INTERNATIONAL ENERGY AGENCY

IEA Energy Policies Review

THE EUROPEAN UNION

2008

IEA Energy Policies Review

THE EUROPEAN UNION 2008

For the first time, the IEA has reviewed the energy policies of the European Union which shape the energy use of almost 500 million citizens in 27 EU member countries. A unique entity governed under complex and almost constantly evolving structures, the EU constitutes a challenge for energy policy makers. Its energy policy has a global impact, not only because of its 16% share of world energy demand, but also because of the EU leadership in addressing climate change.

Strong policy drives are underway in the EU to achieve the completion of the internal energy market, increase renewable energy supply, reduce CO_2 emissions and make the EU more energy-efficient. Concerns about security of supply have also led to a greater focus on improved energy relations with supplier countries, and new institutional structures are being put in place. How much progress has been made in the field of security, internal market and external energy policies? And in which of these areas has the EU already implemented a fully integrated policy? *IEA Energy Policies Review: The European Union - 2008* addresses these questions and also analyses the impact of the most recent major EU policy measures, in particular the Energy & Climate Package of January 2008 and the 3rd Liberalisation Package of September 2007.

This book finds that both of these proposals are highly ambitious. But implementing them and reviewing both volume and allocation of energy R&D will be necessary to achieve a sustainable energy future in a fully competitive integrated EU energy market.

(61 2008 19 1 P1) €75
ISBN 978-92-64-04337-4

INTERNATIONAL ENERGY AGENCY

IEA Energy Policies Review

THE EUROPEAN UNION

2008

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-seven of the OECD 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 promote international collaboration on energy technology.
- To assist in the integration of environmental and energy policies.

The IEA member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States. Poland is expected to become a member in 2008. The European Commission also participates 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.
The European Commission takes part in the work of the OECD.

International Energy Agency (IEA),
Head of Communication and Information Office,
9 rue de la Fédération, 75739 Paris Cedex 15, France.

TABLE OF CONTENTS

List of Figures, Tables and Boxes

FIGURES

TABLES

BOXES

DISCLAIMER

The report is based on a visit to the European Commission which took place in early February 2008, and was drafted between March and late June 2008. It has therefore not been possible to take into account the latest developments in the energy policy of the European Union, most importantly the results of the European Council meeting in June 2008, and the impact of the Irish referendum on the Lisbon Treaty.

EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Significant developments have taken place in European energy policy since 2000, driven by increasing concern about global warming, and the effect of rapidly increasing energy prices on competitiveness and security of supply in the European Union (EU). The European Commission has risen to the challenges, proposing a range of policies to address them. While there have been concerns, for example by some member states regarding some of the policies, overall the proposals by the European Commission are sound. They correctly reflect the energy challenges faced by the world today, and their implementation will bring global benefits. In particular, the Commission's goals in the field of energy and environment are highly ambitious, but pursuing them will be necessary not only to ensure the EU contribution to the mitigation of climate change, but also to send a global signal that meaningful action can and ought to be taken now. To ensure that the very ambitious targets are being achieved in a balanced manner, it will be necessary to ensure regular reviews and constant tracking of the implementation of the whole policy package, not just of individual policies within it. The Commission will need to make sure that a suitable review mechanism is being established to this end. The biannual Strategic Energy Reviews of EU energy policy conducted by the Commission could serve as this mechanism.

Market reform has been a priority of the European Commission since the implementation of the first liberalisation package in 1996. Acknowledging insufficient progress, the 3rd Liberalisation Package was proposed in September 2007 and its options regarding unbundling were a bold step forward to achieve the long-harboured intent to create a true single, fully competitive and transparent internal energy market. The European Commission should be commended for its resolution in this area, and continue to pursue this goal and the acceptance of its proposals with vigour.

Energy security is a pressing issue in energy policy and has rapidly risen up the European Commission's priority list, because of increasing import dependence of the EU, and high energy prices. Import dependence is not a problem in itself, since a population-rich, modern industrialised economy is unlikely to achieve self-sufficiency in energy supply. The important issues are the management of supplier relations and of energy systems, enabling the investment in critical infrastructure, achieving diversification of supply, and preparing adequately for potential supply disruptions. While progress

has been made in all of these, the workload remaining for the European Commission is significant and multi-faceted, ranging from the regulation of infrastructure investment to diplomatic relations with external suppliers. It is in the latter area that a more prominent role for the European Commission could pay dividends for the security of supply of the EU, and the Commission should strive for increased responsibility in this area. Speaking with one voice, and acting in a consistent and unified manner will be crucial to moving towards closer relationships between the EU and the external suppliers on which it will increasingly depend in the future.

Continued use of nuclear energy in the EU is almost certainly going to be necessary to attain the policy goals in the areas of climate change and security of supply. Yet nuclear power generation is on the decline, with some member states pursuing active reactor retirement policies ahead of the economic and environmentally most beneficial dates. Two new reactors are currently under construction, and some member states are now seriously considering returning to nuclear reactor building. To help them achieve their aims, the European Commission should prepare a road-map for the replacement of retired and retiring nuclear capacity in the EU, outlining the policy measures required to facilitate nuclear new build. This is of particular importance for smaller member states, which may be interested in pursuing shared projects.

To pursue cost-effective CO_2 emissions reductions in the industrial and energy sector, the Commission has introduced the European Emissions Trading Scheme (EU-ETS), the first cross-border system of its kind. While the trial phase showed some significant problems, caused by low-quality data, over-allocation of allowances in National Allocation Plans (NAPs), and free allowance allocation, fundamentally the EU-ETS is working as intended, and is already delivering CO_2 savings. The Commission has already taken action to mitigate the problems, for example by significantly cutting allowances in the NAP approval process. Building on this, it has now proposed a major revision to the ETS, starting from 1 January 2013. The proposed changes are expected to remove those aspects of the first phase that led to problems, so that the next phase up to 2020 runs smoothly. The European Commission should be commended not only for taking the bold step to set up an ETS, despite its initial reservations regarding trading during the negotiation of the Kyoto Protocol, but also for persevering in the face of the problems encountered in the first phase of operation. While the Commission has made laudable proposals for the development of the ETS, and the correction of the problems observed, these proposals will now need to be clarified and adopted rapidly, to ensure investor security in particular in the power generation sector, where a new investment cycle is now beginning, but also to assure large energy users about the future framework affecting their industries.

Increasing energy efficiency will be the key to achieving the European Commission's environmental goals in a cost-effective manner, and will at

the same time increase security of supply in the EU. Energy intensity has decreased significantly since 1990, and the EU27 is now a leader among the IEA member regions in terms of energy consumption related to GDP. The EU-ETS is expected to lead to a renewed drive for energy efficiency in the industrial and transformation sectors, but it will not directly affect the 52% of CO_2 emissions from the non-trading sectors. It is in these sectors where national governments have to implement EU policies to improve energy efficiency. The Commission has made some real and impressive policy progress, for example in its proposals for fleet-wide average emission limits for vehicles in the EU, and in its intention to recast existing energy efficiency directives with a view to enhancing their effectiveness. It should follow through on these proposals and ensure their adoption and implementation. Successful implementation is expected to contribute to a reversal of the recent trend in energy efficiency, the improvements of which have slowed down since 2000, and to go some way in reaching the indicative 20% target for improvements. Disconcertingly, however, despite the commendable policies being developed by the Commission, an implementation gap has begun to emerge, and this will put the achievement of all the targets at risk. This concern is reinforced by the lack of a binding target for energy efficiency, which could make it very difficult for the Commission to achieve effective implementation. It should therefore reconsider the decision to make the target only indicative. In general, to ensure effective implementation of energy efficiency legislation, stringent monitoring and enforcement will also be required. Achieving this will not be easy, particularly considering the current understaffing of the energy efficiency activities at European Commission level.

In the area of renewables, although progress has been made, the 2010 targets set out by the Commission in the 2001 and 2003 directives regarding renewables in general, renewable electricity and renewable transport fuels have not been and are unlikely to be achieved. The reaction to this, in the context of the greater urgency assigned now to action on decarbonising energy supply, has been a move to increase targets and make them binding and enforceable. To achieve this very ambitious aim, further analysis of the economic and non-economic barriers which caused the failure to attain the 2010 indicative targets is required, to enable the European Commission and the member states to apply corrective actions. Also, the Commission should outline which action it will consider taking throughout the period leading from now to 2020, should member states miss interim targets. Experience from energy efficiency policy suggests that the actual enforcement mechanism may not be an adequate instrument. Instead, the Commission should reflect again on lifting the proposed restrictions on the trade of Guarantees of Origin ahead of 2020, once adequate progress has been made in delivering renewables production increases. Implementing a successful market for Guarantees of Origin could for example be achieved by using the model of the EU-ETS. The twin benefits of increased enforceability and cost reduction in achieving the target warrant serious consideration being given to such an amendment of the proposed policies.

Air pollution has been one of the early areas of action in energy and environment for the Commission. Commendable improvements have been achieved in reducing the emissions of air pollutants, in particular from large combustion sources, but further reductions are necessary to achieve the longer-term objectives set in the Thematic Strategy on Air Pollution (COM 2005/446). The current recast of the relevant directives takes into account the achievement of the EU policy goals set in the area of climate change. It will be important, as part of the ongoing co-decision process, that the proposals are retained in order to obtain the necessary reductions of air pollutant emissions, provided that they are fully in line with the Energy and Climate Change Package and do not counter security of electricity supply in the EU.

Carbon capture and storage (CCS) is a key technology to address the post-2020 climate challenges, not just within the EU, but on a global level. The Commission's proposed legislation to enable CCS is very welcome, and shows its full commitment to this important technology. It will now be important to raise the funds and consider possible innovative financing mechanisms necessary to proceed with the construction of the demonstration plants that will be required to commercialise CCS.

Fossil fuels contribute significantly to energy supply in the EU, and will continue to do so even when the Commission's targets for 2020 have been reached. Oil will then continue to contribute over 80% of transport fuel, and gas will continue to have a critically important role in power generation, where it is required to provide flexibility, and in heating. Coal, while it will no doubt see the largest decline, will continue to provide a large share of power generation. The Commission should facilitate the continued contribution from these fuels to EU security of supply, keeping in mind the need to significantly increase the efficiency with which they are being used.

Increased efforts in energy R&D are necessary not just to achieve the European Commission's 2050 vision of significant cuts in greenhouse gas emissions, but also to contribute to the 2020 goals. While it is commendable that the 2007 to 2013 Framework Programme 7 (FP7) has increased energy funding, it is arguable that the funding allocated is not commensurate to the aims pursued, when compared to the non-energy component, and that a serious misallocation within the energy component will retard R&D in non-nuclear energy projects, and particularly in energy efficiency. The very significant allocation of funds to nuclear fusion is difficult to understand in the light of the short- and medium-term challenges, which are not going to be addressed by this technology. The Strategic Energy Technology (SET) Plan has delivered a commendable blueprint for a rebalancing on the supply side, but there is still a risk that the overall focus on the supply side may result in a lack of R&D activity on demand-side technologies. The Commission should therefore give serious consideration to recast FP7 at the time of the mid-term evaluation to take account of the

changed priorities in the energy field, in particular by reinforcing non-nuclear and energy efficiency R&D activities within the European Commission's flagship R&D programme.

KEY RECOMMENDATIONS

The European Commission should:

- *Vigorously pursue the implementation of the proposed energy and climate change package of 23 January 2008, while taking particular account of:*
  - *The need to increase energy efficiency throughout all sectors of the economy, and to ensure proper implementation of the ambitious existing and proposed legislation in this area.*
  - *The market compatibility aspects relating to its implementation.*
  - *The need to provide investors in all aspects of energy demand, transport and production infrastructure with appropriate certainty regarding the mid- to long-term investment framework by clarifying policy intentions, and assuring policy implementation.*
- *Continue to push for the adoption of the proposals contained in the 3rd Liberalisation Package of September 2007, to make sure that European energy markets will be open, transparent and competitive in the future.*
- *Augment the funding levels for energy R&D to ensure that they are appropriate to the scale of the energy and climate challenges faced, and also consider rebalancing funding within the energy R&D budget to take proper account of the priorities in non-nuclear R&D.*

PART I

POLICY ANALYSIS

OVERVIEW

The European Union (EU) is a political and economic community with supranational and intergovernmental features. It is more than just a federation of countries, but not a federal state. It is a new type of structure that does not fall into any traditional legal category. Its political system is historically unique and has been constantly evolving over more than 50 years. It is now composed of twenty-seven member states, with together about 500 million inhabitants, and a GDP of around EUR 11 trillion in 2005.

The origin of the European Union (as it is known today) was the European Coal and Steel Community (ECSC), founded in 1951 by the Federal Republic of Germany, France, Italy and the Benelux countries (Belgium, the Netherlands and Luxembourg), and which expired in 2002.[1] These six countries formed the European Economic Community (EEC) through the Treaty of Rome, which was signed in 1957 and took effect on 1 January 1958. They also formed the European Atomic Energy Community (Euratom), which continues to exist alongside the EU. The name of the EEC was changed to the European Community (EC) under the Maastricht Treaty in 1992, which also included the *Treaty on the European Union* (hereafter called EC Treaty). Since then, the EU consists of three pillars:

- The European Community (EC) pillar;
- The Common Foreign and Security Policy (CFSP) pillar; and
- The Police and Judicial Co-operation in Criminal Matters (PJCC) pillar.

There have been seven waves of enlargement since the original six created the EEC: In 1973, Denmark, Ireland and the United Kingdom; in 1981, Greece; in 1986, Portugal and Spain; in 1995, Austria, Finland and Sweden; in 2004, Cyprus[2,3], the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic and Slovenia; and in 2007, Bulgaria and Romania[4]. All member states of the European Union are democratically governed, with a wide variety of structures, ranging from highly federalised states to constitutional monarchies. EU citizens directly elect the members of the European Parliament, while member state governments nominate the

1. This section is taken from the *OECD Economic Surveys: European Union,* Volume 2007, Issue 11, OECD Paris, 2007.

2.3.4. Notes are on page 18.

Commissioners, the members of the European Commission, who act as the executive arm of the European Union for a five-year term. The members of the Commission have to be approved in a process involving the European Parliament before they can commence their duties.

Table 1

Recent Economic Performance of the EU25, 2002 to 2006

in %

	2002	*2003*	*2004*	*2005*	*2006*
Private consumption	1.5	1.6	2.1	1.6	2
Government consumption	2.6	2.2	1.6	1.7	2
Gross fixed investment	–0.6	1	3.2	3.1	5.6
Total domestic demand	1	1.8	2.4	1.9	2.8
Net exports (contribution to growth)	0.2	–0.5	–0.0	–0.1	0.1
Real gross domestic product (GDP)	1.2	1.3	2.4	1.8	2.9
Output gap (EU15, OECD estimate)	0	–1.1	–1.1	–1.6	–0.9
Inflation: harmonised CPI	2.1	1.9	2.1	2.2	2.2
Inflation: harmonised underlying	2.3	1.7	1.7	1.4	1.4
Employment growth	0.4	0.4	0.7	0.9	1.5
Unemployment rate (% of labour force)	8.7	9	9.1	8.8	7.6
Current account balance (% of GDP)	0	0	–0.0	–0.5	–0.6
Government net lending (% of GDP)	–2.3	–3.1	–2.7	–2.4	–1.7

Sources: Eurostat and *OECD Economic Surveys: European Union,* Volume 2007, Issue 11, OECD Paris, 2007.

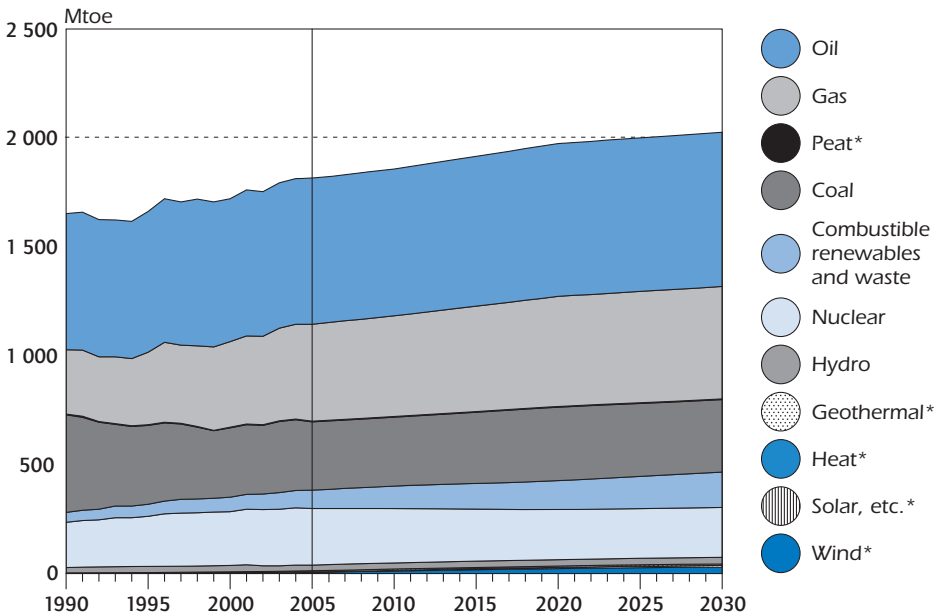
2. **Footnote by Turkey:** The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus" issue.
3. **Footnote by all European Union member states of the OECD and the European Commission:** The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
4. In this review, EU27 refers to all current members of the EU. EU15 refers to the fifteen members that had joined by 1995. EU10 refers to the ten countries that joined on 1 May 2004; the EU25 refers to the EU15 plus the EU10, while EU12 means the EU10 plus Bulgaria and Romania.

SUPPLY

The EU energy economy will become increasingly reliant on energy imports – with import dependence reaching 64% in 2020 and 67% in 2030 in business as usual (BAU) projections, up from slightly more than 50% at present. Dependence on oil imports continues to be highest, reaching 95% in 2030. Dependence on gas imports would rise substantially, from 58% at present to 84% in 2030. Similarly, solid fuel supplies would increasingly be based on imports, reaching 63% in 2030 (up from just under 40% today).

Figure 1

Total Primary Energy Supply, 1990 to 2030



* negligible.

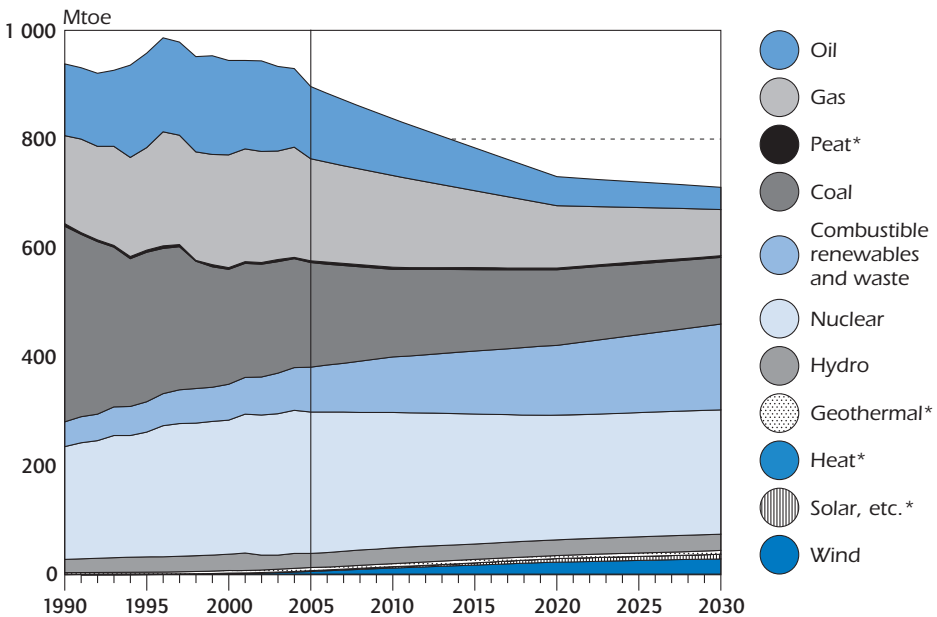
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

The development of the EU energy mix has been relatively stable during the last ten years, even though there has been a significant difference in the development of the energy mix in the new EU member countries (see Figure 3). In 1990 the EU countries used much more coal and lignite

(27%) compared to present levels (17%). The share of oil remained stable during that period. Coal and lignite have been switched mainly to natural gas (18 to 25%), renewables (4 to 7%), and nuclear (12 to 14%). The major energy source used in the EU today is oil with a share of more than one-third (36%). The second most important source is natural gas (25%) followed by solid fuels (17%), nuclear energy (14%) and renewable energy sources (7%).

Figure 2

Energy Production by Source, 1990 to 2030



* negligible.

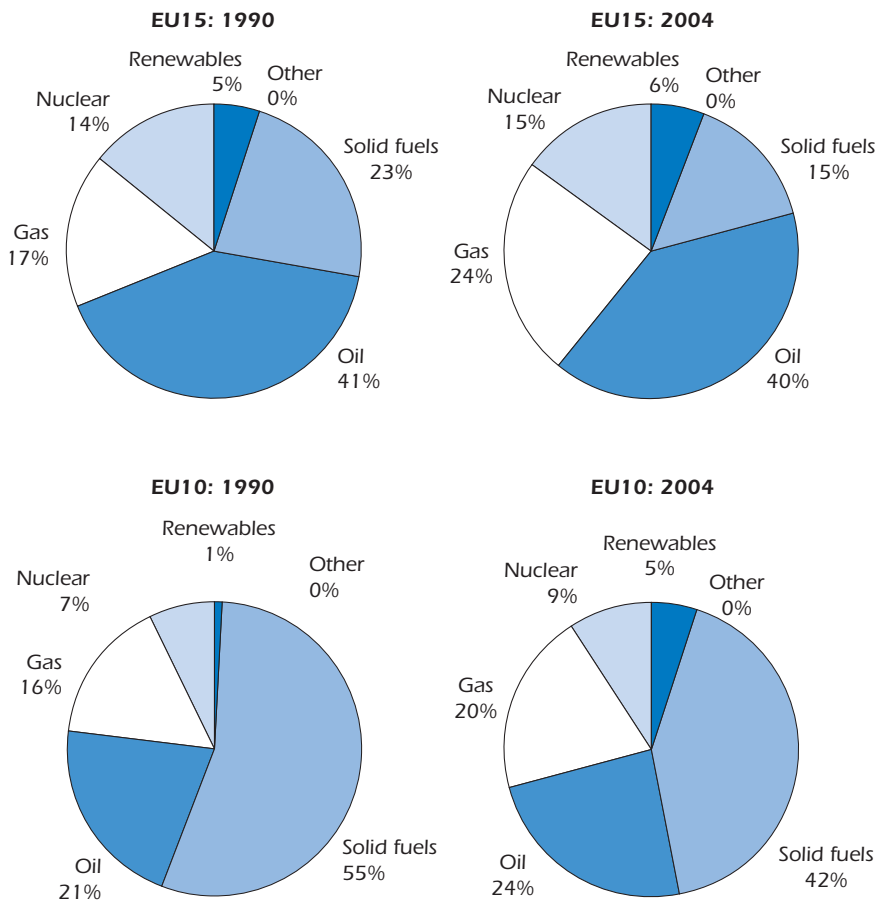
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

The EU has had a long-standing policy to promote renewables, and the European Council of March 2007 decided on a renewable energy supply (RES) target of 20% for 2020. The Commission has published proposals to move to 20% renewables in final consumption by 2020, with a specific target of 10% of liquid fuels to be supplied by biofuels. There has been some increase in the share of renewable energy over recent years and this trend is expected to continue, but under currently implemented policies, the renewables share in final energy demand rises by 4 percentage points between 2005 and 2020, reaching 12.5% in 2020. Achieving the 20%

RES target for 2020 will therefore require strong additional policies, and these were proposed by the European Commission on 23 January 2008. They will be supported by policies on energy efficiency and CO_2 reduction, which should lead to lower energy demand and encouragement of low-carbon energy, making it easier to achieve the renewables production target. Raising the contribution from renewables is expected to help contain the demand for gas.

Figure 3

Comparison of the EU15 and the EU10[1] Energy Mix, 1990 and 2004



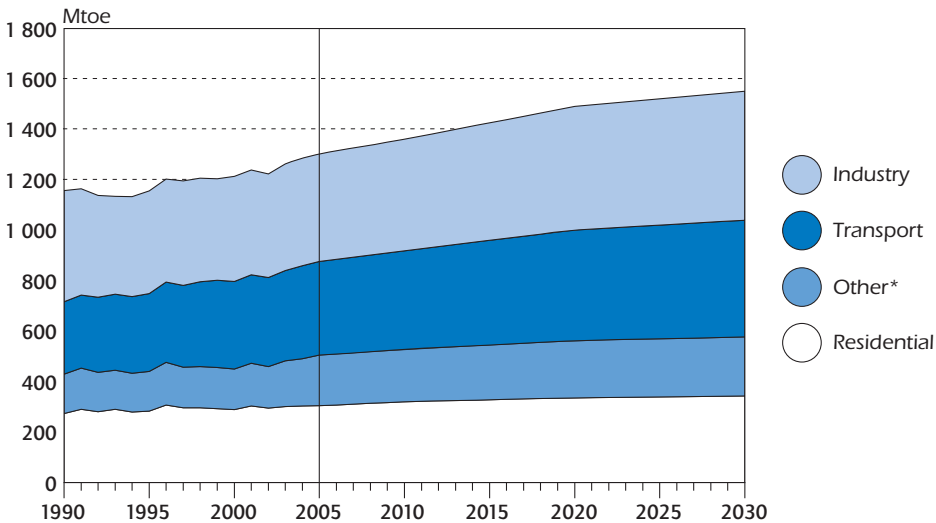
1. Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Slovakia, Slovenia.
Source: EU submission.

DEMAND

Between 1990 and 2005, primary energy consumption grew by 10% in the EU27 showing a strong decoupling from the GDP growth of 35% over the same period; energy intensity (primary energy demand per unit of GDP) improved at a rate of 1.4% per annum In the same period, energy-related CO_2 emissions decreased by 2.5%, implying a significant improvement in the carbon intensity (–0.8% per annum in 1990 to 2005) of the EU27 energy system. The changes in the fuel mix since 1990 in combination with the restructuring of the former centrally planned economies were the key driver for this improvement.

Figure 4

Total Final Consumption by Sector, 1990 to 2030



* includes commercial, public service, agricultural, fishing and other non-specified sectors.

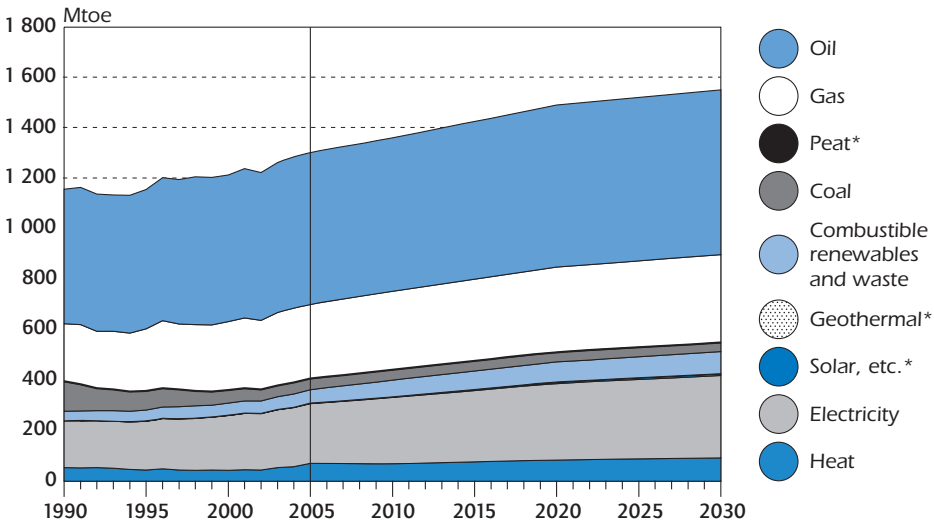
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

The rapid decline of solid fuel consumption by 133 Mtoe, or 30%, between 1990 and 2005 was the cause for the slight decrease of CO_2 emissions in the European Union. Other, cleaner energy sources correspondingly increased their contribution to balance supply. Increased natural gas supply provided most of the growth, rising by 51%, from 295 Mtoe to 445 Mtoe between 1990 and 2005, while renewables grew by about 39%, from 28 Mtoe to 39 Mtoe. Nuclear energy rose by 25% from 207 Mtoe to 260 Mtoe and oil increased its contribution by 7% from 626 Mtoe to 670 Mtoe. These developments led to a significant shift in the structure of primary energy consumption towards more use of natural gas, nuclear and renewables to the detriment of solid fuels (–10 percentage points) with oil almost keeping its share.

While energy demand increased significantly, there was a small decline in primary energy production (–4%), and import dependence consequently increased from 44% in 1990 to 52% in 2005. This increase happened predominantly after 1999 when imports stood at a level of 45%.

Figure 5

Total Final Consumption by Source, 1990 to 2030



* negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

DEMAND PROJECTIONS

Under trends and policies already in place, not including the energy and climate proposals of 23 January 2008 (see below), primary energy demand in the EU is expected to grow by 11% between 2005 and 2030 because of ongoing economic growth (2.2% per annum), and the significant energy intensity improvements (1.7% per annum). This development is due to structural change towards less energy-intensive services and industries as well as energy efficiency improvements in power generation and final demand favoured by a shift to fuels supporting higher efficiencies (for example natural gas, wind). The carbon intensity of the EU economy is expected to improve somewhat in the projection period. More than 15 years after the start of the latest EU-enlargement process, one which helped to foster investments into more efficient electricity generation and industrial use of energy, the decline in energy intensity is projected to be much smaller than in the past because of the nuclear phase-out becoming effective without sufficient compensation from renewables. Implementation

of the political commitments in the *Action Plan on an Energy Policy for Europe* of March 2007 (Council Document 7224/1/07) and the targets on greenhouse gas (GHG) emissions reductions, renewable energy, biofuels and energy efficiency will no doubt affect the evolution of energy demand. The potential impact of these political commitments is currently being studied by the European Commission.

The overall structure of EU energy demand is expected to change towards more use of renewables and natural gas, with the most significant increase being experienced by renewables. Solid fuels and oil use will increase somewhat but not enough to maintain their market share, in line with the long-term trend. Nuclear energy declines following the phase-out decisions in some member states and the EU-mandated closure, on safety grounds, of some nuclear power stations in the EU12. The share of non-fossil fuels in total energy consumption would increase marginally from 21.0% to 21.3% in 2020, in business-as-usual projections. Somewhat higher shares of renewables over time are compensated by a decrease in the nuclear share.

ENERGY POLICY DEVELOPMENT

GENERAL POLICY DEVELOPMENT

EU policy development follows important political principles expounded in the Treaties and political statements, notably *subsidiarity*[5] and *proportionality*[6]. The principle of *better regulation*[7], which has a prominent place in the Lisbon Reform Agenda for Growth and Jobs, is also an important guide. The aim is to ensure that policies are developed in the most democratic, representative, transparent and consensual way possible with clear justifications and balanced assessment of options. All legislative proposals are accompanied by "impact assessments" which outline the advantages/benefits and drawbacks/costs of different policy actions, and justify the course taken in the proposed policy.

Reflecting these requirements, new energy policy proposals are prepared on the basis of wide stakeholder consultations, including national authorities, regional bodies, industrial associations, individual companies, consumers and their associations and non-governmental organisations (NGOs). A number of consultation groups also exist, including the Madrid and Florence Forums (for gas and electricity markets, respectively), the Gas Coordination Group, the Oil Supply Group, the Amsterdam (Sustainable Energy) Forum, the Berlin (Fossil Fuels) Forum and the Prague/Bratislava (Nuclear) Forum. Internet

5. In the EU context, this means taking EU action where it adds value, and leaving alone matters best done at national level.
6. Not going beyond what is necessary to achieve the objectives.
7. Avoiding burdensome legislation, consulting widely on all proposals, and assessing the full impact of proposals before they are made.

consultations may also take place, while *Eurobarometers* and other surveys are also used. This means that proposals made by the European Commission have already been largely tested for their relevance, appropriateness and timeliness. Significant consultations undertaken by the Commission however also take place when required or on an informal level. Independent studies may also be commissioned into specific issues in order to help develop and implement policy initiatives.

Consultations also take place within and between the different EU institutions. Within the European Commission, Inter-Service Groups and formalised Inter-Service Consultations (involving representatives of all interested Directorates-General) smooth the preparation of new initiatives. There is also close contact between the European Commission and the European Parliament committees, specifically for energy with the ITRE and Environment (ENVI) Committees as well as the temporary Climate Change (CLIM) Committee. Together with member states, the Council's Energy Working Group provides the framework for examining the Commission's proposals. Informal co-ordination is carried out by the regular meetings of the Energy Directors-General group of the Commission, although this is not an institutional body. Figure 6 shows the structure of the decision-making process at EU level.

GOVERNANCE

The Commission's role as watchdog is important to ensure the implementation of policy across the EU. At the same time, national regulatory authorities (set up under relevant directives) also have a role in ensuring that national legislation applying EU rules is properly implemented in the member states.

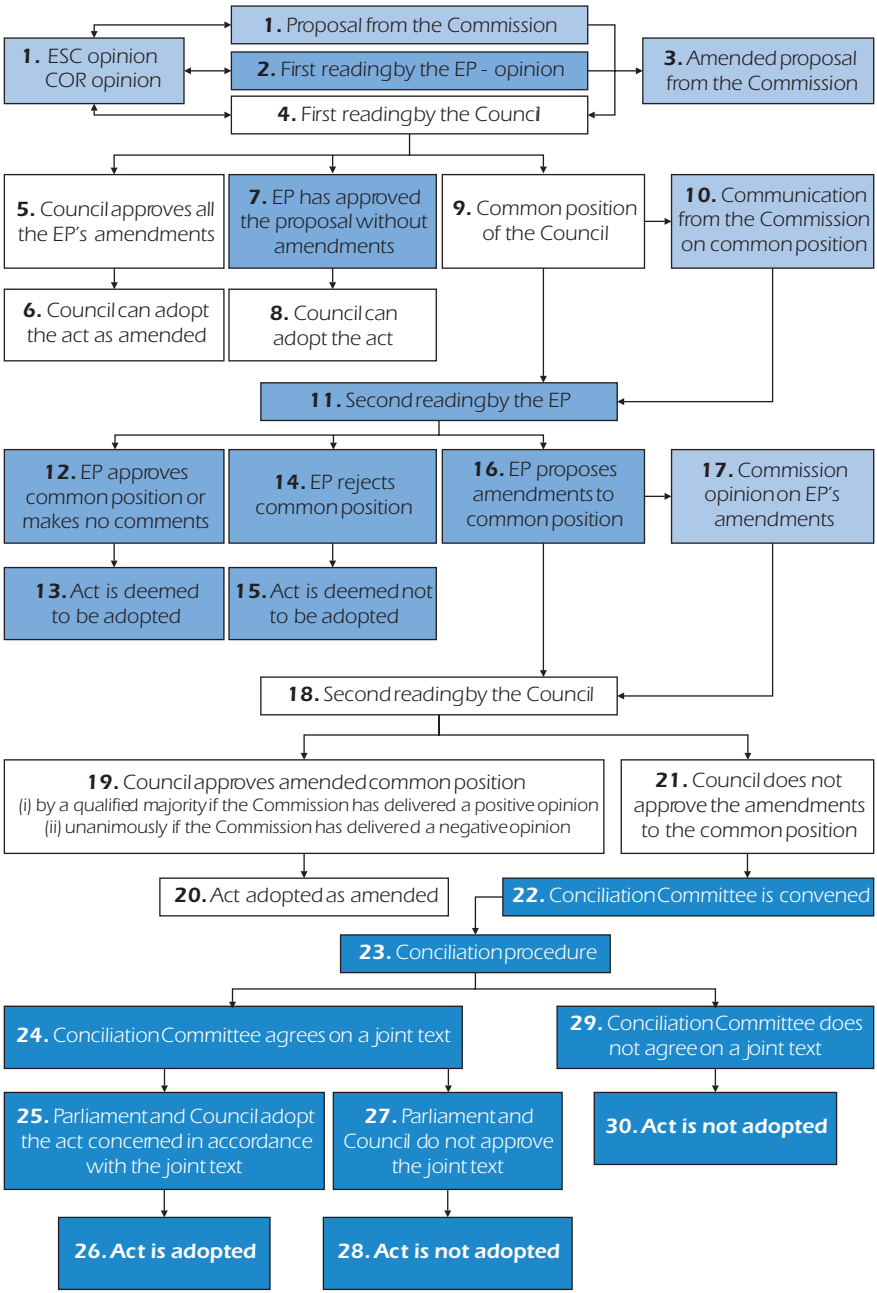
The Council of Ministers, comprising members of national governments, together with the European Parliament, whose members are directly elected by EU citizens, are, broadly speaking, the bodies which jointly take legally binding decisions in the EU (though the Commission has sometimes delegated powers to act autonomously). The European Economic and Social Committee (ESC) and the Committee of the Regions (COR) are also consulted, and give their opinions on policy statements/proposals. Under the Lisbon Treaty, national parliaments will have a stronger role. This ensures full democratic oversight.

ENERGY POLICY DEVELOPMENT

All EU energy legislation is based on the EU Treaties (including Euratom), since the creation of the Union. A European coal policy existed under the European Coal and Steel Community (ECSC) from 1952 until 2002, when the ECSC expired. In nuclear policy, the EU has a clear remit only through the Euratom Treaty of 1957. In 1955, the Messina Declaration by European Heads of State and Government called for more abundant energy at a cheaper price to be put at the disposal of the European economies.

Figure 6

Structure of the Co-Decision Process



COR: European Committee of the Regions; EP: European Parliament; ESC: European Economic and Social Committee.

Source: European Commission.

Because there is currently no specific article on energy in the currently ratified EU treaties, energy-related legislation has so far been introduced under the following legal basis:

- Environment (Art 175);
- Approximation of laws (Art 81-97);
- Trans-European networks (Art 154);
- Difficulties in the supply of products (Art 100);
- Research (Art 166); and
- External relations (various articles in the treaties).

Acknowledging the sensitivities regarding some aspects of energy policy in member states, EU energy policy actions have respected, and will continue to respect, two principles: first, that member states are ultimately responsible for their national energy mix; and secondly, that indigenous energy resources are a national, not European, resource. Notwithstanding this, member states have in the past accepted legally binding, although non-enforceable EU targets for specific energy sources, such as renewables, and are negotiating legally binding, enforceable, national targets within the framework of the draft Renewables Directive. Importantly, the EU has for more than a decade agreed legal provisions for the opening-up of energy networks within the internal energy market and encouraging cross-border collaboration, interconnection and energy flows.

The EU has also developed an external energy policy, acting in areas of its own competence, such as economic, technical and financial co-operation, with agreements covering trade, investment, infrastructure development and use (*e.g.* Energy Community Treaty, Energy Charter Treaty), etc. Energy issues also come up in the framework of political co-operation under the EU's Common Foreign and Security Policy (Title V, Treaty on European Union). While the CFSP is somewhat involved, most of the Commission's external competence derives from the EC Treaty.

The new Lisbon Treaty will confirm and strengthen the legal framework for EU energy policy, once it has been ratified by all member states[8]. It includes a broad legal basis for energy policy in Art. 176a, confirming and enlarging the European Union's specific competences in matters pertaining to the functioning of the internal energy market, to security of energy supply, energy efficiency, the development of renewable energy and the interconnection of energy networks. It also enshrines solidarity among member states in energy matters.

8. The result of the Irish referendum will at least delay the coming into force of the treaty beyond the target date of 1 January 2009.

Energy policy developments at EU level have gained momentum in 2005 when a new political will emerged among member states to work together more closely in energy matters and to strengthen the common policy in certain fields. This was first expressed at the G8 Summit at Gleneagles in July 2005 in an action plan covering climate change, clean energy and sustainable development, and this theme was taken up during the UK presidency of the EU in the second half of 2005. The next major step was taken at the Hampton Court informal summit of EU leaders in October 2005, when heads of EU states and governments called on the Commission to urgently set out how the EU could work together in energy matters. Climate change, international geopolitics and the establishment of the internal energy market were important drivers of these political changes. The recent milestones for a common EU energy policy are the following:

- G8 Summit at Gleneagles, July 2005;
- Hampton Court Informal EU Summit, October 2005;
- March 2006: Green Paper on *A European Strategy for Sustainable, Competitive and Secure Energy* (COM 2006/105);
- March 2006: European Summit request to the European Commission for an Energy Policy for Europe and an Action Plan;
- June 2006: European Commission/SG/HR paper on an External Energy Policy (S160/06);
- June 2006: European Summit request for the development and implementation of an External Energy Policy;
- October 2006: Informal Summit in Lahti recognises the importance of "speaking with one voice";
- October 2006: Communication on an Energy Efficiency Action Plan by the European Commission (COM 2006/545);
- December 2006: European Council endorses the setting-up of a network of energy security correspondents;
- January 2007: Energy Package presented by the European Commission, including the first EU Strategic Energy Review (COM 2007/1);
- March 2007: European Council adopts an Action Plan on an Energy Policy for Europe (COM 2007/1) covering 2007-2009;
- September 2007: Commission proposes the third internal electricity and gas market package (COM 2007/528 – COM 2007/532);
- November 2007: Commission proposes a European Strategic Energy Technology Plan (SET Plan – COM 2007/0723);
- January 2008: Commission proposes the Energy and Climate Change Package (COM 2008/30).

Box 1

Key Energy Policy Proposals by the European Commission since 2006

The Integrated Energy and Climate Change Package

The European Union sees mitigating climate change as one of its greatest political challenges. In March 2007, following the proposal for an energy and climate change package in January 2007, the European Council agreed to reduce greenhouse gas (GHG) emissions by 20%, below 1990 levels, by 2020. The main instruments to achieve this goal would be energy policy and the European Emissions Trading Scheme (ETS). At the same time, improving security of energy supply and developing Europe's industrial competitiveness in new sectors (such as renewables) are also pillars of EU energy policy.

Without greater energy efficiency and more renewable energy use, the proposal states that it will be impossible for the EU to reduce greenhouse gas emissions in line with existing and new commitments or to achieve significant improvements in the security of energy supply. Member states therefore agreed a binding target to raise the share of renewable energy to 20% of EU total primary energy consumption by 2020 (from 8% now, against a background of rising energy demand). The use of biofuels should increase to 10% of vehicle fuel in each member state (up from less than 1% in the EU as a whole) as security of energy supplies is weakest in the transport sector. They also agreed that measures should be put in place to reduce projected energy demand in 2020 by 20%.

A new legislative package published in January 2008 sets out the national targets which member states will need to reach in order to meet their March 2007 commitments on greenhouse gases and renewable energies, as well as proposals for a revision of the ETS and a legal framework for carbon capture and storage.

Within the United Nations Framework Convention on Climate Change (UNFCCC) process, the EU seeks to involve third countries in an international agreement for emissions reductions. When this is achieved, it will raise its 20% GHG emissions reduction target for 2020 to 30%. The EU's 20% commitment, but even more so its eventual 30% commitment, is also likely to give a lift to its international collaboration in areas such as energy efficiency and technology.

The measures which are being pursued in response to climate change are expected to have also a positive impact on energy security. Factors outside the EU's direct control, such as geopolitics, oil and gas reserves

and production, rising energy demand from third countries, and ageing or inadequate infrastructure do present new threats to energy security. At the same time, climate change can also have indirect impacts on energy security, for example carbon emission limits make coal-fired power generation less attractive and water shortages can affect both thermal and hydropower production.

- Within the internal energy market, considerable scope is seen for increasing security of supply. A true European grid would be particularly important in achieving sufficient diversity of supply throughout the EU and in promoting solidarity in a crisis. A more diverse energy mix at local and regional level (including decentralised generation) is expected to strengthen resilience. EU-wide storage (of gas) and stocks (of oil and fuels) arrangements are also planned to deal, in both the short term and the long term, with emergencies (better security of supply challenges). Full use of co-ordination mechanisms (such as the Gas Co-ordination Group, or the Oil Supply Group) can also help to anticipate and forestall potential crises.
- To achieve credibility among energy producers, consumers and investors, priority is given to meeting the agreed domestic commitments and targets, not just through energy policy, but also through other relevant policies, for example in agriculture, research, enterprise, and regional policy.
- The EU expects to have to press for action at all levels to speed up the shift to a low-carbon economy, including the establishment of a well-functioning internal energy market, more and better managed funding for new technologies (through the Strategic Energy Technology Plan), the creation of new infrastructure (notably for alternative energy production and supply, including offshore wind), the extension of the EU Emissions Trading Scheme (ETS), and by ensuring that the ETS becomes the hub for an international carbon pricing mechanism.
- EU actions to reduce GHG emissions and increase renewable energy use and energy efficiency will be undertaken worldwide, and the EU intends to establish its policies on the global level and pursue policy making through international co-operation.
- The European Union also intends to build up an international coalition of energy producers and consumers to address climate change. Steps have already been taken, for example the commitment at the Bali Conference in December 2007 on global negotiations on a climate agreement by end-2009, or through the establishment of the International Partnership for Energy Efficiency Co-operation (IPEEC), which began as an EU initiative to promote energy saving in consumer countries; and the new Renewables and Climate Change Package, which is an international first.

- The European Union intends to strive for a clearer and more coherent energy identity. This is expected not only to enhance the credibility of the EU, but also to bring benefits to member states compared to what they could achieve by acting alone. It aims to give concrete form to the concept of a common external energy voice for the EU, which has been supported by member states, particularly at the Hampton Court Summit in 2005 and again in March 2007. Work is under way to define priorities and means of working in external energy policy, combining EC instruments (for example the Energy Community, Trans-European Energy Networks, European Investment Bank, European Neighbourhood Policy, bilateral agreements) and Common Foreign and Security Policy (CFSP) processes.

Competitive Energy: A Fully Functioning Internal Market

In the view of the European Commission, the EU has the potential to become the world's largest single electricity and gas market with almost 500 million consumers. For this to happen, three conditions are regarded as necessary:

- First, legislation must be agreed and put in place swiftly to provide the basis for fair and equal competition, properly regulated, with full co-ordination among member state actors (regulators, transmission system operators), respecting principles of transparency and good governance. The third internal energy market liberalisation package adopted by the Commission in September 2007 makes important proposals in this regard, including effective unbundling and requiring that non-EU companies operating in EU markets must apply the same rules as EU companies.
- Second, infrastructure must be developed to move towards a truly European network, for the free movement of gas and electricity across the borders of the member states, and to enable rapid growth of renewables. This should also include new import possibilities to increase supply diversity, new networks to incorporate offshore wind into the European grid, as well as gas storage for the benefit of the whole EU network. The third internal energy market package and the Trans-European Networks – Energy (TEN-E) policy are relevant in this regard.
- Third, in the view of the European Commission, greater solidarity must be assured in the internal market, as a local interruption can affect the whole EU market (as was seen with the electricity network interruption in north-west Germany on 4 November 2006). The Commission is developing proposals for solidarity mechanisms among member states. Once functional, a new EU Energy Market Observatory housed in the Directorate-General Transport and Energy of the Commission will carry out analysis of the fundamental situation in the internal energy markets, while constant monitoring will be conducted by energy regulators in co-operation with the proposed Agency for the Co-operation of Energy Regulators.

INSTITUTIONS

EUROPEAN INSTITUTIONS

The key to decision-making in the EU is to find sufficient consensus among the **European Commission**, the **Council** (in which all member states are represented), the **European Parliament (EP)**, and local authorities and social partners, which are represented at EU level through the **European Committee of the Regions (COR)**, and the **European Economic and Social Committee (ESC)**. For this process the roles of the various institutions are all clearly defined in the European Treaties and in European case law.

Most decisions in energy policy are therefore taken in a co-decision process[9] by the Council (ministers from the 27 member states) and the EP. The final legislation is a text agreed in this way, which might be quite different from the original Commission proposal. The Energy Council (energy ministers) is usually the configuration in which energy-related decisions are taken, but other Council configurations (Environment Council, Competitiveness Council, Economy & Finance/Ecofin) also discuss energy dossiers and may influence the final text. Similarly, the Industry, Research and Energy (ITRE) Committee of Parliament is usually the lead committee for the preparation of EP opinions, but other committees give their views to this ITRE Committee before the Parliament as a whole decides.

In the Common Foreign and Security Policy, decisions are taken by the European Council and the Council of Ministers. The EP is kept informed and is consulted on the broad orientations and choices. The Commission may make proposals but does not have exclusive competence.

Increasingly, and in line with changes which will be introduced in the Lisbon Treaty, the European Council (heads of state and government of member states and the Commission president) is involved in the wider energy policy development. At successive summits, notably in March 2006, March 2007 and March 2008, the European Council has been moving towards increasingly detailed indications of what Europe's energy policy should be, based largely on proposals from the European Commission. This confirms the growing relevance of energy policy to wider strategic considerations.

EUROPEAN COMMISSION

The **European Commission** is the executive body responsible for the policy development and administration of the European Union. It is the third part of the institutional triangle that manages and runs the EU, together with

9. Article 251 of the EC Treaty.

the Council of Ministers and the European Parliament. As the EU's executive arm, the Commission implements the decisions taken jointly by the European Council and Parliament, and it has wide powers to manage EU common policies, such as research and technology, overseas aid, regional development. It also manages the budget for these policies. Its members are appointed for a five-year term by agreement between the member states, each of which has the right to propose one Commissioner. Their appointment is subject to approval by the European Parliament. The Commission is also answerable to the Parliament for its actions. As "Guardian of the Treaties", it has to ensure that the regulations and directives adopted by the Council and Parliament are being implemented in all the member states. If they are not, the Commission takes the offending party to the European Court of Justice to oblige it to comply with EU law. An important principle is that the Commission is independent of member state, industrial or financial interests.

In all areas of EU competence, the Commission has exclusive power to propose legislative measures – an important right of initiative. However, it usually only makes proposals following widespread consultations with interested parties, such as social or economic stakeholders, citizens, or pressure groups. Accordingly, the Commission also has a role in assembling and analysing information on market developments, public opinion and strategic considerations with a view to better defining new policy proposals.

The European Commission also has the task of ensuring that member states apply EU legislation. This helps ensure that all member states implement policies in a timely fashion and in a climate of openness and solidarity. Therefore, compliance monitoring, review and follow-up of member states are key activities of the Commission. For example, in October 2007, the Commission started infringement proceedings against 12 member states that had not yet submitted National Energy Efficiency Action Plans (NEEAPs), despite having agreed to do so by 30 June 2007 when they adopted the Energy End-Use Efficiency and Energy Services Directive (Directive 2006/32/EC – see also Chapter 5, section on Energy Efficiency). If a member state refuses to implement an agreed directive or delays its implementation unreasonably beyond the set deadline, then the Commission may decide to bring the case to the European Court of Justice. Often this is not necessary, because the member state in question speeds up the implementation to avoid court action and possible fines.

The European Commission is organised in Directorates-General. The most important of these in the area of energy policy are:

- **DG Transport and Energy (TREN)** which is the lead DG responsible for energy policy making.
- **DG Competition (COMP)**, the Union's competition watchdog.

- **DG Environment (ENV)** which is responsible for environmental legislation such as pollution control and emissions trading.
- **DG Enterprise (ENT)** which is responsible, among others, for the Sustainable Industrial Policy, the Lisbon Strategy on growth and jobs, and the analysis of the effects of energy and environmental policy on industry.
- **DG External Relations (RELEX)** which is responsible for the relations with countries outside the Union.
- **DG Research (RES)** which is responsible for energy research, jointly with DG-TREN.
- **DG Trade** which is responsible for the EU's trade policy.
- **The Joint Research Centre JRC.**

Eurostat is the statistical service responsible for producing energy statistics and outlooks. It is part of the European Commission.

OTHER INSTITUTIONS

The **Euratom Treaty** creates a specific framework and decision-making process for nuclear energy, defining specific tasks and powers of the Euratom Community. Although the European Parliament does not have the same formal powers as under the EC Treaty, the Commission consults the European Parliament on legislative proposals within the scope of the Euratom Treaty. This difference could be reduced within the projected Lisbon Reform Treaty (12th Protocol modifying the Euratom Treaty). The Euratom Supply Agency is responsible for monitoring the uranium supply situation in the EU. It is independent and only administratively overseen by DG TREN.

The **European Environment Agency** (EEA) is working for the EU in data collection and distribution in the area of environmental protection. It is responsible for preparing reports to the UNFCCC, and assists the Commission with information in the preparation of environmental and energy regulation. The Commission is a member of the EEA executive board.

TAXATION

While the EU does not have competence in the area of direct taxation, it has the ability *inter alia* to set minimum taxation rates for certain products, including energy (indirect taxation). Its role in setting value-added tax (VAT) levels is discussed further in Chapter 5, section on Energy Efficiency. Table 2 gives an overview of the minimum taxation levels applying to energy products.

Table 2

Minimum Rates of Energy Taxation in the EU

(Euros)

Fuel	*Unit*	*Minimum excise rate*	
Mobile use		*From 1 January 2004*	*From 1 January 2010*
Petrol	1 000 L	421	421
Unleaded petrol	1 000 L	359	359
Diesel	1 000 L	302	330
Kerosene	1 000 L	302	330
LPG	1 000 L	125	125
Natural gas	Gigajoule	2.6	2.6
Stationary use		*Business use (from 1 January 2004)*	*Non-business use (from 1 January 2004)*
Diesel	1 000 L	21	21
Heavy fuel oil	1 000 kg	15	15
Kerosene	1 000 L	0	0
LPG	1 000 kg	0	0
Natural gas	Gigajoule	0.15	0.3
Coal and coke	Gigajoule	0.15	0.3
Electricity	MWh	0.5	1

Source: Council Directive 2003/96/EC.

CRITIQUE

The European Commission is responsible for significant aspects of energy policy making in 19 IEA member countries which are also members of the EU, and through its proposals for co-decision by Council and Parliament, it is now contributing to or setting energy policy for 27 member countries and almost 500 million citizens. EU energy policy has an impact beyond EU borders, first because of the size of the population and the number of countries it affects, and secondly because of its design, with recent policy proposals being explicit about the aspiration of the EU to become a global leader in creating sustainable energy policy. As a consequence of this ambition, and the realisation of the responsibilities thrust upon it, the Commission has developed some energy policies that are at the cutting edge of global energy policy development, in particular integrating

energy into the broader sustainability objectives, and approaching policy issues in an integrated way, by drawing together energy security, cost, and environmental policies into a comprehensive framework. This is highly commendable, and the Commission is encouraged to continue on this path.

Since 2006, helped by political commitments in the European Council and clear indications from the European Parliament, the Commission is developing and driving a strong, coherent energy policy at EU level, which recognises the increasingly pressing challenges of growing imports of energy, while addressing the environmental impact of energy production and use. There is firm political and public support for this increasingly assertive role of the Commission, which will be enshrined in the Lisbon Treaty once it enters into force. In response to compelling and growing global energy security and climate change challenges, the Commission has developed a clear and comprehensive energy policy built upon three intrinsically linked elements:

- **Sustainable development and building a low-carbon future**

  The Commission has presented the so-called *20 20 by 2020* plan. The targets to which the European Council has committed Europe are very ambitious, yet they offer clear guidance and direction for EU energy policy and will significantly advance energy security and make an important contribution towards a global low-carbon energy future. Developing flexible trading options will be important in meeting these targets.

- **Decisive actions to achieve the long-held European goal of a single energy market**

  The Commission recognised that previous internal liberalisation objectives have fallen far too short of the goal of creating a truly liberalised and integrated internal energy market, and proposed the "3rd package" on gas and electricity market liberalisation. The proposals in the package, most importantly those on unbundling of incumbent energy companies, will remove the central remaining obstacle to building a truly European energy market, and it will offer significant benefits for consumers and the continued global competitiveness of the European economy. A better functioning and more competitive electricity and gas market will also create an environment much more conducive to meeting the environmental targets, while advancing EU energy security. Failure to create this liberalised integrated market on the other hand would risk undermining the EU move to a low-carbon future as well as EU energy security.

- **Energy security and external relations**

  Energy security concerns have grown as a result of developments in international energy markets, and the increasing dependence of the EU on outside supplies. The proposals in the third package, the *20 20 by 2020* commitments to increase renewables use and energy efficiency by 20% by 2020, the energy articles in the Lisbon Treaty, and the Commission's plans to improve mechanisms for responding to a supply disruption could substantially

increase investment in the infrastructure and throughout the energy system, and reduce vulnerability to supply disruptions within and outside the EU. As the Commission assumes greater responsibility in these external areas, it is vital to rely on a market-based approach that avoids new obstacles to a competitive market. While ensuring that foreign participants in the EU energy market operate under principles consistent with the Commission's internal market goals, the Commission should also continue to recognise the importance of a globally competitive energy market open to foreign investment and trade. Without a liberalised and transparent internal market and agreed objectives on a low-carbon future, external energy supply choices will continue to be made bilaterally on a country-by-country basis, furthering national rather than EU-wide needs, and compromise the achievement of the EU ambitions.

These closely interlinked challenges are very difficult to resolve and the Commission is highly commended for offering a range of bold and politically demanding proposals that are essential to success in overcoming them. The energy security/climate change endeavour is taking place at a timely moment for action. The timing also shows the critical risk of failure to deliver the internal market. This will add uncertainties that are detrimental for competitiveness and security of supply and for meeting the challenging political goals; failure to achieve the environmental goals will affect energy security as well.

While the overall policy development is highly commendable, there is also room for improvement in the policy making of the Commission in some areas that are outlined below.

As regards energy efficiency, while it is welcome that the European Parliament has undertaken an evaluation of the Energy Performance in Buildings Directive (EPBD), the Commission's own review will be important in monitoring and planning the next steps. Overall, to ensure enforcement of the implementation not just of the letter, but also of the spirit of EU legislation, constant evaluation and monitoring should be extended to all energy-related policy measures. This would also ensure that a thorough understanding of their performance informs the drafting of the successor measures. A good example is provided by the evaluation criteria for the Framework Programme 7, which should be applied to all the Commission's policy measures. To ensure that its own policy making is based on experience gained from evaluating the effect of past policies, the Commission should verify that it is carrying out the required *ex post* evaluations of directives.

There are questions relating to the interaction of older directives with newly formulated policy goals, for example regarding the impact of the 1992 Habitats Directive (Directive 92/43/EEC) on the construction of wind farms (needed to fulfil the 20% renewables target under the 2008 climate policy). To ensure a more robust preparation of policy proposals, the Commission should therefore continue to identify possible barriers during the development of a new policy.

The Commission has launched a wide-ranging and ambitious agenda. It is however by no means clear that the resources available are allocated in a manner that is commensurate to the goals pursued. Policy implementation, execution and monitoring normally require more resources and sophisticated organisation than policy planning, and a shortage of resources could lead to inadequate compliance, with grave consequences for the achievement of the targets. There appears to be an imbalance of resource allocation to the *20 20 by 2020* targets, with three areas of concern:

- **Energy efficiency** where staff numbers are below those identified as required in the impact assessment, and where it is also questionable if even these identified numbers would suffice, considering the agenda.
- **Energy RD&D**, particularly on CCS, where large-scale public-private partnerships need to be mobilised now if this technology is to contribute to global objectives after 2020.
- **External relations**, notably the dialogue with major producer countries.

RECOMMENDATIONS

The European Commission should:

Policy Development

- *Continue to contribute to the implementation of the Action Plan on competitiveness, security, and sustainability endorsed by the European Council in March 2007. In particular, work towards approval and implementation of the proposed legislation on* 20 20 by 2020 *and market liberalisation during the term of the current parliament.*

- *Facilitate the continued integration of energy and climate policies in the EU, by ensuring that the* 20 20 by 2020 *targets are pursued in an efficient manner.*

Evaluation and Monitoring

- *Increase the effort on timely evaluation and monitoring to further improve evidence-based policy making and programme delivery in the EU.*

- *Conduct* ex post *evaluations of the effects of the existing directives.*

Co-ordination and Consultation

- *Ensure that older legislation is evaluated so that it does not constitute a barrier for the proposed targets.*

Internal Resourcing

- *Align internal resources to the policy goals pursued.*

LEGISLATIVE FRAMEWORK

FIRST MARKET DIRECTIVES

EU efforts to reform electricity and gas industries started in the middle of the 1990s, and the aim to build a fully competitive internal market for gas and electricity is a principle embedded in the creation of the European Union. Making the energy sector in Europe competitive and more efficient is seen as part of the response to growing concerns on the competitiveness of European industries in globalising markets.

Negotiations between the EU authorities, the member states and the market stakeholders during the 1990s culminated in an Electricity Directive in 1996, (Directive 96/92/EC) and, in 1998, in a Gas Directive (Directive 98/30/EC), that introduced a first set of common rules for the EU energy market[10]. With only relatively few and brief experiences with market liberalisation in Europe and in the rest of the world, and with relatively strong opposition from some EU member states, the first market directive only included soft reform provisions. For example, the EC encouraged but did not mandate the establishment of an independent regulatory authority within each country to supervise the market.

With regard to electricity, the directive gave the largest customers the possibility to choose their supplier. It also included provisions to grant open access to the grids, but without a regulated access framework, and also included requirements to unbundle transmission system operator functions through accounting procedures from vertically integrated companies. It also introduced the concept of a single buyer, acting in the internal energy market (IEM) but appointed to be the sole supplier in a specific domain.

For natural gas, the directive aimed at opening the gas networks to third parties (third-party access – TPA), and allowing free choice of suppliers for the largest customers. This was to be achieved through accounting unbundling of the vertically integrated gas operators, thus allowing competition for supplies and customers through the natural monopoly network. The reform was intended to create a more appropriate competitive framework, spurring gas-to-gas competition, thus increasing economic efficiency and lowering costs for

10. These directives also apply to Norway, where they are being implemented through the European Economic Area (EEA) process.

the final consumers in markets frequently dominated by monopolies. At the time, wide divergences in prices paid by large industrial consumers, despite similar wholesale prices, highlighted the lack of competitiveness in EU gas markets in an era of low oil prices.

The member states could (and did) choose different approaches to implement the opening to competition process. These included: negotiated or regulated TPA; accounting unbundling, legal unbundling or complete separation by ownership; *ex ante* or *ex post* regulation of the market; establishment of regulators with varying degrees of independence and varying responsibilities, if a regulator was established at all; etc. Overall, however, equivalent economic results and market opening were required by the EC across the national markets. Derogations to delay the implementation were possible, but in practice only two countries asked for such derogations. These could be granted in the following cases:

- if the opening to competition process could be proved to be contrary to existing public service obligations, to long-term take-or-pay obligations, to security of supply prerogatives, or likely to create other economic difficulties;
- if the national or regional market was not sufficiently interconnected with other EU markets, or had only one external supplier and no indigenous resources;
- in the case of emergent and developing markets, in need of substantial investments.

SECOND MARKET DIRECTIVES

Even before the implementation of the first directives was completed, there was a push to accelerate gas and electricity market liberalisation. The reason for this was that the first directives did not provide much of the legislative framework necessary for comprehensive and targeted liberalisation, and had therefore led to uneven results. When the inadequacies in the light-handed approach towards regulation and unbundling in the first market directives became clear, a new process was launched leading towards a second liberalisation package.

In March 2002, the European Council decided on market opening for all business energy users in 2004 and full market opening in 2005. In 2003, the second market directives were adopted (gas: 2003/55/EC; electricity: 2003/54/EC), together with Regulation (EC 1228/2003) on conditions for access to the network for cross-border exchanges in electricity and full market opening for all customers was agreed for 1 July 2007. The directives were to be implemented by member states by transposing them into their relevant national legislation by 1 July 2004, whereas the regulation was immediately applied. The main parts of the directive and the regulation were:

Directive

- A stepwise opening of retail markets towards full market opening for all customers by 1 July 2007.
- Stricter provisions for the unbundling of transmission networks, leaving only the options of legal separation (establishing a separate company) or full ownership unbundling. Provisions for local low-voltage networks are less strict.
- Provisions for the mandatory establishment of independent regulators.

Regulation

- New detailed provisions on cross-border electricity trade:
  - Provisions for market-based allocation of available transmission capacity.
  - Provisions for the accepted use of congestion rents resulting from auctioning of transmission capacity. These resources were only to be used to reinforce the grid, to counter trade to financially "alleviate" other bottlenecks, or to reduce grid tariffs.
  - Transparent and non-discriminatory procedures to calculate available transmission capacity, based on the real physical bottlenecks.

BENCHMARKING REPORTS AND THE SECTOR INQUIRY

In 2001 the European Council requested the Commission to provide detailed assessments of the implementation of the market directives on an annual basis, and these were required by the second market directive to be finalised by 2005. The series of annual benchmarking reports culminated in a comprehensive report in 2005. In general, the benchmarking reports are very critical about the lack of implementation of directives and regulations in a large number of member states, they point out that in many of them the provisions that are being implemented focus on the letter of the legislation and not on the spirit of creating a true internal market. More details on the reports can be found in Box 2.

THE THIRD LIBERALISATION PACKAGE OF 2007

The sector inquiry, as well as the Green Paper and the March Council conclusions, led the Commission to propose a third liberalisation package in 2007. This agreement materialised in proposals for a third market directive and for a new regulation on cross-border electricity trade. The proposals are mainly aimed at strengthening the requirements and provisions in the second market directive, and maintain the vision for a truly competitive internal market. A group of eight member states rejected the proposal for full ownership unbundling and presented an alternative option in February 2008. The proposals are currently subject to negotiation at the European

Box 2

Market Opening Benchmarking Reports and the Sector Inquiry

In 2004 and 2005, a new series of benchmarking reports published by the European Commission[11] highlighted a number of issues that seemed to block the creation of a truly competitive and well-functioning energy market in the EU:

The reports found that **customer switching** was not sufficient. In the absence of increased **interconnection**, new suppliers were not able to enter the markets, and gas could not circulate freely from one point to another. Competition between suppliers was difficult to achieve on a national basis where **one import source** often dominated the market. **Prices** had not fallen as expected, while regulated end-user prices distorted market functioning. **Investment** was an issue, especially in cross-border interconnections. The **industry structure** was far too concentrated, and TPA not fully efficient. In the gas sector, long-term take-or-pay contracts were singled out as a problem, contributing to market foreclosure. The Commission also recognised that reforms were being implemented legally, but that some member states were (perhaps intentionally) reducing their effectiveness, even if it was required that "*Member States need to give careful consideration to ensure that in their implementation of the Directives in practice, they pursue their spirit and not only their letter*".

The series of critical benchmarking reports was followed by a broad sector inquiry, initiated jointly by the Commissioner for Competition, Mrs Kroes, and the Commissioner for Energy, Mr Piebalgs in 2006. The sector inquiry was launched in accordance with Commission regulation on the implementation of EC Treaty rules on competition. It was conducted by the Directorate-General for Competition. An important part of the context of the sector inquiry was rapidly increasing energy prices. These price increases were driven by higher fuel prices and the costs of internalising a price on CO_2 emissions resulting from the EU-ETS. However, several stakeholders, not least the customers, claimed that they were also the result of poor and ineffective competition. The comprehensive sector inquiry concluded that:

11. Brussels, 5.1.2005 – COM/2004/863 final.
http://ec.europa.eu/energy/gas/benchmarking/doc/4/com_2004_0863_en.pdf

Electricity

- Electricity markets remain national in scope and generally maintain high levels of market **concentration**, leaving scope for the exercise of market power.
- The current level of **unbundling** of networks from supply interests has negative repercussions on the functioning of markets and on incentives to invest.
- Insufficient or unavailable cross-border capacity and different market designs hamper **market integration**, effectively preventing competition from spreading across borders.
- There is a lack of reliable and timely information on the markets, undermining the required level of **transparency** for market functioning.
- More effective and transparent **price formation** is needed to deliver the full advantages of market opening to customers. Regulated tariffs below market prices discourage new entry, to the long-term detriment of consumer welfare.
- Competition at the **retail** level is often limited.
- **Balancing markets** often favour incumbents and create obstacles to newcomers.

Gas

- High market **concentration** in the sector.
- There is a high degree of **vertical integration** between supply and transportation. In particular, the fundamental conflict that arises when new large suppliers seek to use pipelines in competition with the network owners. However, the main difference with electricity is that upstream supply is in majority located outside of the European markets, inflexible in terms of location, and is beyond the reach of European regulation.
- A lack of **transparency** existed, especially on sensitive pipeline or gas storage capacity and flows.
- The European network was **non-integrated**.
- As a consequence, a **lack of incentives** for incumbents to invest in an expanded network, supply or storage capacity, especially if that would enable competition to develop.

The 6th benchmarking report was issued in January 2007 and provided a global overview of the future energy policy of the EU. It envisaged a "third package" of legislative proposals for the European gas and electricity markets, which emerged in September 2007.

Council level, while the European Parliament is also debating them. The most important elements in the proposals are:

- Full ownership unbundling of transmission system operators (TSOs). As a second-best option it is proposed that only system operation be ownership-unbundled, leaving the transmission grid in the ownership of a company with supply interests. This so-called independent system operator (ISO) would have full control over the grids and be responsible for investment plans.
- Stronger and more precise requirements on the establishment of fully independent regulators and an alignment of minimum roles and responsibilities.
- The establishment of an Agency for Co-operation of Energy Regulators (ACER) with some regulatory powers on issues related to cross-border trade and investment in interconnectors.
- The establishment of a European Network of Transmission System Operators (ENTSO) in electricity, with formal responsibilities to develop common commercial and technical codes to ensure efficient and secure cross-border trade and co-operation.
- Provisions to improve transparency in markets.

REGULATION AND IMPLEMENTATION

Recognising the importance and challenges in regulating the liberalised markets, in 1998 the Commission established a forum to discuss the regulation and implementation required to create an internal market: the Florence Forum. The Commission invited regulators, TSOs, governments, electricity industry stakeholders, and other stakeholders such as customer groups to the meetings of the forum. Each year, one or two meetings are being held and the forum has developed into an important platform for discussions, sharing of information and reaching agreements. In 2004 the Commission recognised that the liberalisation process was more regional than previously hoped for, with stepwise advancements in the various regions of Europe, depending on the specific circumstances. As a consequence, a process of meetings in seven regional mini-forums was established to complement the Florence Forum. Also, a separate forum for gas issues was established, called the Madrid Forum.

In 2000 ten national regulators formed the Council of European Energy Regulators (CEER) to facilitate co-operation and exchange experiences. CEER now has 29 members (EU states plus Norway and Iceland) and is established as a formal association with a small secretariat in Brussels. Based on CEER, in 2003 the Commission established the European Regulators' Group for Electricity and Gas (ERGEG) to assist in consolidating the internal energy market. ERGEG focuses its work on issues

Box 3

The Role of Independent Transmission System Operators

Transmission system operators (TSOs) in gas and electricity hold one of the keys for successfully delivering the internal market. They control the operation of the transmission system and make the necessary investment decisions in new transmission infrastructure that are critical for physically tying together local and national energy markets, and will be even more critical in the future as the need arises to adapt to the necessary transformation of the energy mix. Particularly in electricity, operational and investment decisions are so complex, owing to the complexity of secure system operation, that TSOs will always have considerable discretionary powers even if regulators can go a long way in setting rules.

TSOs hold a monopoly and must therefore act independently from specific generation and supply interests, to give all market players equal treatment. TSOs must have incentives to change their way of doing business so that all market players are treated neutrally in a way that minimises transaction costs without jeopardising system security. TSOs must have incentives to harmonise operations with neighbouring systems sufficiently to allow for seamless trade, both in the short term, including balancing power and operational reserves, and in the longer term, including day-ahead trade. Finally, TSOs must have incentives to make investments in transmission systems that optimise social welfare and guarantee security of supply at the level defined by energy policy prerogatives.

Owners of a vertically integrated company will in principle always have an incentive to maximise the total value of the company across the range of its businesses. They will therefore at least be perceived by their competitors, who require access to their infrastructure on identical terms, not to be impartial, and they will seek to let the TSO part of the company give preferential treatment to the other parts of the company. A regulator has the role to prevent this from happening, but suffers from information disadvantages, which are difficult to overcome without resorting to intrusive means of regulation. The experience from some markets, such as those in the United States, shows that regulated solutions, even in a framework based on ISOs, do not provide the same incentives. This is particularly the case when it comes to ensuring investment across network boundaries, as a fully independent network operator solution does. Additionally, depending on the ownership structure of the ISO, it is also possible that new entrants' concerns about impartiality of the network operator may not be resolved by such a solution.

related to congestion management, balancing markets, transparency, retail competition, and transmission investment. The work often leads to guidelines, both for best practice and those that the Commission adopts as binding.

Under the Commission's proposals for the third liberalisation package, a new regulatory co-operation agency (ACER) would be created at EU level, to regulate cross-border affairs in close co-operation with the national regulators. This proposal and the extent of the powers that could be given to such an agency are currently under debate. The agency would be responsible to the European Commission, and would be based on the existing ERGEG structure.

THE ROLE OF NETWORK OPERATORS IN MARKET OPENING

The role of TSOs in the liberalisation process has been recognised as critically important to the success or failure of the liberalisation agenda. For example, market analysis in electricity indicates that where ownership-unbundled TSOs operate, the share of congestion revenue reinvested in interconnection capacity was about twice as high as for vertically integrated TSOs. As a consequence, the third liberalisation package proposal contained the most stringent measures thus far for full independence of the TSOs in Europe.

ENERGY MARKETS

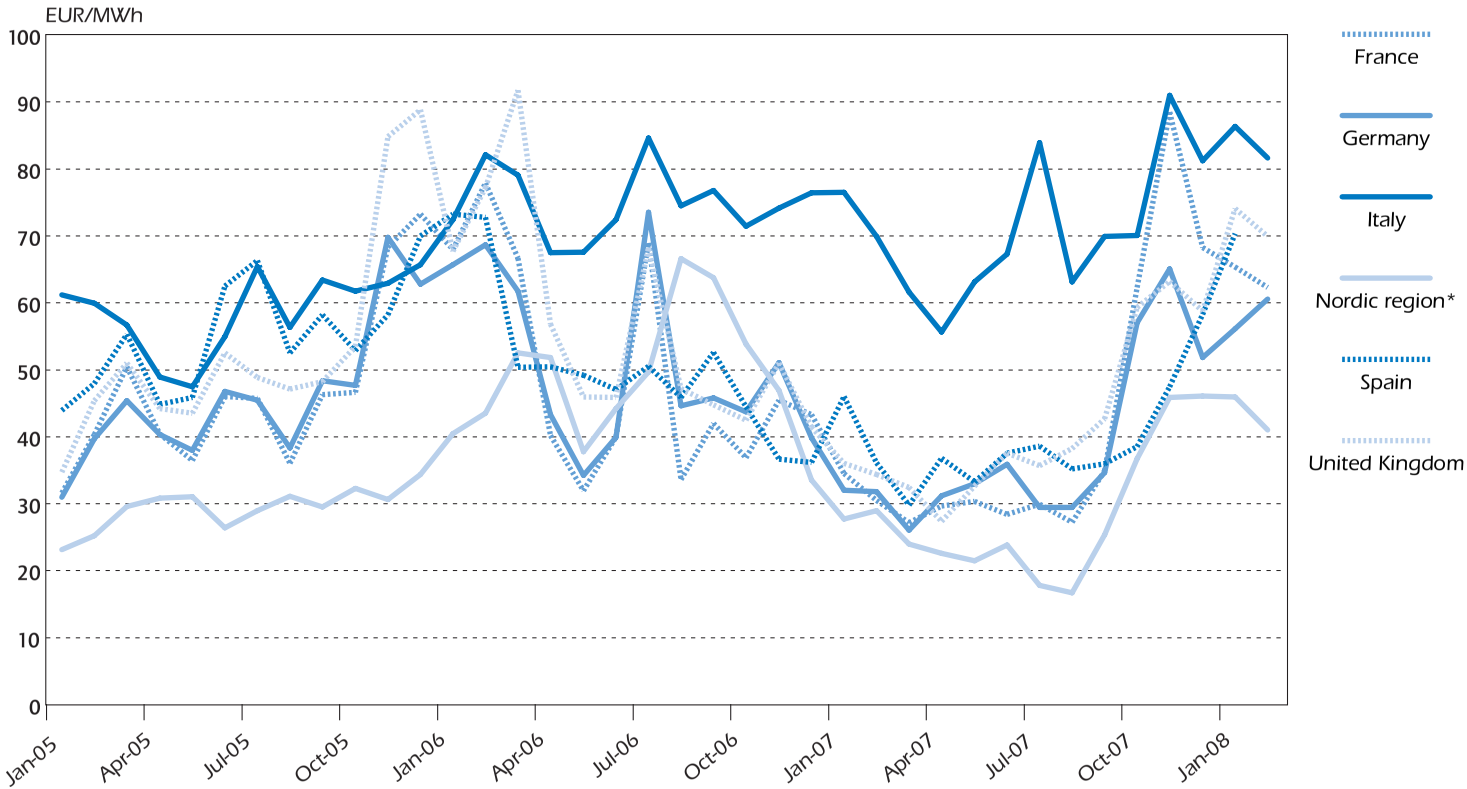
WHOLESALE ELECTRICITY TRADE

Wholesale electricity trade in the EU has developed slowly but steadily during the past decade. The association of European power exchanges, EuroPEX, has members from power exchanges in 14 EU member states. Some of the oldest exchanges are NordPool in the Nordic region, OMEL in Spain, APX in Great Britain and the Netherlands and EEX in Germany.

Figure 7 shows monthly average day-ahead spot prices in selected European markets. The prices illustrate some convergence between countries, but they are still very dependent on the actual resource situation in each country. The convergence is therefore far from complete, and great scope exists to further enhance and improve cross-border trade flows. Monthly average prices also hide the fact that prices vary greatly from week to week, from day to day and from hour to hour. Systems with a high share of hydropower, such as the Nordic region, often have relatively stable prices on an hourly level, but strong variations from season to season depending on hydro resources. Regions with traditional thermal power plants and peaky demand can see very marked price variations from hour to hour.

Figure 7

Monthly Average Day-Ahead Spot Prices



*includes Denmark, Finland, Norway and Sweden.
Sources: Exelon, NordPool, EEX, OMEL, PowerNext, GME.

Total volumes traded through standardised contracts at exchanges and through brokers (over-the-counter – OTC) have increased significantly in some markets during the last few years, but such trades are more or less non-existent in most EU markets. The Commission reports traded volumes corresponding to 1 to 6 multiples of national electricity consumption in the Nordic market, in Germany, in the Netherlands and in the UK in 2005. Liquidity has continued to increase since then in several of these markets.

The level of liquidity of trades is a key indicator for the level of trust that market players put on the spot reference price and for the ease of access to the market in general. One of the main drivers for liquidity and increased robustness of the market has proven to be the scope for seamless and easy trade across major physical bottlenecks. Many of these bottlenecks are between countries but some of them are within countries. The Nordic countries have established a system where all cross-border transmission capacity has been allocated to the power exchange which in turn auctions the capacity as an integrated and simultaneous part of the general day-ahead electricity auction. Such so-called implicit auctions have boosted dynamic cross-border flows and liquidity in spot and forward markets. Projects of full co-operation, like in the Nordic region, were launched between Ireland and Northern Ireland in 2007 and have been under development on the Iberian peninsula since 2003. Similar co-operation to implement implicit auctions was successfully launched in 2007 between France, Belgium and the Netherlands. More such projects to introduce implicit auctions in co-operation between existing exchanges have been announced in the northern part of Europe.

It can be noted that the Commission applies its competition powers under the EC Treaty to promote competition on the wholesale markets. For example, in March 2008 Greece was asked to ensure fair access to its baseload fuel (lignite); and the biggest German utility E.ON offered substantial commitments (divestment of a significant part of its capacity), in the context of a competition case relating to possible withdrawals of capacity by certain generators.

CROSS-BORDER ELECTRICITY INTERCONNECTIONS AND TRADE

Cross-border trade has developed in steps since the first and second market directives came into force in 1996 and 2003. Total gross trade between EU member states increased markedly around the turn of the century but the growth rate has slowed down since then. Initially most trade across borders outside the Nordic region was related to agreements and contracts signed before the start of the liberalisation process. With the unbundling of the sector and the gradual maturity of old contracts, cross-border capacity has

slowly been freed up for the competitive market. Initially most available cross-border capacity was allocated with non-market-based mechanisms, such as first-come-first-served or pro rata. Often the mechanisms were not co-ordinated between the two TSOs involved, making it very challenging for market participants to make good use of the transmission capacity. Then a system of explicit auction of transmission capacity was slowly introduced on a border-by-border basis, where cross-border transmission capacity is auctioned prior to the energy market settlement. EU legislation requires that cross-border capacity be allocated according to market-based principles, with implicit and explicit auctions as mechanisms that fulfill that requirement.

The Commission regulation on cross-border trade includes a provision to establish a mechanism that appropriately compensates transmission owners for the use of transmission grids for transit flows but without setting up border tariffs as it was common in the past. Such mechanisms have been adopted by the European Transmission System Operators' organisation (ETSO) since 2002, but only with considerable resistance and still not with full participation from all ETSO members. The development of an Inter-TSO Compensation Agreement is an indicator of the challenges that lie in establishing appropriate incentives for network owners.

RETAIL SUPPLY

An additional step on the way towards competitive energy markets was achieved on 1 July 2007 with the full opening of national retail markets. Most of the then EU15 states, as well as some new member states, had already opened markets fully for retail competition before the deadline. From a legal perspective, all European consumers are now able to choose their supplier and benefit from competition. Retail competition is, however, only developing relatively slowly.

The level of switching of supplier is an indicator of the level of competition in a market. It cannot stand as the sole indicator but it is important because switching creates a risk for a retail supplier of losing a customer and hence constitutes an important incentive for suppliers to improve services to survive competitive pressure. Retail switching also indicates that transaction barriers for customers and suppliers are sufficiently low to create a competitive pressure. Switching activity for the smallest commercial and residential customers has been above 5% of total customers in only three countries during 2006. In another six countries, there has been a certain level of switching activity but not enough to regard the market as sufficiently competitive. For larger customers, particularly the very largest, there has been significant switching in most EU countries. More than 50% of the largest electricity customers have switched since market opening in

seven countries and more than 15% of the largest customers have switched in 17 countries, including Norway.

Retail prices for electricity decreased considerably in the last part of the 1990s and the first years of the current decade in those markets that the Commission's benchmarking report assessed to be most advanced in the liberalisation process. Since then, retail prices have started to increase, particularly since 2005. There are several reasons for this. The development of effective competition after the phase-in period did put downward pressure on prices. This downward pressure resulted partly from competitive pressure in wholesale and retail markets, and partly from changes in the regulation of networks. Hence, in general these were effects reflecting improved efficiency in the sector. Regarding network regulation, several regulators have, however, recognised that models for efficient network regulation also have to include incentives for investment and system security in addition to incentives to cut short-term costs.

Prices started increasing with the increase of fossil fuel costs. In particular gas prices increased significantly, indirectly feeding through into the electricity price. Also, in 2005 the EU-ETS was introduced, establishing a price on CO_2 emissions, which also seemed to flow directly into wholesale electricity prices as expected and intended.

Another effect has also put upward pressure on wholesale electricity prices during the past three to five years. Most European regions are now in the beginning of a new investment cycle after having benefited from relatively overbuilt systems for ten years. Increasing demand and decommissioning of older plants have tightened supply and demand, so that marginal prices are set by more expensive plants. This creates crucial incentives for new investments.

Retail markets for gas are less well developed than those for electricity, mainly because of limited access to gas supplies for new entrants, leading to only limited scope for trading margins. Even in the most developed market – Great Britain – competitive forces are dominated by gas producers. Entry of new producers to the supply portfolio remains a motor for both competition and security of supply. Liquefied natural gas (LNG) plays an important role in this respect. While the rates of larger customers switching continue to rise, small business customers and households in most cases still only have limited supplier choice. In general, lack of competition in external upstream gas markets has been a serious barrier for wholesale and downstream competition in European markets, as long-term contracts, even if based on oil prices, are designed on a subjective bilateral basis and may not reflect correctly the market value on consumers' markets.

Some countries have responded to price pressure by maintaining regulated tariffs, often below market prices. Such tariffs are intended to protect

customers from the effects of poor competition. Another reason to establish regulated tariffs for some customer groups in the past has been to help the poorest of them. Integration of such social programmes into the monetary flows of the electricity sector was easier to do in the past when monopolies and often state ownership prevailed. The fifth Commission benchmarking report questions the real need for the continued existence of such tariffs by concluding that in all the EU15 states except Portugal, low-income consumers spend less than 1% of their total budget on electricity, and that there are no EU countries where they spend significantly above 3% of their budget, although these figures may have risen somewhat since then because of rising energy prices.

SUBSIDIES

Under current EU legislation, it is possible to provide for subsidies in energy markets. Traditionally, the most important subsidies have been to support coal production, or its gradual phase-out. With the emerging policy objective of decarbonising energy supply, subsidies have become available to renewable energy as well. For energy security and diversification of supply, member states are also allowed to set public service obligations (PSOs), supporting the use of a particular fuel financially. The design of subsidies varies by member state. It is possible for subsidies to be paid largely in a manner that is compatible with an open energy market, or that the subsidy is paid in a way that precludes the active participation of the subsidised energy producer in the market. State subsidies which provide an economic advantage to certain undertakings and have the potential of distorting competition and which affect trade between member states have to be approved by the Commission. However, according to case law, measures (involving for example renewable electricity feed-in tariffs) which are designed according to the relevant legislation fall outside of the Commission's state aid control remit.

The Commission aims to persuade member states to grant less state aid in general and to redirect spending to horizontal purposes of common interest, such as environmental protection. In its new community guidelines for state aid for environmental protection (OJ C 82, 1.4.2008), the Commission allows member states, within certain limits, to continue to encourage state aid for renewable energy and energy efficiency. The Council Regulation 1407/2002/EC on state aid to the coal industry also foresees that this aid has to follow a downward trend.

The European Council meeting of spring 2006 asked for further work on appropriate incentives and disincentives, and called for the reform of subsidies that have considerable negative effects on the environment and are incompatible with sustainable development, with a view to gradually eliminating them. In response to this request, the review of the EU Sustainable

Development Strategy [COM2005(658)Final] calls on the Commission to produce a road-map by 2008, for each of the relevant sectors, on the removal of environmentally harmful subsidies. The Commission stressed in its recently adopted Green Paper on market-based instruments for environment and related policy issues [COM(2007)140] that it will work with member states towards this objective.

It is expected that in the foreseeable future there will be no more possibility to grant direct subsidies to fossil fuel production. Nevertheless, some member states may decide to impose public service obligations with respect to their power generators, forcing them to use domestic fossil energy sources (obligation based on security of supply considerations). Power generators will be able to do this provided they respect the limits imposed by the Electricity Market Directive and provided they are not overcompensated for the public service obligations imposed on them.

CRITIQUE

Energy markets are central to the achievement of EU energy policy objectives in several areas, and they will be increasingly stressed in coming decades. Hence, the efficient functioning of EU gas and electricity markets is a high policy priority for the Commission. It is therefore gratifying to see that the ambitious proposals and actions in the area of sustainable energy policy have been matched with a move in this area, notably the 3rd Liberalisation Package proposed in September 2007. This proposal is based on a well-founded analysis in the sector inquiry as well as in the latest benchmarking report.

The market reform process has now run for a full decade in the EU, with at best mixed and incomplete results, notwithstanding vigorous efforts by the Commission to implement meaningful reforms. The benchmarking reports show that many weaknesses remain in the functioning of energy markets. In the gas sector, the current market circumstances show strong upward demand pressure, within the context of a tight global market for gas. Lack of investment in infrastructure is weakening EU energy security, and removing a potential source of downward pressure on prices. The need for vigorous reform has never been greater if EU consumers are to benefit from competitively priced gas, supplied in a secure and reliable manner. The necessary changes to clarify incentives of TSOs and to strengthen the regulatory framework, and increasing efforts to introduce proper and unbiased competition on wholesale gas markets must be carried through as a matter of urgency. There is no more time for further incremental steps; implementation of stronger measures is needed.

The internal market is in itself an essential tool for meeting these challenges without jeopardising EU competitiveness, sustainable development, and

security of supply. The Commission is relying on market-based instruments in all of these areas. For these to work properly, it is imperative that the underlying energy markets also function effectively, providing transparency, as well as a stimulus for investment and competitive pressures on market actors, so as to enable adequate responses to the short- and long-term stresses on the system. These stresses emanate from a variety of sources:

- After some decades of low investment, a new investment cycle is commencing in electricity generation and networks. The forced retirement of ageing coal-fired plants that no longer fulfil environmental performance standards since the 2001 recast of the Large Combustion Plants Directive (see Chapter 5, section on Air Pollution), or nuclear power plants that are retired because of nuclear exit policies in some EU member countries[12], will exacerbate this need for investment.
- Gas will increasingly become a source for power, rising from less than 8% in 1990 to 25% by 2010, at a time when EU resources for gas are depleting rapidly. Gas import infrastructure investments, both for LNG and long-distance piped gas, are urgently needed. Apart from infrastructure, it is vital that new volumes are guaranteed for the European markets, and for that, investment upstream, which lags today, is crucial to ensure long-term security of supply and liquidity on European markets.
- Large volumes of renewables are set to enter the electricity system, primarily from variable sources such as wind or solar. To accommodate this while ensuring system security, investments in networks are required, on the local level for connection, on the cross-border level to enable balancing load-flows, and into balancing generation plant.

If the EU member states act together, the Union will be able to meet the critical challenges of balancing objectives and constraints. A divided EU on the other hand is likely to see security of supply deteriorating and costs for customers increasing, particularly when trying to reduce the environmental footprint of energy consumption, as required. A truly internal market for gas and electricity, with seamless trade across a truly competitive European market, is an essential factor in the successful balance of energy security, environmental sustainability and economic growth – the 3 Es.

Experiences from markets in IEA countries that have liberalised energy markets with considerable success show that a strong and neutral regulator is required to make market rules and to oversee network companies. This, together with a neutral and independent transmission system operator (TSO), is the key to the success of liberalisation. Predictability and a certain amount of stability are essential to reduce risks, particularly in decisions to invest in new generation and network infrastructure. It is also essential that the regulator balances all

12. Examples include a number of coal-fired stations in the United Kingdom, or the Ignalina and Kozloduy NPPs in Lithuania and Bulgaria, respectively.

interests, including customers', retail suppliers', generators', network companies' and overall society's welfare. Only a well resourced independent regulatory authority can play this crucial role effectively. Such regulatory authorities have developed in the EU, but often lack the required independence from day-to-day political intervention and the required decision-making powers. There is a need for the alignment of their powers, roles and responsibilities, which is commendably addressed in the Commission's proposals.

Because of the historic development of the energy industries and regulation in Europe, the regulatory landscape is considerably more complex than that in other IEA energy markets. As a consequence, strong co-operation among national regulators is essential, but the EU will still be faced with great challenges in fostering an internal market. An internal market requires an institution responsible for cross-border investments, as well as close co-operation and agreement between national regulators. The varied development of regulators across EU member states has made such co-operation difficult and less effective, in particular regarding cross-border issues. The intended creation of an agency with regulatory powers on issues related to cross-border trade and investments is an important step towards the organisation of an effective and sufficiently harmonised regulatory framework. The Commission is commended for its efforts to seek the establishment of a new mechanism through an Agency for the Co-operation of Regulators (ACER). The proposed agency should have the power to set common codes on cross-border infrastructure regarding third-party access (TPA), operating procedures, new capacity requests/additions, interconnection procedures/standards and transparency, thereby achieving network harmonisation.

To increase predictability and investor security, a consistent code of compliance with market regulation and obligations under competition law for electricity and gas industries should be implemented, covering issues such as market dominance criteria, or the treatment of long-term contracts. The Distrigaz case decision in 2006[13] is a welcome development in this regard, and it should be used to build the general approach in competition policy, where existing infrastructure and customers are concerned. Regulators at the same time must also balance customers' welfare and investor-friendly rules to ensure long-term sustainability of gas and electricity markets. New investment is crucial for security of supply in the long term, and EU regulation must provide for rules favourable to investment, notably by allowing for a rate of return that enhances investment where it is needed.

Cross-border trade is a key element for putting competitive pressure on prices. Against this background, sufficient network capacities are one of the main

13. This case related to the treatment of long-term gas supply contracts in Belgium and established the basis for the Commission's approach to addressing the impact of such contracts on the development of competition in the market.

drivers for allowing liquid trade, and investments are needed to overcome bottlenecks. The Commission has undertaken a number of activities under the umbrella of the Regional Initiatives with the operational support of ERGEG. These initiatives are now generally seen as a step on the way to a fully integrated European energy market. They are therefore very positive, but despite them, the Commission will need to continue to monitor cross-border investment, and implement additional processes such as assessments of regional needs and opportunities, should investment be deemed inadequate. Responsibility and financing of new interconnections, which depend on several national regulators and TSOs, should notably be defined and facilitated by cross-border regulations.

Neutral and independent TSOs hold one of the keys for successfully delivering an internal market, because only they can ensure unbiased investment decisions based on the needs of the grid, and free access to all market players. They control the operation of the transmission system and make the necessary investment decisions in new transmission infrastructure that is critical for physically tying together local and national markets, and will be even more critical in the future with the need to adapt to the necessary transformation of the energy mix. It is therefore important to ensure their independence and complete neutrality.

Transparency is an indispensable part of a well-functioning energy market. Necessary information about the status of the system has always been essential in ensuring optimal responses. In a market, these responses are decentralised, coming from individual market players; thus the necessary information must flow freely and in a timely manner to enable optimal responses from individual market players. Information about the status of demand, supply flows, generation, and storage and transmission capacity is of great commercial value to incumbent companies that have traditionally controlled such information. It is natural that they try to protect the information by referring to it as commercially sensitive, but keeping the information from the public domain is detrimental for the optimal operation of the system, jeopardising security of supply and overall economic efficiency. Transparency has only developed very slowly in the EU, even if significant progress has been observed lately. The lack of progress is likely to be related to the deficiencies in TSO incentives and the regulatory framework. Markedly improving transparency must be one of the top priorities of regulators and the Commission is encouraged to continue to use its powers to enforce the necessary transparency requirements, while taking care to avoid creating undue reporting requirements and burdens.

Fully competitive EU-wide electricity and gas markets are the means to maximising consumer welfare and minimising the abuse of market dominance. Internal market policies by the Commission should take a clear view towards the achievement of this goal. Customers should be the focus of attention

since their well-being is the ultimate objective of the energy sector. Retail competition introduces pressure on market players, forcing generators and suppliers to perform better. It is also a critical driver for enhancing liquidity and dynamic trade in markets. The slow and sporadic development of real retail competition for residential customers across the EU shows that attention to this issue has not been strong enough. According to the Commission's sector inquiry, it is likely that the higher prices were also somewhat due to a lack of competition. This is particularly likely in the markets that did not seem to harvest the initial benefits from competition before the upward price pressure started to emerge. Now, the increasing upward pressure on prices reinforces the need to harvest the full efficiency and security benefits from liberalisation and competition.

Switching supplier is one way in which consumers can react to price increases, but switching rates are not the only indicator for true competition in retail markets. Often, competing offers are unavailable or are too similar to constitute a real choice. Member states and national regulators must ensure that transparent and simple switching procedures are in place to provide the necessary confidence to customers. Retail competition, moreover, is distorted by regulated supply tariffs where these exist.

Prices set below market prices through regulatory and political intervention in several member states are a critical barrier to retail competition and generally have the effect of keeping the recipient consumers from moving into the competitive market. While the member states using them argue that such prices have been set with the aim to protect customers from price movements, in the few IEA countries where real retail competition has developed, an effective market has proven to be a far better protection, particularly in the long run. More responsive customers are also the key for the development of direct demand response to prices, improving overall economic and environmental efficiency and market performance.

The risk of regulated tariffs is that they prevent competition to develop and that they shield consumers from information about the price of supply; they have also proven to distort incentives for investment and competition to the detriment of customer welfare in the long run. In the past, price distortions, lack of transparency and lack of clear incentives that followed created the inefficiencies that liberalisation is now meant to remove. It has also proven to be very difficult, if not impossible, to design regulated tariffs that protect customers as a kind of safety net without creating harmful distortions. Such tariffs should not be necessary in any case, since all EU member states have social welfare systems that should be capable of dealing with social issues. The Commission is therefore commended for proposing the creation of a new charter for consumer rights and is encouraged to step up its efforts to nurture the establishment of real choice for customers, effectively empowering them

to take a more responsive role in the market. Improved information disclosure is an important element in consumer choice.

Subsidies paid for energy sources and production in the EU have the potential to affect the operation of the market. Of particular concern here are the increasing subsidies for renewable electricity, which are being encouraged by the Commission, but where care should be taken to integrate them as much as possible in the operation of the internal energy market (IEM). The case for phasing out environmentally harmful subsidies is much more straightforward, and lies in that they are contrary to the Commission's environmental objectives. They are also generally economically inefficient, and distort price mechanisms, but they are still granted by some member states in order to pursue other objectives, such as regional development, energy security and social cohesion. Nevertheless, the Commission should carefully evaluate the effect of subsidy payments in general on IEM operation. The internalisation of the costs of CO_2 emissions through the introduction of the EU Emissions Trading Scheme was one way of eliminating indirect subsidies to energy users, as the costs of CO_2 emission was not previously reflected in any way to help guide the behaviour of CO_2 emitters, except in the road transport sector. This increase in transparency and cost-reflectivity is laudable.

RECOMMENDATIONS

The European Commission should:

- *Vigorously pursue its liberalisation proposals as outlined in the Third Liberalisation Package, in particular by:*
  - *Continuing to pursue the organisation of a predictable and harmonised regulatory framework through the establishment of strong and independent national regulators and the creation of ACER with appropriate regulatory powers over cross-border connections and businesses.*
  - *Promoting the optimal and secure development of energy grids, and pursue the establishment of the European Network of Transmission System Operators (ENTSO).*
  - *Continuing to pursue full ownership unbundling.*
  - *Notably enhancing transparency that allows all market players to respond efficiently and in a timely fashion to the needs of the system. The external dimension of transparency in gas markets should be addressed as well.*
  - *Markedly improving trade across borders, both through existing interconnectors and through clarified investment signals for new interconnectors, especially when those are not naturally driven by market*

participants' needs but are needed to integrate markets and bring competition afterwards.

- *Stepping up efforts to improve the functioning of retail competition, and in particular to avoid the harmful distortions that inevitably follow with regulated tariffs set below market prices.*

- *Continue to pursue regional initiatives as stepping stones towards full European integration.*
- *Work towards the full elimination of state subsidies in the energy sector that are contrary to its policy goals, most importantly production subsidies for fossil fuels.*

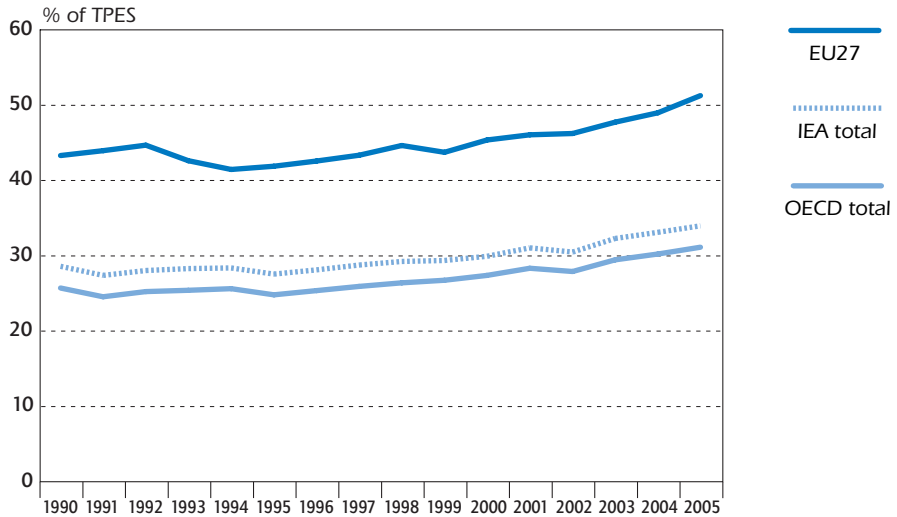
OVERVIEW

Energy security is a key concern for the European Union, and is being addressed on a range of levels, from pursuing closer relations with external suppliers, to increasing international and internal interconnections, from reducing demand to increasing domestic supplies within the Union.

The European Union is dependent to varying degrees on energy imports of oil, gas, coal and electricity. Some individual member states may be self-sufficient in one of these energy sources, or overall net exporters. As Figure 8 shows, EU net imports have increased since 1990, and now stand at 51% of total primary energy supply. The EU net energy import share is therefore considerably higher than that of all OECD member countries, which averages 31%, reflecting the small number of net energy exporters that are members of the EU.

Figure 8

Net Imports as a Percentage of Total Primary Energy Supply, 1990 to 2005



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007.

Table 3

Energy Production by Fuel in the EU27, 2005 to 2030

	2005	*2010*	*2020*	*2030*	*Share 2005*	*Share 2030*	*Change Share 2030/2005*	*Production 2020/2005*	*Production 2030/2005*
	Mtoe				%				
Coal	192	162	138	123	21	19	–10	–28	–36
Peat	3	3	3	3	0	0	5	–2	–2
Oil	132	105	53	41	15	12	–15	–60	–69
Gas	188	168	115	85	21	20	–4	–39	–55
Combustible renewables & waste[1]	82	102	129	158	9	12	33	57	92
Nuclear[2]	260	249	228	229	29	30	3	–12	–12
Hydro	26	29	29	30	3	3	18	11	16
Wind	6	12	23	29	1	1	120	285	386
Geothermal	5	6	6	6	1	1	16	12	20
Solar/Other	2	2	6	9	0	0	46	297	451
Total	**898**	**838**	**732**	**713**	**100**	**100**	–	**–18**	**–21**

1. Note that data on imported combustible renewables are not available for many countries. The figures are therefore overstating the EU internal resource.

2. Note that while uranium is imported into the EU, nuclear is considered to be a domestic source of energy. The uranium **loaded** into EU25 reactors in 2006 equals 210 to 336 Mtoe – owing to different statistical treatment, this figure cannot be compared with the 260 Mtoe supply contribution from uranium in 2005.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

Under current policies, including neither the political commitments made by the EU in March 2007 nor the proposals subsequently made by the Commission (see Chapter 2), net imports of energy would be expected to increase by 41% between 2005 and 2030, as a result of increasing consumption of energy and declining domestic production of fossil and nuclear energy (see Table 3). Under current policies, the projected increase in energy efficiency and renewable energy production would not halt growing import dependence, but would slow the increase between 2020

and 2030. The Commission's proposals published in January 2008, to increase energy efficiency and renewables production, are not yet reflected in these projections (see Tables 3 and 4). They would, if achieved, materially alter the net import position of the EU27 by 2020, particularly for coal and gas for power generation, and gas for heat production. Also, the planned requirement for 10% biofuels would have an impact on import levels for oil and petroleum products into the EU.

Table 4

Net Imports into the EU27 by Fuel, 1990 and 2005

Fuel [1]	*1990*	*2005*	*2005/1990*
	Mtoe		%
Coal	82	125	52
Oil	494	544	10
Gas	135	257	33
Electricity	3	1	–71
Total	**714**	**926**	**20**

1. Uranium not included, see note 2 to Table 3 above.
Source: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2007.

ENERGY IMPORTS AND TRADE

IMPORT DEPENDENCE

The EU is dependent on just a few countries for the bulk of its imported energy supplies. All fossil energy sources, oil, coal and gas, need to be imported to satisfy demand, and imports of all of them are increasing. It is also possible that renewable fuels such as biomass and biofuels will have to be imported on a larger scale in the future, in order to meet the plans for the rapid increase in renewable energy production in the EU27 (see Chapter 5).

Natural Gas

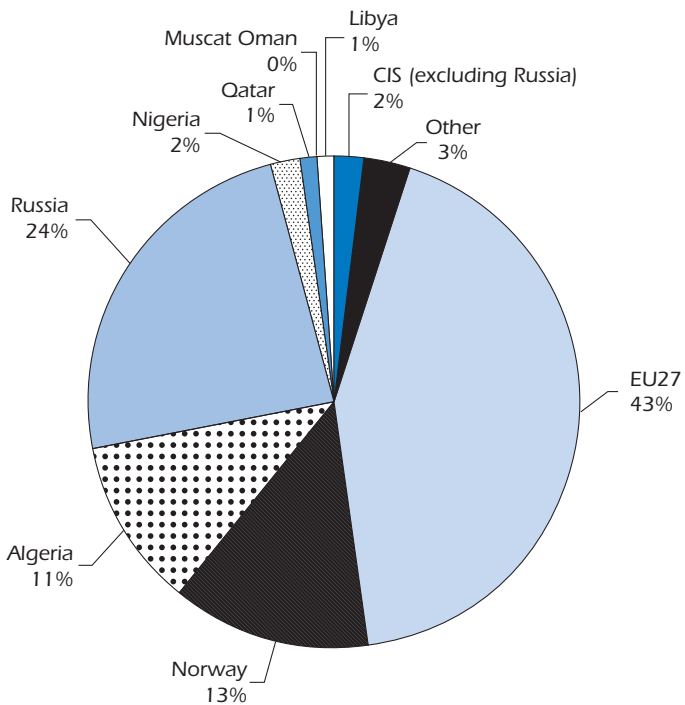
The EU covered 43% of natural gas consumption from internal sources in 2005 (see Figure 9). This is expected to decline quickly over the next few years. EU gas production peaked in 1996, plateauing until around 2004.

This trend seems set to continue, with EU production dropping to the point where 2020 output is projected, under current policies, to be about 39% below 2005 production.

Three countries, Russia, Norway and Algeria, supply 84% of gas imports into the EU27. Russia is the most important supplier, accounting for 42% of EU27 gas imports, exclusively through pipelines. Algerian gas is imported in the form of pipeline gas and LNG into Spain, Italy, France and Greece. LNG imports accounted for about 13% of total gas imports, with the major suppliers being Algeria, Libya, Qatar and Nigeria. Russian and Norwegian gas is imported through pipelines into central Europe, and into Great Britain and the Benelux countries, respectively. In the case of gas, considerable discoveries are sometimes still made in the EU. Given the projected rapid increase in gas consumption, however, it is not likely that these would affect the fundamental position of increasing gas dependence of the EU in the future.

Figure 9

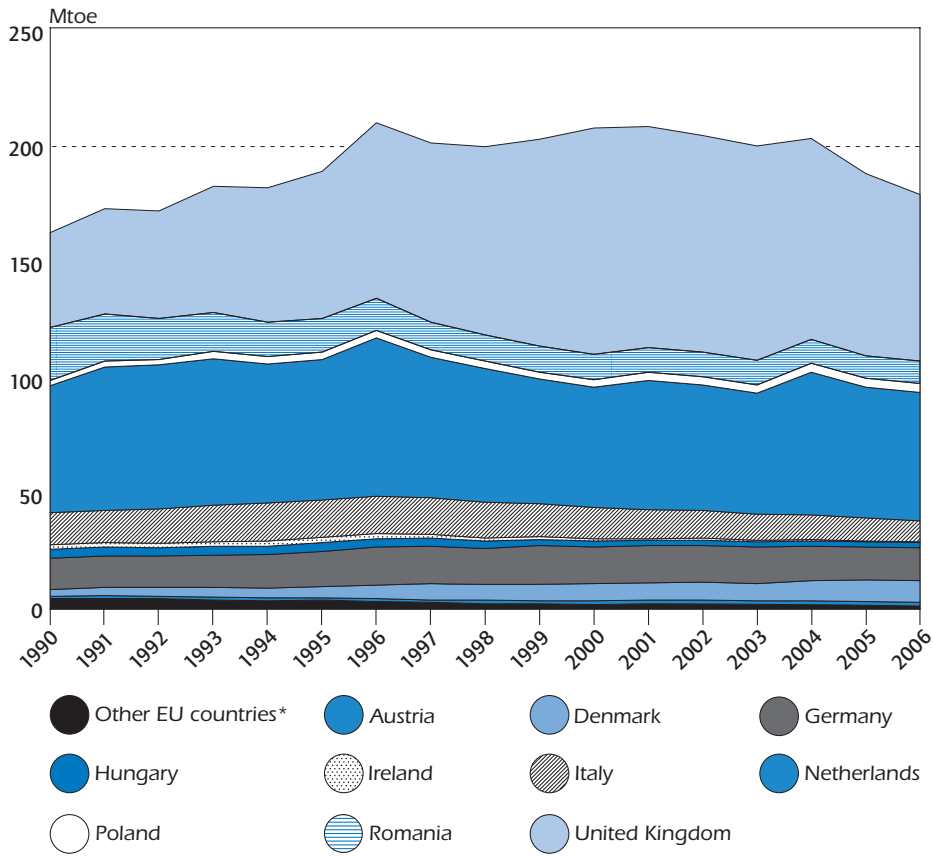
Origin of Gas Consumed in the EU27, 2005



Source: EU submission.

Figure 10

EU27 Gas Production, 1990 to 2006



*"Other EU countries" includes Belgium, Bulgaria, the Czech Republic, France, Greece, the Slovak Republic, Slovenia and Spain.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007.

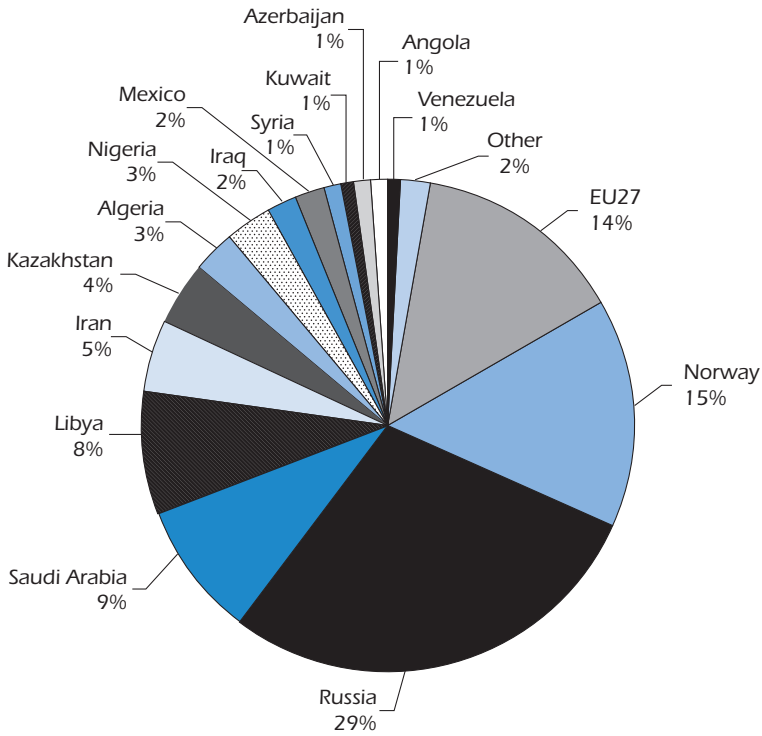
Oil

The EU can only cover 14% of its consumption of oil by internal production (see Figure 11). Two countries, Russia and Norway, together account for 44% of EU oil imports. Their position in the supply mix is benefiting from their geographic proximity and, in the case of Russia, the extensive COMECON era pipeline infrastructure links to refineries in central Europe and Germany. Only one EU country, Denmark, was a net exporter of oil in 2006. The position of the UK, previously a net exporter, changed in 2006 to become a net importer, owing to the rapid decline of North Sea oil fields. While small discoveries

continue to be made in a number of EU countries, it is unlikely that these will affect the fundamental position of the EU in terms of increasing external dependence on oil imports.

Figure 11

Origin of Oil Consumed in the EU27, 2005



Source: EU submission.

A particular challenge for security of supply is the growing imbalance of diesel and gasoline demand in the EU27, driven by tax and vehicle consumption advantages of diesel vehicles over petrol vehicles. Since 1998, diesel consumption has outstripped gasoline consumption, and has continued to grow, while gasoline consumption has reduced considerably. The refining split between the two fuels has remained largely unchanged, leading to the need to import diesel and export gasoline and heavy fuel oil out of the EU27. In 2005, 43 Mt of gasoline were exported, and 110 Mt consumed inside the EU27. In the same year, 36 Mt of diesel had to be imported, equivalent to 13% of demand. This imbalance is likely to increase, given the continuing trend for new road vehicles to be predominantly diesel-engined.

Coal

Coal production in Europe has declined sharply since the 1980s for a number of reasons: competition from countries with lower production costs, reduction of state subsidies, exhaustion of the best reserves and structural moves to activities with higher added value. To meet demand, imports have risen steadily, to 125 Mtoe (191 Mtce) in 2005.

The EU27 is not importing lignite, but is a net importer of hard coal, with net imports covering 40% of supply in 2005. Almost all coal used in the EU is used for power generation, only 14% being used in industrial and other applications. The hard coal imports from outside the EU originate mainly from South Africa (approximately 25%) and Russia (25%). It is difficult to predict what the impact of recent world coal market developments will be on the economics of coal production in the EU. While the general expectation was for production to continue to decrease, this may no longer be the case following improved economic conditions for mining, even though, if subsidies are phased out as foreseen, the world market price would still need to go up considerably to make coal mining in the EU economically viable. It is also not clear how the expected reduction in coal-burning in power generation, because of increasingly stringent environmental constraints and increased cost resulting from the necessity to invest in carbon permits, will affect the import balance for coal in the EU.

Electricity and Nuclear

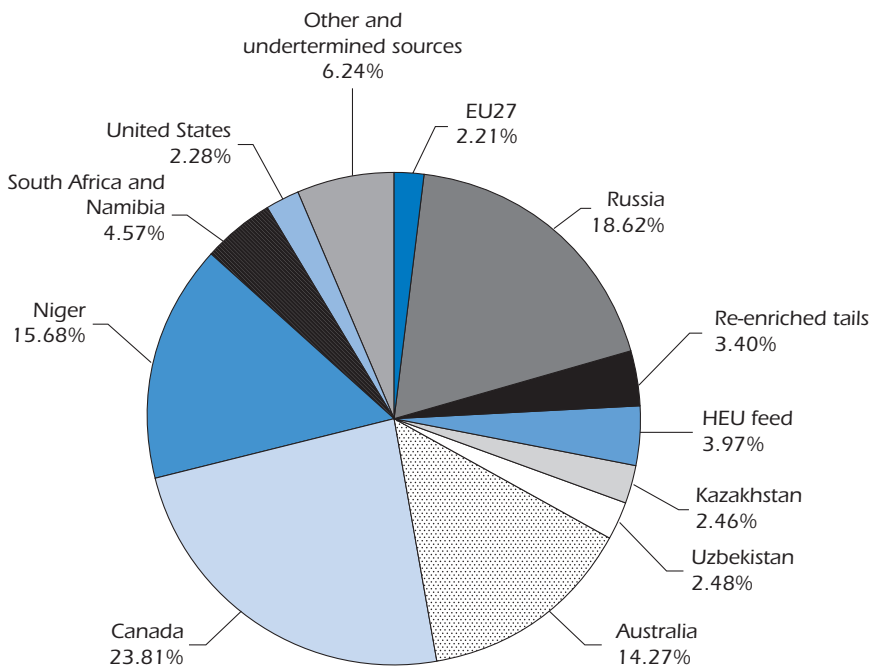
The EU27 was also a net importer of comparatively small volumes of electricity in 2005, primarily from Norway, Ukraine, and Russia (directly or through Belarus). Some EU members, in particular the Baltic states which acceded in 2004, are very heavily dependent on energy imports from outside the EU. Electricity imports are highly variable, depending to a large extent on annual precipitation levels. The EU is also exporting electricity, for example to Morocco.

In the area of nuclear fuel supply, the Euratom Supply Agency conducts market monitoring for the front end of the fuel cycle, and reviews all EU fuel supply contracts to ensure a regular and equitable supply of ores and nuclear fuels for all utilities in compliance with international obligations. It publishes an annual report on market developments and the supply and demand situation for uranium and nuclear fuels. The annual average demand in the EU is estimated at just under 20 000 tonnes of uranium (tU) for the next ten years. In 2006, 21 000 tU were loaded into EU reactors and 21 400 tU were delivered to EU utilities, the first time since 1983 that deliveries exceeded the fuel loaded, indicating that EU reactor operators have stopped running down their fuel stockpiles.

The EU is almost completely dependent on imported supplies of uranium for reactors operating inside the EU27 (see Figure 12). Three countries supply almost 59% of EU needs. The most important supplier in 2006 was Canada, accounting for 24% of supplies. It was followed by Russia, which supplies fuel primarily to reactors in former COMECON member states and Finland, and accounted for 19%, and Niger, which accounted for 16%. To ensure long-term co-operation in the nuclear field, the Euratom has signed bilateral nuclear co-operation agreements on the peaceful uses of nuclear energy with a number of countries supplying uranium and nuclear fuels to the EU, including Australia, Canada, Kazakhstan and the United States. Negotiations are ongoing with Russia

Figure 12

Supply of Uranium to the EU27, 2006



Source: Euratom Supply Agency, *Annual Report 2006.*

Although global resources of uranium are geographically diverse and adequate for long-term fuel supply, difficulties at currently operating mines, the time required to bring new mines into production, the decline of global inventories of previously mined uranium and improving prospects for nuclear power growth have driven uranium prices significantly upward in recent

years. However, even with higher uranium prices, fuel costs remain only a small fraction of the cost of electricity generated in nuclear power plants (NPPs), and these are far less sensitive to fuel costs than fossil fuel electricity-generating plants.

Higher prices for uranium have stimulated uranium exploration and mine development in several EU member states. Although it takes time (more than ten years in some jurisdictions) to bring new production on line, a continuation of strong market conditions could eventually lead to the development of uranium supply from member states, enhancing EU security of energy supply.

INTERNATIONAL INFRASTRUCTURE

IMPORT FACILITIES

A requirement for energy imports is the presence of import infrastructure. In the EU, these are pipelines and LNG terminals for gas; harbour facilities, storage tanks, refineries and pipelines or barges for oil; high-voltage transmission interconnectors for electricity; and harbour facilities and railroad links for coal. For coal, oil and electricity, existing capacity of import infrastructure is generally sufficient to cover the import needs of the EU27 even though the absence of possibilities to switch from one transport route to another makes the EU somewhat vulnerable.

In the area of gas, import capacity is under greater strain, and increasing imports pose a number of important challenges to investment, both in large-scale import infrastructure, storage, and for market reform.

Pipeline entry points to the EU are mainly from Russia directly and via Ukraine and Belarus, from Norway (8 points), from Algeria via Morocco and Tunisia (2 pipelines), from Libya (1 pipeline), and from Iran/Azerbaijan via Turkey (1 pipeline). The total annual entry capacity is about 310 billion cubic metres (bcm). The EU has 14 LNG terminals in operation or under construction with a total capacity of around 115 bcm. Gross import capacity is thus above 420 bcm, with most of the unused capacity on the lines from Russia. This is probably sufficient to meet import needs up to early into the next decade, at least on an annual basis. New supply projects are being built, notably pipelines from North Africa, and a significant number of new or expanded LNG terminals, with more projects proposed, such as new pipelines from Russia and the Caspian region and additional LNG capacity, notably in Northern Europe.

Only small additions in LNG capacity, apart from those already under construction or approved, are expected in the EU27 by 2015. Capacity is then expected to be around 120 bcm. IEA analysis indicates that the demand

for gas imports by pipeline could reach 400 bcm per year by around 2020. Norwegian exports then are likely to be around 120 bcm, although the resource base could probably supply more. Assuming demand for imports of 400 bcm, imports by pipeline from North Africa and Russia, plus other new sources, would therefore need to make up 280 bcm in 2020, barring additional LNG terminals coming forward. In 2005, total imports from Russia, Algeria and Libya were, respectively, 140 bcm, 37 bcm, and 5 bcm, for a total of 182 bcm. Gas demand projections are nevertheless uncertain and it is possible that achieving the European Council's March 2007 energy policy commitments could reduce projected volumes substantially, if additional renewable capacity replaces natural gas.

An additional factor affecting import capacity concerns storage. Currently, EU storage is relatively high, at about 14% of annual demand, although smaller than North America's 20%. Within this gross figure, significant variation exists between countries, with Germany, France and Italy having high storage levels, while other countries are less well supplied (for example Belgium, Spain or the United Kingdom). Depending on the country, this could reflect a lack of suitable geological formations for storage, and/or a recent history of production able to supply swing volumes. There is also a large variation among countries in the type of storage, between depleted oil and gas fields, which are generally better suited to seasonal draw-down, and aquifers and salt caverns, which are better suited to the fast draw-down that gas-fired power generators may need. Storage investment in many EU countries has been slow, because of a combination of local environmental problems, or planning issues, plus lack of suitable geology, or lack of market signals, such as variation in seasonal or diurnal[14] prices. The latter is connected to the linking of gas prices to oil prices, which disconnects them from market fundamentals – a situation that is radically different from that in other IEA gas markets, in particular North America. The declining ability of domestic gas production to respond to demand swings as production declines, plus the need to respond to sharper demand changes as gas becomes more important in the power generating system, mean that the EU needs to build more, and more diverse storage, preferably as close to consumers as possible. Geographical concentration of storage need not be a problem as long as the EU market can flexibly move gas to markets where it is needed. Recent experience shows this is not yet the case.

EU INTERNAL TRADE AND CO-OPERATION

There is considerable EU27 internal energy transmission and trade, in particular of electricity, but also of petroleum products, and natural gas. EU security of

14. Daytime/night-time variation of prices.

Box 4

The Nabucco Pipeline Project

Background

The Nabucco project represents a new gas pipeline connecting European markets with the Caspian region, the Middle East and potentially Egypt via Turkey, Bulgaria, Romania, Hungary and Austria. The pipeline is designed to open the fourth supply corridor for natural gas into Europe, after the North Sea, North Africa and Russia, enabling new suppliers from the Caspian and the Middle East regions to access the European gas market. To help the project to progress, the former Dutch foreign minister and current mayor of The Hague, Jozias van Artsen, was appointed as European Co-ordinator in September 2007.

While it could play a major role in bringing supply into central and western Europe, the pipeline would also allow the transit countries to benefit from supply diversification, as the majority of them depend on only Russian supplies through one supply route. Nabucco would bring additional supplies for growing gas sectors in the region as well as diversify and therefore secure supplies for these markets. The pipeline has been designated a Project of European Interest in the current TEN-E guidelines.

The project has been in gestation for over six years. The Nabucco Pipeline Company, established in 2004, has six equal shareholders, the energy companies OMV (Austria), MOL (Hungary), Transgaz (Romania), Bulgargaz (Bulgaria), BOTAS (Turkey), and since February 2008 RWE (Germany).

Technical Information

The pipeline has been designed to transport a maximum amount of 31 bcm per year. Following a development phase until the end of 2009, it will be constructed in two steps from 2010, the first step with up to 15.5 bcm capacity. It may start with 8 to 10 bcm, depending on availability of supplies, and expand later to the full capacity in a second step by adding further compressor capacity along the whole length of the pipeline to increase its capacity to 31 bcm. The pipeline is expected to become operational by 2013, when it will be able to connect the existing pipeline facilities on the border between Turkey and Georgia. The second step, which will take the pipeline to full capacity, is expected to come on stream by 2019. For the first stage, the project developers estimate that sufficient gas is available in the Caspian region. To expand into the second stage, it will be necessary to access new supplies from the

Figure 13

Map of the Nabucco Pipeline Project

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: Nabucco Pipeline Company.

wider region, and it is at present not clear which of the various options proposed for the project may materialise as real supply. By pushing the second stage out beyond 2015, the developers assume that some of the current political tensions in the region will have subsided, and access to supplies will become easier as a consequence. It is also assumed that for the second phase, sufficient investment in gas production is done in the region in order to fill the pipeline.

The pipeline length is foreseen to reach approximately 3 300 km, starting at the Georgian/Turkish and/or Iranian/Turkish border, with 2 000 km crossing Turkey, and sections of 390/400/460 km crossing Hungary, Bulgaria and Romania. The pipeline will end with a 46 km connection from Hungary into the Baumgarten gas hub in Austria, whence gas will be entering the European grid to be further transported through Austria to the central and western European markets. In each of the transit countries the pipeline will be owned by a national Nabucco company, working under contract with Nabucco International, the owner of the marketing rights or transportation capacity of the pipeline, and responsible for its commercialisation.

Estimated investment and financing costs for a complete new pipeline system amount to approximately EUR 5 billion in 2004 prices.

Recent Progress

During 2007 and 2008, major milestones have been and are expected to be met by the Nabucco project. At the end of 2007 the owner's engineer was appointed to begin detailed technical planning, and the TPA exemption applications were sent out to the regulators of the five Nabucco countries. The exemption decision of the first in time Austrian regulator has been approved by the European Commission in February 2008. The other countries are following.

Analysis

The long development process of the Nabucco project, together with questions about the availability of sufficient volumes of gas in the regions targeted as sources by the project developers, have contributed to the considerable development time at the pre-design stage of the project. These, and the question of parallel developments such as the more recent Southstream project promoted by Gazprom, have repeatedly raised the question of its overall viability, despite the political backing it had received by the European Union. Growing competition from the Russian proposed Southstream pipeline crossing the Black Sea may also erode political support for Nabucco in some of the transit countries, especially those where the Nabucco partners would not have the resources to contribute to two major pipeline projects. While a number

of pipeline projects are currently being proposed, most of these are driven by upstream owners of gas reserves wanting access to the EU market. Nabucco on the other hand is currently one among the few downstream-driven big supply projects, without the direct involvement or influence of an upstream player, which potentially enhances competition in the European markets. This also significantly complicates the project development, by necessitating an iterative process of capacity allocation that allows prospective shippers to guarantee supplies once they have secured a tranche of the shipping capacity.

Progress in moving into the design stage of the project, and the addition of a sixth shareholder which gives the pipeline direct access to the large German gas market, have however increased the viability of the Nabucco project. More recent analysis indicates that future EU gas demand should be sufficient for a number of projects bringing additional gas into Europe, replacing declining EU production, and servicing increasing demand. The sequencing of projects to bring Caspian and Middle Eastern gas to Europe, including Nabucco, and their ultimate success will depend more on political and gas supply developments in the regions that are expected to provide the gas to feed into it.

supply is affected by the ease with which these goods can be transmitted and traded. Figure 14 shows the gross exports of EU member states.

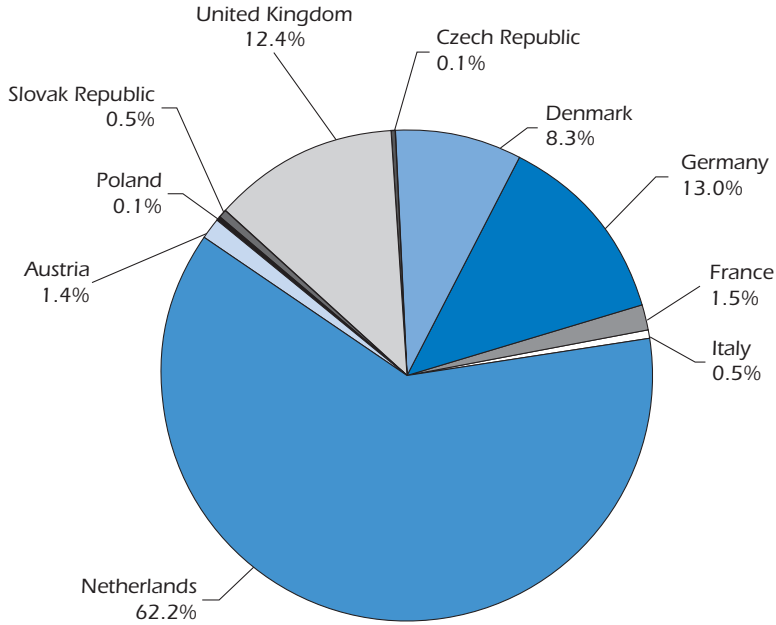
For natural gas, internal trade amounted to 80 bcm in 2005. This compares to 300 bcm of total imports in the same year. The Netherlands is the key European exporter, accounting for over 62% of internal exports in 2005 (see Figure 14). Only two EU countries, the Netherlands and Denmark, are net exporters of gas and between them account for nearly 71% of internal EU gas exports, with the remainder of internal exports[15] coming from net import countries.

The major factor in easing internal trade in gas is the internal market. As part of the completion of the internal market, the Commission has undertaken a number of activities in the gas sector under the umbrella of the Regional Initiatives with the operational support of the European regulators through ERGEG, such as for the South and the South-East Gas Region. Co-operation of gas TSOs is now beginning to develop, with MOL in Hungary attempting to establish a joint pipeline operation company for the high-pressure grid in the Central European region.

15. It is strictly speaking not correct in EU terminology to speak about intra-EU exports or imports as the EU is a Customs Union, but it is difficult to phrase this differently.

Figure 14

EU Member State Gas Export Shares by Country, 2005



Source: EU submission.

The European electricity transmission grid is highly meshed, with some important bottlenecks. The system developed with a national focus, but with interconnections that allowed for robust system operation across the main synchronised blocks and for significant exchange flows across certain borders, such as the French/Italian border. Cross-border transmission capacity is now not only an asset that provides for improved dispatch efficiency and improved system security but it is also seen by the European Commission as an essential element in enabling competition.

The liberalisation of markets has changed flows according to ever more integrated dispatch based on purely economic criteria across larger and larger regions. Certain transmission corridors have emerged out of this economic dispatch and it has highlighted the most important bottlenecks.

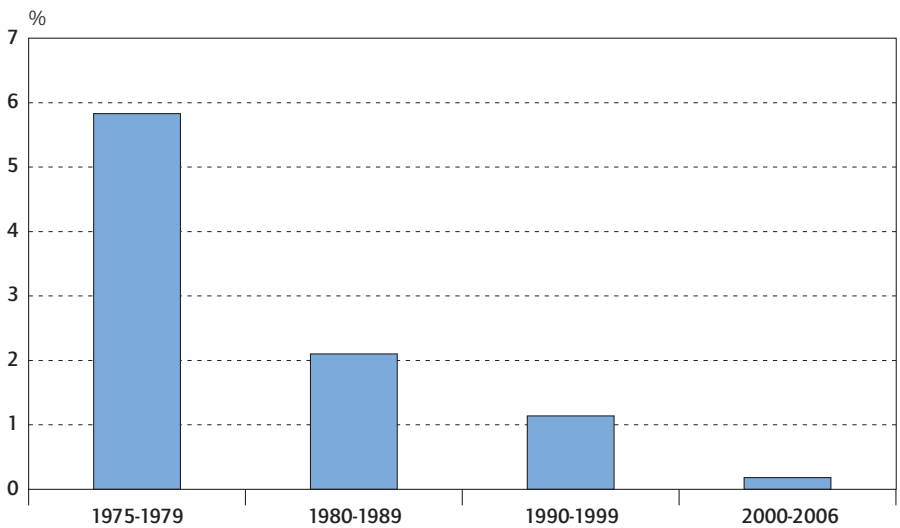
EU transmission system operators co-operate in ETSO, in which the western Balkan states are associate members. ETSO activities cover the study and development of common principles regarding the establishment and harmonisation of rules in order to enhance network operation and maintain transmission system security; the facilitation of the internal European market for electricity; communication and co-operation with organisations and

institutions having similar purpose; and the investigation and solution of scientific and regulatory issues of common interest to the TSO industry. ETSO is therefore active in a range of areas, such as:

- Inter-TSO compensation;
- Congestion management;
- Electronic data exchange;
- Tariffs;
- Security of supply;
- Renewables;
- Balance management;
- Legal and regulatory issues.

Figure 15

Yearly Average Increases in Transmission Lines in 16 European Countries (km of 220 and 400 kV lines)



Sources: UCTE (Austria, Belgium, Switzerland, Denmark, Spain, France, Greece, Italy, Luxembourg, the Netherlands and Portugal); and Nordel (Denmark, Finland, Iceland, Norway and Sweden - only from 1979).

The UCTE (see Box 5) is the organisation responsible for the management of the synchronised European grid, and the largest of the four TSO organisations active in the EU. UCTE covers only central and western Europe and some non-EU members, but excludes the United Kingdom, Ireland, east Denmark, Sweden, Finland and the Baltic states, as well as Malta and Cyprus. As such, it has a particular role in ensuring grid security. The UCTE security package is threefold:

- The *Operation Handbook* as the compendium of technical standards related to the UCTE interconnected system.
- The *Multilateral Agreement* with the *Operation Handbook* as the cornerstone for the legal framework ensuring the security of the interconnected systems.
- The *Compliance Monitoring Process* as a permanent process evaluating the implementation of the rules.

As part of the 3rd Liberalisation Package (see Chapter 3), the Commission has also proposed the establishment of a new reliability organisation for the EU electricity grid, called European Network of Transmission System Operators (ENTSO). In its proposed form, ENTSO would have wider responsibilities and powers in the area of network security than UCTE.

Box 5

The UCTE

The Union for the Co-ordination of Transmission of Electricity (UCTE) is the association of transmission system operators in 24 continental European countries. Over more than fifty years, it co-ordinates the operation and development of the electricity transmission grid from Portugal to Poland and from the Netherlands to Romania and Greece. It provides a market platform to all participants of the internal electricity market (IEM) and beyond. The UCTE network provides electricity supply for some 430 million people in one of the biggest electrical synchronous interconnections worldwide. It also provides comprehensive statistics on electricity generation and transmission in the system.

UCTE is responsible for the efficient and secure operation of the interconnected transmission systems across Europe and gives signals to markets when system adequacy declines. UCTE has been issuing all technical standards required for co-ordination of the international operation of high-voltage grids. These are working at the 50 Hz UCTE frequency related to the nominal balance between offer and demand.

UCTE also monitors and supervises the development of the UCTE synchronous area. The resynchronisation process of the two UCTE zones split in 1991 because of the war events in the former Yugoslavia was successfully achieved on 10 October 2004.

At present, the following requests for enlargement of the UCTE area are investigated:

- the interconnection of Turkey,
- the interconnection Tunisia-Libya that would bring the UCTE frequency up to Syria and Lebanon,

- Ukraine and Moldova have applied for connection and this application is currently under study, and
- Most significantly, the assessment via a major feasibility study on the interconnection of the two largest systems (UCTE and IPS/UPS) that would result in one electricity system spreading from Lisbon to Vladivostok.

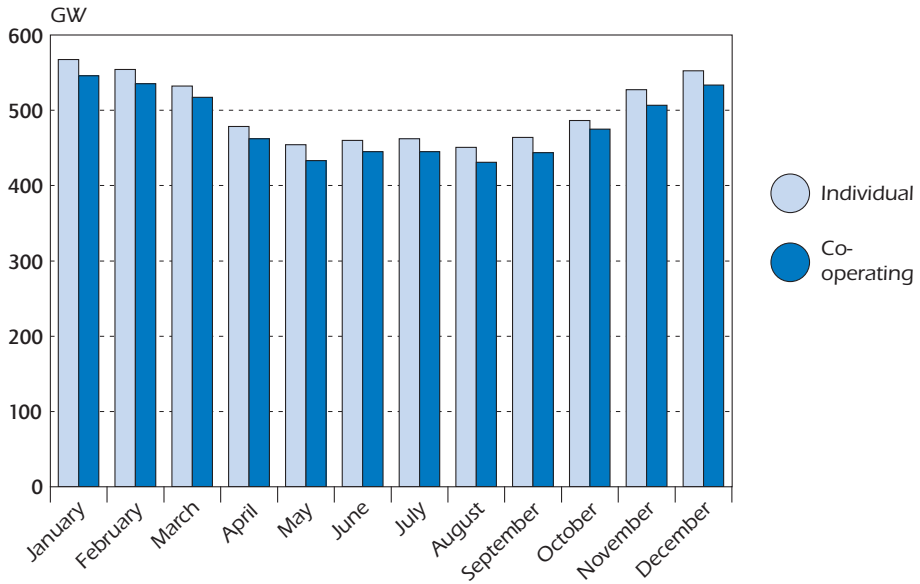
Following the liberalisation of the European electricity market (that resulted in a steep increase of cross-border flows), and the unbundling of the electricity sector (separating vertically integrated utilities into respective generation, transmission and distribution companies), there is a need to make European security and reliability standards enforceable for all interconnected TSOs and, in a later second step, to all grid users.

The UCTE operational standards are now being developed further and transformed into the open document *Operation Handbook.* This gathers policies that might be commented on by all interested stakeholders through an internet-based consultation process.

The enforcement among TSOs of these standards is supported by a Multilateral Agreement (MLA) which entered into force on 1 July 2005.

Figure 16

Hourly Peak Load in UCTE, Great Britain and Nordel (excluding Norway), Aggregate of Individual Countries and Simultaneous across All Countries, 2006



Sources: UCTE, National grid, Energinet.dk, Svenska Kraftnät and Fingrid.

ELECTRICITY GENERATION ADEQUACY

Adequacy of generating capacity to meet demand has to be assessed within the relevant regions, taking local and regional circumstances into account, including the expected level of availability of generating capacity and cross-border exchanges. It is benchmarked against peak demand. Peak demand is a difficult measure when assessing a large and diverse region such as the European Union, since it has to be met area by area and country by country. Co-operation and integration reduces the challenge of managing peak electricity demand, both in terms of reducing actual simultaneous peak load and in terms of reducing the need for installed capacity since reserves can be shared.

Simultaneous peak demand[16] in 2006 in UCTE, Great Britain and Nordel (excluding Norway) was 546 GW in January 2006, whereas aggregate individual peak load in the same countries was 568 GW. This is the challenge that individual countries had to meet in the absence of trade and co-operation. The difference results from variations in the exact timing of peak demand, and corresponds to 22 GW, approximately 4% of simultaneous peak load or 3% of total installed capacity. The potential benefits that can be derived from dynamic trade, co-operation and appropriate transmission capacity are therefore obvious, both in terms of improved security of supply and improved efficiency.

ETSO has compiled broad adequacy assessments on a voluntary basis since 2005. These are based on adequacy assessments from UCTE, Nordel, UKTSOA (Great Britain), ATSOI (Ireland) and BALTSO (Baltic states). The latest, 2007 assessment, is only an update with changes compared with the 2006 assessment. It includes information about known commissioning and decommissioning of plants in the period 2008-2015 and expected demand growth. Each assessment includes two scenarios, one "conservative" scenario including only commissioning of new plants that are regarded as firm. The other "best estimate" scenario also includes commissioning of new projects that are still not firm but can be regarded as reasonably feasible.

Globally, across the ETSO region, the adequacy assessment shows decreasing reserve margins, but adequacy criteria are generally met until 2012. Thereafter, new investments corresponding to 3% of installed capacity have to be committed in addition to those that are firm today, to ensure adequacy. In the "best estimate" scenario, global adequacy criteria are met until 2015. The adequacy assessment is divided into main blocs.

16. Simultaneous peak demand is only relevant to the extent that it is possible to co-operate and trade dynamically across the entire region, and to the extent that sufficient transmission capacity is available.

The **main UCTE bloc**, western continental Europe excluding the Iberian peninsula and Italy, is today a net exporter. It will remain so, but export volumes will decrease. Adequacy criteria are met towards 2015. In UCTE-Centrel, central and eastern continental Europe, the situation is comfortable today, but deteriorates quickly in the conservative scenario from 2010 to 2015 because of the forced decommissioning of old fossil fuel plants to comply with the Large Combustion Plant Directive (2001/80/EC). New investments are needed, as expected in the best estimate scenario, to fill the gap. In the **Nordic bloc,** adequacy criteria are fulfilled towards 2015. Some positive and negative changes have occurred since 2006, more or less balancing each other. The most interesting changes are, on the negative side, the further delay of the new Finnish nuclear plant at Olkiluoto and, on the positive side, wind power is now expected to contribute up to 6% of installed capacity during peak load, compared with 0% in the past. The **British bloc** was, in the 2006 assessment, seen not to fulfil adequacy criteria in the conservative scenario and not to fulfil them from 2009 in the "best estimate" scenario. Some significant changes were seen in the 2007 update. First of all, peak demand did not increase as expected. In 2007, it was 3 GW lower than projected. This was mainly due to demand responding to peak prices. Another significant change is that much more new wind power is expected in the "best estimate" scenario. Wind power is included with an expected availability of 35% of installed wind capacity during peak load. In the **Baltic bloc,** the decommissioning of the nuclear power plant Ignalina in Lithuania results in a non-fulfilment of adequacy criteria from 2010. New capacity will have to be commissioned to replace Ignalina and this investment is not forthcoming in time. On the **Iberian peninsula** and in **Italy**, adequacy criteria are met until 2015. In the **south-eastern European** bloc, adequacy criteria are not met today and they are only met by 2012 in the best estimate scenario. In the **Romania and Bulgaria** bloc, adequacy criteria are met through to 2020, but not with a great margin.

POLICY

OVERVIEW

Since 2005, some major events made energy security of supply a major issue in European energy policy. These events include the rapid rise of fossil fuel prices since 2004; the interruption of gas supplies from Russia in January 2006, with resulting gas shortages in a number of EU member states, and the continuing threat that disputes between neighbouring suppliers and transit countries will affect supplies of gas and oil to the EU; a major electricity blackout in November 2006, affecting large parts of north-western Europe, and caused by a transmission system management failure in northern Germany; the development of the internal energy market; and the political

commitment of the EU to a transition to high-efficiency, low-carbon energy system.

As a consequence of these events and developments, energy security policy has been recognised as a major challenge for the EU27, with action at European level being required. The EU's Common Foreign and Security Policy is now also concerned to a limited extent with the energy sector. One of the key messages of the Action Plan on an Energy Policy for Europe 2007-2009, adopted in March 2007, is that a fully functioning internal market is seen as the best guarantee of supply security and contributes to a better ability to predict demand by increasing transparency and creating forward markets (see also Chapter 2). In addition, the Action Plan highlighted the need for the EU to continue its efforts in the field of a common external energy policy. In support of security of supply, competitiveness and sustainability goals of the EU energy policy, the external policy addresses issues such as:

- promoting diversification of energy imports by fuel, by source and by transportation route;
- promoting the development of production and export capacities in producer countries in a safe and secure environment;
- promoting the upgrade of existing energy transportation infrastructures and the development of new ones by producer and transit countries; improving the investment conditions in third countries;
- improving the conditions for energy trade, including non-discriminatory transit and third-party access to the export pipeline infrastructures;
- promoting the highest levels of physical and environmental safety and security of energy infrastructures;
- encouraging energy efficiency and energy savings in third countries, as well as promoting a global agreement on climate.

The growth of renewable energy's share to 20% by 2020, if achieved, introduces a significant new source of diverse, decentralised and largely domestic energy. In addition, the renewable energy sources that are imported (such as biomass, biofuels) are generally from relatively stable regions. In the renewable electricity sector in particular, the growing number of smaller market players increases supply competition, decentralised production and eases pressure on grid interconnections; in the transport sector, with the weakest security of energy supply, a 10% renewables target has been established. All these factors will ensure that the planned growth of renewable energy will contribute positively to the security of energy supply.

Overall, a range of policies and measures are pursued or have already been implemented within the EU to increase energy security. These include:

- Directives and proposed directives to achieve a well-functioning internal energy market, the best guarantor of security of supply and solidarity.

- Explicit provisions for security of supply in the internal market, in directives on oil, gas and electricity security of supply.
- The gas co-ordination group, set up in 2006, under the Gas Security of Supply Directive 2004/67, whose functioning and objectives will be discussed in the report on the directive by end-2008.
- The setting-up of effective mechanisms for energy crisis management, with possible future proposals to amend the Gas Security of Supply Directive.
- A study on gas storage to start in 2008.
- The existing Oil Supply Group.
- A Commission communication on strategic stocks (oil and gas), and a revision of the Oil Stocks Directive to be tabled by end-2008.
- The Network of Energy Security Correspondents established in 2007 which brings together representatives from the Foreign Affairs and Energy Ministries in the EU member states in order to rapidly exchange information on external supply issues.
- Increasing electricity interconnections.
- Promoting the use of a diverse range of decentralised or domestic renewable energy sources.
- The proposal to create a new organisation of energy network operators, ENTSO.
- The proposal to give additional powers on reliability to the proposed European Regulatory Agency.
- The Trans-European Networks Energy (TEN-E) programme.
- Promotion of high-efficiency, low-carbon energy system, such as CO_2 emissions capping and trading and renewables targets.

EXTERNAL RELATIONS

Co-operation with supplier and transit countries takes place within multilateral frameworks such as the World Trade Organization and the Energy Charter Treaty, through regional initiatives such as the Energy Community Treaty (to which the European Community is a party) and in the bilateral context through Partnership and Co-operation Agreements and Free Trade Agreements, which provide legally binding rules for the energy sector. Energy is also a key element of the European Neighbourhood Policy. Memoranda of Understanding in the energy field have been concluded with producer and major transit countries such as Kazakhstan, Turkmenistan, Azerbaijan, and Ukraine, and through joint declarations with Morocco and Jordan. The EU-Russia Energy Dialogue serves as the main vehicle of co-operation in the energy sector between the EU and its main external supplier. It intends to strengthen the energy dialogue through three joint working parties on market developments, scenarios and energy efficiency. Additionally, comprehensive dialogues are being developed

with energy-consumer countries such as the United States, China, India and Brazil. The new Joint EU-Africa Strategy, adopted at the EU-Africa Summit in Lisbon on 8-9 December 2007 includes the EU-Africa Energy Partnership, which was one of the specific elements identified in the March 2007 Action Plan.

The EU has an explicit policy to integrate and interconnect the neighbouring countries into its IEM, both in the context of the European Neighbourhood Policy and via the expansion of the Energy Community Treaty. In this context, the EU targets technical and budgetary assistance to promote the convergence of energy market regulations, competition rules, environmental protection and safety standards of these countries with those of the EU, as well as to promote energy efficiency, energy savings and renewable sources of energy. The newly launched Neighbourhood Investment Facility is intended to provide grant support for lending operations for priority infrastructure projects connecting the EU and its neighbours in the area of energy.

The EU also supports the development of new pipeline projects that are of European interest through the TEN (Trans-European Networks) framework (see section below). The development of LNG terminals and gas pipelines, which may contribute to the diversification of sources, may be supported through TPA waivers (exemptions), and this preferential treatment is also available to electricity projects if needed. Directive 2004/67EC defines minimum gas security of supply standards that have to be met by every member state. The instruments used to meet these standards are left to the member states. The directive provides a catalogue of possible instruments, such as long-term import contracts, use of storage and production reserves, strategic stocks, emergency plans, obligatory fuel switching, etc. In the case of an emergency, it foresees an EU co-ordination mechanism (emergency action plan) to be defined. The Commission-led Gas Coordination Group, established in 2006, is the platform to discuss EU-relevant security of supply developments in gas.

TRANS-EUROPEAN NETWORKS–ENERGY

The Trans-European Networks–Energy (TEN-E) programme is based on the similar Trans-European Networks–Transport (TEN-T). The first ten projects were chosen by the European Council in 1994. A range of additional projects were selected for inclusion in TEN-E by the member states, based on a proposal by the Commission in 2003, to reflect the new concept of priority axes, and the changing priorities resulting from the addition of ten new member states in 2004. Proposals for the inclusion of additional projects have been made, but no formal additions have been made to the list.

The Priority Interconnection Plan adopted by the Commission on 10 January 2007 in the framework of the so-called Energy Policy for Europe, and the

Action Plan adopted by the European Council on 9 March 2007, specifically mention the nomination of European Co-ordinators for four strategic energy projects, whose role is to bring together the various stakeholders involved in these projects, and to help overcome barriers. It is at present not clear how the role of these co-ordinators will develop in the future. On 13 September 2007, the Commission appointed all four European co-ordinators.

TEN financing is always complementary to member state financing. Unlike the TEN-T, TEN-E has only a small budget available to provide for help with mainly pre-feasibility studies. The total annual budget until 2010 amounts to EUR 21 million. The expectation is that the energy industry, which will benefit from the new connections, will finance them. Where eligible, projects can access financing from the European Investment Bank (EIB).

In the electricity sector, the primary aim of the TEN-E programme is to establish additional internal interconnections to support trade of electricity within the EU, equivalent to cross-border transmission capacity corresponding to at least 10% of installed generating capacity, following a European Council decision in spring 2002. This commitment recognises the importance of cross-border transmission capacity in realising the vision of an internal electricity market. TEN-E identifies major transmission axes, major bottlenecks in these corridors and additional priority projects of regional importance; 196 priority electricity transmission projects were decided in 2003, 32 of them categorised as being of European interest and 164 of common interest. The projects in the latter category are lower down on the priority list, and therefore less likely to receive support. Additional projects outside the EU, in particular in the North African and Middle Eastern countries bordering on the Mediterranean, have been proposed, but none of these have been adopted yet. The list of projects accepted by the programme currently stands as follows:

- Interconnection France-Belgium-the Netherlands-Germany;
- Italian border connections;
- Interconnection France-Spain-Portugal;
- Interconnection Greece-Balkan countries-UCTE system;
- Interconnection Great Britain-continental and northern Europe;
- Interconnection Ireland-Great Britain;
- Interconnection Denmark-Germany-Baltic Electricity Ring;
- Offshore wind connections in the Baltic and North Sea areas.

In the gas sector, the main aim of the TEN-E programme is to provide additional routes and access to more sources of gas, to increase diversification. Projects can either be pipelines, or LNG import terminals, or storage. There are no priority projects for increasing internal interconnections aiming to further EU gas market integration. The list of projects currently stands as follows:

- Gas pipelines from north-west Russia to the United Kingdom via Germany and the Netherlands;
- Gas pipelines from Algeria to Italy and Spain, then on to France;
- Gas pipelines from the Caspian Sea–Middle East regions (Nabucco, see Box 4);
- LNG terminals in Italy in the northern and southern Adriatic, northern Spain, south-west France, and Belgium;
- Gas storage projects in Portugal, Spain, Italy, Denmark.

EMERGENCY PREPAREDNESS

EU member states are obliged to hold emergency oil stocks under Directive 2006/67/EC, which is the codification of older legislation dating back to 1968. Stocks have to cover 90 days of consumption in most member states, except eight states with a transition arrangement and 67.5 days for net exporters or countries in an almost balanced position regarding imports. They should be held in the form of petroleum products, fuel oil, diesel, or gasoline. Member states have to report on their stockholding on a monthly basis, but are free to choose the arrangements they deem appropriate for the stockholding. At the end of September 2007, only two member states were not complying with the stockholding arrangement. Non-compliance can lead to an infringement procedure by the Commission. In case of a supply disruption, the EU Oil Supply Group will consult on releasing the stocks.

Following a decision by the European Council in 2007, the Commission started work on amending the framework of oil stockholding in the EU with the aim to make it more compatible with the tested IEA emergency stockholding system. A consultation on this question has been issued by the Commission, and the work is ongoing, and is expected to lead to legislative proposals in the second half of 2008.

INVESTMENT

Considerable internal and external trade in energy is conducted by the 27 EU member states. In recent years, the Commission's involvement in the regulatory arrangements of existing interconnections, and the development of new interconnections and sources of imports, has grown considerably, with EU regulations affecting decisions made by country regulators on interconnections, for example on third-party access (TPA). Cross-border trade is a key pillar for putting competitive pressure on prices. Against this background, sufficient network capacities are one of the main drivers for allowing liquid trade. Thus, investments are needed to overcome bottlenecks.

The European Union supports the development of electricity and gas transmission infrastructure projects of European interest through the TEN-E

programme, and the European Investment Bank (EIB) is able to provide financing. Most of the projects cross national borders or have an impact on several EU member states. The TEN-E guidelines revised in 2006 also establish a framework for closer co-operation, in particular for projects of European interest. They provide for an exchange of information and the organisation of co-ordination meetings between the member states for implementing the cross-border sections of networks. The intervention of a European co-ordinator is provided for where a project of European interest, such as the Nabucco gas pipeline, encounters significant delays or implementation difficulties.

The EIB provides lending to the energy sector to further the achievement of the EU energy policy. Security and diversification of internal supply are included in the energy priorities of the EIB. Over the past four years, EIB loans signed in support of TEN-E projects have amounted to close to EUR 1 billion per year. A non-exhaustive list of TEN-E projects financed during this period is the following:

- Grain LNG terminal (UK);
- Sagunto LNG terminal (Spain);
- Ireland/Northern Ireland gas pipeline;
- Langeled gas pipeline (Norway-UK);
- Fluxys LNG terminal expansion;
- Algeria-Tunisia-Italy pipeline capacity expansion;
- Netherland-Norway power link;
- New power connections in Spain along the north axis, the Mediterranean axis, the Galicia-Centro axis, the Centro-Aragon axis, the Aragon-Levante axis, the South-Centre axis and the East-Centre axis;
- Underwater cable link between Azores (Portugal).

CRITIQUE

Energy security of supply has rapidly risen up the European policy agenda in recent years, sparked by a series of high-profile incidents, leading to questions about the adequacy of existing arrangements and powers at EU level. With the global energy situation changing rapidly, and the main lines of EU energy policy established, both the European Council and the European Parliament have underlined the importance which they attach to enhancing the energy security of the EU and its member states and to further developing the external dimension of the EU energy policy. In external energy relations, they attach particular importance to the EU and its member states speaking with a common voice. Recent activity in the area of energy external relations, such as the extension of co-operation and the appointment of a project co-ordinator for the Nabucco project, is commendable. The forthcoming Strategic Energy Review focusing on energy security and external relations is also particularly welcome in this regard. Furthermore, the European Commission's development of a

structured dialogue with producer countries, in particular with Russia, but also with the Organization of the Petroleum Exporting Countries (OPEC), is a clear sign that the Commission has recognised the challenge of external dependence, and is prepared to address it, within the limits of its competences.

This increased policy attention is laudable, but it remains nevertheless questionable whether it will suffice to address the challenges in this area. It may also be necessary to investigate and consider increased levels of responsibility for the EU, to enable it to develop policy on a level comparable to the policy activity it is already pursuing in the other two key areas, sustainability and competitiveness. At present, energy security policy appears to be the weakest link in the EU's policy triangle, with the most notable tension between the unified approach and bilateral policies visible in the EU energy relations with Russia. This weakness increases risks to the EU27 security of supply, and weakens its position vis-à-vis major supplier countries.

In the area of external relations, the Commission does not have means comparable to those it has in energy markets and sustainable energy policies, and a common EU external energy policy is relatively poorly developed, even though the EU already speaks and acts with a common voice on international trade policy, including on trade-related aspects of energy. Delays to important supply projects such as Nabucco may have been exacerbated by this lack of a common policy. While the Commission rightly tries to play its role as effectively as possible in energy external relations between the EU and supplier countries, it may have to overcome resistance on the part of some member states in achieving this goal, despite their political commitment to speak with a common voice. The role the Commission played in establishing the Energy Community, or more recently in fostering new cross-border investment for supply route diversification, shows its capacity to act in this area and its added value. This capacity should be built upon, by providing for more effective use of the Commission's legal competences and tools, stronger co-ordination at the EU level, and by ensuring through this that the EU is seen as speaking and acting with one voice on matters of common interest. It may be valuable to consider proposing the creation of a more central role for the Commission in the external energy relations of the EU, beyond its existing legal competences, by providing in particular for stronger co-ordination of member states, namely supplier and transit countries, and outline which increased powers and responsibilities may be necessary to achieve this.

The European Council's and Commission's intent to improve storage and co-ordination capability for emergency response in the case of oil supply interruptions is welcome. By aligning the EU mechanisms with those existing at the IEA, the burden on EU countries that are members of the IEA can be reduced, while greater effectiveness in the case of supply interruptions would be ensured. The Commission should speedily proceed to the realignment of the stockholding systems.

At present, the Gas Security of Supply Directive does not include well-developed emergency preparation provisions. The gas supply interruption of January 2006 showed that the effects can fall differently on different member countries. Ultimately, this is a strategic weakness in the EU, which the Commission should consider rectifying by developing a set of policies that will enable emergency co-operation across the EU, should gas supplies again be curtailed.

Electricity generation in nuclear power plants (NPPs) enhances EU efforts to reduce greenhouse gas emissions and in clean air initiatives as it is a low-CO_2 technology with no emissions of NO_x, SO_x, ozone and particulate matter. Nuclear power also enhances EU security of energy supply, since uranium is widely distributed, and about 50% of global mine production comes from reliable, politically stable trading partners. While individual EU member countries are free to decide upon their own energy mix, the Commission's policy should continue to support those member states that choose to use nuclear energy as part of their electricity generation mix to do so, subject to safety and security standards, in order to ensure overall security of supply in the EU electricity sector. This is particularly the case for EU12, many of which have long experience with nuclear power and favour its continued use. Some of these new entrants have had to close older reactors as a condition of joining the EU and owing to delays in their reaction to this, they are currently facing challenges in building new reactors to replace those retired from service. The Commission should continue to facilitate the replacement of older reactors in those countries, allowing new nuclear capacity that will increase security of supply and extend the generation of carbon-free electricity. It should also use its presence at the emerging regional co-ordination groups to ensure that the EU-wide and regional security of supply effects of the phase-out of nuclear power in some member states are well understood.

Regulatory approval processes for NPPs are typically long and uncertain, and differ from country to country. Construction times typically span more than five years. Of particular importance for the move towards new nuclear capacity is therefore the development of a common EU-wide framework on nuclear safety and a common operating culture consistent with world standards. Particular consideration should also be given to developing a road-map for advancing nuclear power uprates and new build, as well as a common framework for EU-wide approval of new reactor designs, to facilitate replacement of ageing NPPs in the near future. New designs currently require national design certification that can add extra time to this process, and this is an obvious area which the Commission could address through the mechanism of the Euratom Treaty.

The dependence on energy imports of fossil fuels in the EU27 is high, and increasing. Recent policy proposals to increase energy efficiency and the contribution of renewables to energy supply are unlikely to fundamentally

alter this situation, although they will certainly be sufficient to alter the scale of the expected increase in import dependence. While being dependent on energy imports is not a problem in itself, it can become one if the good in question is not traded in an open and transparent market, or if it is bought primarily from a single seller, or a co-operating group of sellers. In the case of the EU, dependence is concentrated on relatively few countries, the most important of which is Russia, which plays a key role in supplies of gas, oil and coal. The Commission's policy response to this – to work towards a well-functioning internal energy market, to diversify within the market and improve energy efficiency and to diversify import routes and sources – is correct, and should be forcefully pursued in the future.

The functioning of the supply system is fully dependent on the existence of an integrated supply network and a well-functioning regulatory framework, in particular in the case of electricity, but also in the cases of petroleum products and natural gas. EU security of supply as a whole is affected by the ease with which these goods can be imported, traded and shipped. Diversification of energy supplies and transit routes, including the upgrade of existing and the development of new energy transportation infrastructures both within the EU and in third countries, is essential for ensuring the EU security of supply in the medium and long term.

In order to decrease the risk from growing import dependence, clear and reliable policies need to be applied to the sectors providing the investment in the necessary import infrastructure. Clarity on TPA exemptions for major supply infrastructure is laudable in this regard. In the area of sustainable energy policies, the Commission should work quickly to elaborate the rules for the post-Kyoto framework in emissions trading, to provide investors in, for example, refineries or coal-fired power with the necessary information to make their investment decisions.

Regarding particular fuels, while the import dependence challenge is clear to policy makers in the areas of gas and oil, the EU27 also appears vulnerable to a future of uncertainty with respect to coal supplies. Over many years, the international coal market has responded well to Europe's increasing import demands, with a variety of supplier options. But the assumption that this will continue to be the case is questioned. There is now a real risk, due to market developments, that Europe is moving into a position of high dependence on comparatively costly Russian coal. It now seems inconceivable that coal can be replaced in the electricity sector, yet the conditions for new investment in this sector are not favourable, owing to a high level of policy uncertainty. New investment will be required in more efficient plants, both for replacement of ageing, inefficient power stations, and for capacity additions. At least additional plant will have to be built with CO_2 capture and storage, if EU objectives on CO_2 emissions reductions are to be met. Only in the case of

like-for-like replacement coal plants will the efficiency increase[17] enable them to be compatible with the EU objectives, even without CCS. The Commission should therefore consider creating a stable regulatory climate for cleaner coal quickly, to enable coal-fired replacement projects for older coal plants to proceed. Because of their higher efficiency, cleaner coal replacement plants would also reduce fuel cost per unit of electricity generated, an important aspect considering the rising world coal prices.

After about 20 years of underinvestment and low uranium prices owing to supply from large inventories of previously mined uranium and poor prospects for growth in nuclear generating capacity, significant changes have considerably tightened the uranium and fuel supply market in recent years. For example, construction of new nuclear power plants is under way in several countries. Combined with the inventory draw-down, the termination of highly-enriched uranium feed deliveries (in 2013) and the supply of re-enriched tailings from Russia, this indicates that Euratom's role in securing equitable supplies of ores and nuclear fuels could become increasingly important in the next few years. Higher prices for uranium have stimulated uranium exploration and mine development in many countries but it takes time (more than ten years in some jurisdictions) to bring new production centres on line. Until these new production centres and new uranium enrichment facilities currently under development are on line, the market for uranium and fuel supply to the global fleet of nuclear reactors is likely to remain tight. Euratom's strategy of encouraging utilities to maintain an adequate level of strategic inventories and to cover most of their needs under long-term contracts with diversified supply sources is an appropriate one for protecting the EU from supply disruptions. In the face of the improving outlook for nuclear power and the trans-boundary partnerships formed today to invest in plant refurbishment, power uprates, life extensions and new build, Euratom is also encouraged to continue to evaluate its role in order to ensure that its activities are continuing to serve member states, in particular those with a positive policy towards nuclear power.

Given the lead times for construction and the expected growth in demand, it is clear that additional importing capacity, both by pipeline and as LNG, will be needed. Many projects are currently at the planning stage. In addition, the increasing need to import gas means that pipeline interconnections between EU countries will need to be augmented to enable the large increments of imported gas to be absorbed efficiently within Europe, and to provide access to LNG supplies to countries without seaborne terminals.

A 2007 report evaluated the progress of TEN-E electricity projects, and found that only 16% of the projects of European interest had been finalised, less than had been expected. Such projects are complex, involving multiple

17. For example, replacing a 1970s coal plant with an efficiency of 35% with a modern plant with an efficiency of 45% will yield about 30% improvement in CO_2 emissions per kWh generated.

stakeholders, including regulators on both sides of a border. Transmission lines involve many property owners and other interest groups along its path, and securing the right-of-way and local acceptance is notoriously difficult. The Commission points out that it is of critical importance for success of such a process that the involved investors have clear incentives to bring the project to fruition. These incentives are not so clear and may be distorted if investors also have other interests in generation and supply. Such concerns are an important part in the motivation of the Commission to propose radically stronger unbundling measures, preferably full ownership unbundling. To improve the TEN-E process, the Commission should consider introducing criteria to achieve overall cost minimisation, by evaluating alternative solutions, and an evaluation of regional needs. Such an evaluation could for example identify the missing North-South route for gas in Eastern Europe, or point to the need to develop a joint LNG terminal for the Baltic countries and Poland, or a direct Caspian corridor. This would then allow individual projects to gain priority along such regional needs and prevent parallel projects being granted the status of priority projects.

A particularly important institution in the context of providing the required investment is the European Investment Bank (EIB). The EIB is providing lending, guided by the objectives of the EU, and can therefore provide finance volumes and structures that are unlike those of direct government funding. Like other banks, it has the ability to mobilise on competitive terms the large amounts necessary to co-finance required infrastructure and to offer long maturities tailored to the economic life of these infrastructures. It can also provide structured finance. In addition, because it carries a detailed technical, environmental and economic assessment of the projects it finances, the EIB's participation often acts as a catalyst to the participation of other financiers. The EIB therefore is a key institution in bringing forward the development of large, capital-intensive projects required for continued security of supply. The Commission should ensure, to the extent of its ability, that EIB investment is channelled into the projects where it can make the greatest difference.

The EU is well diversified in terms of resources and installed capacity for power generation. Coal, gas, hydro and nuclear power have significant shares, with other renewable resources rapidly increasing, particularly wind power. Even if EU dependence on imported natural gas for power generation is increasing markedly, it is well positioned to balance costs, security of supply and critical environmental constraints. Several EU countries have leading global positions in nuclear power and several renewable energy technologies. Indigenous sources cannot meet the challenges alone and the EU will continue to be increasingly dependent on imports of fossil fuels, mainly gas, to power the electricity sector. At the same time, the overall efficiency of power generation is increasing thanks to the adoption of new technologies. This is particularly important in the context of rising electricity demand. Overall, the EU electricity industry is performing well in the area of power supply, and the Commission

should build upon this performance in developing the market reform and environmental policies that will guide the future of the sector.

Nevertheless, the electricity sector of the EU is faced with considerable challenges, many of them similar to the challenges seen in the rest of the world. Investments in power generation capacity besides wind and gas, or in transmission lines, have stagnated during the past decade. Liberalisation slowly introduced incentives to improve the efficient use of existing capacities to the benefit of European electricity consumers. It is now time for the industry to start investing again to meet increasing demand and to replace ageing infrastructure. The EU also needs to continue decarbonising its electricity sector, and new clean energy technologies will have to play a significant role in that endeavour. The Commission's policies should take account of the beginning investment cycle, and harness this opportunity to ensure that the investment is taking place in clean, economic generation, and in networks and technologies that will support a shift towards more decentralised power provision and strong policies to reduce demand.

Electricity generation adequacy is one area in which investment will be required in large areas of the EU between now and 2015. The potential shortfalls should be met in advance by investing in means to allow increased cross-border and inter-regional co-operation, by investing in new generating capacity, and most importantly by investing in energy efficiency to reduce peak demand.

On the operational level, electricity and gas markets are becoming increasingly integrated in the EU, with bilateral and regional trade continuing to evolve. The Commission's proposal to establish an agency for the co-operation of EU energy regulators (ACER) is an excellent first step on the path to much greater harmonisation and predictability of energy regulation in the Union. Such harmonisation will be essential if investment is not to be distorted or dissuaded from greater cross-frontier integration. The Commission should consider charging the new agency with drafting strategic guidelines for national transmission adequacy requirements, and for co-ordinating these at the regional level. It should also facilitate the harmonisation of operational standards across the EU. While this overall development offers significant benefits to consumers by increasing resilience and thereby system security at lower cost than would otherwise be possible, it also raises concerns about the responsibility for system security, given the national nature of system operators, and the absence of a central authority. The rapid spread of the electricity blackout in 11 EU member countries in 2006 is the most graphic example of potential and actual problems in this area. Other indicators are the concerns about electricity shortages following the closure of the Kozloduy NPP in Bulgaria, and the impending closure of the Ignalia NPP in Lithuania, or the uneven distribution of the impact of the gas supply interruption in some EU countries in the winter 2005/06.

At the moment, the continuing integration and growth of geographical coverage of the European grid is not managed under a central authority,

creating failure risks. This concern could be addressed by introducing stronger regional co-operation, including uniform grid operation codes, gas quality requirements, balancing and other standards, and integrated planning for system operation, expansion, and interconnection. To achieve this, the establishment of a central regulatory agency with responsibility for the oversight of the integrated grid, such as exists in North America in the form of the North American Electric Reliability Corporation (NERC), should be considered. The proposals for the creation of ENTSO are therefore very welcome, since this organisation holds the promise to eventually develop into such an authority. Already the work done by ETSO on establishing medium-term outlooks for electricity generation adequacy is highly valuable in providing policy makers and investors with insight into the future requirements for the secure supply of electricity in the EU.

Ultimately, closely co-operating regional grid operators that would remain independent of commercial generation and supply, and whose central interest would be the optimum operation of the regional system, are needed. Once proper management structures are established, the integration and development of European grids will be a key element in the achievement of security of supply and environmental objectives. Developments such as the regional initiatives in energy markets are very positive: the Commission will need to continue to monitor cross-border investment, and implement additional processes such as assessments of regional needs and opportunities, should investment be deemed inadequate.

RECOMMENDATIONS

The European Commission should:

Policy

- *Develop a common EU external energy policy with a coherent diplomacy aimed at achieving the objective of "speaking with a common voice", and achieve agreement to this policy in the European Council and Parliament.*
- *Achieve agreement on the proposals made to implement the Energy Policy for Europe, all elements of which are relevant to security of supply.*

Emergency Preparedness

- *Strengthen information exchange with external partners, so that uncertainties in demand and supply projections can be understood and assessed, notably by investors.*
- *Ensure that the co-ordinated management and release of EU oil stocks are fully compatible with the existing and tested IEA emergency response*

mechanisms, and consider developing emergency preparedness policies for natural gas.

Import Dependence and Investment

- *Facilitate the diversification of gas supply sources by, for example, promoting unified external relations in energy and the judicious use of third-party access exemption clauses where these are appropriate.*
- *Analyse the potential impact of world coal market developments and propose policies on coal supplies and prices to the EU.*
- *Continue urgently to clarify the regulatory and competitive framework under which critical investments in new generation and infrastructure are expected to take place.*
- *Facilitate co-operation between national nuclear regulatory bodies so that the new designs of reactors are available for construction through an effective and efficient regulatory system and develop a road-map for lifetime extension and replacement of ageing nuclear stations.*

Internal Co-operation

- *Pursue harmonised approaches to network regulation across the EU, and facilitate co-operation of TSOs across borders in regional co-operation based on a common European framework by, in particular:*
  - *Pursuing the establishment of a European Agency of Regulators with real power in the area of security of cross-border supply.*
  - *Promoting the optimal and secure development of energy grids.*
  - *Pursuing the creation of a European Network of TSOs, to establish a more formalised and legally binding co-operation between TSOs, with the aim of harmonising existing and implementing new rules, roles and responsibilities.*
- *Promote policies to ensure generating capacity adequacy across the EU, focusing in particular on:*
  - *Ensuring investment in generating and transmission capacity, and on*
  - *Reducing peak demand through energy efficiency and demand-side participation.*
- *Ensure increased co-operation in order to capitalise on developments in the nuclear fuel cycle, including progress towards implementation of disposal of high-level radioactive waste and spent nuclear fuel.*

PART II

SECTOR ANALYSIS

OVERVIEW

POLICY

The EU is committed to limit the average global temperature increase to a maximum of 2°C compared to pre-industrial levels. In February 2005, the Commission therefore published a communication entitled *Winning the Battle Against Climate Change* (COM 2005/0035), outlining key elements for the EU's post-2012 strategy. It highlights the need for broader participation by countries and sectors not already subject to multilateral emissions reduction agreements, the requirement for the development of low-carbon technologies, and the continued and expanded use of market mechanisms, as well as the need to adapt to the already inevitable impacts of climate change.

Building on its 2005 communication, the Commission in January 2007 published a communication, *Limiting Global Climate Change to 2° Celsius: The way ahead for 2020 and beyond* (COM 2007/0002). It suggests a set of actions by developed and developing countries for keeping climate change to manageable levels. The communication is part of a comprehensive package of measures to establish the new Energy Policy for Europe, and represents a major contribution to the ongoing post-2012 discussions. Its objective is to combat climate change and boost at the same time the EU's energy security and competitiveness in order to trigger a new industrial revolution. A –30% reduction target of GHG emissions for developed countries by 2020 is also proposed if an international agreement can be reached. Otherwise, a unilateral EU GHG reduction target of at least 20% by 2020 is proposed, to be achieved in particular through energy-related measures. The following detailed measures are included in this communication:

- An improvement of the EU's **energy efficiency** by 20% by 2020, in line with the Action Plan on Energy Efficiency (adopted in October 2006 as COM 2006/545).
- An increase in the share of **renewable energy** to 20% by 2020. This renewables target will be supplemented by a minimum target for **biofuels** of 10%.
- In addition, a legislative package for renewables was envisaged to include specific measures to facilitate the market penetration of both biofuels and renewable heating and cooling, and this was published on 23 January 2008.
- The setting-up of an environmentally safe strategy to promote the industrial use of **CCS** technology, a directive proposal for which was also published on 23 January 2008.
- The strengthening and expanding of the **EU-ETS**, proposals for which were also published on 23 January 2008.

- A constraint on emissions from **transport** through action focusing on cars, civil aviation and transport fuels.
- A reduction of CO_2 emissions from **other sectors**, such as residential and commercial buildings, and of other GHG emissions from a range of different sources.
- Another significant increase in the EU budget for climate, energy and transport **research** after 2013, to follow up the 7th Research Framework Programme (2007-2013).

The key elements of the communication were endorsed by EU Environment Ministers in February 2007 and were endorsed by EU leaders at their 2007 spring summit. The Commission since then has also come forward with a proposal to include aviation in the EU-ETS, a communication on emissions from cars, and a Green Paper on adaptation. The review of the EU-ETS was concluded with the publication of proposals for a revision, and the 7th Framework Programme for research increased the budget for environment, energy and transport. International policy and technology co-operation has also increased, and regular policy dialogues with key countries such as China, India and the US take place. Access to finance for low-carbon technologies outside the EU is expanded through, for example, the EUR 80 million Global Energy Efficiency and Renewable Energy Fund.

On 23 January 2008, the Commission followed this with a set of legislative proposals, accompanied by the communication *20 20 by 2020 – Europe's Climate Change Opportunity* [COM(2008)30], as well as a draft directive on carbon capture and storage (CCS, see below). In this communication and the accompanying documents, the targets outlined above are confirmed, and more detail has been added. The proposed policies will, following their adoption by the European Council and Parliament, become the basis for the future climate change policy in the EU. It is expected that agreement on the proposals can be reached in 2008.

CLIMATE CHANGE

OVERVIEW

The European Union is a signatory to the Kyoto Protocol, which it ratified in 2002. It is committed to an 8% reduction of GHG emissions during the commitment period 2008-2012, compared to base-year emissions[18]. This target was distributed among the then EU15 through a burden-sharing agreement in 2002. The EU12 are not subject to the burden-sharing agreement but instead have to fulfil their targets as signatories of the Protocol. The burden-sharing agreement stipulated that not more than 50% of emissions reductions in any member state could come from the use of the Kyoto flexible mechanisms (clean development mechanism and joint implementation), but otherwise left

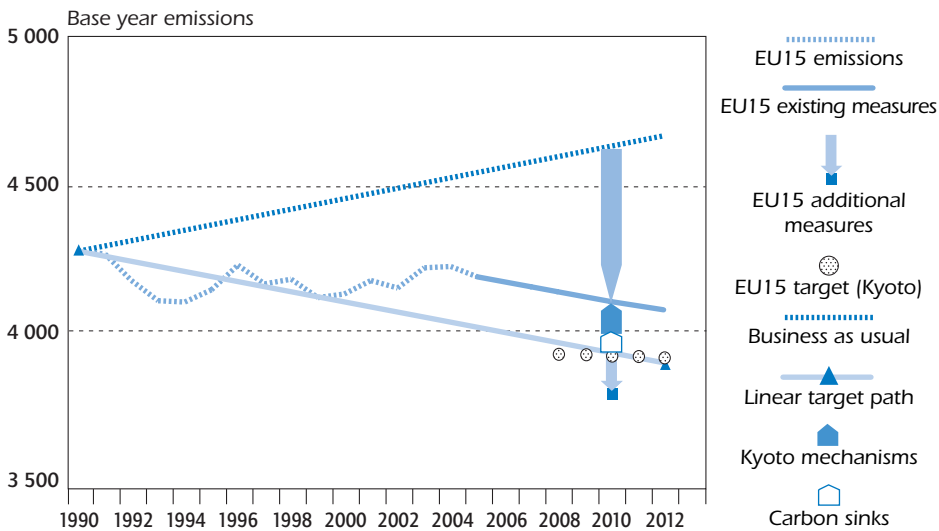
18. Base-year emissions vary between fuels and EU member states to a significant extent.

the development of national policies to reduce GHG emissions up to member state governments. For the post-Kyoto regime, the EU will again aim to have a single target assigned to it, and redistribute it internally.

Overall, the emissions development in the EU has been positive, but since 1999, EU15 emissions have been above the linear target path which serves as a reference the closer the EU comes to the commitment period (see Figure 17). At present, business-as-usual would mean that the EU15 miss the target by a significant margin, requiring additional measures. While it is expected that the recently proposed additional measures will be sufficient to achieve the target, even without the use of these flexible mechanisms, this is by no means guaranteed, and in the case of some countries, highly unlikely, owing to the uncertainty that is attached to these measures. Some of the EU15 will only be able to meet their target by making intensive use of Kyoto flexible mechanisms, which will depend on timely preparation.

Figure 17

EU15 GHG Emissions Development and Projections, 1990 to 2012 (Gt CO_2-equivalent)

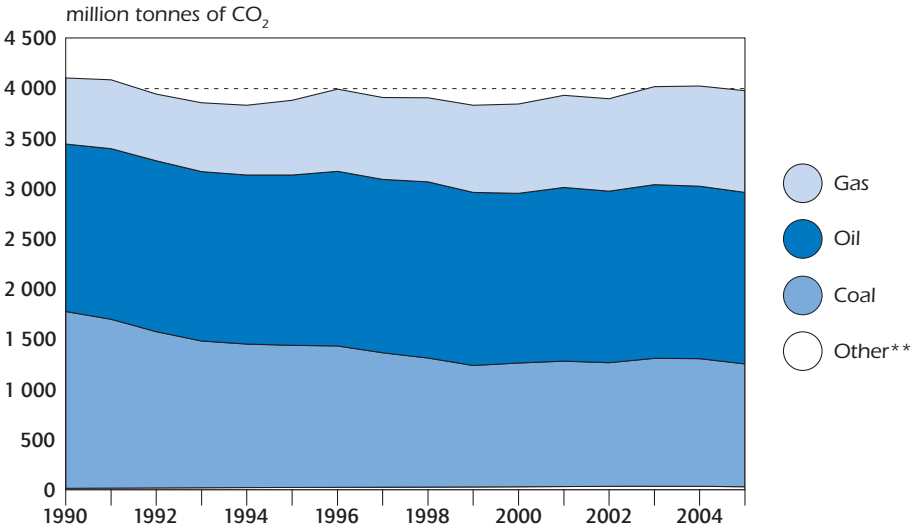


Source: EC Communication SEC(2007)1576.

The Commission is responsible under the Kyoto Protocol for keeping track of emissions in the member states, and for ensuring that they have adequate emissions reduction policies in place, which will enable them to achieve their target. The means by which control is exercised is through the preparation and approval of climate change strategies at the member state level, which have to outline how each one is going to cover the gap towards its target. Each policy included in such a strategy has to have an amount of GHG reduction assigned to it.

Figure 18

CO_2 Emissions in the EU27 by Fuel*, 1990 to 2005



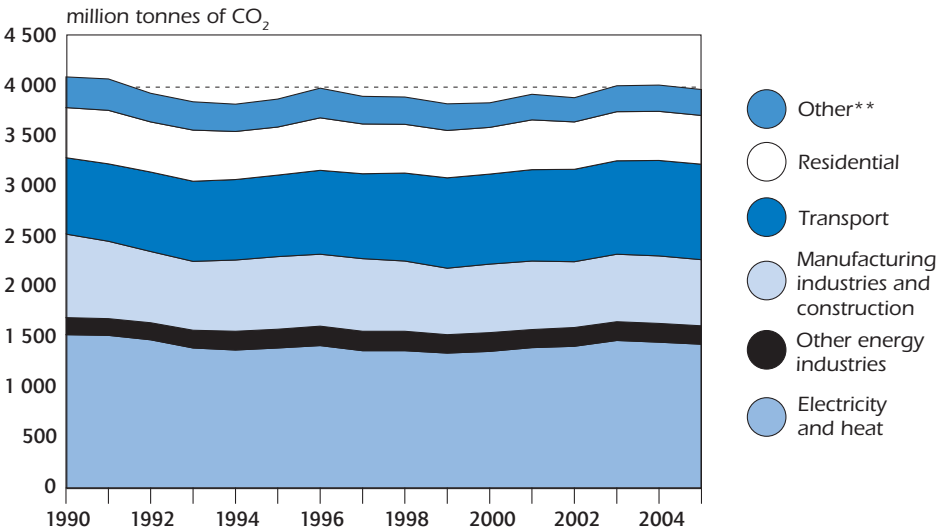
* estimated using the IPCC Sectoral Approach.

** includes industrial waste and non-renewable municipal waste.

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2007.

Figure 19

Energy-Related CO_2 Emissions in the EU27 by Sector*, 1990 to 2005



* estimated using the IPCC Sectoral Approach.

** includes emissions from commercial and public services, agriculture/forestry and fishing.

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2007.

EMISSIONS BY FUEL

According to the latest available data from the EU's UNFCCC submission, between 1990 and 2004, CO_2 emissions, ignoring LULUCF, decreased only slightly in the EU25, by 1% (see Table 5). While the decade between 1990 and 2000 saw a 5% decrease in net CO_2 emissions, primarily owing to the economic collapse of the former COMECON nations that acceded to the EU in 2004, as well as East Germany, most of this decline was negated by a 4% growth of emissions between 2000 and 2004.

Table 5

Overview of EU25 GHG Emissions and Removals, 1990, 2000 and 2004

	Year			*Share (net CO_2)*			*Change*			
	1990	*2000*	*2004*	*1990*	*2000*	*2004*	*Total 2000/ 1990*	*Total 2004/ 1990*	*Total 2004/ 2000*	*Share 2004/ 1990*
	Mt CO_2-equivalent						%			
Gross CO_2 *without considering LULUCF[1] effects*	*4 151*	*3 955*	*4 115*	*84*	*87*	*89*	*–5*	*–1*	*4*	*6*
Net CO_2 considering LULUCF effects[2]	3 847	3 605	3 745	78	80	81	–6	–3	4	4
CH_4	552	449	396	11	10	9	–19	–28	–12	–23
N_2O	484	410	404	10	9	9	–15	–17	–1	–11
Hydrofluorocarbons (HFCs)	28	47	56	1	1	1	68	100	19	114
Perfluorocarbons (PFCs)	19	8	6	0	0	0	–58	–68	–25	–66
Sulphurhexafluoride (SF_6)	11	11	9	0	0	0	0	–18	–18	–12
Total (net CO_2) GHG	**4 941**	**4 530**	**4 616**	**100**	**100**	**100**	**–8**	**–7**	**2**	**0**
Total (gross CO_2) GHG[3]	**5 245**	**4 880**	**4 986**	**106**	**108**	**108**	**–7**	**–5**	**2**	**2**

1. Land Use/Land Use Change and Forestry. 2. Substracting LULUCF effects from emissions. 3. Not substracting LULUCF effects from emissions.

Source: *Annual European Community Greenhouse Gas Inventory 1990–2004*, European Environment Agency.

CO_2 emissions, ignoring LULUCF, were responsible for 89% of GHG emissions in the EU25 in 2004, up from 84% in 1990. The main reason for this increase in share has been a decline in emissions of methane (CH_4) and nitrous oxide (N_2O), due to changes in agricultural practices, and the reduced size of sheep and cattle herds in the EU.

Emissions of other GHG changed, but are overall insignificant in volume. Of particular interest is a doubling of emissions of HFCs between 1990 and 2004, due to an increase in the use of air-conditioning units, which account for 73% of HFC emissions. The emissions of PFCs from electronics manufacturing were reduced by over two-thirds thanks to improved manufacturing practices.

CO_2 EMISSIONS BY SECTOR

CO_2 emissions from fuel combustion have decreased by 3% between 1990 and 2005 (see Table 6). This overall decrease masks important sectoral differences. Most significantly, total emissions from road transport have increased by 27% over the period, while their share has increased by 35%. They now account for close to a quarter of total emissions.

Table 6

Overview of EU27 CO_2 Emissions by Sector, 2005

	Year		*Share*		*Change*	
	1990	*2005*	*1990*	*2005*	*Total 2005/1990*	*Share 2005/1990*
	Mt CO_2		%			
Energy	1700	1617	41%	41%	–5%	0%
Road transport	707	896	17%	23%	27%	35%
Other transport	59	58	1%	1%	–2%	0%
Manufacturing	831	661	20%	17%	–20%	–15%
Other sectors excluding residential	307	257	7%	6%	–16%	–14%
Residential	498	487	12%	12%	–2%	0%
Total	**4 102**	**3 976**	**100%**	**100%**	**–3%**	**n/a**

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2007.

The volume of manufacturing and construction emissions declined significantly from 1990 to 2005, reflecting the significant structural change, energy efficiency improvements, and fuel switching in the sector during the period.

While emissions from other sectors such as agriculture, government, or military have also declined significantly during the period, those from the residential sector have remained relatively stable, declining by only 2%.

POLICY

The Commission, guided by the European Council and Parliament, is responsible for the overall achievement of the Kyoto target in the EU, while national governments are responsible for the achievement of their national target, either set under the burden-sharing agreement for the EU15, or in the Kyoto Protocol for the EU12. In order to move towards achieving the target, many member states have developed climate change strategies, outlining which contribution to savings will be realised by specific measures. These strategies are not compulsory.

Commission policies to reduce emissions of CO_2 date back to 1991, and the first comprehensive policy was launched by the Commission in the form of the European Climate Change Programme (ECCP) in 2000, which is currently in its second phase. The goal of the ECCP is to identify and develop all the necessary elements of an EU strategy to implement the Kyoto Protocol, and it has led to the adoption of a wide range of new policies and measures.

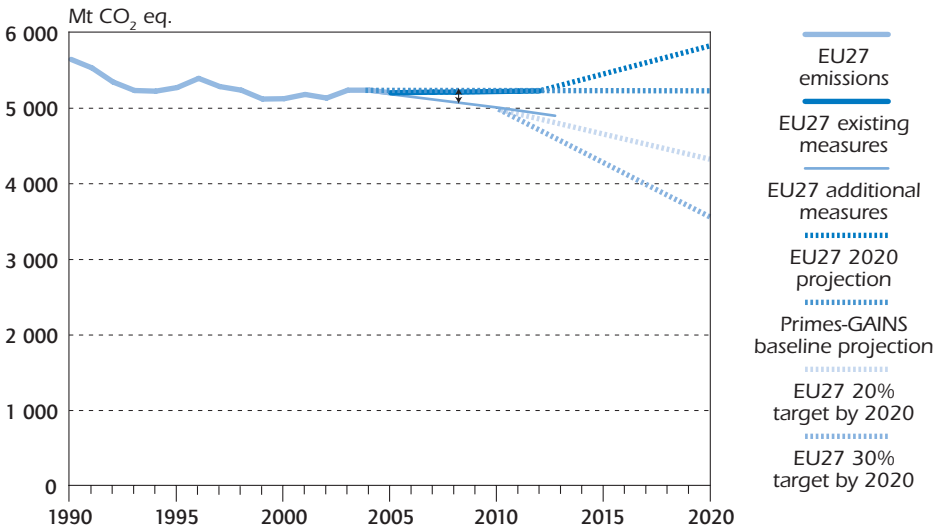
Until 2005, the Commission pursued climate change policy solely as a co-operative exercise within the Kyoto framework. With the date of expiry of this framework by 2013 coming closer, and a perceived lack of urgency on the part of international partners, a policy change took place. As a consequence, in 2007 the EU agreed to pursue unilateral GHG emissions reductions of 20% by 2020, while offering to step these up to 30% in the case of a new global agreement being found.

In the January 2008 communication accompanying the legislative proposals, the Commission outlined the challenge to move towards either a 20% or a 30% reduction of GHG emissions by 2020 (see Figure 20). The most important and one of the most controversial elements of the proposal is the move of the baseline from 1990 to 2005. This move of the baseline will make it much more challenging for countries that have experienced emission declines in the post-1990 period because of industrial restructuring to reach the target, and this question has become an element in the debate on the proposals at European Council level, even though it will not have a significant impact at EU level, because of the relatively small decline of total emissions between 1990 and 2005. The main benefit from this shift will result from basing the target on far more robust data than were available in 1990.

Figure 20

Actual and Projected Emissions for EU27, 1990 to 2020

(Mt CO_2-equivalent)



Source: EC Communication SEC(2007)1576.

THE EU EMISSIONS TRADING SCHEME (ETS)

The most important emissions reduction measure at EU level is the EU Emissions Trading Scheme (EU-ETS), launched on 1 January 2005 and running to 31 December 2012 in its current form, with the possibility of extension. It has become the cornerstone of EU efforts to reduce emissions in a cost-effective manner. The EU-ETS represents the world's largest GHG emissions trading scheme and covers about 45% of the EU25 total CO_2 emissions, or about 2.2 Gt CO_2. More specifically, the activities covered are: electric power, oil refineries, coke ovens, metal ore and steel, cement kilns, lime, glass, ceramics, paper and pulp.

The ETS Directive requires that each member state has to draw up a national allocation plan (NAP) in advance of each trading period. A NAP determines the total allocation for the forthcoming trading period at country level, lists affected installations, and specifies how the allocation is to be distributed to covered installations. The NAP has to be approved by the Commission, and at the end of each year a report has to be prepared by the member state government containing information about emissions and emission allowances. A minimum of 50% of savings is expected to come from domestic action. With the proposed revision of the system from 2013, the country targets would be replaced with an EU target for the trading sectors, and the NAP system would be abolished in favour of a single allocation at EU level.

The scheme was put into operation after a very short preparatory period, leading to significant problems such as late submission and approval of NAPs, late setting-up of registries, high market volatility, and lack of clarity on whether allocations related well to actual emissions in the first year of operation. This was due particularly to the tight time schedules, the limited emissions data availability at an installation level, and the unclear definitions of coverage. When setting up the system, it was also found that the problem of data availability at installation level was further compounded by lack of legal authority to collect the relevant data within the required time frame. As a consequence, a large voluntary data collection effort was required. It is currently expected to run in two phases, 2005 to 2007, and 2008 to 2012 in its current form, with the possibility to add on further five-year commitment periods.

The database of the scheme are national emission inventories at installation level, prepared by member state governments in close co-operation with industry, and a national registry in each member state which keeps track of emission allowances issued to installations and verifies that an installation has sufficient allowances to cover its emissions. Emissions from the installations are monitored, and allowances equal to their emissions need to be surrendered annually. Companies have reporting duties, and are in addition controlled by independent agencies. A penalty scheme for excess emissions is in place, according to which companies have to surrender the missing allowances and to pay an additional penalty of EUR 40 per tonne of CO_2 in the first phase and EUR 100 per tonne of CO_2 afterwards. Emission allowances were issued to installations free of charge in most countries. Only few countries made use of the provision to auction up to 5% in the first phase and up to 10% of the allowances in the second phase. Auctioning allowances was restricted to recovering the cost of setting up and running the scheme.

Trading of allowances is undertaken on private exchanges, or can be on a bilateral basis. The ETS triggered an extensive infrastructure of exchanges, consulting and investment banking firms, as well as other commercial undertakings relating to climate change trading, both outside and in the EU. As a consequence of the possibility to buy credits on the market or to generate credits through flexible mechanisms, many member states have become actively involved in trading of allowances on exchanges, and/or have set up carbon funds to finance projects that will generate credits with which they will be able to demonstrate compliance with the emissions reduction target.

Because of the low level of data quality when the first series of NAPs were prepared, and a tendency to over-allocate emissions, the first phase of the EU-ETS was planned as a trial phase, in which the concept was to be proven. The goal of the pilot phase was to make the system run, and no large emissions reductions were expected, also given the poor data availability. Nonetheless,

recent research[19] shows that there has been some abatement even in the first phase when none was expected. On the basis of the lessons of the pilot phase, and using the much improved database from the first two years of operation, the Commission took a significantly more stringent approach to the approval of phase-2 NAPs for the period 2008 to 2012. All member states had their allowance issues curtailed, in some cases by a large margin. In total across the EU27, the allocation has been reduced by 6.5% compared to the 2005 verified emissions, which represent the first certain data point, or even 12.5% compared to the first-phase allocation. These cutbacks are expected to deliver an important contribution to meeting the EU15's 8% reduction target[20]. In a sign that the market is operating as intended, this action has contributed to increased prices for CO_2 allowances for phase 2, following the crash of allowance prices when the first year's data for phase 1 were published in May 2006.

The EU ETS has had some success in pricing external cost into energy prices by effectively transmitting the carbon price signal, particularly in the electricity sector. This has led to considerable discomfort on the part of some member states that see the ETS contributing to the rise in energy prices, and are concerned about the significant profits generated by the electricity industry owing to the free allocation of allowances in the current ETS. In the industrial sector, the effect of the EU-ETS has been less clear – analysis shows likely effects on some energy-intensive industries in terms of significant reductions in output due to the cost of emission allowances as well as electricity prices. This would result in carbon leakage, increased emissions from these sectors outside the EU. In line with what was proposed in this regard in the January package, the Commission is exploring ways of addressing these concerns, by analysing and facilitating global sectoral approaches to emissions reduction in energy-intensive sectors.

The January 2008 proposals for the revisal of the EU-ETS envisaged several major changes, such as the adoption of an EU-wide cap, the move towards full auctioning of allowances, and the extension of scope by including additional sectors, the most important of which is aviation. They also acknowledged the risk of leakage of CO_2 emissions from industries exposed to competition outside the EU, and suggested to introduce mechanisms, which were not further specified, to address this risk. The proposals continue to view the EU-ETS as a key element among EU policies to mitigate GHG emissions. The Commission also views the EU-ETS as a major tool for forcing energy efficiency improvements in industry and in the power sector.

19. A. Denny Ellerman (MIT) and Barbara K. Buchner (IEA/FEEM),"The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results" in *Review of Environmental Economics and Policy,* Vol. 1, Issue 1, Winter 2007, pp. 66-88.
20. Compared with base-year levels, these decisions will reduce EU15 emissions by 3.4% and EU25 emissions by 2.6%.

NON-TRADING SECTORS

About 52% of EU CO_2 emissions (equivalent to 55% of GHG emissions) are not subject to the EU-ETS. To supplement the ETS in these sectors, the EU is also pursuing increases in renewable energy production and use, energy efficiency, and research and development, including into carbon capture and storage (CCS) technology. These measures are being discussed in the following sections.

One of the criteria that the Commission takes into consideration when evaluating a member state's NAP is the need for consistency with the member state's Kyoto target. NAPs therefore also include an overview of action in the non-trading sectors, and it is through the NAP that the Commission can to a certain extent forecast the performance of a member state in terms of its achievement of the overall target set to it under the burden-sharing agreement. Actual performance in nationwide emissions is verified each year through a report by member state governments to the Commission.

RENEWABLES

OVERVIEW

Renewable energy production in EU has increased significantly since 1990, driven to some extent by the accession of new member states with high shares of renewables, but primarily by continued policy support from a large

Table 7

EU27 Renewables Production by Fuel

	Year						*Change*		
	1990	*2000*	*2005*	*2010*	*2020*	*2030*	*2000/ 1990*	*2010/ 2000*	*2020/ 2010*
	Mtoe						%		
Combustible renewables & waste	46	66	84	104	132	162	45	56	28
Hydro	25	30	26	29	29	30	23	-5	1
Wind	0	2	6	12	23	29	2 757	550	87
Geothermal	3	5	5	6	6	6	48	24	3
Solar/other	0	1	2	2	6	9	221	118	190
Total	**74**	**104**	**123**	**153**	**197**	**237**	**41**	**47**	**29**

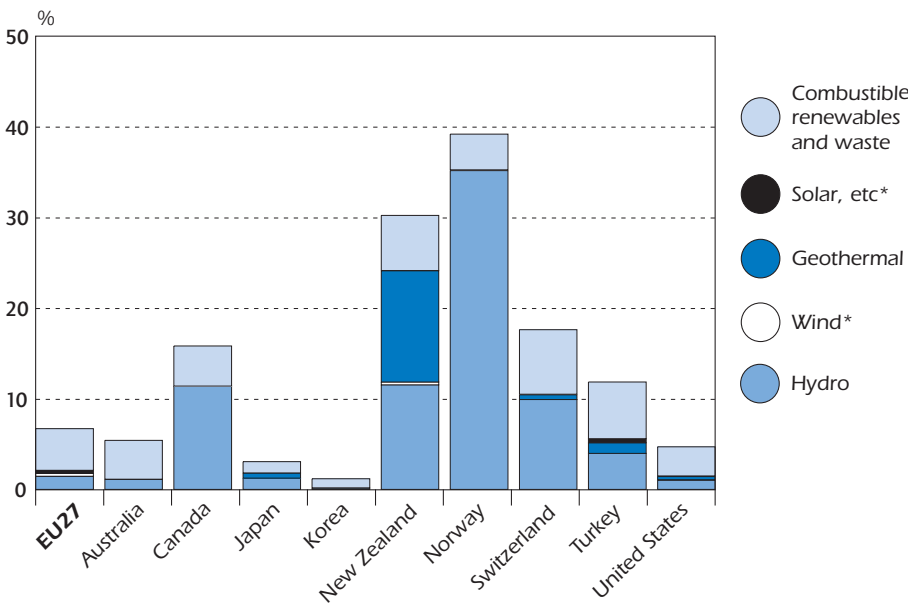
Source: EU submission.

number of member states and the Commission. It is expected that growth will accelerate, driven by the ambitious goals in the area of climate change and sustainable energy production, agreed to by the European Council in March 2007.

Renewable energy consumption is growing in all three energy sectors, heat, transport and electricity, supported either by EU-level policy goals (in electricity and transport), or by member state policies. In international comparison the share of renewables supply, most importantly that of new renewables other than large hydro, in the EU27 is relatively high, compared to some IEA member countries outside the EU (see Figure 21).

Figure 21

Renewable Energy as a Percentage of Total Primary Energy Supply in IEA Countries and in the European Community, 2005



* negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007.

Given the current policy trends, it is likely that the difference between these and the EU27 will increase, due to the expected rapid increase of the contribution of renewables to energy supply in the EU, under the January 2008 sustainable energy proposals. According to the Commission's policy goals, the share of renewables in TFC (including electricity) will have to

increase to 20% by 2020, from 7% in 2005, an increase of 186%, compared to a currently predicted increase of 14% to reach an 8% share under current modelling. Table 8 outlines the expected growth based on modelling undertaken before the publication of these proposals, providing a baseline with which to compare these new policy proposals.

Table 8

Renewables Consumption by Fuel and Share of Gross Production[1]

	Year						Change		
	1990	*2000*	*2005*	*2010*	*2020*	*2030*	*2000/ 1990*	*2010/ 2000*	*2020/ 2010*
Industry	Mtoe						%		
Comb. renewables & waste	14	17	17	17	18	14	21	0	6
Other									
Comb. renewables & waste	24	31	34	36	39	39	31	17	8
Geothermal	0	1	1	1	1	1	38	34	–5
Solar/other	0	0	1	2	5	7	207	335	186
Renewables TFC	***38***	***49***	***52***	***56***	***63***	***61***	***28***	***14***	***13***
Renewable electricity output	***26***	***37***	***40***	***41***	***53***	***71***	***42***	***11***	***30***
Total renewables	**64**	**86**	**92**	**97**	**116**	**132**	**34**	**13**	**20**
Share direct use in %	59	57	57	58	54	46	-4	1	-6
Share electricity in %	41	43	43	42	46	54	6	-2	8
Total TFC	**1 157**	**1 214**	**1 303**	**1 361**	**1 491**	**1 551**	**5**	**12**	**10**
Share renewables in %[2]	6	7	7	7	8	8	28	1	9

1. Transport sector not included. 2. Including electricity.

Source: EU submission.

Table 9

EU27 Renewable Electricity Production by Fuel and Share of Gross Production

	Year						Change		
	1990	*2000*	*2005*	*2010*	*2020*	*2030*	*2000/ 1990*	*2010/ 2000*	*2020/ 2010*
	TWh						%		
Comb. renewables & waste	15	48	85	133	193	278	211	177	45
Hydro	285	353	304	333	337	353	24	–6	1
Wind	0	21	72	143	271	340	n/a	585	89
Geothermal	3	6	7	7	8	9	133	20	15
Solar/other	0	3	10	4	12	22	n/a	20	244
Total renewables	**303**	**431**	**478**	**620**	**821**	**1 003**	**42**	**44**	**32**
Total electricity	*2 567*	*2 992*	*3 274*	*3 584*	*4 105*	*4 418*	*17*	*20*	*15*
Share renewables in %	*12*	*14*	*15*	*17*	*20*	*23*	*22*	*20*	*16*

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

SUPPLY AND DEMAND

Heat

The most important end-use of renewables takes place in the Other sector (see Table 8), where combustible renewables play an important role in providing heat.[21] Current modelling assumes that this form of use will continue to be more important than renewables use in electricity production, even though the growth of biomass use for direct heat production is expected to slow. The main growth is expected to come from solar heating technologies. These have been supported by member states in two forms, either by grants, or by requiring renewable energy provision in new buildings or large-scale refurbishments in the building regulations[22], even though the support framework in most countries is not as extensive as that for renewable electricity. In the case of biomass, this also means that if there is a competing use for the same resource, electricity production will access the resource more easily.

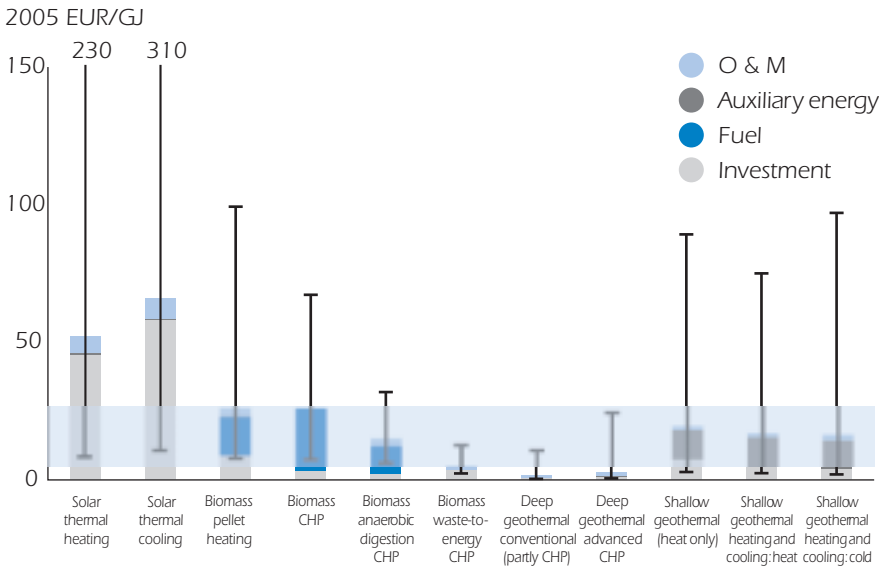
21. Feedstock for combined heat and power (CHP) plant is not included in this calculation.
22. So-called "Barcelona Ordinances", named after the first city where this requirement was introduced.

Achieving substantial growth in renewable heat provision is subject to the creation of a more extensive support framework, as well as to the ability to overcome significant barriers, linked to the availability of natural resources, building regulations, building refurbishment cycles, and overall cost and convenience of the renewable solution compared to a fossil-fuel solution. Unlike in the electricity sector, renewables for heat do not have a network that they can access, but depend on the creation of new infrastructure and networks, as well as on the development of competitive and reliable technologies.

While these factors prevent renewable heat technologies from experiencing the rapid growth rates that appear now possible in renewable electricity, recent price increases for fossil fuels for heating, and the expectation that the prices for these fuels will continue to rise, may change the economic situation of renewable heat technologies considerably in the future (see Figure 22, which is assuming an oil price of USD 50 to USD 70 per barrel).

Figure 22

Cost Breakdowns and Ranges for Selected Renewable Energy Systems for Heating and Cooling



O & M: operation and maintenance.

Note: the conventional energy carrier costs are only based on fuel costs and conversion losses because investment and depreciation costs of appliances per GJ of heat are relatively small. Neither reference system nor avoided costs due to fuel savings are incorporated. Installation costs are included but heat distribution costs and costs allocated to electricity generation for CHP technologies are not.

Source: *Renewables for Heating and Cooling*, IEA/OECD Paris, 2007.

Electricity

Renewable electricity is contributing 44% to total renewables supply in the EU27 in 2005. This share is expected to increase slowly to 46% by 2020, under current modelling. Renewable electricity capacity additions have been the second most important area of new investment in electricity generating capacity in the EU, after natural gas, between 2000 and 2005[23]. The electricity sector has seen the most significant growth of renewables in the EU. The reasons for this is that support policies have the longest history in this sector, and that technological development has been most rapid, enabling onshore wind energy to emerge as a key renewable electricity technology which is now almost able to compete with fossil energy sources without support.

Growth rates have been faster in renewable electricity production than in direct use between 1990 and 2000. Under current modelling, they are assumed to be slower between 2000 and 2010, and accelerate significantly between 2010 and 2020.

In terms of individual technologies, wind had almost caught up with combustible renewables for electricity production by 2005. By 2030, current modelling assumed it would be about the same level as hydro. It is almost certain that this level will now be reached much earlier, owing to the changing policy priorities in the EU.

Renewables for Transport

The production of biofuels for transport has quadrupled since the introduction of a target on EU level in 2003, amounting to an estimated 2.1% of transport fuel consumption in 2007. It has recently come under significant pressure because of changing requirements for policy support, proposed in the January 2008 package, and market developments for agricultural commodities. The future development of biofuels production in the EU will depend on the outcome of the political debate about the sustainability of biofuels production, and the view that is taken of their interaction with agricultural commodity markets.

Unlike in other IEA member countries, where ethanol is the dominant biofuel, biodiesel production dominates in the EU, because of the high share of diesel vehicles. Biodiesel represents 80% of the EU biofuels market, and the EU is the largest producer of this fuel in the world[24]. The main feedstock is rapeseed oil, followed by soy-bean oil and sunflower oil. By using efficient production

23. While capacity additions are an important measure for the investment flows in the electricity sector, it needs to be kept in mind that because of the low load factor of some variable renewable energy technologies, capacity additions for these variable renewables do not provide equivalent levels of electricity production, compared to coal, nuclear or natural gas capacity additions.
24. Most of the data for this section are from the USDA Foreign Agricultural Service GAIN report *EU-27 Biofuels Annual 2007.*

processes, biodiesel from rapeseed oil and palm oil will meet the proposed sustainability criteria (see below), and therefore qualify for counting towards the achievement of the target.

Before the January 2008 proposals, it was expected that biodiesel production capacity would increase rapidly, from 3.9 million tonnes (Mt) in 2005 to 30.4 Mt in 2010, based on industry announcements. In 2006, production was estimated to reach 5.1 Mt, an increase of 31% compared to 2005, while imports were also expected to increase to 0.1 Mt, from 0.02 Mt in 2005. Continuing this level of production capacity increase could lead to capacity being twice the level of demand from 2008 onwards. This, together with recent market developments, notably competition from subsidised exports from the United States and price increases for their feedstock, now makes such a rate of expansion unlikely. In some member states, large modern biodiesel production facilities have already encountered severe economic difficulties for the reasons outlined above.

For bioethanol, EU27 production amounted to 1.36 Mt in 2006, with production capacity at 1.63 Mt, indicating far less overcapacity than in biodiesel production. 2006 imports are estimated at 0.7 Mt of bioethanol. The primary feedstock for EU-produced bioethanol are cereals and sugar beet.

POLICY

Legal Framework

The Commission has long supported the development of renewables through accompanying measures, such as R&D funding. Initially, the White Paper for a Community Strategy and Action Plan – Energy for the Future, [COM(1997) 599], pointed to an EU ambition of 12% for the share of renewable energy in total energy consumption in 2010. With the publication of Directive 2001/77/EC *On the Promotion of the Electricity Produced from Renewable Energy Sources* in 2001, the Commission also formally set renewables targets to member states. The directive set an indicative target[25] for the whole of the EU of 21% for the share of renewables in electricity consumption by 2010, an eight percentage point increase from the 1999 level of 13%. Targets in this directive differed by member state, accounting for the different historical development, and were calculated by adding the eight percentage points to the existing share of renewable electricity in a country. The directive also applied to non-EU member states participating in the EFTA agreement, and candidate countries were given targets separately during their accession negotiations. This directive was followed by Directive 2003/30/EC *On the Promotion of Use of Biofuels and Other Renewable Fuels for Transport*. It set a 5.75% indicative target for the share of renewable fuels in transport in 2010, which applies equally to all member states, since at the time of the publication of the directive, biofuels consumption was practically zero in nearly all of them.

25. Indicative targets are not subject to Commission enforcement.

It is by now almost certain that none of the targets outlined in COM(1997)599, Directive 2001/77/EC and Directive 2003/30/EC will be met. The *Biofuels Progress Report* [COM(2006)845] and the *Renewable Electricity Progress Report* [COM(2006)849] outlined progress by member states on achieving the targets set by the directives. For the EU as a whole, the share of biofuels in transport reached 1.0% in 2005, and the share of renewable electricity reached 14.5% in 2004. Regarding the ambition expressed in 1997 to reach 12% renewables in total energy consumption by 2010, the level achieved in 2005 was 6.5%. It is therefore widely accepted that neither of the targets is likely to be reached at EU level, even though some member states may yet achieve one, two, or all of the targets.

Policy Proposals

As a consequence of growing concern over climate change, and the realisation that none of the indicative targets or ambitions were likely to be met, the Commission adopted a long-term *Renewable Energy Roadmap* [COM(2006)848] in January 2007. The proposal included in this road-map contained an overall binding target[26] of 20% share of renewable energy in total energy consumption by 2020 and a binding minimum target of 10% for transport biofuels by 2020. The European Council of March 2007 agreed to these proposals and asked the Commission to come forward with a legislative proposal, which was submitted on 23 January 2008. The proposals are now subject to discussion by the European Council, and may be altered substantially.

The proposed legislation, accompanied by an impact assessment, reiterated the targets first agreed in 2007. It proposed a more sophisticated allocation to member states than in the 2001 directive, taking into account achieved levels of renewables penetration and GDP compared to the EU average, with poorer member states having to achieve lower growth rates of renewables.

The directive proposal addresses the continued existence of major non-economic barriers such as administrative hurdles (including planning delays and restrictions, and lack of co-ordination between different authorities), identifying measures to streamline procedures, grid access and the lack of information and training.

The option of trade of Guarantees of Origin (see Box 6) between member states is also included in the proposal despite concerns about the risk of trade being detrimental to the development of renewables. The reasons for allowing restrictions in tradability of Guarantees of Origin are that:

26. Binding targets are subject to Commission enforcement through infringement procedures. Governments failing to achieve the target could be subject to a monetary fine, to be paid into the EU budget.

- the development of higher-cost renewables would be stifled;
- trading Guarantees of Origin and existing support systems in most member states may be incompatible;
- windfall profits may accrue to existing producers of (low-cost) renewable energy because of the existence of considerable non-economic barriers, and governments may have less incentive to eliminate non-economic barriers[27] to the large-scale diffusion of renewables.

The impact assessment estimates the costs of not allowing trading at up to EUR 8 billion per year by 2020. As a consequence of this cost assessment, the proposal includes the provision for trading Guarantees of Origin despite the risks outlined above, but in some instances restricts it to cases where the member states have achieved their interim targets and entered into a bilateral agreement enabling this trade, or allows member states to restrict it in order to give themselves control over the use of the renewables potential within their borders, to avoid the risks outlined above.

Box 6

Renewable Energy Guarantees of Origin

Renewable Energy Guarantees of Origin (RE-GO) were introduced in the EU with the first renewables directive (2001/77/EC), which also set the indicative targets for renewable electricity for 2010. Under the directive, member states had to establish a system under which RE-GOs were to be issued to all producers of renewable electricity on request by a central body, from 23 October 2003. The RE-GO did not need to be tied to the electricity for the purposes of trade.

The member states were given freedom on how to implement many aspects of the directive, such as the volume of renewable electricity required to generate a RE-GO certificate, or how to issue them. The expectation at the time of the introduction was that the establishment of the RE-GO system would eventually enable trade between member states, and it was seen as necessary to facilitate trade and increase transparency for consumers. The directive did not require member states to accept RE-GOs purchased in another member state as counting towards the national indicative target, but it left open the possibility for any member state to allow this. It is likely that a restriction of trading would increase the overall cost of reaching the target (see p. 78/79 of the Annex to the Commission's Impact Assessment, http://ec.europa.eu/energy/climate_actions/doc/2008_res_ia_annex_en.pdf).

27. Non-economic barriers include administrative barriers, including planning restrictions; grid access; lack of information, public resistance, and lack of adequate training opportunities.

In the area of biofuels and bioliquids, the proposal outlined a threshold for sustainability of the fuels of 35% improvement compared to fossil fuels, for the fuels to be counted towards the target. The 35% threshold is a hard cut-off, with biofuels failing to achieve it not allowed to count towards the target, while any biofuel reaching the threshold is treated the same, regardless of the margin of achievement.

The Commission proposal also provided a schedule with interim targets under which progress towards the target could be verified, and measures taken to correct any delay in reaching the target. The proposed ramp-up is not a linear growth, but assumes an exponential growth, with most of the installations being added closer to 2020. The interim targets would be indicative only, but would help the Commission to determine the adequacy of the member states' measures to achieve the 2020 targets.

OUTLOOK FOR 2020

The Commission makes scenarios for the development of the energy sector on a regular annual basis, and often in connection with the necessary impact assessments that are required with new legislative proposals. Various models are used for the different aspects that affect energy and economic systems, ranging from models with many details on specific parts of the energy system to broader general equilibrium models. The PRIMES model, developed and run by a consortium of external research communities led by the National Technical University of Athens, is the main model.

The scenarios analysing the impacts from implementing the proposed sustainable energy policies are based on a set of framework assumptions, including an oil price of USD 61 per barrel in 2005 prices, in 2020. Scenarios have also been made assuming a high oil price reaching USD 100 per barrel in 2020 and various relationships between oil, gas and coal prices. The high oil price scenario has a significant impact on the costs and challenges of implementing the proposed package of policies, mainly by making it relatively cheaper and easier.

The result of the modelling (see Table 10) shows that the total cost for achieving both GHG and RES targets is an additional 0.58% of EU27-GDP in 2020 compared to the energy costs in the baseline scenario. Overall GDP is 0.54% lower in the EU27 in 2020 as a result of meeting GHG emissions reduction targets. The cost depends to some extent on the ability of member states to trade Guarantees of Origin.

Full restrictions on the trade of Guarantees of Origin for renewable electricity will increase electricity prices within the EU by 2% above the least-cost renewable energy supply (RES) target fulfilment, which assumes

Table 10

PRIMES Modelling Results for the Sustainable Energy Package[1]

	GHG emissions 2020/1990	*RES share TFC 2020*[2]	*RES-E in 2020*	*Energy consumption 2020/2005*	*Euro/ tonne CO_2 in 2020*	*Euro RES-E support/ MWh in 2020*
Business as usual	–1.5 %	12.5%	20.2%[3]	9%	22	
Only GHG target achieved	–20%	15.8%			49	
Only RES target achieved	–9.3%	20%				56
GHG and RES target achieved	–20%	20%		–10 %	39	45
RES target and high efficiency scenario	–22%[5]	20%	30.3 %[4]	–17%	22	35

1. Without access to flexible mechanism credits, 2005 is base year.

2. 8.4% in 2005.

3. From PRIMES baseline, 2007 update.

4. From PRIMES High Efficiency and High Renewables Scenario, 2006, including a 13.4% improvement in energy efficiency by 2020, based on PRIMES 2007 baseline.

5. Reduction in CO_2 emissions from energy production. Total GHG reductions, including all sectors, are higher.

Source: IEA.

no restrictions on trade. This can add up to EUR 8 billion of extra annual costs by 2020 compared to the scenario where trade is without restrictions. At the same time, the renewable energy mix would only change very marginally, with the main shift seen in a larger share of relatively expensive offshore wind instead of onshore wind. The reason for this is that without the ability to trade Guarantees of Origin, some countries will be forced to use more offshore wind instead of purchasing Guarantees of Origin generated by relatively cheaper onshore wind in other countries. Apart from this higher share of offshore wind, the proposed restrictions on trade will not by themselves contribute to the development and maturity of other higher-cost technologies. However, full trade of Guarantees of Origin could impact on national support systems for RES, which have been instrumental in fostering renewables penetration. The impact assessment assumes that trade increases uncertainty for RES investment and states that the interaction between Guarantees of Origin trade and RES support systems merits consideration.

Two scenarios with oil prices of USD 100 per barrel were calculated. In these scenarios additional RES deployment and greenhouse gas (GHG) emissions reduction measures are economic without further stimulation and the price of CO_2 would fall to EUR 34.5 per tonne. The RES-E (electricity) incentive would decrease to EUR 37 per MWh. This would lower the total cost of the policy package by about 35%, to 0.38% of GDP.

A RES-E share of electricity production of 34% by 2020 is the result of the "Green-X balanced scenario", referred to in the Commission's RES road-map. This scenario deviates from the least-cost and also the "high efficiency and renewables" PRIMES scenarios by projecting a significantly higher uptake of RES in heating and cooling.

In the scenario assuming high energy efficiency improvements, reaching 17% below baseline in 2020 (thus 3% short of the EU target), and meeting the RES target, there are no constraints on GHG emissions but a EUR 22 per tonne of CO_2 is assumed for the ETS sectors. This scenario delivers a 22% reduction in GHG emissions compared to a 17% reduction in the scenario assuming a 20% target for GHG emissions reductions and a 20% RES target[28]. As can be expected, higher results in developing energy efficiency will reduce the other efforts required to reduce CO_2 emissions and to meet the RES target, thereby bringing down substantially the overall cost of achieving the targets.

SUPPORT MEASURES

Direct Funding

Community Structural Funds and the Framework Programme 7 for R&D (see Chapter 8) contain significant funding volumes for the direct support of renewable energy installations and renewables R&D in member states.

Intelligent Energy for Europe Programme: Renewables

Intelligent Energy for Europe (IEE) and its predecessor programmes have been very active in the renewables field, and some projects have had an important impact on Commission policy development, such as the OPTRES report on renewable support scheme performance, published in 2007. A wide range of projects have attempted to create and share knowledge through the network of energy agencies established under the SAVE I and II, and the IEE programmes.

28. Needed CO_2 reductions from the energy sector are less than 20% since some reductions in total GHG emissions from all sectors, including agriculture, have already been achieved.

One area that IEE is focusing on in supporting renewables is the use of RES for heating and cooling, where policy barriers are significant. Work undertaken aims to set priorities for the introduction of the technologies. It also aims to inform and implement policies across the EU. This is accompanied by measures to monitor and transform markets, to change behaviour, and to facilitate access to finance. Finally, the programme aims to develop human resources by providing training and education.

Box 7

Two RES-Heat Project Examples from the Intelligent Energy for Europe Executive Agency

The Solar Keymark II Project

Market research showed that 30 to 50% of all glazed collectors produced in the EU are crossing national borders. This result led to the conclusion that it would be important to eliminate trade barriers, which could easily be created by different national certification schemes, required *e.g.* for establishing the eligibility for government support of an installation. The aim of the project was therefore to create one European CEN Keymark for solar collectors, which would demonstrate quality to consumers and grant providers across Europe.

The main steps of the project are first to clarify trade barriers and problems in trading solar collector equipment across the EU; following this, to update the *Solar Keymark* scheme rules and EN standards to reflect the latest technological developments, and, finally, to publicise and promote the use of the *Solar Keymark* and its improvements to public authorities supporting solar water heating, as well as to manufacturers/traders involved in the industry. The result of the project is that in 2007 most EU countries accept *Solar Keymark* in national certification schemes, and that 40 to 50% of solar collectors sold in the EU now have achieved the *Solar Keymark* requirements.

The IGEIA Project

The aim of the project is to enable industry to evaluate the use of geothermal energy and demonstrate the economic advantages of its use. To this end, the project supports studies showing how to install geothermal energy on industrial sites, enabling cost comparisons between geothermal energy and conventional energy technologies, and conducts market studies for geothermal energy use in industry. Pilot studies have been carried out for Portugal, Estonia and France. Findings are distributed EU-wide to those industries that may be interested in using this form of energy.

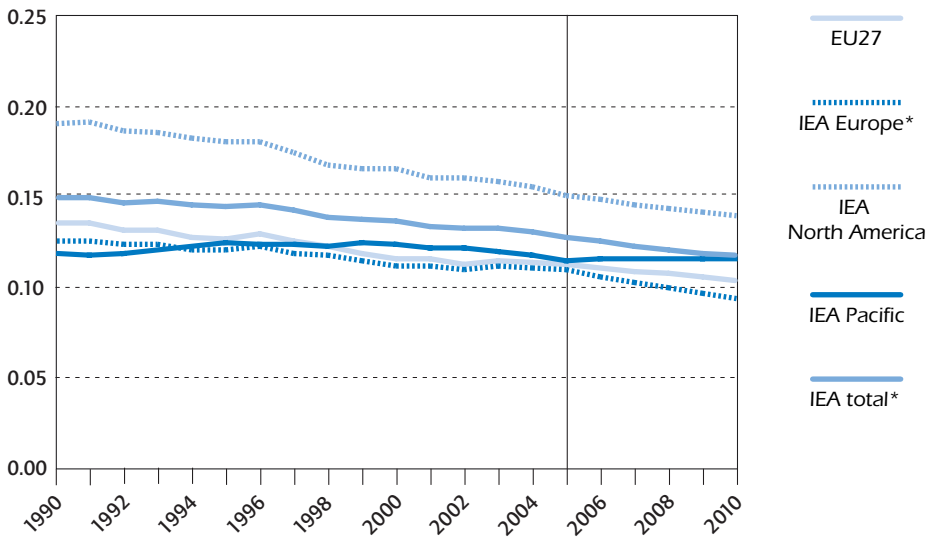
OVERVIEW

Primary energy intensity (TPES/GDP) and total final energy intensity (TFC/GDP) in the EU27 has declined constantly from 1990 to 2005, by around 1.4% per year and 1.2% per year, respectively (see Figure 23). As a result of this decline, total primary energy intensity in the EU27 is now in line with the IEA average, while total final energy intensity is lower than the average for the whole of the IEA, as well as for both the IEA Pacific and North America regions, indicating the progress that has been made by the EU member countries in reducing their energy consumption per unit of GDP.

Figure 23

Total Final Consumption per GDP for the EU27 and Selected IEA Regions, 1990 to 2010

(USD GDP using 2000 prices and purchasing power parities)



* excluding Luxembourg and Norway throughout the series, as forecast data are not available for these countries.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007; *National Accounts of OECD Countries*, OECD Paris, 2007; country and EU submissions.

Figure 24 shows how energy efficiency improvements have reduced EU energy intensity during the past 35 years. It demonstrates that by 2005, *negajoules*[29] have become the single most important energy resource in the EU. Energy

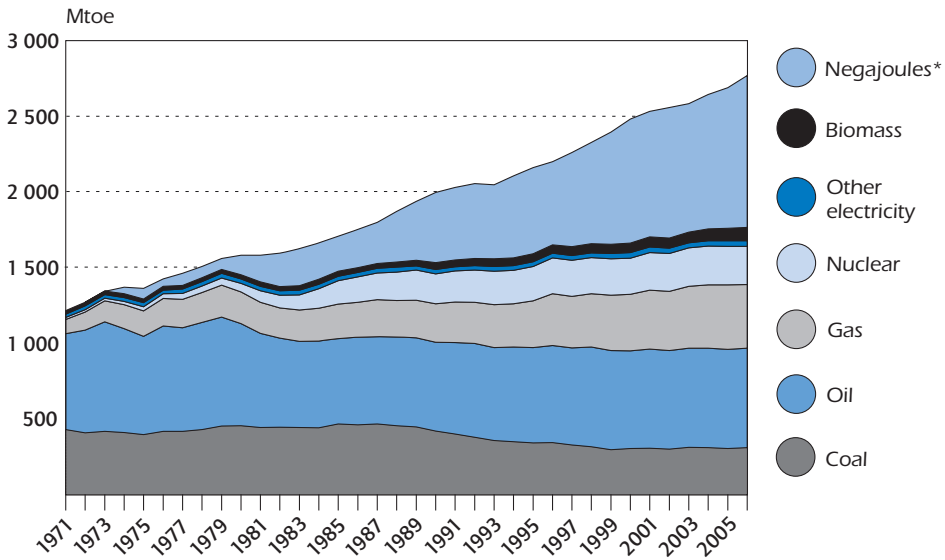
29. Avoided energy consumption through energy savings.

efficiency improvements have not been even across EU member states, however, indicating that they are to a large extent still dependent on policy developments at the national level.

Energy intensity indicators measure a mix of energy efficiency improvements and other factors such as structural changes in the economy, and can therefore not give clear information on energy efficiency improvements. Under the EU-funded Odyssey project, energy efficiency indicators have been developed for the EU. These data confirm that the energy efficiency index[30] in the EU (based on EU25 data) has improved consistently since 1990, but it also shows that since 2000, the rate of energy efficiency improvements has slowed, particularly for some industry sectors.

Figure 24

Development of Primary Energy Demand and Avoided Energy Use in the EU25, 1971 to 2005



* "negajoules": energy savings calculated on the basis of 1971 energy intensity.
Sources: COM(2006)545 and Enerdata 2006.

30. The energy efficiency index is calculated as the weighted average of the unit consumption index of each sub-sector or end-use, with a weight based on the relative consumption of each sub-sector in the base year.

Sectoral analysis reveals different levels of energy efficiency improvement across the EU economy. Data for the EU25 suggest that from 1990 to 2000, industry made larger gains in energy efficiency than other sectors[31].

Since 1990, energy efficiency in industry improved by 20%. The energy efficiency improvement was mainly realised in the chemical industry, which accounted for 41% of total efficiency improvements, the steel industry, which accounted for 19%, and the non-metallic industry, which accounted for 15% of the improvement. Since 2000, energy efficiency improvements in the industry sector have slowed markedly, but it is now expected by the European Commission that the EU-ETS will lead to a renewed efficiency drive in EU industry. The efficiency improvements for the chemicals sector are particularly impressive. Data from the chemicals manufacturing sector show that energy efficiency[32] has improved consistently from 1960 to 2005, by 72%.

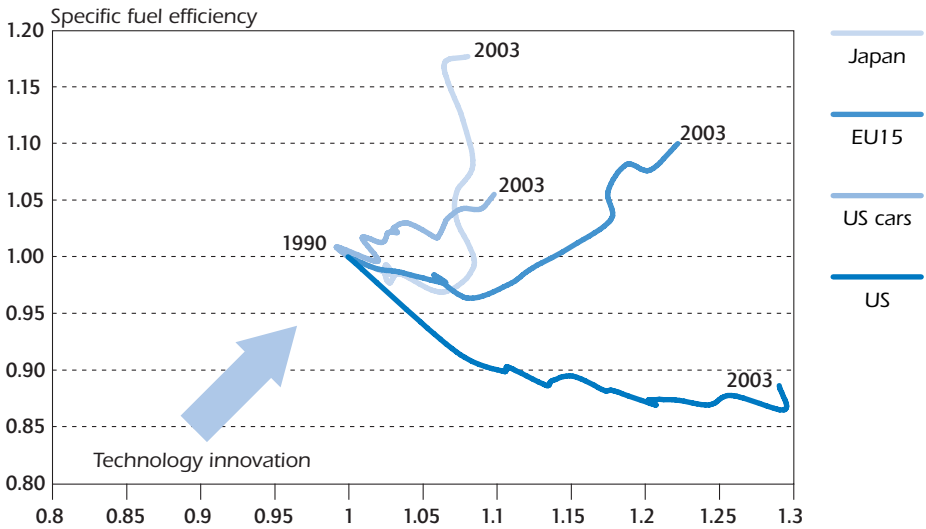
The transport sector has also made improvements in energy efficiency, at a rate of 0.7% per year since 1990. The rate of energy efficiency improvement increased slightly after 1996, to 1.1% per year. Greater progress was achieved in the energy efficiency of both cars and airplanes than was the case for the rest of the sector. Interestingly, the *Odyssee* data do not report any energy efficiency improvement in freight transport since 2001, and this trend is also identified in data on heavy-duty vehicles presented by the European Automobile Manufacturers' Association. Despite the overall improvements in energy efficiency in the transport sector, CO_2 emissions for the EU15 have increased by 25% since 1990, largely because the efficiency gains in the transport fleet have been overridden by increasing fuel use as a result of larger vehicle fleets and greater travelling distances.

While average fuel efficiencies in the EU vehicles fleet have increased over the past decade, the rate of increase in energy efficiency has not kept pace with some other countries – notably Japan. Furthermore, the average mass of an EU vehicle has also increased, and additional energy-consuming features, in particular air-conditioning, have become standard, counteracting developments in engine efficiency to some extent[33] (see Figure 25).

31. Measured in terms of energy used per production index or per tonne and aggregated to the whole sector.
32. Measured as energy consumption per unit of production.
33. Note that this kind of comparison is difficult because of the existence of: different policy objectives, different test procedures, different emission regulations, different compliance methods, different size mixes and power levels, etc.

Figure 25

Comparison of Mass and Specific Fuel Efficiency for Light-Duty Vehicles for Selected Countries/Regions



Source: IEA.

Energy efficiency in the household sector[34] is estimated to have improved by 10% since 1990 for the EU25, although the trend has not been consistent. There was a slight decrease in unit consumption per dwelling from 1990 to 1996, of -0.2% per year. From 1996 to 2000 this trend reversed and the sector's energy consumption per dwelling increased by around 0.8% per year. After 2000, unit consumption per household levelled off, and has remained stable since then. According to *Odyssee*, the rise until 2000 was driven by a rapid increase in the average income per household, by an average rate of 2% per year during the period. Likewise, the stability after 2000 can be explained by the economic slow-down in most EU25 countries, as well as by higher energy prices, which rose on average by 2.5% per year between 2000 and 2004.

OUTLOOK

Even though energy efficiency has improved considerably in recent years, the Commission estimates that the technical and economic potential to save energy continues to be very high. It also assumes that at least 20% of total

34. Measured as energy use per dwelling.

primary energy could be saved through energy efficiency policies by 2020, in addition to what would be achieved by price effects and structural changes in the economy as well as by natural replacement of technology, and measures already in place (see Table 11). The Commission assumes that the cost-effective savings potential is relatively even across the sectors of the economy, and that the largest share of the savings would come from the transport sector, where achieving the potential depends to a significant extent on being able to realise modal shifts.

Table 11

Estimates for Full Energy Saving Potential in End-Use Sectors

Sector	*Energy consumption 2005*	*Energy consumption 2020* (business as usual)	*Total energy saving potential 2020*	*Potential energy saving as share of 2020 consumption*	*Share of total savings 2020*
		Mtoe		%	
Residential	280	338	91	27	26
Commercial buildings	157	211	63	30	18
Transport	332	405	105	26	30
Manufacturing	297	382	95	25	27
Total/average	1 066	1 336	354	27	100

Sources: European Commission, EU25 Baseline Scenario and Wuppertal Institute 2005; COM(2006)545, IEA calculations.

Even with a 20% improvement in energy efficiency, energy use in the EU is expected to grow slightly. According to the Commission, under current trends and policies, primary energy demand is expected to grow by 11% between 2005 and 2030 with an ongoing economic growth of 2.2% per year on average. This estimate already takes into account significant energy intensity improvements, of around 1.7% per year, and it is based on expectations about structural change towards less energy-intensive services and industries as well as energy efficiency improvements in power generation and final demand favoured by a shift to fuels with higher efficiencies, such as natural gas, or renewables such as wind. These changes are expected to be driven by energy import prices reaching USD 63 per barrel[35] of oil in 2030.

35. At 2005 value.

Box 8

The Energy Efficiency Action Plan (EEAP)

On 19 October 2006 the Commission adopted the Energy Efficiency Action Plan [COM(2006)545]. The purpose of the plan is to mobilise the general public, policy makers and market actors, and to transform the internal energy market in a way that maximises the energy efficiency of its infrastructure, products and energy systems. The objective of the plan is to control and reduce energy demand and to take targeted action on consumption and supply in order to save 20% of annual consumption of primary energy by 2020 (compared to the energy consumption forecasts for 2020).

The Action Plan has defined six priority areas relating to energy efficiency:

- dynamic energy performance requirements for products, buildings and services;
- energy transformation;
- transport;
- financing, economic incentives and energy pricing;
- energy-efficient and energy-saving behaviour of energy consumers;
- international partnerships.

It sets out a number of short- and medium-term measures to achieve this objective. The Commission included in the plan all those measures with the lowest environmental cost over their lifecycle. Some measures are identified as priorities for immediate adoption, while others are to be implemented throughout the six-year period set for the plan.

The plan runs for a six-year period from 1 January 2007 to 31 December 2012. The Commission considers this time frame to be sufficient to adopt and transpose most of the measures it proposes. A mid-term review will be carried out in 2009.

POLICY

Energy efficiency has been identified as a cornerstone in the Commission's energy policy, and this is reflected in both the level of attention given to it and the level of actual policy development (see Box 8). Energy efficiency is also regarded as one of the three pillars of the Energy Policy for Europe Action Plan 2007-2009.

Energy efficiency is also one of the pillars of the Commission's *20 20 by 2020* policy targets. The Commission is aiming for an improvement of at least 20% of the EU's energy consumption compared to business-as-usual projections for 2020. This objective corresponds to achieving approximately 1.5% of real energy savings per year up to 2020. If successful, this would mean that by 2020 the EU would use approximately 13% less energy than today, saving EUR 100 billion and around 780 millions tonnes of CO_2 each year, around 20% of the current emissions.

Energy efficiency policies are recognised to be important because they can assist with achieving other EU targets. For example, enhanced energy efficiency will lower total energy use and therefore make the renewable energy target easier to attain. The Commission therefore has a range of policies and measures in place or under development that affect energy efficiency across many sectors. These cover research funding, finance for energy efficiency, fiscal policies and education.

The Commission has over time launched a large array of energy efficiency policies and directives already in place or under development to help achieve its 20% target. Four measures set the framework for the Commission's energy efficiency policy. Annex 1 of the Presidency Conclusions (7224/07) – commonly referred to as the *Energy Policy for Europe Action Plan* (EEAP) – established the overall framework for the future development of the energy efficiency policy in the EU. With respect to actual policy, the conclusions:

- Stressed the need to increase energy efficiency in the EU so as to achieve the 20% energy-saving objective;
- Called for a thorough and rapid implementation of the Commission's Action Plan on Energy Efficiency; and
- Invited the Commission to rapidly submit proposals to enable increased energy efficiency requirements on office and street lighting to be adopted by 2008 and on incandescent lamps and other forms of lighting in private households by 2009.

On the basis of the EEAP, the Commission also plans to draft guidelines and a code of conduct on improving energy end-use efficiency in all sectors. Importantly, the EEAP lists 85 actions to enhance energy efficiency in the EU.

The Directive on Energy End-Use Efficiency and Energy Services (ESD – 2006/32/EC) provides another essential part of the framework for enhancing energy efficiency in the EU for those sectors not covered by the EU-ETS. A key aspect of the directive is the requirement for member states to prepare National Energy Efficiency Action Plans (NEEAPs). Member states have to submit their NEEAPs showing how they will reach an energy savings target of 9% in 2016. NEEAPs are important because

they articulate in detail the strategy each member state intends to take to pursue and monitor progress in achieving their energy efficiency targets.

The annex of the Commission communication, *Moving Forward Together on Energy Efficiency* (COM 2008/11), provides an estimate of the CO_2 benefits from the achievement of the saving targets set by the member states. These results are shown in Table 12.

It is important to note that savings accruing from the EU-ETS are excluded from the targets in the directive. In order to achieve the overall 20% energy savings target, these non-ETS sectors need to save, at the minimum, 9% by 2016. The Commission has suggested a pragmatic approach to how this level of energy savings should be calculated for each member state. Under this proposed system, a country's energy savings target is calculated as 9% of the average total final energy consumption (TFC), without climatic corrections, for the most recent five-year period previous to the implementation of the directive for which there are official data, for example 1998-2003. If the average TFC for a country over the 1998-2003 period was 1 000 Mtoe, then the savings target for 2016 would be 90 Mtoe. Figure 26 provides an indicative graphic illustrating how this approach works.

Table 12

Effects of Energy Efficiency Improvements through the Energy Services Directive

Reduction below baseline	*Year*	
	2016	2020
Final energy demand (Mtoe)	86	124
CO_2 emissions (Mt CO_2)	275	393
CO_2 reduction compared to 1990 emissions in %[1]	6.8	9.7
CO_2 reduction below 1990 levels in %[2]	3.6	4.6

1. This also includes the avoided CO_2 emissions inherent in the baseline up to 2020, *e.g.* 5.1% by 2020, compared to 1990.

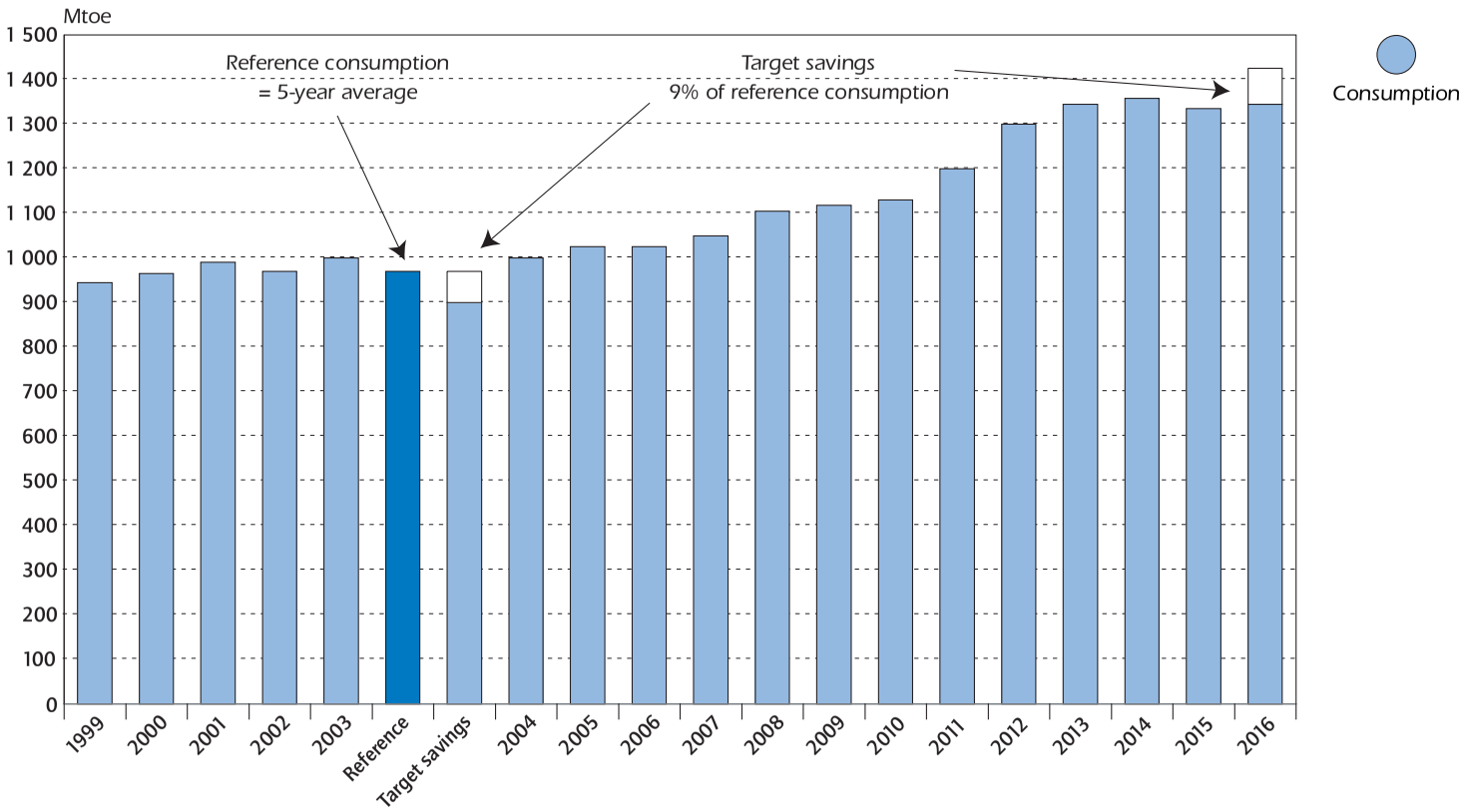
2. Real reductions compared to 1990 level.

Source: COM(2008)11.

The Commission plays an important role in international energy efficiency policy. Most recently, it has been instrumental in laying the ground work for the high-level International Partnership for Energy Efficiency Co-operation (IPEEC).

Figure 26

Calculation of Target Savings



Source: European Commission.

The Energy Policy for Europe Action Plan 2007-2009 also highlighted the need for the EU to continue its efforts in the field of common external energy policy. In support of the security of supply, competitiveness and sustainability goals of the EU energy policy, the external energy policy aims to promote a range of issues, including strengthening international partnerships and building co-operation, based on the existing bilateral energy dialogues with a range of countries, focusing on the reduction of GHG, and energy efficiency.

Other international initiatives related to energy efficiency in which the Commission is playing an important role include the discussions of the post-2012 climate regime under the UNFCCC, the Energy Community Treaty, the Baku Initiative, the Euro-Mediterranean Energy Partnership and its involvement in the Energy Charter.

As part of the IEA's role in the G8 Gleneagles Plan of Action, the IEA has made a range of energy efficiency recommendations to the G8 leaders and its member countries. Annex B summarises the Commission's progress in implementing these recommendations.

MEASURES

Research, development and innovation are essential in the area of energy efficiency. The EU has a number of funding programmes that aim to stimulate energy efficiency. These include the Executive Agency for Competitiveness and Innovation's (EACI) Competitiveness and Innovation Framework Programme, the Seventh Framework Programme, where energy efficiency is one of the nine priority topics in non-nuclear energy research and the Research Fund for Coal and Steel Programme. They are described in more detail in Chapter 8.

The EACI (formerly the Intelligent Energy Europe Executive Agency) manages a range of programmes, including the Intelligent Energy Europe Programme. This programme aims to promote policies and favourable market conditions for energy efficiency and renewables and has a budget of EUR 730 million for the period 2007-2013. This is a 50% increase over the budget for the 2002-2006 period. The programme has five ongoing energy efficiency projects covering buildings, industry, transport, communities and equipment. Data for the 2002-2006 period show that in the SAVE, STEER and horizontal projects, the majority of funding went to three portfolios:

- Multiplying success in buildings;
- Policy measures for an efficient use of energy in transport; and
- Sustainable energy communities.

The Energy Efficiency Action Plan (EEAP) includes several types of measures to facilitate investments designed to boost energy efficiency. For example, the Commission calls on the banking sector to offer financing opportunities

tailored to small and medium-sized enterprises (SMEs) and enterprises providing energy efficiency solutions (energy services). In addition, the private banking sector, the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and other international financial institutions will facilitate the establishment of public-private partnerships. To further encourage investments, the Commission plans to remove, where possible, the national legal barriers to shared savings, third-party financing, energy performance contracting and recourse to businesses providing energy services.

Structural and cohesion funding is also available to finance energy efficiency. At present, a minimum of 1.4% of all structural funding should be spent on improving the energy efficiency projects. A minimum of EUR 4.2 billion is allocated to these projects (40% of the planned total expenditure for energy).

Energy efficiency is one of five priority areas in the energy portfolio of the EIB. While energy efficiency has been part of projects in previous years, specific projects are relatively new. Nevertheless, the bank does have procedures for verifying that energy efficiency has been achieved. The bank is trying to:

- Mainstream energy efficiency in all projects;
- Develop specific financial instruments;
- Develop synergies with Jaspers[36], Jessica[37], Jermeie[38]; and
- Focus on high energy intensity countries.

Taxation is seen as a powerful tool for providing incentives for energy efficiency, and the Commission is planning a range of energy efficiency tax-related work. This will include drafting a Green Paper on indirect taxation, revising the Energy Tax Directive, and investigating the taxation of private cars according to their pollution levels. In addition, there is discussion about the value-added tax (VAT), and how it influences energy efficiency. Current EU rules on VAT, elaborated in the 2006 VAT Directive (2006/112/EC), specify that member states must subject supplies of goods and services to a rate of at least 15%, with the exception of a broad range of areas deemed essential, including energy, where countries are free to apply reduced rates of no less than 5%. Energy efficiency products and services are currently not eligible for the lower rate. There is now a debate for greater flexibility on VAT rates to encourage energy efficiency, and the Commission is expecting to bring forward new legislative proposals on VAT rates in the summer of 2008. Action by DG TAXUD has commenced. An online consultation has been launched between

36. Joint Assistance for Preparing Projects in European Regions.
37. Joint European Support for Sustainable Investment in City Areas.
38. Joint European Resources for Micro to Medium Enterprises.

March and May 2008 to ascertain the views of the public and businesses on the review of the existing legislation on VAT reduced rates.

While the Commission aims to discourage state subsidies in all sectors of the economy, the new Community guidelines for state aid for environmental protection published in May 2007 proposes to continue encouraging state aid for renewable energy and energy efficiency.

SECTORAL POLICIES

Appliances and Equipment Policies

Actions to improve the efficiency of energy-consuming equipment and appliances are included in the Energy Efficiency Action Plan through a twin approach:

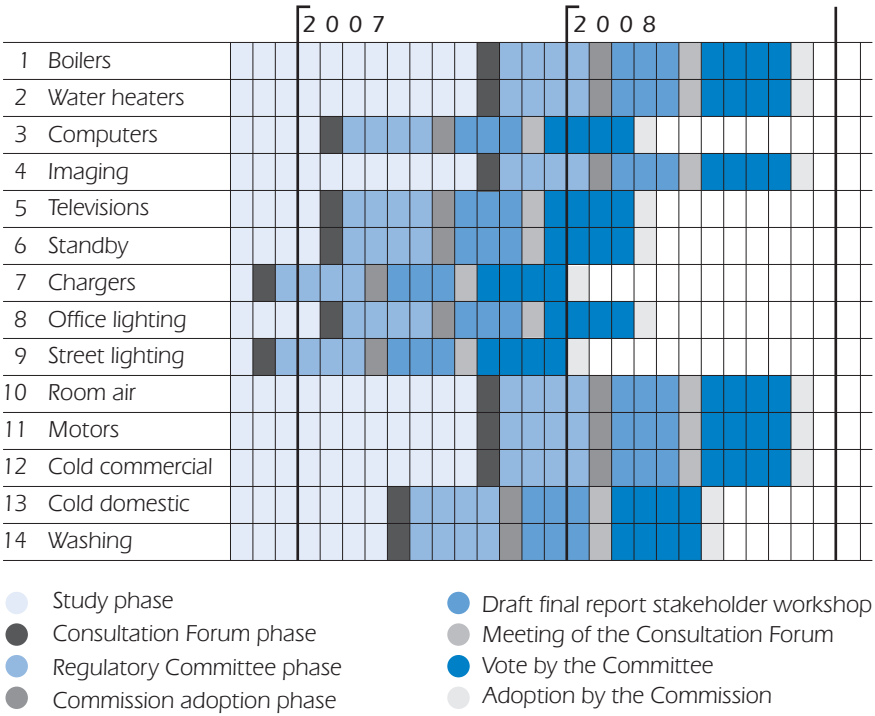
- The establishment of minimum standards to improve the energy yield of 19 groups of products (see below for details) under the Eco-design of Energy-Using Products (EuP) Directive (2005/32/EC) and
- An appropriate, consumer-focused system to label and evaluate energy performance.

The Commission has an ambitious work plan to propose implementing measures under the EuP Directive. The directive, adopted by the European Parliament and the Council in July 2005, establishes the framework for requirements governing the environmental performance of products throughout their lifecycle. Its aim is to achieve environmental protection by reducing the potential impact of EuPs, and it applies to a wide range of non-transport energy-using products, with sales in excess of 200 000 units per annum within the EU. Although improved energy efficiency is only one of the criteria to be considered under the framework, it specifically identifies low-cost measures related to GHG emissions as a priority, in view of the urgent need to meet commitments under the Kyoto Protocol. The directive requires that stand-by or off-mode energy consumption of EuPs should be reduced to the minimum. It will enable the Commission, in consultation with stakeholders including industry and member states, to establish implementing measures without further recourse to the European Parliament and to the Council. While mandatory or voluntary consumer information programmes (such as labelling) and industry agreements are included, the emphasis is placed on the establishment of minimum energy performance standards.

Fourteen products were initially identified for consideration, plus one horizontal issue, stand-by power. Subsequently a further five categories have been added to the list of potential implementing measures. Figure 27 outlines the ambitious schedule for the implementing measures for the first set of products.

Figure 27

Implementation Schedule for Energy-Using Products under the EuP Directive



Source: European Commission.

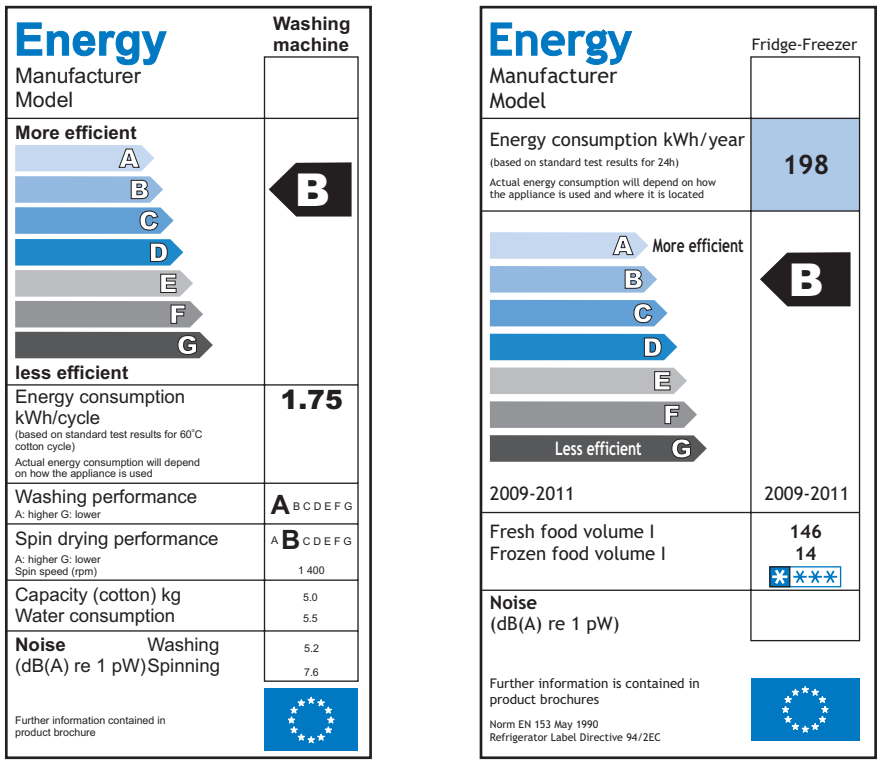
EU energy labelling is seen as a powerful tool to encourage increased energy efficiency in appliances and it is an essential complement to the measures in the EuP Directive. The EU currently has a Framework Directive (92/75/EC), as well as implementation directives relating to energy labelling. These cover compulsory energy labelling for a limited set of products, including household electric refrigerators and freezers and their combinations (2003/66/EC), household washing machines (Directive 96/89/EC), washer dryers (Directive 96/60/EC), household tumble dryers (Directive 95/13/EC), household dishwashers (Directive 1999/9/EC), electric ovens (2002/40/EC), household lamps (Directive 98/11/EC) and room air-conditioners (2002/31/EC). For office equipment (personal computers, monitors, copiers, printers) the EU makes use of the Energy Star Programme managed together with and owned by the US Environmental Protection Agency.

After more than a decade, the Commission is revising the energy labelling Framework Directive. The Energy Efficiency Action Plan required the Commission to revise the directive, beginning in 2007, to enlarge its scope to include other energy-using equipment, such as commercial refrigeration, where this

was assumed to increase its effectiveness. The provision in the Action Plan also requires that the existing labelling classifications, which have not been upgraded since their introduction, will be upgraded and rescaled every five years or when new technological developments justify it. It intends to reserve the A-label status for the top 10 to 20% of best-performing equipment. The revision will also look into compliance problems (including the testing of appliances) and issues relating to consumer confidence and involvement, which may hamper the successful implementation of the label scheme and realisation of energy savings. Figure 28 shows a proposal for a revision of the appliance energy label.

Figure 28

Comparison of the Existing Energy Efficiency Label for Washing Machines in the EU with a Proposal for Revision



Source: European Commission; CECED.

Voluntary Initiatives

In addition to the directives and regulations, the Commission did support a number of voluntary initiatives such as the EICTA Self Commitment on Televisions and DVD Players, CECED Self Commitments on refrigerators and

freezers, washing machines, dishwashers and electric water heaters. Although some of these unilateral voluntary commitments on energy efficiency were successful, the industry associations announced they would not continue with voluntary agreements for three main reasons:

- Increased competition;
- Lack of support from member states;
- Poor enforcement of energy label directives.

Public Procurement

Recognising that the procurement of energy-efficient equipment and appliances by public institutions is one way to stimulate a market for energy-efficient products, on 10 July 2007 the European Council adopted a new regulation for implementing the EU-US Energy Star programme in the EU. It requires EU institutions and the relevant member state government authorities to use energy efficiency criteria no less demanding than those defined in the Energy Star programme when purchasing office equipment. This is the first time that the Council and the European Parliament have set mandatory energy efficiency criteria for public procurement. The Commission has also developed a handbook for guiding energy-efficient public procurement.

Residential and Commercial Buildings

Significant energy efficiency potential remains in the EU building stock. This potential is targeted by the Energy Performance of Buildings Directive (EPBD) (2002/91/EC) which has been in force since January 2003, and which had to be transposed by 4 January 2006 (with a possibility for up to 3 years justified extra time for some of its obligations). The directive promotes the improvement of the energy performance of buildings through five key requirements to be implemented by the member states, which should, according to the document [COM(2004)366], deliver potential emissions reductions of up to 20 Mt CO_2-eq. by 2010 in the EU15:

- A general framework for guiding the calculation of the integrated performance of buildings (Article 3) and the establishment and regular review of minimum energy performance standards (Article 4);
- The requirement for minimum energy efficiency for new buildings (Article 5);
- The requirement for minimum energy efficiency for the refurbishment of large existing buildings (>1 000m^2) (Article 6);
- Energy efficiency requirements for the refurbishment of large buildings (>1 000m^2) (Article 6);

- The requirement for energy certification of buildings when buildings are constructed, sold or rented (Article 7); and
- Inspection and assessment of heating and cooling installations (Articles 8 and 9).

The EPBD is currently being recast under its Article 11. According to the Energy Efficiency Action Plan, the recast will attempt to substantially reduce heat loss in buildings by extending the scope of the directive to cover smaller buildings, to develop minimum performance standards applicable to new and renovated buildings, and to promote so-called passive buildings.

One significant challenge to the implementation of the EPBD has been its rate of transposition by member states. By May 2008, more than two years after the target date, only five member states had properly transposed the directive.

The Commission will also consider proposing EU minimum performance requirements (kWh/m²) for new and renovated buildings and some components, with a target for new buildings to approach the level of passive houses by 2015.

Industry

One of the main instruments for promoting energy efficiency in industry is the EU-ETS. It covers CO_2 emissions from energy-intensive sectors, such as heavy industry and the power sector. The incentive for energy efficiency in ETS sectors will increase as future allocations of emission credits reduce.

In addition to the ETS, the Commission has two other prominent programmes aimed at industry. First, to improve energy efficiency in industrial installations, a horizontal Best Available Techniques Reference Document (BREF) has been drafted under the Integrated Pollution Prevention and Control Directive (96/61/EC). This horizontal BREF is one of several such documents planned, and it is scheduled for adoption in the near future.

The Commission also has a supporting programme for voluntary action on efficient motor systems. The Motor Challenge Programme is an initiative launched in February 2003 to aid industrial companies in improving the energy efficiency of their electric motor-driven systems. It is a voluntary action programme, in which companies are free to decide whether they want to join or not, and which allows participants to withdraw from the programme at any time without any prejudice. The programme focuses on compressed air, fan and pump systems, for which a large technical and economic potential for energy savings has been demonstrated. The core of the programme is an action plan by which a participant commits to undertaking specific measures to reduce energy consumption. The participant determines which production sites, and which types of systems,

are covered by the commitment. The scope of the commitment is flexible, and can be limited to a single shop, or may include all of the company's European production sites.

Transport

The Commission's transport energy efficiency policies focus primarily on private vehicles for several reasons. Private vehicles account for a significant proportion of CO_2 emissions (about 12% of the total). The recent rise in oil prices has provided an even greater need to focus on vehicle fuel efficiency. Furthermore, according to the Commission document [COM(2007)19], the significant improvements in vehicle fuel efficiency technology have not been sufficient to neutralise the effect of increased traffic and car size (see also previous section on Climate Change).

The past policy approach to promoting energy efficiency in private vehicles has been based on three pillars, allowing for the comprehensive integration of measures addressing both supply and demand, as proposed by the Commission in 1995 [COM(95)689]:

- The car industry's voluntary commitments;
- Consumer information;
- The promotion of fuel-efficient cars via fiscal measures.

In 2007 the Commission released its document *Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles (Review of historical performance)* [COM(2007)19]. In the report, it acknowledges that the 1995 Strategy has had mixed results. Specifically, it registers growing concerns regarding progress under the voluntary approach. With respect to consumer information, the Commission points to the Labelling Directive (1999/94/EC) relating to the availability of consumer information on fuel economy and CO_2 emissions of new passenger cars, stating that while this is a useful tool in raising awareness, its impact has not been visible, because of strong variations in label quality between member states. Similarly, regarding taxation, the Commission states that the level of implementation has been disappointing.

As a result of this review, the Commission now plans to adjust its policy mix, and to set a binding target to reduce car emissions to achieve the threshold of 120 grams of CO_2 per kilometre (gCO_2 per km) by 2012. It also intends to address the issue of car components, such as air-conditioning and tyres, in particular by issuing a European standard for rolling resistance and by promoting tyre pressure monitoring. Moreover, strengthening the rules on vehicle labelling will help to promote the most energy-efficient vehicles, as will proper awareness-raising campaigns and public authorities purchasing clean vehicles. The Commission therefore, on 19 December 2007, proposed legislation

titled *Proposal for a Regulation of the European Parliament and of the Council setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles* [COM(2007)856]. It sets the limit of CO_2 emissions per km, the first time that an efficiency standard for vehicles is introduced in the EU. The draft legislation defines a limit value curve of CO_2 emissions allowed for new vehicles according to the mass of the vehicle. The curve is set in such a way that a fleet average of 130 gCO_2 per km is achieved. The legislation is set to ensure that a manufacturer's measured fleet average emissions are below the limit value curve by 2012, at which point all vehicles manufactured and registered in a given year by the manufacturer in question are taken into account. This means that the level of emissions by heavier cars will have to be improved proportionately more than lighter cars compared to today. Manufacturers will still be able to make cars with emissions above the limit value curve provided these are balanced by cars which are below the curve as long as the fleet average remains at 130 gCO_2 per km. Manufacturers' progress will be monitored each year by the member states on the basis of new car registration data.

The proposal also includes an incentive for manufacturers to meet the CO_2 emission target. The Commission proposes imposing an excess emissions premium if a manufacturer's average emission levels are above the limit value curve. This premium will be based on the number of grams of CO_2 emitted per kilometre by which an average vehicle sold by the manufacturer is above the curve, multiplied by the number of vehicles sold. A premium of EUR 20 per gCO_2 per km has been proposed in the first year (2012), rising to EUR 35 in the second year, EUR 60 in the third year and EUR 95 by 2015.

The Commission is also proposing to revisit the Vehicle Labelling Directive (1999/94/EC) and is currently carrying out an impact assessment for a revision of the Car Labelling Directive (1994/94/EC).

With regard to enhancing the energy efficiency impact of taxes on passenger cars, the Commission proposes a range of measures, even though it appears that progress with the vehicle taxation issue is hampered by several significant institutional barriers. Measures proposed are:

- Phasing out car registration taxes over a transitional period of five to ten years;
- Establishing a system for reimbursing registration taxes for passenger cars registered in one member state and then exported or permanently transferred to another member state;
- Introducing an element linked to CO_2 emissions into the taxable amount of road or annual circulation tax (ACT) and registration taxes.

While other transport modes are less prominent than private vehicles with respect to their CO_2 emissions, the Commission still recognises the potential for improving their energy efficiency. Accordingly, the Energy Efficiency Action

Plan includes a range of initiatives focusing on other transport modes. These include studies into the viability of extending the EU-ETS to the air transport sector, improving the air traffic control (SESAR) to increase efficiency, implementing the third rail package, and connecting ships to the electricity network when in harbour. It is also expected that at least some TEN-T projects will contribute to achieving modal shifts, in particular the high-speed rail corridors, which could lead to travellers shifting from plane to train use.

Furthermore, urban transport was the subject of the Green Paper *Towards a new culture for urban mobility* (COM 2007/551) adopted on 25 September 2007. Its aim is to pool experience to encourage the use of alternatives to car transport, such as public transport, non-motorised transport and teleworking. An Action Plan on Urban Mobility is now being prepared, to be presented in October 2008.

EDUCATION AND AWARENESS

Consumers' purchasing decisions influence the success of the energy efficiency policies. The Commission therefore plans a number of educational measures to raise public awareness of the importance of energy efficiency, including education and training programmes on energy and climate change issues. It also proposes to organise a competition to reward the most energy-efficient school in the EU. In addition, it considers that public authorities should set an example. The Commission itself plans to obtain EMAS certification for all the buildings it owns, and then to extend the initiative to all EU institutions. Furthermore, the Commission plans to adopt guidelines on tenders and to set up networks for cities to exchange good practices concerning energy efficiency in urban areas.

ENERGY EFFICIENCY BUDGET

Within the Commission, energy efficiency issues are principally covered by two units in the Directorate-General for Transport and Energy (DG TREN). One unit is responsible for general energy efficiency co-ordination and energy efficiency policies on the demand side, energy performance of buildings as well as the promotion of end-use efficiency and energy services, and on the supply side, energy efficiency in co-generation; it also covers international co-operation issues on energy efficiency. The second unit deals with the energy efficiency of products, eco-design of energy-using products and energy labelling of household appliances. The two units consist of 33 members of staff of which four are administrative staff.

The Commission has allocated EUR 15.2 billion from the Cohesion Funds for investments in renewable energies and energy efficiency. In particular, the 2007 to 2013 programmes for EU27 make provision for supporting with EUR 6.2 billion the promotion of clean public transport, of EUR 4.8 billion for renewable energies and of EUR 4.2 billion for improving energy efficiency.

MONITORING AND EVALUATION

Impact assessment, monitoring and evaluation are to be an integral part of the Commission's energy efficiency policy process. Any new policy, revisions or recasts to existing policies must be accompanied by an impact assessment report. These reports are themselves reviewed by the Impact Assessment Board within the European Commission.

There is no general requirement to undertake an *ex post* evaluation of directives or Commission policies. However, monitoring requirements are usually written into the relevant directives. For example, articles 14 and 15 in the ESD outline in detail how the national energy efficiency action plans will be evaluated and the process for reviewing the overall energy services framework.

AIR POLLUTION

Air pollution was one of the early areas of the Commission's energy and environment policy, and pollution control legislation is now affecting transport and power generation in particular. Most affected are coal-fired power stations, in particular because of the legislation restricting SO_2 emissions. In the area of transport, NO_X and particles are being controlled, with implications for diesel vehicles.

The most important policy instruments affecting the energy sector are the Integrated Pollution Prevention and Control Directive (IPPCD, Directive 96/61/EC, as amended), regulating a broad range of industrial and agricultural activities as well as the Large Combustion Plant Directive (LCPD, Directive 2001/80/EC, which has replaced the old LCP Directive 88/609/EEC from 1988), setting out minimum requirements for emissions to air from these plants. Industrial installations covered under the IPPC Directive are responsible for 83% of the EU's SO_2 emissions, 34% of NO_X emissions, 43% of dust and 55% of volatile organic compound (VOC) emissions, according to the Commission.

Under the IPPC Directive, installations have to be constructed and operated according to permit conditions based on Best Available Techniques (BAT). Following an intensive information exchange, the Commission adopts the so-called BAT Reference documents (BREFs) which determine what is considered BAT at EU level for a particular sector. Competent authorities have to take into account the relevant BREFs for determining permit conditions generally or in specific cases. A BREF on Large Combustion Plants was adopted in 2006 by the Commission.

Under the LCP Directive, emissions to air of SO_2, NO_X and particles from thermal installations with a capacity above 50 MW are regulated. New plants (licensed after 1 July 1987) had to comply with the emission limit

Figure 29

Schedule for the Introduction of the New Directive on Industrial Emissions

December 2007	Proposal for a Directive of the European Parliament and of the Council on industrial emissions (Integrated Pollution Prevention and Control, IPPC) adopted by the Commission on 21 December 2007.
December 2010	Completion of the co-decision process and publication of the Directive on Industrial Emissions (IED) in the *Official Journal* on 12 December 2010 (indicative).
	Directive on Industrial Emissions (IED) enters into force in 01 January 2011 (20 days after publication in the *Official Journal*).
July 2012	Member states fully transpose IED by 01 July 2012 (18 months after entry into force). IED applies to all **new** installations from this date onward except for large combustion plants (LCPs).
January 2014	All existing installations previously subject to IPPC, Waste Incineration, Large Combustion, Solvent Emissions and Titanium Dioxide Directives, must meet the requirements of IED by 01 January 2014 (3 yerars after entry into force) except for LCPs.
July 2015	All **existing** installations for **newly prescribed** activities must meet the requirements of IED by 01 July 2015 (4 years and 6 months after entry into force).
January 2016	The Large Combustion Plants Directive is repealed. Large combustion plants must meet the minimum requirements set out in Chapter 2 of IED by 01 January 2016. Permits for such plants must also take account of the revised LCP BREF through permit revision.

Source: European Commission.

values of the directive immediately. Existing plants were given time until 1 January 2008 either to comply with the emission limit values or to be subject to a national emissions reduction plan, setting overall emission ceilings for all plants covered by it. Plants which are operated not more than 20 000 hours between 1 January 2008 and 31 December 2015 may opt out under the directive, meaning that the emission limit values or requirements under a national plan will not apply to them.

In December 2007 the Commission adopted a proposal for a recast of the IPPC Directive, including among other directives the LCP Directive, strengthening the application of the BAT and containing new minimum emission limit values for large combustion plants foreseen to come into force by 2016. The recast is expected to result in further significant reductions in emissions.

CARBON CAPTURE AND STORAGE

Carbon capture and storage (CCS) is a key policy for the achievement of EU climate change targets, as acknowledged by the January 2008 climate change policy communications of the Commission. As part of the sustainable energy package published on 23 January 2008, the Commission proposed a directive to enable environmentally safe capture and geological storage of carbon dioxide in the EU.

The communication regarding this proposed directive on CCS [COM(2008)18] – see Box 9) endorses CCS and also removes some obstacles by refining the regulations to a significant extent. Two other key steps relating to CCS were taken with the proposed sustainable energy package: first, it expanded the Commission's guidelines on when member states are permitted to subsidise industries to allow for the potential inclusion of CCS; secondly, the Commission confirmed in the proposed directive that the current ETS, before 2012, can recognise CO_2 captured and safely stored as not emitted, enabling early demonstration plants to benefit from credits. It also stipulates that all combustion plants with a capacity of 300 MW_{th} or more will be required to have space for the installation of CCS and developers will be required to assess the availability of suitable storage sites and transport facilities, alongside the technical feasibility of retrofitting CCS, prior to permitting.

CCS is currently not the subject of a separate R&D programme but is rapidly emerging as a key technology in the long-term low-carbon energy scenarios, and it is one of the nine thematic areas of the Seventh Framework Programme (FP7, see Chapter 8), and also one of the six technologies favoured by the Commission in its Strategic Energy Technology Plan (SET Plan, see Chapter 8). Investment requirements to bring CCS to market are substantial. According to the Commission, around EUR 1 billion will have to be spent between now and 2020 on R&D activities to bring CCS technologies to a state in which they

can be widely deployed commercially. The funding does not include the CCS demonstration projects required to deploy commercially the technology, and the Commission is recommending funding at the member state level.

Box 9

The Draft Directive on CO_2 Storage

The proposed directive on CO_2 storage outlines legislative measures for aiding the environmentally safe capture, transport and storage of CO_2, including:

- Measures to establish a legal framework for site selection and the issuing of permits for site exploration and CO_2 storage: these measures would deem sites suitable if they pose no significant risk of CO_2 leakage or of any adverse environmental or health impacts. Permits issued by the Commission will be required prior to any site exploration and also prior to commencing any CO_2 storage operation.
- Criteria for the characterisation and assessment of storage sites: wide-ranging criteria covering the geological characteristics of potential sites, proximity of sites to CO_2 sources, local population distribution, interaction with valuable natural resources and leakage potential. These criteria are designed to assist with risk and environmental impact assessments, as well as to establish economic viability.
- Legislation on site operation, closure and post-closure obligations: includes definitions of what constitutes an acceptable CO_2 stream for storage, requirements for monitoring, reporting and inspections of sites, measures for dealing with unexpected leakage, procedures for closure, and post-closure obligations. There is also a requirement that operators of CO_2 storage sites provide adequate financial security to cover closure and post-closure obligations.
- Third-party access to storage sites: guidelines are provided for third-party access rights to transport and storage facilities which should not be unduly withheld.
- Confirmation that CO_2 stored underground will not count as emissions: emission credits from the ETS will not be required for any CO_2 stored underground. However, any leakage from a site will be classed as additional CO_2 emissions and operators must surrender matching allowances and take corrective measures.

The Commission is also involved in international capacity building efforts, as well as in CCS demonstration projects in China through the Near Zero Emission Coal (NZEC) initiative.

CRITIQUE

OVERVIEW

An integrated climate change policy covering all aspects of energy production, transport, and use, is a cornerstone of the Commission's sustainable energy policy. In reaction to growing concerns about global warming, the Commission has now presented an action plan calling for reducing greenhouse gas (GHG) emissions by 20%, increasing renewable energy supply to 20% and energy efficiency by 20%, the so-called *20 20 by 2020* plan. All the targets proposed are highly ambitious, yet they offer clear guidance and direction for energy policy and will significantly advance EU energy security and make an important contribution towards a global low-carbon energy future. Nevertheless, the Commission should proceed with caution, keeping cost-effectiveness and the impact of the achievement of the targets on other policies firmly in mind. Pursuing the targets by developing integrated and compatible policies will be the key for their achievement in a cost-effective manner.

CLIMATE CHANGE

The EU is justified in claiming leadership in international climate policy since the launch of the European Climate Change Policy (ECCP) in 2001, and it has indeed initiated a comprehensive strategy against climate change. Its post-2012 strategy has improved significantly. In 2005, the main objective was to reach out to partners and explore options for a future climate regime based on common but differentiated responsibilities; in other words, the EU was willing to take the leadership role in international climate policy, but only if the rest of the world would co-operate. Following a reassessment of the seriousness of the challenge, a major change took place in 2007, when the EU announced that it would be willing to take leadership and to adopt a strong commitment to GHG reduction, even if the rest of the world would not co-operate, while it proposes at the same time to take on an even greater share of the burden if international co-operation could be achieved. The Commission's policy proposal for a 20% reduction of GHG emissions by 2020, and a commitment to extend this to 30% in case of global co-operation, is a strong signal that the EU is willing and able to show worldwide leadership in the mitigation of climate change, and reflects a serious intent to fully integrate energy and climate policies. The main message delivered by this decision was that a unilateral move on GHG reduction, with a noticeable global impact, is possible. This development is laudable since it adds a strong incentive to the international negotiations.

The Commission also considers that market-based instruments should play a key role in the future international system, and through its announcement of the new goals it ensured long-term liquidity in the nascent global carbon

market, by assuring demand for prospective suppliers of GHG abatement projects. At the same time, the possible constraint on project-based credits in the EU-ETS post-2012 indicates that the EU also seeks to involve developing countries more closely in climate change efforts to meet this large challenge, instead of just seeing them as project credit providers. The reaching out to partners thus continues to be high on the political agenda of the Commission, which is recognising that international climate policy without the participation of other major emitters is difficult. This commendable policy should be continued and reinforced.

Depending on the outcome of the international negotiations, the proposed GHG abatement targets could be either for a 20% or a 30% reduction of GHG emissions by 2020, compared to 2005. The prospect of the 30% target without detailing the policy amendments necessary to achieve it creates a significant degree of uncertainty for investors. Until these policy amendments are elaborated, this uncertainty for the energy industry and investors remains, and this is a problem in an industry where it takes more than 10 years to build the infrastructure to meet public policy targets and company strategic expectations. The Commission should therefore seek to remove this uncertainty by outlining quickly and in sufficient detail what measures would be required by whom to reach the 30% reduction.

The keystone of the Commission's environmental policy in the energy sector is the EU Emissions Trading Scheme (ETS), which has been implemented successfully. It is a market-based tool that complements the internal electricity market well, and owing to its nature, it could eventually be linked to systems beyond the borders of the EU. Some of this integration has already happened through the possibility to use credits from Kyoto flexible mechanisms, and this is highly commendable.

While the start of the EU-ETS was difficult, the lessons of the initial pilot phase have arguably been learned. Considering the scale of the challenge to implement the ETS, it is arguable that the Commission has done very well indeed, and it should be commended for this. It has shown commendable willingness to adapt the scheme in the light of experience gained. For example, the current framework of the EU-ETS includes features such as a predominantly free allocation of allowances or varying provisions for new entrants across the member states, and has suffered from over-allocation due to poor data quality, and from the initial compromises that needed to be made in order to launch the scheme. All of this inappropriately distorted incentives to energy users and producers. The Commission is now laudably proposing that these features be modified from the next phase of the ETS beginning in 2013. Concerning the current phase of the ETS, the determination shown by the Commission in the decision to cut back member state allocation plans for the period 2008 to 2012 is highly commendable, since it reinforces the credibility of the EU-ETS. Even more importantly, the proposal to remove

the national allocation plans (NAPs) from 2013, and to move to a single allocation at EU level is very welcome, since it will help to increase investor security, avoid conflict between the European Commission and the member states, and eliminate the incentive for a "race to the bottom" that exists with the current NAP system. The Commission is strongly commended for choosing this approach.

The Commission is also commended for making this early proposal on the future of the ETS. It will provide energy producers and users with some degree of certainty regarding their investments beyond 2013. Particular aspects of the proposals, such as the proposed adoption of an EU-wide cap, the move towards full auctioning from 2013, as well as the intent to provide protection for industries threatened by competition from outside the EU, are also highly laudable. At the same time, the proposed reduction in the overall cap of emissions from trading sectors, of 21% below the 2005 level by 2020, is highly ambitious, but certainly in line with the overall environmental and energy policy pursued by the Commission. The proposals for this next phase put a strong emphasis on reducing GHG emissions in a stable and clear framework, and are very welcome. In addition, the move to adjust the baseline is commendable, because it puts the foundation of the next phase of the policy onto a robust database of emissions, further underlining the serious approach that the Commission is taking.

In the case of industries subject to considerations of leakage, care should be taken by the Commission to establish the rules for exemption and to phrase these in such a way that no distortion in fuel-use/energy-delivery choices occurs because of it. Speeding up the currently proposed schedule for the development of these special rules should be considered to increase investor security. Owing to the relatively low CO_2 emissions of the EU energy sector and industry, compared to those of other parts of the world, leakage may be a real concern not just in terms of a specific industry's loss of competitiveness, but also in terms of addressing global emissions.

The EU-ETS only covers 48 to 49% of the EU's CO_2 emissions or 40% of GHG emissions in the industrial and power generation sectors, where achieving savings is most cost-effective. Nevertheless, it is important not to regard the EU-ETS as a panacea for energy efficiency improvements in the EU, and to continue to focus on improving energy efficiency policies in non-trading sectors by continuing to ensure that member states pursue appropriate policies in the non-trading sectors pre- and post-2013. While the Commission's 2007 report on progress towards meeting the Kyoto objectives shows that the EU is moving closer to achieving its targets, there is no doubt that additional initiatives need to be adopted and implemented swiftly to ensure success. The latest projections show that to reach the targets for 2020, the EU will have to put emissions on a much steeper reduction path after 2012. This underlines

the need for the EU and member states to agree on the policies and measures set out in the energy and climate change package as soon as possible, and to rapidly move to implement them.

RENEWABLES

The target of 20% of energy supply to be obtained from renewable sources is ambitious, and the EU energy industry may well be stretched to the limit when it comes to deliver it. There is also a need to ensure that such growth does not distort other policies outlined by the Commission, most importantly electricity market reform, where the addition of significant levels of electricity production that are not subject to market trading could have a negative impact on liquidity and market development. Preventing this from happening is crucial for the overall balancing of sustainability, costs and security of supply. Care should therefore be taken to ensure that the target is pursued taking into account parallel policy developments.

While the proposed target does include heating, cooling, and transport energy supply and use, a large part of it will most likely be delivered by renewable electricity because of the superior economics and greater ease of implementation of this form of renewable energy production. This will therefore require a significantly more aggressive growth performance of renewable electricity (RES-E) than hitherto expected. Depending on the development of electricity demand, it could mean that renewable electricity production may account for up to 35% to 40% of all electricity production in the EU, implying that most, if not all growth in the power sector between now and 2020 will come from renewables. The most likely technology here is onshore wind, while a strong contribution can also be expected from offshore wind and a doubling of current biomass use, even though this may risk competing with biomass use for heating and transport. This will require a profound change in the way electricity grids in Europe are developed and managed.

Like the non-ETS GHG targets, the renewables target will not be pursued at EU level, but is subject to individual country targets. The Commission's impact assessment analysis identifies potential cost savings of up to EUR 8 billion per year by 2020, if full trading of certificates were implemented, compared to a case of no trading. This would be a considerable cost reduction for the achievement of the target in general. As a consequence of this assessment, the Commission proposes that trading will be possible though restrictions on trading by member states would be allowed, and it is commended for bringing it into the proposed directive. Trading of Guarantees of Origin (GOs) between countries is introduced as a voluntary option. According to the proposal, only member state governments which have achieved intermediate targets are allowed to sell GOs to other countries. The intention of this is to guarantee that trading can only begin once a certain critical mass of renewables has been deployed. Producers

of renewable electricity or heating could themselves also sell GOs to entities or governments in other member states, though such trade could be restricted by a member state if the government assessed it as a risk to national support schemes and the achievement of the targets. The proposed directive does not outline in detail how this would work, but despite the possibility for restrictions, it is nevertheless expected that trading will encourage countries with good renewable resources and deployment levels to produce more renewable energy and sell the excess to other countries that have more difficulty in reaching the targets. This approach is seen as a compromise that would ensure that countries undertake domestic action, while avoiding the cost drawback that would result from not allowing full trading. While introduction of safeguards is commendable to ensure real achievements and liquidity in the market once it is opened, it is far less clear whether the proposed possible restrictions of trade are necessary in the long term.

There are several problems with the proposed restrictions. First, the very fact that trading could be restricted and subject to bilateral agreements is contrary to the spirit on which the EU has been founded, and it will be interesting to see whether any such restriction on the trade of GOs will be upheld in court, should it be challenged. Secondly, it is not clear on what basis a member state could make the decision to restrict trading.

Despite these issues, concerns about allowing full, immediate trading are warranted to some degree, even though they may be based on an overly negative view of the impact of trading. Concerns about the compatibility of trading with existing schemes could for example be addressed by the cancellation of GOs where a renewables installation is already benefiting from a national renewables support scheme. Finally, regarding the argument about windfall profits accruing to low-cost renewables in a trading scheme, it is obvious that in the current situation in the EU, where important blocks to renewables investment exist in the form of non-economic barriers, the potential for significant windfall profits does indeed exist. However, in order to achieve the 20% target, these barriers will have to be very quickly removed or overcome in any case. Once they disappear, the argument about windfall profits will cease to have the relevance it has now, and what are now windfall profits should instead be seen as correct marginal prices set in a functioning market with low entry barriers, stimulating investment and research into lower-cost renewable solutions, thereby furthering the achievement of the target. Another important argument against the move to a trading and obligation scheme is the view that once the target is reached, or the volume comes close to it, the price for the GOs will fall to zero. While this is a legitimate concern, it needs to be seen in the context of the long-term ambitions in the area of climate change, clearly stated by the European Commission, which foresee an even more significant reduction in GHG emissions by 2050. This long-term view should give investors in renewables the necessary long-term security for their investment decisions. Finally, it is important to note that the experience

with national renewables trading schemes in the EU has not been too positive, since some national obligation-based markets in the EU have been fragile, costly, and have not achieved their intended goals. There is a range of reasons for this, including the dependence of renewables investment on effective planning and licensing provisions, equal to other large infrastructure investments, the limitation imposed by existing natural resources, and specific problems with the development and implementation of obligation-based support policies. The experience with small obligation schemes is therefore not necessarily a guide to how a larger one would perform, since a market stretching across the entire EU would be far more robust. Instead, it is more instructive to look at the development and features of the EU-ETS, since any EU-wide renewables trading scheme could emulate many of these, and significantly benefit from this experience in its development. At the same time, the Commission should continue to use all the powers at its disposal to comprehensively address non-economic barriers, and ensure that electricity market liberalisation and integration in the EU proceeds, since this will also benefit renewables development.

Overall, the Commission's intent to allow limits on the trade of Guarantees of Origin is at odds with the free-trade approach chosen in almost all other policy areas. It has the potential to increase significantly the cost of achieving the target by 2020 if trading does not develop. Also, the continued existence of national support schemes might affect the integration of renewable electricity generation into the single electricity market for many years, to the detriment of the Commission's objectives in this area. The Commission should therefore reconsider the current provision, and work to remove restrictions to the trade of GOs from the final directive, as long as certain conditions have been met, and in a time frame that allows the renewables industry to adjust, while enabling safeguards for national support schemes as appropriate. The ultimate aim should be the establishment of uniform EU targets, and the full integration of the EU-wide support system with the internal electricity market and the EU-ETS. Achieving this full integration will contribute to the effective mobilisation of all renewable resources in the EU27 in a cost-efficient framework.

A way forward would be the eventual establishment of an EU-wide renewables support system with full Guarantee of Origin tradability, based on an obligatory target, with a penalty for non-compliance, a system comparable to the proven EU-ETS. For example, governments could be asked to establish renewable action plans under which they allocate a share of the responsibility for achieving the target to energy suppliers, while keeping another share under their own responsibility, to provide space for the development of less mature technologies and smaller investors. This would create strong incentives to make the necessary investments in renewables, to search for the least costly options with existing and new technology, and to integrate renewables support fully with the liberalising internal electricity market and the EU-ETS.

Such a system would have to be implemented in stages in order not to be disruptive, to allow the renewables industry time to adjust, and to allow governments time to remove or overcome non-economic barriers. Achieving this integration could be tied either to dates when markets are opened further in GHG emissions trading, and/or to minimum achievements in the area of renewable energy production. This gradual opening should be preceded by a review of performance in achieving the target across the EU, and further opening should be subject to the result of monitoring and impact assessment. The current vision of not moving more forcefully towards this integration before 2020 is too conservative, and the Commission should reconsider it. To ensure that trading does not prevent national action, safeguards specifying a minimum amount of domestic action, along the lines of those used in the EU-ETS, could be considered.

It will also be necessary to consider what kind of support system is appropriate for renewable energy technologies not yet economic, but which are expected and required to contribute to the achievement of the long-term goals in the area of climate change. Some of these technologies may benefit from parallel developments in energy markets, for example photovoltaic electricity production could benefit from the possible move towards more flexible electricity tariffs, while others will require specific direct support on top of market incentives to overcome the barrier between the laboratory and the market, and to be able to compete in their own right. A trading system will have to provide room for these technologies to continue to be developed, and the Commission should consider this and make appropriate provisions when it develops its renewables trading policy.

A key additional advantage of elaborating such a trading system would be that enforcement would be moved from the use of the infringement procedure at interim target points to a continuous supervision of energy supply companies by the Commission, similar to the system that has been established for the EU-ETS. It is highly unlikely that the infringement procedure will be a sufficiently strong instrument to force member states to comply with the targets, because of its long and drawn out nature, its *ex post* application after a target has been missed and the inability to directly influence market actors. Even if it would eventually allow the Commission to impose penalties on a member state government for non-compliance with the renewables target, these would only apply long after the target would have been missed, and would not feed through into the electricity market. By contrast, a system such as the one outlined above would allow reconciling performance with targets on an annual basis, and direct enforcement with the governments and energy suppliers who would be responsible for the achievement of the target. The Commission should therefore give very serious consideration to replicate this system for renewable energy, to ensure that the renewables targets are attained.

The Commission has in the proposed directive commendably acknowledged that non-economic barriers have a large impact on the possibility to deploy renewables, and can in some cases cause long delays to projects or prohibit construction completely. Nevertheless, in some cases it is previous EU legislation, such as the Water Framework Directive and the Habitats Directive, which may have a direct impact on the possibility of developing renewable projects. The Commission should continue to review such legislation with a view to removing all undue barriers that will hinder the achievement of the ambitious targets, when evidence is becoming clearer on its impact. The Commission is commended for also requiring member states to report on progress in removing such barriers, and should consider a Europe-wide information campaign to help overcome public resistance to renewables, which has considerably slowed down their development in some parts of the EU.

The proposed renewables directive sets sustainability criteria for biofuels, a move which is highly laudable. Nevertheless, the way in which transport biofuels sustainability is addressed raises questions. Some have argued that using a 35% fixed cut-off will not favour more sustainable biofuels over less sustainable ones, as long as both meet the 35% threshold. However, such an incentive is expected to be introduced through a complementary measure, if accepted, in the Commission's proposal to amend the Fuel Quality Directive (Directive 98/70/EC). It will be important that such an incentive is related to the sustainability impact of different biofuels. The Renewable Energy Directive will reinforce this incentive, through the double-counting of waste and second-generation biofuels. The Commission should in particular take care to resolve the certification issues for transport biofuels without creating a cumbersome accreditation bureaucracy.

At the same time, other biomass-based technologies also have impacts on sustainability. This topic is already a concern in some EU member states, particularly where it concerns biomass co-fired in power stations. To ensure that the pursuit of the renewables target does not lead to the support of renewables that have either no positive, or even a negative impact on sustainability, the Commission should continue with its plans for developing and eventually introducing sustainability criteria for all biomass-based renewable sources, and it should ensure that, in the case of competing uses for biomass, the most effective use in environmental terms is given priority.

Open electricity markets will be the key to enabling least-cost investment in renewable electricity sources in the EU. Vigorously pursuing electricity market liberalisation will benefit renewables by ensuring investment in cross-border connections, and opening markets for balancing power and ancillary services. The Commission should therefore continue with this policy, and it should conduct and publish studies elucidating the connection between reducing the cost of attaining the renewables target, and continued liberalisation of electricity markets.

To achieve the Commission's intent of securing a wide portfolio of renewable energy technologies, increased R&D into immature technologies will be required. Renewables R&D policy will have to be included in the development of a consistent framework of deployment incentives to ensure that less mature technologies are given the possibility to be brought to marketable maturity levels. The Commission's intent to provide funding for renewable R&D both in the Framework Programme 7 and in the SET Plan is therefore very welcome.

Climate change will also have an unpredictable but potentially serious impact on the resource availability for hydro and biomass, as well as on conventional thermal power stations, even if strong mitigation measures are taken. A modelling approach of the renewable resources taking this into account, and target-setting based on such modelling, are indispensable and should be elaborated further, to ensure that investment decisions can reflect these possible future developments.

ENERGY EFFICIENCY

The Commission's energy efficiency policies are being developed within the complex and dynamic milieu of the broader energy policy and market environment of the EU, and commendable and consistent improvements in energy efficiency have been made since 1990. Still, a significant potential for energy efficiency remains untapped within the EU27. Acting from this finding, the Commission has recently increased its efforts in the area of energy efficiency policy development significantly, proposing new policies and sharpening existing ones across a broad range of sectors. The Commission should continue its efforts to improve the integration of energy efficiency into the energy policy of the EU and ensure that the implementation of energy efficiency policies is consistent with the overall goals of its wider energy policy and the organisational framework of the internal energy market.

As with overall energy policy, the Commission's mandate to engage with energy efficiency must explicitly link its policy proposals to energy security as well as environmental policy. The Commission should strive to acquire a wider remit, particularly relating to implementation in the area of energy efficiency, to ensure that policies are being implemented in a timely and consistent manner across the EU27.

In accordance with the mandate it received through the Energy Policy for Europe Action Plan, the Commission has also played an important role as leader in the international energy efficiency policy development arena. This is praiseworthy, and it should continue to take international leadership in energy efficiency, particularly in the establishment of the International Partnership for Energy Efficiency Co-operation.

The Commission has proposed a range of ambitious targets to reduce CO_2 emissions, but surprisingly, while the 2020 targets for the overall reduction in CO_2 emissions and the increase in renewable energy production are proposed to be binding, the energy efficiency target is not. The lack of an intention to make it binding is surprising, given that all European institutions are constantly reiterating the importance of energy efficiency in the policy mix. The Commission is of the opinion that the energy efficiency target does not need to be mandatory because it is subject to a range of directives that promote energy efficiency. While this is correct, the same argument should apply to the other two areas, for example the renewable energy target is also subject to a directive, yet it is binding. Considering the experience with previous indicative targets, the non-binding nature of the energy efficiency target gives rise to concerns regarding whether it will be attained. Given the importance of the energy efficiency target and its critical role in underpinning the overall ambitions, and indeed its necessity to ensure that these are achieved in a cost-effective manner, the Commission should reconsider its decision and make the energy efficiency target binding.

The EU has a significant array of directives aimed at promoting energy efficiency, but it has become clear that many of these directives as they currently stand are not capturing the full energy efficiency potential. It is thus encouraging to see that the Commission is devoting increased attention to revising several key directives and attempting to strengthen their capacity to deliver energy efficiency. Achieving the potential for energy efficiency will depend on the ability of the Commission to take full advantage of the opportunities this enhancement process presents.

In particular, the Commission is giving considerable attention to the Directive on End-Use Efficiency and Energy Services (ESD) and particularly to the development of National Energy Efficiency Action Plans (NEEAPs). It is rapidly becoming obvious that both the progress with the member states' completion of these NEEAPs, as well as the quality of their content needs urgent attention. It was therefore encouraging to see the Commission's candid review of the current state of NEEAPs in January 2008. It should continue to devote significant effort to ensuring the timely completion of high-quality NEEAPs, and take action where member states fail to act.

The Energy Performance of Buildings Directive (EPBD) is an impressive piece of energy efficiency policy for buildings. One of the innovations in the EPBD is the building certification scheme – where the EU is the first region in the world to establish mandatory requirements. Nevertheless, there is considerable room for improving the directive, and realising this, the Commission is currently engaged in recasting it. The recast provides an important opportunity to strengthen it and the Commission should be commended for initiating the process, and indeed initiating it earlier than planned. Regarding the recast, two important issues need to be addressed: first, the process of recasting

should proceed with urgency while at the same time not disrupting the ongoing, already delayed, transposition process, by diverting resources from it. Secondly, the content of the recast directive must address some crucial shortcomings of the current directive. Specifically, it should aim to achieve the following outcomes, several of which have already been identified by the Commission:

- Provide further guidance on energy efficiency levels for new buildings (Article 5) by at least providing guidance on methods to calculate the minimum energy requirements for buildings or components (for example by recommending the use of 30-year life-cycle cost);
- Remove the 1 000 m^2 limit relating to building refurbishment requirements and establish no lower limit on floor area (Article 6). This change alone would lead to an extra 250 000 jobs being created and achieve savings of 70 Mtoe and 140 Mt CO^2;
- Enhance the building certificate system (Article 7). Particular attention should be given to requiring a mandatory provision to give tenants energy building certificate rating information, to considering the status of energy efficiency recommendations in the building certificates and to harmonisation of the certification process for non-residential buildings;
- Stimulate member states to introduce financial instruments for energy efficiency improvements in buildings, in accordance with the Energy Performance Certificate Scheme recommendations;
- Establish stricter enforcement oversight within member states;
- Ensure that Energy Performance Certificates are permanently and prominently displayed in all buildings visited by the public; and
- Reflect on provisions requiring national initiatives towards high-performance buildings, such as low- or zero-energy buildings, passive houses, low- or zero-carbon buildings.

In the area of energy efficiency and labelling of energy-using products (EuPs) and appliances, it is encouraging to note that the Commission is currently taking action on minimum energy performance standards (MEPS) under the EuP Directive and revising the Labelling Directive (92/75/EC). This work should have begun years ago, and should now be pursued vigorously. Because of the delay, the EU now lags significantly behind some other OECD countries both regarding the level of its MEPS and in the area of labelling. With respect to the EuP Directive, the Commission must continue to press ahead with urgency, by establishing quickly the implementing measures for the 19 product classes, and it should also consider the extension of MEPS to further product groups as appropriate. The situation with respect to the energy efficiency labelling of products is also calling for urgent attention. In particular, there are three issues that need to be addressed: the coverage, quality and compliance with energy efficiency labelling. The Commission should continue to expand the coverage, update and improve the quality of energy efficiency labels, and ensure that

labelling issues are developed in synergy with the EuP Directive measures. One way to enhance the effectiveness of the labelling scheme is to reconsider their design in order to accommodate continuous improvement of energy efficiency levels. Because of the urgent need for action to address these issues, the Commission should complete this review as soon as possible. In order to address these issues and to improve the energy efficiency of the EU appliances, it will be important that the Commission devotes sufficient resources to establishing the EuP implementing measures, labelling improvements and to exploring ways for the member states to ensure adequate compliance.

Compliance and enforcement of energy efficiency policies, at all levels of governance, is essential to maximise the effectiveness of these policies. The Commission has now commendably started to address the compliance issue. For example, it has begun 20 infringement procedures relating to the EPBD, 21 more relating to the Eco-Design Directive, as well as 10 relating to National Energy Efficiency Action Plans. These infringement procedures should be pursued vigorously, to ensure that EU-level policy intentions are implemented across the Union. In this context, monitoring by the Commission should also include the resourcing of energy efficiency in member states, and ensure that sufficient staff is being assigned to this policy area. It is also encouraging to see that the EuP Directive explicitly addresses the enforcement issue, and similar provisions should be added when existing energy efficiency directives are being recast. Nevertheless, despite the enforcement action there is still a significant compliance gap within the EU, particularly at the local level, and outside the realm of the legal procedures available to the Commission. For example, EURIMA estimates the total cost in the EU for non-compliance with insulation requirements for new buildings to be around EUR 220 million per annum. The Commission should therefore devote increased attention to encouraging compliance with its energy efficiency policies throughout the EU. This issue needs to be addressed throughout the whole chain of policy development and implementation – both by the Commission and member states. While market surveillance and compliance is under the jurisdiction of member state authorities, the Commission can, and should, give more attention to encouraging effective and real implementation in line with its energy efficiency policies throughout the EU. Approaches that the Commission can take to encourage compliance and enforcement include:

- Conducting a study of compliance and enforcement to gauge the scale of the problem in different sectors and publish the results to raise awareness of the issue and its impact;
- Considering compliance and enforcement early in policy design. For example, during the recasting of the EPBD, the Commission could consider requiring annual progress reports from member states on new building compliance to the directive. Alternatively, were it felt that member states are already overloaded with requests for reporting, the EPBD Concerted Action and the meetings with the EPBD committee (Article 14 of the

directive) should provide opportunities for monitoring. Further work on alternative approaches to improving compliance and enforcement could also be considered, for example by conducting cross-country studies through the Commission;

- Continuing to facilitate effective implementation of directives in member states, through concerted actions and the IEE/CIP programme, such as is already done for the EPBD since 2005;
- Taking prompt legal action against those member states that do not comply with directives in terms of lack of delivery and quality of content and transposition;
- Providing guidance on good practice in compliance and enforcement, perhaps through Intelligent Energy Europe;
- Strengthening monitoring and review procedures in individual directives; and
- Strengthening the Commission's horizontal monitoring and review across directives.

Fiscal policies can directly impact on the uptake of energy efficiency, and the value-added tax (VAT) is a particular example of this. While taxation generally falls within the competence of the member states, indirect taxation such as VAT is handled at the EU level. The VAT Directive specifies that member states must subject supplies of goods and services to a rate of at least 15%. In addition, the list of products or services for which the VAT is imposed at a lower rate (with a minimum of 5%) must be agreed by all governments. The way in which the VAT Directive handles such exemptions currently permits the lowest rate of VAT to be charged on electricity and heating fuels – while at the same time preventing member states from introducing tax reductions on many energy saving measures. This means that in some EU countries there is a taxation bias in favour of energy consumption rather than energy efficiency. A short-term derogation option does exist that allows governments to charge 5% VAT on certain energy-saving measures in buildings, if they are installed by registered VAT contractors. This derogation was introduced to encourage employment in the construction industry, but unfortunately only a minority of member states is making use of it. Furthermore, even where this derogation is in force, it excludes measures which are installed through do-it-yourself work, instead of registered VAT contractors. The derogation also excludes the possibility of using the VAT system to encourage installation of more energy-efficient alternatives such as high-efficiency lighting or glazing. The Commission should quickly conclude the ongoing review of the VAT situation for energy efficiency goods and services to bring the VAT Directive into line with the EU policy goals regarding energy efficiency.

Taxation is also an instrument available to improve vehicle energy efficiency. Progress with enhancing the effectiveness of taxes on passenger cars, for example through the proposed Directive on Vehicle Taxation [COM(2005)261],

is hampered by questions of competence, and as a result, it is difficult to achieve a harmonised system for vehicle taxation. The Commission should be commended for continuing to pursue amendments to the passenger car taxation regime, and should continue to press the European Council and Parliament for the adoption of the proposed directive.

At the sectoral level, in the area of industrial energy efficiency, the Commission has achieved some important gains, particularly thanks to the coverage of large industrial installations by the EU-ETS. However, progress on energy efficiency in non-trading industrial sectors has been relatively limited. For example, in the area of stationary motors, despite the voluntary Motor Challenge Programme, the energy efficiency of motors installed in Europe lags behind that in some other parts of the world such as the United States. In this area, international experience shows that voluntary agreement programmes are useful, but not sufficient, for achieving improvements in motor energy efficiency. Similarly, there has been little policy attention focused on small and medium-sized enterprises (SMEs), which is not unusual, since many countries around the world are struggling with how to engage SMEs in energy efficiency. It is encouraging in this context to note that the Energy Efficiency Action Plan mentions the need to develop appropriate policies for SMEs explicitly but despite this, to date there appears to be little progress in this area, and the Commission should put serious consideration into how to proceed to develop appropriate policies for this sector.

In the transport sector, the Commission has made encouraging advances regarding vehicle energy efficiency since 2007. In particular, the proposed legislation introducing a limit value curve of CO_2 emissions per km for new vehicles according to the mass of the vehicle is a sensible best-practice approach in line with the IEA's G8 Summit recommendations (see Annex B), and the Commission should be praised for adopting it. Given the significant scale and rapid growth of CO_2 emissions from this sector, it is important that this policy is not diluted during the process of finalisation. To complement this proposal, the Commission could consider recasting the existing Vehicle Labelling Directive (1999/94/EC), which is considered not to have been effective. In order to maximise the potential for energy savings in the transport sector, the recommendations made by the European Parliament's ITRE Committee should be considered and, where appropriate, implemented. They were:

- To implement vehicle labelling using the A to G format used in appliance labelling; and
- That a minimum of 20% of any space devoted to the advertising and marketing of new cars should provide information on fuel efficiency and emissions.

Other aspects of vehicle energy efficiency that need policy attention by the Commission include efficiency standards for non-engine components of vehicles such as air-conditioning and tyre rolling resistance, as well as

standards for heavy-duty vehicles. The Commission has indicated that it intends to address these issues and a proposal for a regulation addressing tyre rolling resistance and monitoring of tyre pressure is to be adopted by the summer 2008.

To improve the efficiency of the broader transport system (for example through the Action Plan on Urban Mobility), the Commission will have to consider how best to use investment in transport infrastructure to encourage modal shifts towards more sustainable means of transport, and also how to increase the overall efficiency of the traffic systems. TEN-T and the SESAR project are important measures in this respect and should be utilised by the Commission to achieve overall system improvements in efficiency.

The recent increase in energy efficiency policy activity in Europe has led to increased workload and expectations – both within the Commission and in member states. Regarding the Commission, the increased workload was acknowledged in the impact assessment relating to the Energy Efficiency Action Plan, where it was estimated that an additional 20 full-time staff would be needed to ensure the successful implementation of the Action Plan. This would bring the energy efficiency policy staff to around 30 full-time equivalents. The Commission has made some changes to both the structure of its energy efficiency policy divisions and staffing numbers, and it has established a second energy efficiency policy unit within DG-TREN responsible for, among other things, the follow-up to the EU Energy Efficiency Action Plan, international co-operation in the field of energy efficiency, as well as the Directives on Co-generation and the EPBD and the ESD. Furthermore, the number of staff working on energy efficiency is being increased by adding about a dozen posts in DG-TREN. In total this will result in 18 statutory staff, supported by six detached national experts and some contract agents. While this increase is commendable, there nevertheless remains very serious concern over whether it will be sufficient to manage and support the already considerable and fast-growing energy efficiency workload of the Commission. By comparison, the US EPA has about 32 full-time equivalent staff just to manage the Energy Star Program, while the Commission employs fewer staff to cover a much broader range of policies. There appears to be a mismatch between ambition and capacity, and the Commission should urgently seek to increase the staffing in the energy efficiency policy area in line with, but not limited to, the numbers identified in the impact assessment relating to the Energy Efficiency Action Plan.

AIR POLLUTION

In the area of air pollution, the Commission is proposing a revision of the Integrated Pollution Prevention and Control Directive, combined with the Large Combustion Plant Directive. The impacts of the policy on Climate

Change and Energy (CC&E) have been considered in the preparation of the Commission's *Proposal for a Directive on Industrial Emissions*. The implementation dates and the proposed emission limits take into account the achievement of the Commission policy goals in the areas of climate change and air pollution and it does not expect that they will have a detrimental effect on the security of supply. From an investor security perspective, early clarity on the new BREF for large combustion installations would be helpful.

CCS

A particular technology challenge for the long-term development of clean energy in Europe, and in particular the achievement of the 2050 vision, is the development to market maturity of carbon capture and storage (CCS) technologies. Both to ensure a continued role of fossil fuels, in particular coal, in the EU fuel mix, as well as to reduce global emissions, CCS is a required technology. The effort and investment in developing and deploying CCS is justified because it is consistent with the EU's leadership ambitions in global climate change policy.

The regulatory system that needs to be developed to enable CCS will have to serve a dual purpose: to provide a suitable and practicable regime for the operation of CCS installations and to provide an incentive for commercial operators to deploy the technology. In this context, the proposed directive is a very welcome development because it provides much of the clarification required to make CCS a reality. It is a comprehensive approach to removing legal and regulatory barriers to investors, to gaining public acceptance and should facilitate the vision of 10 to 12 plants being built during the next decade. Also, the clarification regarding the availability of ETS certificates to CCS plants already under the current phase of the ETS is particularly welcome. With the proposal, the Commission has decided that assessing the environmental impacts of CCS falls under existing EU directives. The proposed legal framework should reduce uncertainty and encourage private-sector investment. It has also decided not to make CCS mandatory since developers will be drawn towards this technology, and other low-carbon technologies, by the price signal on CO_2 emissions under the ETS. Overall, the Commission's draft directive on CCS is a forward-looking piece of legislation that should help to enable the technology, and it will now have to be followed by rapid action on the deployment front.

Once the non-economic barriers have been removed, it will be important to consider how the Commission can help the technology move from the laboratory onto the market, and this is where the key weakness in the Commission's CCS policy persists. If CCS-equipped fossil-fuel-fired generation is to become commercially available soon after 2020, the expected 10 to 12 demonstration plants are quickly needed. In the recent proposal, however,

no budget was set aside to finance the CCS demonstration plants. Public financing for these projects is needed either from the member states or the EU, and the Commission could for example consider the innovative financing approaches introduced in the US Energy Policy Act 2005 for clean coal plants to enable the technology. Regardless of this, in addition to public financing, the EU will have to draw on considerable private investment to finance these CCS projects.

RECOMMENDATIONS

The European Commission should:

Climate Change

- *Continue to develop its ambitious climate change policy, in particular with regard to:*
  - *The need for close international co-operation;*
  - *The requirement to take a holistic and flexible approach to allow targets to be achieved in a cost-effective manner;*
  - *The need to continue to reinforce the ETS as a credible system by improving data and allocation quality; and*
  - *The possibility to link the EU-ETS beyond the borders of the Union.*
- *Aim at establishing the proposed allocation rules for industries exposed to significant risks of carbon leakage, possibly ahead of the currently intended deadline of June 2011, taking into account the need for necessary data on the industry processes and the outcome of an international agreement which may be reached at Copenhagen.*
- *Continue to develop and propose policies to ensure further reductions of GHG emissions in the non-trading sectors.*

Renewables

- *Ensure that the proposed renewables directive leads to the implementation of effective and cost-efficient renewable energy schemes in the Union.*
- *Consider developing a harmonised trading system for renewables in the EU that is consistent with the internal energy market and the ETS, gradually opening unrestricted trading. This system should aim at a progressive and non-disruptive integration of renewable energy techologies in the market.*

- *Ensure that undue non-economic barriers are removed or overcome, in particular where they emanate from EU legislation.*
- *Develop and consider introducing sustainability criteria for all biomass-based sources of renewable energy.*
- *Ensure R&D and deployment efforts are consistent with developing a broad range of energy technologies.*

Energy Efficiency

- *Continue its effort to improve the integration of energy efficiency into the energy policy of the EU and ensure that the directives are consistent with the internal energy market.*
- *Continue to take international leadership in energy efficiency, particularly in the area of establishing the International Energy Efficiency Platform.*
- *Consider making the energy efficiency target mandatory.*
- *Continue to progress and strengthen existing energy efficiency-related directives, by specifically:*
  - *Ensuring that the recasting of the EPBD proceeds urgently and enhances, rather than disturbs the ongoing transposition process;*
  - *Devoting significant effort to ensuring the timely completion of high-quality NEEAPs;*
  - *Devoting urgent attention to implementing measures under the Eco-Design Directive, and revising the Labelling Directive which needs to be modernised.*
- *Pursue the removal of taxation discrepancies between energy and energy efficiency measures.*
- *Increase its attention to encouraging compliance with its energy efficiency policies throughout the EU.*
- *Continue to pursue stringent fuel efficiency standards for all types of vehicles.*
- *Use investment in infrastructure to complement ambitious energy efficiency targets, and encourage modal shifts towards more sustainable means of transport.*
- *Urgently seek to increase the staffing in the energy efficiency policy area in line with, but not limited to, the numbers identified in the impact assessment relating to the Energy Efficiency Action Plan.*

CCS

- *Provide a clear outline for the path to demonstrating CCS in the EU, ensuring in particular that:*
  - *The proposed directive on CCS is enacted as early as possible to provide investor security;*
  - *State-aid rules and existing directives will not become a barrier to the development of CCS;*
  - *Potential public perception issues regarding CCS are overcome at an early stage and do not develop into a significant barrier.*
- *Consider innovative approaches to financing the demonstration plants, for example by studying the approach taken by the United States in the Energy Policy Act 2005 to stimulate investment in new nuclear and clean coal capacity.*

ELECTRICITY

DEMAND AND SUPPLY

Demand

During the past 15 years electricity consumption increased at a rate of 1.7% per year on average, but this development has been in several phases, with consumption moving in different directions. From 1990 to 1995, the annual average growth rate was only 1%, owing to the economic recession in Eastern Europe following the fall of the iron curtain. From 1990 to 1992 total electricity consumption in EU27 fell slightly with the steep reduction in electricity consumption in the former communist countries. Growth then increased markedly from 1995 to 2000, with annual average growth rates of 2.3% to slow down again, from 2000 to 2005, to an average annual growth rate of 1.8%. Economic growth outpaced electricity consumption growth from 1995 to 2000 with average annual real growth rates of 2.8%. From 2000 to 2005, economic growth was at par with electricity consumption growth.

This general picture is obscuring some important developments in parts of the Union, in particular the rapid growth in electricity demand on the Iberian peninsula, or the shift of consumption growth from the industrial to the tertiary sector. The EU has several large industrial nations as member states, and this is reflected in electricity consumption patterns. In 2005, about 41% of electricity was consumed in industry. This is a high share compared to IEA countries in general and, remarkably, it is a relatively small decline from the 46% share in 1990, compared to non-EU IEA member countries. It is expected that this share will now remain stable, although this expectation is subject to developments in electricity supply costs, driven by increasing fuel prices, investment in renewables, and the cost for CO_2 certificates after 2013. Growth of electricity consumption has been particularly rapid in the "Other" sector[39], where it increased considerably, both in volume and in share. The household part of this sector alone consumed about 29% of total electricity in 2005, and the expected growth in the use of appliances, especially for air-conditioning, makes it likely that demand in the residential sector will continue to increase strongly throughout the EU. Transport electricity consumption is relatively small, at only 3%, and is expected to remain stable. Table 13 gives further details on sectoral and overall consumption developments.

39. This sector includes government, households, agriculture, and the services industry.

Table 13

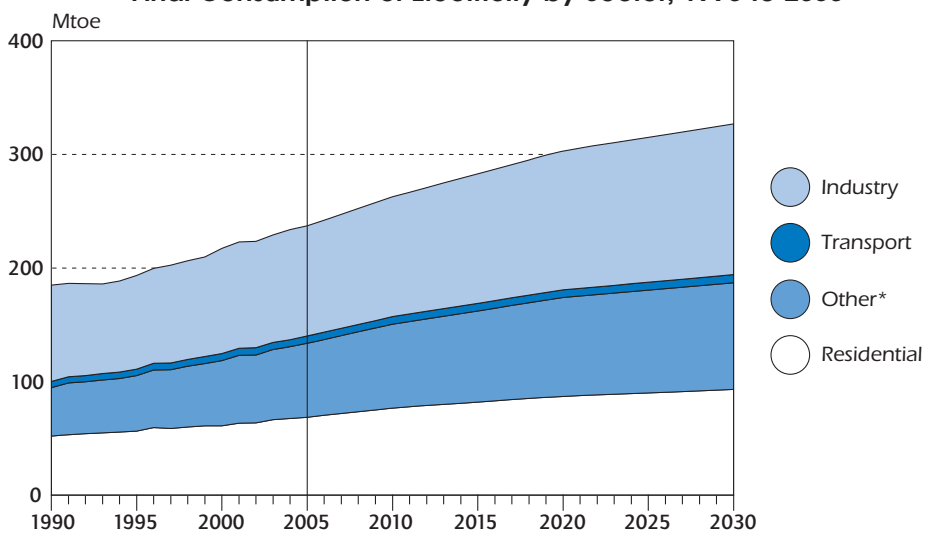
Electricity Consumption in the EU by Sector, 1990 to 2030

	Year					Change in %	
	1990	*2005*	*2010*	*2020*	*2030*	*2005/1990*	*2020/2005*
Industry sector							
Consumption in Mtoe	85	97	106	122	133	14	26
Share of industry TFC in %	19	23	24	25	26	18	10
Other sector							
Consumption in Mtoe	95	134	150	174	187	41	30
Share of TFC in %	22	27	29	31	32	20	17
Transport							
Consumption in Mtoe	5	6	7	7	7	18	5
Share of TFC in %	2	2	2	2	2	–9	–11
Total							
Consumption in Mtoe	**185**	**237**	**263**	**303**	**327**	**28**	**28**
Share in %	**16**	**18**	**19**	**20**	**21**	**14**	**12**
Industry share of TFC in %	*46*	*41*	*40*	*40*	*41*	*–1*	*–1*
Other share of TFC in %	*51*	*56*	*57*	*57*	*57*	*10*	*2*
Transport share of TFC in %	*3*	*3*	*3*	*2*	*2*	*–8*	*–18*

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

Figure 30

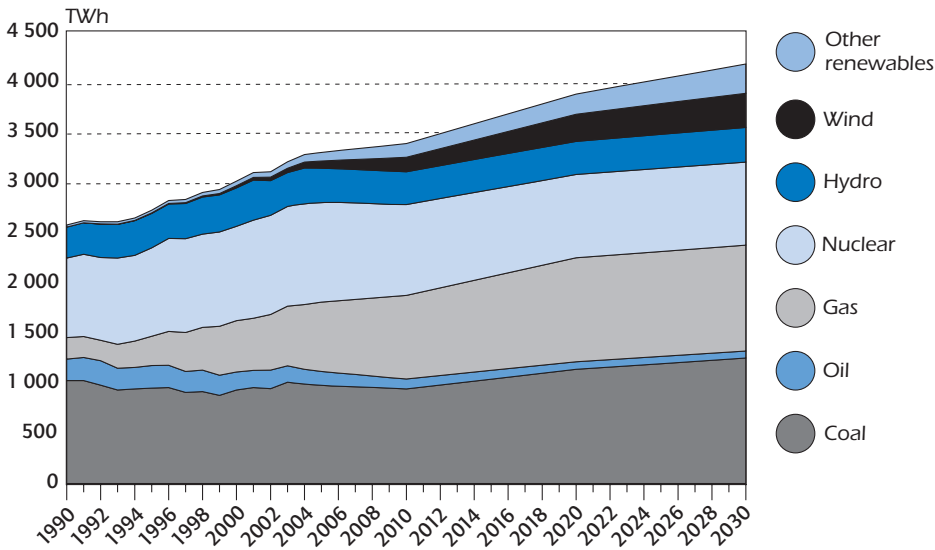
Final Consumption of Electricity by Sector, 1990 to 2030



* includes commercial, public service, agricultural, fishing and other non-specified sectors.
Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2007 and EU submission.

Figure 31

Power Generation in the European Union by Fuel, 1990 to 2030



Sources: Eurostat and EU submission.

Supply

Power generation in the European Union is well diversified. About 30% of production is from coal and another 30% is from nuclear, while the share of coal has decreased from about 40% in 1990 to 30% in 2005 (see Figure 31). Natural gas has been the main source for replacing coal-fired capacity, increasing its share from 7% in 1990 to 20% in 2005. This trend is expected to continue, with natural gas station output growing further to 25% by 2010, and becoming the second most important source of power after coal and ahead of nuclear early next decade. By 2020, gas-fired power output is expected to reach 1100 TWh per year, up from 600 TWh in 2005. Gas has also replaced oil which still played a prominent role in 1990, contributing 8% of generation, but fell to 4% in 2005. Renewable energy sources contribute the remainder. In 1990 their share was 12%, almost entirely from hydro. In 2005 the share had increased to 15%, with the importance of hydro reduced to 10% and marked increases mainly in wind power and power from biomass, each contributing about 2% in 2005. An indicative target of having 21% of electricity generation from renewables by 2010 has been set by the Commission, and it now expects that member states will fall somewhat short of that, reaching 19 to 20% (see Chapter 5).

In terms of installed generating capacity, the EU fuel mix is even more diversified than it appears when looking at generation volumes. The latter are the result of an economic dispatch of the least-cost options, and the technical ability of renewable sources to contribute. Installed capacity indicates the level of flexibility to respond to changes in resource conditions. In 2005 coal and gas capacity shares were at about the same level as their corresponding shares of power generation output. Nuclear power only represented 18% of installed capacity but generated 30% of power. This corresponds to an average capacity factor of 84%, a marked increase from the average nuclear capacity factor of 72% in 1990, indicating the progress made in increasing the economic performance of the plants. Average coal and gas capacity factors are both at 54% in 2005. This reflects that some coal plants are old and see little utilisation, but are still present as a source of flexibility. Gas plants are often used as mid-merit plants, with utilisation rates varying with the price of gas. Capacity factors from hydro plants are relatively stable, depending on precipitation levels. Hydro is an essential source of short-term flexibility but will depend on precipitations to deliver seasonal flexibility. Wind power is obviously also fully dependent on wind resources. Hence, seasonal flexibility to meet changes in resource or demand conditions will have to come from coal-, gas- and to a certain extent biomass-fired plants.

In terms of capacity addition and replacement by technology, from 2000 to 2007, wind provided 37% of capacity addition and replacement capacity in the EU.

In 2007 alone, 11.5 GW of net new natural gas capacity was added, and from 2000 to 2006, net capacity additions stood at 92 GW, roughly equivalent to the total generating capacity of the United Kingdom. Gas-fired power plants have many advantages in their own right, including relatively small size and low capital cost, hence minimising risk, plus a smaller environmental and greenhouse gas footprint, compared to coal. Their flexible operation makes it the preferred choice to meet Europe's increasingly peaky and seasonal power demand, and also the obvious technical and economic choice to back up intermittent renewables generation such as from wind. Because of these characteristics, gas has become the preferred choice for new thermal power plant investment in most EU countries, and in several cases where build of new nuclear plants is formally prohibited, and coal plants are difficult to develop, gas is the default option.

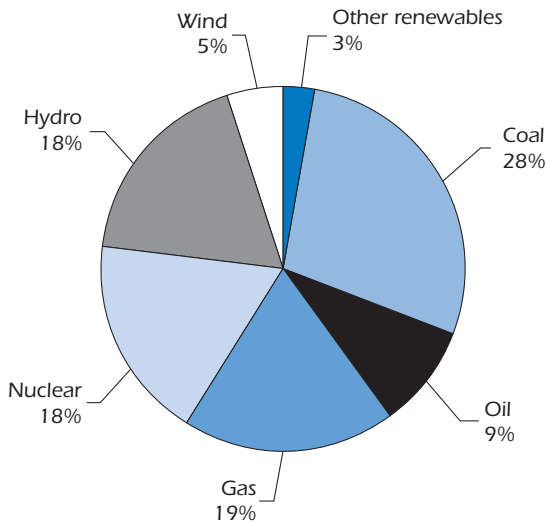
From 2000 to 2006, net capacity of nuclear power generation has reduced by 2.6 GW in the EU. There will also be no significant new nuclear capacity before 2011, when the new Finnish reactor is expected to be commissioned. Later in the next decade, a new French reactor currently under construction will come on line, while there are expectations that some new reactors

may begin generating towards the end of the next decade in Great Britain. Over the next decade these additions, even when combined with capacity increases at some existing reactors, will not suffice to reverse the trend of declining nuclear power generation capacity in the EU because of the parallel decommissioning of significant capacity in a number of member states.

Coal capacity also reduced by 11 GW since 2000. Increasingly demanding environmental performance standards from the Large Combustion Plant Directive (LCPD – see Chapter 5 on Air Pollution), together with the expected impact from the move towards full auctioning in the next phase of the ETS (see Chapter 5), will put pressure on the economics of investment in new coal plant for as long as carbon capture and storage is not a commercial technology.

Figure 32

Installed Capacity in the European Union by Fuel, 2005



Sources: IEA data and Eurostat.

The increasing share of wind power, competition and trade within and across regions, pressure from the EU-ETS since 2005, and most importantly the preference for highly-efficient gas turbine plants, have significantly increased the efficiency of power generation in the EU27 between 1990 and 2005, despite the accession of some new member states with relatively inefficient power generation. It is expected that this trend will continue, with the remarkable result that loss volumes are assumed to stay relatively constant,

while production volume is increasing considerably. Table 14 outlines the expected development based on pre-January 2008 modelling, therefore not taking into account the ambitious renewables targets proposed by the Commission.

Table 14

Power and Heat Generation Efficiency in the EU27, 1990 to 2030

	1990	*2005*	*2010*	*2020*	*2030*
Efficiency	34%	38%	38%	38%	42%
Change	n/a	12%	0%	1%	8%
Cumulative change	n/a	12%	12%	13%	23%
Total losses in Mtoe	431	451	431	431	432
Production volume increase compared to 1990 in %	n/a	27.5	39.6	59.9	72.1
Loss volume increase compared to 1990 in %	n/a	4.7	0.2	0.0	0.3

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

INDUSTRY STRUCTURE

Overview

The European electricity industry employs more than 700 000 people directly, and is one of the largest industries in the EU. A transformation of the industry has taken place during the past decade, owing to technological change, and the introduction of the Commission's first Electricity Market Directive in 1996 (see Chapter 3). Monopoly network parts have been unbundled at varying paces and to varying extents and considerable merger and acquisition activity has taken place in several countries, some involving cross-border mergers and acquisitions, in which European utilities are now beginning to emerge (see Table 15).

The electricity industry in the EU is highly concentrated, at both EU and member state level. As Table 15 shows, the 7 largest utilities in the EU had total sales corresponding to 72% of total demand in 2006. The same companies produced 49% of total generation and owned 49% of total installed capacity. According to the Commission, generation markets in Belgium, France, Estonia, Ireland, Greece, Portugal, Latvia, Slovenia and Slovakia were highly concentrated in 2005.

The retail market for sales to final customers is slightly more concentrated than the generation market. This picture is reinforced when looking at the market position of the largest European utilities. Several of these utilities also have other activities, most notably gas, making them significantly more important in terms of their role in the EU energy sector.

Table 15

Power Generation and Sales in the EU by the Seven Largest European Utilities, 2006

Company	*Sales TWh*	*EU market share in %*	*Generation TWh*	*EU market share in %*	*Capacity GW*	*EU market share in %*
EDF[1]	635	23	643	19	134	18
E.ON	369	13	195	6	46	6
RWE	312	11	224	7	43	6
Vattenfall	200[2]	7	165	5	35	5
Endesa	162	6	124	4	33	4
SUEZ/Electrabel	157	6	136	4	30	4
Enel	152	6	129	4	50	7
Total (7 largest companies)	**1 987**	**72**	**1 616**	**49**	**371**	**49**
Total EU[2]	**2 756**		**3 310**		**757**	

1. Including EnBW in Germany (45.1% stake) and Edison in Italy (51.58% stake).

2. Data for 2005.

Sources: Company annual reports for 2006.

Distribution and Supply

According to Eurelectric, the association of the European electricity industry, there were almost 3 000 distribution companies in the European Union in 2003. Consolidation has continued since then, but there are still a high number of relatively small distribution companies in some member states. In 2003 there were 5 distribution companies or more in 15 EU countries. According to the Commission, there were 85 companies in the EU with a 5% market share or higher in each country in 2005. In 7 countries there is only one company with a market share higher than 5%. In 12 out of the EU25 countries the three largest companies had a retail market share of 90% or higher in 2005. The distribution and retail supply part of the sector has a very high number of companies, but relatively few large companies have very high market shares in half of the EU countries.

The second Electricity Market Directive currently in force includes requirements for all distribution companies with more than 100 000 customers to unbundle network activities at distribution level from sales and generation. The unbundling can be by either legal or functional separation of network activities. However, according to the Commission, only 6 countries complied fully and unambiguously with the distribution network unbundling requirements by the end of 2005.

Transmission and System Operation

The second Electricity Market Directive requires legal separation of transmission system operators (TSOs) to ensure that they operate independently from generation and supply interests, and enable fair and open access to the transmission grid. More than half of the EU member states have chosen to fully unbundle TSOs through ownership separation. According to the Commission, only 16 countries (including Norway) had unambiguously and effectively implemented unbundling requirements for transmission system operation in 2005.

European TSOs have a long tradition of co-operation at regional level and beyond. All of them, including those in the United Kingdom and Ireland, have formed the association of European Transmission System Operators (ETSO) to facilitate co-operation on European Union issues, including cross-border trade. Within UCTE (see Chapter 4), a system of operational agreements has developed. Since the large blackout in Italy in 2003, the agreements have been more detailed, formalised and contractually binding. In the Nordic region, the TSOs have formed Nordel, which is the platform for co-operation on operation, market design issues and network planning.

Generation

A total of 104 generation companies had a national market share of installed capacity above 5% in 2005 in the EU, according to the Commission. In terms of generation output, 90 generation companies had national market shares above 5% in 2003 according to Eurelectric. In seven countries, the 3 largest generators had national market shares above 90% in 2005.

NUCLEAR ENERGY

OVERVIEW

Nuclear energy is currently the largest single source of low-carbon electricity in the EU, equivalent to 260 Mtoe, or 14% of the EU total energy supply. There are 146 nuclear power plants (NPPs) operating in 15 member states and in 2007 these provided 31% of the total electricity generated in the

Union. European NPPs are among the most efficiently operated reactors in the world. Those operating today, and the 67 NPPs that operated previously and were retired from service, have delivered significant amounts of baseload electricity.

Nuclear fuel cycle facilities in member states employ leading-edge technologies and have sufficient capacity to supply EU requirements. Technologies available include reprocessing, which makes more efficient use of the energy available in uranium through recycling and reduces the volume of spent fuel waste. Some member states also have the most advanced programmes in the world to safely dispose of spent nuclear fuel in deep geological repositories.

POLICY

Nuclear power remains a controversial issue and the EU nuclear reactor fleet is ageing. Power uprates and lifetime extensions, in some cases to 60 years, of several EU reactors have improved performance and output. Despite this, EU nuclear generating capacity will decline from now on, unless significant investment is forthcoming in the near future for plant lifetime extensions and the replacement of facilities reaching the end of their operating lives. Without this investment, this low-carbon source of baseload electricity generation could be reduced from 31% to 21% of the total electricity generated in the EU in 2020. Reduced electricity generation in NPPs will make the ambitious EU goal of a 20 to 30% reduction of carbon dioxide emissions by 2020 even more challenging.

NPPs in the EU were originally built and operated by private and national government-owned utilities. Privatisation since the 1980s has led to more NPPs being owned and operated by private-sector utilities. The activities of these private utilities are often multinational in scope. Some utilities that own and operate NPPs based in member states with nuclear phase-out legislation or policies are investing in nuclear power plant operation and construction in EU countries that support the use of nuclear power to generate electricity, including in the EU12.

EURATOM

The European Atomic Energy Community (Euratom), established by treaty at the same time as the European Economic Community in 1958, plays a key role in civilian nuclear activities within the EU. No major changes have been made to the treaty since it came into force. As outlined in the Euratom Treaty, its specific tasks are to:

- promote research and disseminate technical information;
- establish uniform safety standards to protect the health of workers and the public;

- facilitate investment in the basic installations necessary for the development of nuclear energy in the EU;
- ensure that all member states with nuclear power receive an equitable supply of uranium and nuclear fuel;
- ensure that civil nuclear materials are not diverted to other (particularly military) purposes.

In 2007, the Commission prepared a Nuclear Illustrative Programme (PINC), an overview of the status of the nuclear power industry, for the first time in ten years. The PINC, adopted after a favourable review by the European Economic and Social Committee, highlights the importance of public opinion and perception of nuclear power (in particular the disposal of spent fuel, radiation protection and control of radioactive materials). A Nuclear Forum and a high-level group on nuclear safety and radioactive waste management were subsequently formed to address these issues.

FUEL SUPPLY

Although global resources of uranium are geographically diverse and adequate for long-term fuel supply, difficulties at currently operating mines, the time required to bring new mines into production, the decline of global inventories of previously mined uranium and improving prospects for nuclear power growth have driven uranium prices significantly upward in recent years. However, even with higher uranium prices, fuel costs remain only a small fraction of the cost of electricity generated in NPPs, and NPPs are far less sensitive to fuel costs than electricity-generating plants powered by fossil fuels.

Higher prices for uranium have stimulated uranium exploration and mine development in several EU member states. Although it takes time (more than ten years in some jurisdictions) to bring new production on line, a continuation of strong market conditions could eventually lead to the development of uranium supply from member states.

CRITIQUE

ELECTRICITY

The EU is well diversified in terms of resources and installed capacity for power generation. Coal, gas, hydro and nuclear power have significant shares, with other renewable resources rapidly increasing, particularly wind power. Even if EU dependence on imported natural gas for power generation is increasing markedly, it is well positioned to balance costs, security of supply and critical environmental constraints. Several EU countries have leading global positions in nuclear power and several renewable energy technologies. Indigenous

sources cannot meet the challenges alone and the EU will continue to be increasingly dependent on imports of fossil resources, mainly gas, to fuel its electricity sector. At the same time, the overall efficiency of power generation is increasing thanks to the adoption of new technologies. This is particularly important in the context of rising electricity demand and the strong ambitions of the Commission in the area of climate change mitigation. Overall, the EU electricity sector, through technology use, operation, consolidation and trade, has adapted well to the changing economic, environmental and political framework. The Commission should build upon this performance in developing the market reform and environmental policies that will guide the future of the sector.

Nevertheless, the electricity sector of the EU is faced with considerable challenges, many of them similar to the challenges seen in the rest of the world. Investments in power generation capacity besides wind and gas, or in transmission lines, have stagnated during the past decade. Liberalisation slowly introduced incentives to improve the efficient use of existing capacities to the benefit of European electricity customers. It is now time for the industry to start investing again, in order to meet increasing demand and to replace ageing infrastructure. The EU also needs to continue decarbonising its electricity sector, and clean energy technologies will have to play a significant role in that endeavour. The Commission's policies should take account of the beginning investment cycle, and harness this opportunity to ensure that the investment is taking place in clean, economic generation, and in networks and technologies that will support a shift towards more decentralised power provision and strong policies to reduce demand.

NUCLEAR

Electricity generation in NPPs enhances EU efforts to reduce greenhouse gas emissions and clean air initiatives as it is a low-emission technology with no direct emissions of CO_2, NO_x, SO_x, ozone and particulate matter. Nuclear power also enhances EU security of energy supply, since uranium is widely distributed and about 50% of global mine production comes from reliable, politically stable trading partners. In 2006, Canada, Australia and the United States supplied about 40% of the natural uranium to EU utilities.

While individual EU member countries are free to decide upon their own energy mix, the Commission's policy should continue to support those member states that choose to use nuclear energy as a part of their electricity generation mix. This is also the case for the new member states, many of which have long experience with nuclear power and favour its continued use. Some of these new entrants have had to close older reactors as a condition of joining the EU and they are currently facing challenges in building new reactors to replace those retired from service. The Commission should continue

to facilitate the replacement of older reactors in those countries with new capacity, in particular by outlining the path towards replacement of nuclear capacity in the EU.

Governments without nuclear phase-out legislation or policies are increasingly recognising that nuclear energy has an important role to play in generating low-CO_2 baseload electricity. This, combined with the international scope of utilities with nuclear power in their portfolio of electricity-generating technologies, is changing future prospects for nuclear power and the way in which investment partnerships in nuclear power projects are structured, but it is hindered by negative public perception of nuclear technology in many member states of the EU. Since public perception of nuclear power has such significant economic and environmental consequences today and in the future, it is essential that public opinion is formed on factual information. The Commission should therefore consider improving awareness of the operational history of nuclear reactors in the EU and the impact that this technology has had and can have in future efforts to reduce emissions of CO_2, NO_x, SO_x, ozone and particulate matter by publishing factual accounts of the operating history of these facilities. Information about radioactive waste disposal is equally important. In this context, the adoption of the PINC and the formation of a Nuclear Forum and a high-level group on waste management are commendable initiatives and the Commission is encouraged to continue with these efforts.

In the face of the improving outlook for nuclear power and the trans-boundary partnerships formed today to invest in plant refurbishment, power uprates, life extensions and new build, Euratom is encouraged to continue to evaluate its role to ensure that its activities are continuing to serve member states, in particular those with a positive policy towards nuclear power generation.

Within the EU there are widely differing attitudes to the acceptability of nuclear power and it is up to each member country to choose to include it as part of its energy mix. Similarly, nuclear regulation is a national responsibility. Regulatory approval processes for NPPs are typically long and add to investor uncertainty, and they differ from country to country. Construction times typically span more than 5 years. While regulation will remain a national responsibility, there are moves for greater co-operation internationally, for example the Multi-National Design Evaluation Process and the activities of the Western European Nuclear Regulators' Association. The EU is encouraged to facilitate this co-operation so that the new designs of reactors marketed today, developed in recent years to improve safety and operational efficiency, are available for construction under an effective and efficient regulatory system. In addition, consideration should be given to developing a road-map for advancing power uprates and new build.

RECOMMENDATIONS

The European Commission should:

Electricity

- *Continue urgently to clarify the regulatory and competitive framework under which critical investments in new generation and infrastructure are expected to take place.*

Nuclear

- *Develop a road-map for lifetime extension and replacing ageing nuclear stations.*
- *Publish factual accounts of the operating history of NPPs to improve awareness of the safe operational life of these facilities in the EU and the impact that this technology has had in terms of reducing emissions of CO_2, NO_x, SO_x, ozone and particulate matter.*
- *Ensure increased co-operation in order to capitalise on developments in the fuel cycle, including progress towards implementation of disposal of high-level radioactive waste and spent nuclear fuel.*
- *Facilitate co-operation between national nuclear regulatory bodies so that the new designs of reactors are available for construction under an effective and efficient regulatory system.*

OVERVIEW

Fossil fuels play a key role in the energy supply of the EU27, and will continue to do so, even though a rapidly increasing share will come from imports instead of domestic production. European oil and gas fields are now entering a period of decline, which in some cases is expected to be rapid, while coal production is phased out in most European countries.

Since 1990, the overall production of fossil fuels in the EU27 has declined by 25% mainly because of a decline in coal production that was not met by increases in oil and gas production. It is now expected to fall by another 45% by 2020, when a further decline in coal will be reinforced by a decline in gas, and a significant drop in oil production (see Table 16).

Table 16

Production Volume and Share of Fossil Fuels in the EU27, 1990 to 2030

	1990	*2005*	*2010*	*2020*	*2030*	*2005/ 1990*	*2020/ 2005*
Production volume			**Mtoe**				**%**
Coal	361	192	162	138	123	-47	-28
Oil	132	132	105	53	41	1	-60
Gas	162	188	168	115	85	16	-39
Total fossil fuel production	655	513	435	307	248	-25	-45
Total fossil fuel in TPES	1 372	1 431	1 455	1 548	1 560	4	8
Production share by fuel				**%**			
Coal	81	61	51	41	37	-24	-33
Oil	21	20	16	8	6	-6	-62
Gas	55	42	36	23	16	-23	-46
Total	**48**	**36**	**30**	**20**	**16**	**-25**	**-45**

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

In 1990, the EU27 produced 48% of fossil fuel demand domestically. The distribution between fuels was uneven, with 81% of coal being produced domestically, but only 21% of oil. By 2005, domestic coal production had decreased to 61% of consumption, while oil had remained stable, and gas had declined from 55% domestic supply in 1990 to 42%. Even though the amount of coal use is thought to decline further, domestic coal production is expected to shrink significantly faster than that, and the self domestic supply of coal is expected to drop to 41% of demand by 2020. In the same year, the EU27 is expected to be able to meet 23% of its gas needs, and only 8% of its oil needs.

Table 17

Direct Use of Fossil Fuels by Sector in the EU27, 1990 to 2030

	1990	*2005*	*2010*	*2020*	*2030*	*2005/ 1990*	*2020/ 2005*
TFC (Mtoe)			**Mtoe**			**%**	
Coal	118	43	41	39	35	–64	–10
Oil	532	601	608	642	654	13	7
Gas	228	295	311	337	348	29	14
Total	**879**	**939**	**960**	**1 018**	**1 037**	**7**	**8**
Electricity	57%	55%	56%	59%	58%	**–4**	**7**
Share fossil	*76%*	*72%*	*71%*	*68%*	*67%*	**–5**	**–5**
Sector							
Industry total	**322**	**295**	**302**	**323**	**325**	**–8**	**9**
Coal	69	32	31	31	29	–53	–4
Oil	140	144	147	150	151	3	4
Gas	113	118	124	142	145	5	20
Industry share	*73%*	*69%*	*68%*	*66%*	*64%*	*–5*	*–5*
Transport total	**287**	**372**	**391**	**439**	**463**	**30**	**18**
Other total	**276**	**282**	**287**	**290**	**290**	**2**	**3**
Coal	49	11	10	8	6	–78	–27
Oil	111	96	90	87	82	–14	–10
Gas	115	175	187	195	202	52	11
Other share	*64%*	*56%*	*54%*	*51%*	*50%*	*–13*	*–8*

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007 and EU submission.

Just under two-thirds of fossil fuels are used directly in end-use sectors of the economy, and this share was expected to stay relatively stable from now until 2020, before the publication of the *20 20 in 2020* proposals. Before the publication of these proposals, the volume of fossil fuels in TFC was expected to increase by 8% by 2020. In the transformation sector, fossil fuels contributed 57% to electricity generation output in 1990, and this share has remained largely unchanged (Table 17).

Direct use of fossil fuels contributed 76% to final consumption in 1990, and this had declined to 72% by 2005. The most important fossil fuel in end-use is oil, over half of which is being used in the transport sector. This is followed by gas, and then coal. Coal use has declined in both the industrial and the other[40] sectors since 1990, with the decline in the other sectors close to 78%, due to fuel switching in home heating, and coal is expected to be insignificant in this sector by 2030. Oil use in industry has increased slightly between 1990 and 2005, while in the other sectors it has declined. Oil use is now primarily driven by transport consumption. Of particular interest is the rapid rise of gas use in the other sectors, by 52% between 1990 and 2005.

NATURAL GAS

Natural gas has become an important source of diversity in EU energy supply, growing from 10% of TPES in 1973 to 18% in 1990, and to 25% in 2005. Overall, gas use has grown by 50% between 1990 and 2005. The importance of gas in TPES varies considerably, even among the bigger member states. Gas accounts for 23% of TPES in Germany, 35% in the United Kingdom, and 38% in Italy. The Netherlands and Hungary have the highest share of natural gas in TPES in the EU, at about 43%. The ability of gas to rapidly increase its contribution to energy supply is best shown by Spain, where gas has moved from 6% of TPES in 1990 to 22% in 2006.

Gas now provides some 28% of industrial energy needs in the Union, and more than a third of residential and commercial needs, being especially important in space heating. In the power sector, its role has increased sharply from barely 7% of power output in 1990, to 16% in 2000, and to more than 20% in 2005. Moreover, this trend is expected to continue, growing further to 25% of power generation by 2010, and becoming the second most important source of power after coal and ahead of nuclear early in the next decade.

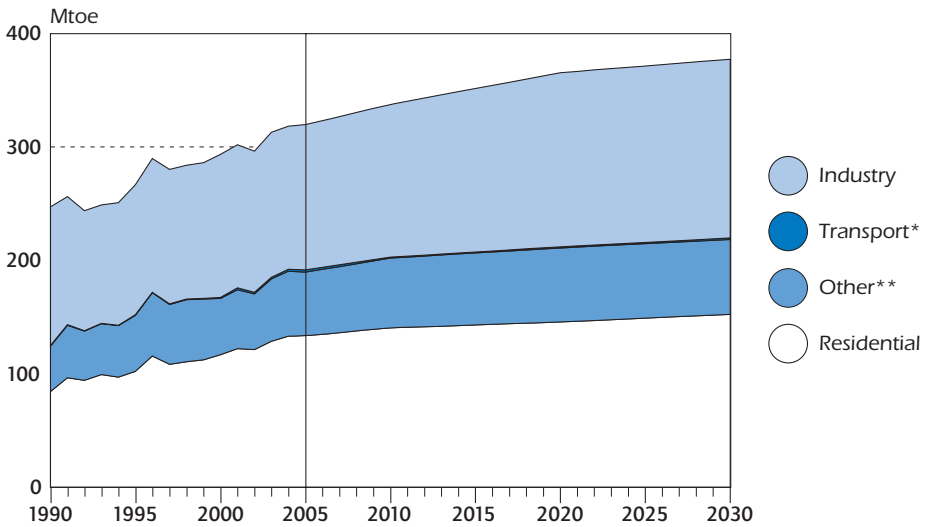
Of particular interest is the role of gas in the EU12. A number of these states have a high level of dependence on gas in their TPES (in particular Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia). Most of them

40. Commercial, agriculture, government, and residential demand.

are countries that have previously been under the Soviet sphere of influence, and are receiving gas mainly from the former Soviet Union, often via only one pipeline. In some of them, Russian gas still accounts for 100% of imports.

Figure 33

Final Consumption of Natural Gas by Sector, 1990 to 2030



* negligible.

** includes commercial, public service, agricultural, fishing and other non-specified sectors.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2007 and EU submission.

Gas will also begin to interact more and more closely with the electricity sector, where gas prices can be expected to determine electricity prices in large portions of EU electricity markets for much of the year in the future. At the same time, EU production will decline further and imports will rise from about 320 bcm in 2004 to about 540 bcm in 2020.

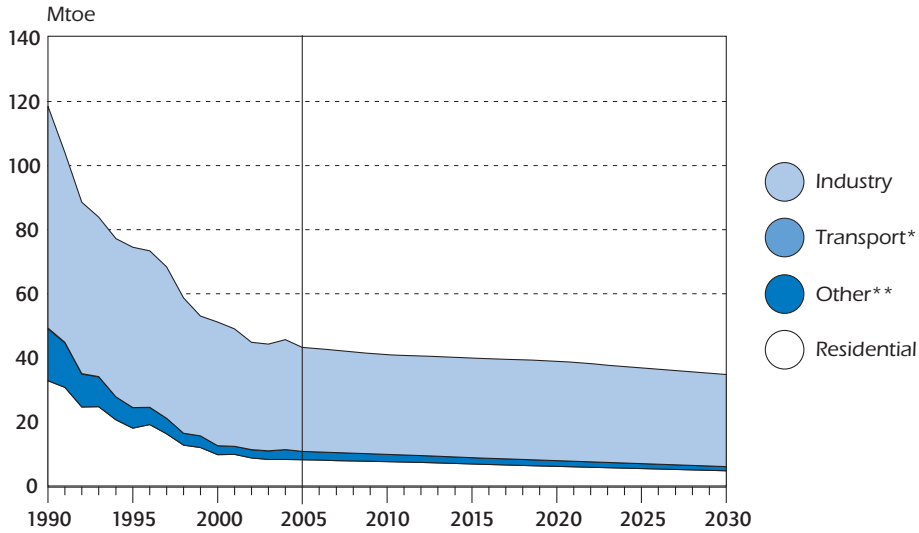
COAL

The use of coal in the EU27 has declined considerably since 1990, both in power generation, where it has been replaced by gas, and in direct use, where its once prominent role in residential heating has declined into insignificance in most of the EU27. Coal is being produced in the form of hard coal, and lignite, with particularly important deposits of lignite existing in the EU12 and in eastern Germany.

In the industrial sector, the decline of steel production is linked to the move towards electric arc furnaces in steel-making. Because of environmental considerations, and the impact of the EU-ETS, it is unlikely that direct use of coal will increase significantly in the future.

Figure 34

Final Consumption of Coal by Sector, 1990 to 2030



* negligible.

** includes commercial, public service, agricultural, fishing and other non-specified sectors.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2007 and EU submission.

OIL

Oil is a fuel of critical importance for the EU27, and this is expected to remain the case in the foreseeable future. Oil use is most important in transport, followed by industry. The *20 20 by 2020* proposal in this area is for a target of replacing 10% of transport fuel use with biofuels by 2020. The achievement of this target is dependent on the commercial availability of second-generation biofuels. Even a 10% share of biofuels would still lead to an increase in the amount of oil consumed by transport, as overall transport demand will increase by 18%.

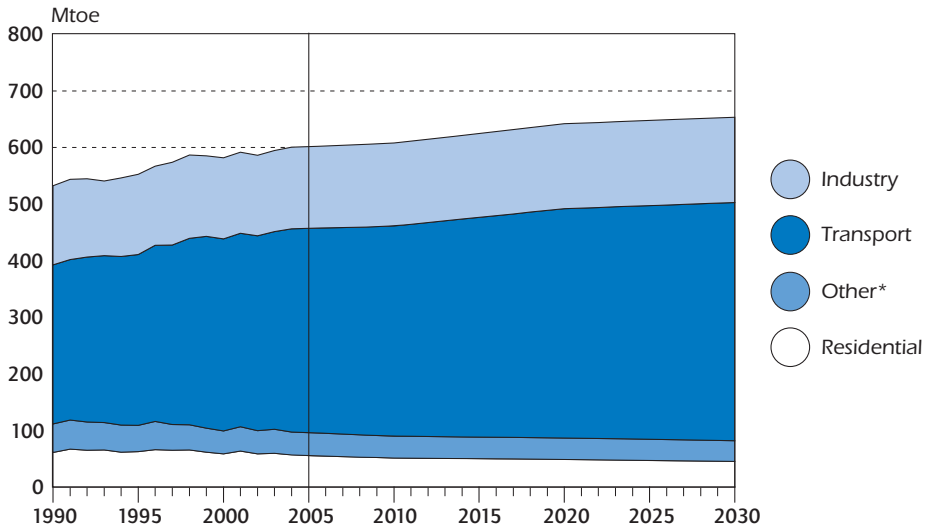
Of particular importance in restricting the growth of oil consumption in the EU has been the move towards diesel as the fuel of choice for new vehicles. This development is driven by preferential taxation policy applied to diesel in many EU member states, and has led to the EU27 countries becoming

net exporters of gasoline, primarily to the United States. There are no policy measures in place to encourage the development of more efficient gasoline vehicles in the EU.

In power generation, oil use has more than halved since 1990, because of fuel switching to natural gas. This trend is expected to continue, with oil remaining a fuel only in niche markets such as isolated island systems. These require high flexibility in operation and size, and often cannot support gas-fired power generation, or do not have gas available.

Figure 35

Final Consumption of Oil by Sector, 1990 to 2030



* includes commercial, public service, agricultural, fishing and other non-specified sectors.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2007 and EU submission.

PART III

ENERGY TECHNOLOGY

ENERGY RESEARCH AND DEVELOPMENT

OVERVIEW

Collaborative R&D, including energy R&D, has a long history in the EU, and the Commission has traditionally been in charge of preparing and developing programmes with a dual focus on achieving R&D results and on creating an integrated European research landscape. European energy R&D has been integrated in the very first endeavours at European co-operation, the Montan Union (see Chapter 2), and Euratom (see Chapter 6). An important decision taken at the Barcelona Summit in March 2002 was to pursue the establishment of a European Research Area (ERA), which is part of the EU strategy to meet the goal of increasing R&D investment to 3% of the EU's total GDP by 2010, and the existing R&D framework is aiming to achieve this goal.

European energy R&D funding is today primarily aiming to integrate R&D efforts across borders, by building long-term partnerships and increasing effective exchange of R&D results at European level. The EU support programmes therefore run in parallel with national support programmes, but have now become an important source of funding for R&D institutions in the EU.

With the recent strong focus on creating a competitive low-carbon economy in Europe, energy R&D has also become a key element in the Commission's low-carbon strategy. This is backed by other European institutions, most importantly the European Council, that on 14 March 2008 emphasised the need for sustained investment in research and development and an active take-up of new technologies in energy.

EUROPEAN RESEARCH PROGRAMMES

THE FRAMEWORK PROGRAMME FOR RESEARCH AND TECHNOLOGY DEVELOPMENT

Background

The multi-annual Framework Programme for Research and Technology Development (FP) is the main instrument for the implementation of European energy research policy, and for the provision of funding by the EU to R&D

activities since 1984. It covers almost all aspects of European research. The FP is the EU's main financial and legal instrument to implement the European Research Area. The current Seventh Framework Programme (FP7) is running from 2007 to 2013. It comprises four specific sub-programmes: Cooperation (including energy), Ideas, People, and Capacities, and is part of the Lisbon Agenda (see Chapter 2) of the EU.

The Commission, Parliament and the Council together decide on the FP, as set out in the European Treaties. The Commission plays a key role in the development of the FP, and attempts to use it to support overall policy goals. Using its exclusive right under the Treaty, the Commission starts the process of developing the FP, consulting widely on its research policy and making use of various committees and expert bodies to assist in drafting the detailed proposals. It then drafts proposals for the overall FP and, later, for the specific sub-programmes for each research activity, in collaboration with other bodies, such as Energy Technology Platforms (ETPs – see below).

The European Council and the European Parliament jointly decide on the content of the overall FP as proposed by the Commission, and determine how the budget is to be allocated between various research activities. The Council decides by qualified majority voting on the definitive content and detailed funding of the specific research programmes, ensuring that each programme mirrors the political priorities of the Union.

R&D project funding from FP7 is allocated through annual calls for proposals. These will be set out in annual work programmes providing details about the topics, timings and implementation. The calls for proposals are developed with the help of the various European Technology Platforms that bring together technology know-how, industry, regulators and financial institutions, and that also contribute to the work programmes.

Administration and Structure

The energy theme within FP7 is managed by two General Directorates of the European Commission, the Directorate-General for Research (DG RTD) and Directorate-General for Transport and Energy (DG TREN). In the work programme for 2007 DG RTD received EUR 124 million and DG TREN received EUR 137 million for FP funding.

Under the structure of FP7, energy research is split into nuclear R&D, managed by the Euratom Directorate of DG TREN, with the programme running from 2007 to 2011, and non-nuclear energy research, from 2007 to 2013 (see below for funding of these areas).

Under the energy theme of the FP7 Co-operation Programme, nine subject areas for non-nuclear energy research have been identified, as set out below. These continue to be strongly focused on energy supply technologies (see section on funding).

- **Hydrogen and fuel cells,** integrated action to provide a strong technological foundation for competitive EU fuel cell and hydrogen industries to develop stationary, portable and transport applications. The Hydrogen and Fuel Cells European Technology Platform contributes to this activity by proposing an integrated research and deployment strategy.

- **Renewable electricity generation,** technologies to increase overall conversion efficiency, cost efficiency and reliability, driving down the cost of electricity production from indigenous renewable energy sources, including waste, and the development and demonstration of technologies suited to different regional conditions.

- **Renewable fuel production,** integrated fuel production systems and conversion technologies to develop and drive down the unit cost of solid, liquid and gaseous (including hydrogen) fuels produced from renewable energy sources, including biomass and wastes, while aiming at the cost-effective production, storage, distribution and use of carbon-neutral fuels, in particular biofuels for transport and electricity generation.

- **Renewables for heating and cooling,** research, development and demonstration of technologies and devices, including storage technologies to increase efficiencies and drive down the costs of active and passive heating and cooling from renewable energy sources, ensuring their use in different regional conditions where sufficient potential can be identified.

- **CO_2 capture and storage technologies for zero-emission power generation,** research, development and demonstration of technologies to drastically reduce the environmental impact of fossil fuel use aiming at highly efficient and cost-effective power and/or heat generation plants with near-zero emissions, based on CO_2 capture and storage technologies, in particular underground storage.

- **Clean coal technologies,** research, development and demonstration of technologies to substantially improve plant efficiency, reliability and cost through development and demonstration of clean coal and other solid fuel conversion technologies, producing also secondary energy carriers (including hydrogen) and liquid or gaseous fuels. Activities will be linked as appropriate to CO_2 capture and storage technologies or co-utilisation of biomass.

- **Smart energy networks,** research, development and demonstration of how to increase the efficiency, safety, reliability and quality of the European electricity and gas systems and networks, notably within the context of a more integrated European energy market, for example by transforming the current electricity grids into an interactive (customers/operators) service network, developing energy storage options and removing obstacles to the large-scale deployment and effective integration of distributed and renewable energy sources.

- **Energy efficiency and savings,** research, development and demonstration of new concepts, optimisation of proven concepts and technologies to improve energy efficiency and to enable further savings in final and primary energy consumption, over their life cycle, for buildings (including lighting), transport, services and industry. This includes the integration of strategies and technologies for energy efficiency (including co- and poly-generation), the use of new and renewable energy technologies and energy demand management measures and devices, and the demonstration of minimum climate impact buildings.
- **Knowledge for energy policy making,** development of tools, methods and models to assess the main economic and social issues related to energy technologies and to provide quantifiable targets and scenarios for medium- and long-term horizons.

The bulk of nuclear spending in FP7 is allocated to the ITER fusion reactor project at Cadarache in France. For fusion energy, the priorities are the realisation of the ITER project, including an accompanying programme for the exploitation of the ITER device and the preparations for the development of demonstration reactors. In the nuclear fission R&D area, FP7 priority activities include the following three areas:

- Waste management, including geological disposal;
- Reactor systems, including nuclear installation safety and development of advanced reactor concepts;
- Radiation protection.

Evaluation

Article 7 of the FP7 sets the criteria for evaluation, stipulating an externally assisted interim evaluation of both programme management and projects funded by 2010. This interim evaluation will have to be preceded by a progress report as soon as sufficient data become available. The focus of the evaluation will be on the effectiveness of the new actions initiated under the FP7 and of the efforts made with regard to simplification. Regardless of the outcome of this evaluation, there is no formal provision for a recasting of FP7 priorities during the time it is running.

Two years after the end of the current FP, the Commission will be asked to carry out an external evaluation by independent experts of its rationale, implementation and achievements. This will follow the example of the evaluation of FP6, and take into account the results of the interim evaluation. Evaluation of the FP6 is currently in progress, and no data are available at this point.

An *ex post* evaluation of FP5 shows that significant resources have been devoted to energy efficiency projects in the past. FP5 funded 72 energy efficiency projects (21% of the total number of projects) totalling EUR 111 883 000 (26% of the total).

The European Strategic Energy Technology Plan (SET Plan)

The European Council agreed on an "Energy Policy for Europe" (EPE) in March 2007, backing the Commission's proposals on energy and climate change, and underlining the need to strengthen energy research, in particular to accelerate the competitiveness of sustainable energies, notably renewable energy and low-carbon technologies and the further development of energy-efficient technologies. The Council decision acknowledged that low-carbon technologies will play a vital role in reaching the European Union's energy and climate change targets.

Because of the timing of the start of FP7, it had not been possible to reflect this in the design of the FPAs, and energy technology innovation therefore had a relatively low priority in the funding allocation of FP7. To rectify this to some extent, the Commission adopted the SET Plan on 22 November 2007. Its main goal is to accelerate the development and implementation of low-carbon technologies, and to help overcome the issue of funds already allocated for the period 2007 to 2013 under FP7. The SET Plan describes Europe's dependence on fossil fuels and under-investment in clean technologies as "the greatest and widest-ranging market failure ever seen". It accordingly identifies six key areas for focus in research, and these are to become priority areas within FP7. The priority initiatives are wind, solar, bioenergy, CCS, the European electricity grid and sustainable nuclear fission.

No budget is allocated to the plan, its intention being to realign the objectives between FP7 national and industry programmes and the EPE. During the March 2008 spring Council meeting, EU member states endorsed the proposed industrial initiative – outlined in the SET Plan – by the Commission, but failed to identify additional sources of funding. Precisely how and by whom the SET Plan's ambitions will be financed will be debated in the course of 2008, with the Commission expected to propose a separate communication on SET Plan financing by the end of 2008.

The time horizon of the SET Plan includes both a 2020 perspective and a long-term vision to 2050. It also sets out the key EU technology challenges for the next ten years to meet the 2020 targets and also the technology challenges that will have to be addressed (see Box 10) to put the EU on course to achieve the 2050 vision. The plan assumes that a broad technology portfolio might avoid locking the EU into technologies that may not provide the best solution in the long run, and it calls on the Commission to reinforce R&D efforts now to ensure that these technologies become available as early as possible. The plan aims to provide a twin-track approach, of reinforcing research to lower costs and improve performance; and of continuing proactive support measures to create business opportunities, stimulate market development and address the non-technological barriers that discourage innovation and the market deployment of efficient and low-carbon technologies.

Box 10

The SET Plan's Key Technology Challenges

Technology development in the next ten years to meet the 2020 targets

- Make second-generation biofuels competitive alternatives to fossil fuels, while respecting the sustainability of their production.
- Enable commercial use of technologies for CO_2 capture, transport and storage through demonstration at industrial scale, including whole system efficiency and advanced research.
- Double the power generation capacity of the largest wind turbines, with off-shore wind as the lead application.
- Demonstrate commercial readiness of large-scale photovoltaic (PV) and concentrated solar power.
- Enable a single, smart European electricity grid able to accommodate the massive integration of renewable and decentralised energy sources.
- Bring to mass market more efficient energy conversion and end-use devices and systems, in buildings, transport and industry, such as poly-generation and fuel cells.
- Maintain competitiveness in fission technologies, together with long-term waste management solutions.

Technology development in the next ten years to meet the 2050 targets

- Bring the next generation of renewable energy technologies to market competitiveness.
- Achieve a breakthrough in the cost efficiency of energy storage technologies.
- Develop the technologies and create the conditions to enable industry to commercialise hydrogen fuel cell vehicles.
- Complete the preparations for the demonstration of a new generation (Gen-IV) of fission reactors for increased sustainability.
- Complete the construction of the ITER fusion facility and ensure early industry participation in the preparation of demonstration actions.
- Elaborate alternative visions and transition strategies towards the development of the trans-European energy networks and other systems necessary to support the low-carbon economy of the future.
- Achieve breakthroughs in enabling research for energy efficiency: for example materials, nanoscience, information and communication technologies, bioscience and computation.

European Technology Platforms

European Technology Platforms (ETPs) bring together R&D stakeholders, led by industry, to define medium- to long-term research and technological development objectives. There are seven Energy Technology Platforms: Hydrogen and Fuel Cells (established in 2003), Solar Photovoltaics (2005), Zero-Emission Fossil Fuels (2005), Smart Grids (2006), Biofuels (2006), Solar Thermal (2006) and Wind (2006).

ETPs help the stakeholders establish long-term strategic research agendas, and contribute directly to the FP7 work plans, ensuring that EU-funded R&D is relevant for users. The ETPs follow a three-stage process of development:

- Stakeholders led by industry come together to agree a common vision for the technology;
- Guided by the vision, stakeholders define a common and ambitious Strategic Research Agenda (SRA) in a strategically important area, setting out the necessary medium to long-term objectives for the technology;
- Stakeholders implement the Strategic Research Agenda with the mobilisation of significant human and financial resources, utilising also FP7 funds.

In order to secure implementation of their SRA, a primary objective of the ETPs is to influence industrial and research policy, at EU, national and regional levels, and to encourage public and private investments in R&D and innovation in key technological areas. The SRAs have provided input which was taken into account when designing FP7 and will continue to impact on the annual work programmes of the FP7.

The European Technology Platform for Zero-Emission Fossil Fuel Power Plants (ETP-ZEP) was established in 2005 to support R&D in CCS. In September 2007, it published a research agenda for CCS and a programme for strategic deployment. In this it recommends a network of up to 10 to 12 integrated, large scale demonstration projects across Europe and maximum co-operation at the international level. At this point in time, it is not clear how funding for the proposed programme is going to be made available to ensure its progress.

Joint Technology Initiatives

Some ETPs have developed Joint Technology Initiatives (JTIs).The concept of JTIs was introduced in FP7 as a way of creating public-private partnerships in European R&D. In a limited number of cases, JTIs may be set up to implement

ETP SRAs (or parts thereof) where these have achieved such an ambitious scale and scope that existing instruments are not appropriate. To help identify such cases where a JTI could be of particular relevance, identification criteria have been developed by the Commission.

The first JTI in the energy field will be the Fuel Cells and Hydrogen Joint Undertaking. On 25 February 2008 the Competitiveness Council reached an agreement on a general approach for the setting-up of a fuel cells and hydrogen JTI. This JTI is aimed at co-ordinating European research efforts by providing a framework encouraging large companies and small and medium-sized enterprises (SMEs) throughout the EU to co-operate between themselves, as well as together with other stakeholders within the fuel cells and hydrogen field. The main objectives are:

- Achieve early market applications by 2010;
- Stationary applications by 2015;
- Transport applications by 2020;
- Achieve a penetration of 10 to 20% of "clean" hydrogen demand by 2020.

While ETPs allow public and private stakeholders to jointly define research needs, JTIs are a way of implementing large-scale applied and industrial-focused research activities, based in part on the needs identified by ETPs.

Research Fund for Coal and Steel

The industry-focused research programme of the Research Fund for Coal and Steel (RFCS) is complementary to and managed outside FP7. It was created when the European Coal and Steel Community (ECSC) Treaty expired in July 2002. With a yearly budget of around EUR 60 million, financed by the interests accrued each year by the assets of the ECSC (EUR 1 600 millions) at the time of the Treaty's expiry, the fund supports research projects in the areas of coal and steel.

Competitiveness and Innovation Programme

The Competitiveness and Innovation Programme (CIP) and especially its Intelligent Energy for Europe pillar are aiming to complement the FP7 activities by addressing non-technological barriers and providing support to accelerate investment and stimulate the market uptake of innovative technologies across the Community. This programme is run by the Executive Agency for Competitiveness and Innovation (linked to DG TREN, among other DGs). The key aim of the CIP is to create an EU-wide network of actors capable of participating in European as well as national, regional and local initiatives furthering sustainable energy use. This EU-wide infrastructure is expected to allow the extensive sharing of experiences through dedicated networks.

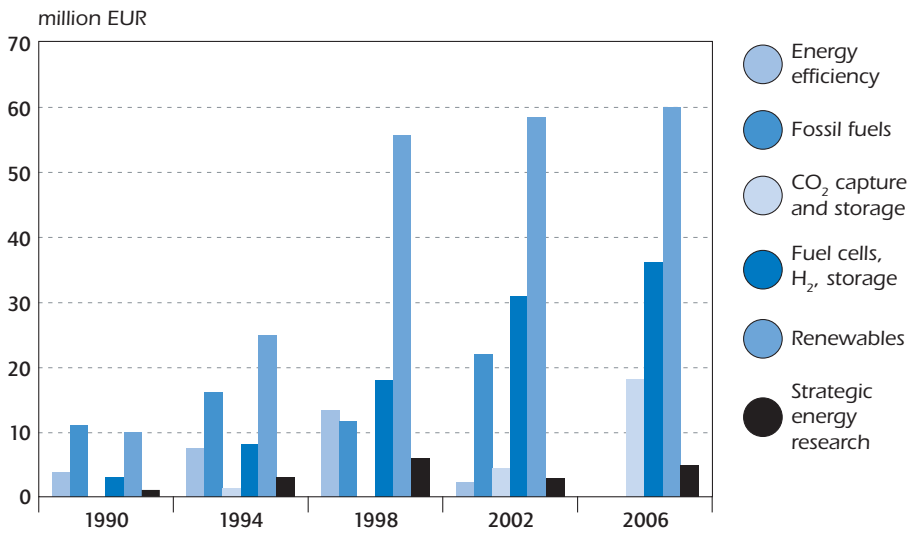
FRAMEWORK PROGRAMME 7

Funding allocation to specific research areas of the FP is dependent on the current political priorities at the time of its development. This has led to a decline of the allocation of funding to energy research since the inception of the FP. Fossil fuel research was a key topic after the oil crises but in the past few years it decreased. The main stakeholders of fossil fuel research in Europe are now engaged in CO_2 capture and storage technologies, which have become an increasingly important R&D area in recent years. Nuclear research is not managed within the general energy theme, but through the Euratom Treaty provisions.

The composition of budgets to the different energy research areas has also changed considerably over the years. Renewable energy research accounted for about one-third of non-nuclear energy research at the end of the 1980s and about 50% since the FP4. Especially photovoltaic, wind and biomass technologies have steadily gained importance (see Figure 36). Consequently, fossil-fuel technologies and energy efficiency R&D have been reduced. While it is not clear how much money will be devoted to energy efficiency and renewables under FP7, the goal of the Commission is to ensure that more than 50% of the allocation goes to energy efficiency and renewables.

Figure 36

Allocation and Development of FP Energy R&D Budget in Non-Nuclear Research Areas, 1990 to 2006



Source: EU submission.

Under FP7 EUR 2.35 billion is allocated to non-nuclear energy research from 2007 to 2013, and EUR 2.751 billion for nuclear R&D for the period 2007 to 2011, primarily for fusion R&D. This contrasts with EUR 9.05 billion for information and communication technologies and EUR 6.1 billion for health, and reflects the drafting of FP7 before sustainable energy R&D emerged as a key concern at EU level.

The FP7 Euratom provision for nuclear research and training activities includes EUR 2 751 million to be spent over five years (2007-2011). EUR 1 947 million is allocated to fusion energy research and EUR 287 million to nuclear fission and radiation protection. EUR 517 million is reserved for the nuclear activities of the Joint Research Centre.

OTHER RESEARCH PROGRAMMES

The industry-led Joint Technology Initiatives will receive EUR 470 million of funding from the EU's research programme over the next six years, an amount to be matched by the private sector. The SET Plan mentions this initiative as an example for future European actions to develop new energy technologies.

The Competitiveness and Innovation Programme has a funding allocation to its Intelligent Energy for Europe (IEE) element of EUR 720 million for the period 2007-2013. None of the funding is available for capital spending.

IEA IMPLEMENTING AGREEMENTS

Participation in these agreements allows governments, research institutions, and private companies to co-operate closely and share information on emerging energy technologies. They are seen by the Commission as an important complement to the EU research programmes, by allowing co-operative energy R&D within a multinational framework. The Commission therefore participates in 20 Implementing Agreements: Renewables (7), End Use (1 under preparation), Fossil Fuels (2), Fusion (9), and Cross-Cutting (1).

CRITIQUE

Technology research and development has traditionally been an area in which the Commission has been closely involved, striving to foster and deepen an integrated European research community within which R&D activities are conducted across borders. This is a laudable effort by the Commission. In the longer term, new generations of technologies have to be developed if Europe is to meet the greater ambition of reducing GHG emissions by 60% to 80% by 2050. Given the time scales for energy R&D, this means that the research effort must commence now, a situation which poses a challenge for the Commission.

The key element in European energy research today is the FP7. It is approved through the co-decision procedure, and the energy research priorities can therefore be considered as a genuine "EU choice". This is a commendable way of ensuring that R&D is steered by political priorities. Nevertheless, a challenge is posed by the fact that within the FP budget allocations, energy R&D has declined considerably since the 1980s, when it played a much more important role. Unfortunately, FP7 was developed before energy emerged as a key concern in EU energy policy. As a consequence of this misstep in timing, only EUR 2.35 billion is allocated to non-nuclear energy research from 2007 to 2013. This contrasts with EUR 9.05 billion for information and communication technologies and EUR 6.1 billion for health research. It is questionable whether this volume of funding is commensurate with the ambitions of the Commission in the energy field. When recasting the FP7, more funding will have to be allocated to energy, so as to accurately reflect the existing challenges relating to sustainable energy use, and to the need for technology to address them. Given the time scales of the current FP, a recasting including reallocation of funding of the FP before the expiration in 2013 should be seriously considered by the Commission. Redressing the overall balance in the FP will be a key challenge to the achievement of the energy R&D aims of the Commission.

To at least partially correct the current misalignment of FP7 with EU energy policy, the Commission has developed the SET Plan, in order to ensure that the limited amount of funding is channelled into the areas most needing it. This quick action in trying to realign policy and existing funding frameworks is commendable. In order to turn the SET Plan into action, the Commission has to find ways to mobilise additional resources. Member states can either make financial resources available themselves, or it should also be considered how to attract private funds into the early stages of development of sustainable energy technologies. It is at present unclear whether this effort will succeed, since private-sector energy R&D budgets have been declining since the 1980s, and most European energy firms now spend less than 1% of their net sales on clean technology innovation. This is an unfortunate development that has potentially serious effects on the ability of new technologies to bridge the so-called "Valley of Death" between the laboratory and the market. To ensure that technologies survive this crucial step, private-sector involvement is required, since public-sector funding is unlikely to be able to provide the large funding volumes required to ensure successful introduction in the market place. The SET Plan should be seen as an opportunity to involve the private sector to a larger extent in European research, but the Commission should also consider other ways in which it can attract private funding to publicly funded R&D, and it should in particular try to build on the positive experience of the ETPs.

A potentially serious flaw in the EU agenda for energy R&D is posed by the two significant imbalances within the energy R&D budget allocation. The SET Plan does not redress these, and the Commission should consider

addressing them with urgency. First, the current balance of research activity is focused on the supply side to a significant extent. Out of nine non-nuclear thematic areas, only one is covering the demand side, and it is doing so in a global manner, while the remaining eight are covering specific sub-sections of energy supply-related R&D. This is continuing the historically low allocation of funding to energy efficiency. Given the priority now accorded to achieving energy efficiency goals within European energy policy, the Commission should consider reappraising the level of funding allocated to demand-side research, by prioritising this area through the annual work programmes. It will also be important to ensure that, despite the global nature of the area, an effort will be made to provide sufficiently detailed work plans for demand-side R&D. In this context, it is also raising concern that demand-side technologies do not feature at all in the six priority areas of the SET Plan. Secondly, the nuclear research portion of EU funding is providing funding for nuclear fusion R&D on a level that is almost equivalent to the total non-nuclear energy funding. Given that it is impossible for nuclear fusion to contribute to the EU's policy aims for a low-carbon energy supply by 2020, and unlikely that it will do so by 2050, this choice in the allocation of funds is difficult to understand, and the Commission should consider reallocating funds from this R&D area at the earliest opportunity, keeping in mind its international obligations towards the ITER project.

Evaluation of R&D programmes is built into the programme design for the Framework Programmes. This is highly commendable, and the Commission should continue to ensure evaluation of all EU-funded R&D efforts. Nevertheless, it should strive to integrate evaluation results into the development of the next FP as soon as possible, by for example allowing for a recast at mid-term, when the evaluation results of the previous FP are available.

The Commission is not only aiming to create a European-wide energy R&D landscape, but is also a direct participant in international partnerships and research agreements. It thereby contributes directly to information and knowledge-sharing across the international energy R&D community in a laudable manner.

RECOMMENDATIONS

The European Commission should:

- *Strengthen the focus and role of energy technology policy in the EU.*
- *Continue to facilitate effective public-private co-operation in all energy technology R&D fields through alliances, initiatives, and platforms.*
- *Address the current imbalances in energy R&D funding in FP7 by:*

- *Considering a recasting of FP7 before it expires to ensure a sufficient volume of energy R&D within it.*
- *Balancing the energy R&D funding between the supply and the demand sides.*
- *Balancing the energy R&D funding as far as possible between the non-nuclear and the nuclear sides of the programme.*

◗ *Implement the SET Plan, in particular by:*

- *Following up the proposals on a better governance structure in the SET Plan to build synergies across the EU and national research programmes and between public and private energy R&D, and*
- *Financing, together with the member states and industry, its proposed industrial initiatives and research efforts as part of the SET Plan to increase the further development uptake of all low-CO_2 technologies in the EU.*

◗ *Speed up evaluation and the release of interim evaluation results of the FP, and extend thorough evaluation to all EU programmes of R&D.*

PART IV

ANNEXES

ORGANISATION OF THE REVIEW

REVIEW TEAM

The In-Depth Review Team visited Brussels, Belgium from 4 to 12 February 2008. During the visit, the team met with Commission administrators, the Presidency, representatives of the European Parliament, energy industry associations, environmental pressure groups and various other organisations and interest groups, and addressed the major issues relating to the EU's energy situation.

The team is grateful for the co-operation and assistance of the many people it met during its visit. Thanks to their willingness to share information and their open hospitality, the visit was both highly productive and enjoyable. The team wishes to make special mention of the understanding and courteous professionalism displayed by colleagues at DG TREN in preparing and accompanying the visit.

The members of the team were:

Stephen Gallogly
Department of State, USA
(Team Leader)

Brendan Morling
Department of Resources,
Energy and Tourism, Australia

John Foran
Natural Resources Canada

Martin Finucane
Department of Communications,
Marine, and Natural Resources,
Ireland

Kazunori Kainou
Research Institute of Economy,
Trade and Industry, Japan

Johan Vetlesen
Ministry of Oil and Petroleum,
Norway

Zafer Ates
Ministry of Foreign Affairs,
Turkey

Robert Vance
Nuclear Energy Agency

Ian Cronshaw
International Energy Agency

Dominika Zahrer
International Energy Agency

Ulrik Stridbaek
International Energy Agency

Nigel Jollands
International Energy Agency

Andreas Biermann
International Energy Agency
(Desk Officer)

Andreas Biermann managed the review and drafted the report with significant contributions from Ian Cronshaw (gas), Ulrik Stridbaek (electricity), Robert Vance (nuclear), Dominika Zahrer (energy R&D), and Nigel Jollands (energy efficiency). Monica Petit and Bertrand Sadin prepared the figures. Viviane Consoli edited the review.

ORGANISATIONS VISITED

- ACEA: European Automobile Manufacturers Association
- AEA: Association of European Airlines
- BEUC: European Consumers' Organisation
- CECED: European Committee of Domestic Equipment Manufacturers
- CEFIC: European Chemical Industry Council
- Cogen Europe
- EREC: European Renewable Energy Council
- ERGEG: European Regulators' Group for Electricity and Gas
- ETSO: European Transmission System Operators
- Euratom Secretariat
- Eurelectric
- Euro ACE: Association for the Conservation of Energy
- Eurocoal
- Eurogas
- EBRD: European Bank for Reconstruction and Development
- European Commission
  - Commission President Cabinet
  - DG Competition
  - DG Environment
  - DG Enterprise
  - DG External Relations
  - DG Research
  - DG Trade
  - DG Transport and Energy
- EIP European Investment Bank
- Europia
- EWEA: European Wind Energy Association
- Greenpeace
- European Parliament ITRE Committee
- Executive Agency TEN-T

- IFIAC
- Executive Agency for Competitiveness and Innovation
- NordPool
- World Wildlife Fund

REVIEW CRITERIA

The *Shared Goals* of the IEA, which were adopted by the IEA Ministers at their 4 June 1993 meeting held in Paris, provide the evaluation criteria for the in-depth reviews conducted by the Agency. The *Shared Goals* are set out in Annex D.

IMPLEMENTATION OF IEA GLENEAGLES RECOMMENDATIONS IN EU ENERGY POLICY

IEA recommendation	*Detailed recommendation text*	*Implementation progress in the European Commission energy efficiency policy*
1) Building codes for new buildings	a) Countries that do not currently have mandatory energy efficiency standards for new buildings in Building Codes should urgently set, enforce, and regularly update such standards.	a) Implemented
	b) Those countries that currently have mandatory energy efficiency standards for new buildings should significantly strengthen those standards.	b) Policy under development
	c) Energy efficiency standards for new buildings should be set by national or state government and should aim to minimise total costs over a 30-year lifetime.	c) Not implemented
2) Passive energy houses and zero-energy buildings	a) Countries should support and encourage the construction of buildings with very low or no net energy consumption (passive energy houses and zero-energy buildings) and ensure that these buildings are commonly available in the market.	a) Policy under discussion
	b) Governments should set objectives for PEH and ZEB market share of all new construction by 2020.	b) Not implemented
	c) Passive energy houses or zero-energy buildings should be used as benchmark for energy efficiency standards in future updates of building regulations.	c) Not implemented
3) Existing buildings	Governments should systematically collect information on energy efficiency in existing buildings and on barriers to energy efficiency. Standardised indicators should also be calculated for energy efficiency in buildings for international comparison, monitoring and selection of best practices. On the basis of this information,	Implemented

IEA recommendation	*Detailed recommendation text*	*Implementation progress in the European Commission energy efficiency policy*
3) Existing buildings *(continued)*	governments should construct a package of initiatives to address the most important barriers to energy efficiency in buildings. This package should set standards to ensure that energy efficiency improvements are achieved during the refurbishment of all buildings. Also, the package should increase awareness of efficiency in the building sector and raise the market profile of a building's energy performance.	Implemented
4) Mandatory energy performance requirements or labels	All countries should adopt mandatory energy performance requirements and, where appropriate, comparative energy labels across the spectrum of appliances and equipment at a level consistent with international best practices. Adequate resources should be allocated to ensure that stringency is maintained and that the requirements are effectively enforced.	Partially implemented
5) Stand-by power	All countries are recommended to adopt the same 1-watt limit and apply it to all products covered by an International Electrotechnical Commmission definition of stand-by power, with limited exceptions.	Policy under development
6) Low-power modes for electronic equipment	All countries should adopt policies which require electronic devices to enter low-power modes automatically after a reasonable period when not being used. Countries should ensure that network-connected electronic devices minimise energy consumption.	Policy under development
7) Television "set-top" boxes and digital television adaptors (DTAs)	International best practice with respect to energy-efficient set-top boxes are policies that establish a minimum efficiency standard for digital television adaptors (DTAs). These regulations should specify the maximum power levels while "on" and "off" and ensure that the consumer can easily switch the unit to the lower power level. A second aspect of best practice is to ensure that government-subsidised units meet higher efficiency requirements.	Policy under development
8) Best practice in lighting policy	The G8 are recommended to endorse the objective of across-the-board best practice in lighting.	Policy under development

IEA recommendation	*Detailed recommendation text*	*Implementation progress in the European Commission energy efficiency policy*
9) Phase-out incandescent lamps	Governments should move to phase out the most inefficient incandescent bulbs as soon as commercially and economically viable.	Policy under development
10) Fuel-efficient tyres	International best practice with respect to fuel-efficient tyres consists of two elements: Setting maximum allowable levels of rolling resistance for major categories of tyres; and Introducing measures to promote proper inflation levels of tyres.	Policy under discussion
11) Test procedures	Governments should adopt new international test procedures for measuring the rolling resistance of tyres, to set maximum rolling resistance limits and for road-vehicle tyre labelling. In addition, all governments, in co-operation with international organisations including UNECE, should make the fitting of tyre-pressure monitoring systems on new road vehicles mandatory.	Not implemented
12) Mandatory fuel efficiency standards for light-duty vehicles	All governments should: a) Introduce new mandatory fuel efficiency standards for light-duty vehicles if they do not already exist, or, where they do exist, make those standards more stringent, b) Announce the more stringent content of the proposed standards as soon as possible, and c) Harmonise, if appropriate, as many aspects of the future standards as possible.	a) Not implemented b) Not implemented c) Not implemented
13) High-quality energy efficiency data for industry	Governments should support the IEA's energy efficiency indicator work that underpins critical policy analysis by ensuring that accurate energy intensity time series data for industrial sectors are reported regularly to the IEA.	Implemented
14) Increased investment in energy efficiency	Governments should: a) Adopt, and publicise to the private sector, a common energy efficiency savings verification and measurement protocol, to reduce existing uncertainties in quantifying the benefits of energy efficiency investments and stimulate increased private-sector involvement,	a) Implemented

IEA recommendation	*Detailed recommendation text*	*Implementation progress in the European Commission energy efficiency policy*
14) Increased investment in energy efficiency *(continued)*	b) Review their current subsidies and fiscal incentive programmes to create more favourable grounds for private energy efficiency investments,	b) Implemented
	c) Collaborate with the private financial sector to establish public-private tools to facilitate energy efficiency financing.	c) Implemented
15) National energy efficiency strategies and energy intensity reduction objectives	All countries should set goals and formulate action. Energy efficiency policy agencies should be adequately resourced. Best practice action policy already developed but not implemented should:	
	a) Assess energy consumption by end-use in all sectors,	a) Implemented
	b) Identify the economy's energy savings potentials.	b) Implemented
	c) Establish objectives and adequate methods for evaluating the success of the policy already developed but not implemented.	c) Implemented

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1990	2000	2004	2005	2010	2020	2030
TOTAL PRODUCTION		**939.76**	**946.04**	**931.48**	**897.90**	**838.32**	**732.18**	**712.88**
Coal		360.66	211.90	200.47	192.35	161.65	138.46	122.51
Peat		3.96	2.54	2.26	3.37	3.30	3.30	3.30
Oil		131.76	173.79	144.68	132.48	104.67	53.11	40.82
Gas		162.40	207.50	202.82	187.97	168.21	114.93	84.76
Comb. Renewables & Waste[1]		45.49	66.03	78.82	82.39	101.96	129.23	158.04
Nuclear		207.31	246.35	262.96	260.16	249.34	228.44	228.54
Hydro		24.61	30.32	27.53	26.14	28.75	29.11	30.32
Wind		0.07	1.91	5.07	6.06	12.44	23.32	29.44
Geothermal		3.19	4.71	5.47	5.41	5.85	6.04	6.48
Solar/Other[2]		0.31	0.99	1.40	1.57	2.15	6.24	8.67
TOTAL NET IMPORTS[3]		**714.27**	**778.22**	**884.95**	**927.33**	**1020.30**	**1242.80**	**1314.02**
Coal	Exports	40.97	33.41	31.30	27.94	..	..	..
	Imports	122.98	131.79	155.87	152.62	..	..	..
	Net Imports	82.02	98.38	124.57	124.68	153.32	200.09	209.83
Oil	Exports	268.14	341.67	353.95	360.05	..	..	..
	Imports	797.58	870.23	928.66	955.10	..	..	..
	Bunkers	35.60	43.29	49.05	51.32	53.65	58.32	61.76
	Net Imports	493.84	485.27	525.66	543.73	569.37	648.48	667.43
Gas	Exports	28.29	48.92	60.80	60.09	..	..	..
	Imports	163.30	241.39	295.43	316.83	..	..	..
	Net Import	135.01	192.48	234.62	256.73	294.23	389.96	431.45
Electricity	Exports	15.84	20.81	24.75	26.91	..	..	..
	Imports	19.17	22.50	24.13	27.89	..	..	..
	Net Imports	3.34	1.69	–0.62	0.97	1.50	1.04	0.92
TOTAL STOCK CHANGES		**2.22**	**–2.18**	**–3.79**	**–9.99**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**1656.25**	**1722.08**	**1812.64**	**1815.23**	**1858.62**	**1974.98**	**2026.90**
Coal		447.67	318.72	324.06	314.19	314.97	338.55	332.34
Peat		3.24	2.51	2.95	2.79	3.30	3.30	3.30
Oil		625.91	655.11	669.49	669.73	674.04	701.59	708.25
Gas		294.79	393.30	434.81	444.64	462.44	504.89	516.21
Comb. Renewables & Waste[1]		45.83	66.49	79.55	83.58	103.84	132.46	162.43
Nuclear		207.31	246.35	262.96	260.16	249.34	228.44	228.54
Hydro		24.61	30.32	27.53	26.14	28.75	29.11	30.32
Wind		0.07	1.91	5.07	6.06	12.44	23.32	29.44
Geothermal		3.19	4.71	5.47	5.41	5.85	6.04	6.48
Solar/Other[2]		0.31	0.99	1.39	1.57	2.15	6.24	8.67
Electricity Trade[4]		3.34	1.69	–0.62	0.97	1.50	1.04	0.92
Shares (%)								
Coal		*27.0*	*18.5*	*17.9*	*17.3*	*16.9*	*17.1*	*16.4*
Peat		*0.2*	*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
Oil		*37.8*	*38.0*	*36.9*	*36.9*	*36.3*	*35.5*	*34.9*
Gas		*17.8*	*22.8*	*24.0*	*24.5*	*24.9*	*25.6*	*25.5*
Comb. Renewables & Waste		*2.8*	*3.9*	*4.4*	*4.6*	*5.6*	*6.7*	*8.0*
Nuclear		*12.5*	*14.3*	*14.5*	*14.3*	*13.4*	*11.6*	*11.3*
Hydro		*1.5*	*1.8*	*1.5*	*1.4*	*1.5*	*1.5*	*1.5*
Wind		*–*	*0.1*	*0.3*	*0.3*	*0.7*	*1.2*	*1.5*
Geothermal		*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
Solar/Other		*–*	*0.1*	*0.1*	*0.1*	*0.1*	*0.3*	*0.4*
Electricity Trade		*0.2*	*0.1*	*–*	*0.1*	*0.1*	*0.1*	*–*

0 is negligible, – is nil, .. is not available.

EU27 historical data and forecasts produced by the European Commission have been adjusted to conform to the IEA methodology. Forecasts for solar/other do not include tide, wave and other sources. In 2005, this amounts to 6.3 TWh.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2005	2006	2010	2020	2030
TFC	1157.20	1214.09	1285.87	1303.08	1361.12	1491.18	1551.29
Coal	118.49	51.14	45.67	43.21	40.92	38.98	34.77
Peat	1.15	0.51	0.47	0.46	0.55	0.55	0.55
Oil	532.50	581.54	600.40	601.28	607.75	641.79	653.53
Gas	228.00	270.81	293.70	294.97	311.43	337.27	348.22
Comb. Renewables & Waste[1]	37.58	48.66	52.39	53.83	66.41	78.89	87.70
Geothermal	0.41	0.57	0.65	0.69	0.76	0.72	0.67
Solar/Other	0.14	0.42	0.63	0.69	1.83	5.23	6.85
Electricity	184.95	217.13	233.81	237.00	262.65	303.13	326.81
Heat	53.99	43.32	58.17	70.95	68.82	84.62	92.19
Shares (%)							
Coal	*10.2*	*4.2*	*3.6*	*3.3*	*3.0*	*2.6*	*2.2*
Peat	*0.1*	–	–	–	–	–	–
Oil	*46.0*	*47.9*	*46.7*	*46.1*	*44.7*	*43.0*	*42.1*
Gas	*19.7*	*22.3*	*22.8*	*22.6*	*22.9*	*22.6*	*22.4*
Comb. Renewables & Waste	*3.2*	*4.0*	*4.1*	*4.1*	*4.9*	*5.3*	*5.7*
Geothermal	–	–	*0.1*	*0.1*	*0.1*	–	–
Solar/Other	–	–	–	*0.1*	*0.1*	*0.4*	*0.4*
Electricity	*16.0*	*17.9*	*18.2*	*18.2*	*19.3*	*20.3*	*21.1*
Heat	*4.7*	*3.6*	*4.5*	*5.4*	*5.1*	*5.7*	*5.9*
TOTAL INDUSTRY[5]	**440.30**	**416.59**	**426.01**	**426.04**	**441.90**	**489.81**	**511.00**
Coal	69.23	38.57	34.29	32.42	31.07	31.10	28.69
Peat	0.40	0.30	0.26	0.25	0.30	0.30	0.30
Oil	139.95	143.16	144.20	144.48	146.51	149.93	150.83
Gas	112.70	116.37	116.38	118.18	124.27	141.69	145.47
Comb. Renewables & Waste[1]	13.87	16.79	16.80	16.76	17.69	13.73	14.17
Geothermal	–	–	0.00	0.00	–	–	–
Solar/Other	–	–	0.00	0.00	–	–	–
Electricity	84.94	92.58	96.96	96.95	105.54	122.41	132.71
Heat	19.21	8.83	17.12	17.00	16.52	30.65	38.83
Shares (%)							
Coal	*15.7*	*9.3*	*8.0*	*7.6*	*7.0*	*6.3*	*5.6*
Peat	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Oil	*31.8*	*34.4*	*33.8*	*33.9*	*33.2*	*30.6*	*29.5*
Gas	*25.6*	*27.9*	*27.3*	*27.7*	*28.1*	*28.9*	*28.5*
Comb. Renewables & Waste	*3.1*	*4.0*	*3.9*	*3.9*	*4.0*	*2.8*	*2.8*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	–	–	–
Electricity	*19.3*	*22.2*	*22.8*	*22.8*	*23.9*	*25.0*	*26.0*
Heat	*4.4*	*2.1*	*4.0*	*4.0*	*3.7*	*6.3*	*7.6*
TRANSPORT	**287.08**	**347.16**	**368.77**	**372.09**	**390.88**	**438.53**	**462.92**
TOTAL OTHER SECTORS[6]	**429.83**	**450.35**	**491.10**	**504.95**	**528.34**	**562.84**	**577.37**
Coal	49.05	12.56	11.37	10.79	9.85	7.88	6.08
Peat	0.76	0.21	0.21	0.22	0.25	0.25	0.25
Oil	111.45	99.05	97.52	96.15	90.01	86.87	82.15
Gas	114.96	153.56	175.67	174.91	186.51	194.70	201.67
Comb. Renewables & Waste[1]	23.69	31.15	33.54	33.93	36.42	39.21	39.42
Geothermal	0.41	0.57	0.65	0.69	0.76	0.72	0.67
Solar/Other	0.14	0.42	0.63	0.68	1.83	5.23	6.85
Electricity	94.60	118.34	130.46	133.65	150.41	174.01	186.92
Heat	34.78	34.49	41.05	53.95	52.30	53.97	53.36
Shares (%)							
Coal	*11.4*	*2.8*	*2.3*	*2.1*	*1.9*	*1.4*	*1.1*
Peat	*0.2*	–	–	–	–	–	–
Oil	*25.9*	*22.0*	*19.9*	*19.0*	*17.0*	*15.4*	*14.2*
Gas	*26.7*	*34.1*	*35.8*	*34.6*	*35.3*	*34.6*	*34.9*
Comb. Renewables & Waste	*5.5*	*6.9*	*6.8*	*6.7*	*6.9*	*7.0*	*6.8*
Geothermal	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Solar/Other	–	*0.1*	*0.1*	*0.1*	*0.3*	*0.9*	*1.2*
Electricity	*22.0*	*26.3*	*26.6*	*26.5*	*28.5*	*30.9*	*32.4*
Heat	*8.1*	*7.7*	*8.4*	*10.7*	*9.9*	*9.6*	*9.2*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1990	2000	2004	2005	2010	2020	2030
ELECTRICITY GENERATION[7]							
INPUT (Mtoe)	**651.29**	**678.97**	**734.68**	**732.44**	**739.61**	**783.54**	**811.77**
OUTPUT (Mtoe)	**220.77**	**257.30**	**279.69**	**281.57**	**308.23**	**353.01**	**379.94**
(TWh gross)	2567.09	2991.87	3252.16	3274.12	3584.02	4104.71	4417.93
Output Shares (%)							
Coal	*40.7*	*31.8*	*30.9*	*30.3*	*27.9*	*29.4*	*30.1*
Peat	*0.4*	*0.2*	*0.3*	*0.2*	*0.2*	*0.2*	*0.2*
Oil	*8.6*	*6.0*	*4.5*	*4.2*	*3.0*	*2.0*	*1.7*
Gas	*7.4*	*16.1*	*19.0*	*20.3*	*24.9*	*27.0*	*25.5*
Comb. Renewables & Waste	*0.6*	*1.6*	*2.4*	*2.6*	*3.7*	*4.7*	*6.3*
Nuclear	*31.0*	*31.6*	*31.0*	*30.5*	*26.7*	*21.4*	*19.9*
Hydro	*11.1*	*11.8*	*9.8*	*9.3*	*9.3*	*8.2*	*8.0*
Wind	*–*	*0.7*	*1.8*	*2.2*	*4.0*	*6.6*	*7.7*
Geothermal	*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
Solar/Other	*–*	*0.1*	*0.2*	*0.3*	*0.1*	*0.3*	*0.5*
TOTAL LOSSES	**501.39**	**509.60**	**529.34**	**509.96**	**497.50**	**483.80**	**475.61**
of which:							
Electricity and Heat Generation[8]	369.68	372.56	390.11	372.07	341.58	324.26	318.74
Other Transformation	25.72	23.77	20.96	18.98	34.54	33.54	30.23
Own Use and Losses[9]	105.99	113.28	118.27	118.90	121.38	126.00	126.64
Statistical Differences	**–2.34**	**–1.61**	**–2.57**	**2.20**	**–**	**–**	**–**

INDICATORS

	1990	2000	2004	2005	2010	2020	2030
GDP (billion 2000 USD)	6805.91	8461.66	9060.30	9212.43	10473.86	13277.20	15870.27
Population (millions)	472.95	482.90	489.67	491.75	494.20	496.40	494.80
TPES/GDP10	0.24	0.20	0.20	0.20	0.18	0.15	0.13
Energy Production/TPES	0.57	0.55	0.51	0.50	0.45	0.37	0.35
Per Capita TPES11	3.50	3.57	3.70	3.69	3.76	3.98	4.10
Oil Supply/GDP10	0.09	0.08	0.07	0.07	0.06	0.05	0.05
TFC/GDP10	0.17	0.14	0.14	0.14	0.13	0.11	0.10
Per Capita TFC11	2.45	2.51	2.63	2.65	2.75	3.00	3.14
Energy-related CO_2 Emissions (Mt CO_2)[12]	4101.1	3842.4	4020.9	3975.9	4058.1	4318.3	4337.8
CO_2 Emissions from Bunkers (Mt CO_2)	183.6	253.3	279.9	294.6	320.0	374.8	422.8

GROWTH RATES (% per year)

	90–00	00–04	04–05	05–10	10–20	20–30	90–30
TPES	0.4	1.3	0.1	0.5	0.6	0.3	0.5
Coal	–3.3	0.4	–3.1	0.1	0.7	–0.2	–0.7
Peat	–2.5	4.1	–5.2	3.4	–	–	0.1
Oil	0.5	0.5	0.0	0.1	0.4	0.1	0.3
Gas	2.9	2.5	2.3	0.8	0.9	0.2	1.4
Comb. Renewables & Waste	3.8	4.6	5.1	4.4	2.5	2.1	3.2
Nuclear	1.7	1.6	–1.1	–0.8	–0.9	0.0	0.2
Hydro	2.1	–2.4	–5.0	1.9	0.1	0.4	0.5
Wind	39.8	27.6	19.6	15.5	6.5	2.4	16.4
Geothermal	4.0	3.8	–1.2	1.6	0.3	0.7	1.8
Solar/Other	12.4	9.0	12.7	6.5	11.2	3.3	8.7
TFC	0.5	1.4	1.3	0.9	0.9	0.4	0.7
Electricity Consumption	1.6	1.9	1.4	2.1	1.4	0.8	1.4
Energy Production	0.1	–0.4	–3.6	–1.4	–1.3	–0.3	–0.7
Net Oil Imports	–0.2	2.0	3.4	0.9	1.3	0.3	0.8
GDP	2.2	1.7	1.7	2.6	2.4	1.8	2.1
Growth in the TPES/GDP Ratio	–1.7	–0.5	–1.5	–2.1	–1.7	–1.5	–1.6
Growth in the TFC/GDP Ratio	–1.7	–0.2	–0.7	–1.6	–1.5	–1.3	–1.4

Please note: Rounding may cause totals to differ from the sum of the elements.

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

1. Combustible renewables and waste 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.

2. Other includes tide, wave and ambient heat used in heat pumps.

3. In addition to coal, oil, gas and electricity, total net imports also include peat, combustible renewables and waste and trade of heat.

4. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.

5. Industry includes non-energy use.

6. Other Sectors includes residential, commercial, public services, agriculture, forestry, fishing and other non-specified sectors.

7. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.

8. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear, 10% for geothermal and 100% for hydro and photovoltaic.

9. 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.

10. Toe per thousand US dollars at 2000 prices and exchange rates.

11. Toe per person.

12. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach from the *Revised 1996 IPCC Guideline*. 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 2006 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.

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The 27 member countries* of the International Energy Agency (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 27 member countries of the IEA 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, the Slovak Republic (since November 2007), Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

the nuclear 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 and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention in each chapter, this glossary provides a quick and central reference for many of the abbreviations used.

ACER	Agency for Co-operation of Energy Regulators
ACT	annual circulation tax
CC&E	climate change and energy
CCS	carbon capture and storage
CEER	Council of European Energy Regulators
CFSP	Common Foreign and Security Policy
CIP	Competitiveness and Innovation Programme
CO_2	carbon dioxide
EBRD	European Bank for Reconstruction and Development
ECOFIN	Council of Economics and Finance Ministers of the European Union
ECCP	European Climate Change Programme
ECSC	European Coal and Steel Community (expired 2002)
EC Treaty	Treaty establishing the European Community
EEA	European Environment Agency
EEA	European Economic Area
EEAP	Energy Efficiency Action Plan
EFTA	European Free Trade Area
EIB	European Investment Bank
ENTSO	European Network of Transmission System Operators

EPE	Energy Policy for Europe
ERA	European Research Area
ERGEG	European Regulators' Group for Electricity and Gas
ESD	Energy Services Directive
EPBD	Energy Performance in Buildings Directive
ETP	Energy Technology Platform
ETSO	European Transmission System Operators Organisation
EU	European Union
EuP	energy-using product
FP7	Framework Programme 7
GO	Guarantee of Origin (also RE-GO)
IED	Industrial Emissions Directive (proposed)
IEM	Internal Energy Market
IPEEC	International Partnership for Energy Efficiency Co-operation
IPPC	Integrated Pollution Prevention and Control
ISO	independent system operator
ITER	Internatinal Thermonuclear Experimental Reactor
ITRE	Industry, Research and Energy Committee of the European Parliament
JTI	joint technology initiative
LNG	liquified natural gas
Mt	million tonnes
Mtce	million tonnes of coal equivalent
MEPS	minimum efficiency performance standard
Mtoe	million tonnes of oil equivalent
NAP	National Allocation Plan
NEEAP	National Energy Efficiency Action Plan
NO_x	oxides of nitrogen

NPP	nuclear power plant
NZEC	near-zero emissions coal
OTC	over-the-counter
O&M	operation and maintenance
PJCC	Police and Judicial Co-operation in Criminal Matters
PSO	public service obligation
RE-GO	Renewable Energy Guarantee of Origin
SO_x	oxides of sulphur
SET Plan	Strategic Energy Technology Plan
TEN-E	Trans-European Networks – Energy
TEN-T	Trans-European Networks – Transport
TPA	third-party access
TSO	transmission system operator
UCTE	Union for the Co-ordination of Transmission of Electricity
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	volatile organic compounds

The Online Bookshop

International Energy Agency

All IEA publications may be bought online on the IEA website:

www.iea.org/books

You may also obtain PDFs of all IEA books at 20% discount.

Books published before January 2007 - with the exception of the statistics publications - can be downloaded in PDF, free of charge from the IEA website.

IEA BOOKS

Tel: +33 (0)1 40 57 66 90
Fax: +33 (0)1 40 57 67 75
E-mail: books@iea.org

International Energy Agency
9, rue de la Fédération
75739 Paris Cedex 15, France

CUSTOMERS IN NORTH AMERICA

Turpin Distribution
The Bleachery
143 West Street, New Milford
Connecticut 06776, USA
Toll free: +1 (800) 456 6323
Fax: +1 (860) 350 0039
oecdna@turpin-distribution.com
www.turpin-distribution.com

You may also send your order to your nearest OECD sales point or use the OECD online services:

www.oecdbookshop.org

CUSTOMERS IN THE REST OF THE WORLD

Turpin Distribution Services ltd
Stratton Business Park,
Pegasus Drive, Biggleswade,
Bedfordshire SG18 8QB, UK
Tel.: +44 (0) 1767 604960
Fax: +44 (0) 1767 604640
oecdrow@turpin-distribution.com
www.turpin-distribution.com

IEA PUBLICATIONS, 9, rue de la Fédération, 75739 PARIS CEDEX 15
PRINTED IN FRANCE BY STEDI MEDIA
(61 2008 19 1P1) ISBN : 978-92-64-04337-4