–	–	–	–	–	–
IV.1.3 Fuel Cycle	–	–	–	–	–	–	–	–
IV.1.4 Nuclear Supporting Technology	–	–	–	–	–	–	–	–
IV.1.5 Nuclear Breeder	–	–	–	–	–	–	–	--
IV.1.6 Other Nuclear Fission	7.99	14.12	7.49	12.82	–	–	–	–
IV.2 Nuclear Fusion	8.78	15.51	12.06	20.64	1.49	1.19	1.47	2.46
GROUP V: HYDROGEN AND FUEL CELLS	**–**	**–**	**–**	**–**	**3.23**	**2.58**	**2.93**	**4.89**
V.1 Total Hydrogen	–	–	–	–	1.96	1.57	1.91	3.19
V.1.1 Hydrogen Production	–	–	–	–	1.96	1.57	1.91	3.19
V.1.2 Hydrogen Storage[1]	–	–	–	–	–	–	–	–
V.1.5 Hydrogen End Uses incl. Comb; excl. Fuel Cells	–	–	–	–	–	–	–	–
V.2 Total Fuel Cells	–	–	–	–	1.26	1.01	1.02	1.71
V.2.1 Stationary Applications	–	–	–	–	0.24	0.19	0.09	0.15
V.2.2 Mobile Applications	–	–	–	–	1.02	0.81	0.94	1.56
V.2.3 Other Applications	–	–	–	–	–	–	–	–
GROUP VI: OTHER POWER AND STORAGE TECHS	**–**	**–**	**–**	**–**	**14.60**	**11.66**	**8.09**	**13.49**
VI.1 Electric Power Conversion	–	–	–	–	12.34	9.85	6.68	11.15
VI.2 Electricity Transm., and Distr.	–	–	–	–	1.22	0.97	0.82	1.37
VI.3 Energy Storage	–	–	–	–	1.05	0.84	0.58	0.97
GROUP VII: TOTAL OTHER TECH./RESEARCH	**2.01**	**3.55**	**1.95**	**3.33**	**19.48**	**15.55**	**8.22**	**13.71**
VII.1 Energy System Analysis	0.34	0.59	0.34	0.58	6.59	5.26	4.67	7.79
VII.2 Other	1.68	2.96	1.60	2.74	12.89	10.29	3.55	5.92
TOTAL ENERGY RD&D	**56.58**	**100.00**	**58.46**	**100.00**	**125.25**	**100.00**	**59.95**	**100.00**

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
Note: Budgets provided for recent years by some countries may have been estimated.
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Switzerland				Turkey[1]				United Kingdom			
2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%	2004 USD	%	2005e USD	%
16.97	11.20	18.43	11.86	0.20	18.09	0.32	24.44	-	-	-	-
2.02	1.33	2.00	1.29	0.15	13.75	0.17	12.91	-	-	-	-
7.68	5.07	8.81	5.67	-	-	-	-	-	-	-	-
7.27	4.80	7.61	4.90	-	-	-	-	-	-	-	-
–	–	–	–	0.05	4.34	0.15	11.53	–	–	–	–
11.72	7.73	12.02	7.73	0.18	15.60	0.21	15.95	9.33	10.36	11.89	9.16
11.72	7.73	12.02	7.73	0.06	5.13	0.09	6.88	–	–	–	–
–	–	–	–	0.03	2.28	–	–	–	–	–	–
–	–	–	–	0.02	1.50	0.00	0.23	–	–	–	–
–	–	–	–	0.01	0.71	0.03	2.64	–	–	–	–
11.72	7.73	12.02	7.73	–	–	0.01	1.15	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	0.01	0.64	0.04	2.87	–	–	–	–
–	–	–	–	0.12	10.47	0.12	9.06	–	–	–	–
–	–	–	–	0.08	6.98	0.05	4.19	–	–	–	–
–	–	–	–	0.01	0.78	–	–	–	–	–	–
–	–	–	–	0.03	2.71	0.06	4.88	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	9.33	10.36	11.89	9.16
38.39	25.33	40.06	25.77	0.54	47.79	0.41	31.78	36.45	40.46	66.49	51.18
24.65	16.27	25.64	16.49	0.10	8.90	0.01	1.15	18.14	20.13	26.07	20.07
5.66	3.73	6.01	3.87	0.02	2.14	0.01	1.15	8.38	9.30	11.16	8.59
12.12	8.00	12.82	8.25	0.08	6.77	–	–	9.76	10.83	14.91	11.48
6.87	4.53	6.81	4.38	–	–	–	–	–	–	–	–
1.21	0.80	1.20	0.77	0.01	0.85	0.00	0.29	3.48	3.86	30.39	23.39
–	–	–	–	–	–	–	–	9.36	10.39	2.31	1.78
6.06	4.00	6.41	4.12	0.31	27.35	0.31	23.47	5.18	5.75	7.57	5.83
–	–	–	–	0.13	11.68	0.18	13.54	..	..	..	..
–	–	–	–	0.18	15.67	0.13	9.93	..	..	..	..
6.06	4.00	6.41	4.12	–	–	–	–	..	..	..	..
–	–	–	–	–	–	–	–	..	..	..	..
2.42	1.60	2.40	1.55	0.12	10.68	0.09	6.88	0.14	0.15	0.14	0.11
4.04	2.67	4.41	2.84	–	–	–	–	0.16	0.17	–	–
2.42	1.60	2.40	1.55	–	–	–	–	–	–	–	–
1.62	1.07	2.00	1.29	–	–	–	–	0.16	0.17	–	–
–	–	–	–	–	–	–	–	–	–	–	–
42.84	28.27	42.47	27.32	–	–	–	–	33.27	36.94	39.74	30.59
24.25	16.00	24.04	15.46	–	–	–	–	4.29	4.76	4.23	3.25
4.85	3.20	4.81	3.09	–	–	–	–	..	..	..	..
2.42	1.60	2.40	1.55	–	–	–	–	..	..	..	..
5.66	3.73	5.61	3.61	–	–	–	–	..	..	..	..
11.32	7.47	11.22	7.22	–	–	–	–	..	..	..	..
–	–	–	–	–	–	–	..	..	..	..	..
–	–	–	–	–	–	–	–	..	..	..	..
18.59	12.27	18.43	11.86	–	–	–	–	28.99	32.18	35.51	27.33
10.51	6.93	11.22	7.22	0.05	4.70	0.22	16.92	4.98	5.53	4.39	3.38
2.42	1.60	2.40	1.55	0.00	0.36	0.11	8.66	2.77	3.08	2.72	2.09
0.81	0.53	0.80	0.52	0.00	0.36	0.11	8.61	..	..	..	..
1.62	1.07	1.60	1.03	–	–	0.00	0.06	..	..	..	..
–	–	–	–	–	–	–	–	..	..	..	..
8.08	5.33	8.81	5.67	0.05	4.34	0.11	8.26	2.21	2.46	1.67	1.28
4.85	3.20	4.81	3.09	0.05	4.27	0.09	7.23	..	..	..	..
3.23	2.13	4.01	2.58	0.00	0.07	–	–	..	..	..	..
–	–	–	–	–	–	0.01	1.03	..	..	..	..
16.16	10.67	16.03	10.31	0.04	3.35	0.05	3.50	6.05	6.71	7.40	5.69
5.66	3.73	5.61	3.61	0.02	1.42	0.02	1.26	–	–	–	–
8.08	5.33	8.01	5.15	0.02	1.42	0.02	1.26	4.69	5.21	6.49	5.00
2.42	1.60	2.40	1.55	0.01	0.50	0.01	0.98	1.35	1.50	0.91	0.70
14.95	9.87	15.22	9.79	0.12	10.47	0.10	7.40	–	–	–	–
12.53	8.27	12.82	8.25	0.12	10.47	0.10	7.40	–	–	–	–
2.42	1.60	2.40	1.55	–	–	–	–	–	–	–	–
151.54	100.00	155.45	100.00	1.13	100.00	1.30	100.00	90.08	100.00	129.91	100.00

Table B13 *(continued)*

IEA Government Energy R&D Expenditure by Country, 2004 and 2005

(USD million at 2005 prices and exchange rates)

	United States			
	2004 USD	%	2005e USD	%
GROUP 1: ENERGY EFFICIENCY	**390,79**	**13.17**	**366.09**	**12.13**
I.1 Industry	92.94	3.13	74.80	2.48
I.2 Residential/Commercial	59.39	2.00	65.46	2.17
I.3 Transport	177.14	5.97	165.41	5.48
I.4 Other Conservation	61.33	2.07	60.42	2.00
GROUP II: FOSSIL FUELS	**442.92**	**14.92**	**335.15**	**11.11**
II.1 Total Oil and Gas	78.03	2.63	78.76	2.61
II.1.1 Enhanced Oil and Gas Production	56.93	1.92	57.69	1.91
II.1.2 Refining, Transp. and Stor. of Oil and Gas	8.93	0.30	8.35	0.28
II.1.3 Non-Conventional Oil and Gas Production	-	–	–	–
II.1.4 Oil and Gas Combustion	–	–	–	–
II.1.5 Oil and Gas Conversion	–	–	–	–
II.1.6 Other Oil and Gas	12.17	0.41	12.72	0.42
II.2 Total Coal	324.43	10.93	211.03	6.99
II.2.1 Coal Prod., Prep., and Trans.	–	–	–	–
II.2.2 Coal Combustion	288.22	9.71	178.63	5.92
II.2.3 Coal Conversion (excl. IGCC)	–	–	–	–
II.2.4 Other Coal	36.22	1.22	32.39	1.07
II.3 Total CO_2 Capture and Storage	40.46	1.36	45.36	1.50
GROUP III: RENEWABLE ENERGY SOURCES	**249.61**	**8.41**	**242.81**	**8.05**
III.1 Total Solar Energy	82.95	2.79	85.07	2.82
III.1.1 Solar Heating and Cooling (incl. Daylighting)	..	..	..	..
III.1.2 Photovoltaics	..	..	..	..
III.1.3 Solar Thermal Power and High Temp. Apps	..	..	..	..
III.2 Wind Energy	40.90	1.38	40.80	1.35
III.3 Ocean Energy	–	–	–	–
III.4 Total Bioenergy	86.93	2.93	80.85	2.68
III.4.1 Prod. of Transport Biofuels incl. from Wastes	..	..	..	..
III.4.2 Prod Other Biomass-Derived Fuels incl. Wastes	..	..	..	..
III.4.3 Applications for Heat and Electricity	..	..	..	..
III.4.4 Other Bioenergy	..	..	..	..
III.5 Geothermal Energy	25.30	0.85	25.27	0.84
III.6 Total Hydropower	4.80	0.16	4.86	0.16
III.6.1 Large Hydropower (capacity >10 MW)	..	..	..	..
III.6.2 Small Hydropower (capacity <10 MW)	..	..	..	..
III.7 Other Renewables	8.73	0.29	5.95	0.20
GROUP IV: NUCLEAR FISSION and FUSION	**393.97**	**13.27**	**444.54**	**14.73**
IV.1 Total Nuclear Fission	131.07	4.42	170.64	5.65
IV.1.1 Light-Water Reactors (LWRs)	..	..	..	..
IV.1.2 Other Converter Reactors	..	..	..	..
IV.1.3 Fuel Cycle	67.56	2.28	67.46	2.24
IV.1.4 Nuclear Supporting Technology	63.51	2.14	103.18	3.42
IV.1.5 Nuclear Breeder	–	–	–	–
IV.1.6 Other Nuclear Fission	–	–	–	–
IV.2 Nuclear Fusion	262.89	8.86	273.90	9.08
GROUP V: HYDROGEN and FUEL CELLS	**153.76**	**5.18**	**171.39**	**5.68**
V.1 Total Hydrogen	82.62	2.78	94.01	3.12
V.1.1 Hydrogen Production	..	..	..	..
V.1.2 Hydrogen Storage[1]	..	..	..	..
V.1.5 Hydrogen End Uses incl. Comb; excl. Fuel Cells	..	..	..	..
V.2 Total Fuel Cells	71.14	2.40	77.39	2.56
V.2.1 Stationary Applications	..	..	..	..
V.2.2 Mobile Applications	..	..	..	..
V.2.3 Other Applications	..	..	..	..
GROUP VI: OTHER POWER and STORAGE TECHS	**116.19**	**3.91**	**120.68**	**4.00**
VI.1 Electric Power Conversion	93.35	3.15	111.30	3.69
VI.2 Electricity Transm., and Distr.	13.83	0.47	5.42	0.18
VI.3 Energy Storage	9.00	0.30	3.97	0.13
GROUP VII: TOTAL OTHER TECH./RESEARCH	**1 220.73**	**41.13**	**1 337.10**	**44.31**
VII.1 Energy System Analysis	–	–	–	–
VII.2 Other	1 220.73	41.13	1 337.10	44.31
TOTAL ENERGY RD&D	**2 967.96**	**100.00**	**3 017.77**	**100.00**

1. Hydrogen storage also includes transport, distribution, other infrastructure and systems R&D.
Note: Budgets provided for recent years by some countries may have been estimated
Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

Table B14

Estimated IEA[1] Government Energy R&D Expenditure

(USD million at 2005 prices and exchange rates)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005e
I: ENERGY EFFICIENCY	**1 138.8**	**1 239.7**	**1 170.4**	**1 111.3**	**1 328.3**	**1 460.9**	**1 496.7**	**1 622.6**	**1 627.0**	**1 215.9**	**1 094.3**	**1 075.0**
I.1 Industry	407.5	428.8	442.6	458.8	676.3	761.3	779.2	824.3	707.5	535.8	176.6	150.1
I.2 Residential and Commercial	298.7	328.8	301.3	253.1	254.8	291.0	254.5	288.3	237.4	168.5	153.5	157.2
I.3 Transport	359.5	405.0	359.1	333.8	328.4	341.2	360.0	397.5	408.5	312.6	237.6	217.0
I.4 Other	73.1	77.0	67.4	65.6	68.8	67.5	103.2	112.5	273.6	199.0	526.5	550.8
II: FOSSIL FUELS	**1 313.2**	**1 050.2**	**1 058.9**	**829.3**	**751.9**	**686.8**	**612.3**	**762.3**	**1 099.1**	**1 010.7**	**1 089.9**	**1 006.9**
II.1.1 Enhanced Oil and Gas	158.3	165.8	119.8	112.4	140.1	141.7	132.4	143.3	124.6	101.9	85.5	88.7
II.1.3 Non-conventional Prod.	23.5	18.9	29.7	35.2	36.9	18.1	19.3	22.7	19.8	24.4	19.6	24.1
II.1.6 Other Oil and Gas[2]	288.9	305.7	302.4	316.1	237.8	188.2	189.0	210.3	459.2	399.5	395.5	393.4
II.2.2 Coal Combustion	522.3	264.5	349.9	163.5	147.3	153.6	117.8	238.9	287.2	280.9	359.2	286.5
II.2.3 Coal Conversion	171.1	180.1	166.1	125.7	117.7	96.8	69.5	37.8	77.3	71.8	75.8	66.8
II.2.4 Other Coal[3]	149.2	115.2	90.9	76.4	72.0	88.5	84.3	109.5	131.0	132.2	85.1	76.7
II.3 CO_2 Capture and Storage	..	..	..	..	..	..	..	..	..	..	69.2	70.5
III: TOTAL RENEWABLE ENERGY	**761.8**	**808.6**	**729.5**	**707.4**	**797.7**	**811.9**	**773.2**	**833.4**	**896.3**	**868.6**	**1 082.3**	**1 113.2**
III.1.1 Solar Heating and Cooling	71.6	59.9	41.0	43.2	41.1	38.4	50.5	42.9	40.2	39.3	52.2	60.4
III.1.2 Photovoltaics	258.4	279.2	257.4	256.2	288.8	307.9	321.7	297.3	310.0	303.0	372.2	362.7
III.1.3 Solar Thermal Power [4]	74.9	60.3	53.0	51.8	37.1	39.5	26.8	53.6	89.0	75.5	78.7	77.7
III.2 Wind Energy	105.5	134.5	130.3	111.2	120.8	122.4	104.6	122.9	118.2	123.9	128.0	161.4
III.3 Ocean Energy	4.8	2.7	2.5	2.4	12.7	8.0	8.8	12.0	5.3	4.1	9.7	4.7
III.4 Total Bioenergy	162.5	167.6	153.8	154.8	210.5	204.3	178.6	212.0	229.8	236.2	296.6	300.3
III.5 Geothermal Energy	69.4	86.7	76.3	74.4	74.4	73.8	61.4	72.9	76.3	58.2	47.2	54.5
III.6.1 Large Hydro (≥10 MW)	12.5	15.3	11.3	9.1	8.1	8.6	14.9	12.4	12.2	10.6	11.4	10.6
III.6.2 Small Hydro (<10 MW)	2.2	2.3	3.8	4.2	4.2	9.0	5.8	7.3	15.3	17.8	19.9	20.9
III.7 Other Renewables	..	..	..	..	..	..	..	..	..	..	66.6	60.2
IV.1 Nuclear Fission	**3 489.6**	**3 616.4**	**3 553.8**	**3 413.8**	**3 326.5**	**3 386.6**	**3 405.7**	**3 199.8**	**3 497.4**	**3 502.5**	**3 065.5**	**3 168.1**
IV.2 Nuclear Fusion	**1 124.1**	**1 120.3**	**1 002.8**	**968.9**	**901.7**	**819.3**	**892.7**	**838.6**	**707.1**	**719.6**	**698.0**	**715.2**
V.1 Hydrogen	..	..	..	..	..	..	..	..	..	..	**111.0**	**127.9**
V.2 Fuel Cells	..	..	..	..	..	..	..	..	..	..	**143.0**	**153.1**
VI: OTHER POWER AND STORAGE	**398.8**	**373.5**	**362.6**	**379.4**	**430.5**	**451.7**	**566.7**	**631.1**	**523.1**	**506.4**	**373.0**	**343.2**
VI.1 Electric Power Conversion	234.1	209.7	213.6	224.6	261.5	264.8	313.9	354.3	239.1	239.4	176.0	179.0
VI.2 Electricity Transm. and Distrib.	106.1	108.9	98.0	92.7	107.7	110.8	167.4	193.7	124.4	111.4	150.8	129.0
VI.3 Energy Storage	58.6	54.9	51.0	62.0	61.2	76.1	85.5	83.1	159.6	155.6	46.1	35.2
VII: CROSS-CUTTING/RESEARCH	**1 306.3**	**1 274.2**	**1 274.7**	**1 309.9**	**1 257.1**	**1 409.4**	**1 322.9**	**1 627.8**	**1 815.8**	**1 875.9**	**1 772.4**	**1 883.7**
TOTAL ENERGY R&D	9 532.6	9 482.9	9 152.8	8 719.9	8 793.7	9 026.5	9 070.2	9 515.7	10 165,8	9 699.6	9 429.5	9 586.3

1. IEA totals include estimates where data are not available. Because of missing data, the following countries have not been inlcuded in the total: the Czech Republic, Greece, Hungary, Ireland, Korea and Luxembourg.
2. Other Oil and Gas includes refining, transportation and storage, oil and gas combustion, oil and gas conversion.
3. Other Coal includes production, preparation and transportation.
4. Solar Thermal Power also includes high-temperature applications.

Sources: *OECD Economic Outlook No 78*, OECD Paris, 2006, and country submissions.

ANNEX C

INTERNATIONAL ENERGY AGENCY

Member countries of the IEA* seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1. **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4. **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA members wish to retain and improve the nuclear

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. Although these terms are generally written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

AGP	Ad-Hoc Working Group (Kyoto Protocol)
AMEM	ASEAN Ministers of Energy Meeting
ANWR	Arctic National Wildlife Refuge
APEC	Asian Pacific Economic Co-operation
APG	ASEAN Power Grid
APSA	ASEAN Petroleum Security Agreement
ASCOPE	ASEAN Council on Petroleum
ASEAN	Association of South East Asian Nations
bcf	billion cubic feet
bcm	billion cubic metres
CCS	carbon capture and storage
CERM	Co-ordinated Emergency Response Mechanism
CFL	compact fluorescent lights
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co-generation" is used
CO_2	carbon dioxide
COP	Conference of the Parties (to the Kyoto Convention)
CTL	coal to liquids
DH	district heating
DSM	Demand Side Management (Programme)
ERGEG	Energy Regulators Groups for Electricity and Gas
ETSO	European Transmission System Operators
EC	European Commission
EU	The European Union, whose 25 members are Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom

EUA	European Union allowances
EU-ETS	European Union GHG Emissions Trading Scheme
FERC	Federal Electricity Regulatory Commission
FSU	former Soviet Union
GDP	gross domestic product
GHG	greenhouse gas
GNEP	Global Nuclear Energy Partnership
GWh	gigawatt-hour(s)
HAPUA	Heads of ASEAN Power Utilities and Authorities
HMT	UK Treasury
IEA	International Energy Agency whose members are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States
IEF	International Energy Forum
JODI	Joint Oil Data Initiative
kb/d	thousand barrels per day
kWh	kilowatt-hour, or one kilowatt × one hour, or one watt × one hour × 10^3
LNG	liquefied natural gas
LPG	liquefied petroleum gas; refers to propane, butane and their isomers, which are gases at atmospheric pressure and normal temperature
LTA	long-term agreements on energy efficiency
mb/d	million barrels per day
MBtu	million British thermal units
mcm	million cubic metres
mt	million tonnes
MOP	Meeting of the Parties (Kyoto Protocol)
Mtoe	million tonnes of oil equivalent; see toe
MW	megawatt(s)
NAFTA	North-American Free Trade Agreement
NAP	National Allocation Plan

NBP	National Balancing Point (UK)
NEGP	North-European Gas Pipeline
NERC	North-American Electric Reliability Council
NOPR	notice of proposed rule
OATT	open-access transmission tariff
OCS	Outer Continental Shelf
OECD	Organisation for Economic Co-operation and Development
O&M	operating and maintenance
OPEC	Organization of the Petroleum Exporting Countries
PV	photovoltaic
RD&D	research, development and demonstration
R&D	research and development
RES	renewable energy sources
RIA	Regulatory Impact Assessment
SARS	Severe Acute Respiratory Syndrome
SLT	Standing Group for Long-term Co-operation
SOME	ASEAN Senior Officials Meeting on Energy
TAGP	Trans-ASEAN gas pipeline
TFC	total final consumption of energy; the difference between TPES and TFC consists of net energy losses in the production of electricity and synthetic gas, refinery use and other energy sector uses and losses
toe	tonne of oil equivalent, defined as 10^7 kcal
TPA	third-party access
TPES	total primary energy supply
UNFCCC	United Nations Framework Convention on Climate Change
WEO	World Energy Outlook
ZET	Zero Emissions Technologies
1Q	First quarter
2Q	Second quarter
3Q	Third quarter
4Q	Fourth quarter
..	Not available
–	nil

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