International Energy Agency

Energy Policies of IEA Countries

BELGIUM

2009 Review

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Belgium is making commendable progress towards a clean and sustainable energy future. Energy intensity has recently declined, as have greenhouse gas emissions. Measures have been implemented to promote energy efficiency. Public funding for energy R&D has risen substantially. Energy security measures have been reinforced for different fuels, and an integrated emergency response policy is under development. Market reforms are advancing in both the electricity and gas sectors. Belgian energy policies are playing an increasingly important role in ensuring energy security not only in the country but also in northwest Europe. The country's strategic location makes it an important transit hub for natural gas, oil and electricity.

Nevertheless, challenges remain. A comprehensive, national strategy is needed to stimulate investment and adequately address energy security and climate change concerns. The Belgian position on the phase out of nuclear power should be reconsidered. The government should also try, through increased market transparency and streamlined planning procedures, to ensure that investment in new generation capacity is an attractive option for new players as well as incumbents. The overlapping responsibilities of the federal and regional governments reduce the cost-effectiveness of policies.

This review analyses the energy challenges facing Belgium and provides critiques and recommendations for further policy improvements. It is intended to serve as a guide as the country continues on its way towards a more sustainable energy future.

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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy.

The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea (Republic of)
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA.

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EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Since the last in-depth review in 2005, Belgium has made substantial progress towards a clean, clever and competitive energy future. The energy intensity of the Belgian economy has declined, as well as primary energy demand and greenhouse gas (GHG) emissions. The share of renewables in energy supply has grown, although from a very low base. A variety of measures has been put in place to promote energy efficiency. Public funding for energy research and development has risen substantially, particularly at the regional level, mainly to support research on energy efficiency and renewables. Energy security measures have been reinforced for different fuels, and an integrated emergency response policy is under development. Market reforms are advancing in both the electricity and gas sectors. These are very laudable achievements.

The government has launched a series of initiatives to address the three Es of energy policy – energy security, economic growth and environmental protection – in a comprehensive manner. In particular, the public consultation process known as "Spring of the Environment" aims to build consensus on energy and climate policies. The creation of the Energy Observatory is expected to improve energy policy making and the functioning of the market through better market transparency. Prospective Studies on electricity and gas are being conducted to determine how best to achieve a balance between supply and demand. Based on these and other commendable steps, the IEA encourages the government to continue to develop a comprehensive energy and climate strategy.

DECIDING ON THE FUTURE ENERGY MIX

Any such comprehensive strategy will be influenced by the government's decision on the future of nuclear power as part of the broader energy mix. Currently nuclear energy provides over 55% of Belgian electricity and over 20% of total primary energy supply (TPES), but a law enacted in 2003 stipulated the phase-out of nuclear electricity generation capacity between 2015 and 2025. Economic, climate change and energy security conditions have changed significantly since the adoption of the law, and more and more stakeholders are coming to realise that the implementation of the phase-out policy would pose a real challenge for the country.

The government has therefore commissioned a so-called GEMIX expert group to examine the ideal energy mix in the medium to long term. On the basis of GEMIX findings, the government expects to take a decision on the nuclear

phase-out by the end of 2009. The IEA encourages Belgium to review its current nuclear phase-out policy as soon as possible, taking into account: *i)* energy security concerns, particularly large investment needs in new electricity generation; *ii)* climate change; and *iii)* cost implications, *i.e.* the impact on the Belgian economy and people's well-being.

FURTHER ENHANCING CO-ORDINATION

Because of the federal structure of Belgium, certain fragmentation of energy policy and duplication of some measures is unavoidable. However, given the relatively small size of the country, it is critical to enhance information exchange, co-ordination and co-operation in order to increase synergies and maximise the benefit of limited human and financial resources. The efforts made to date through the CONCERE/ENOVER (Energy Consultations between the State and the Regions), the Belgian Inter-university Platform on the Reliability of the Networks (BE PRONE), the Belgian Forum for the Regulatory Bodies (FORBEG), the Inter-ministerial Commission on Science Policy and other platforms are commendable. However, the federal and regional governments could further enhance collaboration in areas of common policy interest, particularly energy efficiency, renewable energy and energy R&D.

At present, the complex partition of competences between federal and regional levels continues to reduce rationality of policies. For example, different systems of green and CHP certificates, a bewildering array of subsidies for the same investment in energy efficiency and various mechanisms supporting R&D for the same technologies all hamper the cost-effectiveness of measures. Potential investors in energy infrastructure may be wary in such an incoherent environment. The existence of four energy regulators adds complexity to the Belgian energy market thus creating an additional barrier to entry.

While taking into account the specific circumstances in each region, further co-ordination and, where possible, harmonisation of policies and measures could maximise their overall effectiveness.

CONTINUING PROGRESS ON ENERGY SECURITY

The strong emphasis that Belgium places on energy security is encouraging. The country has recently taken measures to enhance the security of supply in various energy sectors, particularly electricity and gas. The ongoing process of developing an integrated emergency response policy covering different fuels is commendable and should be implemented as quickly as possible.

In the oil sector, the creation of a public stockholding agency, *Agence du Pétrole* (APETRA), is in principle a positive decision. However, the introduction of APETRA in Belgium's stockholding scheme has been difficult owing to an

insufficient transition period. APETRA is not yet able to meet its stockholding obligations, although Belgium has been compliant with IEA stockholding requirements thanks to available industrial stocks. It is important to take immediate actions to ensure the country's compliance with its stockholding obligation in the future.

Security of electricity supply is another area for government action. The electricity sector faces an investment challenge to replace ageing facilities. The decommissioning of nuclear power plants between 2015 and 2025 will likely further exacerbate the serious risk of capacity shortage. Insufficient domestic generating capacity can result in power cuts and blackouts during periods of peak demand, and, possibly, upward pressure on electricity prices.

Belgium is addressing this challenge by integrating its physical grid and electricity markets with neighbouring countries. The IEA strongly supports the development of regional power markets and encourages the government to continue its admirable efforts. Nevertheless, Belgium should also try, through increased market transparency and streamlined planning procedures, to ensure that investment in new generating capacity is an attractive option for new players as well as incumbents.

When developing a comprehensive emergency response policy, the Belgian government also should consider the interrelationship of fossil fuels and the power sector with regard to supply security. The increased demand for gas to replace nuclear for electricity generation would increase Belgium's gas needs and could intensify the impact of supply disruptions.

MEETING SUSTAINABILITY GOALS

Energy policy in Belgium is shaped by the European Union targets for 2020 on greenhouse gas (GHG) mitigation, renewable energy and energy efficiency. The country will have to cut GHG emissions from the sectors outside of the EU Emissions Trading Scheme (EU-ETS) by 15% below their 2005 levels by 2020. It will also have to increase the share of renewable energy sources in final energy consumption from 2.2% in 2005 to 13% in 2020. Belgium and other EU member states also have a separate binding target for renewable energy to cover 10% of transport fuel demand in 2020. Belgium's efforts to improve energy efficiency will also support the EU's target of cutting energy demand by 20%, although there are no binding targets for energy efficiency.

Modelling exercises commissioned by the government demonstrate that the achievement of these targets is feasible, although this will require a complete and urgent overhaul of Belgium's energy sector. The scale of the challenge is considerable because the country's economy has historically been characterised by high energy intensity while its renewable energy potential is relatively small.

Belgium has already adopted – at both regional and federal levels – many mechanisms to promote energy efficiency and renewables along with other measures to reduce GHG emissions. However, there is still need for a comprehensive long-term strategy bringing together climate and energy policies. Given the strong interactions between reducing GHG emissions, expanding renewable energy supply and improving energy efficiency, it is important to have integrated policy planning to achieve the targets in the three areas simultaneously. The compilation of the National Energy Efficiency Action Plan and the National Climate Plan is a positive step towards streamlining existing measures. The IEA encourages the government to enhance its efforts in building a comprehensive long-term policy on energy and climate.

PURSUING MARKET REFORMS

Belgium has made significant strides in liberalising its gas and electricity markets. Progress towards full unbundling of the networks, the creation of a power exchange, the coupling with the Dutch and French markets and the multi-annual transmission and distribution tariffs are just a few examples of positive developments. In the gas sector, the expansion of the Zeebrugge hub has been remarkable and the measures to enhance market liquidity are noteworthy. More and more players are entering the retail electricity and gas markets, although competition in the wholesale segment is not yet very active. Despite the current progress, liberalisation should be continued and the competitive environment should be further improved. For example, the gas and electricity markets remain concentrated although the recently adopted measures intend to substantially reduce concentration in the future.

The cornerstone of liberalised markets is transparent market-based pricing, sending appropriate signals to investors and consumers. Overall, Belgium has no regulated prices for energy, which is a very important achievement that should be maintained. However, certain aspects of the pricing and taxation policies should be reviewed, for example price caps on oil products and an exceptional tax on nuclear generators.

KEY RECOMMENDATIONS

The government of Belgium should:

- *Develop a comprehensive, national strategy which will create an enabling environment to stimulate timely investment so as to adequately address the imminent dual challenge of energy security and climate change. In order to develop this strategy, urgently reconsider the stated nuclear phase-out*

policy, taking into account possible serious consequences for security of supply, economic efficiency and carbon dioxide emissions.

- *Give priority to the development of a long-term strategy for the transition towards a low-carbon energy future, building on the EU 20-20-20 goals, integrating policies on GHGs, renewables and energy efficiency, and providing a clear and stable regulatory framework for investors and consumers.*

- *Intensify ongoing efforts to design a more comprehensive emergency response policy, including gas and other fuels. In particular, continue to consider the interactions of fossil fuels with the power sector. Take immediate action to assure oil stockholding compliance in the future.*

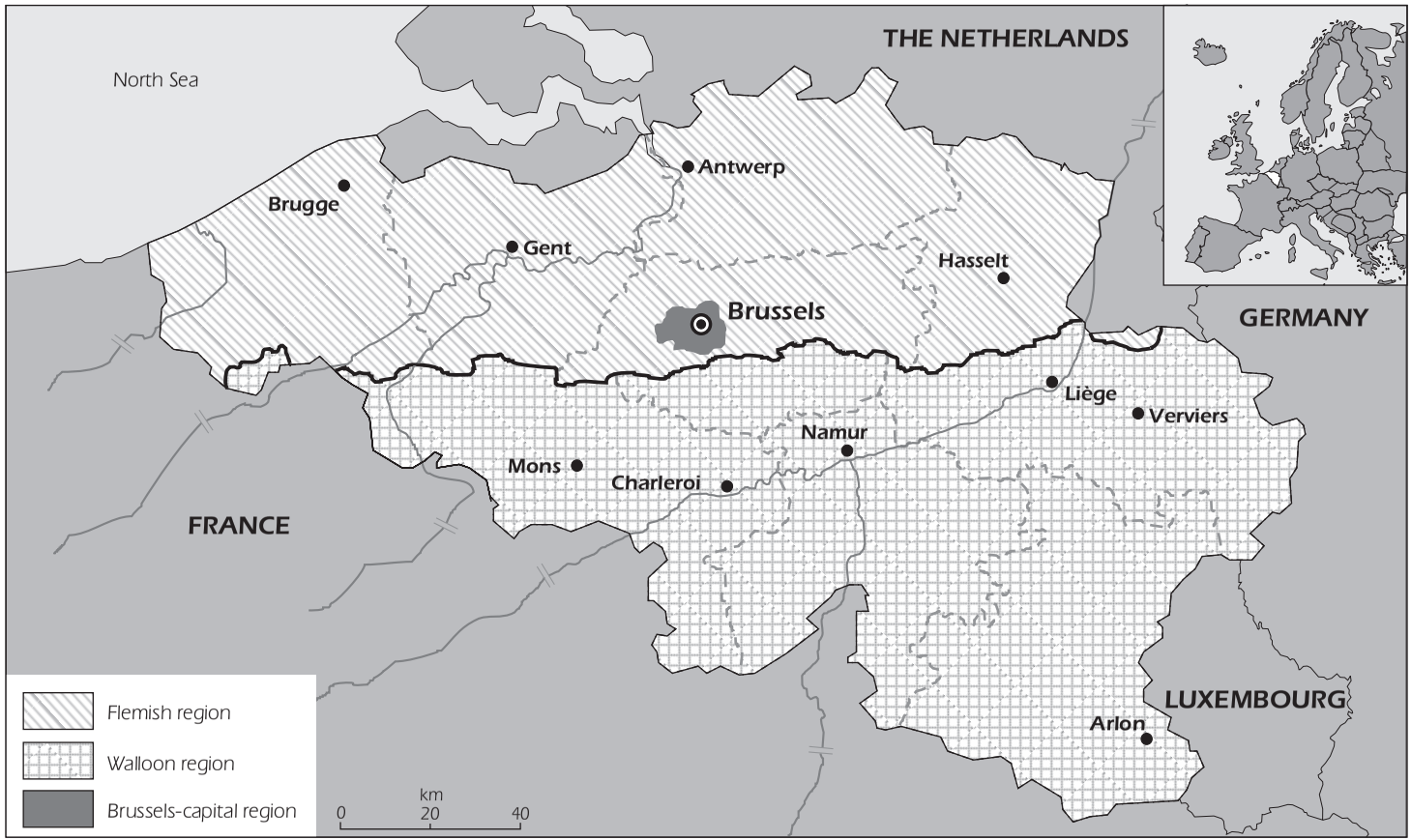
- *Continue to work towards harmonisation and coherence of energy policies and measures between federal and regional levels and across regional levels, while strengthening the collaborative processes of the federal and regional governments.*

PART I

POLICY ANALYSIS

Figure 1

Map of Belgium



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.

COUNTRY OVERVIEW

Belgium is a modern European state and member of the European Union (EU) and the North Atlantic Treaty Organization (NATO). It is a federal parliamentary democracy under a constitutional monarch. As a result of several constitutional revisions, it has become a federalist state with three levels of government – federal, regional, and linguistic – with a complex division of responsibilities. Each of the Belgian three regions (Flanders, Wallonia and Brussels-Capital) and each of the three linguistic communities has its own parliament and government.[1] The responsibilities for economic and energy policy are distributed between the federal state and the regions. The communities are primarily responsible for cultural and linguistic affairs and education, including higher education at universities (see also Chapter 9 on R&D).

With a population of over 10.5 million people living on 30 528 m^2, Belgium is among the most densely populated in the OECD. It is a technologically advanced economy that has capitalised on its central geographic location, highly developed transport network, and diversified industrial and commercial base. Economic integration of Belgium with neighbouring countries – Germany, France and the Netherlands – is very high, with many cross-border companies. With few natural resources, Belgium must import substantial quantities of raw materials and export a large volume of manufactured products, making its economy highly dependent on the state of world markets. Economic growth, which was 2.7% in 2007, dropped sharply in 2008/09 because of the global economic slowdown. This has had implications for energy demand.

INSTITUTIONAL FRAMEWORK

DISTRIBUTION OF RESPONSIBILITIES

As Table 1 demonstrates, the federal responsibilities include security of supply, the nuclear fuel cycle and tariff regulation. The regions of Flanders, Wallonia and Brussels-Capital are principally responsible for energy efficiency, renewables, non-nuclear energy R&D, and distribution and supply of electricity and gas.

1. The region of Flanders and the Flemish linguistic community have the same government and parliament.

Table 1

Division of Energy Policy Responsibilities

Federal level	*Regional level*
Security of supply	Promotion of the efficient use of energy
National Prospective Studies	New and renewable sources of energy (except nuclear)
Nuclear fuel cycles and related R&D programmes	Energy R&D (except nuclear)
Large stockholding installations	Market regulation for distribution of gas and electricity
Production and transmission /transport of energy (electricity grid >70 kV), including large storage infrastructure	Distribution and transmission of electricity (electricity grid <70 kV)
Distribution and transport tariffs	Public distribution of natural gas
Energy statistics and balances	District heating equipment and networks
Offshore wind energy	Recovery of waste energy from industry or other uses
	Energy statistics and balances

Source: Country submission.

As part of further liberalisation, electricity and gas distribution lies within the scope of the responsibilities of the independent distribution system operators (DSOs). DSOs are legally unbundled from supply/production companies and perform their functions independently from the government bodies. There are two types of DSOs: "pure" (without private partners) and "mixed" (with private partners).

KEY ENERGY POLICY INSTITUTIONS

At the federal level, the Minister of Climate, Energy, Sustainable Development and Customer Protection is responsible for energy and climate issues. A specific feature of the Belgian institutional structure is Federal Public Services (FPS), which are equivalent to ministries but their areas of responsibilities do not necessarily coincide with the areas covered by one specific minister. Each FPS can report to several ministers, and each minister can have several FPS under his/her authority. Thus, energy matters are handled by the Federal Public Service for Economy, Small and Medium-sized Enterprises (SMEs), Self-employed and Energy while environmental issues are handled by the FPS for Health, Food Chain Safety and Environment, although there is one minister responsible for both energy and environment. The FPS for Mobility and Transport is responsible for the transport sector.

Alongside the Federal Public Services, Belgium has Federal Public Planning Services (PPS) which handle *ad hoc* matters that require co-ordination between several FPS. The Sustainable Development PPS develops and implements policy on sustainable development. The Science Policy PPS is responsible for research programmes, as well as for Belgium's participation in European and international R&D organisations and networks (see Chapter 9).

The Directorate-General for Energy, part of the Federal Public Service for Economy, SMEs, Self-employed and Energy is the key administration that develops and implements energy policy. It created an Energy Observatory which became operational in April 2009. The main objectives of the Energy Observatory are monitoring the energy markets and enhancing energy security through the following measures:

- collecting and disseminating data on demand and supply;
- processing information on consumer protection, market access and unfair commercial practices;
- establishing a permanent consultation forum for relevant stakeholders.

The Federal Planning Bureau conducts modelling and analytical studies on economic, energy, social and environmental issues, and develops different scenarios and outlooks.

The Federal Agency for Nuclear Control (AFCN) and the National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) are discussed in more detail in Chapter 8. Chapter 5 describes the National Oil Board and other institutions related to the oil sector.

At the regional level, energy policy making is the responsibility of the sectoral ministers and relevant administrations: Minister of Sustainable Development and Public Service in Wallonia, Minister of Energy, Housing, Cities and Social Economy in Flanders, and Minister of the Environment, Energy, Water, Urban Renewal, Housing, Fire Fighting and Emergency Medical Aid in Brussels-Capital.

ENERGY REGULATORS

The national energy regulator is the Electricity and Gas Regulatory Commission (CREG). Its main power is the approval of transmission/distribution tariffs and market monitoring. It also has an advisory role in other market areas. The working costs of the CREG are covered by licensing fees and levies on electricity and natural gas (these levies finance the various funds run by the CREG).

Each region has its own regulatory institution: the Flemish Regulation Entity for Electricity and Gas (VREG) in Flanders, the Walloon Commission for

Energy (CWaPE) in Wallonia and the Commission for Energy Regulation in the Brussels-Capital Region (Brugel) in the capital. The three regional regulators are responsible for the licensing and regulation of the distribution of natural gas and electricity (below 70 kV); technical regulations for the management and extension of natural gas networks; monitoring of the regional electricity and gas markets and the green certificate schemes; arbitrating grid access disputes; and advising the regional government. Chapter 5 provides more details on the regulators' respective roles in the gas sector, and Chapter 7 in the electricity sector.

Through the Programme-law of April 2008 the Belgian government strengthened the role of the federal regulator. It reinforced the investigation powers of the CREG to enable it to monitor retail market prices. The CREG now has power to analyse all electricity and gas price components. In theory, this means that the energy regulator will have access to the real costs of producers, importers and suppliers. A Royal Decree has been drafted to grant inspectors of the CREG the capacity of judicial police officers.[2]

The CREG now also has the competence to state anti-competitive behaviour or unfair business-to-consumer commercial practices if it discovers such evidence in conducting its normal control and monitoring tasks. It presents assumed infringements to the Competition Council. It may also give advice to the Minister of Energy regarding good market functioning and propose measures to improve the situation and transparency on the market.

FEDERAL–REGIONAL CO-OPERATION

In 1992, the federal government and the three regional governments created a formal body for discussions on all energy matters, a co-operation group called Energy Consultations between the State and Regions, or CONCERE/ENOVER (*Concertation Etat-régions pour l'Energie/Energie-overleg*). Its role is primarily advisory. It holds plenary monthly sessions and has several thematic working groups.

The four regulators have also launched a structural consultative process in the framework of the Belgian Forum for the Regulatory Bodies (FORBEG). It is a voluntary platform for discussion with a plenary session and several working groups focusing on the following issues: technical questions; information; complaints; green power; tariffs; and strategy.

2. This Royal Decree has been accepted by the Council of Ministers on 17 July 2009 and is currently being examined by the Council of State. It is expected to pass Parliament before the end of the year.

The National Climate Commission (established in 2003), and the Federal Interdepartmental Commission for Sustainable Development are two other policy-making forums bringing together different stakeholders from the regions and the federal level.

SUPPLY AND DEMAND

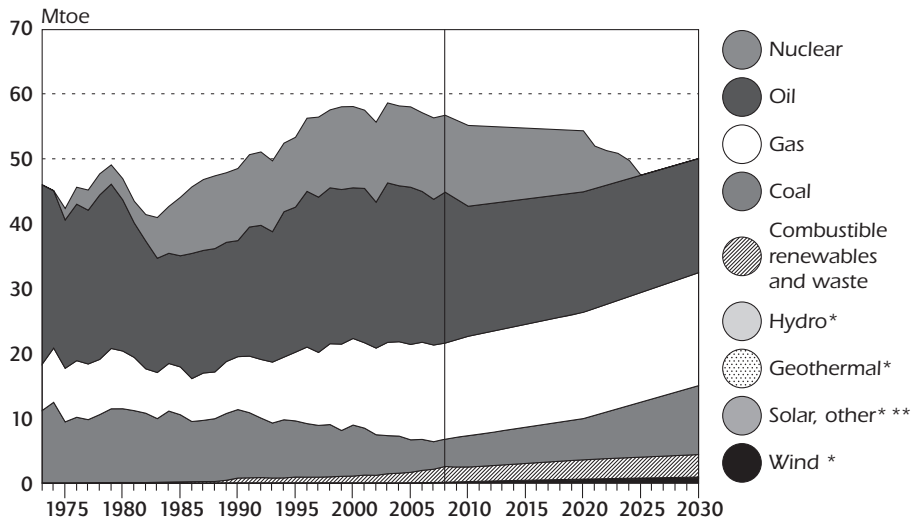
ENERGY SUPPLY

Belgium is heavily dependent on imported energy. The main indigenous source was once coal, supplies of which are now mostly exhausted or extractable only at uncompetitive prices. There has been no domestic production of coal since the closure of the last mine in 1992.

As Figure 3 demonstrates, Belgium's energy mix is relatively well diversified compared to other IEA countries. Fossil fuels provide the bulk of total primary energy supply (TPES): oil accounts for about 40%, natural gas for over 25% and coal for over 7% of TPES (Figure 2). Nuclear provides over one-fifth of TPES and over 55% of electricity generation.

Figure 2

Total Primary Energy Supply, 1973 to 2030



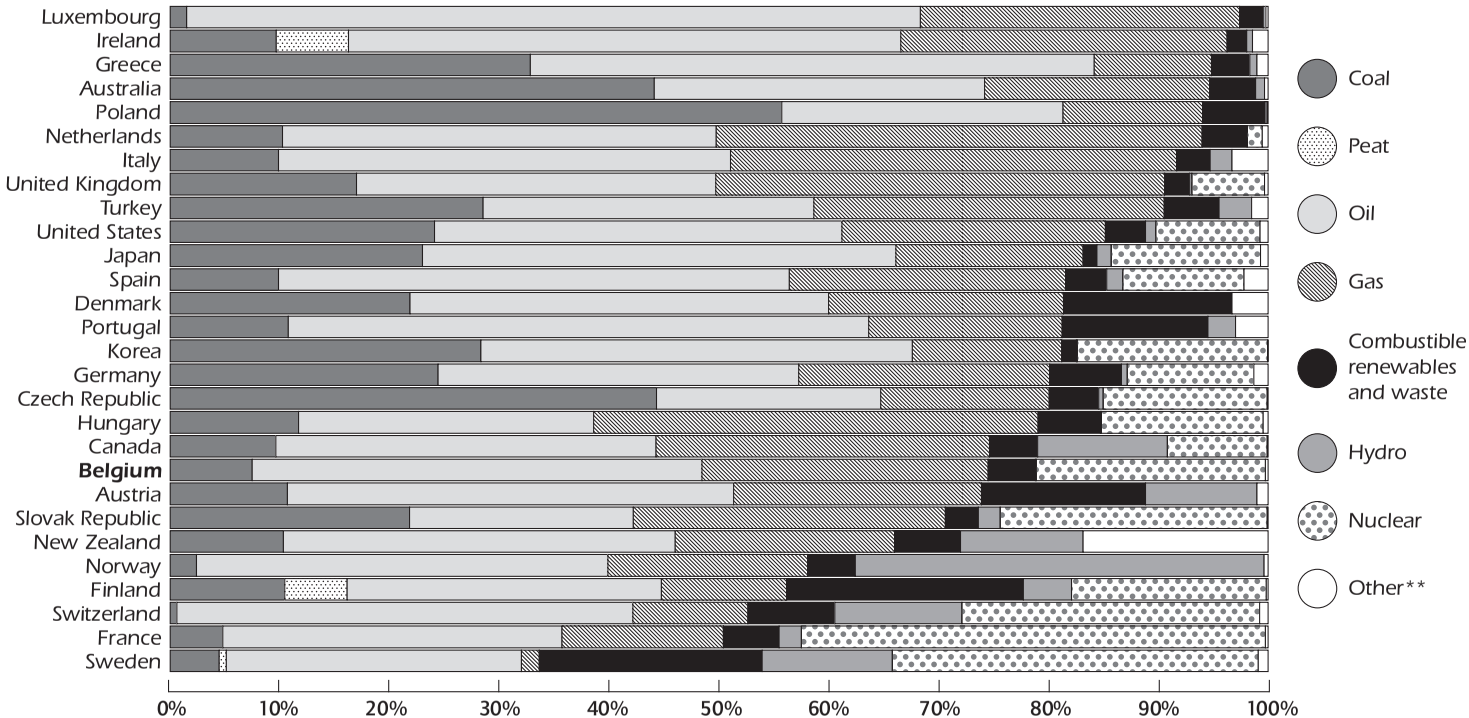
* negligible.

** other includes ambient heat used in heat pumps.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009 and country submission.

Figure 3

Total Primary Energy Supply in IEA Member Countries, 2008*



* estimates.

** includes geothermal, solar, wind, and ambient heat production.

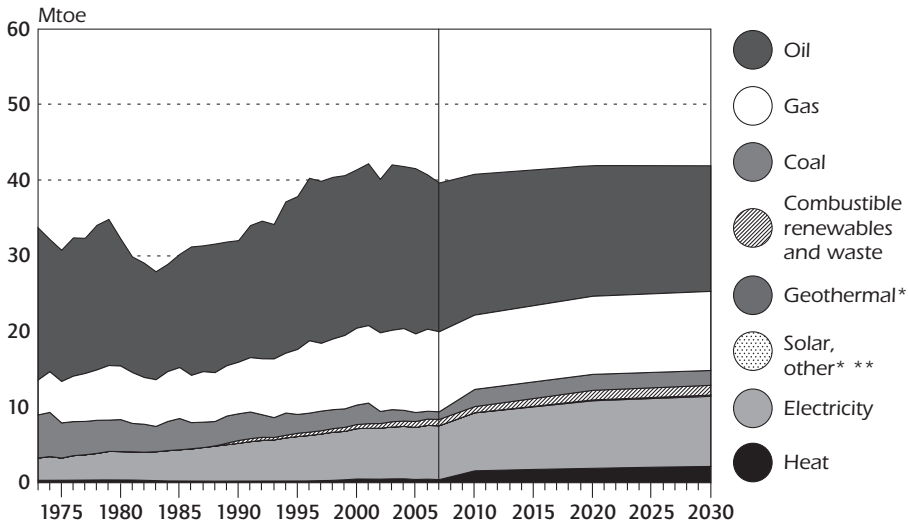
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

ENERGY DEMAND

In 2007, total final energy consumption (TFC) was 39.6 Mtoe, a 2.6% decline from the previous year. Energy demand has been declining steadily since 2004. It is set to decline further in 2009 as the general economic downturn has affected demand. Over the past three decades, the most prominent trend was the increase in consumption of electricity and natural gas (Figure 4). Oil still accounts for the majority of energy demand and its share in TFC has remained rather stable (around 50%) since the 1980s. The share of coal, on the other hand, dropped significantly from 13% of TFC in 1980 to 6% in 2000 and just 2.5% in 2007.

Figure 4

Total Final Consumption of Energy by Source, 1973 to 2030



* negligible.

** other includes ambient heat used in heat pumps.

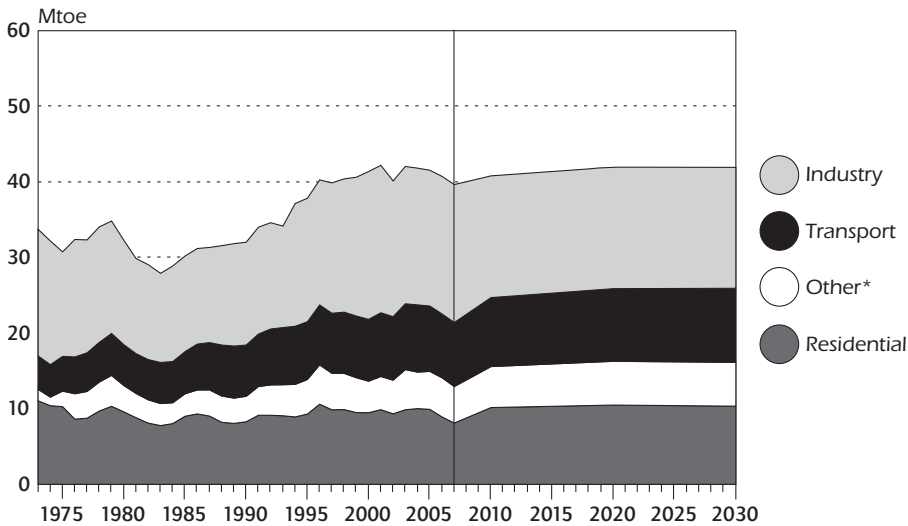
Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009 and country submission.

Figure 5 shows the breakdown of Belgium's energy consumption by sector. Industry accounts for the bulk of total consumption: 46% in 2007 compared to 43% in 1980 and 42% in 1990. The share of transport grew from 17% in 1980 to over 21% in 2007, while the share of the residential sector in TFC dropped from 30% to 20% over the same period. In absolute terms, energy consumption in the transport sector grew by nearly 57% between 1980 and 2007, from 5.4 Mtoe to 8.5 Mtoe, although it declined slightly in 2005 and 2006 compared to the previous years. Residential demand declined by about 15% since 1980 to reach 8.1 Mtoe in 2007. Energy demand in the commercial,

public services, agriculture, forestry, fishing and other non-specified sectors ("other") grew by 38% from 1980 to 2007, and the overall share of these sectors in TFC grew from 10.8% in 1980 to over 12% in 2007.

Figure 5

Total Final Consumption of Energy by Sector, 1973 to 2030



* includes commercial, public services, agriculture, forestry, fishing and other non-specified sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

STUDIES ON SUPPLY-DEMAND BALANCE

The Directorate General for Energy and the Federal Planning Bureau jointly conduct studies on perspectives in the supply of electricity and natural gas in order to determine the most advantageous method to achieve a balance between energy supply and demand, taking into account fuel diversification, use of renewable energy and climate change objectives. These Prospective Studies also identify maintenance needs and outline indicative programmes for investments in infrastructure, as well as emergency measures. This work takes place in consultation with many stakeholders including the regional administrations, the regulators, the transmission system operators (TSOs) and the distribution system operators (DSOs), the Central Bank and the Interdepartmental Commission for Sustainable Development. The prospective study on electricity is updated every three years; the latest study "Perspectives for Electricity Supply 2008-2017" is expected to be published in November 2009. A Prospective Study on gas will be completed by end-2009, but will only be published after the public consultative process, which takes about eight months.

KEY ENERGY POLICIES

POLICY DIRECTIONS

The key objectives of the Belgian energy policy are security of supply based on diversification of geographical sources and fuels, energy efficiency, transparent and competitive energy pricing, and environmental protection.

Energy policy is more and more driven by the EU requirements in line with the EU efforts to deal with the energy and climate challenges. Chapters 3, 4 and 6 describe Belgium's objectives for CO_2 emissions reductions, energy efficiency improvements and renewable energy, set at the EU level.

In June 2008, the Federal Minister of Energy and Climate launched an initiative named "Spring of the Environment" which brought together the federal and regional stakeholders. A political consensus has been reached on a number of energy and environment issues, and the government has taken commitments to pursue further actions in each of the discussed areas, including energy efficiency, green certificates, green taxation, offshore wind, biomass and transport (see Chapters 3, 4 and 6 for more details).

On November 2008, Minister of Climate and Energy Paul Magnette released a General Policy Statement outlining federal policies for the following four years in the areas of energy, climate change and air quality. This policy document reconfirms the government's commitments to the so-called three Es – energy security, economic growth and environmental protection. At the same time, it outlines several measures in the framework of the "social" energy policy, which aims at reducing energy bills for disadvantaged households.

The three regions have also outlined their energy policy objectives in their areas of competence. A key priority at the regional level is the promotion of rational energy use (energy efficiency) and renewable energy sources. Wallonia's energy policy objectives are outlined in its Plan for Sustainable Use of Energy of 2003, which is being reviewed, and in the Air-Climate Plan adopted on 15 March 2007. The Flemish region has also adopted a Climate Policy Plan 2006-2012 and the Brussels-Capital has a Plan for Structural Improvement in Air Quality and Fight against Climate Change, 2002–2010.

NUCLEAR PHASE-OUT

In January 2003, the Belgian Parliament passed a law codifying the national policy to phase out nuclear energy for commercial electricity production. The law prohibited the construction of new nuclear power plants (NPPs) and set a 40-year limit on the operational period of existing plants. The implementation of this law will lead to the closure of the seven Belgian nuclear plants

between 2015 and 2025 (see Chapter 8 for a more detailed discussion of the nuclear phase-out plan). This law is still in force and can only be overruled by amending legislation or by a Royal Decree based on a recommendation from the federal Gas and Electricity Regulatory Commission (CREG) in the case of *force majeure* or if the evolution of electricity prices negatively impacts security of supply.

Several studies have assessed the impact of the nuclear phase-out on the electricity sector and on the general Belgian energy and environmental policies. In particular, a comprehensive study by the Commission for the Analysis of the Belgian Energy Policy towards 2030 (Commission Energy 2030) came to the conclusion that the government should reconsider its 2003 law because the nuclear phase-out would lead to higher electricity prices and endanger the country's energy security and ability to meet its climate change targets. On the other hand, some other studies concluded that it was possible for Belgium to reach its EU targets even if the nuclear phase-out policy were maintained.[3] However, most of the existing studies have focused on the European 20/20/20 targets looking at Belgium's energy mix only until 2020, while the consequences of the nuclear phase-out will be mostly felt after 2025. Therefore, the government has commissioned another study to an expert group, called GEMIX.

THE GEMIX EXPERT GROUP

In November 2008, the government commissioned the so-called GEMIX study to an expert group consisting of four Belgian and four international experts. The mission of the experts is to elaborate different scenarios and to provide the government with recommendations on the ideal energy mix for Belgium in the medium and long term. The recommendations will be based on three fundamental principles: security of supply, competitiveness of the Belgian economy and sustainable development. On the basis of the GEMIX findings, the government expects to take a decision regarding the nuclear phase-out policy by the end of 2009.

ENERGY SECURITY

Belgian energy policy places strong emphasis on energy security. The country has recently taken various measures to enhance the security of supply, including the publication of prospective energy studies on gas and electricity, the creation of the Energy Observatory and the commissioning of the

3. See, for example, the study by Federal Planning Bureau, *Impact of the EU Energy and Climate Package on the Belgian Energy System and Economy*, Brussels, November 2008, discussed in more detail in Chapters 3 and 6.

GEMIX expert group. Developing interconnections and enhancing regional integration have also been essential for improving the security of electricity and gas supplies, as discussed in Chapters 7 and 5 respectively. The federal government has also launched an Inter-university Platform in order to enhance the reliability of the electricity networks (more details in Chapter 9 on R&D).

Regarding oil emergency policy, Belgium has had difficulty in consistently meeting its IEA stockholding obligation. While being compliant as of March 2009, total stocks had fallen below the 90 day level in the previous 12 months. In order to address the problem of compliance, the government created a public stockholding agency, the *Agence du Pétrole* (APETRA), and established a schedule for shifting stockholding responsibilities from industry to APETRA. APETRA started operations in April 2007. The introduction of APETRA in Belgium's stockholding scheme has been difficult owing to an insufficiently long transition period. The transfer of the obligation from industry to the agency, amounting to 75 days of consumption, took place on the agency's first day of operation, fundamentally changing the country's stockholding regime overnight (see Chapter 5 for more details).

In total, APETRA's stock coverage at the end of 2008 equated to 11 million barrels (mb) of oil or approximately one-third of the national obligation instead of the 85% that APETRA was supposed to hold. The rest of the obligation was covered by industry, which happened to hold sufficiently large commercial stocks at that time. In the future, however, there is no guarantee that commercial stocks will be sufficient to allow Belgium meet its obligation if APETRA remains non-compliant. It is therefore important to take immediate actions to ensure the country's compliance with its stockholding obligation in the future.

Realising that currently Belgium only has fragmented emergency measures for separate energy sources, the government has created a task force to develop an integrated emergency response policy. Bringing together a more comprehensive energy security policy for oil, gas, electricity and nuclear will entail updating the emergency response handbook for oil emergencies and elaborating national response plans for natural gas and electricity disruptions. An action plan is to be presented to the Energy Minister before the end of 2009, with the goal of implementing the plan in 2010.

MARKET REFORM

Belgium has made significant progress in liberalising its gas and electricity markets. The opening of the Belgian markets to competition was completed in January 2007, in accordance with the EU Electricity Directive. The pace of market liberalisation has varied considerably among the regions. In Flanders, liberalisation had already been in force since 1 July 2003, while in Brussels-

Capital and Wallonia electricity and gas markets were fully liberalised only from 1 January 2007.[4] The federal regulator has changed the methodology for calculating the transmission and distribution tariffs to a 4-year tariff structure that provides a more stable framework for network operation and investment in electricity and gas infrastructure.

An electricity spot market, Belpex, has been created and the coupling with the Dutch and French markets has been achieved with very visible convergence of wholesale prices. The availability of interconnection capacity with neighbouring markets has been reinforced and new projects are under development, while market-based allocation methods have increased available capacity in the south and north borders.

In the gas sector, the expansion of the Zeebrugge hub has been remarkable, contributing to security of supply in north-west Europe. Fluxys, the gas transmission system operator, has taken several measures to enhance liquidity on the hub. The ZEE Platform Service, offering unlimited capacity transfers in the Zeebrugge area, interruptible capacity products for transit, day-ahead capacity trading for domestic transportation, a Belgian-French platform for trading of secondary capacity (Capsquare) and synergies between transit and transportation services – all these developments are expected to enhance liquidity and competition.

There remain, however, important policy challenges for both the electricity and gas markets. Both markets remain highly concentrated although the dominance of the incumbents is set to decline in the future. In early 2009, Electrabel still had a dominant position in both electricity generation and supply but this situation was expected to change as a consequence of the developments discussed in Chapter 7. The GDF Suez group is the most important player on the Belgian gas market but recent market transactions, discussed in Chapter 5, are decreasing its predominance. GDF Suez still has an important stake in the transmission system operator, Fluxys; however, the legislation in place imposes strict corporate governance rules and an independent functioning.

The commercial and residential markets are becoming more and more competitive, especially in Wallonia and Flanders, with a number of active electricity and gas suppliers of different sizes. Market opening in the Brussels-Capital region has been slower. Despite the progress in developing competition in Belgium, there is room for further improvements. In particular, competition is still rather limited in the electricity market segment supplying large industrial customers, although the government has taken measures to enhance wholesale competition. On the gas market, the current system of "enhanced entry-exit" and the relatively complex balancing regime make it difficult for shippers to book

4. In Wallonia, high-voltage and business customers and residential customers willing to choose a "green supplier" were free to choose their electricity supplier since 1 July 2004. In Brussels, industrial customers could also choose suppliers from 1 July 2004.

capacity for supplying their customers. In addition, "contractual congestion" at certain cross-border points exacerbates the difficulties related to the entry on the Belgian gas market. The government and the transmission system operator, Fluxys, are addressing these and other problems.

More generally, the regulatory framework remains very complex because of the differences between the rules, regulations and institutions in the three regional markets and the federal electricity and gas markets. Four different supply licences exist in Belgium for gas and electricity. Different markets for combined heat and power (CHP) and green certificates, as well as differences in the implementation of the public service obligations, are another factor limiting effective market operation. Administrative procedures to obtain the necessary permits and authorisations for the construction of power plants and gas/electricity infrastructure are often long and complex, which deters the much needed investment.

ENERGY PRICES, TAXES AND SUBSIDIES

PRICING POLICIES

Formally, neither the government nor the national energy regulator, CREG, has the legal means to control energy prices for final users. However, a June 2008 law gives the CREG additional competences to have access to information on suppliers' costs "to protect consumers against predatory pricing" (see section on the Institutional Framework above).

The government maintains a system of price caps on main petroleum products, so called Programme Contract – an agreement between the Belgian State and the oil federation. The price ceilings are intended to act as a buffer against price shocks and volatility trying to protect customers in the event of short-term price spikes. Actual oil prices set by industry tend to be below the maximum ceiling. Nevertheless, the price ceiling could reduce demand response to a price spike.

Price formation on the Belgian electricity market seems rather opaque with the resulting prices not reflecting the underlying economic conditions, as discussed in Chapter 7. For historical reasons, many operators set retail electricity prices not based on either wholesale prices or actual costs but according to the formula calculated by the CREG (indexed to fuel prices and inflation).

Belgium has regulated "social" electricity and gas tariffs granted to certain categories of disadvantaged people. The social tariff is calculated once every six months by the CREG and is based on the lowest commercial tariff in the

country. The entitled consumers use energy at the subsidised "social" tariff, and the suppliers receive the difference between this tariff and the market price from a fund managed by the CREG and financed by a "federal contribution". Many market players perceive the obligation to supply consumers at regulated prices as a financial and administrative burden, which can hamper new entry and reduce competition. Low-income households can also obtain a discount on their heating bills.[5] In addition, a "free quota" for electricity still exists in Flanders, so that all households (not only the most vulnerable ones) receive a certain amount of electricity for free.

Many consumers who are entitled to social tariffs do not receive them because of the complex and burdensome application procedure (Table 2).

Table 2

Social Tariffs

	Households entitled to the social tariff, %	*Inhabitants entitled to the social tariff, %*	*Households using their right to the social tariff, %*	*Inhabitants using their right to the social tariff, %*
Electricity	6.8	3.1	4.6	2.1
Gas	4.7	2.1	2.2	1.0

Source: Country submission.

The social tariffs for gas and electricity have been automated since the beginning of July 2009. This means that the categories of disadvantaged people will no longer have to apply for the social tariff on the basis of specific certificates, but that the government will automatically identify the persons who can benefit.

As part of the Economic Recovery Plan adopted in late 2008, the government earmarked EUR 135 million for reducing households' expenses on energy. A lump-sum reduction on electricity bills of EUR 30 is expected to reduce the total energy expenses of each household by 4% on average.

ENERGY TAXES AND LEVIES

The value-added tax (VAT) rate on gasoline as well as on electricity and natural gas for households is 21%; the VAT rate on steam coal for households is 12%. There is no VAT on coking coal for industry and electricity generation.

5. The discount rate is EUR 105 in 2009. Because of the price decline since 2008, the discount of EUR 105 on the heating bill will no longer be granted in 2010. The government is considering to create an improved and harmonised social policy in the coming years, in order to come up with a more structural and sustainable measure in case of a crisis.

Belgium has a special levy on domestic energy products (*cotisation fédérale*) on gasoline, light heating oil, natural gas, liquefied petroleum gas (LPG) and electricity. These levies are used to finance various public services such as the energy regulator, the Kyoto Fund, public social assistance centres, and measures to help protected customers. Coal, electricity and gas under social tariffs as well as diesel fuel are exempt from this levy.

In 2008, the government introduced an exceptional tax of EUR 250 million on the nuclear generators. This decision has been driven by the concerns that the Belgian nuclear power plants were depreciated before liberalisation and are now making large profits because of "stranded benefits".

Taxes on motor fuels are lower in Belgium than in neighbouring countries. In the first quarter of 2009, the tax component in final prices was 66.5% for gasoline and 51.8% for diesel. The current tax regime gives a clear preference to diesel compared to gasoline and results in a lower end-user price for diesel. This contributes to the continued dieselisation of the Belgian market, which poses significant challenges, including growing dependence on imports and insufficient storage capacity (see Chapter 5).

CRITIQUE

The Belgian government remains committed to the IEA *Shared Goals* summarised as the so-called three Es – energy security, economic growth and environmental protection. Security of supply, competitive market, mitigation of climate change and promotion of sustainable energy continue to be the key drivers of Belgian energy policy. The government has launched a series of initiatives to meet its policy objectives, among others: *i)* the GEMIX expert group to examine the ideal energy mix in the medium to long term; *ii)* Prospective Studies to determine the most advantageous method to achieve a balance between supply and demand for electricity and gas; *iii)* the Energy Observatory to improve energy policy making and to enhance the functioning of the market through better market transparency; and *iv)* Spring of the Environment to find consensus on energy and climate policies.

Building on these commendable developments, the IEA encourages the government to continue developing a comprehensive strategy laying out the energy mix and its policy ramifications, which will create an enabling environment to stimulate the timely and necessary investment to ensure sufficient supply.

The final decision on the nuclear phase-out, expected to be taken by the end of 2009, will be a very important part of such a comprehensive energy strategy. Given the current important role of nuclear power in Belgium, the law stipulating its phase-out in 2015-2025 presents a significant challenge for the

country. The Belgian government is therefore encouraged to review its current nuclear phase-out policy, taking into account the following considerations:

- Security of energy supply, including concerns related to *i)* huge investment needs in new electricity generating capacity; *ii)* reduced diversification of the fuel mix; and *iii)* increased imports of electricity and of natural gas for gas-fired electricity generation;

- Feasibility of meeting national climate change targets;

- Impact on the Belgian economy and people's well-being: total cost of this policy for final consumers, including the costs of building new electricity generating capacity and the costs of meeting national climate change obligations.

The strong emphasis that the Belgian energy policy places on energy security is encouraging. The country has recently taken measures to enhance the security of supply in various energy sectors, particularly electricity and gas. The ongoing process of developing an integrated emergency response policy, covering different fuels, is commendable and should be implemented as quickly as possible.

In the oil sector, the creation of a public stockholding agency, APETRA, is in principle a positive decision. However, the introduction of APETRA in Belgium's stockholding scheme has been difficult owing to an insufficiently long transition period. APETRA has been unable to meet its stockholding obligations yet, although Belgium has been compliant with IEA stockholding requirements because of available industrial stocks. It is important to take immediate actions to ensure the country's compliance with its stockholding obligation in the future.

Belgium has made significance strides in liberalising its gas and electricity markets and introducing measures to further improve the competitive environment. Progress towards full unbundling of the networks, the creation of a power exchange and cross-border wholesale electricity market and the multi-annual transmission and distribution tariffs are just a few examples of positive developments. More and more players enter the retail electricity and gas markets, although competition in the wholesale segment is not yet very active. Despite current progress, liberalisation needs to be further improved. For example, the gas and electricity markets remain concentrated although the recently adopted measures intend to substantially reduce concentration in the future. The incumbents have historical advantages and form a structural barrier to new entrants.

The government urgently needs to accelerate the process towards effective and competitive markets with market-based prices that create incentives for the efficient use of existing resources and that adequately reward new investment.

Competitive markets have proven to serve as an effective tool for efficiency and reliability. But decisive government action and ongoing commitment are required to effectively monitor the unbundled networks and system operation, and to establish effective trading arrangements. Half-hearted liberalisation can seriously jeopardise efficiency and reliability; necessary investments may be deferred. Once established, competitive markets must be allowed to function without undue intervention – even when occasional shortages are priced at extreme levels.

The complex partition of competences between federal and regional levels, despite calls for improvement in co-ordination, continues to hamper the cost-efficiency of measures and results in lack of coherence in policies. For example, different systems of green and CHP certificates, a bewildering array of subsidies for the same investment in energy efficiency (as discussed in Chapter 4), the federal regulator deciding the tariff for the distribution network and the regional regulators or authorities being responsible for public services and the investments needed for the distribution – all these add complexity to the Belgian energy market. Meanwhile, there are positive developments in the direction of better co-ordination and greater coherence among the entities, notably the creation of the Belgian Forum for the Regulatory Bodies.

Along with energy security and market reforms, another important priority for the Belgian government is the so-called "social" energy policy, which aims at reducing energy bills for vulnerable households. Belgium has a "social tariff" for electricity and gas supplies to several end-user groups. It also continues to provide heating subsidies to the households and to keep a price ceiling on certain oil products. Moreover, free energy provision to households still exists in the Flemish region. The recently adopted economic recovery plan aims to reduce energy prices for end-users.

While the rationale behind these policies is understandable, especially in the current economic downturn, the government is encouraged to minimise and, where possible, eliminate price interventions, which constitute a distortion to energy markets. While optimising the current system of social tariffs, the government could consider a transition towards targeted social policies to protect the most vulnerable citizens instead of using energy pricing as a social protection tool.

Overall, Belgium has no regulated prices for energy, which is a very important achievement and should be maintained. However, certain aspects of the pricing and taxation policies could be reviewed, for example, oil price caps and an exceptional tax on nuclear generators. Special taxes of this kind as well as price caps are found to discourage future investments. Market-based pricing is the key to properly allowing markets to send the correct price signal to investors and consumers. Transparent prices in all parts of the value chain are the cornerstone of liberalised markets.

RECOMMENDATIONS

The government of Belgium should:

- *Develop a comprehensive, national strategy which will create an enabling environment to stimulate timely investment so as to adequately address the imminent dual challenge of energy security and climate change.*
- *In order to develop this strategy, urgently decide on the stated nuclear phase-out policy, taking into account possible serious consequences for security of supply, economic efficiency and carbon dioxide emissions.*
- *Continue to monitor the effects of recent market restructuring and, if needed, take additional measures to further enhance competition.*
- *Continue to work towards harmonisation and coherence of energy policies and measures between federal and regional levels and across regional levels, while strengthening the collaborative processes of the federal and regional governments*

KEY DEVELOPMENTS IN ENERGY AND ENVIRONMENT POLICY

EU ENERGY AND CLIMATE PACKAGE

Policies related to energy and the environment have evolved appreciably in recent years, with a range of policies and measures being implemented in various areas by the regional and federal authorities. However, with the EU energy and climate package agreed to by all 27 member states at the EU Council of 11-12 December 2008, Belgium faces a new challenge. The climate and energy package aims at reducing the EU's greenhouse gas emissions to 20% below 1990 levels by 2020, or even by 30% if other developed countries commit to comparable reductions under a new global climate change agreement. The package also implements the EU's target of more than doubling the share of energy generated from renewable sources such as wind, solar and biomass to 20% by 2020. In addition, the measures agreed will contribute towards meeting the EU's goal of increasing energy efficiency by 20% by 2020.

This new legislation, which was adopted by the Council on 6 April 2009, requires Belgium to meet the following requirements:

- To adhere to the new provisions of the EU Emissions Trading Scheme (EU-ETS), *i.e.* to implement the EU27 target for power generation and other covered industries.
- To reduce its GHG emissions by 15% in 2020 in the sectors not covered by the EU-ETS (mainly transport, buildings, waste management and agriculture) compared to 2005.[6]
- To increase the share of renewable energy in final energy consumption to 13% by 2020, including a specific 10% target in the transport sector.
- To be in line with an improvement of energy efficiency at EU level by 20% by 2020.

This new legislation poses a new challenge for Belgium.

6. This corresponds to the 20% GHG reduction target at EU level. Therefore, the targets are also called "20-20-20 target". A 30% target is proposed if other Parties were to take equally ambitious mitigation objectives. Thus, Belgium's target for the non-ETS could also be higher than 15%.

SPRING OF THE ENVIRONMENT

In June 2008 the Federal Minister of Energy and Climate launched an initiative named "Spring of the Environment". Different working groups were established with participation of the federal and regional governments, civil society, non-governmental organisations, social partners and the scientific community. During three months, these groups worked on various topics, including harmonisation of incentives, green certificates, green taxation, offshore wind, biomass and transport. A political consensus has been reached on a number of energy and environmental issues, and the n government has taken commitments to pursue further actions in each of the discussed areas. Notably, within one of the working groups, the intention to create a climate committee on post-2012 issues was manifested, which demonstrates the understanding that a long-term vision in the area of climate policy is needed.

Similarly, an understanding of the importance of monitoring and evaluating policies and measures is evolving at all government levels:

- In 2007, the National Climate Commission launched a research study to create a national monitoring system. The database and the indicator collection are still under construction. The national monitoring system is expected to become operational by the end of 2009.
- The National Climate Commission has the competence to evaluate annually whether the implementation of measures from the federal government is in accordance with the *ex ante* estimation. The first report is expected to be published by the end of 2009.
- Regions also monitor their policies and measures and periodically evaluate their impact, both *ex ante* and *ex post*, by using a number of methodologies.

CLIMATE CHANGE

KYOTO TARGET

Belgium has ratified the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol and has agreed to reduce emissions by 7.5% below the base year levels (1990 for most GHGs) in 2008-2012, according to the EU Burden-Sharing Agreement. Through a burden-sharing agreement among the federal and regional governments, the three regions have different targets (see Table 3). Wallonia has committed to reduce its emissions by 7.5% below 1990 levels during the 2008–2012 period. Flanders' target is to reduce its emissions by 5.2%. The Brussels-Capital region can increase its emissions by 3.5%. The federal authority will compensate the

difference between the total emissions under Belgium's regional burden-sharing agreement and its commitment under the Kyoto Protocol (2.46 Mt/year) by acquiring emission credits on the international market.[7] The gap must be filled by credits from joint implementation (JI) and the clean development mechanism (CDM) projects through 2007. Since 2007, the Belgian government may purchase reductions on the international market from countries with excess assigned amount units (AAUs).[8] For example, many countries with economies in transition are expected to more than meet their Kyoto targets, because of the economic downturns they faced in the period after the base year, and can offer their excess AAUs to the international market. However, this origin often renders AAUs questionable in international discussion, unless the revenues of the AAUs sales are invested in measures which reduce the emissions of GHG and thereby contribute to the greening of these economies. Therefore, the federal government has decided that AAUs on the international market will only be purchased if the market prices of credits from JI and CDM projects rise such that the available budget allocated to the Kyoto Fund to buy emissions reduction credits from the carbon market is insufficient to close the gap to the Kyoto target.

Table 3

Belgium's Burden-Sharing Agreement to Meet the Kyoto GHG Commitment

Units: $MtCO_2eq$	*Base year GHG emissions*	*2008-2012 GHG emissions (annual)*	*Change from 1990*
Wallonia	54.7	50.6	–7.5%
Flanders	87.0	82.5	–5.2%
Brussels-Capital	4.0	4.2	+3.457%
Total	**145.7**	**137.2**	**–5.8%**
Kyoto commitment		134.8	–7.5%
Difference from Kyoto commitment (to be purchased by the federal government)		2.4	

Note: The figures in the table are those following the decision by the UNFCCC Compliance Committee of 22 April 2008 on Belgium's assigned amount units for the Kyoto commitment period. The National Climate Commission decided on 29 May 2008 on the assigned amount units for each region following the national burden-sharing agreement.

Sources: Country submission, IEA analysis.

7. The regions also fulfil part of their emissions target through the purchase of reductions on the international market, depending on, in part, the extent to which they reach their targets internally.
8. The assigned amount is the total amount of GHG that each Annex B country is allowed to emit during the first commitment period of the Kyoto Protocol. An assigned amount unit (AAU) is a tradable unit of 1 tCO_2-eq. Annex B countries are the 39 emissions-capped countries listed in Annex B of the Kyoto Protocol.

The EU Directive on Emissions Trading[9], which is considered as the cornerstone of EU policy to reach the Kyoto target, has been fully transposed into law by all three regions.

EMISSIONS TRADING SCHEME

In January 2005, the European Union launched its Emissions Trading Scheme (EU-ETS), a mandatory cap-and-trade programme to cap CO_2 emissions from the power sector and several industries in Europe. The system currently covers slightly more than 45% of European CO_2 emissions and about 40% of European GHG emissions, released from 11 500 installations in 27 EU member states, and represents by far the largest emissions trading system in the world. Belgium, as an EU member state, is covered by this scheme.

While not directly linked to the UN Framework Convention on Climate Change and the Kyoto Protocol, the EU ETS constitutes a cornerstone of the EU's strategy to meet the Kyoto commitment. The first phase of the scheme, intended as a pilot phase, ran from 2005 to 2007. The second phase corresponds to the first commitment period of the Kyoto Protocol, and covers 2008-2012. Based on experiences from phase 1, several important design elements have been strengthened to increase the effectiveness of the system in phase 2. These improvements include tighter emission targets, more attention to internal EU harmonisation and, most importantly, longer-term visibility for action to reduce emissions until 2020.

In addition, a review of the ETS Directive was initiated as part of the climate and energy package, which led to significant changes of the system starting in phase 3, from 2013 to 2020. An EU-wide cap was adopted, which gradually falls to a GHG emissions level of -21% by 2020 compared to 2005.[10] Allocation rules were harmonised, with a focus on auctioning, and access to flexibility was ensured by enabling banking and clarifying the use of international offsets. Together, this has created considerable certainty up to 2020 in the EU carbon market. While observers concur in saying that this review has established an aggressive trajectory for ETS reductions over phase three of the system (2013-20) and meaningful scarcity, which is needed to transmit the carbon price signal to the actors on the market, economic circumstances imply a negative short-term outlook as the target has become less stringent owing to a reduction of production, and thus emissions in the industries covered by the system.

The changes for the post-2012 period imply that no more individual national allocation plans will need to be prepared after 2012. However, for the first

9. EU Directive 2003/87/EC establishing a scheme for GHG emission allowance trading within the Community, 13 October 2003.
10. The annual reduction factor also applies to beyond 2020, unless changed by other policy decisions.

two phases, Belgium, like all other EU member states had to establish national allocation plans (NAPs), which specify the total quantity of emission allowances that it allocates to its energy and industrial companies and installations. In particular, the plan lists affected installations, determines the total allocation of emission allowances and specifies how allowances are to be distributed. Belgium completed its second national allocation plan for the phase 2008-2012 in October 2006; its assessment was concluded by the European Commission in January 2007. Belgium submitted its new plan, including the changes requested by the Commission, in February 2008. The Commission approved the revised allocation plan on 30 June 2008. The Belgian NAP-table was approved by the Commission on 10 October 2008. Its details are provided in Table 4, in comparison with 2005 emissions as these are the first verified data source for the sectors covered by the EU-ETS.

Table 4

National Allocation Plan Allowances by Region and Sector 2008-2012

$MtCO_2$	*2005 verified emissions (ETS sectors)*	*Average annual emissions allocations (2008–2012)*	*Difference from 2005*
Wallonia	**21.7**	**21.6**	**–1%**
Electricity sector	*3.96**	*1.9*	
Other sectors		*17.9*	
*New entrants reserves ***	*2.04*	*1.8*	
Flanders	**n.a.**	**36.9**	**n.a.**
Industry (existing)		*27.3*	
Energy production (existing; incl. CHP, blast-furnace gas)		*5.3*	
New entrants reserve		*4.3*	
Brussels-Capital	**0.064**	**0.045**	**–29%**
Energy		*0.002*	
Industry		*0.027*	
Tertiary		*0.004*	
New entrants reserve		*0.012*	
Total	**55.6**	**58.5**	**+5.3%**

* Including the transfer of blast-furnace gases.

** Compared to phase 1, the scope in the 2008-2012 period has been extended. Therefore, a direct comparison of the 2005 verified emissions and the 2008-2012 allocation might be slightly misleading. Nonetheless, the table provides a useful insight in the order of magnitude.

Source: Belgian National Allocation Plan for the allocation of greenhouse gas emission allowances 2008-2012 (February 2008).

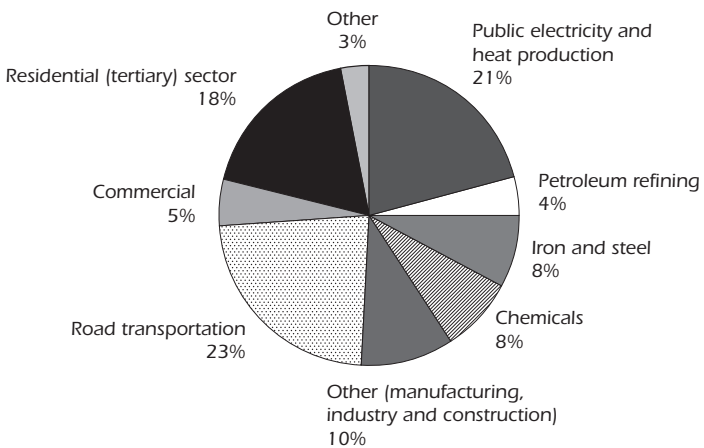
The regional authorities are responsible for allocations to all installations. Allocation rules are different for the energy production sector, the industrial sector and the tertiary sector. They also differ between the regions, even though almost complete harmonisation in allocation rules for the electricity sector was reached. Industrial installations were allocated allowances on the basis of benchmarking agreements in Flanders or energy audit covenants in Wallonia. Also, the Brussels-Capital region determined allocation based on data supplied directly by the operators concerned, using energy audits. Approximately 5.5 $MtCO_2$ was set aside to accommodate any new market participants in "new entrants reserves". These reserves are not interchangeable between regions.

TRENDS IN CO_2 EMISSIONS

In Belgium, energy accounts for 81% of total GHG emissions. The largest sources of energy-related emissions are highlighted in Figure 6.

Figure 6

Energy-Related CO_2 Emissions by Sector, 2007



Source: Belgium's Greenhouse Gas Inventory (1990-2007), National Inventory Report submitted under the UNFCCC.

In 2006, according to IEA/OECD data,[11] total energy-related CO_2 emissions were 117 Mt, a 6.3% increase from 1990 when emissions were 110 Mt

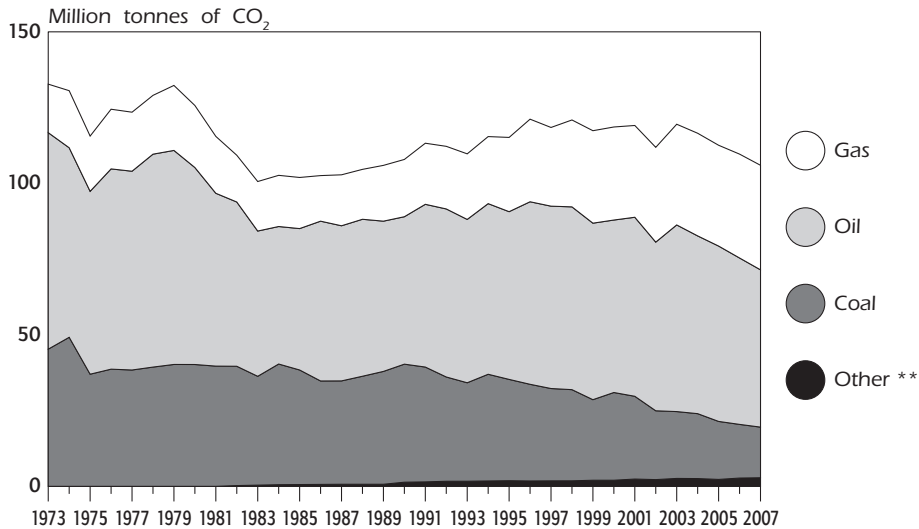
11. Figures in the IEA/OECD database are those submitted by member countries. However, these data do not match GHG emissions estimates submitted by Belgium to the UNFCCC because of data treatment differences. According to Belgium's 2009 submission to the UNFCCC, CO_2 emissions from fuel combustion activities were 104.7 Mt in 2007, a 5.1% decline from the 110.4 Mt recorded in 1990. The average annual growth rate was -0.3%.

(see Figure 7). Over that period, emissions grew at an average annual rate of 0.4%. Emissions from coal dropped by more than 54%, thanks to fuel switching from coal to natural gas for electricity generation, as well as to restructuring in the iron and steel industry. Gas consumption in this industry has declined by 4.8% per year since 1990. Emissions from coal now account for just over a third of CO_2 emissions. Emissions from oil have grown by 13% since 1990; they now account for about 44% of total emissions. The largest growth, by 80%, in emissions was from natural gas, which now account for about 17% of total CO_2 emissions.

The main drivers of the increase in emissions are road transport and the commercial and industrial sector (primarily heating). Emission decreases occurred in the iron and steel sectors and in manufacturing industry and construction.

Figure 7

CO_2 Emissions by Fuel*, 1973 to 2007



* estimated using the IPCC Sectoral Approach.

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

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2009.

When the last in-depth review was being prepared (2004), Belgium's GHG emissions were slightly higher than emissions in 1990. However, in 2007 total GHG emissions (excluding land-use change and forestry) were 9.9% below base year emissions, being thus below Belgium's Kyoto commitment. Given this shift, Belgium appears now to be on track to meet its Kyoto commitment. This is particularly true because both the federal and the regional governments intend to purchase a portion of their reductions – 7.0 $MtCO_2eq$ per year – on

the international market. In addition, Belgium needs to buy additional international credits to close the gap between its Kyoto target and the sum of the regional Kyoto targets based on the burden-sharing agreement. Over 2008-2012, 12.3 $MtCO_2eq$ will be purchased on the federal level (including 2.46 MtCO2eq/year to close the gap between federal and regional targets). In addition, the Flemish region plans to buy 8.9 $MtCO_2eq$.[12]

Table 5 details GHG emissions by region and for all of Belgium, comparing 1990 emissions, 2007 emissions and the 2008-2012 Kyoto target. It shows that, currently, all three regions and the federal government have emissions below their Kyoto targets. In addition, it also highlights that, given the decline in emissions in Wallonia between 1990 and 2007 and the Brussels-Capital region's small share of overall emissions, the greatest responsibility for the achievement of the Kyoto target is held by the Flemish region.

Table 5

Progress towards the Kyoto GHG Emissions Target by Region

($MtCO_2eq$)	*1990 emissions*	*2007 emissions*	*Kyoto target under Belgium's burden-sharing agreement* (2008–12)*	*Difference between 2007 emissions and Kyoto target*
Wallonia	54.79	45.17	50.6	–5.43
Flanders	87	80.77	82.5	–1.73
Brussels-Capital	4.02	3.86	4.16	–0.3
Total**	**145.08**	**129.8**	**137.26**	**–7.46**

* Actual Kyoto target is 134.8 $MtCO_2eq$/year. The federal government intends to purchase 2.46 $MtCO_2$/year to make up the difference.

** According to Belgium's 2009 submission to the UNFCCC, total national emissions were 141.8 $MtCO_2eq$ in 1990 and 129.8 in 2007. Instead, according to the annual European Community Greenhouse Gas Inventory 1990-2007, 2007 emissions amounted to 131.3 $MtCO_2eq$. It should also be noted that Belgium made use of the provision of the Kyoto Protocol that allows the use of 1995 as the base year for fluorinated GHGs. Using this option, emissions for the "reference year" (not 1990) are 145.7 Mt.

Sources: Annual European Community Greenhouse Gas Inventory 1990–2007 and Inventory Report 2009; Belgium's Greenhouse Gas Inventory (1990-2007), National Inventory Report submitted under the United Nations Framework Convention on Climate Change; country submission.

In its submission to the European Environment Agency, Belgium has reported its overall progress towards its greenhouse gas commitments in 2009. Belgium's 2009 Monitoring Mechanism submission projects total emissions to be 9.4% below the Kyoto base year in 2010. However, with the use of Kyoto flexible mechanisms, Belgium's emissions are projected to eventually reach a

12. See Progress Report 2008.

level of 9% below base year emissions by 2010. All sectors, except transport, are expected to have reduced emissions in 2010 compared to 1990 levels. The greatest reductions relative to 1990 emissions are expected to occur in the waste and industrial process sectors. Significant reductions are also expected in the agricultural sector.

With the approval of the National Allocation Plan for the period 2008-2012 however, the Kyoto target is translated into a target for the sectors not covered by the EU-ETS. This target equals 76.3 $MtCO_2eq$. The average non-ETS emission level in the Kyoto period is estimated to be 79.9 $MtCO_2eq$ or 3.6 $MtCO_2eq$ above the target. This difference determines the amount of flexibility mechanisms Belgium will use in the Kyoto period. The government foresees at this moment more use of flexible mechanisms than is strictly needed, in order to account for uncertainties.

The recent GHG projections Belgium reported in May 2009 to the EC under the Monitoring Decision Directive, show that total greenhouse gas emissions under the "with measures" scenario increase up to 150.8 Mt in 2020, which is largely due to the increased electricity demand, the planned decommissioning of the first nuclear reactors in 2015 and an increase in industrial process emissions due to expansion of activities. Projections with the macroeconomic model suggest a lower emission level in 2020 (139.0 $MtCO_2eq$). Both model approaches suggest an increase in emissions after 2010. Uncertainties regarding exogenous variables such as economic growth, climate conditions and electricity imports exist and their level influences the resulting greenhouse gas emissions, notably in the sectors covered by the EU-ETS. The proposed additional measures show an increased reduction potential of 11.3 Mt in 2020, reducing the total amount in the "with additional measures" scenario to 139.5 $MtCO_2eq$.

The revised trend in GHG emissions, the projected use of flexible mechanisms[13] and latest emission projections indicate that Belgium is likely to meet its Kyoto target. Nonetheless, modelling studies suggest that while Belgium is on track to reach the Kyoto target, it will still be very challenging to pave the way beyond the first Kyoto commitment period towards compliance with the new EU-wide target in the context of the EU-ETS, a 21% reduction in GHG emissions by 2020 below the 2005 level and particularly with the new target in the context of the EU energy-climate package of 15% reduction in non-ETS GHG emissions by 2020 below the 2005 level.

According to a modelling study by the Federal Planning Bureau (2008)[14] in a "business-as-usual" scenario (without additional policies), GHG emissions

13. Note, however, problems related to the availability of international credits, which may render the achievement of Belgium's Kyoto target more difficult or expensive than expected.
14. Bossier, F., D. Devogelaer, D. Gusbin and F. Verschueren, F. (2008), "Impact of the EU Energy and Climate Package on the Belgian energy system and economy", Federal Planning Bureau, Working Paper 21-08.

are projected to surpass 2005 emissions by more than 13% in 2020. In a "with measures" scenario, the total GHG emissions are expected to reach 141.6 $MtCO_2eq$ in 2010 and to increase slightly to 145.8 $MtCO_2eq$ in 2020, mainly because of the increasing electricity demand and the planned closure of the first nuclear reactors in 2015. The implementation of additional measures allows a reduction in the total GHG emissions to 138.6 $MtCO_2eq$ by 2020, about 2% below the 2005 level. While the power sector and its corresponding emissions reduction requirements are subject to the EU-ETS provisions, without corresponding targets at the country level, these numbers indicate that Belgium might face a challenge to decarbonise its power sector, which will be critical to be in line with the ambitious goal for international climate policy set in July 2009 in L'Aquila, Italy, by 17 heads of industrialised and non-industrialised countries participating in the Major Economies Forum on Energy and Climate: the increase in global climate temperature above pre-industrial levels ought not to exceed 2°C.

Focusing on the GHG and renewable targets only, the Federal Planning Bureau study shows that these targets actually correspond to the cost-efficient outcomes in the scenarios where no flexibility mechanisms are allowed, without taking in consideration execution barriers. The study also demonstrates that the large emissions reductions in line with the EU-wide 2020 targets could be achieved in Belgium – albeit at substantially higher CO_2 prices and costs than if flexibility mechanisms were used – even if the initial stages of nuclear phase-out are implemented as foreseen (starting from 2015) and if some of the recent reductions from the steel industry were revised. Moreover, the study does not include the decision adopted by the main steel company in the winter of 2009 to slow down production. In addition, the study does not specifically incorporate energy efficiency measures, which have a high potential to reduce emissions cost-effectively, except energy efficiency measures that are driven by the carbon price (*e.g.* reduction of energy consumption). Finally, the study does not include the effect of the recent financial crisis.

While modelling thus sends a positive signal regarding the feasibility of the targets, its results also highlight that the changes needed are significant and require a complete and urgent overhaul of Belgium's energy sector. This will call for considerable investments. The challenge may even be more significant than indicated by the study because the scenarios are only modelled until 2020, while the major impact of the nuclear phase-out and of the ageing power plants is expected to be visible only after 2020. The power sector will have to continue its efforts to limit GHG emissions also beyond 2020, as there is a clear indication that the power sector under the EU-ETS is moving towards auctioning. However, if all the nuclear generating capacity, currently providing over half of the country's electricity, is shut down by 2025 as planned, GHG emissions are likely to grow because much of the replacement capacity will be fired by fossil fuels. Therefore, the overall Belgian power sector will face an extra financial burden since fossil-fuel-based power plants will have to account for the CO_2 price.

ACTIONS TAKEN TO MEET THE EMISSIONS REDUCTION TARGETS

NATIONAL CLIMATE PLAN

In the Belgian federal system, policies and measures to reduce GHG emissions are mapped out at different levels of responsibility based on the division of powers between the federal government and the regions. Each level of power establishes its own priorities for environmental and climate policies. Co-ordination bodies have been set up to harmonise and create synergy between the policies implemented by the federal government and the three regions:[15] the National Climate Commission (climate policies) and CONCERE/ ENOVER (energy policies).

The general context for the preparation of climate change policies and measures is thus determined by the plans established by the federal and regional authorities setting out policy objectives and strategies. Federal and regional governments are implementing various policies and measures to achieve the national goals.

A National Climate Plan for the period 2009-2012 has finally been developed and was adopted in April 2009. The plan provides a good overview of the current situation and the measures decided at different levels of power and competences.

However, while the plan provides a good inventory of policies and measures, it does not incorporate some important recommendations of the previous in-depth review of Belgian energy policies. It also misses the opportunity of putting Belgium at the forefront of climate policy in Europe:

- First, little analysis on the cost-effectiveness and the potential emissions reductions of individual implemented measures has been carried out. Also, no overall evaluation of all measures is available, making it difficult to understand the combined impact of all existing policies towards the GHG objectives and the comparative advantage of specific measures.[16.]

- Secondly, the plan highlights that measures adopted at different levels are often poorly or even insufficiently co-ordinated, without moving towards a more integrated, harmonised approach where possible.

15. A co-operation agreement adopted in 2002 formalised co-operation between the federal state and the three regions with a view to ensuring optimal integration of the policies of the different authorities and guaranteeing a coherent and ambitious National Climate Plan.
16. This is in contrast to the last in-depth review, which recommended "the calculation of emissions reduction potentials and cost-effectiveness of all policies and measures" as an essential part of the plan.

- Finally, a long-term vision on how to achieve the significant emissions reductions needed to put Belgium on track towards a low-carbon energy future is missing.

While the plan is thus clearly a step in the right direction, and constitutes a useful basis upon which a long-term strategy could be based, the Belgian authorities should consider these issues in revising the plan in 2010.

To achieve the economy-wide climate goals, the climate policies adopted by the regional and federal authorities have evolved appreciably in recent years. A range of policies and measures were implemented in various areas:

- **Energy production**: In addition to the regional Green Certificates scheme (a system of quotas for all renewable energy sources), the federal authorities have implemented several measures to promote offshore wind farms.

- **Energy consumption**: Investments designed to improve energy efficiency and promote rational use of energy are encouraged by tax deductions or subsidies granted to companies and/or individuals. Since the last in-depth review, these policies were considerably reinforced.

- **Transport**: The actions undertaken by the federal and regional authorities focus basically on checking the growth of car traffic, promoting a "modal shift" (to rail and waterway), and the use of biofuels.

- **Industry**: New measures designed to reduce industrial non-energy-related GHG emissions come within the scope of regulations on environment permits (restriction on the use of fluorinated gases, introduction of best available technologies, etc.) and the voluntary agreements negotiated between the regional authorities and industrial federations.

- **Agriculture and forestry**: New actions in agriculture focus primarily on reducing the factors of production (establishing new land application standards for animal manure, limiting growth of the livestock) and improving farming practices (treatment, storage and spreading of manure, recovery of waste, combating soil degradation, etc.). Reforestation and forest conservation are encouraged by specific laws.

- **Waste**: The policies and measures implemented to reduce the volume of waste and to optimise treatment are reinforced (environmental taxation, stricter regulations *e.g.* ban on landfill, compulsory treatment of landfill gases, standards for incinerators, development of specific channels for treating and recovering some waste materials).

- **Research**: Research activities cover the climate system and the effects of climate change, socio-economic aspects as well as technological aspects (energy). Climate research at the federal level is primarily integrated into

the framework of the "Science for Sustainable Development" programme, which has a total budget of EUR 65.4 million[17] for the period 2005-2009. A partnership agreement is in force between the federal and the federated authorities concerning the definition of research priorities.

FLANDERS

At the regional level, the Flemish climate policy plan 2006-2012 and its 2008 Progress Report foresee a reduction of GHG emissions by 5.2% over the period 2008-2012 compared to 1990, to meet Flanders' Kyoto target. This objective was made conditional on the federal authority taking helpful measures in the fiscal area and with regard to transport and product policy.

The new Flemish Climate Policy Plan builds upon the lessons and challenges of the 2002-2005 version and the progress reports, both in terms of process and content. The organisation of the Flemish Climate Conference, a broad-based consultation process with all economic actors, social unions, environmental groups, local authorities and experts, proved to be an important element in building a new policy.

The results of this consultation process were integrated in the new Flemish Climate Policy Plan, which therefore represents a strategic policy plan with actions in all relevant Flemish competence areas, clustered in ten topics. Overall targets are set for five topics covering climate friendly and sustainable mobility, rational energy use, sustainable and low-carbon energy supplies, industry and sustainable agriculture and forestry. Five horizontal topics deal with research and innovation, awareness-raising, flexibility mechanisms, the lead role of the government and the adaptation to climate change impacts. Every topic clusters the various measures which must contribute to achieving the overall target and the specific objectives. In order to monitor the achievement of the plan's objectives in the best way, special attention is paid to the formulation of indicators for every subject, as well as to the monitoring and co-ordination with other policies and policy levels. In particular, to allow efficient follow-up of the policies in the Flemish Climate Policy Plan not covered by the ETS, a database was developed with all the measures and their monitoring indicators. A concise six-monthly report on the evolution of the projects and the possible problems in implementation is submitted to the Flemish government. A two-yearly in-depth process report (Progress Report 2008) has been approved by the Flemish government on 15 May 2009. The Progress Report 2008 includes 107 climate policy measures. The corresponding regional budget to realise these measure amounts to EUR 1.3 billion in the period 2006-2012.

17. On average in 2008, EUR 1 = USD 1.462.

Among these policies and measures, the following six are particularly encouraging:

- The Energy Renovation Programme 2020 for existing housing;
- The implementation of energy performance certificates for buildings;
- Evaluation of the energy performance regulation;
- Increased objectives for rational use of energy imposed on the grid managers;
- The promotion of rational use of energy in low-income families;
- The extension of communication and information campaigns concerning rational use of energy and environment-friendly energy production.

WALLONIA

The Walloon Air Climate Plan was adopted by the Walloon government on 15 March 2007. It proposes about 100 measures for the period 2010 to 2020, integrating air and climate policy.[18]

BRUSSELS-CAPITAL REGION

In November 2002, the Brussels-Capital government adopted an eight-year air and climate plan, the "Plan for Structural Improvement in Air Quality and Fight against Climate Change, 2002–2010".[19] This plan has 81 prescriptions concentrated on concrete actions to reduce the main air pollutants and GHGs. The most efficient prescriptions for reducing GHG emissions are in three areas:

- Road transportation: Actions in traffic and parking management, mobility plans for public transport, clean vehicles, etc.
- Energy consumption of building-heating systems: Actions in thermal regulation, control, energy certification, eco-construction, etc.
- Commercial consumption: Regulation and control of refrigeration installations, etc.

The plan is directed at the main sectors that emit greenhouse gases, whether they are covered by the "Emissions Trading" (ET) Directive or not.[20]

18. For more details, see http://airclimat.wallonie.be.
19. "Plan for the Structural Improvement of Air Quality and the Fight against Global Warming, 2002-2010", Government decision of Brussels-Capital region of 13 November 2002 (http://www.ibgebim.be/francais/pdf/Air/PLANAC_complet.pdf).
20. The plan does not distinguish between the sectors concerned or not by the ET Directive, which, in the Brussels-Capital region, only relates to a very limited portion of emissions from "industry" and "tertiary" sectors.

These requirements are currently being implemented on the basis of new concrete measures applied by the government in the residential and transport sectors. Since 2004, several actions aimed at reinforcing and/or accelerating the implementation of the Air Climate Plan were decided and realised. Among other things, the region decided in November 2004 to invest USD 9.5 million until 2014 in the "Carbon Fund" of the World Bank, the "Community Development Carbon Fund" (CDCF), while applying the supplementary principle and vowing to avail of flexibility mechanisms for a maximum of 50% of its reduction effort.[21]

On 6 December 2007, the government approved a road-map aiming to approve in December 2008 an integrated climate plan for 2020. This climate plan, which will be based on a multidisciplinary approach, is still in preparation.

AIR POLLUTION

Belgium's policy on air quality is mainly based on European directives and international protocols. It concerns various pollutants: ozone (O_3), nitrogen oxides (NO_x), nitrogen dioxide (NO_2), volatile organic compounds (VOCs), benzene, dust (PM_{10} and $PM_{2.5}$), polycyclic aromatic hydrocarbons (PAH) and heavy metals (lead, cadmium, nickel, arsenic, mercury). For the concentrations of pollutants, the Framework Directive 96/62/EC of 27 September 1996 on ambient air quality was followed by four related directives. These directives will be replaced in June 2010 by the directive 2008/50/CE. They fix, among others, the concentration limit value, the target value and, where necessary, the population warning threshold for each key pollutant in ambient air. The emissions of pollutants have to respect the National Emission Ceilings (NEC) Directive 2001/81/CE and the international protocols (Göteborg, Oslo and Aarhus).

The situation regarding air pollution is ambiguous in Belgium. The three regions have made significant progress in reducing emissions but some air quality objectives – those concerning emissions at national level (NO_X for the transport sector) and concentrations at regional level (PM_{10}, NO_2 and O_3). – are not yet respected.

In Wallonia, concentrations of the different pollutants are all below the threshold imposed by EU directives, except for PM_{10} that exceed values to a large extent, particularly around industrial areas. SO_2 concentrations decreased by 40 to 85% between 1990 and 2005, through the use of less polluting fuels. Also, NO_x concentrations fell over the last years and are now largely in line with the limit values. Nevertheless, levels of tropospheric ozone

21. According to the current investment plan of the CDCF, Brussels-Capital can count on around 100 kt of CO_2 per annum in certified emissions reduction (CER) credits.

often exceed quality objectives, mainly in rural areas, given that its origin is mainly natural (related to vegetation) rather than correlated to traffic.

Flanders has made significant progress in reducing other emissions. In Flanders, for example, SO_2 and NO_x emissions have fallen by 58% and 21%, respectively, since 1990. These reductions have been achieved by a combination of legislation (emission limit values) and voluntary agreements. The same approach will be used in the future. Agreements with the electricity industry will limit SO_2 emissions from 25 000 tonnes in 2002 to 4 300 tonnes in 2013. NO_x emissions will be limited to 11 000 tonnes, down from 29 000 tonnes in 2002. These reductions will be achieved by further implementation of primary and end-of-pipe techniques, and a further switch to cleaner fuels and cleaner production. A voluntary agreement on NO_x emissions is under discussion and expected to be signed in the near future with the chemical sector, glass producers and a major iron and steel plant.

In the Brussels-Capital region, most of the pollutants concerned by the directive and international protocols have decreased drastically since 1990 (-55% for NO_X, -64% for VOCs, -83% for CO, -80% for SO_2, -30% for PAH, -96% for lead, -73% for fine particles). Nevertheless, reducing emissions of VOCs for Brussels-Capital and NO_x for the transport sector (at national level) might be difficult. According to the Brussels Institute for Environmental Management (IBGE), which is in charge of monitoring and combating air pollution, the air quality objectives for the concentration of fine particles, nitrogen dioxides and ozone will probably not be fulfilled also in the Brussels-Capital region. Some additional measures are thus still necessary to achieve the objectives of the EU directives especially in the transport sector. Given that a part of the concentrations of particles, ozone precursors (VOC and NO_2) and particles (NH_3), is coming from outside the region (see Directive 2008/50/CE[22]), the measures have to be applied at regional, national and international levels to decrease the background concentrations of these pollutants.

CRITIQUE

Belgium's total GHG emissions (excluding land-use change and forestry) in 2007 were 9.9% below base year emissions, being thus below its Kyoto commitment of a -7.5% reduction. The country's GHG emissions path has strongly changed since 2003, which is a positive development. The revised trend in GHG emissions, the projected use of flexible mechanisms[23] and latest emission projections indicate that Belgium is likely to meet its Kyoto target.

22. http://ec.europa.eu/environment/air/quality/legislation/time_extensions.htm
23. Note, however, problems related to the availability of international credits, which may render the achievement of Belgium's Kyoto target more difficult/expensive than expected.

Nonetheless, modelling studies suggest that it will be very challenging to pave the way beyond the first Kyoto commitment period towards compliance with the new EU target for GHG emissions reductions by 2020. In particular, the drop in GHG emissions over the last years needs to be evaluated in more depth to understand whether the policies and measures adopted were the main drivers, or whether other factors like high oil prices, the evolution in the iron and steel industry (and the impact on coal demand)[24] or the particular climate and economic conditions have led to this situation. A better evaluation of the effect of Belgium's policies and measures at the different levels helps to understand whether the emissions path is permanently altered.[25]

While modelling exercises suggest that the achievement of the multiple targets is feasible, their results and some of the underlying assumptions also highlight that the changes needed are significant and require a complete and urgent overhaul of Belgium's energy sector. And the scale of the challenge is considerable. Belgium's economy is very energy-intensive, because of the importance of the steel and petrochemical industries.[26] While there have been closures of steel plants in 2008, these are only temporary. Studies concur that mitigation potential is minor in the industry sector. While this fact would probably be taken into account in the future allocation rules at the European level, this structural feature poses a first difficulty for Belgium to meet stringent GHG targets. In addition, because of Belgium's central geographical position, emissions from transport have significantly increased over the last years.

The nuclear phase-out beginning in 2015 reinforces the challenge to achieve the significant GHG emissions reductions required to attain the longer-term low-carbon energy future outlined by the EU-wide 2020 commitment and the broader international climate policy targets. In addition, the electricity sector is characterised by very old plants adding to the financial challenge of meeting the GHG goals, and early retirement of carbon-intensive units might be needed. Finally, there is almost no potential to store CO_2 on Belgian territory.[27] CO_2 capture and storage (CCS), while generally acknowledged as an important part in the portfolio of technologies for a low-carbon future, can thus not be counted on to a major extent. In brief, certain technologies are not available for Belgium's long-term mitigation strategy, while emissions reduction potentials are mainly concentrated in the energy sector, the transport sector, the residential sector, and the tertiary sector.[28]

24. Two highly emission-intensive steel plants are temporarily closed in Wallonia.
25. Note that this evaluation is ongoing within the National Climate Commission. The results will be available by the end of 2009.
26. Industry (combustion and process) is responsible for 30% of Belgium's GHG emissions, and in the Walloon region for 44%. Energy industries contribute a further 21%.
27. However, carbon capture in Belgium and its transportation for storage in neighbouring countries is an option under consideration.
28. Regarding non-CO_2 gases, a significant potential lies in the agricultural sector.

In the light of these conditions, Belgium's emission path necessitates dramatic improvements in energy efficiency and a rapid shift in the fuel mix towards a higher share of renewable sources. The government already has plans to promote energy efficiency and renewables. However, it is important to have integrated planning of policies to achieve the GHG, renewables and energy efficiency targets simultaneously, given the strong interactions between measures in the three regions. Multiple measures to tap the country's extensive energy efficiency potential and to promote substantial renewable energy should be taken without further delay to attain the 20-20-20 goal (reducing GHG emissions by 20%, increasing renewables' share in energy supply to 20% and improving energy efficiency by 20% by 2020). Given the phase-out policy, Belgium should ensure that plans to meet any CO_2 emission commitments beyond 2015 take into account the emissions of CO_2 from any sources that replace nuclear, also in terms of financial implications as the power sector under the EU-ETS is moving towards auctioning.

In addition, Belgium needs a further focus on a few key elements to render its environment and energy strategy successful.

First of all, a long-term perspective on climate and energy policies is needed. The "Spring of the Environment" initiative demonstrates the awareness of the need for such a strategy: one of its working groups manifested the intention to create a climate committee on post-2012 issues, and this is encouraging. Nonetheless, the adoption of the National Climate Plan highlights that a clear long-term vision is still missing, as this plan would have been the opportunity to share it. In developing this long-term vision, closer co-ordination between climate and energy policies should be achieved. In particular, consideration should be given to the impact of early retirement of fossil fuel capacities and of the nuclear phase-out.

In addition, more attention should be paid to monitoring and evaluation. It is already partially done at different levels, but better co-ordination is needed. Above all, the methodology to evaluate polices and measures should be harmonised, in order to ensure comparability and the ability to identify the most efficient measures. In this context, it is encouraging that such co-ordination already occurs in the context of federal and regional emission projections, based on standardised modelling assumptions. Also, work is ongoing to harmonise statistics.

Overall, while the establishment of co-ordination bodies to harmonise and create synergies between the policies implemented by the federal government and the three regions is encouraging, co-ordination should be further improved. In fact, similar policies and measures such as green certificates, incentives for energy-efficient investment and voluntary covenants are adopted at different levels. While taking into account the specific circumstances in each region, the co-ordination and, where possible, harmonisation of these policies and measures should be pursued in order to maximise their overall effectiveness.

As discussed in Chapter 6 on renewable energy, the harmonisation of green certificate schemes would be a beneficial first step to maximise the benefits of market-based actions to reduce CO_2 emissions.

Finally, a sound analysis of the mitigation potential and abatement costs in all sectors and of all options – including the purchase of reductions on the international market – should be urgently pursued. This analysis of cost-effectiveness should be the basis for deciding how Belgium will meet its commitments, including the Kyoto and the new EU targets both in the sectors covered by the EU Emissions Trading Scheme and the remaining sectors. It also should be the basis for deciding how much can be expected from domestic policies and how much should be purchased by the government from the international market. Finally, it also should be the basis for allocating the new goals between regions, in order to ensure that actions are taken efficiently. This strategy is essential to draw the attention to the financial resources required to implement the emissions reduction objectives. The National Climate Plan, which fails to provide an overall evaluation of all measures, should address these issues in its revised version.

RECOMMENDATIONS

The government of Belgium should:

- *Give priority to the development of a long-term strategy for the transition towards a low-carbon energy future building on the EU 20-20-20 goals, integrating policies on GHG, renewables and energy efficiency, so as to provide a clear and stable regulatory framework for investors and consumers.*

- *Strive to co-ordinate and, where possible, harmonise policies and measures at federal, regional and local levels that all directly or indirectly influence climate policy with a view to maximising their overall effects.*

- *Enhance evaluation and monitoring of policies and measures. Ensure that monitoring and evaluation at different government levels are based on harmonised methodologies allowing cross-comparisons and thus identifying the most efficient measures.*

- *Ensure effective allocation of the EU 20-20-20 targets among regions on the basis of sound emission projections, mitigation potential assessments and cost-effectiveness of all policies and measures.*

OVERVIEW

Energy intensity of Belgium's economy has been improving since the 1970s but it is still higher than the IEA Europe average. The energy efficiency policy is increasingly driven by the EU requirements and targets. Energy efficiency is primarily the competence of the three Belgian regions but several policies and measures to promote efficient use of energy exist at the federal level as well.

TRENDS AND PROJECTIONS

The energy intensity (primary energy consumption per unit of GDP) of Belgium's economy is higher than that of its neighbours and the IEA Europe average (see Figure 8). This is in part due to a very energy-intensive industrial sector with a large share of iron/steel industry and chemicals. Energy intensity has improved significantly since the early 1970s but the improvement rates have been irregular over time. Energy intensity mainly increased in the late 1980s and through most of the 1990s and started declining in 1997. Both energy intensity and domestic energy consumption in absolute terms have been declining steadily since 2004, although it is difficult to determine exactly which factors had an influence on this decline, including energy efficiency policies, structural changes in the economy, milder weather and economic conditions.

POLICY FRAMEWORK

INSTITUTIONAL FRAMEWORK

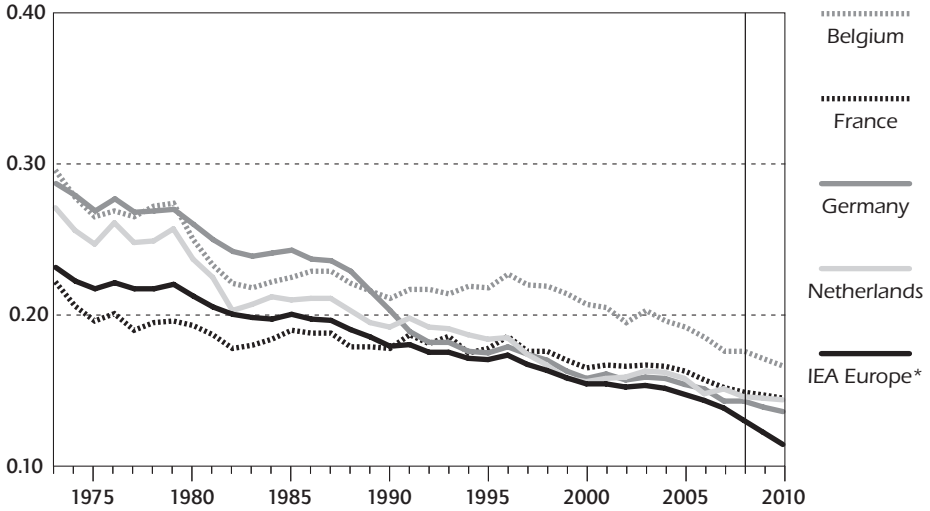
Energy efficiency policy is primarily the competence of the three Belgian regions – Brussels-Capital, Flanders and Wallonia. They stimulate energy efficiency through a wide variety of measures including investment subsidies, low- or zero-interest loans, premiums and information campaigns. The federal government contributes to enhancing energy efficiency through energy-related taxes and other fiscal incentives, energy performance standards for equipment, energy labelling, soft loans and other measures.

In addition to the federal and regional aids, some support schemes exist in a number of municipalities. Incentives provided at the different levels – federal, regional and local – can be accumulated. For final consumers it is sometimes difficult to understand the interactions between different schemes and their overall benefits.

Figure 8

Energy Intensity in Belgium and in Other Selected IEA Member Countries, 1973 to 2010

(toe per thousand USD at 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, 2009 and *National Accounts of OECD Countries*, OECD Paris, 2009 and country submissions.

A co-ordination body, CONCERE/ENOVER, has been set up to harmonise and create synergy among the policies implemented by the federal government and by the three regions (see also Chapter 2). One of the tasks of CONCERE/ENOVER is to monitor all measures existing at the federal and regional levels and to evaluate their impact on energy demand. The results of this evaluation will be published annually.

All three regions have established networks of so-called "energy experts" or "facilitators" with the objective to facilitate investments in energy efficiency improvements. Their mandates generally include information dissemination, advice to potential investors, and energy audits of buildings and – in some cases – of industrial installations.

EU TARGETS AND DIRECTIVES

The Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC) contains an indicative national energy savings target of 9% to 2016, to be reached by way of energy services and other energy efficiency improvement

measures in the sectors that are not part of the EU Emissions Trading Scheme (EU-ETS). The reduction is calculated against the annual average total final consumption (TFC) of energy in the non-ETS sectors over the most recent five-year period previous to 2008 for which official data are available.

The Directive on the Energy Performance of Buildings (2002/91/EC) sets requirements for a more energy-efficient building code, including minimum performance standards and energy certificates. Requirements for energy labelling of household appliances, in turn, are based on several directives adopted over the past 15 years. They also include compulsory minimum efficiency requirements. Over the longer term, the Directive Establishing a Framework for Setting Ecodesign Requirements for Energy-Using Products (2005/32/EC) will improve the energy efficiency of new products outside the transport sector. Furthermore, the EU-ETS has an indirect, but strong effect on energy efficiency in heavy industry and the heat and power sector.

In addition to the -9% target by 2016, Belgium and other EU member states have also agreed to a non-binding -20% target for 2020. This 2020 target is calculated as savings in total primary energy supply (TPES) from the business-as-usual scenario.

KEY POLICY DIRECTIONS

As required by the EU Directive on Energy End-Use Efficiency and Energy Services, in 2007 Belgium submitted to the European Commission (EC) a National Energy Efficiency Action Plan consisting of one federal and three regional plans. These plans list diverse measures to promote energy efficiency that already exist in the regions and at the federal level. Each region has set an energy efficiency target but there is no specific federal target: the national target is the sum of the three regional ones. The targeted savings is 27 515 GWh, 62% of which is to be achieved in the Flemish region, 30% in Wallonia and 8% in Brussels-Capital. The Action Plans of the federal government and the regions (with the exception of Flanders) do not contain, or contain very few, estimates of energy savings that can be achieved through the implementation of the measures outlined in the plans, as this is not obligatory according to the EU directive.

The more recent National Climate Plan 2009-2012, adopted in April 2009, lists energy efficiency policies and measures active as of 31 December 2008.

The measures outlined in the National Energy Efficiency Action Plan and the National Climate Plan vary significantly among regions in terms of conditions, amounts, the scope of application and target groups. A number of these measures target low-income households. For example, the « Energiesnoeiers » project in Flanders aims to give training and employment to individuals from low-income households so that they can work in the area of energy efficiency,

primarily conducting energy audits. In Wallonia, the MEBAR plan (*Ménages à bas revenus*) provides subsidies to low-income households for improving the energy efficiency of their dwellings.

In the context of the economic and financial crisis in 2008, the federal government set up a Federal Plan on Economic Recovery in order to boost the Belgian economy and employment. This plan has a strong focus on energy efficiency.

POLICIES AND MEASURES BY SECTOR

BUILDINGS

Buildings in Belgium are the main energy users accounting for 31% of energy demand in 2007.[29] Energy savings potential in this sector is very large. Half of Belgian dwellings (approximately 2 million) do not meet current building codes.[30]

The federal government has established fiscal incentives for energy efficiency improvements in buildings, such as improving insulation, replacing inefficient boilers, installing double or triple glazing, and carrying out energy audits. Households (both owners and tenants) can deduct up to 40% of their investment costs from the tax base. The amount of fiscal reductions is updated every year and is set to grow progressively. An additional tax reduction of EUR 600 was introduced in 2007 for buildings that meet the requirements of "passive houses".

The federal government has also set up a Fund for the Reduction of Energy Costs (FRCE/FRGE) which serves to finance energy efficiency improvements in buildings by households with low incomes In 2008/09, the government took measures to facilitate and improve the Fund's functioning. The Fund's capital has been raised from EUR 50 million to EUR 250 million. Additionally, the Flemish region has set up an "energy renovation loan" *(Energierenovatiekrediet)*, and the Walloon and Brussels-Capital regions both propose zero interest loans for investments in energy efficiency.[31]

The federal government created in 2005 the Federal Energy Services Company (FEDESCO). Its current mandate includes not only improving energy efficiency in public buildings through third-party financing and energy performance contracts, but also installing photovoltaic (PV) panels on public buildings (see Chapter 6). In November 2008, the Council of Ministers adopted an ambitious target to reduce CO_2 emissions in public buildings by 22% in 2014, and decided to provide EUR 100 million towards reaching this target. FEDESCO will manage this budget.

29. Panorama de l'économie belge, 2007.
30. Intervention by Paul Magnette, Minister for Climate and Energy, 14 January 2009.
31. In Brussels-Capital, zero interest loans *(prêt vert social)* target low-income households.

To comply with the EU Directive on the Energy Performance of Buildings, each Belgian region is developing its own system of energy performance certificates for new buildings and major renovations. The regions are setting energy performance requirements for buildings in the residential, commercial and public-service sectors, and evaluate energy performance taking into account characteristics of the regional building stocks. They work together towards harmonisation of evaluation methodologies within CONCERE/ENOVER.

The regions have also put in place many other initiatives to promote energy savings in the existing and new buildings. For example, the "Build with Energy" programme, launched in Wallonia in 2004, brings together architects, construction companies, public authorities and other stakeholders in order to achieve high energy performance of new buildings. In the framework of the "Energy Advice Procedure", the Walloon region subsidises energy audits of single family houses, supports inventory of energy performance of buildings and provides advice on improving energy performance of dwellings. In Flanders, the "Energy Renovation Programme 2020" aims at making the existing dwellings more energy-efficient, particularly through insulation, double glazing and energy-efficient heating.

TRANSPORT

Improving energy efficiency in the transport sector has proven difficult in all IEA countries. In Belgium, because of its geographical position and its active role in merchandise transportation in Europe, this task is particularly challenging.

The Federal Planning Bureau, in co-ordination with the Federal Public Service (Ministry) of Mobility and Transport, released a *Planning Paper* in early 2009, which estimates the development of Belgium's transport system until 2030. According to the business-as-usual scenario, passenger transportation will grow by 30% and freight by 60% between 2005 and 2030.[32] Although the share of rail and navigation will grow slightly, road will remain the dominant means of transportation, accounting for 84% of passenger travel and 70% of freight in 2030. Road congestion is expected to worsen; as a result the average speed will decline. Air pollutants from transport will decrease nonetheless because of stricter environmental regulations and technological improvements. However, despite such improvements, GHG emissions in transport are still expected to grow by 18% between 2005 and 2030 in the business-as-usual scenario. This Planning Paper demonstrates the need for changes in the policy and regulatory framework if Belgium is to make its transportation system more sustainable.

32. This increase is mainly due to the transit of goods through Belgian territory.

Belgium's policy regarding transportation is based on the following four pillars:

- Favour modal shifts towards more sustainable transportation options;
- Improve efficiency of transportation;
- Promote environment-friendly vehicles;
- Promote biofuels (see Chapter 6 for more details).

Modal shifts

Each region has its own mobility plan. The regional and federal authorities work together to improve coherence and co-ordination between the regional and federal plans, in particular regarding mobility to and from Brussels-Capital. The regions and the federal government also encourage the development of local mobility plans, in co-operation with municipalities and/or enterprises and public institutions (*e.g.* schools).

One key priority of the Belgian mobility policy is to promote public transportation. Significant efforts have been made to date in this area at all levels – federal, regional and local. As a result, the share of public transportation in total passenger transport has been growing steadily in recent years, especially in Flanders and Brussels-Capital. However, cars are still the dominant mode of transportation in Belgium, accounting for 76% of the total, compared to 4.9% for public transport and 6.7% for train.

In 2008, the federal government set an objective for the national railway company, SNCB, to increase the number of passengers transported by rail within Belgium by 3.8% per year in 2008-2012. To make railway more attractive, the government has introduced reduced or free tariffs for several groups of passengers, and has established various requirements for SNCB in terms of service quality, security, accessibility and availability of information.

As for freight, Belgium encourages the use of rail and river navigation through different measures taken at the federal and regional levels. However, freight by road (currently 72% of the total) is growing faster than freight by railway (10% of the total) or river (14%) mainly because of Belgium's attractiveness as a logistical centre of Europe.

Improving efficiency of transportation

To improve efficiency of road transportation and reduce fuel consumption, Belgium uses a number of measures, including:

- Speed limits;
- Promotion of car-sharing and car-pooling;
- Promotion of work from home;
- Eco-driving;

- Rationalisation of parking spaces (in Brussels-Capital);
- Optimisation of freight through various measures.

Environment-friendly vehicles

Several policies and measures aim at improving environmental performance of vehicles. The federal government has introduced fiscal incentives to encourage companies and households to purchase cars that emit little CO_2 and other pollutants. A tax rebate is granted for the purchase of a new car emitting 115 g/km of CO_2 or less. In addition, Wallonia established a bonus-malus system for private vehicles in 2008. If a car purchased emits less CO_2 than the norm established by the Walloon regulation, the purchaser receives a bonus; in the opposite case he/she has to pay a supplement. Wallonia also provides specific support for the manufacture of clean vehicles.

The regions participate in the development of the so-called ECOSCORE system – evaluation of cars from the point of view of their environmental characteristics (including CO_2 emissions and other pollutants). Related to the ECOSCORE system, a tax reform is under development in Belgium regarding circulation taxes and vehicle taxes. This tax reform will aim at the promotion of vehicles and circulation patterns more respectful of the environment.

APPLIANCES AND EQUIPMENT

Mandatory energy labelling of domestic appliances is based on the EU directives. It covers lamps, ovens, refrigerators, freezers, washing machines, tumble-dryers and dishwashers. Appliances are classified from A to G, where class A is for the most energy-efficient appliances. In 2004, two new classes were introduced: compared to class A, electricity consumption in class A+ is 25% lower and in class A++ 40% lower. Implementation and evaluation of energy labelling is the responsibility of the federal government. In addition, in the Flemish and the Brussels-Capital regions, consumers purchasing certain energy-efficient domestic appliances can receive premiums.

In the coming years, minimum energy efficiency standards for appliances will be introduced in Belgium and other EU member states. These standards will be set by EU regulations based on the Ecodesign Directive (2005/32/EC). Since autumn 2008, the EU Commission has been gradually proposing such standards for close to 20 product groups.

INDUSTRY AND UTILITIES

The European Union Emissions Trading Scheme (EU-ETS) is the key driver for energy efficiency improvements in industry and the energy sector (see Chapter 3). A number of additional measures aim to reinforce the

incentives provided by the ETS, and to create additional incentives for industrial companies not covered by the ETS.

Flanders has signed benchmarking covenants with 172 large energy-intensive industrial enterprises (annual consumption 0.5 petajoules or more) covered by the EU-ETS. In the covenant, the enterprise takes a voluntary commitment to reach the top world level of energy performance by 2012. The Flemish region also signed "audit conventions" with 232 medium-sized energy-intensive enterprises (annual consumption between 0.1 PJ and 0.5 PJ) to stimulate energy audits and cost-effective investments in energy efficiency improvements. For companies signing the covenants, the Flemish authorities provide compensations such as tax benefits, exemptions from additional regulatory requirements and possible financial aids. Both the benchmarking and audit covenants cover approximately 400 companies accounting for 93% of industrial primary energy consumption in Flanders. The eligible companies which do not sign a voluntary covenant must have an energy plan conducted by an authorised expert, who identifies the company's energy saving potential and possible measures to reduce energy consumption. The company must then carry out investments to achieve energy savings during the period of the plan's validity (4 years).

Wallonia also signed voluntary agreements with over 160 companies which jointly account for 90% of industrial energy consumption. These agreements set an objective for each signatory company to reduce its energy intensity and CO_2 emissions by 2010 or 2012, according to the sector-based agreements; in exchange, the company will be exempt from future obligatory requirements and can benefit from subsidies for energy audits and other support measures. The Brussels-Capital region, which has little energy-intensive industry, grants a label "Eco-dynamic enterprise" to companies with sustainable practices, including efficient energy use. It is also considering the introduction of voluntary agreements.

Enterprises in Belgium can take advantage of fiscal deductions (13.5%) for investments in energy efficiency improvements. In addition, the three regions provide different types of financial aids for such investments.

Belgian utilities have public service obligations which include energy savings requirements. In the Flemish region, electricity distribution network operators are obliged to encourage their final customers to achieve primary energy savings. From 2008, annual energy savings must reach 2% for residential users and 1.5% for non-residential ones. In case of non-compliance, the network operators are fined. Brussels-Capital also requires electricity and gas network operators to promote efficient energy use among their final customers. Wallonia, on the other hand, promotes end-use efficiency by premiums to energy suppliers for energy-saving measures.

COMBINED HEAT AND POWER

The Flemish region has a target to provide 19% of electricity from high-quality combined heat and power (CHP), also known as co-generation, in 2010, from less than 15% in 2007. Wallonia's target is 10% in 2020 against 8.1% in 2007.

The three regions promote co-generation primarily through CHP certificates. They are part of the "green certificate" systems discussed in greater detail in Chapter 6. Each of the three regions has a quota obligation for electricity suppliers to supply a certain share of total electricity sales from "quality" CHP and renewables. Flanders and Wallonia have minimum prices for CHP and other green certificates. Support for CHP in Wallonia[33] is limited to plants with capacity below 20 MW. Biomass-fired co-generation benefits from a higher level of support than that fired by fossil fuels. The regional schemes have significant differences. In Brussels-Capital and Wallonia, the certificates are based on avoided CO_2 emissions, while in Flanders, on the amount of electricity generated from CHP. Given the relatively small Belgian market, the existence of different regional CHP certificate schemes reduces their overall efficiency.

There are additional incentives for CHP in some regions. For example, the Walloon government awards grants for the installation of micro co-generation systems. Households, enterprises, self-employed workers and private entities are all eligible to receive grants.

PUBLIC PROCUREMENT

The federal government has made available on the Internet a catalogue of "sustainable" procurement schemes for public markets according to the European Directives on Public Procurement. It has more than ten categories covering office equipment, computers, vehicles and other goods. The regions each have a set of guidelines for these public procurements. The federal and regional guidelines are mandatory above a certain threshold.

CRITIQUE

Since the last review of 2005, domestic energy consumption has been declining steadily, and energy intensity of the economy has been improving. This is partly due to energy efficiency policies and measures. Overall, a significant number of such measures exist in Belgium at the regional and federal levels, targeting all end-use sectors. This is very positive. However, the

33. Decree of 12 April 2001 (amended) on the organisation of the regional electricity market (M.B. of 1 May 2001, p. 14118) paragraph 8. As regards hydroelectric production plants, high-quality co-generation plants or electricity produced from biomass, green certificates are awarded for the electricity produced by these plants for up to a 20 MW production (Decree of 4 October 2007).

overall effectiveness and cost-efficiency of the existing and planned support schemes could be improved further by addressing several challenges.

First, there is room for improvement in streamlining the existing support measures. There is some overlap of federal, regional and local policies and measures covering various sectors. Insufficient co–ordination complicates the implementation of support schemes, increases the overall financial burden on different government levels and in many cases leads to sub-optimal results. Encouragingly, a working group within CONCERE/ENOVER has been established to improve the co-ordination of financial support schemes. These efforts should be pursued. Better co-ordination and, where possible, harmonisation of policies and measures at the federal, regional and local levels as well as between sectors will help identifying synergies and avoiding overlaps, thus maximising their overall effectiveness.

Secondly, there seems to be no clear understanding among stakeholders, including end-users, about how all different policies interact. As mentioned above, many support schemes target the same measures at different government levels, which makes it confusing for the users (both industry and households) to access these in an easy manner. This constitutes a significant barrier for energy efficiency improvements. Making information more transparent for users is therefore essential. The ongoing initiatives in this area ("facilitators", websites,[34] information centres) should be further enhanced.

The compilation of the National Energy Efficiency Action Plan and the National Climate Plan is a good first step towards streamlining policies and measures. These plans present detailed measures in all sectors, ranging from information dissemination to tax reduction schemes, and serve as a good inventory of tools currently used. However, there is no clear evaluation yet of the cost-effectiveness of the existing policies, and of their exact impact on energy consumption. The regions and the federal government are working together to establish a common methodology for calculating energy savings, a process to be commended. Monitoring and evaluation of the implemented measures should be enhanced further at all levels with a view to identifying the most effective solutions.

Another challenge is the proper enforcement of the adopted policies and measures in a co-ordinated and harmonised way. Several steps taken in this direction are praiseworthy; and the federal and regional governments are urged to make compliance and enforcement an even higher policy priority.

Improving energy efficiency in buildings is rightly one of the key priorities of the federal and regional governments as buildings account for the bulk of Belgium's energy consumption. The existing and planned policies to stimulate

34. See, for example, tax reductions for energy efficiency at Federal Public Service Finance, www.minfin.fgov.be and for regional premiums: www.energiesparen.be, www.energie.wallonie.be, www.ibgebim.be.

energy efficiency in the existing and new buildings are ambitious and should be pursued. In designing and implementing new policies, particular attention should be paid to the identification of non-economic barriers (for example, conflict of interest between tenants and owners) and to addressing them. Various non-economic barriers significantly hamper investments in energy efficiency even where such investments are cost-effective and can lead to large savings.

While there is potential for further energy efficiency improvements in all sectors of the Belgian economy, reducing energy use in the transport sector is the most challenging, as in all OECD countries. An additional challenge for Belgium is its important role in European road transit, which contributes to the use of petroleum products and the related emissions. The initiatives already introduced by different regions and the federal government are to be commended. The planned revision of the taxation policy is a welcome opportunity to better internalise the externalities related to transport. Nevertheless, an even stronger political will is needed to effectively address transport challenges. In particular, there is need to further streamline the complex distribution of competences between various authorities. Relevant institutions should enhance collaboration to improve the overall efficiency of transport policy and its integration with the energy, fiscal and environmental policies.

Energy efficiency in industry is primarily stimulated through voluntary agreements (covenants). In principle, this is a very positive approach as it gives industrial companies flexibility and reduces the administrative burden, compared to mandatory measures. However, it is important to ensure that voluntary agreements are transparent enough and provide sufficient incentives for industry to make significant energy efficiency improvements. It is also necessary to monitor the progress achieved by industry; and if energy efficiency improvements are lower than the economic potential, the governments can consider reinforcing or optimising the covenants or introducing other, more effective measures.

Belgium supports CHP primarily through the regional systems of green certificates. Given the relatively small Belgian market, the existence of different regional CHP certificates reduces their overall effectiveness (see Chapter 6 for a more detailed discussion).

The governments and public administrations, which are large buyers of products and services, can play an important role in promoting best practices to other end-users. Procurement schemes are generally recognised as cost-effective and important drivers for promoting energy-efficient technologies and services. It is positive that the federal and regional governments are starting to use this mechanism to a certain extent. Since the scale effect is important, co-ordination and harmonisation of public procurement schemes at federal, regional and local (municipality) levels will enhance their overall effectiveness. In particular, the EU guidelines for Green Public Procurement

(GPP) can serve as a basis in this respect. Furthermore, Directives on Ecodesign, Energy Labelling and Ecolabelling can be used in designing procurement schemes for products.

To improve energy efficiency, the IEA also urges the Belgian government to continue its work in making its national policies consistent with the energy efficiency policy recommendations initially presented to the Group of Eight (G8) and endorsed by the IEA energy ministers (see Box 1).

Box 1

IEA G8 Energy Efficiency Recommendations

At the Group of Eight* (G8) Summit in 2005 in Gleneagles, Scotland, the G8 countries asked the IEA to assist in developing and implementing energy efficiency policies. Responding to this request, the IEA subsequently prepared a set of energy efficiency policy recommendations covering 25 fields of action across seven priority areas: cross-sectoral activity, buildings, appliances, lighting, transport, industry and power utilities. These 25 recommendations were presented to the summit of the G8 in Hokkaido, Japan in July 2008. The fields of action are outlined below.

1. The IEA recommends action on *energy efficiency* across sectors. In particular, the IEA calls for action on:
   - Measures for increasing investment in energy efficiency.
   - National energy efficiency strategies and goals.
   - Compliance, monitoring, enforcement and evaluation of energy efficiency measures.
   - Energy efficiency indicators.
   - Monitoring and reporting progress with the IEA energy efficiency recommendations themselves.
2. *Buildings* account for about 40% of energy used in most countries. To save a significant portion of this energy, the IEA recommends action on:
   - Building codes for new buildings.
   - Passive energy houses and zero-energy buildings.
   - Policy packages to promote energy efficiency in existing buildings.
   - Building certification schemes.
   - Energy efficiency improvements in glazed areas.
3. *Appliances and equipment* represent one of the fastest growing energy loads in most countries. The IEA recommends action on:
   - Mandatory energy performance requirements or labels.

- Low-power modes, including stand-by power, for electronic and networked equipment.
- Televisions and set-top boxes.
- Energy performance test standards and measurement protocols.

4. Saving energy by adopting efficient *lighting technology* is very cost-effective. The IEA recommends action on:
   - Best-practice lighting and the phase-out of incandescent bulbs.
   - Ensuring least-cost lighting in non-residential buildings and the phase-out of inefficient fuelbased lighting.

5. About 60% of world oil is consumed in the *transport* sector. To achieve significant savings in this sector, the IEA recommends action on:
   - Fuel-efficient tyres.
   - Mandatory fuel efficiency standards for light-duty vehicles.
   - Fuel economy of heavy-duty vehicles.
   - Eco-driving.

6. In order to improve energy efficiency in *industry*, action is needed on:
   - Collection of high-quality energy efficiency data for industry.
   - Energy performance of electric motors.
   - Assistance in developing energy management capability.
   - Policy packages to promote energy efficiency in small and medium-sized enterprises.

7. *Energy utilities* can play an important role in promoting energy efficiency. Action is needed to promote:
   - Utility end-use energy efficiency schemes.

Implementation of IEA energy efficiency recommendations can lead to huge cost-effective energy and CO_2 savings. The IEA estimates that, if implemented globally without delay, the proposed actions could save around 8.2 Gt CO_2/yr by 2030. This is equivalent to one-fifth of global energy-related CO_2 emissions in 2030 under the IEA Reference Scenario, in which no new policies are adopted or implemented. Taken together, these measures set out an ambitious road-map for improving energy efficiency on a global scale.

The IEA will shortly publish its evaluation of the performance of all Member Countries, including Belgium, of these recommendations.

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* The Group of Eight is an international forum for the governments of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.

RECOMMENDATIONS

The government of Belgium should:

- *Enhance the systematic monitoring and evaluation of energy efficiency programmes and measures; use the evaluation results to improve the quality and cost-effectiveness of new and existing measures and programmes across regions and sectors in order to reach the national targets for energy efficiency in the most effective way.*
- *Strive to co-ordinate and, where possible, harmonise policies and measures at federal, regional and local levels as well as between sectors with a view to maximising their overall effectiveness.*
- *Improve access to information about available financial support for energy efficiency and simplify administrative procedures.*
- *Develop an integrated national transport plan to harness the maximum energy savings potential in transport through enhanced co-ordination among relevant ministries (transport, energy, finance and environment) at all government levels.*
- *Consider to implement EU guidelines on Green Public Procurement at all governmental and local levels in order to promote energy-efficient technologies and services even further.*

PART II

SECTOR ANALYSIS

OVERVIEW

Oil, natural gas and coal provide over 70% of Belgium's total primary energy supply (TPES), respectively accounting for 39%, 26% and 7% in 2007. While total energy use is expected to decline slightly in the coming decades, the country's commitment to phase out nuclear from its energy supply mix will require increases in the supply of other fuels, notably natural gas. With no domestic production of fossil fuels, Belgium is fully dependent on imports. Yet, because of its geographical location and infrastructure, Belgium plays an important role in Europe's oil, gas and coal supply chains. In the case of natural gas, the country is a major hub of gas flows in the region. Some 1.0 to 1.3 million tonnes of coal per year transit to other European countries and its role as a transit country in this fuel could potentially be further enhanced. Belgium's large domestic oil-refining sector results in the country being a net exporter of refined products.

As discussed in Chapter 2, Belgium is currently in the process of developing an integrated emergency response policy. This will entail updating the emergency response handbook for oil emergencies and elaborating a national response plan for natural gas disruptions. An action plan is to be presented to the Energy Minister before the end of 2009, with the goal of implementing the plan in 2010.

GAS

SUPPLY AND DEMAND BALANCE

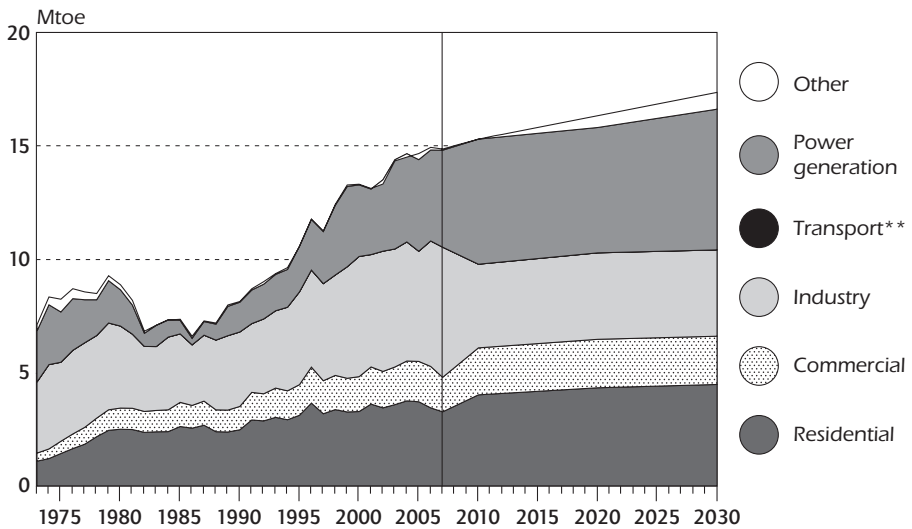
Belgium's gas consumption was approximately 17.5 bcm in 2007. Industry (primarily petrochemicals) consumed 32% of this amount. Electricity generation made up 30% of gas consumption, and household demand another 22% (see Figure 9). Gas provides some 27% of total electricity production.

Although primary gas as a share of TPES declined slightly in 2007 compared to the previous year, it is expected to grow in the medium and long term. The government's forecasts project a strong growth of gas consumption in power generation because the new capacities that need to be built (particularly to replace a large portion of the nuclear generation capacity to be phased out between 2015 and 2025) will be mainly gas-fired. An increase in intermittent

renewables-based power generation could also increase demand for gas to fuel backup facilities. Growth in gas demand is also expected in the residential sector because households continue to move away from gasoil towards natural gas for heating.

Figure 9

Natural Gas Supply by Sector*, 1973 to 2030



* total primary energy supply by consuming sector. Other includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes commercial, public services, agriculture, forestry, fishing and other final consumption.

** negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

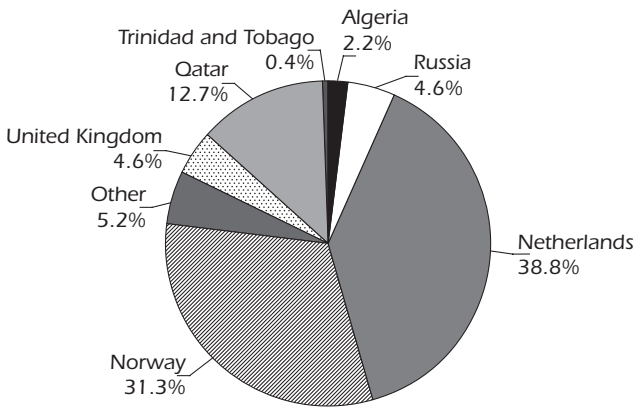
Belgium relies entirely on imports for its gas consumption. The current import portfolio is fairly well diversified by origin and type of supply (Figure 10). The Netherlands and Norway are the principal pipeline suppliers, while Qatar is the main source of LNG imports. The majority of gas imports are based on long-term contracts, while approximately 6% are from the spot market.

Imports from the two most important supply countries will decline – from the Netherlands in the medium to long term and from Norway in a more distant future – and this will increase dependence on imports from Russia and the Middle East.

The Directorate-General for Energy and the Federal Planning Bureau, in co-operation with the CREG, Fluxys, the National Bank and other stakeholders, prepare a prospective study on natural gas every four years. The time frame in these studies is currently five years but in the future it will increase to ten years. The study estimates the domestic demand for natural gas and the evolution of supply sources, and prepares an indicative programme on investment in gas infrastructure.

Figure 10

Natural Gas Imports by Country, 2007



Source: Country submission.

GAS MARKET STRUCTURE AND REGULATION

Regulatory framework and market liberalisation

As discussed in Chapter 2, there are four regulators in Belgium – one federal and three regional ones. The CREG, the federal regulator, monitors the natural gas market and approves transportation and distribution tariffs and other regulated assets. It also has a general advisory role on gas markets. Regional regulators (VREG of Flanders, CWaPE of Wallonia and Brugel of Brussels-Capital) also have legal powers to monitor the distribution of natural gas and ensure compliance with regional public service obligations. The division of responsibilities between the regional and federal regulators is shown in Table 6.

Table 6

Roles and Responsibilities of the Federal and Regional Gas Market Regulators

Federal CREG	*Flanders* VREG	*Wallonia* CWaPE	*Brussels-Capital* Brugel
Control TPA; approve conditions of TPA into transmission networks	Distribution of natural gas	Distribution of natural gas	Distribution of natural gas
Control execution of plans regarding development of the natural gas transmission network and continuity of supply	Appoint DSOs	Technical regulations for the management and expansion of the natural gas distribution network	Ensure compliance with legal and statutory functions
Ensure that public service obligations are fulfilled by suppliers and the network operator	Grant delivery licences to suppliers	Ensure compliance with legal and statutory functions	
Work with the competition authority	Technical regulations for the management and expansion of the distribution network	Advise the Walloon government on. operation of the Walloon energy market	
Verify the absence of cross-subsidies between categories of clients	Provide mediation regarding disputes	Ensure that public service obligations are fulfilled	
Approve the tariffs charged for using the transmission and distribution network	Ensure compliance with legal and statutory functions	Control the eligibility of clients for the competitive market	
	Advise the Flemish government on operation of the Flemish energy market		
	Ensure that public service obligations are fulfilled		

Source: Country submission.

Liberalisation of energy markets in Belgium has taken place in gradual steps and the pace of reforms has varied among the regions. Flanders fully legally opened its gas market on 1 June 2003. Wallonia and Brussels-Capital opened the market to industrial consumers in 2004 and to residential ones in 2007. The overall Belgian gas market has been fully liberalised since 1 January 2007 when supplier choice was granted to all consumers in all the regions. Gas transportation and distribution have been legally unbundled from import and supply activities. In March 2006 Fluxys was appointed by law as the only operator of the natural gas transmission grid and the underground gas storage facility, and Fluxys LNG as the operator of the LNG terminal and the peak-shaving facility. In 2007 and 2008, several other regulatory reforms took place: the gas transmission and distribution tariff system was

amended and the powers of the regulator were reinforced (see more details in Chapters 2 and 7). Figure 11 shows the key players on the Belgian gas market and the status of different activities.

Figure 11

Structure of the Gas Market

Unbundled activities	Players	Status
Import	Distrigas, GDF, Wingas, BP, etc.	Free competition
Transportation network	Fluxys, Fluxys LNG	Regulation (CREG)
Distribution network	19 DNOs	Regulation (CREG / regional regulators)
Supply	Distrigas, ECS, Luminus, Nuon, GDF, etc.	Free competition
Taxes	Governments: federal and regional	Laws and decrees (through TSO, DNO, supplier)

Source: Country submission.

Historically, the Suez group and its subsidiaries has had the dominant position on the Belgian market. After the merger of Suez with GDF, the GDF Suez group became the most important player on the Belgian gas market. This situation is changing gradually. In November 2008, the Italian company ENI bought shares in Distrigas, the largest supplier, from GDF Suez (57.24%) and municipalities (31.25%). At the same time, Distrigas sold the transit activities it held (through its affiliate Distrigas & Co) to Fluxys, the latter also acquiring GDF's share of their common Belgian transit subsidiary (SEGEO). Therefore, all Belgian transit activities are now controlled by Fluxys. These developments have decreased the predominance of the GDF Suez group, although its affiliates Electrabel Customer Solutions (ECS) and GDF jointly still own significant market shares. GDF Suez also still has an important stake in the transmission system operator, Fluxys, and therefore seems formally to have a significant degree of control over the transmission networks, the storage facility and the strategic hub in Zeebrugge, which includes an LNG terminal; however, the legislation in place imposes strict corporate governance rules and an independent functioning. GDF Suez's stake in Fluxys has decreased from 57% to 45% and a further decrease to 39% is foreseen in 2009. There are discussions of further reducing the share of GDF Suez in Fluxys below the 25% threshold. The Belgian government has no ownership in the upstream/downstream but still has a golden share in Fluxys and Distrigas.

Wholesale market

Wholesale market players in Belgium provide natural gas to 17 of the distribution companies and to about 260 large industrial end-users and power stations connected directly to the transmission grid. In 2007, over thirty authorisation holders had the right to sell gas to customers connected to the natural gas transmission grid, but only five of them actively operated on the market. In 2008, there were nine active wholesale suppliers, and the market share of Distrigas reached 72.4% (a 5.8% decrease from 2007).[35]

As Belgium has no indigenous gas production, all of its gas is imported. Belgium has two different types of gas: H-gas (with high caloric value) and L-gas (with low caloric value), and two separate networks for transporting them. The L-gas market serves a quarter of the Belgian customers and supplies certain regions exclusively, including the Brussels region. There are several supply sources for H-gas – either by pipeline or LNG. Competition on the L-gas market is much more limited. Most supplies are based on a long-term contract between the Dutch gas supplier GasTerra and Distrigas. However, other operators are gradually entering this market: in early 2009 four shippers were reportedly importing L-gas to Belgium.

The government acknowledges the advantages of the present arrangements: the Dutch supplies are reliable and the L-gas is of good quality. At the same time, it recognises that the current situation is not sustainable: a large part of Belgian consumers depend on one single source of gas, which may come to an end in the future. Both the government and the CREG highlight that the conversion of the L-gas system to an H-gas system will be necessary at some point in the future when the import of L-gas comes to an end.[36] The short-term priority for the CREG is to evaluate how L-gas consumers can benefit from liberalisation. The eventual conversion would require sound preparation. The government has decided to use a step-by-step approach and to set up an expert group in order to evaluate, develop and lead this conversion process.

Secondary trading in Belgium only takes place for the H-gas at the Zeebrugge hub (see section on the Zeebrugge hub below). Huberator, the operator of the hub, facilitates over-the-counter trading of natural gas, while exchange-based trading is operated by APX Gas ZEE, established in 2005. It provides a spot market for trading of within-day and day-ahead gas contracts. No active secondary trading for L-gas exists and the shippers manage demand fluctuations mainly through their contracts with GasTerra.[37]

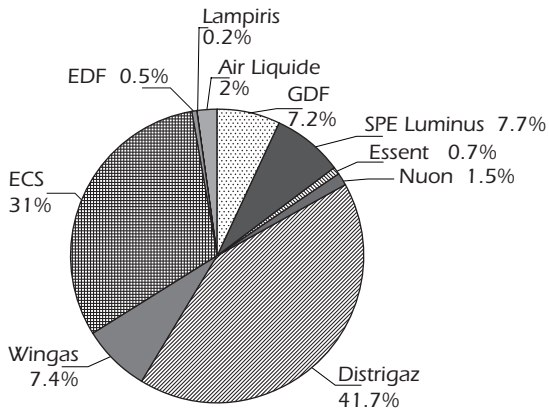
35. CREG, CWaPE, Brugel, VREG, *Le développement des marchés de l'électricité et du gaz naturel en Belgique. Année 2008.* Press Communiqué.
36. The CREG's General Council states that « short-, medium- and long-term scenarios must be developed to prepare a cost-effective transition to the period which will follow the end of L-gas imports into the country » (GREG,Press Comminiqué, 23 October 2008).
37. Cambridge Economic Policy Associates (2008), *Structure and Functioning of the Natural Gas Market in Belgium in a European Context,* Cambridge, March 2008

Retail market

Following the gradual market opening in 2003-2007, many new players have entered the retail market, although the market power of the incumbents is still quite large. In 2008, there were 24 authorised suppliers at the federal level, 16 in Flanders, 11 in Wallonia and 8 in Brussels[38], although not all of them operated actively. The market shares of gas supply companies in 2008 are shown in Figure 12. Since then, the market has been actively evolving; the share of Distrigas has continued to decline and is expected to decline further in the future. Like elsewhere in the world, liberalisation is an ongoing process; therefore possible future mergers and acquisitions should be taken into account when analysing the Belgian gas market structure.

Figure 12

Market Shares of Natural Gas Supply Companies, 2008



Note: The gas market is constantly evolving and this figure does not reflect the latest developments.

Source: Country submission.

The degree of market opening varies considerably among regions. In the Brussels-Capital region, Electrabel Customers Solutions (ECS) still dominates the market, while the market share of all alternative suppliers combined was only 8.3% (in terms of volume) in 2008 (up from 3.3% in 2007). In Flanders, Distrigas and ECS owned approximately 42% and 28% of market shares in 2008, while several other active players shared the rest of the market. In Wallonia, shares of Distrigas and ECS were 41% and 21.4% respectively; SPE Luminus owned approximately 17% and GDF Suez 11.3%.

38. According to FEBEG, the Belgian Federation of Electricity and Gas Companies.

Consumer switching rates also vary among regions. In Wallonia, for example, by the end of 2008, two gas consumers out of three had signed a contract with a supplier of their choice; one-third of these active clients had opted for changing their historical supplier. In Flanders, approximately 75% of professional customers and 90% of the residential ones have signed a contract with a gas supplier of their choice.

GAS NETWORK AND INFRASTRUCTURE

Network and interconnections

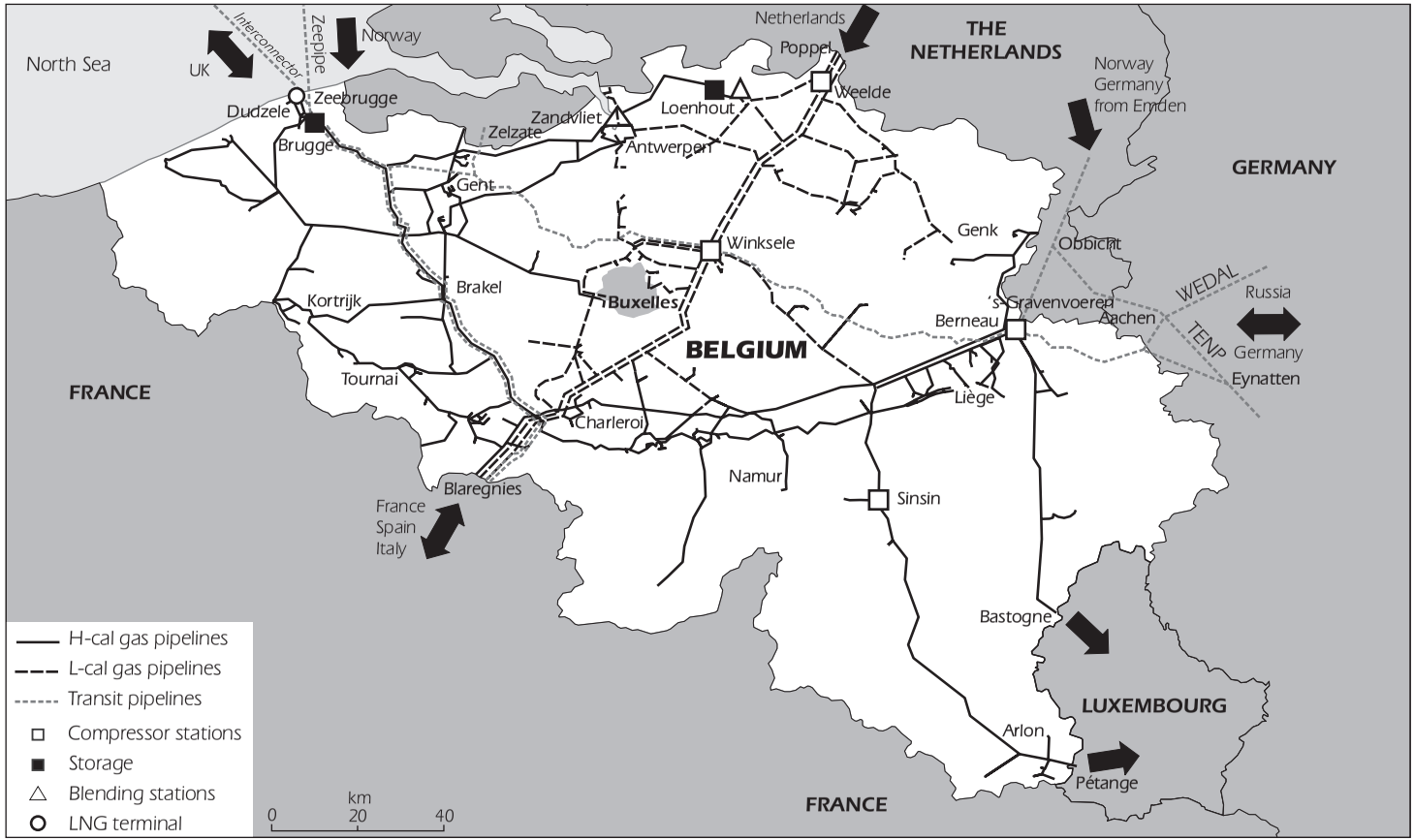
Fluxys, Belgium's transmission system operator, has a network of about 3 800 kilometres of pipelines with 18 interconnection points and five compressor stations. This network is used to transport 17.5 bcm (or 193 TWh) of natural gas for consumption in Belgium and for the transmission of about 80 bcm (or 236 TWh) of gas to other end-user markets in the Netherlands, Germany, Luxembourg, France and the United Kingdom. Fluxys's network delivers gas to about 260 large industrial end-users and power stations directly, and supplies the grids of 17 distribution system operators which deliver gas to residential and small to medium-sized industrial users.

Historically, there has been a distinction between transit of gas from border to border and transportation of gas for consumption in Belgium (see Box 2) but Fluxys is now developing synergies between the two activities. The transit of gas through Belgium is assured via the major two-way high-pressure pipeline systems connecting Belgium to its neighbours. The line from Zeebrugge to Blaregnies linking the North Sea and the United Kingdom to France (H-gas) is still used purely for transit. There is a separate pipeline, parallel to the Zeebrugge-Blaregnies pipeline, for domestic transportation in the western part of the country. At present, with the takeover of all transit activities by Fluxys, all pipelines are lined up to be used for transit as well as for domestic transportation. Operational and investment decisions do take into account existing contracts, quality requirements and recent market consultations. The VTN-RTR pipeline (H-gas) is bidirectional, linking the Zeebrugge hub with Germany and the Netherlands; the Segeo pipeline (H-gas) runs from the Dutch border in 's Gravenvoeren to France; and the Poppel-Blaregnies pipeline runs from north to south, linking the Netherlands with France (L-gas) (see Figure 13). More than 40 shippers are active on the transit market whereas the number of shippers active on the Belgian domestic transport market increased from three to more than ten between 2008 and 2009.

The balancing rules are rather complicated compared to other European countries, particularly given the relatively small size of Belgium. In Belgium there are four balancing zones (three for H-gas and one for L-gas). The so-called "enhanced entry-exit" system adopted by Fluxys requires shippers

Figure 13

Natural Gas Infrastructure



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.
Source: *Natural Gas Information*, IEA/OECD Paris, 2009.

to book domestic transportation capacity along the whole transportation route with matching both entry and exit capacities (which can be situated in the same or different balancing zones). At the contractual level of capacity booking, this system is less flexible than a true entry-exit regime, for example in the Netherlands or the United Kingdom, where shippers can purchase entry and exit capacity separately. At the operational level, however, the balancing system functions in an entry/exit mode (nominations) through a single balancing point (imbalances over the three H-gas balancing zones are automatically redistributed to create one balancing zone).

Transport capacity is allocated to shippers on the "first committed first served" basis. In early 2009. Fluxys developed a new mechanism of capacity allocation whereby three capacity reservation windows are proposed on a recurrent yearly basis *: i)* the Subscription Period whereby medium-term capacity for a maximum duration of 5 calendar years can be subscribed on entry points for which the market demand exceeds the availability; *ii)* the First Committed First Served market for capacity reservations on all the other entry points for a duration of maximum 5 calendar years as well; *iii)* and the Open Subscription Window (or short-term market) where a certain percentage of entry capacity on all the physical entry points into the Belgian grid can be subscribed for the following calendar year, thus enabling new market players to have access to the necessary entry capacity. Better co-ordination was also organised between Fluxys and the adjacent TSOs. In the past, many market players perceived the system of transport capacity allocation as unfavourable for new market entry. Moreover, insufficient co-ordination between TSOs in Belgium and in neighbouring countries on communicating information about available transmission capacity is often quoted as another important problem hampering the development of a competitive market. Fluxys has taken these perceptions into account with the elaboration of the new allocation rules. An additional effort has also been made over the past year with regard to the publication of information on the availability of capacity and flow data.

In the last several years, capacity booking rates at some specific entry points to the Belgian gas transportation network have been higher than the underlying physical gas flows, which results in contractual congestion. By law,[39] shippers are not allowed to book more capacity than they need for the execution of their contracts and must offer the firm capacity obtained and not needed (temporarily or permanently) on the secondary market. However, because of the distinction between transit and domestic transport discussed in Box 2, the code of conduct does not apply to transit capacity booked under the existing contracts, although the transit-transport synergy service supported by Fluxys should allow bringing transit capacity back to the national transmission market in case of a congestion risk. In any case, many market players, particularly those who source their gas abroad and therefore need capacity at

39. Royal Decree of 4 April 2003 concerning the code of conduct for access to gas transmission networks.

entry points to the Belgian network, complain about the existing contractual congestion and perceive it as an obstacle for market access. Stronger "use it or lose it" rules, applying to both transport and transit capacity, would be beneficial for competition. In the meantime, it should be noted that Fluxys has further diversified its service offering in order to make better and more efficient use of the existing capacities by offering non-nominated day-ahead capacity and different levels of interruptible capacity.

Box 2

Transit vs. Transportation

In Belgium, like in some other transit countries, there is a distinction between the transit of gas from border to border and the transportation of gas to national end-users. Historically, these two activities were commercialised by different companies. At present, Fluxys commercialises and operates both the transit and domestic transport infrastructure but it supports maintaining the regulatory and contractual distinction between the two, while developing synergies between these activities. The rationale behind this distinction, according to Fluxys, is the need to guarantee the transit volume necessary to cover the cost of investments in transit infrastructure, which are associated with higher risks than investments in domestic transmission lines. These higher risks arise mainly because of the international competition between transit routes, LNG supply and storage. The European law, however, does not distinguish between transit and transportation of gas within the EU. For this reason the tariff decision of the CREG, which was based on this distinction, has been suspended by the Court of Appeal. Many market players feel that this distinction decreases liquidity and hampers entry by new shippers because it has been rather difficult to use transit capacities for shipping gas to the domestic market. The elimination of the distinction could be beneficial for competition and for better integration with other European gas networks.

On the other hand, given that gas transit volumes through Belgium, about 21.4 bcm (236 TWh) per year, exceed domestic consumption, about 17.5 bcm (193 TWh) per year,[40] an argument can be made for maintaining special conditions for transit, at least in the transition period. Domestic customers, however, benefit from investments in transit through increased security of supply and market liquidity because of the availability of several gas sources. The challenge remains to operate both activities while respecting their specificities and at the same time using their full potential for operational synergies to the benefit of all users.

40. See "Flux de gaz naturel en Belgique" (http://www.synergrid.be/index.cfm?PageID=18214)

As mentioned above, Fluxys has implemented a number of measures to address the existing problems and to improve the overall liquidity of the market (see also section on the Zeebrugge hub below). In addition, the Fluxys group is actively upgrading its system to expand the physical transmission capacity. It has an indicative 10-year investment programme for 2007-2016 valued at EUR 1.7 billion which is regularly updated taking into account new market signals. The programme includes infrastructure projects in domestic transport (60% of the total funding), transit (25%), storage (10%) and the LNG terminal (5%).

The new compressor station, which came into operation at Zelzate in early December 2008, is one of the recent investments aimed at meeting the growth in Belgian gas demand. It also enables larger volumes to be transported to and from the underground storage facility in Loenhout. From 2010, the Zelzate facility will also be used for additional natural gas flows from the Dutch grid.

The transmission capacity on the VTN-RTR (east-west) pipeline will be increased significantly. Following an open season (market consultation) held in 2005-2006, Fluxys is building a second pipeline along the existing Zeebrugge-Zelzate/Eynatten (VTN) transmission axis. It is planned to be commissioned in phases from the end of 2010 onwards.

Market consultation for the doubling of the north-south axis, conducted in co-ordination with adjacent grid operators, ended in December 2008. Fourteen grid users concluded long-term contracts for new capacity from the Belgian-Dutch and the Belgian-German border or from the Zeebrugge area to Blaregnies at the Franco-Belgian border. The new capacity of almost 10 bcm per year in the direction of France could be commissioned in late 2013.

Zeebrugge hub

Zeebrugge serves as a crossroads of two major axes in European natural gas flows, as both the Zeepipe terminal (natural gas coming from Norway) and the Interconnector terminal (natural gas coming from or going to the United Kingdom) are situated in the harbour zone. This allows the flow of gas on the east-west axis from Russia to the United Kingdom and the north-south axis from Norway to Southern Europe. The Zeebrugge port also has an LNG regasification terminal with a capacity of 9 bcm per year (see below). The various facilities at Zeebrugge together have an annual throughput capacity of 40 bcm of natural gas, which represents about 7% of gas consumption in OECD Europe.

Zeebrugge also has a key commercial role in the natural gas trade, as one of Europe's major spot markets for natural gas. It is operated by Fluxys's affiliate Huberator. More than 70 members are active on the hub and approximately 45.4 bcm of natural gas was traded on the hub in 2008, equivalent to over twice the annual consumption of Belgium. The churn ratio, *i.e.* the ratio of traded gas volumes at the hub to the actual physical volumes exchanged, has

been stable at 5 over the past four years. Huberator offers various services, including title tracking, matching of nominations, allocation and automatic backup service for intra -hub Zeebrugge trading and Zeebrugge hub trading for onward delivery.

Facing growing competition from the Netherlands' virtual market place, the Title Transit Facility (TTF), Fluxys has taken several measures to enhance liquidity on the Zeebrugge hub in the past years. In February 2008, it launched the ZEE Platform Service, offering unlimited capacity transfers in the Zeebrugge area, which enables shippers to transfer gas between all entry points (Interconnector terminal, Zeepipe terminal, LNG terminal and Zeebrugge hub) without capacity limitations. Additionally, interruptible capacity products for transit and day-ahead capacity-trading for domestic transportation have been introduced, as well as synergy services between transit and national transportation. In December 2008, Fluxys and GRTgaz, the French TSO, launched a joint secondary market capacity-trading platform, Capsquare, although its use is still limited.

Storage

There are three sites in which H-gas is stored in Belgium; there is no storage for L-gas. An aquifer in Loenhout is used to compensate for seasonal swings in purchase contracts and is the only facility exclusively designed for storage. Short-term LNG storage is available at the Zeebrugge LNG terminal, and at a storage site in Dudzele, which is used as a peak-shaving facility, where LNG is transported by truck.

The storage capacity in Loenhout, operated by Fluxys, is allocated in priority to storage users who supply gas distribution companies. The remaining capacities are then allocated to other potential storage users according to the "first come, first served" rule.

Table 7

Natural Gas Storage Capacity in Belgium, end-2008

Location	*Type*	*Working capacity (mcm)**	*Peak output (mcm/day)***
Loenhout	Underground	625	12
Dudzele	Tank	59	12
Zeebrugge	LNG	228	-
Total		**912**	**24**

* working gas capacity = total gas storage less cushion gas.

** peak output = the maximum rate at which gas can be withdrawn from storage.

Source: Country submission.

Fluxys will gradually increase the capacity at the Loenhout facility from 600 to 700 million cubic metres over four years (2008-2011). At end-2008, the workable storage volume had already increased from 600 to 625 million cubic metres (mcm).

Fluxys is also looking into potential sites for underground gas storage in the Limburg province in collaboration with the Flemish Institute for Technological Research (VITO) and the Limburg Investment Company (LRM). Exploratory drilling to confirm the characteristics of the subsoil and to analyse possible storage structures is planned for 2010.

Given the low gas storage potential in Belgium, there is a need to find other means of flexibility, which is challenging. Currently Belgium uses, for the L-gas grid in particular, the Dutch L-gas fields as swing supplier. With shrinking Dutch gas production, maintaining the flexibility of this gas supply could be more difficult or more costly (depending on contractual arrangements) in the future.

LNG

The LNG terminal in Zeebrugge is operated by Fluxys LNG, which is owned by Fluxys (93%) and Tractebel (7%). In 2008, the terminal's throughput capacity was doubled to 9 bcm per year by building a fourth storage tank and additional send-out capacity. Currently, the terminal has an unloading capacity of up to 12 000 m^3 LNG per hour and can unload 110 LNG cargoes per year. The four storage tanks can hold about three shiploads of LNG, which can be pumped into the regasification unit and then injected into the grid. Alternatively, depending on the demand, the LNG can be sent from the storage tanks into LNG tanker trucks for supplying the peak-shaving facility in the port of Zeebrugge. In July 2008, Fluxys LNG also launched new LNG loading services in response to requests from terminal users willing to better exploit commercial opportunities on the LNG market.

The capacities of the LNG terminal are allocated through an open season procedure. Until a new open season procedure is launched, any remaining unused capacity is allocated according to the "first come, first served" rule. Fluxys LNG signed long-term contracts with three terminal users as of 2007: Qatar Petroleum/ExxonMobil, Distrigaz and Suez LNG Trading. In June 2007, Qatar Petroleum/ExxonMobil announced its contract had been transferred to EDF Trading for 4.5 years, while Suez LNG Trading announced in February 2008 that it had subleased part of its capacity to ConocoPhillips. In addition to these long-term contracts, tankers from Egypt, Nigeria, Trinidad, Malaysia and Qatar deliver spot LNG.

In 2007, Fluxys LNG launched a market consultation (open season) to assess the level of demand for additional terminal capacity at the Zeebrugge LNG terminal. Depending on the level and the nature of market interest, Fluxys

LNG could increase the existing send-out capacity of the Zeebrugge terminal or add one or more LNG storage tanks and a second berthing jetty.

Tariff regulation

Law of 1 June 2005 and Royal Decree of 8 June 2007 changed the methodology for gas and electricity transportation tariffs from yearly "cost-plus" tariffs to 4-year tariffs based on "secured revenue". For transmission, these tariffs are applicable as from 2008 and for distribution from 2009 operating year. The new system guarantees the system operator, for a regulatory period of four years, revenue that is sufficient to cover the costs incurred and obtain a fair profit margin in return for the capital invested in its network. The income for each year of the regulatory period is divided into controllable and non-controllable costs. Controllable costs are subject to incentive regulation, whereby the system operator is rewarded for exceptional performance. Contrary to the previous "cost-plus" system, the difference between the actual controllable costs and the budgeted costs is granted to the transmission system operator. The new tariff system also contains an incentive to increase investment: it allows operators to keep capital gains as an investment reserve, which can be used as a source of self-financing.

CREG has approved tariffs for gas TSO Fluxys for 2008-2011; however, the Brussels Court of Appeal has suspended CREG's decision for having applied, among others, the Belgian law instituting a distinction between domestic transportation and transit which might result in discrimination prohibited by European law. The Court of Appeal has asked CREG to request from Fluxys another tariff proposal which would not distinguish between transit and transportation.

Another court case concerns distribution tariffs. The Brussels Court of Appeal called for an increase in distribution tariffs in 2008, thus reducing CREG's competences in tariff-setting.

As for LNG terminal services, by Belgian law, such services, including unloading, storage and sending-out, are subject to regulated tariffs, which are cost-based. However, it is allowed to apply multi-annual tariffs and a specifically calculated fair profit margin for new infrastructure of national or European interest if this is necessary for the long-term development of this infrastructure. From 2007, Fluxys LNG applies multi-annual tariffs for the period 2007-2027, which were approved by CREG in 2004.

Regional gas market

Belgium is part of the regional Gas Platform that brings together energy ministers from Belgium, Germany, France, Luxembourg and the Netherlands. Two working groups operate in the framework of this platform: *i)* on market and competitiveness issues, and *ii)* on security of supply. The objective of the

first working group is to facilitate cross-border trade. Its priorities for 2009 include a regional view on allocation mechanisms; more compatible balancing regimes; and identifying differences in legal frameworks. In 2010-2011 it will start discussions on market coupling and will focus on more compatible transport procedures.

NATURAL GAS SECURITY

Belgium does not have a specific emergency response policy for natural gas. Currently, it relies on the TSO, Fluxys, to assure the safety and reliability of the network and to safeguard natural gas supplies. Fluxys is given the responsibility for maintaining crisis mechanisms through a Royal Decree on public service obligations related to natural gas (23 October 2002) and a number of other laws and regulations. This responsibility includes the requirement to have an emergency plan and a backup plan, to be updated every two years. It also includes a code of conduct which contains a range of operational and administrative guidelines for gas network users.

Fluxys has an emergency plan for ensuring the integrity of its grid (maintaining line pressure and gas quality). In the case of significant loss of gas supply to the Belgian market, the TSO looks to balance the network by compensating temporarily the loss until the concerned shippers manage to shift their gas supplies to other entry points. In doing this, it maintains also an "interruption plan" for cutting supply to end-users for short periods of time. Through the tariff mechanism, the regulator compensates Fluxys for the full loss of gas at its largest entry point for the duration of six hours, during which time the affected shippers should reallocate their supplies through alternative entry points or take other measures to compensate for the loss. In case the shippers are unable to react adequately during that period, Fluxys would begin cutting off supplies to specific end-users on the basis of an interruption hierarchy that takes into account safety issues and alternative sources. This begins with power plants, followed by certain categories of industrial users (the priority list is dictated by law). Domestic users are considered "priority consumers" and are the last ones to be cut off in the priority list. The government realises that the current interruption hierarchy has the potential to transform possible gas supply disruptions into electricity blackouts. Possible revision of this classification is currently under discussion.

As discussed earlier, the CREG, the federal regulator, monitors the natural gas market and approves transportation and distribution tariffs and other regulated assets. Thus any plans of Fluxys to increase capacity for dealing with supply disruptions would have to be approved by the CREG in order to pass on costs to end-users through increased tariffs.

Following a severe accident on the gas network, Fluxys and the electricity TSO Elia have, upon request by the government, established the Federal Cables

and Pipeline Contact Point (KLIM/CICC).[41] Through its website, all interested parties envisaging construction works can obtain information on underground cables and pipelines across the Belgian territory as well as guidelines on the necessary precautions to take.

Belgium also plans to develop an integrated emergency response policy, which would also include natural gas, as discussed in Chapter 2.

One of the two working groups of the regional Gas Platform (see section on the Regional gas market above) focuses on the security of supply. Its working priorities include transparency on the need for investment; strengthening regional co-operation between TSOs; clarifying the role of TSOs in security of supply; and developing common open season procedures.

PRICES AND TAXES

Prices for gas imports are mostly based on long-term contracts and are linked to the price of oil products with a certain time lag. Belgium also imports some spot cargoes whose prices follow spot prices. For the past several years, gas prices were steadily rising until the end of 2008, reflecting high oil prices. Since the end of 2008, they have been dropping sharply, in the context of the global economic slowdown and decreasing oil prices.

According to Eurostat,[42] gas prices for households (before taxes) in Belgium were slightly below the EU average in 2007 and above the EU average in 2008. Prices for large industries, all taxes included, were below the EU average in 2008, according to provisional Eurostat data.

OIL

SUPPLY AND DEMAND

Demand

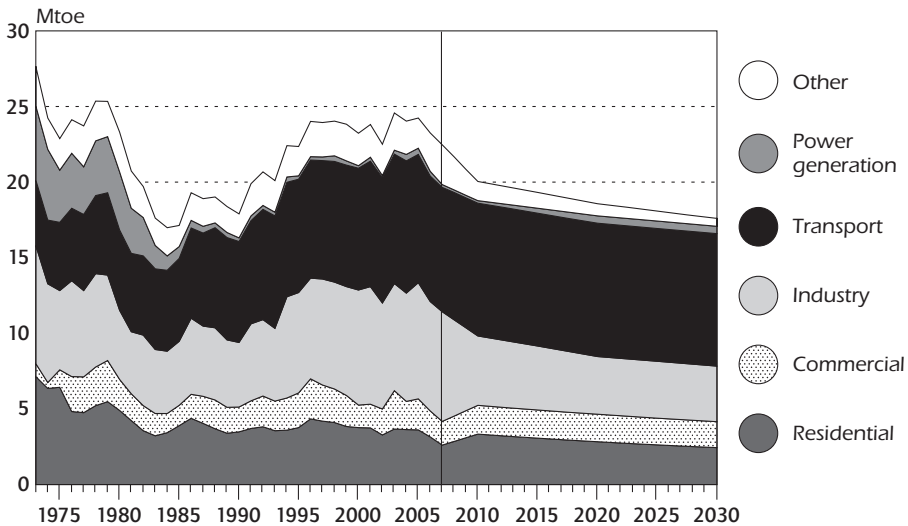
Oil demand in 2008 was just over 31 million tonnes (Mt), or an average of some 633 thousand barrels/day (kb/d).[43] This is an annual average decrease of 1.3% from 2005, a year when oil demand peaked after a period of growth.

41. Federaal Kabels en Leidingen Informatie Meldpunt / Point de Contact Fédéral Informations Câbles et Conduites.
42. The IEA collects data on gas prices and taxes but Belgium has not submitted this data to the IEA since 2001.
43. This is demand as defined by the IEA's monthly *Oil Market Report.* Thus, it is the sum of adjusted gross inland deliveries, refinery fuel and international marine bunkers, minus adjusted backflows. The inclusion of bunkers is noteworthy in the case of Belgium, as a significant amount of residual fuel oil attributed to Belgian demand is for deliveries to international marine bunkers.

The transport sector makes up the largest single share of oil consumption in Belgium, representing 46% in 2008, according to the government's estimates. Industry accounts for 33% of the total, mostly used in the petrochemical sector. Residential use, in the form of heating oil, represented 18% in 2008. Heating oil use is structurally declining as the country moves towards natural gas and electricity-based heating and is expected to decline further (Figure 14).

Figure 14

Oil Supply by Sector*, 1973 to 2030



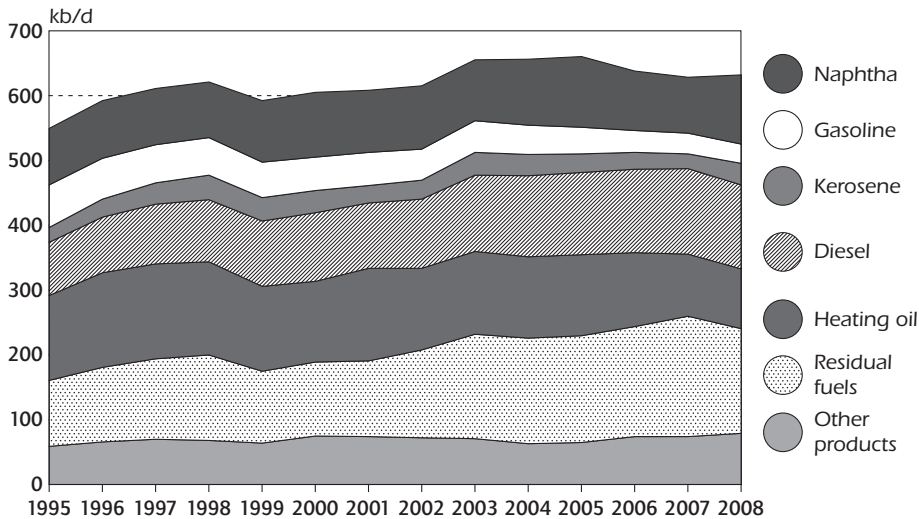
* total primary energy supply by consuming sector. Other includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes commercial, public services, agriculture, forestry, fishing and other final consumption.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009 and country submission.

Residual fuel oil is the largest component of the oil products consumption in Belgium (Figure 15). However, the vast majority of this, 90%, goes to international marine bunkers, fuelling international sea-going ships. The remainder is primarily used for industrial purposes and power generation; however, demand is declining owing to environmental concerns and greater use of natural gas. Naphtha represents also a large component of the country's oil demand, as Belgium is one of the main petrochemical hubs in Europe. Middle distillates represent the bulk of the fuels used domestically, primarily made up of diesel for transport use.

Figure 15

Oil Consumption by Product, 1995 to 2008



Source: *IEA Monthly Oil Statistics*.

The use of diesel has risen steadily over the past decade. From 1995 to 2008, demand for transport diesel grew by 3.6% per year. This compares to a decline over the same period in the demand for gasoil for heating (-2.7% p.a.) and motor gasoline (-5.9% p.a.). Even in recent years when overall oil demand decreased, diesel use continued to grow, with annual growth averaging 0.8% from 2005 to 2008.

Diesel accounts for roughly 82% of fuels used for transport, and its share is expected to grow. Roughly 9 out of 10 new cars sold in Belgium have diesel engines.

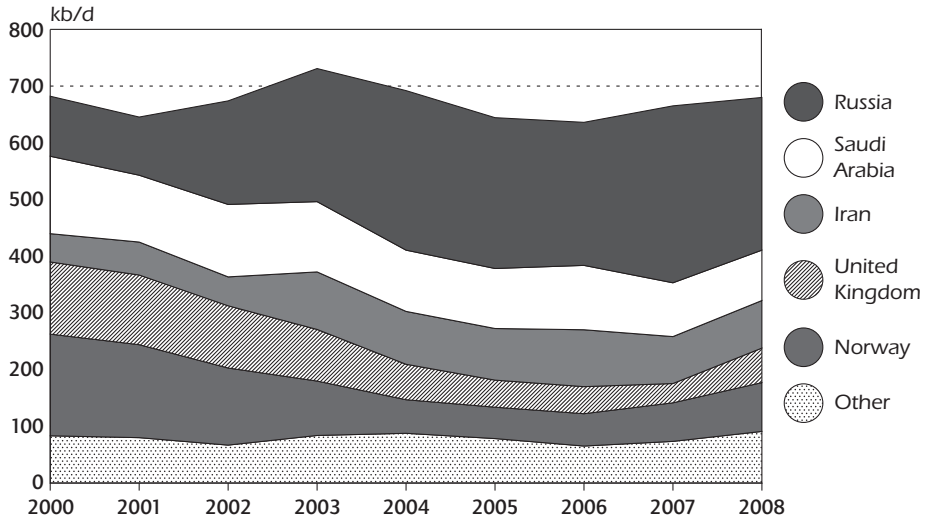
Imports and exports

Belgium has no indigenous oil production. In 2008 the country's refineries processed some 33.8 million tonnes of crude oil, roughly 675 thousand barrels per day (kb/d). Crude oil imports in 2008 came primarily from the former Soviet Union (41%), OPEC (31%) and the North Sea (22%). Russia is the single largest source of crude oil imports, providing some 270 kb/d in 2008. Its share in Belgium's total crude imports has risen significantly over the past decade, representing 40% of the total in 2008, compared to 15% in 2000.

While fully dependent on crude oil imports, Belgium is a net exporter of refined products. In 2008, it imported some 383 kb/d (18.2 Mt) and exported some 410 kb/d (19.5 Mt) of refined products.

Figure 16

Crude Oil Imports by Source, 2000 to 2008



Source: *IEA Monthly Oil Statistics.*

Belgian refinery output is traded across much of Europe. Refineries supply two-thirds of Luxembourg's product import requirements; jet kerosene, gas/diesel oil and gasoline are also exported to Germany, France and Switzerland. At the same time, Belgium imports significant quantities of gas/diesel oil from the Netherlands and to a lesser extent from Russia. Furthermore, it is increasingly becoming a net importer of fuel oil to meet growing international bunker fuel demand.

INDUSTRY STRUCTURE

There are currently three companies operating in the Belgian refining industry: Total, ExxonMobil and Petroplus (Belgian Refining Corporation and Nynas-Petroplus). Twenty companies, including majors and independents, import oil while between 700 and 800 distributors, primarily small companies delivering heating oil, operated on the Belgian market in 2008. The number of filling stations in operation has declined from 4 750 in 2000 to 3 295 in 2007.

Refining

Belgium has four refineries – all of which are located in Antwerp – with a total crude distillation capacity of around 790 kb/d (38.95 million tonnes per year). Refining capacity is expected to reach 807 kb/d by 2010. The most notable change in refinery activity in recent years is the increase of desulphurisation capacity, which reflects EU specifications to reduce sulphur

content for gasoline and diesel, including the move in January 2009 to 10 parts per million (ppm).

The two major refineries, owned by Total (357 kb/d) and ExxonMobil (298 kb/d) are world class refineries capable of producing a relatively high yield of light and middle distillates. The third refinery, owned by Petroplus, is the smallest and least complex of the three; however, investment in hydrotreating has allowed it to produce 10 ppm diesel from a predominantly sour crude slate. The fourth refinery is an asphalt plant with a capacity of approximately 21 kb/d.

In 2007, the capacity utilisation rate of Belgium's refineries was 84.6%. The composition of production from these refineries was gasoline (15.3%), jet fuel (5.3%), gas/diesel oil (38.9%), residual fuel oil (22.4%) and naphtha (4.8%).

Infrastructure

Belgium is part of the North-West European oil market that is fully integrated into global oil markets. It is part of the ARA spot market (Amsterdam-Rotterdam-Antwerp) that serves as a major reference point for crude oil and petroleum product trade in North-West Europe. The Antwerp area represents one of Europe's main refining centres with major capacities for storage of petroleum products. The Port of Antwerp is Belgium's main sea port for oil trade. It handles a growing amount of oil trade and imports.[44]

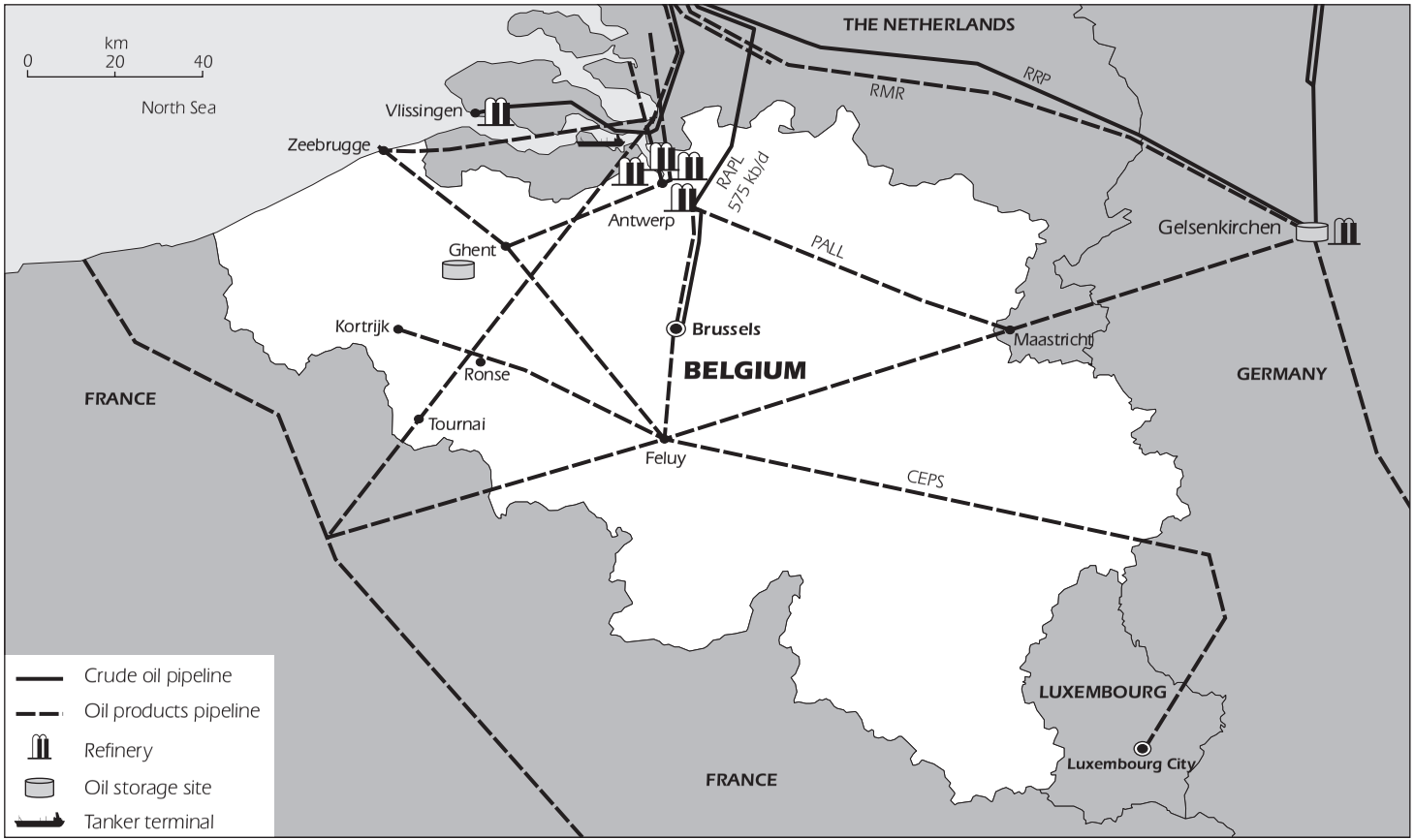
The main crude oil pipeline serving Belgium is the Rotterdam-Antwerp pipeline (RAPL), which originates in Rotterdam (the Netherlands) and travels into the Antwerp area. It has a capacity of 575 kb/d.

A key method for transportation of oil products in Belgium is via the Central European Pipeline System (CEPS). The CEPS is a North American Treaty Organization (NATO) pipeline network in Europe comprising 6 000 km of pipeline interconnected to roughly 8.2 million barrels (mb) or 1.3 mcm of oil storage capacity. NATO maintains this distribution system primarily to provide fuel supply support to military bases. However, for many years, the pipeline's surplus capacity has been leased for civilian storage, transportation and delivery of oil products. The contracts signed between NATO and the oil companies are based on market prices and supervised by the Ministry of Economic Affairs.

44. According to the Antwerp Port Authority, maritime cargo trade of crude oil (4.4 Mt) and products (25.8 Mt) exceeded 30 Mt in 2007.

Figure 17

Oil Infrastructure



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: Country submission.

Storage capacity

There are over 40 oil storage facilities in Belgium with a total combined capacity of just over 9.7 mcm, or 61 million barrels (8.3 Mtoe). This includes capacity used by industry for normal operations as well as storage capacity used by both industry and the public stockholding agency APETRA (*Agence du pétrole*) for strategic reserves.

EMERGENCY RESPONSE POLICY

Belgium's response to an oil supply crisis would be the use of oil stocks of the public stockholding agency, APETRA. Demand restraint could also be employed, as stipulated in existing, dormant decrees which can be activated in a crisis.

Emergency response policy is under the responsibility of the Minister of Energy (within the Federal Public Service Economy, SMEs, Self-Employed and Energy), in consultation with the Council of Ministers. Under the Minister of Energy, the General Directorate for Energy, in the framework of the National Oil Board, serves as the core of the National Emergency Sharing Organisation (NESO). This team is responsible for maintaining and implementing emergency response measures in a supply disruption, for monitoring the domestic oil and gas markets and for data collection.

In the event of an oil supply disruption, the Minister of Energy has the legal authority to draw down oil stocks. The minister would direct APETRA to draw down its emergency stocks.

The National Oil Board (NOB) was created by the Royal Decree of 11 October 1984 and is charged with the supply and distribution of oil products in time of crisis. The permanent unit of the NOB is the General Directorate for Energy. In a crisis, it can be expanded to include experts from the Department of Economic Affairs, other ministerial departments and the oil industry. All proposed measures would have to be considered by the Inter-Ministerial Economic Commission (CEI), which represents various government departments. The Minister of Energy would then submit the proposals to the Council of Ministers for final approval.

The NOB's main tasks in case of a supply disruption are to identify vital points (*e.g.* refineries, pipeline, storage), propose possible crisis measures (*e.g.* use of oil stocks, demand restraint) and to determine essential users. The NOB has three stages of operations in a crisis:

- The monitoring phase: monitoring market developments and update information required for the implementation of crisis measures;
- The active phase: proposing measures to the Council of Ministers; and

- The operational phase: implementation of measures and communication with other international bodies, *i.e.* Benelux, EU, IEA and NATO.

Emergency oil reserves

Until 2007, Belgium relied entirely on its domestic oil industry to meet its IEA stockholding obligation. This was done by placing a minimum stockholding obligation on oil importers which was based on EU regulations regarding the three main categories of products (gasoline, middle distillates and fuel oil).

In January 2006, the Belgian Administration passed legislation which created the public stockholding entity, the *Agence du Pétrole* (APETRA), and established a schedule for shifting stockholding responsibilities from industry to the public agency. APETRA is managed by a board of directors which consists of three representatives from industry, three from the public sector, a chairman and a Government Commissioner. The agency is financed through a levy on all industry participants delivering oil on the domestic market.

On the first day of APETRA's operation, 1 April 2007, the obligation on industry[45] was reduced from covering the full stockholding obligation (90 days of supply) to only 15 days. The remainder of the national stockholding obligation became the responsibility of APETRA. The portion of the obligation attributed to industry is to be reduced each year by three days, until 1 April 2012, at which time APETRA becomes fully responsible for meeting Belgium's national stockholding obligation.

During the transition period, the remaining obligation on industry must be met through stocks held domestically; companies may not hold stocks abroad or use stockholding ticket arrangements with other companies to meet their stockholding obligation. APETRA is authorised to hold stocks on behalf of any operator not able to meet its individual obligation. The operator will pay a service fee to APETRA.

The stock requirements on APETRA may be met by stocks of crude oil and/or finished products, either owned (purchased by tender) or through ticketing. APETRA has the legal obligation to own 50 days of middle distillate stocks by 2012.

APETRA stocks may be held by both Belgian and foreign oil companies, and retained within their normal operating systems. Up to a maximum of 30% can be kept abroad under bilateral agreements. Belgium has such agreements with France, Germany, Ireland, Luxembourg, the Netherlands and the United Kingdom. The 30% maximum amount of APETRA stocks abroad can be altered by the Minister of Energy if there are insufficient tickets available in Belgium, or if the price of tickets in Belgium is higher than the contribution paid by Belgian industry through the levy.

45. The obligation applies to large oil companies (quantities delivered to the domestic market above 100 kilotonnes per product category).

Compliance

Belgium has had difficulty in consistently meeting its IEA stockholding obligation. While meeting its IEA stockholding commitment as of March 2009, total stocks in Belgium had fallen below the 90 day level since March 2008. Belgium's non-compliance with the minimum 90 day obligation was noted in past emergency response reviews and in-depth reviews conducted by the IEA. With respect to its EU obligations, Belgium was criticised by the Court of Justice of the European Communities in July 2008. The Administration took the initiative to create a public stockholding agency in order to address the problem of compliance with its obligation.

The introduction of APETRA in Belgium's stockholding scheme has been difficult because of an insufficiently long transition period. The transfer of obligation from industry to the agency, amounting to 75 days of consumption, took place on the agency's first day of operations, fundamentally changing the country's stockholding regime overnight. The initial plan of APETRA was to use tickets, or "rights of disposal", on industry stocks to fully cover its stockholding obligation and to begin purchasing volumes of middle distillates in a second stage. However, obtaining tickets of middle distillates proved difficult, as the agency's tendering process resulted in insufficient offers from industry, and often at prices which were well beyond what the agency was prepared to pay. This arrangement does not preclude industry in Belgium from providing tickets to companies in other countries that have a stockholding obligation with their respective host country.

Table 8

APETRA Stockholding Obligation (thousand metric tonnes)

Location	*2007-2008*	*2008-2009*	*2009-2010*
Gasoline (cat. I)	399.3	386.4	347.1
Middle distillates (cat. II)	2 900.7	2 953.9	3 153.5
Fuel oil (cat. III)	262.8	179.1	126.6
Total APETRA obligation	**3 562.9**	**3 519.4**	**3 627.2**
days cover	*80 days*	*83 days*	*85 days*

Source: Country submission.

Since starting operations, APETRA has generally been able to cover its stockholding requirements through tickets for categories I and III (gasoline and fuel oil); however, it has had significant difficulty in covering the category II obligation which includes diesel oil and represents by far the largest category obligation for Belgium (Table 8). APETRA plans to buy more oil directly and to contract out existing and new storage capacity in order to reduce its dependence on finding ticket agreements with industry.

At the end of 2008, APETRA owned 222 thousand tonnes (1.64 mb) of crude oil entirely held in Germany and 330 kt (2.46 mb) of gas/diesel oil. At the same time, APETRA held tickets with industry in Belgium, France and the Netherlands which totalled 290 kt (2.45 mb) of gasoline, 493 kt (3.68 mb) of middle distillates and 170 kt (1.1 mb) of heavy fuel oil.

On the basis of 2008 net imports, Belgium must hold total oil stocks between 29.2 and 36.5 million barrels (depending on the mix of crude and products) in order to meet its IEA 90-day minimum stockholding obligation. In total, APETRA stock coverage at the end of 2008 amounted to 11 mb of oil or approximately one-third of the national obligation instead of the 85% of the national obligation that APETRA was supposed to hold. The rest of the obligation was covered by industry, which happened to hold sufficiently large commercial stocks at that time. In the future, however, there is no guarantee that commercial stocks will be sufficient to allow Belgium to meet its obligation if APETRA remains non-compliant. It is therefore important to take immediate actions to ensure the country's compliance with its stockholding obligation in the future.

Oil demand restraint

The government does not have a specific plan to implement demand restraint measures in the case of a supply disruption, but has at its disposal a number of dormant decrees which the Minister of Energy could activate after deliberation of the Council of Ministers. Possible measures include:

- speed limits;
- driving restrictions (*e.g.* sundays, even or odd number plates) or complete driving ban;
- rationing of distribution of fuel oil;
- rationing of the distribution of motor oil;
- restriction of exportation of certain oil products.

The government has not made volumetric estimates for each of the separate demand restraint measures, but estimates the total impact of all measures to be less than 5% of total oil consumption.

The National Oil Board has compiled a crisis management manual that includes updated lists of the priority end-users of petroleum products. These lists serve as a reference for drawing up ministerial decrees regarding demand restraint measures that focus on specific products or consumer groups.

Fuel switching

Fuel switching is principally driven by market forces and is not subject to any legal obligations. The "IEA Short-term Fuel-Switching Survey 2001" showed

that within Belgium's transformation and industry sector, 63% of oil capacity was switchable to another fuel source. As industry represents 33% of oil consumption currently, there would appear to be substantial potential for industry to switch out of oil in a crisis.

PRICES AND TAXES

A lower tax rate for diesel gives it a price advantage compared to gasoline (Figures 18 and 19). Belgium maintains excise duties on diesel (EUR 0.318/litre in 2008) lower than that which it places on motor gasoline (EUR 0.586/litre at end 2008). This is also the case for VAT, where EUR 0.191/litre was applied to non-commercial diesel at the end of 2008, compared to EUR 0.223/litre for gasoline (98 RON).

Price cap

Since 1987, Belgium has maintained a maximum price setting mechanism in the framework of the so-called Programme Contract (*Contrat de programme*). This sets limits on prices charged to end-consumers for gasoline, heating and automotive gasoil, fuel-oil and LPG. The maximum prices are calculated daily. If the price change for each product compared with the previous day or compared with the moving average for the previous 7 days exceeds a calculated threshold, a new tariff comes into effect the following day.

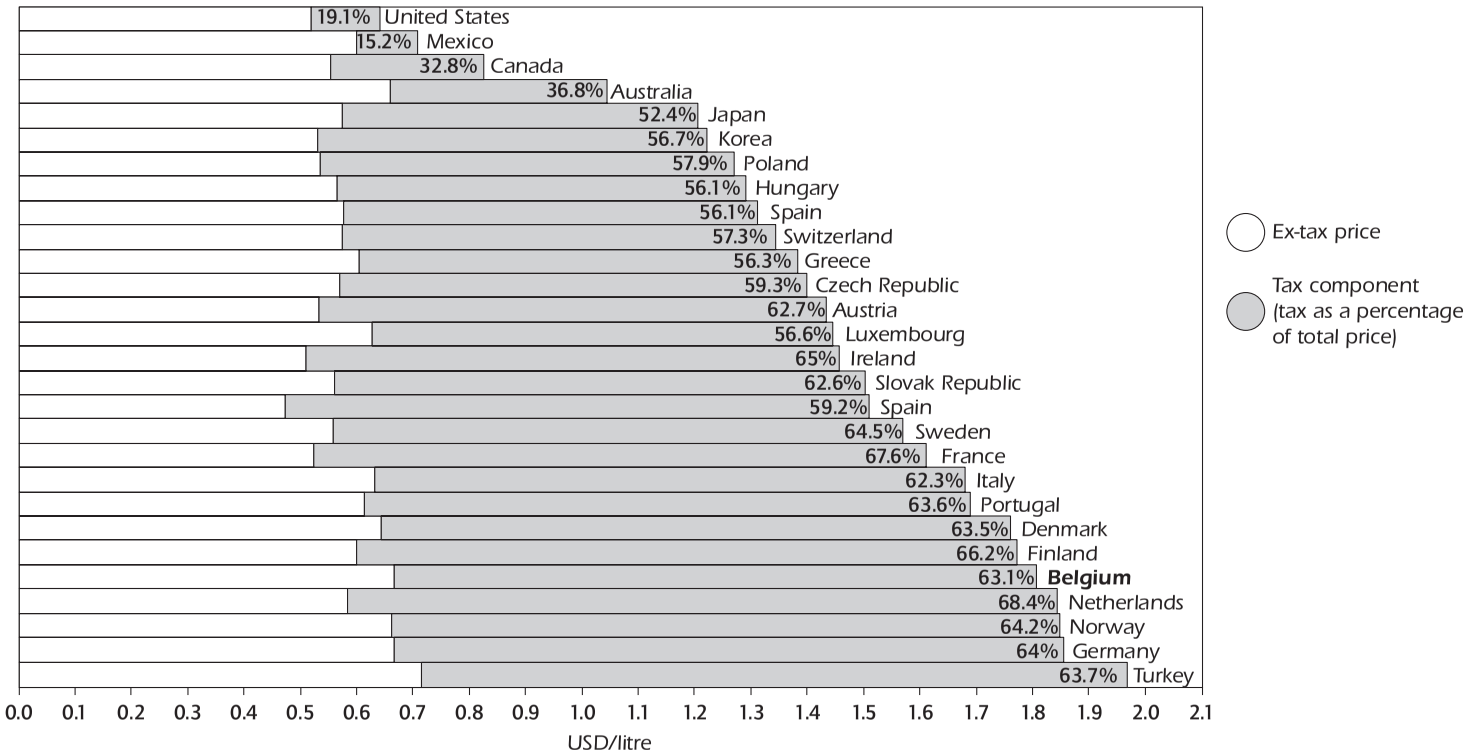
The formula for setting the maximum price is based on ex-refinery prices, primarily on the Rotterdam market. To this is added a distribution margin which is indexed annually and is comprised a uniform element for all products and a sales margin (incorporating a fixed profit margin) as well as the APETRA levy, excise duties and VAT. The formula is agreed in a 3-year contract between the Belgian State and the Belgian Oil Federation. In addition to this formula for setting the maximum price, there is a system which adjusts the level of excise duties in order to absorb 50% of the change in the maximum price.

Thus, in a market of rising oil prices, oil product prices for Belgian consumers rise at a slower rate than would otherwise be the case. At the same time, the level to which prices rise in Belgium is also lower, as excise duties are also reduced. Previous emergency response reviews and in-depth reviews have recommended removing this maximum price-setting mechanism, as this could inhibit natural market mechanisms that are necessary for reducing demand in a crisis.

However, simply eliminating the Programme Contract would not be sufficient, as oil product prices would fall under another existing price-regulating framework less appropriate than the current one. The Programme Contract was created following the oil shocks in 1974 as an alternative to the way maximum prices on oil products were being set. At that time, prices of oil products, as well as those of a variety of other consumer goods, were determined by the minister under the Law of 22 January 1945 on Economic

Figure 18

OECD Unleaded Gasoline Prices and Taxes, Second Quarter 2009

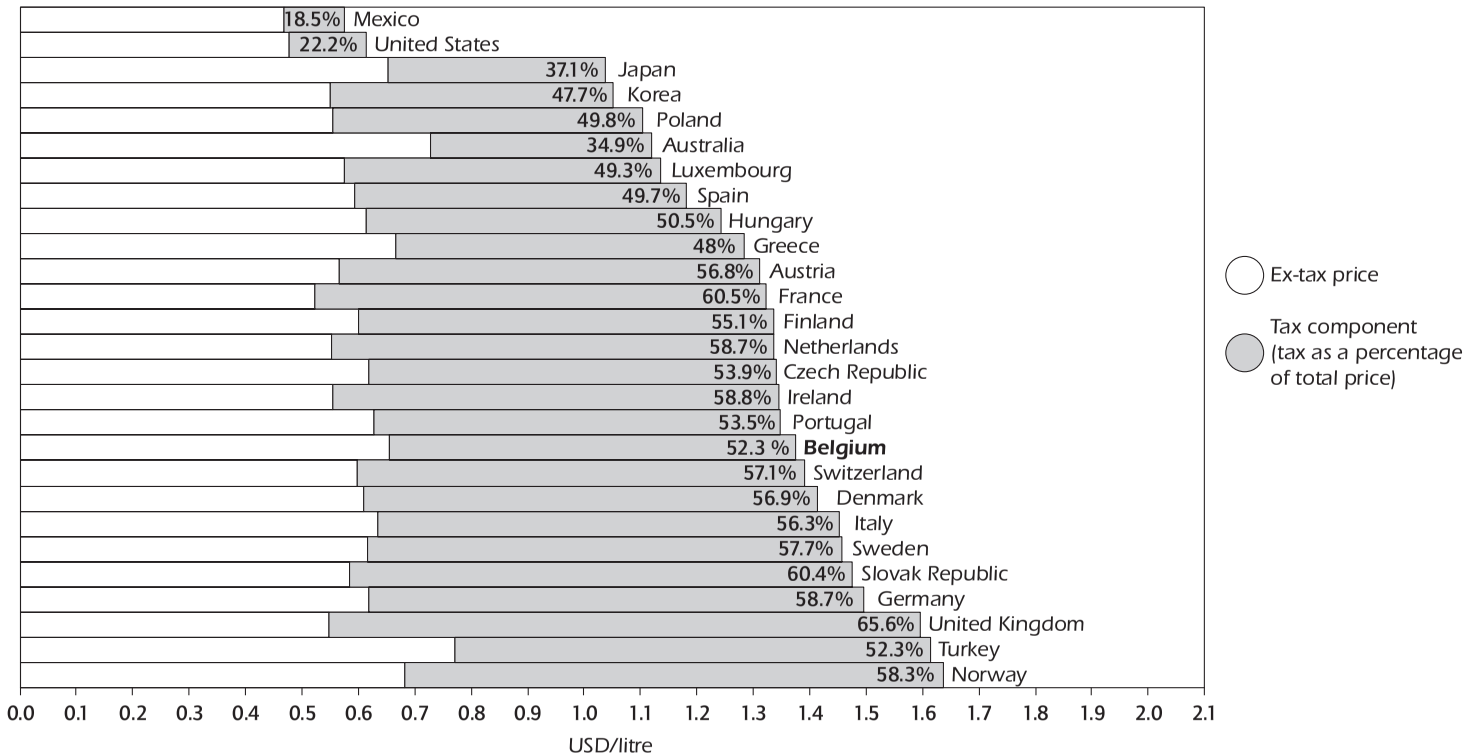


Note: data not available for New Zealand.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2009.

Figure 19

OECD Automotive Diesel Prices and Taxes, Second Quarter 2009



Note: data not available for Canada and New Zealand.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2009.

Regulation and Prices. The Programme Contract brought a more market-based mechanism for oil products. Its elimination would require changing the entire legal framework for price regulation; otherwise oil products will revert to the previous maximum price system.

QUALITY CHECKS

Created in 1995 and operational in 1996, the Fund for the Analysis of Oil Products (FAPETRO – *Fonds d'analyse des produits pétroliers)* carries out systematic quality checks, including both chemical make-up and temperature, on oil products on the Belgian market. FAPETRO is made up of representatives from the oil industry, government and professional organisations. It is funded by the petroleum sector.

This programme has been successful since its introduction, significantly increasing compliance with fuel quality specifications. The share of faulty samples has dropped to 3.1% in 2008, the lowest level since the programme's inception. Through the continuing operation of the fund, Belgium aims to ensure that quality levels achieved will be maintained when new environmental product specifications are introduced in the future.

ENVIRONMENTAL ISSUES

BOFAS Fund

In March 2004, Belgium's Fund for the Clean-up of Polluted Service Station Soil (BOFAS[46]) became operational. The fund provides financial assistance for service station clean-up projects. If a service station is closing down permanently or was already permanently shut down, the fund provides 100% of the costs and carries out the clean-up project itself. If service station activities continue at the site, the fund provides only a limited share of the costs. The fund is based on an agreement between the federal and regional governments and is financed equally by the oil sector and motor fuels consumers. The EUR 400 million project is scheduled to last 15 years.

Fund for heating oil storage tanks

In addition to BOFAS, Belgium is planning to develop another fund for the clean-up of soil polluted by heating oil storage tanks. As a large number of Belgium's households heat their homes with heating oil, there are about 1 150 000 underground and above-ground heating oil storage tanks (about 750 000 underground storage tanks). This future fund will presumably be based on an agreement between the federal and regional governments and will be financed entirely by heating oil consumers. The fund will have two

46. Bodemsaneringsfonds voor tankstations/Fonds d'assainissement des sols des stations-service.

primary tasks: to clean up existing soil pollution caused by leaking tanks and to prevent tanks from leaking in the future. The second task will be accomplished by, among other things, developing quality standards for heating oil tanks, developing and promoting leak detection devices and providing information to end-users. The goal of the fund is to completely eliminate leaks in the future. The programme has been under negotiation for several years. As of mid-2009 it was not yet operational because of technical difficulties and different regional laws and regulations which have been hindering its full implementation.

DATA ISSUES

The General Directorate for Energy collects monthly and annual oil data from the main companies operating in Belgium. The legal basis for data collection is the Royal Decree of 13 March 2003. This requires a monthly report from the companies which have an excise number for oil products or which consume, or deliver to consumption, more than 25 kt/year.

Since 1 January 2008, a new questionnaire has been created for collecting oil and gas data to be submitted electronically. This updates the coverage of national statistics with regard to products, economic sectors, import origins and export destinations. Companies are identified by their excise number. In 2008 there were approximately 80 companies reporting each month. While the new questionnaire provides more precise data on final consumption, there remain some difficulties. For example, as the reporting system is linked with custom and excise taxes, imports are considered as amounts coming from outside the EU only. The Administration intends to review and adapt the questionnaire in order to be more closely aligned to the IEA and EUROSTAT questionnaires.

COAL

SUPPLY AND DEMAND

Belgium imports all of the coal it consumes. Its imports are well diversified in the case of steam coal, although less so in the case of coking coal.

Primary coal demand has been declining steadily over the past decades. It dropped from nearly 10.6 million tonnes of oil equivalent (Mtoe) in 1990 to 4.2 Mtoe in 2007. In 2006, nearly half of primary coal supply was used for electricity and heat generation[47] and over 30% by the coal transformation sector.[48] Industry (mainly iron and steel) consumed 0.9 Mtoe and the residential sector another 0.13 Mtoe. In power generation, the most inefficient

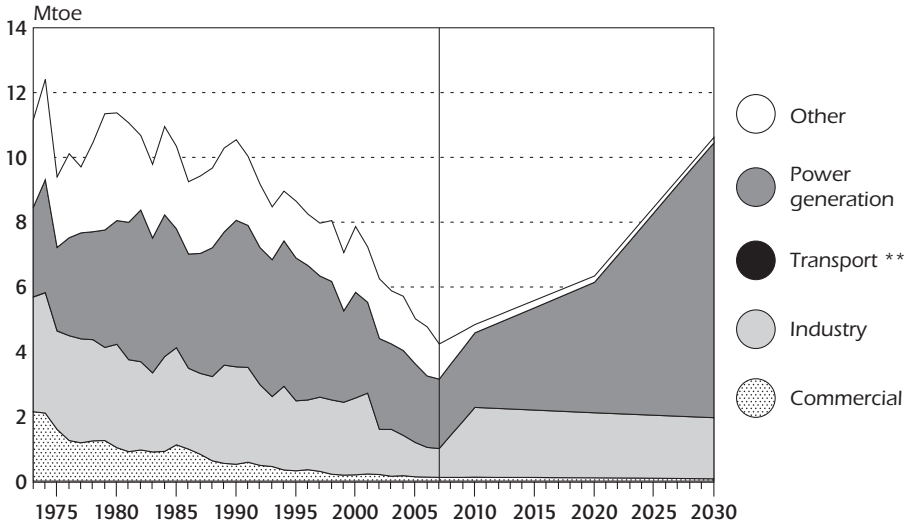
47. Both at electricity plants and autoproducers'facilities (industrial and other users having their own co-generation capacity).
48. Mainly blast furnaces and coke ovens.

coal-fired plants have been recently closed and there are further plans to close or refurbish several other old and inefficient units. In 2008-2009, coal demand dropped sharply in the steel industry, mainly because of the global economic slow-down. Arcelor Mittal temporarily closed one of its large blast furnaces for an uncertain period of time.

However, the government forecasts that the use of coal will increase in the medium and long term, mainly because a significant share of current nuclear power generation is expected to be replaced by coal after 2015-2025. Two challenges are related to this projection. First, it is not clear how realistic these forecasts are, given past and current investment trends. The current investment framework does not appear attractive for new generating capacity, particularly coal-fired, because of strict air quality regulations in some regions, obstacles to planning approvals, uncertainty about future CO_2 prices, and doubts about the speed with which CCS technologies can be deployed.[49] Secondly, if the use of coal for electricity generation does grow without CCS, this will lead to more greenhouse gas emissions.[50] The government will need to find the right balance between energy security benefits offered by coal and effectively addressing related environmental concerns.

Figure 20

Coal Supply by Sector*, 1973 to 2030



* total primary energy supply by consuming sector. Other includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes residential, commercial, public services, agriculture, forestry, fishing and other final consumption.

** negligible.

Sources: *Energy Balances of OECD Countries,* IEA/OECD Paris, 2009 and country submission.

49. For further discussion see Chapter 7.
50. GHG emissions in the power sector fall under the EU-ETS.

Coal trade in Belgium is dictated by supply and demand and coal prices are set by the market. Belgium closed its last remaining coal mines in the 1980s and early 1990s (see Box 3) since these were not competitive, and coal is no longer produced in Belgium.

Box 3

Coal Mine Closures

Since the 1960s, the coal industry in Belgium had been heavily reliant on state subsidies to cover its costs. By the early 1980s, it provided work for around 19 000 people in a region that was economically depressed, with unemployment rates around 25%. In the mid-1980s, the Belgian government committed USD 2.5 billion to cover the costs of closing the industry and for future regional economic regeneration. Strong incentives were provided for a rapid mine closure programme, with more funds than being available for regeneration. Options for redundant miners included early retirement, accepted by around 40% of those affected, or a lump-sum redundancy payment and the opportunity for retraining. Between 1988 and 2000, the Limburg Mining Region Counselling Service (Begeleidingsdienst Limburgs Mijngebied or BLM vzw) and other training centres assisted a total of around 25 000 people, including around 8 000 former miners, with advice, specialised training services and job placement.

The use of coal is regulated by the regions as part of their environmental policy. Belgium re-exports about 1 to 1.3 Mt of coal to other EU countries and its role as a transit country could be further enhanced as import demand grows in Germany to replace declining indigenous production.

Coal-fired electricity generation

All existing coal plants in Belgium are owned by Electrabel-Suez, but it will cede two coal units (Langerlo 1 and 2) to E.ON AG in mid-2009, under the Pax Electrica II agreement. Most plants are old and relatively inefficient, although they comply with the EU Directive 2001/80/EC. The "Electricity Law" imposes the use of "best available technologies" to grant authorisations for new plant projects. Regional legislations add particular specifications to this condition.

Production from the older plants is gradually falling, owing to efficiency and environmental constraints. Electrabel-Suez plans to close its oldest plant in 2010. Gross average electrical efficiency of power-only plants varied between 37.5% and 38% in the 2005 to 2008 period.

Table 9

Belgian Coal-Fired Power Stations

Plant name	*Owner*	*Operation start year*	*Capacity*	*Fuel used*
Amercoeur 1*	Electrabel-Suez	1967	129 MW	coal, fuel oil, natural gas and coke-oven gas
Amercoeur 2**	Electrabel-Suez	1968	127 MW	coal (also adapted to fire biomass)
Langerlo 1	Electrabel-Suez	1975	258 MW	co-combustion coal and biomass
Langerlo 2	Electrabel-Suez	1976	258 MW	co-combustion coal and biomass
Mol 11**	Electrabel-Suez	1963	124 MW	coal, fuel oil, natural gas (conversion to biomass planned)
Mol 12**	Electrabel-Suez	1967	131 MW	coal, fuel oil, natural gas (conversion to biomass planned)
Rodenhuize 4***	Electrabel-Suez	1979	268 MW	coal (also adapted to fire blast-furnace gas and biomass)
Ruien 3	Electrabel-Suez	1967	130 MW	coal (also adapted to fire biomass)
Ruien 4	Electrabel-Suez	1966	122 MW	coal (also adapted to fire biomass)
Ruien 5	Electrabel-Suez	1973	290 MW	coal (also adapted to fire biomass)

* Operated very rarely since 2005.

** Electrabel plans to close it in January 2010.

*** Electrabel plans to replace Rodenhuize 4 by a more efficient 305 MW unit in March 2010.

Note: This table does not include autoproducers of electricity: co-generation installations at refineries, steel and pulp and paper industries. In total, autoproducers used 0.3 Mt of coal equivalent for electricity and heat generation in 2006.

Sources: Country submission, IEA statistics and IEA Clean Coal Centre.

CO_2 capture and storage (CCS)

Clean coal technologies, in particular carbon dioxide capture and storage (CCS), are possible means to achieve environmental and energy security/diversification goals simultaneously. Belgium's first attempts to investigate

its CCS-related opportunities are commendable. As discussed in more detail in Chapter 9 on R&D, a Belgian company, C.GEN, is actively promoting a CCS project in Rotterdam. Encouragingly, E.ON Benelux planned the construction of a CO_2-capture-ready power plant in Antwerp with a gross capacity of 1 100 MW which may become one of the biggest European projects with CCS planned at the outset, The environmental impact assessment for this project was rejected by the Flemish authorities on 18 May 2009. E.ON Benelux consequently introduced an adapted assessment which was approved on 3 July 2009. The environmental impact assessment precedes the environmental permitting procedure.

CRITIQUE

Gas

Belgium relies entirely on imports for its gas consumption. The current import portfolio is fairly well diversified by geographic origin and type of supply (pipeline and LNG). Belgium occupies a key position in the European gas grids and serves as an important transit country.

In recent years, the Belgian gas market has seen some positive developments. The expansion of the Zeebrugge hub has been remarkable. The hub is attracting international trade as a collection of connection points of several pipelines and as an important LNG terminal, which contributes to security of supply in north-west Europe.

Fluxys, the transmission system operator, has taken several measures to enhance liquidity on the hub. The ZEE Platform Service, offering unlimited capacity transfers in the Zeebrugge area, interruptible capacity products for transit, day-ahead capacity trading for domestic transportation, a Belgian-French platform for trading of secondary capacity (Capsquare) and synergies between transit and transportation services are all expected to enhance liquidity and competition, and are praiseworthy. The Belgian government should monitor the effects of these measures and continue to stimulate the further development and liquidity on the Zeebrugge hub.

Other positive developments include changes in the structure of the Belgian gas market. The market share of the incumbent, GDF Suez, is gradually declining. More and more players are entering the retail market, especially in Flanders and Wallonia, although progress in the Brussels-Capital region is much slower. However, GDF Suez still has an important stake in Fluxys, thus having a large degree of control over the transmission system, the LNG terminal, the underground storage facility and the strategically important Zeebrugge hub. Even if the incumbent does not abuse its market power, new entrants perceive this control as a threat, which constitutes a significant

market barrier. The plan to decrease the GDF Suez stake in Fluxys below 25% is commendable and should enhance competition. The government should continue to monitor the development in the market structure and the level of competition, and take corrective measures if necessary.

The above-mentioned developments contribute to the liquidity and competition as well as the security of supply on the Belgian gas market. Nevertheless, some significant challenges remain.

One challenge is the future supply and demand balance and the related issue of security of supply. Natural gas consumption is likely to grow sharply because the new power generating capacities that need to be built will be mainly gas-fired, particularly if the nuclear phase-out is implemented. Growing electricity generation from intermittent renewable sources could also increase gas demand for backup facilities. At the same time, supply from the two most important import countries, the Netherlands and Norway, will likely fall in the long term, which will increase the dependence on imports from Russia and on LNG. To match growing imports, ambitious investments in the gas infrastructure will be needed. This requires sound forecasts of future gas demand and a translation in realistic grid investment plans. The preparation of "prospective studies" and other analytical studies with medium- to long-term forecasts of gas demand and supply patterns is a commendable development. On the basis of these forecasts the Belgium government should develop integrated plans of how to meet gas demand under different scenarios.

Developing specific emergency response measures for natural gas, as part of an integrated policy, is another challenge for the Belgian government. Currently, the government relies on the TSO, Fluxys, to assure the safety and reliability of the network and to maintain natural gas supplies. The existing natural gas emergency response policy is rather fragmented across various pieces of legislation and various authorities. Codifying it under one law and a single regulator would be a significant step forward. The task force established by the government to develop an integrated emergency response policy should be encouraged and intensified.

As part of this process, the government should consider developing contingency plans for dealing with a natural gas supply disruption which exceeds the current parameters of the emergency plans of Fluxys. This is all the more necessary as Belgium only has one small underground storage facility. This could include backup sources of energy supplies where switching capacity exists, and demand restraint. Given the growing importance of natural gas in the transformation sector, it would make sense to re-evaluate the current policy of the "interruption plan" which defines a hierarchy of users to be cut off from supplies, starting with power plants.

Belgium rightfully seeks to preserve and enhance its role as a European gas hub. Increasing transit flows through the Belgian territory should be a viable

means to attract sufficient volumes to the domestic market thus enhancing energy security and competition. However, several factors hamper the potential positive impact of transit volumes on the Belgian domestic market, and therefore deserve particular attention of the government.

First, the current system of "enhanced entry-exit" and the relatively complex balancing regime with four balancing zones make it difficult for shippers, especially new entrants, to book capacity for supplying their customers in Belgium. Secondly, "contractual congestion", discussed below, exacerbates the difficulties related to the entry on the Belgian gas market. Being unable to ship gas from their preferred sources, new entrants have to buy it in Belgium from their incumbent competitors. This obviously diminishes the attractiveness of the Belgian market for new players, thus effectively reducing the level of competition. Facilitating access to gas transportation and the introduction of a true entry-exit regime would be beneficial for competition and for better integration with other European gas networks.

Capacity booking rates on the Belgian gas network appear to be higher than the underlying physical gas flows, particularly at specific entry points. This "contractual" congestion creates an obstacle for market access. The introduction of the Capsquare platform as a secondary market is a good step to ease this problem. In addition, the "use it or lose it" mechanism that forces shippers to offer reserved but non-nominated capacity back to the market should be reinforced and extended to transit capacity.

Finally, uncertainty on transit/transport tariffs and the relatively complex and burdensome regulatory regime (with four different regulators) not only creates a barrier for new entry but also can harm investments in cross-border capacity. Administrative procedures to obtain the necessary permits and authorisations for the construction of transmission infrastructure are often long and complex, which deters much-needed investment.

Another challenge concerns the two types of natural gas traded in Belgium: H-gas (with high caloric value) and L-gas (with low caloric value), transported via two separate networks. The L-gas comes exclusively from the Netherlands and serves a quarter of Belgium customers. While the reliability of the Dutch supplies to date should be acknowledged, the government should take the necessary measures to prepare for the end of L-gas imports taking into account security of supply, flexibility and cost-efficiency of supply. The government has decided to use a step-by-step approach and set up an expert group in order to evaluate, develop and lead the process of conversion of L-gas to H-gas. The conversion is a complex and expensive process which requires sound preparation and implementation. Important aspects are cost estimations and cost-sharing decisions. The timing of the process is crucial; conversion should be in place before the end of the supply of L-gas while a premature conversion would lead to a loss of L-gas import potential. In the light of the uncertainty about the Dutch gas supply in the long term, the installation of

conversion capacity (to convert H-gas to L-gas but not the other way round) is commendable. Such conversion capacity would make it possible to continue using (parts of) the L-gas network, thus taking advantage of the possible prolongation of L-gas imports. In addition, in the shorter term, conversion capacity could increase competition on the L-gas market.

Oil

In April 2007, Belgium's agency responsible for managing emergency oil stocks, APETRA, started operations. This is a commendable development aiming to increase the country's compliance with its stockholding obligations and to improve its energy security in general. However, the agency's initial start-up proved very difficult largely because there was no transition period from the previous scheme where all emergency stocks where held by the petroleum industry. While APETRA should be commended for good progress in increasing its stockholding cover since the end of 2008, it will likely remain non-compliant at least until 2011. This will leave Belgium non-compliant with its EU obligations and subject to falling non-compliant with IEA requirements, as this becomes contingent on stocks held by industry which has a decreasing stockholding obligation.

To assure stockholding compliance, the government should take urgent and proactive actions, such as *i)* maintaining (or raising back) the industry stockholding obligation until APETRA is compliant; *ii)* encouraging industry to provide tickets to APETRA by using as leverage the authorisation powers for holding tickets for foreign companies; *iii)* increasing budget to purchase tickets and/or oil; and *iv)* speeding up decision-making procedures by reallocating decisional power from the Board to the management of APETRA.

As part of the process of developing an integrated emergency response policy, Belgium is updating the emergency response handbook for oil emergencies. This is a laudable initiative, and its current schedule should be accelerated. A clear decision framework should be rapidly developed and incorporated in the handbook update. This could include a streamlined process for international tendering in the case of an IEA co-ordinated action and a draw-down plan outlining step-by-step actions to be taken by the National Emergency Sharing Organisation (NESO) and APETRA.

The recent increase in staff numbers working under the NESO is to be applauded. The NESO team is encouraged to develop closer contact and interaction with the domestic oil industry, establishing an emergency contact list which is constantly kept up to date, and to conduct regular training and exercises which would include a broad range of oil industry participants.

The government maintains a system of price caps on main petroleum products, the so called Programme Contract. The price ceilings are intended to act as a buffer against price shocks and volatility, and to protect customers

in the event of short-term price spikes. Actual oil prices set by industry tend to be below the maximum ceiling. Nevertheless, the price ceiling could reduce demand response to a price spike. Such ceilings could be counter-productive, impeding the ability of higher prices to reduce demand and contributing to oil price instability. Because of these ceilings, the oil industry might not be able to recover its supply costs adequately, which would especially be the case in a context of fast rising crude oil prices, potentially leading to underinvestment.

Simply eliminating the Programme Contract would not be sufficient, as oil product prices would fall under another existing price-regulating framework less appropriate than the current one. Belgium should therefore consider removing these caps as well as the system that adapts the excise duties to raising prices, in an overall legislative revision which would take away oil products from the list of commodities with regulated prices.

The continued dieselisation of the Belgian market poses significant challenges, including growing dependence on imports and insufficient storage capacity. The current tax regime gives a clear preference to diesel compared to gasoline and results in a lower end-user price for diesel. Belgian refinery industry is unable to meet all domestic demand for diesel, and the country therefore imports some of its diesel consumption and exports gasoline. The government could consider narrowing or eliminating the differences in duties and taxes between diesel and gasoline in order to help alleviate this imbalance.

On the positive side, the refining industry has recently invested into additional desulphurisation capacities in order to comply with new EU legislation requiring lower sulphur levels for motor fuels and to allow for refining more sour crude oils increasingly sourced from Russia.

It is commendable that the FAPETRO fund – aimed at improving quality of oil products sold on the Belgian market – continues operating. This fund has been very successful since its introduction, significantly increasing compliance with fuel quality specifications. Regarding the reduction of the environmental impact of oil distribution and storage, Belgium has made good progress in utilising the BOFAS fund, set up to enable the remediation of soil contamination at petrol stations. Unfortunately, a similar fund for the clean-up of soil polluted by heating oil storage tanks has not yet started operation. This was proposed several years ago, but the political debate is still ongoing.

To enhance both oil and gas security, it could be beneficial to conduct studies to quantify the amount of oil and gas which can be switched to another fuel source during an oil or gas supply disruption. On the basis of these studies, the government may consider the possibility of establishing a plan for implementing compulsory fuel switching in times of a disruption in oil or gas supply.

Coal

Although the coal market in Belgium is market-driven, the impact of government policies on coal use should not be underestimated. For example, as a result of the current policy and regulatory framework, any prospects for building new coal-fired electricity generating capacity are extremely uncertain. While it is essential for regional and local authorities to take into consideration air quality and social concerns, as well as the challenge of global warning, in designing their policies, it is equally important to keep in mind energy security considerations. In the present situation, where there is the threat of a shortfall in electricity generating capacity (as discussed in Chapter 7), potential benefits of coal-fired electricity generation need to be assessed carefully. The government should find the right balance between energy security benefits offered by coal and effectively addressing related environmental concerns. It is encouraged to increase its attention to CO_2 capture and storage (CCS) and other clean coal technologies as potential means to reduce the environmental impact of coal use within a framework that allows investment in new plants.

To take full advantage of the potential benefits of CCS, Belgium should provide more support to domestic projects and more actively participate in international efforts. At the same time, the government should develop a legal and regulatory framework for CCS, as will be required under the agreed EU Directive on the Geological Storage of CO_2, and enhance public awareness.

RECOMMENDATIONS

The government of Belgium should:

- *Intensify ongoing efforts to design a more comprehensive emergency response policy including gas and other fuels. In particular, continue to consider the interactions of fossil fuels with the power sector.*

Natural gas

- *Continue efforts to facilitate entry of new actors on the gas market and to enhance competition, in particular through ensuring effective third-party access to the gas transportation network. Decrease contractual congestion by additional mechanisms that bring reserved but non-nominated capacity back to the market.*

- *Simplify the long and complex administrative procedures to obtain the necessary permits and authorisations for the construction of transmission infrastructure.*

- *Proceed with forecasting future gas demand and supply patterns, and develop integrated plans to meet gas demand under different scenarios.*

- *Codify natural gas emergency response policy under one law and a single regulator, rather than the current fragmented policy across various pieces of legislation and regional authorities. Develop contingency plans for dealing with a natural gas supply disruption which exceeds the current parameters of the emergency plans of Fluxys.*
- *Continue to ensure a sound planning and implementation of the conversion from L-gas to H-gas taking into account the required flexibility and security of supply.*

Oil

- *Continue building public emergency stocks owned by APETRA and decreasing reliance on short-term ticket agreements.*
- *Take immediate action to assure stockholding compliance in the future.*
- *Consider changing the legal framework in order to remove the oil price ceiling and any other oil price regulations that may inhibit demand response to oil price spikes and lead to potential underinvestment into the retail sector by industry.*
- *Consider balancing the excise tax differential for gasoline and diesel, taking into account industrial issues.*
- *Put the fund for the clean-up of soil polluted by heating oil storage tanks into operation as quickly as possible.*

Coal

- *Given the projected increased use of coal for power generation, balance national goals on air quality, climate change and energy security, taking into account best available clean coal technologies (including CCS) and Belgium's overall climate change strategy.*

OVERVIEW

In 2007, renewable energy accounted for 3.8% of total primary energy supply (TPES) and 2.1% of final energy consumption. According to the EU directive, Belgium has a national binding target for renewable energy to account for 13% of gross final energy consumption in 2020. Renewables policy is mainly the responsibility of the regions with the exception of offshore wind. Regions support renewable energy technologies mainly through investment subsidies and green certificates. Additionally, the federal government provides tax incentives and investment subsidies.

SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Renewable energy accounted for 2.7% of total primary energy supply (TPES) in 2007 (1.52 Mtoe), up from just 1% in 1990 0.48 Mtoe). The majority of renewable energy supply (95% in 2007) comes from renewable combustibles and waste, 2.2% from hydro and 3.3% from other sources, mainly wind. Renewables and non-renewable waste combined provide 3.7% of TPES, which ranks Belgium twenty-third among the 28 IEA countries (Figure 22). For comparison, renewables and waste account for nearly 50% of TPES in Norway and over 30% in New Zealand and Sweden.

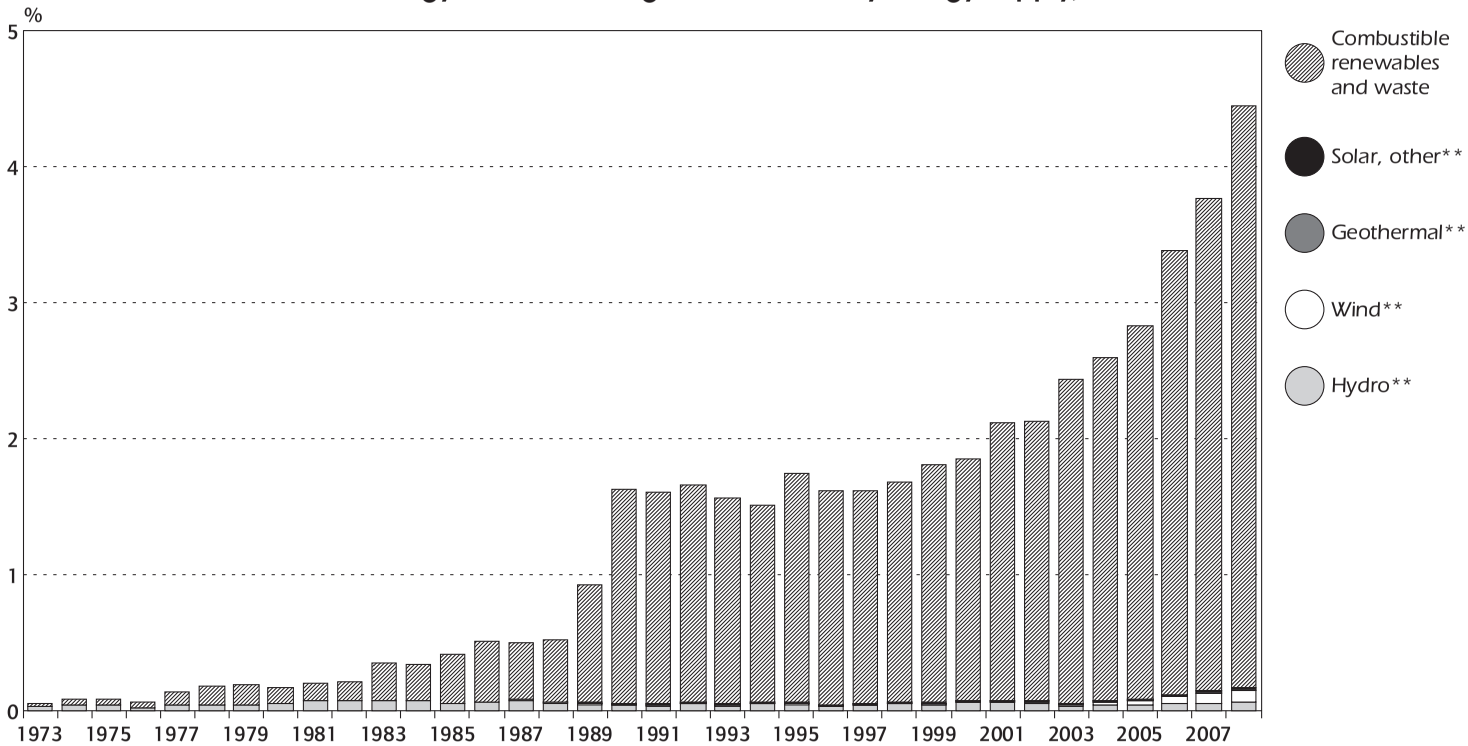
ELECTRICITY AND HEAT

Renewable energy and waste accounted for about 7% of total electricity generation (5 516 GWh) in 2008 (based on provisional data). This is the sixth-lowest share among the IEA countries (Figure 23) mainly because of the lack of hydropower. However, this represents a large increase from 1990 when only 1627 GWh were generated from renewables and waste.

Heat production from renewable sources and waste in the energy transformation sector was 297 TJ in 2007 (down from 411 TJ in 1990), or 1% of the total commercial heat supply. Of this, less than half was renewable waste and

Figure 21

Renewable Energy as a Percentage of Total Primary Energy Supply, 1973 to 2008*

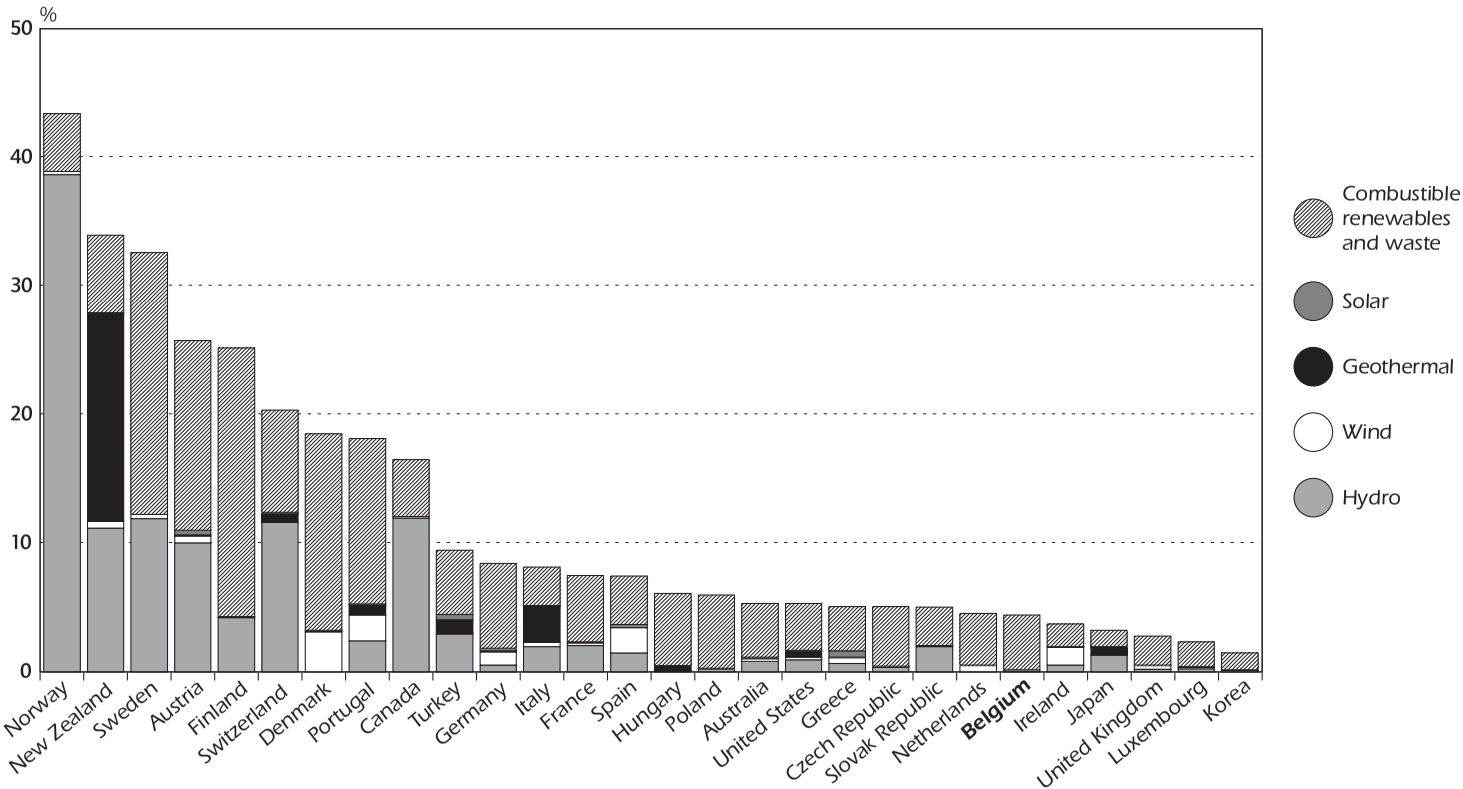


* 2008 = estimates.
** negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

Figure 22

Renewable Energy as a Percentage of Total Primary Energy Supply in IEA Member Countries, 2008*

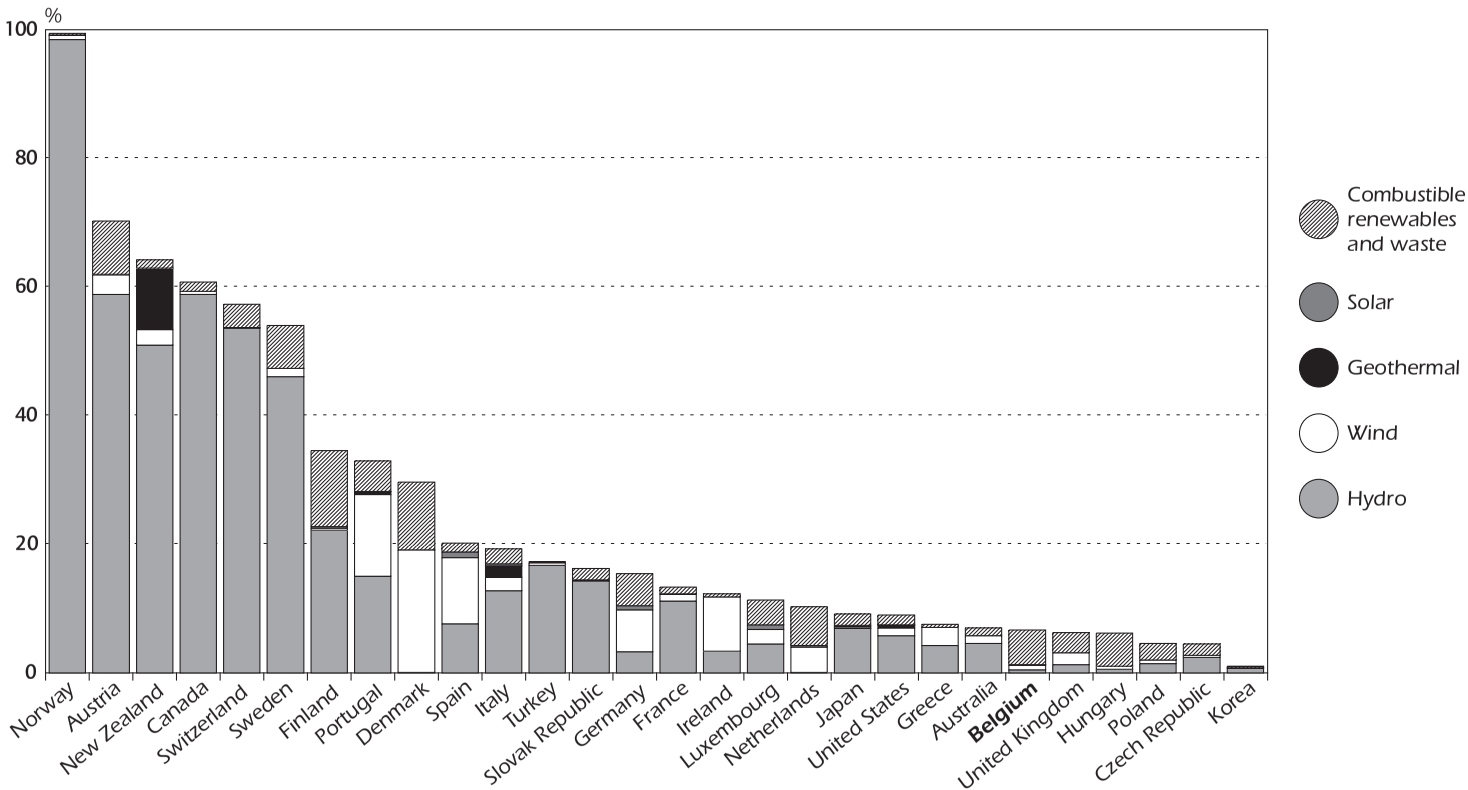


* estimates.

Source: Energy Balances of OECD Countries, IEA/OECD Paris, 2009.

Figure 23

Electricity Generation from Renewable Sources a Percentage of All Generation in IEA Member Countries, 2008*



* estimates.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

biomass, and the rest being non-renewable municipal and industrial waste. This does not include heat from renewable sources produced by end-users for their own use.

There are 136 MW_{th} or 194 000 m^2 of operating solar thermal capacity in Belgium, according to the IEA Solar Heating and Cooling Implementing Agreement.[51] Approximately 70 GWh/year is produced, equivalent to 250 TJ or 6 ktoe (less than 0.1% of TPES).

POLICY FRAMEWORK

Renewable energy policy in Belgium, like in other EU countries, is increasingly guided by EU requirements and interlinked with the climate change policy. Policies that support renewable energy development at the same time facilitate the achievement of the country's climate policy objectives. Renewable energy policy is also closely linked with energy efficiency policy. Energy efficiency improvements and the consequent reduction (stabilisation) of energy demand make relative targets for renewables easier to achieve. See Chapters 3 and 4 for a more detailed discussion of Belgium's climate and energy efficiency policies.

INSTITUTIONAL FRAMEWORK

Renewable energy policies and measures are mainly within the competence of the regional governments. One exception is offshore wind, which falls under the responsibility of the federal government. The federal authorities are also responsible for setting taxes and excise duties, as well as for policies regarding biofuels. For example, the federal government has introduced tax deductions[52] for investments in renewable energy technologies and granted EUR 1.5 million to the Federal Energy Services Company (FEDESCO) for setting up PV panels on roofs of public buildings. Table 10 provides an overview of policies and measures implemented at the federal and regional levels.

51. http://www.iea-shc.org.
52. Tax deduction for investments in energy efficiency and renewables: 40% for households. The tax deduction for companies making investments was raised to 15.5%. More details are provided in Chapter 4.

Table 10

Key Renewable Energy Policies and Measures: Division of Responsibilities

	Federal	*Wallonia*	*Flanders*	*Brussels*	*Target sector*
Green certificates systems	x (without obligation)	x	x	x	Electricity/Industry
Minimum prices	x	x	x		Producers of electricity from renewable sources
Fiscal incentives	x (federal taxes)	x (local taxes and levies)		x	Various sectors
Investments subsidies	x	x	x	x	Various sectors

Sources: Country submission; IEA analysis.

RENEWABLE ENERGY POTENTIAL

Renewable energy resource potential in Belgium is relatively low compared to other countries because of its geographic and climatic conditions, and high population density. The Federal Planning Bureau,[53] the federal regulator CREG and the Commission Energy 2030 have noted that Belgium has no or very limited hydro and geothermal energy potential while biomass and offshore wind seem to have the highest development potential. The limited potential adds to the overall costs and challenges of developing renewable energy. It is important, therefore, to carefully evaluate the economic potential of all available technologies and ensure that right incentives are given to attract investment in the most cost-efficient projects first.

TARGETS, OBJECTIVES AND KEY POLICY DIRECTIONS

EU requirements

In accordance with the EU directives, Belgium's indicative targets are: 6% of electricity from renewables and 5.75% of transport fuels from biofuels by 2010. The new EU Directive on Renewables adopted in December 2008 sets a binding target for renewable energy to account for 13% of Belgian final gross energy consumption[54] in 2020. To ensure steady progress towards the 2020

53. Bureau Fédéral du Plan, Projet d'Etude sur les Perspectives d'Approvisionnement en Electricité 2008-2017.
54. The EU definition of *gross* domestic energy consumption includes transmission and distribution losses and is therefore different from the total final consumption (TFC) used in the IEA methodology.

targets, the directive sets a series of interim targets ("indicative trajectory"), shown in Table 11. Belgium must present a national action plan (NAP) based on its indicative trajectory to the Commission by 30 June 2010, followed by progress reports submitted every two years. The plan will need to be defined along three sectors: electricity, heating and cooling, and transport.

As part of the overall 13% target, Belgium has a separate target for biofuels and other renewable sources to cover 10% of transport fuel demand in 2020.[55]

Table 11

Renewable Energy Targets and Indicative Trajectory to 2020

	Indicative trajectory targets (% of final gross energy consumption)
2005	2.2 (historical)
2011-2012	4.4
2013-2014	5.5
2015-2016	7.1
2017-2018	9.3
2020	13

Source: Country submission.

Belgium will have some flexibility in meeting the 13% target: *i)* each country is free to decide its preferred domestic mix of renewables; *ii)* the EU directive allows one member state to sell excess renewable energy credits to another, based on statistical values (so called "statistical transfers"). These transfers can also be applied in cases where member states co-operate on joint projects. However, the availability of surplus renewable energy credits in other EU members may be limited because the targets are high for all the countries and statistical transfers are allowed only if the selling country exceeds its own indicative trajectory targets. The federal government and regional authorities will decide jointly how each of the regions will contribute to meeting these national targets.

A study released by the Federal Planning Bureau in early 2009 forecasts that renewable energy will account for 7.9% to 8.8% of gross domestic energy demand in 2020 without additional policies and measures.[56] Another study

55. The binding character of this target is "subject to production being sustainable" and to "second-generation biofuels becoming commercially available".
56. Federal Planning Bureau, Projet d'Etude sur les perspectives d'approvisionnement en électricité 2008-2017, version du 13/12/08.

of the Planning Bureau, analysing Belgium's capacity to reach the targets set by the EU Energy and Climate Package (released in November 2008), had come to a similar conclusion.[57] Under the baseline scenario (taking into account policies and measures as of the end of 2006) Belgian renewable energy supply is forecast to reach 3.2 Mtoe or 7.5% of gross energy demand in 2020. Meeting the 13% target will require more vigorous and more ambitious policies to stimulate the deployment of renewables. The 20-20 target scenario[58] released by the Bureau shows how the share of renewables in Belgian gross domestic energy demand can reach 12.3% by 2020. The remaining 0.7% is expected to be met through flexibility mechanisms. The total direct cost of reaching both the GHG and renewable energy targets is estimated at EUR 3.5 billion in 2020, or 0.86% of Belgian GDP.

In any case, the EU directive sets a very challenging target; to meet it Belgium will need very effective policies and measures in place. Achieving the relative renewable energy target will be easier if at the same time Belgium reduces its energy consumption.

Other objectives

Before the adoption of the EU 2008 directive, two Belgian regions had set specific targets. The Walloon region has an objective for renewables to cover 8% of electricity in 2010 and 12% in 2012, and 9% of heat in 2010. The Flemish region has a 6% target for renewables-based electricity in 2010.

The federal government has adopted an objective to install 2 000 MW of wind generation capacity in the territorial sea and the exclusive economic zone of Belgium, of which 880 MW by 2012 (see section on Offshore wind below). It also plans to install 1 km^2 of solar PV panels on public buildings and infrastructure.

POLICIES AND MEASURES

INVESTMENT INCENTIVES

Both the federal and the regional governments provide subsidies and tax incentives for investment in renewable energy technology. At the federal level, tax deductions are available for 15.5% of investment costs for enterprises and up to 40% for households.

57. Federal Planning Bureau, *Impact of the EU Energy and Climate Package on the Belgian Energy System and Economy*, Brussels, November 2008.
58. The 20-20 target scenario comprises the EU targets for a 20% GHG reduction and a 20% share of renewable energy in final energy demand by 2020.

The Walloon region grants investment subsidies and an exemption from real estate taxes to companies which invest in sustainable energy production[59] and energy efficiency. The overall amount of the support varies from 20% to 40% depending on the size of the enterprise and the objective of the investment programme.

Flanders grants an investment subsidy known as "Ecologybonus" for investments in sustainable energy.[60] The support level varies with the size of the company and the renewable energy technology. Biomass receives the highest level of support in terms of the share of investment cost. Brussels-Capital finances 50% of feasibility studies and 40%[61] of total investment costs of biomass, wind, solar and geothermal projects.

All three regions provide significant subsidies for investment in PV (see section on Solar PV below). The Walloon and Flanders regions provide support for R&D in renewable energy technologies (see Chapter 9). The three regions have established so called "facilitator" services – free advice and technical guidance for renewable energy and CHP projects.

ELECTRICITY

The main policy instrument to promote renewables-based electricity in Belgium is green certificates. All three regions have established their own green certificate schemes, and the federal government has introduced an additional scheme for offshore wind as well as wind and hydro installations in the exclusive economic zone of Belgium, which is under the federal government's jurisdiction.

The four schemes have significant differences (Table 12). In Flanders and in the federal scheme, a producer is awarded one certificate for every 1 megawatt/hour generated from a renewable energy source. Wallonia and Brussels-Capital award certificates on the basis of the avoided CO_2. Each of the three regions has a quota obligation for electricity suppliers to supply a certain share of total electricity sales from renewables. This quota (different for each region) is growing every year. The federal government does not set quotas or targets. It allows producers either to sell their federal certificates on one of the regional green markets or to the transmission system operator (TSO) at a minimum price. In other words, the federal support system bears some similarities with a feed-in tariff scheme: the TSO has an obligation to purchase the certificates at or above the established minimum price. The regions (except Brussels-Capital) also have minimum prices for green certificates (Table 13).

59. Hydro, wind, solar, geothermal, biogas, organic products and waste from agriculture and forestry, arboriculture, biodegradable organic part of waste.
60. Solar thermal power, photovoltaic energy, wind energy, biomass (electricity/heat/CHP) and heat pumps.
61. This 40% subsidy only applies to the services and industrial sectors.

Table 12

Green Certificate Systems

	Federal state	*Walloon region*	*Flemish region*	*Brussels-Capital*
Based on	Energy production (MWh)	CO_2 emission saving	Energy production (MWh)	CO_2 emission saving
Fines	–	EUR 100	EUR 125	EUR 100
Quota 2008	–	8%	4.5%	2.5%
Quota 2009	–	9%	5.25%	2.5%
Quota 2010	–	10%	6%	2.75%
Minimum prices	yes	yes	yes	no
Duration	20 years	10+5 years*	10 years (20 for solar)**	10 years
Type of certificates accepted		Walloon only	Flemish only	Brussels-Capital and Walloon

* A reduction coefficient (k-factor) is applied for the last five years.

** In Flanders, the price for solar PV is guaranteed for 20 years, but from 2013 this will be reduced to 15 years.

Sources: Country submission; IEA analysis.

Table 13

Minimum Prices for Green Certificates (euros)

	Federal state	*Walloon region*	*Flemish region*
Offshore wind (<216 MW)	107		
Offshore wind (>216 MW)	90		
Onshore wind	50	65	90
PV	150	455*	450**
Hydro	50	65	95
Biomass	50	65	90
Geothermic energy	50	65	95

*Since 2008: EUR 455 for a power plant < 5 kW. The price will decrease with power plant size. For a power plant > 250 kW, the minimum price is EUR 65.

**guaranteed price for PV certificates will decline annually in Flanders.

Source: Country submission.

Belgium's green certificate schemes are rather complex and can be improved in order to maximise their efficiency. Given the relatively small size of each of the three regional markets, harmonisation of the different regional systems and the ability to trade certificates among the regions could significantly improve their efficiency. The question of harmonisation of the different schemes has been discussed between the federal and regional administrations and stakeholders. They concluded that in the short term the stability of the support schemes was more important than harmonisation. However, many stakeholders were in favour of an optimisation of the renewables policies in the long term.

Solar PV

Solar photovoltaic systems receive significant public support in Belgium, both at the federal and regional levels. This has resulted in a significant increase in PV installed capacity over the last few years. For instance, only in Flanders, about 60 MW had been installed by the end of 2008 from close to zero in the early 2000s.

The federal government has set an objective to install 1 km^2 of solar panels on public buildings. It has announced a tender for roof concessions to attract PV developers. It has also allocated EUR 1.5 billion to FEDESCO for setting up PV panels on roofs of other federal public buildings not covered by the tender.

In Wallonia, in the framework of the SOLWATT programme, households, small enterprises, self-employed workers and private entities which invest in PV can receive grants equivalent to 20% of the investment costs with a limit of EUR 3 500. In Brussels-Capital, solar photovoltaic systems benefit from an investment subsidy of EUR 3/We, covering up to 50% of investment costs for households or 40% for the tertiary and industry sectors.

Given Belgium's climatic conditions, such a high level of support for solar electricity may not be the most cost-effective way of spending public money. The federal and regional governments should assess the cost-effectiveness of the existing and planned support schemes.

Public support to solar photovoltaic, solar thermal and to a lesser extent to other renewable energy sources must not be considered only under the green energy production in the Belgian context. Other issues should be considered, such as public education and participation in the mitigation of greenhouse gases and energy efficiency. The installation of solar thermal panels was the first way to produce green (thermal) energy accessible to anybody.

Offshore wind

The federal government aims to stimulate offshore wind in the North Sea. In addition to green certificates discussed above it has introduced or plans to introduce a number of other measures to stimulate offshore wind development.

It has established an obligation for the grid manager to contribute up to EUR 25 million to financing a submarine cable for each wind project over 216 MW. It intends to simplify procedures for domain concessions; to create a special regime that is adapted to the differences in the production by the offshore installations (balancing); and to establish a guarantee of return on investment should construction of a wind farm be interrupted by any authority.

The development of offshore wind is behind the schedule originally planned by the government because of many barriers, including siting and permitting constraints, difficult access to financing exacerbated by the financial crisis, and access to the grid. It is very difficult to choose a site with good wind potential in the North Sea close to the Belgian coast because the waters are used for many other conflicting purposes such as navigation, fishing, and pipelines or cables. The zone currently selected for offshore domain concessions is 30 to 50 km from the coast with a depth of between 15 and 40 metres, which is not ideal from an economic point of view. Up to 2 000 MW of wind capacity can be installed in this zone. The first 30 MW were built in 2008. Overall, the government plans to have over 880 MW installed by 2012 but it is unlikely that this objective will be met on time.

Grid access and system integration

Grid operators in Belgium are obliged, according to EU legislation, to offer non-discriminatory access to electricity from independent producers, including those using renewable sources. However, problems related to grid access are often perceived as a potential barrier for renewable energy technologies. The Belgian electricity grid was built mainly to transport electricity from large centralised plants. Introduction of many smaller and decentralised renewable energy plants in the medium and longer term may require adaptation of the grid. Additionally, large-scale penetration of intermittent renewable energy production can have an impact on the overall system's reliability. The government recognises that the integration of renewables-based electricity into the network is an important part of the overall strategy to promote renewables. For example, it has taken measures to facilitate the connection of offshore wind plants to the grid (see section on Offshore wind above).

HEATING AND COOLING

Until the end of 2008, the federal and regional authorities dedicated most support measures to renewables-based electricity. All three regions provided support for solar heating but a comprehensive policy targeting the heating and cooling sector was lacking. Only the Walloon region had a specific target for renewables-based heat: 9% by 2010. This will certainly change with the adoption of the Energy and Climate Package in December 2008, which sets an overall 13% target for the share of renewables in total final energy

consumption, which can be met in various sectors, including heating and cooling. The regions and the federal government plan to develop strategies for promoting renewable energy use in heating and cooling, as part of the Action Plan to be submitted to the EC by June 2010.

The Walloon SOLTHERM programme, established in May 2001, aims to develop a sustainable solar water-heating industry in the region. The target is to install 200 000 m^2 of panels by 2010 (75% through building renovations and the remaining 25% in new construction). The programme includes pilot projects, training, a promotional campaign, grants to households, small and medium-sized enterprises and municipalities, and "solar auditing" for communities. In early 2009, 92 000 m^2 were installed.

In Flanders, provincial and (inter-)municipal government bodies and a few other public institutions can apply for a 20% grant for investment in a solar thermal installation.[62] Since 2007, solar thermal investments in the Brussels-Capital region are eligible for a regional subsidy covering 50% of the bill, with a maximum of EUR 3 000 for sanitary hot water producing installations and EUR 6 000 for combined hot water and heating support systems.

BIOFUELS AND BIOMASS

In accordance with the EU Directive 2003/30/EC on biofuels, Belgium adopted a Royal decree in 2005 setting an indicative target for biofuels to provide 5.75% of all fuels sold in Belgium for transport purposes in 2010.[63] To achieve this goal, a number of laws were adopted in 2006 setting a legal and regulatory framework for the use of first-generation biofuels.

In particular, a law on biofuels (10/06/2006) allows the reduction of excise duties on diesel oil containing at least 3.37% of biodiesel (with an annual increase of 0.92% to 5%) and on gasoline containing at least 7% of bioethanol. It defines the maximum volumes that can benefit from the fiscal deduction until 30 September 2013: 1 485 500 m^3 for bioethanol and 2 565 000 m^3 for biodiesel. A Royal Decree (22/11/2006) defines a series of rules for introducing non-standardised biofuels into the market (as part of a specific project between a limited number of parties) and for pure rapeseed oil.

The Belgian government launched a European tender and selected several operators who could produce the fiscally deducted volumes for the Belgian market: four companies for biodiesel and three for bioethanol. The reduced level of excise duties can apply only to biofuels from these certified production units.

62. The Flemish region used to provide a grant of EUR 625 for solar heating systems (in the framework of the EUR 1 million programme mentioned above). Additionally, most of the communes provided EUR 250 to 750.
63. The percentage is set on the basis of the energy content. The target share of biofuels was set at 2% in 2005, to grow by 0.75% per year.

Pure rapeseed oil can be exempt from excise duties under certain conditions: *i)* if it is produced by a farmer or a co-operative and sold to the final consumer without intermediary; and *ii)* if it is used for transport.

However, these tax incentives have proven to be rather ineffective and the share of biofuels on the Belgian market is still minor (Table 14). About 110 450 m^3 of fatty acid methyl esters (FAME) was put on the Belgian market in 2008 (down from 117 000 m^3 in 2007).

Table 14

Shares of Biofuels in Total Fuel Consumption, 2006 to 2008

Share of biofuels in transport fuel by type	*2006*	*2007*	*2008*
FAME in diesel, %	0.014	1.380	1.300
Bioethanol in gasoline, %	0.000	0.000	1.250
BioC in diesel+gasoline, %	0.011	1.100	1.300

Source: Country submission.

The new EU Directive on Renewables includes a binding target of 10% share for renewable energy in transport in 2020.[64] To achieve this ambitious target, Belgium should consider implementing stronger measures to enforce the increased use of biofuels or other renewable energy sources in transport. At the same time, Belgium, like other EU members, must ensure that biomass used for transport meets the sustainability criteria defined at the EU level.

The law on compulsory incorporation of biofuels in fossil fuels for consumption has been published (3 August 2009). This law requires all registered oil companies to blend biofuels with fossil fuels up to at least 4% (volume) of the amount of diesel and gasoline put in the market for consumption annually. Fines are imposed in case of non-compliance with the required percentage. The practical implementation of the law is regulated by Royal Decree issued on 10 August 2009 on the obligations regarding information and administration, control of obligations and administrative penalties provided by law.

Within the scope of the "Spring of the Environment", which took place in Brussels in May 2008, the government has taken political commitments to:

- Create a national observatory of biomass (possibly within the framework of the national Energy Observatory, described in Chapter 2). Its objectives will include collecting data and reporting on biomass flows; harmonising biomass data collection methodologies; and identifying the need for the development of a national biomass strategy.

64. The binding character of this target is "subject to production being sustainable" and to "second-generation biofuels becoming commercially available".

- Evaluate the current policies and measures in terms of reaching the 2010 target for biofuels; propose corrective measures if necessary.
- Organise transparency and dissemination of information regarding biomass production in Belgium.
- Establish norms for solid combustible biomass.

In the Flemish region there is a biomass action plan to 2020 and a detailed inventory of biomass available in the region for energy use. Wallonia is working to adopt a similar action plan.

CRITIQUE

Since the last in-depth review, Belgium has made progress in promoting renewable energy. In addition to green certificate schemes (with minimum prices), the regions and the federal government have introduced or enforced subsidies for investments in renewable electricity and heat production. As a result, investments in wind, solar and biomass technologies have grown significantly and the share of renewables in TPES has increased from 1% in 1990 to 2.7% in 2007. However, there is still a long way to go to meet Belgium's goal of 13% of total gross final consumption by 2020, as defined by the EU Energy and Climate Package.

This target is very challenging and to achieve it, Belgium will need more vigorous and more ambitious policies to promote renewables. The cost of such support policies must be carefully evaluated. In Belgium, however, there is a lack of comprehensive information on the total costs of the existing public support for renewable energy. Therefore, the government should enhance the efforts to collect and analyse the information on support measures provided at all levels, including federal, regional and local, and their relative costs. This is necessary to evaluate the effectiveness of the existing policies and adapt them accordingly.

More generally, the government should view its renewable energy policy in a broader perspective, ensuring the cost-effectiveness of the overall energy and climate strategy, taking into account economic and social concerns. In particular, meeting the renewables target will be easier if at the same time the governments vigorously encourage energy efficiency improvements. In the National Climate Plan Belgium should consider in a holistic manner how to reach its targets of renewable energy and energy efficiency by 2020 and its goals for reduction of greenhouse gas emissions. Such an integrated approach will help Belgium optimise its renewable energy policies.

Given that the resource potential for renewable in Belgium is relatively low and the cost of supporting renewables increasingly high, it is important to carefully evaluate the potential of all available technologies and ensure that

right incentives are given to attract investment in the most cost-efficient projects first. The current very costly support mechanisms for solar PV may not be economically justified given Belgium's climatic conditions. At the same time, however, the governments should provide appropriate incentives guaranteeing a specific level of support to less mature (and therefore more expensive) technologies, in order to exploit the significant potential of the large basket of renewable energy technologies over time. Studies may be necessary to more carefully assess all costs and benefits of the existing and planned support mechanisms and reach the most cost-effective solutions taking longer-term objectives into consideration.

Given the potentially high cost of meeting the 13% target domestically, the flexibility mechanisms (joint projects and "statistical transfers" between EU countries) can be an attractive option for Belgium. However, the availability of surpluses of renewable energy credits in other EU members may be limited because the targets are high for all the countries and statistical transfers are allowed only if the selling country exceeds its own indicative trajectory targets. It is important, therefore, to assess carefully how flexibility mechanisms can be used in Belgium in the most optimal way.

The key instruments used in Belgium to stimulate renewables in the electricity sector – green certificate schemes – are rather complex and can be improved so as to maximise their efficiency. The overall Belgian energy market is rather small, which is a barrier for renewable energy deployment by itself. The existence of several support schemes (as well as several regulation regimes) further fragments the markets and increases the costs of renewable electricity production and trade. Harmonisation of the different regional systems and allowing the trading of certificates between regions could significantly improve the efficiency of the green certificate market. Although the stability of the support schemes is important in the short term, more active steps should be taken towards their progressive harmonisation. The implementation of the new EU Directive on Renewables and the development of the National Climate Plan should be a good opportunity to move towards harmonisation.

Most policies and measures existing in Belgium before 2009 targeted the electricity sector. The government will have to develop more specific measures related to renewables-based heating and cooling as part of the Renewable Energy Action Plan to be submitted to the EC by June 2010. The first actions in this direction are commendable. Belgium is encouraged to investigate the cost-effective potential for renewables-based heating and cooling, and design support schemes to tap this potential.

As mentioned earlier, achieving the ambitious renewables target will require a well-designed strategy based on a broader policy framework of which incentive schemes are a part. The removal of non-economic barriers to the deployment of renewable energy technologies should be an important part of this strategy. Institutional barriers include administrative hurdles that make

the licensing process restrictive or time-consuming. The regional authorities should more actively identify areas with good resources or conditions for renewable energy production and low conflict with environmental issues or other stakeholder interests. In such areas, simplification of procedures for obtaining licences and/or concessions could be considered.

Other barriers include insufficient public awareness about benefits and opportunities of renewables, and the NIMBY (not in my backyard) effect, which is partly related to the high population density and limited space available in Belgium. The government is commended for its efforts to increase public awareness and is encouraged to pursue and enhance ongoing work in this direction.

Problems related to grid access can be another possible barrier to the deployment of renewable energy technologies. Therefore, good co-ordination between the development of grid capacity and renewable energy production should be encouraged. Non-discriminatory rules for grid access should be ensured and predictable policies for the cost-sharing of necessary grid investments implemented. It is also very important to analyse the implications of the large-scale penetration of intermittent renewable energy production in the overall energy system, with regard to overall cost efficiency and system reliability.

Belgium has taken some measures to increase the use of biofuels: legislation has been adapted to allow market access and a tax reduction on biofuels has been introduced. These measures have, however, proven not to be very effective, and the share of biofuels on the Belgian market is still minor. The new EU Directive on Renewables includes a target of 10% renewables share in transport in 2020. In order to achieve this ambitious target, Belgium should consider implementing stronger measures to enforce the increased use of biofuels or renewable electricity in transport. The government should monitor the effectiveness of its policy towards the national targets as well as the compliance with the sustainability criteria of the biofuels in the market.

RECOMMENDATIONS

The government of Belgium should:

- *In the context of implementing the EU Directive on Renewable Energy, consider how to reach Belgium's renewable energy targets in a holistic manner, taking into consideration the goals for energy efficiency and for reduction of greenhouse gas emissions by 2020.*
- *Evaluate all available technologies and ensure that right incentives are given to attract investment in the most cost-efficient projects first.*

- *In co-operation with regional governments, undertake a broad analysis of all possible institutional barriers to investments in new renewable energy production, and consider how these could be removed or reduced.*
- *Harmonise the federal and regional green certificate systems with a goal of establishing a national green certificate market.*
- *Assess an optimal use of flexibility mechanisms such as joint implementation projects or statistical transfers with other EU member states.*
- *Continue to investigate the cost-effective potential for renewables-based heating and cooling and improve the design of support schemes to tap this potential.*
- *Implement stronger measures to stimulate the use of biofuels and other renewables in transport; and carefully monitor the effectiveness of implemented policies.*

DEMAND AND SUPPLY

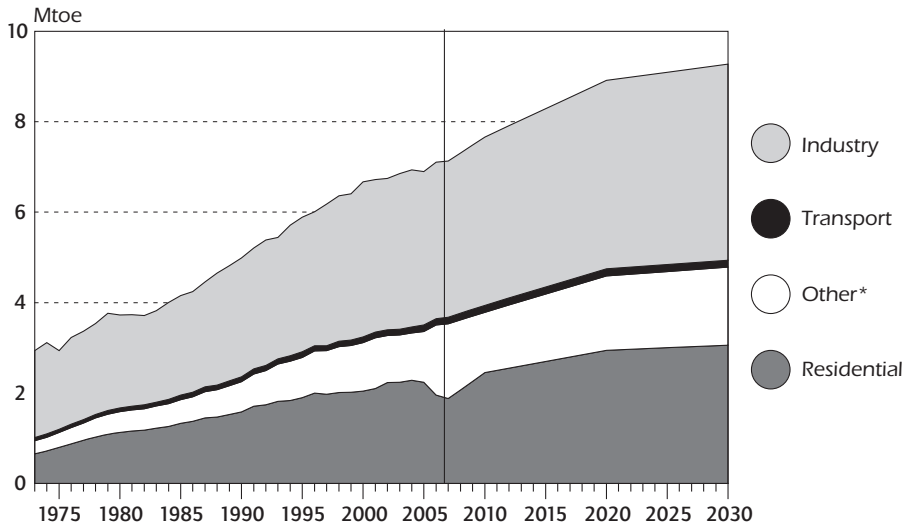
DEMAND

After decades of strong growth, electricity demand in Belgium has stabilized since 2006. In 2007, with a mild winter, demand only grew by 0.4% compared to the previous year, mainly due to lower residential sector demand (-3.8%). The highest demand for electricity in 2007 was 14 000 MW, reached on 17 December. In 2008, demand decreased as a result of the economic downturn at the end of the year. This trend is likely to strengthen in the near future, as the current financial and economic crisis severely hit electricity demand.

Looking at consumption by sector, the most significant changes occurred between 1975 and 1985, when industrial demand dropped from 65% of total consumption in 1975, to 54% in 1985, while residential demand increased significantly. At present, industrial demand still accounts for around half of total electricity consumption (Figure 24).

Figure 24

Final Consumption of Electricity by Sector, 1973 to 2030



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

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

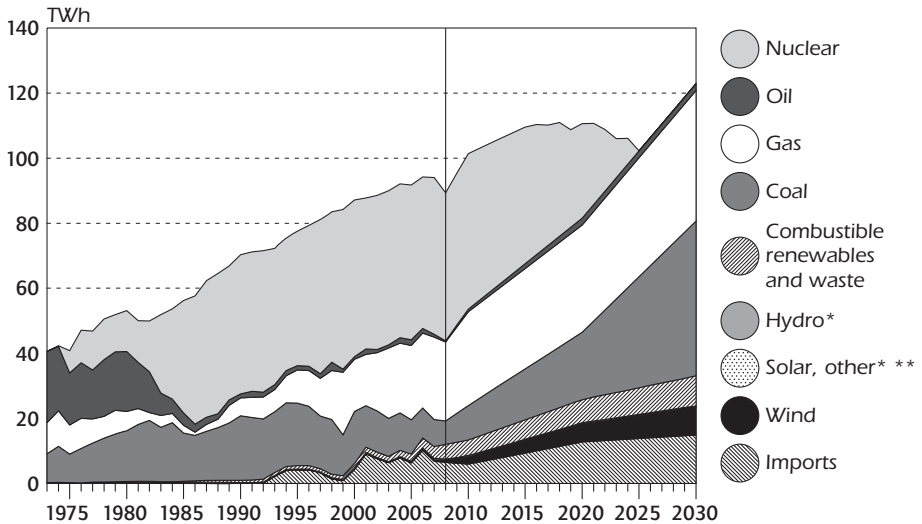
GENERATION AND IMPORTS

Over the last 30 years, Belgium has experienced tremendous growth in electricity generation, especially nuclear,[65] in line with a sustained increase in electricity consumption. More recently, however, electricity imports have increased considerably. Belgium has been a net power importer since the beginning of the 1990s. In 2008, imports accounted for more than 13% of electricity demand. Domestic electricity production was 77.6 TWh in 2008, down from 88.8 TWh in 2007 and 85.5 TWh in 2006. Nuclear power is currently the main electricity source providing over half of the total generation. Belgium, however, has adopted a law stipulating a phase-out of nuclear generation between 2015 and 2025 (see Chapters 2 and 8 for more details).

Figure 25 shows historical electricity generation and the Belgian government's projections to 2030.

Figure 25

Electricity Generation by Source, 1973 to 2030



* negligible.

** other includes ambient heat used in heat pumps.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2008 and country submission.

Other important trends in the Belgian electricity generation mix are an increasing share of natural gas, a reduction in the share of coal, and a shift away from liquid fossil fuels. Natural gas accounted for nearly 30% of total

65. For more details on nuclear power, see Chapter 8.

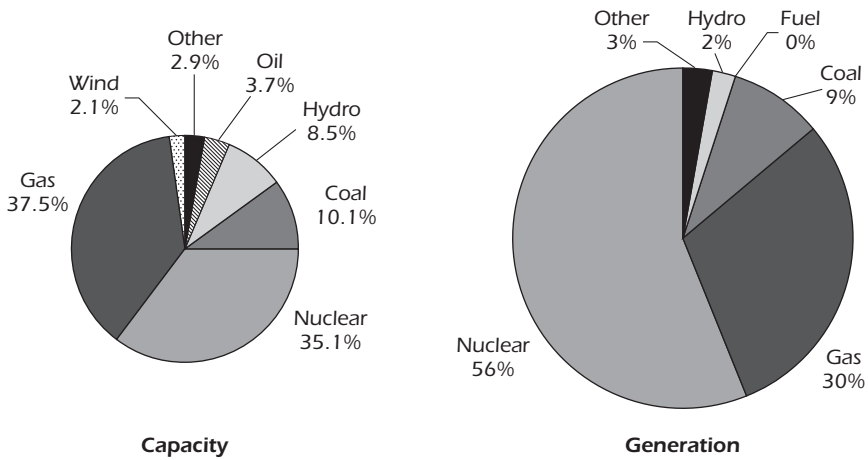
generation in 2007, up from 8% in 1990. Electricity production from coal fell from 27% of total generation in 1994, to 13.6% in 2004 and only 9.5% in 2007. The share of liquid fuels (oil) decreased from 52.7% in 1975 to only 0.9% in 2007. The share of renewable energy and waste grew to 5.1% in 2007 from 1.5% in 1990.

CAPACITY

Current installed electricity generating capacity in Belgium is some 16 500 MW, of which the majority is gas-fired, followed by nuclear. Figure 26 shows installed capacity and generation in 2008.

Figure 26

Electricity Production Capacity and Generation, 2008



Source: ELIA

SUPPLY AND DEMAND BALANCE

The Federal Planning Bureau estimates that there will be a need to build 9 000 MW of new capacity between 2008 and 2017 to meet domestic demand (according to the reference scenario).[66] Of this, 1 800 MW will be needed to replace the three nuclear power plants to be phased out by 2015. Even if the government decides to reverse its nuclear phase-out policy, there will still be a need to invest in 7 200 MW of new capacity. The investment

66. New capacity needs amount to between 7 600 and 11 700 MW under alternative scenarios.

needs in the power generation sector are estimated at EUR 1 billion per year in 2008-2016, according to FEBEG (Belgian Federation of Electricity and Gas Companies), or at EUR 7.3 billion for the overall period 2008-2017, according to the Federal Planning Bureau.

There is 1 975 MW of mainly gas-fired capacity under construction in Belgium: one combined cycle gas turbine (CCGT) plant of 420 MW to be commissioned in 2009, two open cycle gas turbines (OCGTs) totalling 130 MW by end-2009, two more CCGT plants to be commissioned by 2011 totaling 820 MW, and 605 MW of other types of plants. There are plans to add even more generating capacity but the implementation of these additional plans is highly uncertain. As of March 2009, there were plans for additional gas-fired capacity of over 450 MW (authorised but not yet decided) to be put in service over the next three years. Moreover, 2 020 MW more are undergoing the authorisation process, including a 1 100 MW coal-fired plant to be commissioned by 2015. Furthermore, 846 MW of offshore wind farm capacity has been authorised and is planned to be built between 2009 and 2013. Another 1 400 MW of offshore wind generating capacity is undergoing the authorization process. Such a pattern is typical of many IEA countries, where near-term new capacity is gas-fired (under construction), while planned capacity expansions are largely coal-based.

According to the federal regulator, only 1 000 MW can be realistically built by 2011. Delays and cancellations of projects are frequent because of licensing hurdles and social acceptance issues. For example, the Flemish regional government initially rejected E.ON's proposal for a large coal-fired power plant at Antwerp for environmental reasons. The environmental impact assessment for this project was rejected by the Flemish authorities on 18 May 2009. E.ON Benelux consequently introduced an adapted assessment which was approved on 3 July 2009. The environmental impact assessment precedes the environmental permitting procedure. Taking into account the decommissioning of nuclear power plants and the oldest coal-fired power plants, there could be a serious risk of electricity production capacity shortage in the near future. Should this risk materialise it would have an impact both on meeting demand and on prices (peak and forward prices).

However, in May and June 2009 Belgium became a net exporter of electricity and, in the first half of the year; it only imported 0.4 TWh as compared to 7.6 TWh in the first six months of 2008. Total electricity consumption dropped by 10% while production increased by 6.2%.[67]

67. Source: ELIA Newsletter 44, available at http://com.elia.be/optiext/optiextension.dll?ID=s_qws2t+ossssY

MARKET DESIGN, COMPETITION AND REGULATION

REGULATORY FRAMEWORK

The liberalisation of the Belgian energy market began in April 1999 with the transposition of the first EU Directive on Electricity and Gas Markets. The law of 1 June 2005 fully implemented the EU Directive 2003/54/EC on the common rules for the internal electricity market. Liberalisation has been carried out in gradual steps (Table 15). The electricity market was legally fully opened on 1 June 2003 in Flanders. Wallonia and Brussels-Capital followed in 2004 and 2007. From 1 January 2007, supplier choice has been granted to all consumers in all regions. In 2007 and 2008 several other regulatory reforms took place: the electricity transmission and distribution tariff system was amended and the powers of the regulator were reinforced (see details below).

Table 15

Energy Market Opening by Region

Flemish region	Since 07/2003
Walloon region (large users and business customers only)	Since 07/2004
Walloon region (all customers) and Brussels-Capital region	Since 01/2007

Source: Country submission.

The regulatory framework for the electricity market is rather complex. The national energy regulator – the Electricity and Gas Regulatory Commission (CREG) – regulates and licenses electricity transmission above 70 kV, approves both transmission and distribution tariffs and monitors the market. The three regional regulatory institutions – VREG in Flanders, CWaPE in Wallonia and Brugel in Brussels-Capital are responsible for the licensing and regulation of electricity distribution below 70 kV. A Forum for the Regulatory Bodies (FORBEG) has been established as a voluntary platform for discussion between the four existing regulatory bodies. Chapter 2 provides more details on the Belgian energy regulators.

UNBUNDLING

The liberalisation process in Belgium is based on legal unbundling, so that only legal (or accounting) separation of the transmission operator from other segments is required. The legal separation between companies involved in production, transmission and distribution of electricity was completed in 2007 and ELIA, the transmission system operator, and the regional distribution system operators are legally fully unbundled from supply/production companies.

Historically, the Suez group and its subsidiaries had the dominant position on the Belgian market. Following their merger, Suez and Gaz de France (GDF) agreed with the European Commission to reduce their involvement in certain segments. Despite the sale of GDF's share in SPE, Belgium's second largest electricity operator,[68] most of the segments of the market remain highly concentrated in the hands of the merged company GDF Suez, through its subsidiary Electrabel.

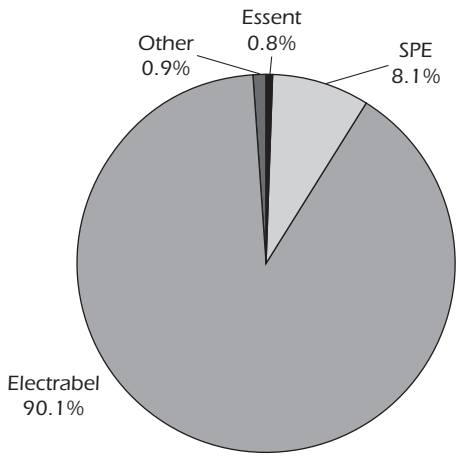
In order to enhance the TSO's independence, the federal government has required the share of the incumbent, Electrabel, to be brought under 25%, which is the threshold for non-controlling stakes. Electrabel's participation in ELIA has been reduced to 24.36%. Similarly, to guarantee the independence of the DSOs from incumbents, the Flemish Region and Brussels-Capital have set up a cap of 30% for the private sector's share, while in the Walloon region a minimum share of 51% is guaranteed for the public sector. As a result, Electrabel has only minority shares (below 30%) in the regional DSOs, as of early 2009. The Brussels-Capital region plans to bring Electrabel's share to 0% by 2012 and both Flanders and Wallonia by 2018.

WHOLESALE MARKET

Wholesale markets in all the three regions remain highly concentrated. About 80% of generating capacity was owned by Electrabel (GDF Suez) in early 2009, although this share is likely to be reduced in the coming years.

Figure 27

Power Generation Market Shares, 2008



Sources: ELIA and Belgian federal and regional regulatory authorities

68. GDF sold its share in SPE to British operator Centrica in July 2008. In May 2009, Centrica agreed to sell its 51% of shares in SPE to EDF.

The government has taken steps to encourage auctioning off of some of the incumbent's spare capacity and introduced royalties to be paid for un- (or under-) used electricity production sites. These efforts aimed at easing entry for new generators are yielding results and should be continued.

The government has also imposed the so-called "Pax Electrica" deals on Electrabel in order to reduce its dominance in the power generation market. The Government's objective is to allow two other generation companies to increase their market shares up to 15% each. As part of these deals, SPE, the second-largest Belgian electricity producer, is to obtain 350 MW_e of Electrabel's nuclear capacity through an asset swap and a sale, and to be given a long-term supply contract for another 285 MW_e of nuclear capacity, pending an authorisation from the EU Commission Competition Authority. More importantly, through a 1 700 MW asset swap, Electrabel is selling 950 MW of Belgian conventional power and granting 770 MW procurement rights on Belgian nuclear power to the third-largest Belgian electricity producer (E.ON) in return for a similar amount of generating capacity and procurement rights in Germany. Once the swap is effective, E.ON will hold a market share of 10 to 15%. As a result of these transactions, over 2 000 MW of Electrabel's generation assets will be transferred to new entrants, which is expected to decrease its market share to 65% of the electricity produced in Belgium by 2010.

The establishment of a wholesale exchange pool – the Belgian electricity spot market (Belpex) – at the end of 2006 is a commendable step towards enhanced competition at the wholesale level, as this type of exchange has proven beneficial for competition in a number of OECD countries. However, the role of Belpex could be further enhanced. At present, liquidity in the wholesale market is very thin. Only around 13% of total electricity consumption was traded at Belpex in 2008, of which 61.1% was imported electricity. This is a significant increase from 2007, when only 5% of Belgian consumption was traded at Belpex. The volume traded at Belpex reached a record level of 31% of the Belgian electricity demand on 3 May 2008. Yet, insufficient liquidity in the wholesale market has so far deterred entry on the supply-side, especially in the larger industrial market segment.

Since October 2007 Belpex has been coupled with the French and Dutch electricity markets, Powernext and APX. Thus a new market-based mechanism was created: an implicit auction of day-ahead capacities between the Belgian, French and Dutch wholesale electricity markets. It allows more efficient cross-border trade by guaranteeing an optimal use of available day-ahead capacities between the three countries. The market coupling with the French and Dutch electricity markets created a single electricity market in the three countries with a single price, only differing when there is insufficient interconnection capacity available on the Belgian–French or the Belgian–Dutch border. The trilateral market coupling has resulted in increased liquidity on the Belgian wholesale market. As mentioned above, electricity imports are the biggest seller on the Belgian spot market. In 2008, the average daily traded volume was 30 372 MWh, including average exports of 1 816 MWh and average imports of 18 582 MWh.

Wholesale market coupling with neighbouring France and the Netherlands mean that since 2007 the available transmission capacity is traded directly on the three national exchanges so that for 70% of the time there is one single wholesale price in the three areas.

RETAIL MARKET

Since retail market regulation is the competence of the three regional regulators, electricity suppliers have to obtain separate operating licences to be able to sell electricity in each region. Regulatory requirements (for example public service obligations) differ among regions. The complex regulatory structure divides the Belgian electricity market – already relatively small – into three fragmented markets with different end-user prices and different levels of competition. The establishment of the Belgian Forum for the Regulatory Bodies (FORBEG) has been a positive step towards better market co-ordination. Since 2005, harmonised and coherent retail market statistics have been jointly published by the four regulators. The three regions have harmonised electricity bills since December 2008.

After a number of years of operating in a fully open electricity market, residential customer switching rates in Flanders stabilised at around 5.6% in 2007 and 2008. In Wallonia, in the 18 months following recent market opening and as a result of a public information campaign, the share of customers who switched supplier between March 2007 and September 2008 reached 18% in the residential market and around 21% in the non-residential market,. In the Brussels-Capital region, switching rates are still very low: only 0.6% of residential customers and 1.4% of non-residential customers changed supplier since market opening. More competition at the retail level would need to be supported by greater access to wholesale markets for independent suppliers.

The level of concentration in the retail market in Belgium varies among regions and among the market segments. A number of active suppliers of different sizes operate in the Walloon and Flemish commercial and residential markets. Both markets are considered dynamic and competitive with high switching rates. The global share of Electrabel and Electrabel Customer Solutions (ECS) in this market segment decreased to 70.6% in Flanders and to 68.7% in Wallonia in 2007, and is expected to decline further. In the Brussels-Capital region, Electrabel retained a nearly 92% market share in 2007 and there were few new entries, mainly because of a regulatory framework that locks customers into long-term contracts. At the same time, suppliers, who are not allowed to cut off customers in debt without a court order, have to bear the grid costs of debtors. Administrative burdens related to public service obligations are reported to be particularly high in the Brussels-Capital region.

Table 16

Licensed Electricity Suppliers, as of 31 December 2008

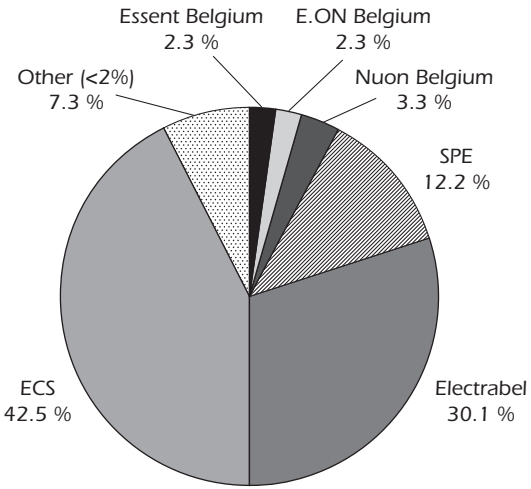
Suppliers	*Federal level*	*Flemish region*	*Walloon region*	*Brussels-Capital*
Anode BV		✓		
DB Energie		✓		
Duferco Energia SRL	✓			
E.ON Belgium SA		✓	✓	✓
E.ON Sales & Trading GmbH	✓	✓		
E.ON Energy Trading AG		✓		
E.ON Energy Sales GmbH		✓	✓	✓
Ecopower CVBA		✓		
EDF Belgium SA	✓	✓	✓	✓
Electrabel Customer Solutions SA		✓	✓	✓
Electrabel SA	✓	✓	✓	✓
Elektriciteitsbedrijf Merksplas BVBA		✓		
ENDESA Energia SA	✓	✓	✓	✓
Eneco International BV	✓	✓	✓	✓
Energie 2030 Agence SA			✓	
Essent Belgium SA	✓	✓	✓	✓
Essent Energy Trading BV	✓			
Gaselys SAS	✓			
Lampiris SA		✓	✓	✓
Nidera Handelscompagnie BV		✓		
Nuon Belgium NV	✓	✓	✓	✓
RECYBOIS SA			✓	
Reibel SA		✓	✓	✓
Renogen SA			✓	
RWE Key Account GmbH	✓			
RWE Solutions AG	✓			
Seva SA			✓	
SPE SA, including brand Luminus	✓	✓	✓	✓
Thenergo		✓		
Trianel Energie BV		✓		✓
Wase Wind CVBA		✓		

Source: Federal and regional regulatory authorities.

In the absence of baseload generation assets, new independent entrants are able to compete primarily in the residential/commercial market. As for supplying large industry, the incumbents (Electrabel and SPE) remain largely unchallenged in their historical territories. According to the CREG, the market share of the incumbent in the industrial supply market (half the total Belgian market or some 40 TWh) was about 87% at the end of 2008 (but smaller if taking into account the 7.3% share in the hands of autoproducers).[69] The overall market share of Electrabel in the retail electricity supply market was 62% in 2008, according to the federal Ministry of Economy.

Figure 28

Electricity Retail Market Shares, 2008



Total 78.15 TWh

Sources: CREG, CWaPE, Brugel and VREG.

DEMAND RESPONSE MECHANISMS

Belgium has adopted measures for energy saving and energy efficiency in order to manage energy demand. The federal government in co-operation with the regions will continue implementing the National Energy Efficiency Action Plan and will work towards simplifying and harmonising existing energy-saving measures at the federal and regional levels. At the same time, some policies introduced for social reasons (for example the "free quota" for electricity in the Flemish region or the measures to reduce electricity bills as part of the economic recovery plan[70]), do not necessarily encourage energy savings.

69. Tessenderloo Chemie, and industrial consumers with no supply licence.
70. See more details in the section Prices and Tariffs below and in Chapter 2.

Flanders and Wallonia have plans to develop smart grids in their territories, to optimise grid capacity and management, which in combination with a smart metering roll-out, could support enhanced demand-side market interaction. There are, however, no comprehensive electricity demand response policies at the federal or regional level. A country-wide demand response in the Belgium context of a very tight supply-demand balance would bring about substantial benefits for the overall efficiency of the electricity market.

NETWORK INFRASTRUCTURE AND OPERATION

INFRASTRUCTURE

The Belgian network forms an integral part of the European transmission network and has connections with the Netherlands, France and Luxembourg. It includes about 8 400 km of high-voltage lines, 800 stations and four control centres (see Figure 29). International electricity exchanges are primarily carried through 380-kV cables. Nuclear power stations and the Coo hydroelectric power station are also connected to this high-voltage grid. 220- and 150-kV cables ensure domestic electricity supply. Large industrial consumers are directly connected to the high-voltage grid. Finally, power is carried through 70- and 36-kV lines to the off-take points used by the distribution companies.

The Belgian TSO, ELIA, must present a network development plan every three years, 12 months after the approval of the Prospective Study on Electricity published by the Ministry of Economy and the Federal Planning Bureau (see Chapter 2).

GRID OPERATORS

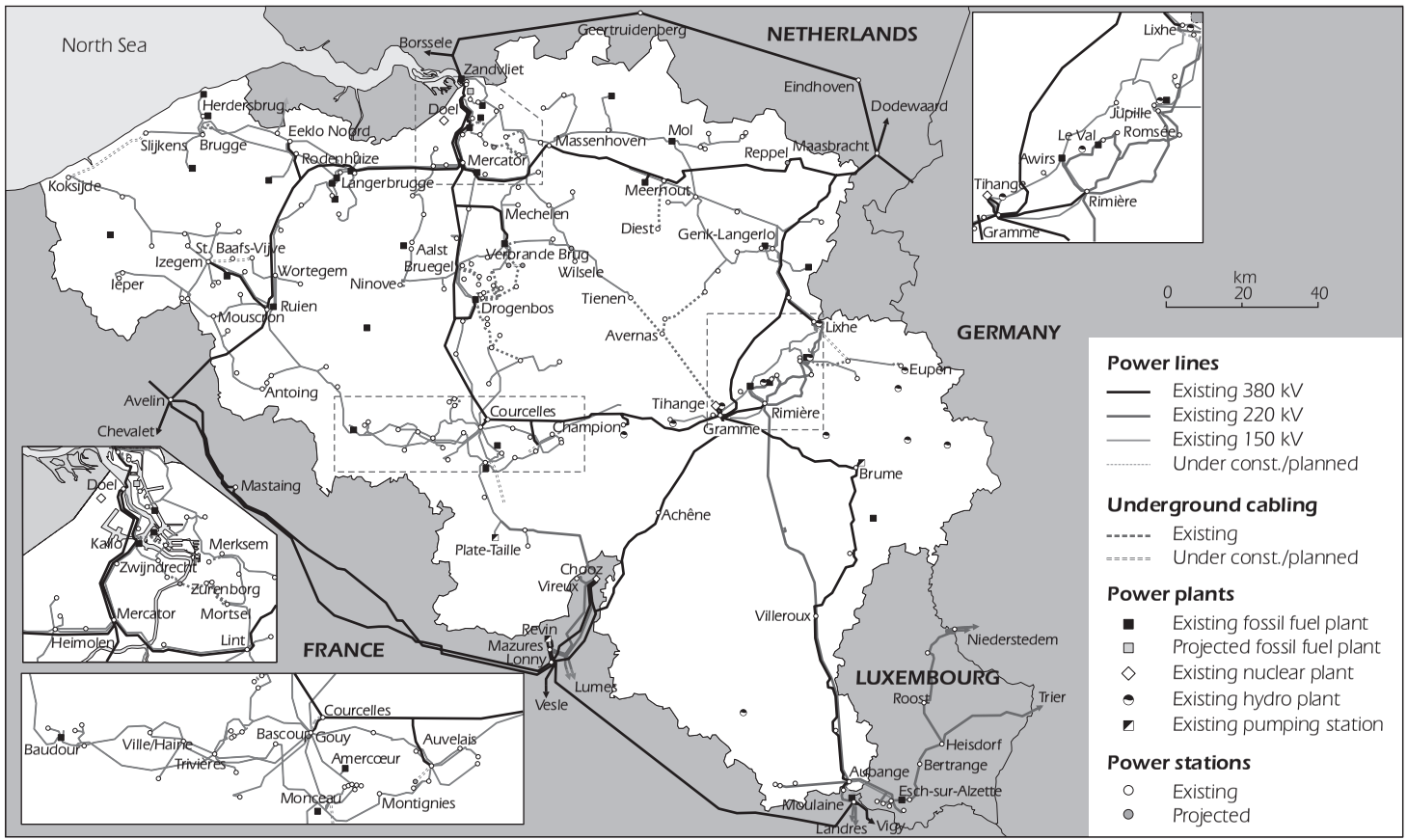
ELIA operates the grids from 26 kV to 380 kV and its legal responsibilities are the following:

- Provide access to the grid for third parties.
- Operate and maintain the grid.
- Manage improvements and extensions of the grid, including interconnections, so as to provide transmission capacity for its customers.
- Manage electricity flows so as to reach equilibrium between supply and demand of electricity (taking exports and imports into account).
- Ensure, with the available means, the security, reliability and efficiency of the Belgian power system (including the availability of ancillary services).

ELIA does not buy or sell electricity except for ancillary services, compensation of losses on the grid at the regional level and balancing services. Distribution system operators (DSOs) operate, maintain and develop lower-voltage grids – usually below 15 kV.

Figure 29

Belgian Electricity Network



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: ELIA.

CROSS-BORDER INFRASTRUCTURE, TRADE AND CONGESTION MANAGEMENT

The Belgian electricity transmission system is highly interconnected, among the most interconnected in Europe. Total cross-border electricity exchanges (imports and exports) increased from 19 TWh in 2000 to 23.7 TWh in 2008, peaking at 27.55 TWh in 2006 (see Table 17). This represented 27.4% of Belgian electricity demand in 2008 and 30.5% in 2006, significantly higher than the EU average. Figure 30 shows Belgium's electricity trade by country.

Table 17

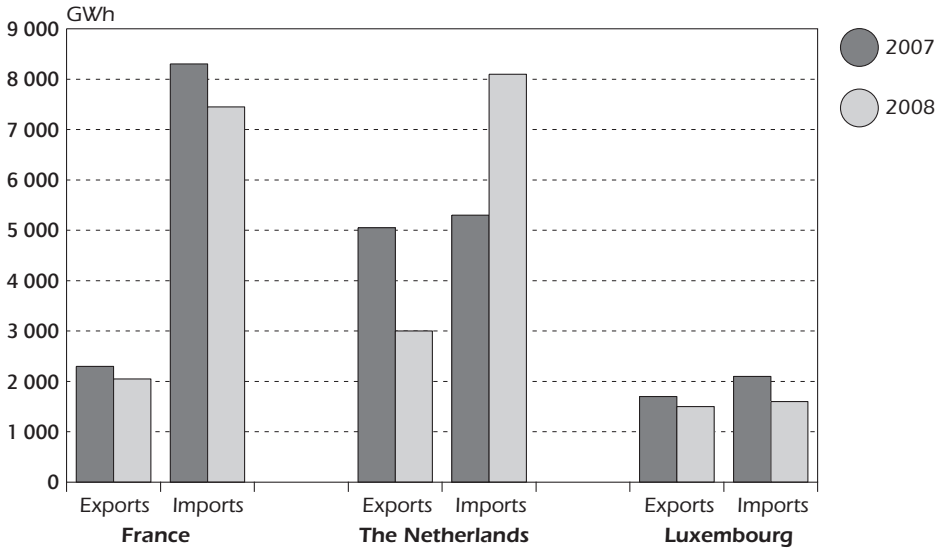
Belgium Cross-Border Electricity Exchange, 2000-2007 (GWh)

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Imports	11 645	15 818	16 658	14 664	14 567	14 328	18 853	15 816	17 134
Exports	7 319	6 712	9 070	8 254	6 789	8 024	8 696	9 037	6 562
Net	4 326	9 106	7 588	6 410	7 778	6 304	10 157	6 779	10 572

Sources: "Le marché de l'énergie en 2007", SPF Economie, PME, Classes Moyennes et Energie, ELIA annual reports.

Figure 30

International Electricity Exchanges, 2007 and 2008



Source: ELIA.

According to the federal regulator, it is necessary to expand further the interconnection capacity at Belgium's borders.[71] More interconnections are under development in Central-Western Europe, especially with Germany. This will further facilitate regional market integration. ELIA has currently three projects under study to increase Belgium's interconnection capacity with its neighbours:

- Interconnector United Kingdom–Belgium (Nemo project): 1 000 MW direct-current cable.
- Belgium–Luxembourg: interconnection with Cegedel.
- Interconnector Germany–Belgium: common study RWE–ELIA.

On 16 April 2009 the Belgian and German transmission operators, ELIA System Operator and RWE Transportnetz Strom, launched the planning phase for the first direct interconnection between Belgium and Germany. The link will help improve access to spare power generating capacity in Germany. This increased access should in turn result in more competition in the Central-West region and in a better utilisation of different power generating sources, including renewables. The new interconnector is expected to contribute to the creation of an integrated regional market and to enhance the reliability and security of supply.

Belgium is part of the Pentalateral Energy Forum set up in 2007, which brings together the governments, regulators, transmission grid operators and power exchanges of Belgium, the Netherlands, Luxembourg, France and Germany. The meetings held under this Forum led to the signing of a Memorandum of Understanding with a view to introducing flow-based market coupling and improving the conditions relating to security of supply.

In February 2007, the five regulators of the Central-West European region published an action plan for the period 2007-2009 with the aim of accelerating regional integration of electricity markets. This plan makes a list of various priority areas requiring intervention and identifies specific actions with an implementation schedule. The priority areas are the harmonisation and improvement of explicit auctioning mechanisms, creating flow-based market coupling, introducing cross-border intra-day and balancing trade, drawing up a common method to calculate interconnection capacities, maximising interconnection capacities, developing a regional investment plan for the transmission grid, transparency and enhancing regional market supervision.

In this context, the regulators published their joint statement on auctioning rules after having consulted the representative regional organisations of the market players and the transmission system operators on the general terms and conditions of the rules for auctioning cross-border capacity on a monthly

71. CREG, Etude (F) 090126-CDC-811 relative à l'échec de la formation des prix sur le marché belge libéralisé de l'électricité et les éléments à son origine, Brussels, 26/01/2009.

and annual basis. In the same context and so as to enable the application of the EU guidelines on congestion management[72] in the Central-West European region, the five regulators published a report on the procedure for implementation of the transparency aspect of these guidelines.

As regards the Belgian-French interconnection, ELIA initiated the reorganisation of the capacity allocated over the various periods of time in favour of daily capacity. In April 2007, ELIA introduced a mechanism for the allocation of intra-day capacity at the Belgian-French interconnection. A similar mechanism for the allocation of intra-day capacity has also been put in place since May 2009 at the Belgian-Dutch interconnection.

NETWORK ACCESS AND REGULATION

ELIA provides grid access on a non-discriminatory basis. Despite the differences between the regional regulations, for the sake of transparency and simplicity ELIA has created a single grid access contract that is used in the three regions. The access contract has been approved by the CREG. It outlines the access holder's and ELIA's rights and obligations as regards access to the grid for the injection and off-take points directly connected to the grid.

To add any new connection or make any major modifications to an existing connection, a connection request must be submitted to ELIA. ELIA will examine the information provided by the requesting party, and make a proposal regarding the connection or modification. If the applicant and ELIA reach agreement over the technical solutions, ELIA will draw up a draft connection contract or a draft amendment to the existing one. The requesting party can also ask ELIA to conduct an orientation study which sets out the technical options for the connection and the estimated costs involved. In the case of intermittent facilities, a power quality study is also carried out upon connection.

The new multi-annual tariff-setting mechanism for transmission and distribution was introduced by Royal Decree of 8 June 2007 with the aim to provide a more stable and predictable framework that ensures an adequate return on investment. For transmission, these tariffs are applicable as from 2008 and for distribution from 2009.

The new system guarantees the system operator, for a regulatory period of four years, revenue that is sufficient to cover the costs incurred for execution of the tasks required by law and obtain a fair profit margin in return for the capital invested in its grid. The income for each year of the regulatory period is divided into controllable and non-controllable costs. Controllable costs

72. Annex to the EC Regulation No 1228/2003 on conditions for access to the network for cross-border exchanges of electricity.

are subject to incentive regulation (RPI-X) whereby the TSO is rewarded for excellent performance. Budget reductions have been imposed for four years over the first regulatory period, and, if the TSO succeeds in reducing costs even further, it is allowed to keep the difference. Contrary to the previous "cost-plus" system, the difference between the actual controllable costs and the budgeted costs is granted annually to the transmission system operator. The new tariff system also contains an incentive to increase investment: it allows operators to keep capital gains as an investment reserve, which can be used as a source of self-financing.

DISTRIBUTED GENERATION AND RENEWABLE ENERGY

In view of the tightness of the Belgian electricity market at times of peak-load, the use of distributed generation creates a new and important resource. With competition and liberalisation, backup generation, small-scale CHP, renewable energy systems and other distributed resources benefit from access to new markets and can contribute to operational reserves and other ancillary services. However, the Belgian electricity grid was built mainly to transport electricity from large centralised plants. The introduction of many smaller and decentralised plants in the medium and longer term may require adaptation of the grid. Moreover, large-scale penetration of intermittent renewable energy production can have an impact on overall system reliability. For example, in Flanders high penetration of CHP has already put pressure on the distribution systems. The governments and the regulators recognise that the integration of distributed generation and renewables-based electricity into the network is an important challenge that needs to be addressed.

In order to allow for improved control of neighbouring energy flows on the ELIA grid and for improved reliability and optimisation of transmission capacity with interconnected networks, three phase-shifters have been commissioned at the end of 2008, with a total investment of EUR 54 million. Located at the Van Eyck and Zandvliet high-voltage stations, this is an important development to avoid loop flows coming from wind generation from Germany and will also serve to increase interconnection capacity at the border.

The Belgian Minister of Energy presented to the Pentalateral Forum a new initiative on establishing an ad hoc working group to explore, in co-operation with other relevant stakeholders, how to create an offshore grid in the North Sea. Increased interconnector capacity will integrate offshore wind energy into the electricity network, while improving the functioning of the internal market. If the member countries of the Pentalateral Forum respond favourably to this idea, the ad hoc group will also explore the possibility of inviting the United Kingdom, Denmark and Norway to its activities.

Belgium electricity prices are somewhat above the EU average. Prices for households, in particular, are well above those in OECD countries with the most competitive electricity markets.[73]

Price formation in the Belgian market remains non-transparent and the resulting prices do not reflect the underlying economic conditions. The Programme-Law of 8 June 2008, however, gives the CREG additional competences to look into price components so as to protect consumers against predatory pricing (see Chapter 2 on General Energy Policy). Wholesale market prices are based on ENDEX (forward prices). But only around 12% of electricity consumed in Belgium is traded in the day-ahead wholesale market, Belpex, of which 61.1% is imported electricity. Liquidity is even thinner at the financial market (derivatives) ENDEX Power BE where, according to the federal regulator, CREG, during 3 out of 4 days in 2008 there was not a single transaction.[74] Most electricity produced in Belgium is traded internally within vertically integrated utilities or on bilateral contracts with large industrial customers.

Domestic retail prices, for historical reasons, are not related to either wholesale prices or to actual costs, but instead indexed to fuel prices (coal and gas) and the RPI. Although the retail electricity prices are not regulated, most suppliers choose to use a variation of a cost indexation formula calculated by CREG, which was historically used to determine the regulated price before the markets were liberalised. The publication of the price components by CREG creates the risk of the regulator acting as a price co-ordinator on the retail market. This formula is based, among others, on the Zeebrugge hub spot gas price and available nuclear plant capacity, both of which can be strongly influenced by the incumbent companies.

The relationship between electricity prices and generation costs has been a subject of vigorous public debate in Belgium. Concerns have been raised that the nuclear and coal-fired power plants which were depreciated before the liberalisation, are now supposedly making large profits because of their "stranded benefits". This is not a unique feature for Belgium but a general phenomenon linked to the transition from a regulated to a liberalised market. Such concerns provided a basis for an exceptional tax of EUR 250 million imposed by the government in December 2008 on the nuclear generators (Electrabel and SPE). Another EUR 250 million tax was decided for 2009. Electrabel appealed to the Constitutional Court against this tax on the basis that it is discriminatory (it has to bear 90%) and disproportionate.

73. See Eurostat http://epp.eurostat.ec.europa.eu. The IEA collects data on electricity prices and taxes but Belgium has not submitted this data to the IEA since 2001.
74. CREG, Etude (F) 090126-CDC-811 relative à l'échec de la formation des prix sur le marché belge libéralisé de l'électricité et les éléments à son origine, Brussels, 26/01/2009.

Public service obligations (PSOs) appear broad and burdensome, and deter entry owing to the regional specificities, especially in the Brussels-Capital region where, despite formal market opening, there has been very little new entry in the residential market arguably because of the stringent regulations. In 2007 new regulation for social energy tariffs was introduced in order to provide eligible consumers the lowest energy tariff and to abandon the provision of guaranteed free energy. However, a free quota of electricity per household member still exists in Flanders, as of early 2009. It is available not only to the most vulnerable population groups but to all households, and, as such, the benefits of this policy are questionable from the point of view of social protection and the impact on energy demand (see Chapter 2 for more details on social tariffs).

The less expensive night-time tariff was extended to the weekend for grid-users connected to the low voltage grid by Royal Decree of 21 December 2006. This decree puts an obligation on the distribution grid operator to record the electricity consumption of low-voltage end-users (families, self-employed workers and small enterprises) who have a dual hourly-rate meter (day and night) on the night-time meter during the weekend. New rules are applicable since 1 January 2007.

CRITIQUE

Since the last IEA in-depth review, the opening of the Belgian electricity market to competition has been completed with the liberalisation of the domestic markets in the Walloon and Brussels-Capital regions in January 2007, in accordance with the EU Electricity Directive. Furthermore, the creation of the electricity spot market, Belpex, and the coupling with the Dutch and French markets with very visible convergence of wholesale prices is a very positive development. The envisaged extension to the German market is also to be commended. The federal regulator has changed the methodology for calculating the transmission and distribution tariffs to a 4-year tariff structure that provides a more stable framework for network operation and investment in electricity infrastructure. The availability of interconnection capacity with neighbouring markets has been reinforced (including three new phase-shifters) and new projects are under development, while market-based allocation methods have increased available capacity at the south and north borders. There remain, however, important policy challenges for the electricity sector.

Investment

The most urgent challenge in the Belgian electricity sector is to increase investment to expand supply capacity and to replace ageing facilities. Since 2000, demand has been greater than generation, so imports have risen. At present, there is a gap in generating capacity of 1 000 MW, with imports amounting to more than 13% of demand for electricity in 2008 (some 10 TWh out of total 77.6 TWh) meeting that gap. Furthermore, 50% of present

capacity is more than 30 years old (almost all coal-fired baseload capacity) and will have to be replaced by 2020. The decommissioning of nuclear power plants between 2015 and 2025 will likely further exacerbate the serious risk of capacity shortage. This lack of domestic generating capacity could result in power cuts and blackouts during periods of peak demand. It could also have an upward impact on prices (peak and forward prices).

If Belgium chooses to rely intensively on electricity imports to meet its domestic demand, export capacity (the availability of surplus) in neighbouring countries, namely in France, will become critical. However, this is beyond the control of the Belgian government. Cross-border trade is welcome as a source of competition, enhanced price stability, flexibility and reserve sharing, assuming that *i)* the trading partners have enough generating capacity to share; and *ii)* that there is enough *ex ante* guaranteed interconnection capacity available.

The IEA strongly encourages the development of regional power markets and the Belgian government should continue its admirable efforts to integrate its physical grid and electricity markets with neighbouring countries. Provided that this is successful, it is not essential that there should be a balance of demand and supply within Belgium alone. Nevertheless, particularly while regional energy markets remain imperfect, Belgium will expose itself to a higher risk of blackouts or exceptional price spikes if disincentives for investment in new generating capacity lead to a systematic and growing shortfall. Building more domestic generating capacity will therefore contribute to the security of supply and more affordable prices for end-users. For this reason, Belgium should try, through increased market transparency and streamlined planning procedures, to ensure that investment in new generating capacity, to meet local and regional demand is an attractive proposition for new players as well as incumbents.

There are important hurdles in relation to the construction of new generation plants in Belgium; these include finding suitable construction sites and permitting. Belgium is the third most densely populated country in the OECD and most suitable sites are historically owned by the incumbent company, making them inaccessible to other companies. The auction of three sites by Electrabel in 2006 and the imposed tax on unused sites aim to change this situation, but more measures aimed at greater availability of suitable sites should be evaluated. On the other hand, smooth, timely, stable and transparent approval procedures for construction of new power plants are essential for competition and reliability of supply.

Market reform

The transition to competitive and liquid markets is proving especially challenging in Belgium, as markets remain highly concentrated. In early 2009, Electrabel still had a dominant position in both generation and supply but this situation was expected to change as a consequence of the sale by Electrabel of more than 2 000 MW of its capacity in Belgium to two competitors.

The Walloon and Flemish commercial and residential markets are more competitive with a number of active suppliers of different sizes. In the absence of baseload generation assets, new independent entrants are only able to compete in this market segment. As for supplying large industrial customers, the incumbents (Electrabel and SPE) remain largely unchallenged in their respective historical territories. Although progress has been made and retail prices have experienced downward pressure owing to developing competition, the rules and processes for customer switching may need to be improved further. In particular, it is essential to align regulations and obligations for retail suppliers in different regions and reduce administrative burdens related to public service obligations.

Improved cross-border trade not only allows for better sharing of resources across larger areas. For smaller markets, cross-border trade may be the most efficient way to improve competition among local generators. Once initiated, competition must be allowed to drive the organisation of the sector to deliver its full efficiency potential – even if this requires larger, consolidated firms. If it is not possible or desirable to break up dominant firms, the only other option may be to enlarge markets through integration. Effective cross-border trade requires extended regulatory harmonisation across interconnected markets; in this regard, the current work of the Pentalateral Energy Forum is a step in the right direction.

Pricing

Market-based pricing is the key to allowing markets to send the correct price signal to investors and consumers. Transparent prices in all parts of the value chain are the cornerstone of liberalised markets. In particular, prices should be allowed to reflect the balance of supply and demand, especially in peak hours. Today, neither wholesale nor retail market prices are the result of fundamental market conditions. Necessary investments will be forthcoming in sound markets with efficient regulation of monopoly activities; in the absence of sound markets, investment will be affected.

Price formation on the Belgium markets seems non-transparent and the resulting prices do not reflect the underlying economic conditions. However, new competences with regard to price monitoring have been assigned to the CREG, as discussed in Chapter 2. As the national wholesale market is integrated into the supranational Central-West European market with converging prices, the wholesale prices in Belgium reflect the demand and supply situation in this larger regional market.

Liquidity is thin at the financial market (derivatives) ENDEX Power BE where prices are supposed to cover the cost of investment in new generating capacity. The eventual development of new measures to enhance the liquidity and the efficiency of the day-ahead wholesale market should provide a neutral platform for the further development of financial products

in the forward market. This can provide assurance to all market participants and improve the ability of independent suppliers to source in their electricity needs in the market.

Domestic retail prices, for historical reasons, are not related to either wholesale prices or to actual costs, but instead are indexed to fuel prices and to inflation. The large investment needs in the electricity sector combined with ambitious environmental targets requiring a cleaner generation portfolio, may put significant upward pressure on prices. These facts give support to calls for the reintroduction of price regulation and even for new additional taxes on some vertically integrated suppliers allegedly making windfall profits or "stranded benefits" from depreciated nuclear and coal assets. Permanently high margins may be a symptom of the non-competitive state of a market. Nevertheless, special taxes of this kind are found to discourage future investments. There might also be conflicting policy objectives between the need for new investments/entry and the government's aim "to lower electricity bills" (as part of the recent "economic stimulus package"). The government should resist pressures to cap prices. Moreover, while it is legitimate for the government to want to allow society enjoy the economic benefits of the existing nuclear capacity, the way it is done is questionable. "Exceptional" taxation of nuclear operators does not necessarily stimulate competition, nor does it lead to lower prices for end-users.

Flexibility

In view of the tightness of the Belgian electricity market at times of peak load, enhanced consumer participation and use of less traditional resources, such as backup power and distributed generation, create a new and important resource. In times of scarcity, even a very small degree of price elasticity can be enough to deliver the critical resources to balance the system, particularly if prices are allowed to spike. With competition and liberalisation, backup generation, small-scale CHP, and other distributed resources benefit from access to new markets and can contribute to operational reserves and other ancillary services. In Denmark, smaller distributed CHP units now bid into the market for operational reserves, providing real competition in an otherwise concentrated market. At the same time, the sale of reserves provides important cash flow to these plants. Aggregation of back-up generation, also to serve as reserves, is pursued in several other markets.

Trading arrangements that send clear and effective market-based price signals to the end-users are necessary to have an impact on consumer behaviour. To optimise demand-side management on the retail side, the enabling of new metering infrastructure ("smart meters") is required. Sufficient investment in the modernisation of the distribution grids (towards eventually a "smart grid") is recommended, allowing for the integration of large shares of distributed generation into the grid. Smart grids act at the distribution level, which is the

competence of the regions. Co-ordination of the different existing regional projects for smart grids should be harmonised to reach a minimum efficiency scale. The cost of these infrastructure investments will be high and must be passed through to consumers.

RECOMMENDATIONS

The government of Belgium should:

- *Continue the commitment to effective and competitive markets with market-based prices that create incentives for and adequately reward new investment in power generation.*
- *Lower as much as possible the existing structural and regulatory barriers to investment in power generation, namely the lack of available sites for new capacity, by streamlining and shortening the permitting procedures.*
- *Closely monitor the state of competition in concentrated wholesale and retail market, and, if necessary, address abuse of dominant position from incumbents through adequate and proportionate measures, while ensuring easy access for new entrants by keeping barriers to entry and to expansion low.*
- *Ensure further integration with the Central-West Europe region to enhance competition and to share resources across larger areas, thus reducing the overall need for investments in costly peak capacity.*
- *Work together with the transmission system operator and distribution system operators to increase flexibility in the system, for example through demand-side programmes and related enabling technologies.*

GENERAL OVERVIEW

Belgium has seven operating nuclear power reactors – all pressurised water reactors – that have a total generating capacity of 5 824.5 MW_e net. This represents a net capacity increase of 23 MW_e since the last in-depth review as a result of a capacity upgrade at Doel 4.

Table 18

Nuclear Power Reactors in Belgium

Name of plant	*Start of commercial operation*	*Projected shut-down**	*Net capacity (MW_e)*
Doel 1	15 February 1975	2015	392.5
Doel 2	1 December 1975	2015	433.0
Doel 3	1 October 1982	2022	1 006.0
Doel 4	1 July 1985	2025	1 008.0
Tihange 1	1 October 1975	2015	962.0
Tihange 2	1 February 1983	2023	1 008.0
Tihange 3	1 September 1985	2025	1 015.0
Total			**5 824.5**

*Projected shut-down framework based on the nuclear phase-out law, which is described below.

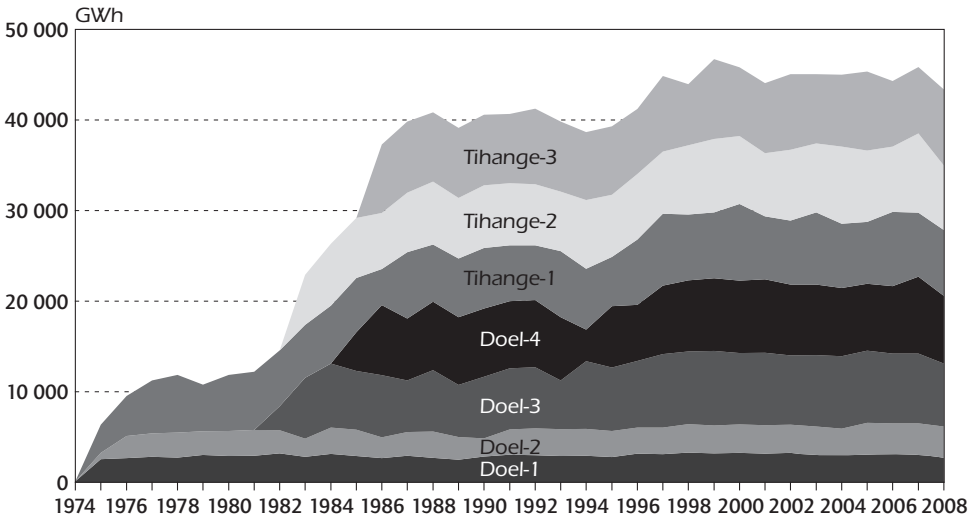
Source: Country submission.

Being in operation for 1 526 348 hours (63 597 days; 174 years) in total, nuclear power reactors in Belgium have produced 1 145 002 GWh of electricity since the first reactor, Doel 1, was connected to the power grid (see Figure 31). Nuclear power generation significantly contributes to Belgium's efforts to reduce air pollution (NO_X and SO_2) and avoid CO_2 emissions.

In 2007, the Belgian reactors produced 45.9 TWh, more than half of the country's electricity generation, and more than a fifth of total primary energy supply. According to the Plant Reliability Information System (PRIS) database of the International Atomic Energy Agency (IAEA), the Belgian reactors have historically had high operational reliability. The cumulative load factors put all the Belgian reactors in the first quarter of the list of the 436 operational nuclear reactors in the world (see Table 19).

Figure 31

Electricity Produced by Nuclear Power Reactors, 1974 to 2008



Source: International Atomic Energy Agency, Power Reactor Information System database.

Table 19

Cumulative Load Factors of Power Reactors

Unit	*Cumulative (lifetime) load factor [%]*	*Rank**
Tihange 3	86.6	22
Tihange 2	85.3	31
Doel 1	84.9	35
Doel 4	82.9	61
Doel 3	82.7	66
Doel 2	81.6	85
Tihange 1	78.8	116

* Rank among the 436 operational reactors worldwide.

Source: IAEA.

The overall performance of Belgian nuclear power reactors is generally world class, having had an average availability of 87.9% from 2004 to 2007.

Table 20

Key Indicators of Nuclear Electricity Production, 2004 to 2007

Year	*Nuclear production [TWh$_e$]*	*Annual availability factor [%]*	*Nuclear share in electricity production [%]*	*Nuclear share in TPES [%]*
2004	44.9	88.3	55.1	20.6
2005	45.3	89.2	54.8	20.8
2006	44.3	86.9	56.4	20.5
2007	45.9	89.9	56.0	21.4

Source: Country submission.

NUCLEAR ENERGY POLICY

Policy related to the nuclear sector, the nuclear fuel cycle and R&D in both nuclear fusion and fission is the responsibility of the federal government. Belgium was a groundbreaker in adopting nuclear technology for peaceful purposes in the early 1960s. For many years the Belgian nuclear industry covered almost all activities in the nuclear fuel cycle.[75]

In January 2003, the National Assembly passed a law codifying the national policy of Belgium to phase out nuclear energy for commercial electricity production. The law prohibited the construction of new nuclear power plants (NPPs) and set a 40-year limit on the operational period of existing plants. The implementation of this law will lead to the closure of three plants in 2015 (1.75 GW$_e$ net combined) with the remaining four plants (4.0 GW$_e$ net combined) closed by 2025 (see Table 18 for the shut-down schedule for each plant). This law is still in force and can only be overruled by amending legislation or by a Royal Decree based on a recommendation from the federal Gas and Electricity Regulatory Commission (CREG) if Belgium's electricity supply is threatened by the closure of the plant(s).

Several studies have assessed the impact of the nuclear phase-out on the electricity sector and on the general Belgian energy and environmental policies.[76] In particular, a comprehensive study by the Commission for the

75. Belgium made a step back from being one of the world leaders in the nuclear fuel cycle by shutting down most facilities involved in mixed oxide (MOX) fuel production and reprocessing.
76. Even before the adoption of the 2003 law, as early as 1999, the Commission for the Analysis of the Means of Electricity Production and the Restructuring of the Energy Sector (Commission, Ampere) recommended to keep the nuclear option open by maintaining the scientific and technological potential needed to ensure optimal conditions for safety and performance, by preserving the national know-how on nuclear energy and by participating in mostly private-sector R&D on future reactor types. An international peer review of the final report of the Commission Ampere also came to the same conclusion.

Analysis of the Belgian Energy Policy towards 2030 (Commission Energy 2030) came to the conclusion that the government should reconsider its 2003 law because the nuclear phase-out would lead to higher electricity prices and endanger Belgium's energy security and ability to meet its climate change targets (see more details in Chapter 2). Other studies have concluded that it is possible for Belgium to reach its EU targets even if the nuclear phase-out policy continued.[77] However, most of the existing studies have focused on the European 20-20-20 targets which look at Belgium's energy mix only until 2020, while the consequences of the nuclear phase-out will be mostly felt after 2025. Therefore, in 2008 the government commissioned another expert group to study the ideal energy mix for Belgium in the medium and long term, the so-called GEMIX study (see Chapter 2). On the basis of the findings of the GEMIX expert group, the government expects to take a decision regarding the nuclear phase-out policy by the end of 2009.

The economic, geopolitical and environmental situation has changed significantly since 2003, when the phase-out law was voted. Today, energy security concerns have become much more acute and Belgium's climate change mitigation obligations even more challenging. Given the increasing scarcity of fossil fuel resources and the growing geopolitical tensions related to energy supplies, more and more countries are turning to nuclear energy as a way of ensuring domestic energy security and to reduce import dependence while addressing the climate change challenge. Some G8 countries, such as Italy and the United Kingdom, are re-evaluating their nuclear policies.

In this changing context, maintaining the phase-out policy would have significant adverse effects on energy security, climate change mitigation and economic growth in Belgium. More specifically, Chapter 7 describes the serious investment challenge in the Belgian electricity sector. The shut-down of nuclear plants would further exacerbate the capacity imbalance which may drive up prices. It could also increase the risk of blackouts during periods of peak demand. While the IEA welcomes the development of regional energy trade, too great a reliance on electricity imports may create energy security concerns, especially since the availability of export capacity in the neighbouring countries is beyond the control of the Belgian government. At the same time, the extension of the operational lifetime of the Belgian nuclear power reactors would further contribute to maintaining security of electricity supply and could delay otherwise required investment in new electricity generating capacities or reduce the need for power imports. Chapter 3 suggests that it will be extremely costly for Belgium to meet its EU GHG reduction targets if it continues the nuclear phase-out policy.

77. See, for example, the study by the Federal Planning Bureau, *Impact of the EU Energy and Climate Package on the Belgian Energy System and Economy*, Brussels, November 2008, discussed in more detail in Chapters 3 and 6.

Moreover, the current situation is ambiguous: the phase-out law is officially in force but more and more experts and stakeholders question whether it will be realistically implemented. This sends ambiguous signals to market actors, thus delaying the urgently needed investments in both the electricity sector and in climate change mitigation technologies. Therefore, to ensure Belgium's energy security, to enhance its ability to meet its climate change obligations in a cost-effective way, and to improve the investment climate, it is necessary to review the current phase-out law as soon as possible.

PRESERVING THE ABILITY TO OPERATE NUCLEAR POWER PLANTS IN THE EVENT OF *FORCE MAJEURE*

The operating licences of the Belgian nuclear power plants are based on the principle of the decennial revisions which is in compliance with international practice. Electrabel, the operator of the Belgian reactor fleet, continuously makes efforts to maintain the required nuclear safety level. The evolution of the safety assessment methodologies has led to complementary investments. Examples of such investments are the planned replacement of the steam generators of Doel-1 in 2010 and of the emergency diesel generators of Doel-1 and 2 in 2009-2010. As a result of these continuous efforts, it should be feasible to maintain safe and reliable operation of the Belgian reactors beyond the 40 years of exploitation foreseen in the phase-out law.

PUBLIC VIEW ON NUCLEAR ENERGY

Public attitudes towards nuclear energy have changed only slightly in the last five years. There are slightly more people in favour of nuclear energy than against it (47% of the total population in 2008 vs. 50% in 2007 and 48% in 2005), and even more would be in favour (58% both in 2005 and in 2008) if the issue of radioactive waste was solved, according to the European Commission's Eurobarometer. The share of Belgian people undecided about nuclear energy is one of the lowest in Europe.

A domestic poll, performed by the Institut Français d'Opinion Publique (IFOP) in 2007, showed significant differences in public view between the three regions. While about half of Belgians consider that advantages of nuclear power outweigh inconveniences, a majority (about 60%) think so in Flanders. However, in 2007, a larger majority of people wanted to maintain the nuclear phase-out law in Flanders (70%) than in Wallonia and in Brussels (about 60%).

As the deadline for the shut-down of the oldest nuclear power reactors is gradually approaching, the political attitude towards nuclear energy is changing. More and more politicians are supporting the idea of extending the operational lifetime of the Belgian reactors beyond 40 years. However, there is no political consensus on this issue and the public debate is continuing. As political parties and the government can have a strong influence on public

opinion, it is very important to have transparent communication about all the aspects of maintaining or phasing out nuclear power, including the possible economic, environmental and energy security impacts.

It is for each country to form its own view on nuclear power. However, it is essential to recognise that the phasing-out of nuclear power in the current Belgian context would pose great challenges for the future supply of secure and environmentally acceptable electricity.

INDUSTRY STRUCTURE AND KEY INSTITUTIONS

The ownership structure of the Belgian nuclear sector is very complex. As Figure 32 illustrates, Electrabel (GDF Suez) is the operator of all commercial reactors in Belgium. It owns 96% to 100% of shares in six out of the seven Belgian reactors. The seventh reactor, Tihange-1, is 50% owned by Electrabel and 50% by EDF through its subsidiary Semobis. Four per cent of the shares in four Belgian reactors belong to SPE, which is owned by the Belgian State, public authorities and Centrica. Electrabel and SPE also own shares in the French Chooz B plants.[78] In addition, Electrabel has a share of the Tricastin power plant in France.

Synatom (wholly owned by Electrabel, except for one preferential share owned by the federal government) is the only entity in Belgium responsible for all aspects of the nuclear fuel cycle, except the management of radioactive waste. Synatom owns a share in the uranium enrichment plant of Eurodif (European Gaseous Diffusion Uranium Enrichment Consortium), situated at the French Tricastin site. Belgonucléaire was a manufacturer of mixed oxide fuel (MOX) until July 2006. Belgatom, belonging to Suez-Tractebel and Belgonucléaire, is an engineering company for the nuclear industry. SCK.CEN is a nuclear research centre (see more details in Chapter 9). The National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) owns 100% of Belgoprocess, which manages radioactive waste and dismantles nuclear installations.

Suez-Tractebel has acquired a participation in GBII-Holding, the company which will construct the new enrichment facility George Besse II (a centrifuge plant) in France. This facility will be the successor to the Eurodif facility.

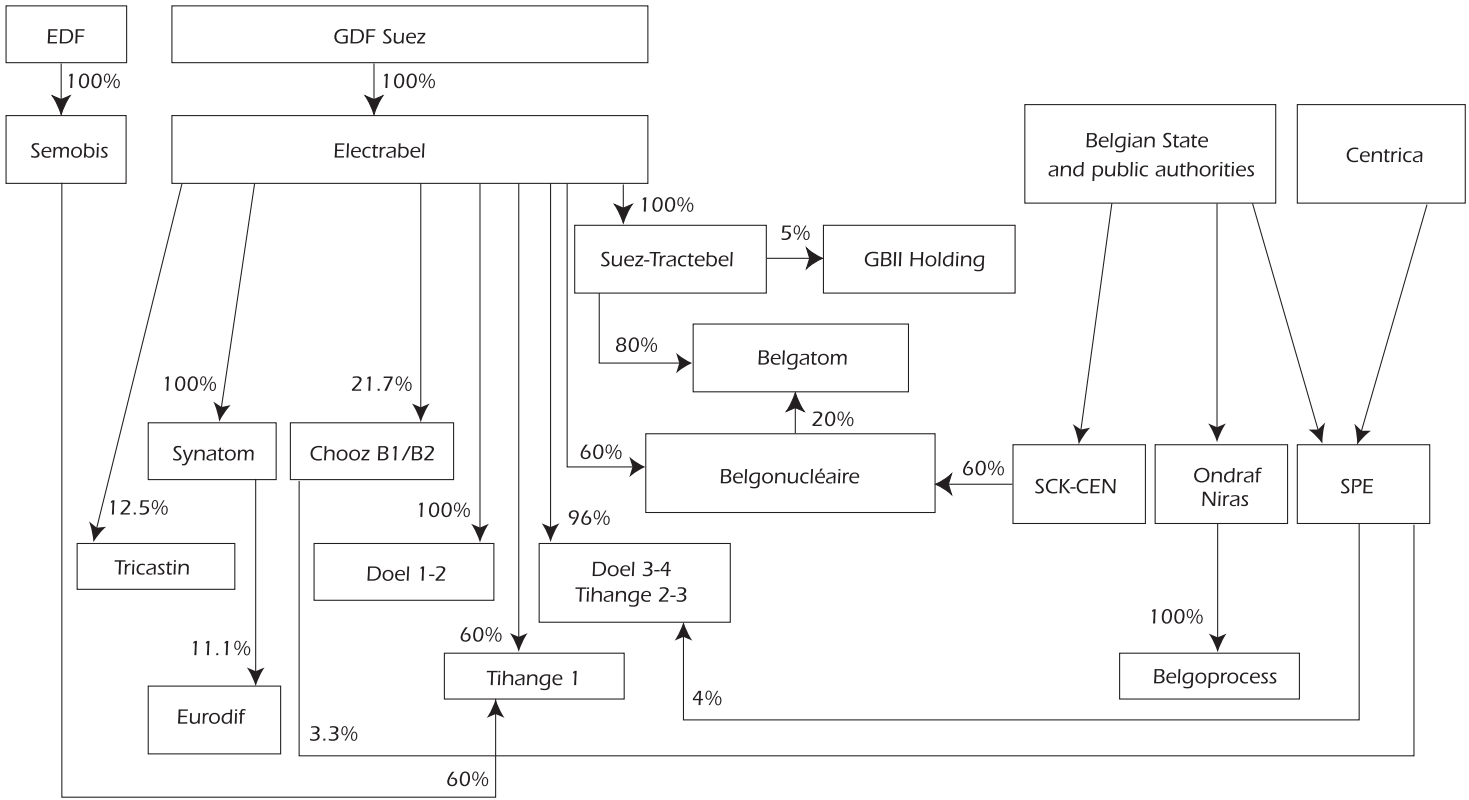
This market structure – where one company operates all existing nuclear reactors which were depreciated before the liberalisation – is considered by many stakeholders to be a significant barrier, preventing other players from entering the Belgian electricity market (see more details in Chapter 7).

The FPS for Economy, SMEs, Self-Employed and Energy is responsible for nuclear policy within the Belgian government. Figure 33 depicts Belgian nuclear policy institutions.

78. There is an agreement between Electrabel and SPE according to which Electrabel will take over all the shares of SPE in Chooz as part of an asset swap. This transaction is subject to approval from the European Commission.

Figure 32

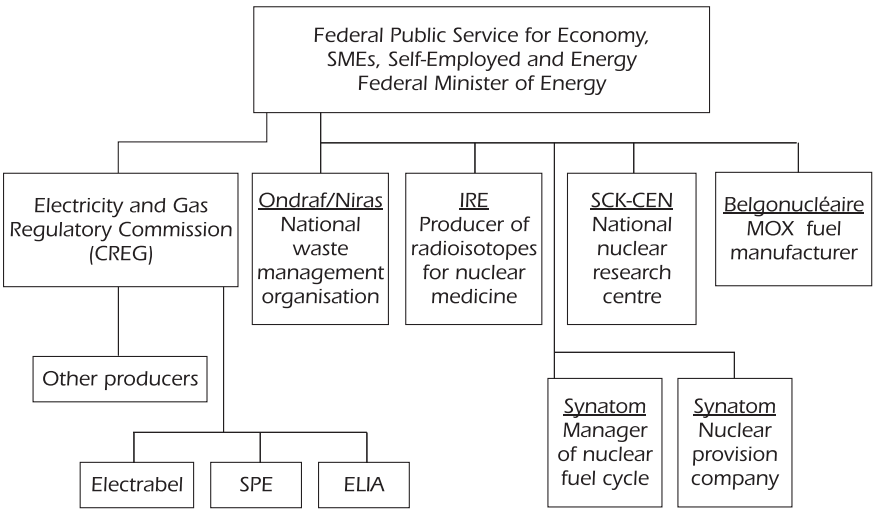
Ownership of the Nuclear Industry



Source: Country submission.

Figure 33

Federal Nuclear Policy Institutions



Source: Country submission.

NUCLEAR SAFETY REGULATION

The safety of the nuclear installations in Belgium is governed by the law of 15 April 1994 with regard to the protection of the population and the environment against the dangers from ionising radiations. This law entrusts the supervision of nuclear safety to the Federal Nuclear Control Agency (AFCN – Agence Fédérale de Contrôle Nucléaire/Federaal Agentschap voor Nucleaire Controle). On 1 September 2001, the AFCN formally took full responsibility for the supervision of all Belgian nuclear activities. AFCN is an independent federal agency reporting to the Ministry of Interior that exercises regulatory authority over nuclear operations. Its budget is paid for by the users and operators. The surveillance of nuclear activities in Belgium is achieved primarily through the operators, who are responsible for meeting the requirements of their licences.

Since the last in-depth review AFCN has gradually increased the number of its professional and support staff. Its relations with technical support organisations have also changed. In 2008 AFCN created a subsidiary BelV that took over many functions formerly performed by the Authorized Inspection Organization (Association Vinçotte Nucléaire/Associatie Vincotte Nucleair – AVN) and other smaller technical support organisations. AFCN and BelV now directly carry out on-site inspection and examine licence requests and safety reports of the operators. AFCN and BelV have taken over a large part of the staff of the former technical support organisations, but have also

recruited experts from elsewhere. The former technical support organisation AVN has become a smaller entity acting as a consultant and providing advice and technical support for nuclear safety and radiation protection to nuclear installation licensees.

NUCLEAR FUEL CYCLE

Belgium has a highly developed nuclear industry, which is considered world class in many areas of the nuclear fuel cycle. It is one of the founding members of the Euratom Treaty that created the Euratom Supply Agency which is responsible for controlling the front-end of the nuclear fuel cycle through assuring equal access to the resources and a common European supply policy of broad diversification.

Synatom is the sole entity in Belgium which is responsible for all aspects of the nuclear fuel cycle (*e.g.* procurement, conversion, enrichment, fuel fabrication and reprocessing), except for the management of radioactive waste. It retains the ownership of nuclear materials through the whole cycle until the material is disposed of. Synatom has increased the diversification of its uranium supply that is secured through medium and long-term contracts with uranium exporters from Australia, Canada, Kazakhstan, the United States, Russia and South Africa. The Eurodif plant in France assures very secure enrichment services. Long-term contracts have also been signed with Urenco and Tekhsnabexport in Russia. This approach creates a stable supply situation.

Belgium has no natural uranium that can be mined economically. There was some limited production of uranium from imported phosphates in the past, but it has been terminated for economic reasons. However, rising uranium prices could revive this production in the future.

The uranium fuel fabrication plant is located in Dessel and operated by FBFC (Société Franco-Belge de Fabrication de Combustibles) International, a subsidiary company of Areva. The mixed oxide fuel (MOX) fabrication plant of Belgonucléaire at Dessel stopped its operation in July 2006, owing to lack of contracts. Preparations for the dismantling have already started, all fissile materials have been removed from the plant, and the licence for dismantling has been issued by the safety authorities. Dismantling activities are expected to commence in 2009. FBFC International continues assembling MOX fuel elements with pins fabricated in the MELOX plant in Marcoule in France.

At the back-end of the nuclear fuel cycle, Belgium has traditionally followed a policy of reprocessing the spent nuclear fuel of its own power reactors. In the late 1970s, Synatom concluded four reprocessing contracts with the French company Cogéma. The reprocessing took place in several steps between 1981 and 2000. The reprocessed uranium has been recycled into MOX fuel and used in three Belgian power reactors. Reprocessing also resulted in

the production of vitrified, compacted and bituminised waste, as well as some plutonium. By the end of 2007 all vitrified waste had been returned to Belgium in 14 shipments. Compacted waste from reprocessing will be shipped back to Belgium in the coming years. Synatom has started consultations with Areva to find the solution for the reshipment of the bituminised waste produced during the first period of reprocessing. The separated plutonium resulting from the first reprocessing contracts was partly used for the fabrication of MOX fuel for fast reactors.[79] Another part was used by Belgonucléaire as an operational stock for the implementation of its fabrication contracts of MOX fuel for light-water reactors.

A parliamentary debate in 1993 led to the suspension of the fifth reprocessing contract signed in 1991 and reprocessing planned between 2001 and 2010. Belgium suspended the reprocessing strategy, but completed the fourth reprocessing contract and used MOX fuel in the reactors Doel-3 and Tihange-2 with plutonium from the fourth contract. R&D activities of ONDRAF/NIRAS for direct geological disposal of spent fuel were given the same priority as reprocessing. Interim storages for spent nuclear fuel were put into operation at the Doel and Tihange sites. The Belgian Parliament decided to review the country's nuclear fuel cycle strategy on a regular basis.

In 1998 the Council of Ministers decided to introduce a moratorium on nuclear fuel reprocessing, to cancel the fifth reprocessing contract and not to allow new reprocessing contracts without formal approval by the government. However, a formal decision regarding the final solution for the back-end of the fuel cycle has not been taken yet. Belgium continues comparing the economics of the open and closed fuel cycle options. The government will have to decide on the future of the back-end of the nuclear fuel.[80] Thanks to the use of plutonium resulting from reprocessing for the fabrication of MOX fuel, no plutonium is accumulated in Belgium apart from small quantities resulting from R&D activities.

All other services to support plant operations are either indigenous or obtained commercially from established suppliers in a number of diversified countries.

PLANT DECOMMISSIONING AND RADIOACTIVE WASTE MANAGEMENT

In April 2003, a law established the roles, responsibilities and processes that govern the decommissioning of nuclear power plants, the management of the spent nuclear fuel and the financing of these operations. Under

79. The use of MOX is authorised in Belgium, but limited to the quantities obtained from the reprocessed spent fuel from the reactors.
80. Belgium shows strong interest in R&D for the fast breeder/burner reactor technology that could cope with the industrial scale transmutation of the high-level waste generated and currently stored in special storage facilities.

the 2003 law, Synatom is responsible for managing the provisions for the dismantling of the power reactors and for the management of the spent nuclear fuel. Synatom must ensure future funding to fully cover the costs of these operations. The Belgian government's controlling share in Synatom gives it the right to overrule any decision taken by the governing board of Synatom. The law also created a supervision committee charged with ensuring the sufficiency of the funding arrangements. This committee is composed of high-level representatives of the government, the banking sector, the CREG, the Radioactive Waste Management Organisation (RWMO) and nuclear safety authorities, the latter two in a consultative role. The committee must take account of advice provided by ONDRAF/NIRAS on the adequacy of funding provisions. As the law of 11 April 2003 was modified in 2007, in addition to the six original members representing the Belgian State, the supervisory committee was expanded by three new members delegated by Synatom.

To ensure future funding for decommissioning, Synatom introduced a fee that nuclear electricity producers must pay each trimester starting from 2003 so that after 40 years of operation full decommissioning costs for each plant are covered. Operators also pay another fee proportional to the amount of spent nuclear fuel produced during the year. This payment is used to finance the management of spent nuclear fuel. The fees are part of the electricity production costs and paid for by final consumers.

Synatom is authorised to lend up to 75% of the funds earmarked for plant decommissioning and spent fuel management to nuclear electricity producers. The loan conditions have to be fixed in conventions between Synatom and the electricity producers, to be approved by the supervising committee. If entities other than the present nuclear operator obtain ownership and production rights in the nuclear power plants, they inherit the rights and obligations linked to nuclear provisions. The other 25% (or more) have to be invested in assets outside the nuclear operator with sufficient diversification in order to minimise risks.

As of early 2009, the economic crisis reportedly had no significant impact on the value of the funds earmarked for plant decommissioning and spent fuel management. The part of the funds invested outside the nuclear operator is put in long-term loans, or in bonds of the type AA or AAA, which are only subject to variations in the interest rate.

An autonomous public body, the National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS)[81] is legally responsible for the transportation, management and final disposal of all conditioned radioactive waste in Belgium, including interim waste storage outside waste producer facilities. Belgoprocess, a daughter company of ONDRAF/NIRAS, is located at Dessel. This company treats and conditions all radioactive wastes of Belgian origin, except some categories of waste which are produced, treated and conditioned directly

81. Organisme National des Déchets Radioactifs et des Matières Fissiles Enrichies/Nationale Instelling voor Radioactief Afval en Verrijkte Splijtstoffen.

at the nuclear power plants. All production of non-conditioned and conditioned waste (at the plants and at Belgoprocess) is controlled and supervised by ONDRAF/NIRAS in order to assure that it meets all safety criteria.

TREATMENT AND CONDITIONING

Belgoprocess operates a number of treatment and conditioning facilities[82] for low-, intermediate- and high-level solid and liquid radioactive waste equipped with incinerator, supercompactor and cementation technologies. With these facilities, Belgium is able to treat and condition all kinds of radioactive waste produced in the country. As some of the facilities are rather old, studies of their possible modernisation are being carried out.

Historically Belgium has dealt with all technological phases of the nuclear fuel cycle and has offered its nuclear services to the international market. As a result, facilities are over-dimensioned for the quantities of radioactive waste produced in the country. Treatment of radioactive waste of foreign origin is authorised by the Belgian government under the condition that it would be returned to the country of origin after conditioning.

INTERMEDIATE STORAGE

Currently, all radioactive waste in Belgium is stored pending the availability of facilities for its permanent disposal. In addition to some storage capacity existing at the sites of the nuclear power plants, Belgoprocess operates storage facilities at its Dessel site, on the account of ONDRAF/NIRAS. At these storage facilities it is possible to store in safe conditions all the radioactive waste resulting from the operation of the Belgian nuclear plants and the nuclear fuel cycle.

DISPOSAL OF SHORT-LIVED LOW- AND INTERMEDIATE-LEVEL WASTES

The governmental programme for disposal of short-lived low- and intermediate level wastes relies on a broad social dialogue and partnership between ONDRAF/NIRAS, the local authorities and the population of the concerned municipalities. By the end of 2005, two local communities (Dessel and Mol) had accepted to host the integrated disposal projects together with the accompanying measures to support the economic, social and the environmental development of the region. A third disposal project in Fleurus-Farciennes was abandoned.

82. Such as CILVA, Mummie, Eurobitum, 208X.

The government decided in 2006 that the short-lived low- and intermediate-level wastes were to be disposed of in a near-surface facility in the municipality of Dessel. ONDRAF/NIRAS is elaborating the details of an integrated disposal project. The local participation process is maintained continuously with Dessel, Mol and the surrounding municipalities showing a legitimate interest. Finalisation of the detailed concept is expected by 2011, construction of the different facilities is planned between 2011 and 2015. Start of the operation is foreseen by 2016.

DISPOSAL OF LONG-LIVED MEDIUM- AND HIGH-LEVEL WASTES

ONDRAF/NIRAS is preparing a waste plan for long-lived intermediate- and high-level wastes that will meet the organisation's strategic objectives and will integrate the technical, economical and societal aspects of disposal. Dialogue, alternative solutions or complementary options, and stakeholder involvement in the decision-making process are all important elements of the strategy towards the long-term management of all radioactive wastes. As a part of the dialogue, the waste plan and the environmental impact assessment need to be presented to all stakeholders, including all relevant Belgian authorities and other countries in case of trans-boundary environmental impacts. ONDRAF/NIRAS plans to complete the public consultation process and present the final waste plan to the government by the end of 2010. ONDRAF/NIRAS expects that, on the basis of this plan, the federal government will take a general decision on the waste management option to be pursued and will outline procedures related to the implementation of this selected option.

Assuming that the government approves the possible candidate host locations (Boom Clay as reference and Ypresian Clay as alternative) in its general decision, ONDRAF/NIRAS will evaluate the safety and the feasibility of a disposal facility in one or several zones in these two locations. This first safety and feasibility case should be ready by 2013. A second safety and feasibility case proposing the optimal disposal site is expected to be completed by 2020 at the earliest. It will serve as an input to the licensing process,

ONDRAF/NIRAS has elaborated a detailed programme for the period between 2009 and 2014 that includes actions in the areas of safety and environmental assessment, consultation with the safety authorities, public consultation and R&D. (Nuclear R&D is discussed in Chapter 9).

HUMAN RESOURCE MANAGEMENT

The policy to phase out nuclear energy may impact the sector's ability to attract and keep qualified personnel and replace an ageing workforce. In Belgium, education and training continues to assure that enough competent

and skilled people can be employed in the nuclear sector. The National Nuclear Research Centre (SCK.CEN – Studiecentrum voor Kernenergie/Centre d'Etude de l'Energie Nucléaire) is making particularly important efforts, including:

- Collaborating with five Belgian universities to create the Belgian Nuclear Higher Education Network (BNEN). This network aims at transferring nuclear knowledge and expertise to young scientists through selective and advanced courses on nuclear engineering. For many years the SCK.CEN has had a special programme for PhD students in co-operation with the Belgian universities and offers grants on an international basis to post-doctoral students who want to come and work for two years in one of its laboratories. The number of students involved has doubled since 2003 and is gradually increasing.
- Participating in the European Nuclear Engineering Network (ENEN). Under the co-ordination of SCK.CEN, this network produced a handbook for a global strategy on a European Master of Science in Nuclear Engineering.
- Adopting a practical knowledge management approach, which includes building databases, assembling nuclear and technical information, implementing quality assurance procedures, conducting training and writing publications.
- Organising advanced courses and seminars, as well as practical training in the areas of nuclear engineering (reactor physics and reactor operation; nuclear materials), radiation protection, nuclear emergency management, decommissioning, radioactive waste disposal and organisational approaches. The number of students and graduates is rather constant.
- Research on trans-disciplinary aspects of education and training.
- Policy support with regard to applied education and training at national and international levels.

In 2005, GDF Suez decided to develop its nuclear activities and created a dedicated Nuclear Activities Division. One of its missions is to anticipate needs in junior engineers with maximum two years of experience for replacing retiring managers and for staffing new nuclear projects. Candidates recruited were integrated in a Nuclear Training Programme (NTP) specifically designed for junior engineers. The training programme delivers nuclear knowledge, review of nuclear activities of the group and helps to establish a network of experts inside the GDF Suez group. A similar training programme is planned for senior engineers having no specific nuclear knowledge. Experts from SCK.CEN, Corys-Tess, Areva, Tractebel Engineering, Glass Model (Germany) and other institutions support the training programme.

The group also has education agreements with the Belgian Nuclear Higher Education Network (BNEN), Belgian and French universities (such as the Paris Institute of Technology, National Institute for Nuclear Science and Technology,

and other higher education institutions in France) and with nuclear study centres (such as CEA in France and SCK.CEN in Belgium).

As of early 2009, the employment situation in the nuclear sector remained rather stable and seemed not to endanger continued operation of the Belgian reactors beyond 2015. SCK.CEN, the National Institute for Radioelements (IRE) and the Federal Agency of Nuclear Control (FANC) recently reported improvements in the employment situation.

CRITIQUE

Nuclear energy provides more than half of Belgium's electricity and more than a fifth of total primary energy supply. It currently plays a key role in ensuring the country's energy security and contributes significantly to avoiding emissions of CO_2 and air pollutants. Nuclear fuel is delivered to Belgium from diverse sources and the main suppliers are operating in politically stable countries. Nuclear fuel costs are a small portion of the total cost of electricity generated by nuclear power plants.

The nuclear industry continues to ensure safe operation of nuclear power plants. The operational performance records of the Belgian reactors are among the best in the world. Recent power upgrades have contributed not only to improving economic performance but also security of electricity supply. Safety reviews help the government to monitor how internationally accepted safety requirements are met in the nuclear power plants in Belgium. Nuclear R&D aims at conducting research on waste reduction and disposal technologies and at developing future nuclear technologies (see Chapter 9). Efforts are made to attract new generations of scientists to research and development in these technologies.

Given the current important role of nuclear in Belgium, the 2003 law that stipulates the phase-out of nuclear power generation between 2015 and 2025 presents a significant challenge for the country. Despite the growing supply from renewable energy sources, the nuclear phase-out will result in increased reliance on gas for power generation and on electricity imports over the coming years. If Belgium chooses to rely extensively on electricity imports, this can create concerns for domestic energy security, as discussed in Chapter 7. The construction of new generating capacity to replace nuclear reactors and other ageing power plants will require huge investments. Additional investments would be also needed for the development of infrastructure for gas and electricity transportation. Total investment requirements would be much higher in comparison with the costs of extending the lifetime of the nuclear reactors.

The nuclear phase-out will likely result in greater reliance on imports of fossil fuels, especially gas. This will also lead to an increase in carbon dioxide

emissions. Chapter 3 demonstrates that Belgium may have difficulty in meeting its EU obligations to reduce GHG emissions if it continues the nuclear phase-out policy. Without nuclear power in the energy mix, the cost of emissions reduction will be high. These costs will be inevitably passed on to the Belgian people and companies. This may hamper the country's economic development and people's well-being.

It is of course for Belgium to take its own decision on nuclear power. However, increased prices for fossil fuels, heightened concerns about security of supply and the need to cut carbon dioxide emissions have led in the last few years to renewed interest in nuclear power in many IEA countries. Within the EU, several member states are reconsidering their policy towards nuclear power. Most G8 countries are also actively considering building new nuclear plants or are already doing so.

The Belgian government is therefore encouraged to review its current nuclear phase-out policy as soon as possible, taking into account the following considerations:

- Security of energy supply, including concerns related to *i)* large investment needs in new electricity generating capacity; *ii)* reduced diversification of the fuel mix; and *iii)* increased imports of electricity and of natural gas for gas-fired electricity generation.
- Feasibility of meeting Belgium's climate change targets;
- Impact on the economy and people's well-being: total cost of this policy for final consumers, including the costs of building new electricity generating capacity and the costs of meeting climate change obligations.

Public acceptance is crucial if a country wants to keep nuclear power in the fuel mix. Public opinion data from Eurobarometer reports suggest that increased support for nuclear power is linked to solving the nuclear waste disposal issue. While people in Belgium recognise the important role that nuclear energy plays in reducing greenhouse gas emissions and oil dependency and in diversifying energy sources, the public also has some misconceptions. For example, some people do not have correct information on the final treatment of radioactive waste, still thinking that waste is sent for final disposal to other countries or dumped in the sea. The government needs to put further efforts to present to the public all aspects of nuclear power, with special attention paid to the environmental, climate change, supply security and economic advantages of extending the lifetime of plants.

The lifetime extension of the Belgian nuclear reactors is technically and economically feasible. In other countries, similar reactors are expected to have operating lifetimes of at least 40 years, and in many cases up to 60 years.

Irrespective of whether the phase-out goes ahead as planned, Belgium will need to continue its ongoing programmes for the final disposal of radioactive

waste. It should also continue open discussion with all stakeholders on main issues linked to the nuclear fuel cycle. Ongoing relationships between policy makers, the nuclear industry and society that develop knowledge building and public involvement are essential to grasp all the aspects of nuclear power in a more balanced way.

The decommissioning fund is an issue that requires close attention of the government, regardless of the decision on the nuclear phase-out policy. Governments in IEA countries with nuclear decommissioning funds choose different options to carefully maintain the right balance between the expected return on capital invested and the acceptable level of risk. Some countries like Sweden invest a segregated decommissioning fund in low-risk securities such as Treasury bonds; others choose to closely control the annual expenditures. For example, in France it is the government and in Spain and Hungary the national parliaments that approve the release of funds earmarked for decommissioning and decide on the level of risk with which these funds should be invested. The Belgian government should ensure transparency for managing the decommissioning fund and adequacy of the guarantees for the investments with higher risks.

The policy to phase out nuclear energy may increase the difficulty in replacing an ageing workforce. The SCK.CEN, with the involvement of several universities, plays a key role in maintaining nuclear competences in Belgium that require continued management of sufficient resources. Qualified staff will be needed to conduct and oversee the closure and decommissioning of the commercial reactors, the development, start-up and operation of waste disposal facilities and the continued operation of medical radioisotope production and other nuclear activities.

RECOMMENDATIONS

The government of Belgium should:

- *Further maintain the ability to safely operate nuclear plants after 2015 in the event of* force majeure*, consistent with the law on the nuclear phase-out.*
- *Reconsider the nuclear phase-out policy, taking into consideration security of supply, reduction of GHG emissions and economic efficiency.*
- *Given the importance of reaching national consensus, raise awareness about all aspects of nuclear power, including advantages offered by a lifetime extension of the plants.*
- *Continue to ensure the availability of qualified personnel for the nuclear sector and relevant regulatory bodies.*

INSTITUTIONAL ORGANISATION

Energy R&D policy responsibilities are divided between the federal government, the three regional governments and the linguistic communities, reflecting the country's federal structure (see Chapter 2). The federal government is exclusively responsible for nuclear energy R&D (fusion and fission) while the regions are primarily responsible for developing and implementing policies for non-nuclear energy R&D. The linguistic communities are responsible for basic research at universities. In addition, the federal government also supports non-nuclear R&D through policy support research programmes such as Science for Sustainable Development (SSD). (See Figure 34 for a detailed breakdown of energy R&D responsibilities).

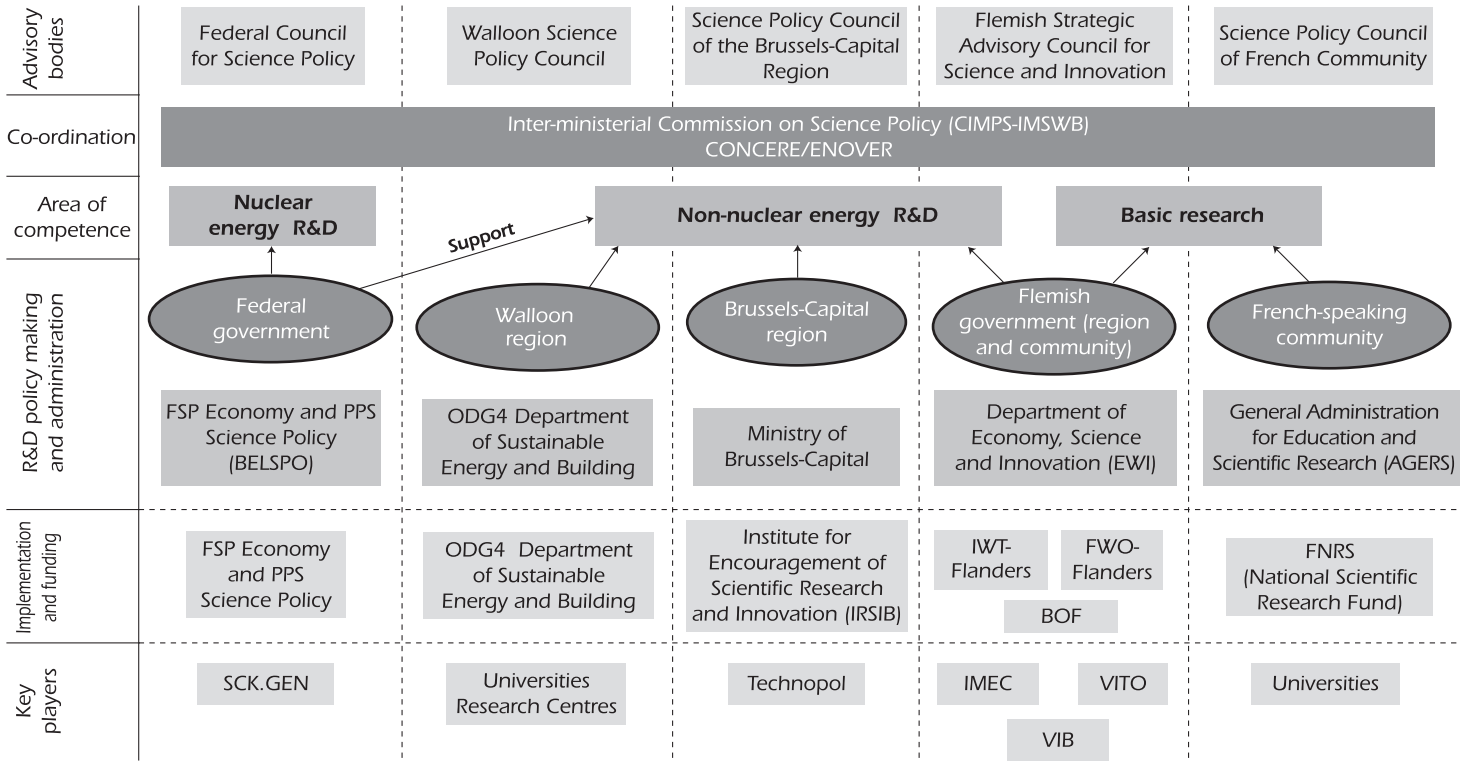
At the federal level, the Minister for Economy, SMEs, Self-Employed and Energy, Agriculture and Scientific Policy determines priorities for science and technology policy linked to its own areas of competence, research in the federal scientific institutes and in particular areas such as Antarctica, Space or Earth System Observation. The minister also develops science and technical institutions' (STI) activities of national and international interest in agreement with the communities and regions. Concerning energy research, the major activities fall under this last type of financing or within research activities of the federal scientific institutes. Other ministers are also responsible for activities related to research and scientific services in their respective areas. The Federal Public Service[83] for Economy, SMEs, Self-employed and Energy (FPS Economy) is the key public authority responsible for developing general guidelines of energy R&D policy as well as for managing and funding nuclear energy research programmes.

Most other federal energy R&D programmes (except nuclear) are managed by the Federal Public Planning Service (PPS) Science Policy, also known as the Belgian Federal Science Policy Office (BELSPO).

83. As noted in Chapter 2, the Federal Public Service (FPS) is equivalent to a ministry. However, responsibilities of ministers do not necessarily coincide with areas covered by FPSs. Each FPS can report to several ministers, and each minister can have several FPSs under his/her authority.

Figure 34

Energy R&D Organisation and Division of Responsibilities



Note: The region of Flanders and the Flemish linguistic community have one common government.

Sources: IEA analysis based on country submission; *European Trend Chart on Innovation, Energy Policies of IEA Countries: Belgium*; IEA Paris, 2005 and other sources.

In Flanders, energy R&D policy is the responsibility of the Minister for Economy, Enterprise, Science, Innovation and Foreign Trade and is executed by the Department of Economy, Science and Innovation (EWI). The Flemish Institute for the Promotion of Innovation by Science and Technology (IWT-*Flanders*) implements industrial R&D policy and distributes funds among businesses and research institutes. The Research Foundation-Flanders (FWO-*Flanders*) implements policy with regard to basic research at universities. In addition, the Special Research Fund (BOF) finances basic science research at universities. VITO, the Flemish Institute for Technological Research, is a specialised research centre that carries out market-oriented technological research, develops products and processes and provides specialised services in the field of energy, the environment and advanced materials. IMEC, the Inter-university Micro-Electronics Centre is an important actor in micro-electronics, nanotechnologies and photovoltaics. The Flanders Inter-university Institution of Biotechnology (VIB) plays an important role in biotechnology research.

In Wallonia, general R&D policy is the responsibility of the Departments of Technology Development, Research Programmes and Financial Management in the General Directorate for Economy, Employment and Research, which was created on 1 August 2008. Since 1999, energy R&D policy has been the responsibility of the Department of Sustainable Energy and Building, which was incorporated in the Operational Directorate-General for Land Management, Housing, Patrimony and Energy (ODG4) on 1 August 2008. Before this date, the Technology Development and Research Department, the Energy Department and their respective Financial Management Departments and Services were gathered in the General Directorate for Technology, Research and Energy. Funding to universities is also provided by the French Community through the General Administration for Education and Scientific Research (AGERS).

The Minister of the Brussels-Capital Regional Government is in charge of all R&D policy in the Brussels region. The Institute for the Encouragement of Scientific Research and Innovation of Brussels (IRSIB) implements the R&D policy. Technopol Brussel-Bruxelles is a non-profit organisation financed by the regional government to support technology transfer and innovation development with the co-operation of all science, technology and economic and public actors in the region.

All the federal entities have established advisory bodies that involve various stakeholders and provide recommendations to the authorities on energy R&D policy making.

CO-OPERATION AND CO-ORDINATION

The dispersed institutional structure unavoidably leads to some fragmentation of the overall Belgian R&D policy. Therefore, efforts have been made to establish mechanisms for collaboration at several levels including:

- Co-ordinating R&D efforts between different federal entities (regions, communities and the federal state);
- Building the link between basic science and energy R&D; and
- Enhancing co-operation between public authorities and the private sector.

The key platform for R&D co-operation between the regions, communities and the federal state is the Interministerial Conference on Science Policy (IMCSP) and its two permanent committees: the International Co-operation Commission (CIS) and the Federal Co-operation Commission (CFS). The CIS-ENE is the subcommittee that deals with energy research, development and technology issues. The Energy Consultation platform CONCERE/ENOVER has also established a working group dedicated to energy technology R&D.

In addition, there are a number of joint R&D programmes that involve players from different federal entities. For example, the Belgian Inter-university Platform on the Reliability of the Networks (BE PRONE) aims at achieving synergy and better co-ordination between university research centres, the FPS Economy, the energy regulator CREG, the TSO ELIA and other players. The key objectives of BE PRONE are to:

- Contribute to the security of supply by providing R&D support to the institutions in charge of power grids;
- Provide the authorities with guidelines for monitoring the reliability of and the investments in the transmission system; and
- Enable universities to maintain a high level of know-how in the field of electricity grids.

The federal government and the regions co-fund, jointly with industrial companies, sectoral collective research centres meeting specific scientific and technological research needs of the companies. The federal and regional authorities also co-operate with regard to the legal framework for intellectual and industrial property and standardisation.

Through a series of incentives such as grants, loans, technical and economic assistance and sectoral studies, the Belgian regions stimulate technological innovation in industrial research and co-operation between industry and universities. For example, in 2005 the Walloon region and the French community launched the Marshall Plan for Research which enables universities, enterprises and training centres to work together on themes of industrial development in so-called "clusters of competitiveness". In the Flemish region, the co-operation and co-ordination between industrial actors and researchers are stimulated through the so-called Flemish Co-operation Innovation Networks. In the energy field, two thematic innovation networks were established. The network "Generations" and the Flemish Innovation Network on Hydrogen and Fuel Cells bring together a number of companies and research institutes

to stimulate information dissemination and innovation in renewable energy technologies and hydrogen and fuel cells. In addition, an Environmental and Energy Technology Innovation Platform (MIP) was established in 2004 to stimulate co-operative projects related to the sustainable use of energy and materials.

R&D STRATEGY AND FUNDING

Each region builds its energy R&D strategy on the basis of its own priorities, the key objective being the support of the scientific, economic and social development of the region. Public support for R&D projects is generally given only if these projects are based in the region or have a large participation of regional partners. At the federal level, the majority of energy R&D is directed at nuclear energy, which is one area of federal competence. Only small amounts of funding go to R&D programmes that would support other strategic objectives of the federal government, such as energy security.

The total public budget for energy R&D was EUR 97 million in 2007, an increase of nearly 80% compared to 1999 (Table 21). This represents approximately 0.03% of Belgian GDP, compared to the IEA average of 0.04%.[84] While the federal (nuclear) spending has grown only slightly, the growth at the regional level has been impressive: the Walloon budget[85] more than doubled and the Flemish one more than tripled between 1999 and 2007. In 2007, nearly half of the total public energy R&D funding in Belgium was spent on nuclear R&D, one-quarter on energy efficiency and 16% on renewables (Figure 35).

Table 21

Public Funding for Energy R&D (EUR million)

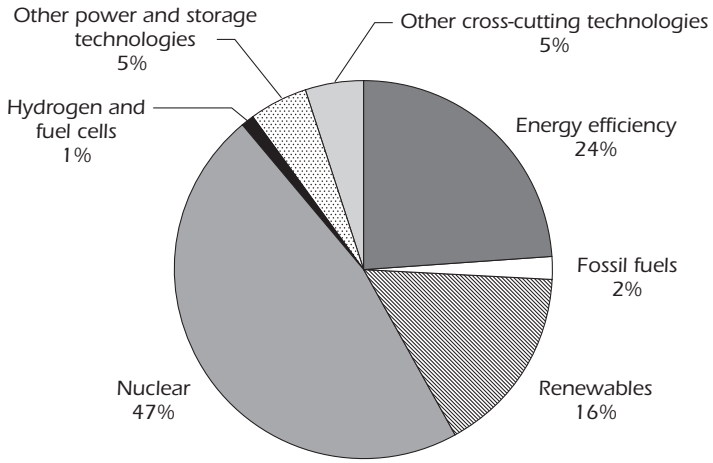
	1999	*2003*	*2007*
Federal (nuclear)	37.5	43.2	44
Wallonia	8.7	10.1	22
Flanders	8.4	23.4	30
Brussels-Capital	–	–	1
Total	**54.1**	**76.7**	**97**

Source: FPS Economy.

84. The IEA average does not include Australia, Greece, Luxembourg, the Netherlands, Poland and Slovakia because data are not available.
85. In Wallonia, the annual energy research spending stayed around EUR 8–10 million until 2006. In 2007, there was a significant increase of some 220% compared with 2006.

Figure 35

Public Funding for Energy R&D by Area, 2007



Source: Country submission.

There are various systems of financial support for research in Belgium. Part of the budget is directly allocated to the researchers by the competent state and federated administrations. The remainder is granted indirectly, by funds or autonomous funding institutions. In 2005, Belgium introduced a series of tax incentives designed to lower salary costs of researchers and reduce research costs for companies.

In Flanders, the overall funding policy of funding agencies is based on a bottom-up approach, where research projects are proposed by the players without thematic restrictions. However, the IWT-Flanders gives priority to "Sustainable Technological Development" projects, which foster energy efficiency and renewable energy sources. On the other hand, the strategic research institutes (VITO and IMEC) use a thematic approach, based on the R&D priorities identified by consultative process. The thematic, or top-down, approach is also used in implementing the so-called "spearhead policy", *i.e.* identification and promotion of technological clusters. Flanders currently gives priority to five energy clusters: PV, wind, hydrogen and fuel cells, biofuels, and smart grids.

Wallonia also uses both bottom-up and top-down approaches. In the first case, enterprises and research institutions propose projects based on their priorities. In the second case, the Walloon region regularly launches calls for proposals on specific thematic priorities of research, named *"Programmes mobilisateurs"*. The priorities are set up in co-operation with Walloon R&D stakeholders. Universities, technical schools, research centres and enterprises are invited to participate. In 2007, many calls for projects were launched in the framework of the Marshall Plan for Research, discussed above. As a result, funding for energy efficiency and renewable energy rose significantly.

Overall, both Flanders and Wallonia spend the bulk of their R&D funding on renewables and energy efficiency, which corresponds to the priorities of their general energy policy. Interestingly, the largest share of the total funding for renewable energy (89% in Flanders and nearly 50% in Wallonia) is dedicated to solar photovoltaics (PV). It can be questioned, however, whether this technology is the most promising from the point of view of energy policy given that annual solar irradiation is less than 1 200 kWh/m^2.[86] The large share of PV in the R&D portfolio reduces funding for other technologies.

Brussels-Capital's research budget is very small. However, the region's research centres, universities and companies are active in broader EU programmes. Total public funding of energy R&D was EUR 0.9 million in 2005 and EUR 0.7 million in 2006, rising to over EUR 1 million in 2007. It focused on energy production, retail and rational use of energy.

MONITORING AND EVALUATION

The regions and the federal government regularly evaluate their energy R&D programmes. The requirements and framework for monitoring and evaluation vary among federal entities and also among various research institutions.

Evaluating R&D policies and programmes is challenging in most countries because of difficulties related to data collection. In Belgium, this task is particularly difficult because of the lack of consistent and coherent data on the funding and the results of various R&D programmes in the whole country. While the regions collect information on R&D spending, there remain difficulties in compiling these fragmented sets of data at the national level.[87]

ENERGY R&D PROGRAMMES

FEDERAL

Non-nuclear[88] energy R&D programmes at the federal level are relatively small and limited to non-technological research projects. On 4 March 2005, the Council of Ministers approved the research programme, Science for Sustainable Development 2005-2009 (SSD).[89] This programme is managed by the Belgian Federal Science Policy Office (BELSPO). Energy is one of the priority areas of

86. "Photovoltaic solar electricity potential in European countries", European Commission Joint Research Centre, 2006.
87. The IEA collects statistics on public RD&D spending in IEA member countries but Belgium has not consistently provided information.
88. Nuclear R&D programmes are discussed in detail in the following section.
89. SSD continues the first and second Scientific Support Plans for Sustainable Development Policy (SPSD I 1996-2001 and SPSD II 2000-2005).

SSD, and energy-related projects focus on climate change, energy efficiency, renewable energy and the organisation of energy systems over the medium and long term. Nine projects are currently financed, covering a wide range of analyses like the effect of balancing wind on the grid, impacts of introducing biofuels in the Belgian transport system, the potential contribution to climate, energy and economic policies of bioenergy from agriculture, the development of an integrated sustainability assessment of Belgian long-term energy systems, the development of an economic-environmental model assessing possible pathways for CCS development in Belgium. The Royal Belgian Institute of Natural Sciences, a federal research institute, is involved in this last project and has developed expertise on CCS within the group GeoEnergy. Moreover, the General Directorate for Energy of the FPS Economy carries out studies on the reliability and optimisation of electricity grids.

FLANDERS

Energy efficiency and renewable energy (with a strong focus on solar PV) are key areas of R&D policy in Flanders. The two Strategic Research Institutes in the field of Energy, the Flemish Institute for Technological Research (VITO) and the Inter-university Micro-Electronics Centre (IMEC) receive large shares of government funding. Energy research activities of the IMEC concentrate on solar PV cells. VITO carries out market-oriented technological research, develops products and processes, and provides specialised services in the field of energy, the environment and advanced materials. VITO also has a considerable portfolio of policy supporting activities in the field of energy and environment for both the Flemish and the federal governments.

Electric power and storage technologies will become more important in Flemish future R&D policy. "Smart Systems for Intelligent Energy Networks" is the programme set up at VITO, focusing on smart grids and flexibility of grid-connected systems (including appliances, generation and storage). Biofuels, including third-generation, are an important theme of current VITO research in the area of "sustainable chemistry". VITO also provides services for other countries in the areas of CCS (geological modelling, seismographical analyses) and geothermal energy. In 2004 the Flemish government set up an Environmental and Energy Technology Innovation Platform (named MIP), to boost innovation in environmental and energy technology. In 2008 the focus of the MIP was reoriented towards projects related to sustainable use of energy and materials. From 2009 onwards, VITO will host the MIP.

Recently the Flemish government has identified strategic technological clusters and funded five "Green Technology" initiatives in 2009. The first three initiatives were funded via the Flemish Co-operation Network "Generations" (a network of companies and research institutes involved in renewable energy technologies), namely the Photovoltaic Initiative, the Wind Energy Initiative

and the Smart Grid Initiative. These initiatives are public-private partnerships with considerable co-financing from the private sector. Governmental funding was about EUR 8.7 million (Photovoltaic Initiative), EUR 5 million (Wind Energy Initiative) and EUR 9.5 million (Smart Grid Initiative). The two other initiatives are Interreg IV-projects. The project "Hydrogen Region Flanders-the Southern part of the Netherlands" receives co-financing from the Flemish government of EUR 3.6 million. The Interreg project "Biobase Europe" focuses on the production of bioenergy and bioproducts from renewable biomass resources and receives Flemish co-financing of EUR 7 million.

Whereas the Flemish Co-operation Network "Generations" focuses on energy technologies, the focus of the MIP is on environmental technology. In February 2009, the Flemish Smart Grid Platform was established. The objective of the platform is to facilitate and stimulate commercial breakthroughs in the field of smart grids, via the establishment of multi-disciplinary and cross-sectoral co-operation between all the Flemish actors in the field of smart grids (companies and research institutes).

WALLONIA

As in Flanders, renewables and energy efficiency are the key areas of public R&D support in the Walloon region. In recent years, R&D has had a particular focus on buildings: solar heating and cooling, natural and artificial lighting, micro-CHP and heat pumps. Another policy priority is solar thermal and, more recently, PV. The Walloon region invests in long-term research for thin-film solar cells, dye-sensitised solar cells and plastic solar cells. Small hydro and biomass (combustion, gasification, biomethanisation, biofuel from lignocellulosics) are other important areas of Walloon R&D. For example, public funds granted in 2007 enabled the development of a 500 kW hydro-generator floating on a river.

Wallonia also provides some support for emerging technologies for fossil fuel combustion. In comparison with the previous years, funding levels for hydrogen and fuel cells have declined.

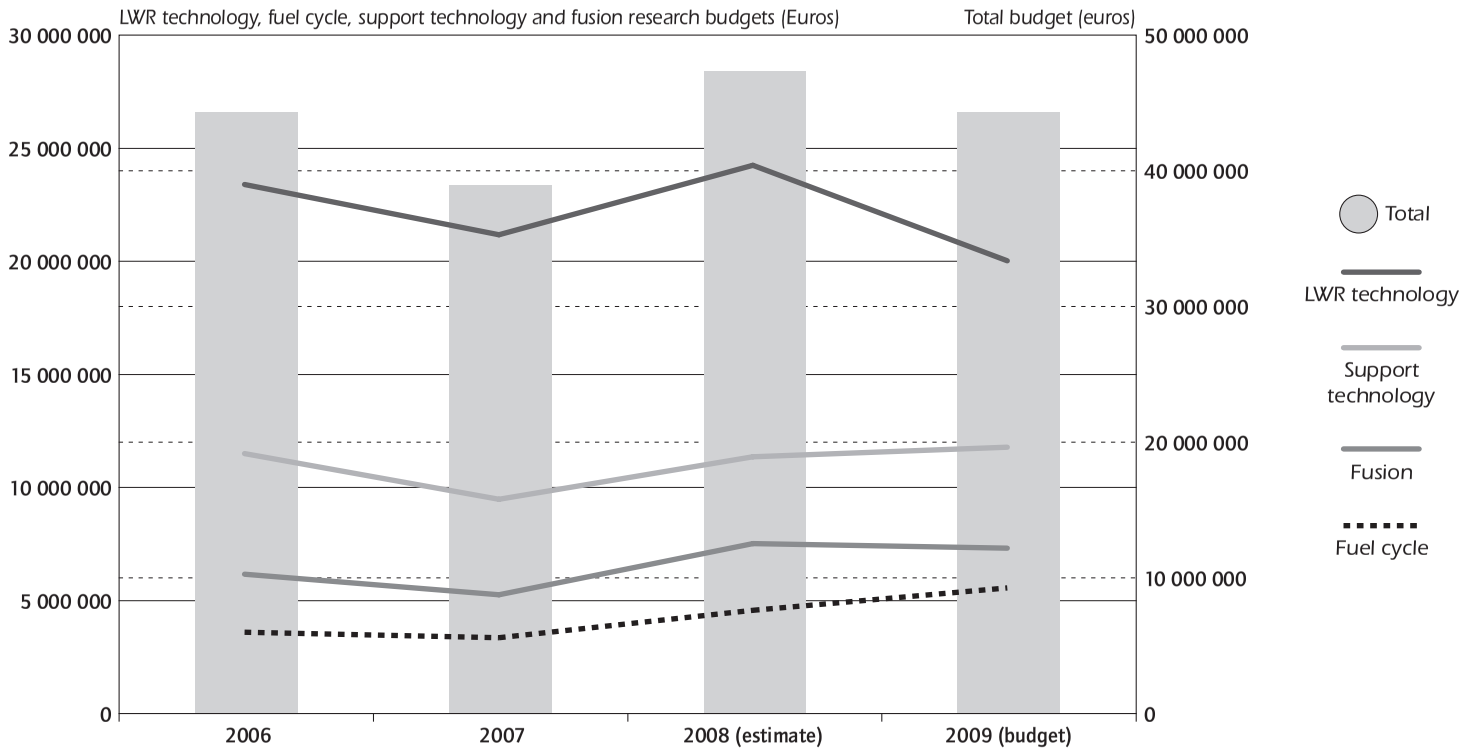
NUCLEAR R&D PROGRAMMES

Most of the nuclear research in Belgium is carried out at the National Nuclear Research Centre, SCK.CEN, located in Mol. The Centre works under the supervision of the Ministers of Economy and Energy.

Being a research centre for nuclear energy and ionising radiations, SCK.CEN also provides training and other services to the nuclear industry, the medical sector and the authorities, and promotes public awareness of nuclear technology.

Figure 36

R&D Budget for Nuclear Fission and Fusion Activities, 2006 to 2009



LWR = light-water reactor.
Source: Country submission.

Figure 36 shows the state budget for nuclear energy R&D in 2006-2009. The research areas for SCK.CEN are authorised by Royal Decree. The first priority is to maintain the safety of the nuclear power plants. This involves research of the ageing of their main components and the safety aspects of fuel development. The work is carried out in co-operation with Tractebel Engineering, the nuclear engineering company of Electrabel.

The second priority is to find an appropriate solution for the long-term management of the long-lived medium- and high-level radioactive wastes. The most advanced solution is geological disposal. In Belgium, the R&D programmes on waste management are defined by the National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) in consultation with SCK.CEN and the nuclear facilities.

SCK.CEN is working on the transmutation of high-level radioactive wastes, in order to reduce its volume and to shorten its lifetime. For this purpose, SCK.CEN built a research reactor, called Myrrha, an accelerator-driven system (ADS) cooled with lead-bismuth. Myrrha is also seen as a key element of the European Research Area on Experimental Reactors, serving as the basis within the EC-integrated project Eurotrans. At the end of this project, the conceptual design of the machine will be available. The purpose of Myrrha is to improve nuclear safety, to develop innovative materials for future energy systems that are under development in the Generation IV International Forum, to study the transmutation of high-level radioactive waste, to support training of nuclear specialists and fundamental research, and to produce medical radioisotopes.

As the Myrrha project would require an investment of about EUR 960 million, a considerable part of its investment cost is expected to be covered by the Belgian government. The government has asked the OECD Nuclear Energy Agency (NEA) to perform an independent evaluation of the project and will take a decision when the results of the evaluation are available.

The fusion research of SCK.CEN focuses on the radiation effects on materials used in a fusion reactor and on diagnostic and remote-handling sensing systems. The long-term programme elaborated in the framework of Euratom on the effects of ionising radiations, emergency planning and effects on the environment are other important aspects of the Belgian R&D activities.

Further R&D activities of SCK.CEN focus on:

- severe accident management through the European Severe Accident Research Network of Excellence (SARNET);
- advanced safety evaluation methodologies and guidelines for probabilistic safety assessments;
- development of innovative reactors through the Euratom framework programmes.

Several universities are involved in nuclear research, mostly in synergy with the activities of SCK.CEN and the Euratom framework programmes, or on request from industry. The most important institutes are the Université catholique de Louvain-la-Neuve, participating in the Nuclear Reactor Integrated Simulation Project (NURISP) and in materials research; the Université de Liège, which is involved in the Actinide re-Cycling by Separation and Transmutation Project (ACSEPT) and the Université Libre de Bruxelles, which is involved in materials research. The Laboratory for Plasmaphysics of the Royal Military Academy is a leading association in fusion R&D being involved in plasma heating by ion-cyclotron resonance waves, confinement studies and plasma modelling for the international thermonuclear experimental reactor (ITER).

As for industry, Tractebel Engineering (Suez-Tractebel) develops and executes a number of research activities, mainly in the area of lifetime management for operating reactors. These activities are mostly driven by commercial interests and focus on the ageing of nuclear power plant components.

INTERNATIONAL COLLABORATION

Belgium currently participates in 13 IEA Implementing Agreements (IA). Most recently, Belgium became a signatory to the Implementing Agreement on Industrial Energy-Related Technologies and Systems (2007); the Implementing Agreement for Electricity Networks Analysis, Research and Development (2006); and the Implementing Agreement for a Co-operative Programme on Ocean Energy Systems (2006).

The Flemish Institute for Technological Research (VITO) is a signatory to the Implementing Agreement for a Programme of Research, Development and Demonstration on Advanced Fuel Cells and to the Implementing Agreement for Co-operation on Hybrid and Electric Vehicle Technologies and Programmes. The University of Ghent participates in the Implementing Agreement for Co-operation on Technologies and Programmes for Demand-Side Management. Moreover, Belgium participates in the European Technology Platforms on Smart Grids, Photovoltaics, and Carbon Capture and Storage, as well as in the Joint Technology Initiative on Fuel Cells and Hydrogen.

The fusion research is largely carried out within the framework of the Euratom programmes and other international platforms. The SCK.CEN is a member of the European Sustainable Nuclear Energy Technology Platform (SNE-TP) launched in 2007.

CRITIQUE

The Belgian science and innovation system, including energy R&D, is strong, although fragmentation in the governance of the system somewhat reduces its effectiveness. Belgium's 2007 energy R&D budget of EUR 97 million is a large increase from EUR 76.7 million in 2003, a trend to be commended. Budget growth has been particularly impressive at the regional level. However, public spending on energy R&D as a percentage of GDP (0.03%) is still below the IEA average (0.04%).

Energy R&D policy in Belgium has many positive features, including a strong scientific base, tax incentives for innovation by the private sector, and programmes to promote sustainable energy technologies. However, several challenges can be addressed to make the R&D spending more cost-effective and to ensure successful expansion of modern energy technologies through the research chain, from basic research through development, demonstration and deployment to commercial use.

One key prerequisite for this is a well-designed R&D strategy closely linked with the overall energy strategy. At the regional level, R&D priorities and the allocation of budgets are consistent with the priorities of the overall regional energy policy. Thus, the majority of total R&D spending in Wallonia and Flanders are allocated to renewable energy and energy efficiency; these two areas being priority policy directions for both regions.

When looking at the total Belgian R&D budget, it is not very clear if there is a strong consistency between the country's energy policy objectives and the energy R&D strategy. For example, offshore wind development is one of the priority goals for the federal government; but this is not sufficiently reflected in the federal R&D programmes. The government should therefore seek to enhance consistency between its energy policy and energy R&D programmes. To achieve this, stronger co-operation between energy and industry administrations and between science and technology administrations will be necessary. This would result in more cost-effective funding and more successful deployment of new energy technologies.

Because of the federal structure of Belgium, gaps and overlaps between R&D efforts are unavoidable. Although commendable efforts have been made with the creation of the Inter-ministerial Commission on Science Policy, the R&D group within CONCERE/ENOVER and the Belgian Inter-university Platform on the Reliability of the Networks (BE PRONE), it remains critical that Belgium further enhance information exchange, co-ordination and co-operation in areas of common interest in order to improve synergies and maximise the benefit in spite of limited human and financial resources.

Current efforts at the regional level to enhance public-private partnerships and to foster science-industry linkages are also laudable and should be developed further. The regional governments could further strengthen the efforts to link basic science, R&D and demonstration and deployment of energy technologies, particularly given the fact that responsibilities for all these areas are divided between different ministries and different levels of government.

Taking into account that total financial resources dedicated to energy R&D are limited, it is essential to clearly identify strategic choices and carefully monitor and evaluate the results of the implemented programmes. It is questionable whether the current R&D budgets in Belgium are allocated in the most cost-effective way. For example, both Flanders and Wallonia give significant support to R&D on photovoltaics, although it is not the energy technology with the greatest potential in Belgium. In addition, the large share of PV in the R&D portfolio reduces funding and potentials for other technologies. It is important that the regional and federal governments further develop and apply methods to review energy R&D policies and spending, to ensure that they are in line with overall energy policies, and that they will bring long-term benefits to the regions and the country.

A major impediment to effective cost-benefit analysis – and the ultimate optimisation – of R&D programmes is the lack of reliable data on R&D activities, funding and the allocation of that funding. The federal and regional governments should enhance efforts in the area of R&D data collection and exchange.

The federal government has conducted a socio-economic analysis on CCS in co-operation with both regions and the Netherlands. Considering the current interest in CCS among IEA member countries, this is a commendable development. Belgium is encouraged to implement R&D projects based on those results through closer interregional and international co-operation.

The government should be praised for maintaining nuclear-related R&D with a view to ensuring reliable and safe operation of nuclear power plants. Nuclear R&D contributes to maintaining the nuclear option in Belgium as long as it is allowed by law, thus contributing to the country's energy security. It is important to maintain the existing strong expertise of Belgium in nuclear R&D taking into consideration the country's strategic priorities (such as energy security and climate change mitigation) and the potential role of Belgium on the international R&D scene. In the present context of the pending nuclear phase-out decision, the key R&D priorities are to maintain the safety of the nuclear power plants and to find an appropriate solution for the long-term management of the long-lived medium- and high-level radioactive wastes. In the longer term, R&D on nuclear fusion contributes to the possible diversification of electricity generation.

On a more general note, Belgium's active participation in IEA Implementing Agreements and other international programmes and platforms is noteworthy. International co-operation is an effective way to optimise R&D spending and avoid duplication. Belgium could even further enhance its international activities, not only on CCS, but also on offshore wind, second- and third-generation biofuels and other priority areas.

RECOMMENDATIONS

The government of Belgium should:

- *Enhance information exchange, co-operation, and co-ordination among regional governments and other energy R&D players in the areas of common interest, such as energy efficiency and renewables-related R&D.*
- *Enhance co-ordination between the offices responsible for energy/industry policy and science/technology policy to ensure the consistency between energy policy and energy R&D programmes.*
- *Improve the collection of data on energy R&D funding and the allocation of that funding.*
- *Further promote international R&D co-operation, particularly in the case of CO_2 capture and storage.*
- *Promote nuclear R&D capability, carefully evaluate programme requirements and continue to adequately fund the National Nuclear Research Centre, as it is an important contributor to international R&D efforts.*

PART III

ANNEXES

ORGANISATION OF THE REVIEW

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 IEA. The *Shared Goals* are set out in Annex C.

REVIEW TEAM

The in-depth review team visited Brussels from 23 to 27 March 2009. The team met with government officials, energy suppliers, interest groups and various other organisations. This report was drafted on the basis of these meetings, the government response to the IEA energy policy questionnaire and other information. The team is grateful for co-operation and hospitality of the many people it met during the visit. Thanks to their openness and candour, the visit was highly productive and enjoyable. In particular, the team wishes to thank the staff of the Directorate-General for Energy of the Federal Public Service Economy, SMEs, Self-employed and Energy for their professionalism and hard work in preparing and co-ordinating the review process.

The team members were:

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Ms. Barbara Buchner
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Ms. Maria Sicilia,
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Ms. Elena Merle-Beral,
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Elena Merle-Béral managed the review and drafted most of the report. Barbara Buchner drafted Chapter 3, Maria Sicilia drafted Chapter 7 and Pal Kovacs drafted the majority of Chapter 8 and the section on nuclear R&D in Chapter 9. Most of the section on oil in Chapter 5 was drafted by Jason Elliott who conducted the Emergency Response Review of Belgium. Teresa Malyshev finalised the report and prepared it for publication.

The report also benefited from comments of many IEA experts including Richard Baron, Hugo Chandler, Anne-Sophie Corbeau, Ian Cronshaw, Paolo Frankl, David Fyfe, Rebecca Gaghen, Hiroshi Hashimoto, Neil Hirst, Nigel Jollands, Tom Kerr, Eduardo Lopez, David Martin, François Nguyen, Samantha Olz, Sara Piskor, Cedric Philibert, Carrie Pottinger, Brian Ricketts, Wouter van der Goot and Aad van Bohemen.

Monica Petit and Bertrand Sadin prepared the figures. Karen Treanton, Yasmina Abdelilah, Erdinç Pinar and Alex Blackburn provided support on statistics. Viviane Consoli provided editorial assistance.

ORGANISATIONS VISITED

The team held discussions with the following energy and environment stakeholders:

Government institutions

- Federal Public Service Economy, SMEs, Self-employed and Energy (FPS Energy)
- Federal Planning Bureau (FPB – BFP)
- Federal Public Planning Service for Science Policy (PPS Science Policy, also known as BELSPO)
- Federal Public Service Health, Food Chain Safety and Environment
- National Bank of Belgium (NBB – BNB)
- Brussels' Institute for Environmental Management (IBGE – BIM)
- Flemish Energy Agency (VEA)
- Flemish Department for Economy, Science and Innovation
- Flemish Department for Environment, Nature and Energy (LNE)
- Public Service for Wallonia (SPW), Department for Energy and Sustainable Construction
- Walloon Agency for Air and Climate

Energy regulators

- Gas and Electricity Regulatory Commission (CREG, rhe federal energy regulator)
- Commission for Energy Regulation in the Brussels-Capital Region (Brugel)
- Flemish Regulation Entity for Electricity and Gas (VREG)
- Walloon Commission for Energy (CWaPE)

Other stakeholders

- Aanbieders.be
- ABVV-FGTB Algemeen Belgisch Vakverbond
Fédération Générale du Travail Belge
General Federation of Belgian Labour
- ACLVB-CGSLB Algemene Centrale der Liberale Vakbonden van België
Centrale Générale des Syndicats Libéraux de Belgique
General Confederation of Liberal Trade Unions of Belgium
- ACV-CSC Algemeen Christelijk Vakverbond
Confédération des Syndicats Chrétiens
Confederation of Christian Trade Unions
- Agoria Employers' federation of the technology industry
- BBL Bond Beter Leefmilieu
Flemish umbrella organisation for environmental and nature associations
- Distrigas
- Econotec
- Electrabel
- ELIA Electricity transmission system operator
- Energie en Armoede, Samenlevingsopbouw
- Essent Belgium
- Evelop
- FANC-AFCN Federaal Agentschap voor Nucleaire Controle
Agence Fédérale de Contrôle Nucléaire
- FEBEG Federatie van de Belgische Elektriciteits- en Gasbedrijven
Fédération Belge des Entreprises Electriques et Gazières
Belgian Federation of Electricity and Gas Companies

- FEBELIEC Federation of Belgian Large Industrial Energy Consumers
- FLUXYS Gas transmission system operator
- Greenpeace
- IEW Inter-Environnement Wallonie
- Kansarmoede
- Netwerk Bewust Verbruik
- Nuon Belgium
- SPE/Luminus
- SYNERGRID Federation of electricity and natural gas network operators
  Royal Belgian Institute of Natural Sciences
- WWF World Wildlife Fund

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

	1973	1990	2006	2007	2010	2020	2030
TOTAL PRODUCTION	**6.5**	**13.1**	**13.8**	**14.4**	**14.6**	**12.6**	**3.9**
Coal	6.4	1.2	0.0	–	0.0	0.0	0.0
Peat	–	–	–	–	–	–	–
Oil	–	–	–	–	–	–	–
Gas	0.0	0.0	–	–	–	–	–
Comb. Renewables & Waste[1]	0.0	0.8	1.5	1.6	1.9	2.5	2.9
Nuclear	0.0	11.1	12.2	12.6	12.5	9.4	–
Hydro	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind	–	0.0	0.0	0.0	0.2	0.5	0.7
Geothermal	–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Other[2]	–	0.0	0.1	0.1	0.0	0.1	0.2
TOTAL NET IMPORTS[3]	39.5	35.1	44.4	41.6	41.1	42.9	47.5
Coal Exports	0.8	1.1	0.8	1.0	..	..	..
Imports	5.3	10.7	5.4	5.0	4.8	6.3	10.6
Net Imports	4.6	9.6	4.6	4.1	4.8	6.3	10.6
Oil Exports	14.9	19.0	24.1	24.7	..	..	..
Imports	46.4	41.6	57.0	56.6	29.4	29.0	29.0
Int'l Marine and Aviation Bunkers	3.6	5.0	9.4	10.2	9.3	10.4	11.4
Net Imports	27.9	17.6	23.5	21.7	20.1	18.6	17.6
Gas Exports	–	–	–	–	–	–	–
Imports	7.1	8.2	15.0	14.9	15.4	16.4	17.4
Net Imports	7.1	8.2	15.0	14.9	15.4	16.4	17.4
Electricity Exports	0.2	0.7	0.7	0.8	..	..	..
Imports	0.1	0.4	1.6	1.4	0.5	1.1	1.3
Net Imports	–0.1	–0.3	0.9	0.6	0.5	1.1	1.3
TOTAL STOCK CHANGES	**–0.0**	**0.1**	**–0.1**	**1.0**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)[4]	**46.0**	**48.2**	**58.1**	**57.0**	**55.7**	**55.5**	**51.4**
Coal	11.2	10.6	4.8	4.2	4.8	6.4	10.6
Peat	–	–	–	–	–	–	–
Oil	27.7	17.9	23.3	22.5	20.1	18.6	17.6
Gas	7.1	8.2	15.0	14.9	15.4	16.4	17.4
Comb. Renewables & Waste[1]	0.0	0.8	1.9	2.1	2.2	3.0	3.5
Nuclear	0.0	11.1	12.2	12.6	12.5	9.4	–
Hydro	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind	–	0.0	0.0	0.0	0.2	0.5	0.7
Geothermal	–	0.0	0.0	0.0	0.0	0.0	0.0
Solar/Other[2]	–	0.0	0.1	0.1	0.0	0.1	0.2
Electricity Trade[5]	–0.1	–0.3	0.9	0.6	0.5	1.1	1.3
Shares (%)							
Coal			*24.3*	*21.9*	*8.2*	*7.4*	*8.7*
11.4	*20.7*						
Peat	–	–	–	–	–	–	–
Oil	*60.2*	*37.1*	*40.0*	*39.4*	*36.0*	*33.5*	*34.3*
Gas	*15.5*	*16.9*	*25.8*	*26.2*	*27.6*	*29.6*	*33.9*
Comb. Renewables & Waste	–	*1.6*	*3.3*	*3.6*	*4.0*	*5.4*	*6.8*
Nuclear	–	*23.1*	*20.9*	*22.0*	*22.4*	*17.0*	–
Hydro	–	–	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Wind	–	–	*0.1*	*0.1*	*0.4*	*0.9*	*1.4*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	*0.1*	*0.1*	–	*0.2*	*0.3*
Electricity Trade	*–0.1*	*–0.7*	*1.5*	*1.0*	*0.9*	*2.0*	*2.5*

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

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2006	2007	2010	2020	2030
TFC	**33.7**	**32.0**	**40.7**	**39.6**	**40.8**	**42.0**	**41.9**
Coal	5.7	3.5	1.0	1.0	2.3	2.1	2.0
Peat	–	–	–	–	–	–	–
Oil	20.2	16.1	20.4	19.7	18.6	17.3	16.6
Gas	4.6	6.8	10.9	10.6	9.8	10.3	10.5
Comb. Renewables & Waste[1]	–	0.4	0.8	0.8	0.8	1.3	1.3
Geothermal	–	–	–	–	0.0	0.0	0.0
Solar/Other	–	0.0	0.0	0.0	0.0	0.1	0.2
Electricity	2.9	5.0	7.1	7.1	7.7	8.9	9.3
Heat	0.3	0.2	0.5	0.4	1.6	1.9	2.2
Shares (%)							
Coal	*16.9*	*11.0*	*2.6*	*2.5*	*5.6*	*5.0*	*4.7*
Peat	–	–	–	–	–	–	–
Oil	*59.8*	*50.2*	*50.1*	*49.6*	*45.7*	*41.2*	*39.6*
Gas	*13.6*	*21.3*	*26.6*	*26.7*	*24.1*	*24.6*	*24.9*
Comb. Renewables & Waste	–	*1.2*	*2.0*	*2.1*	*2.0*	*3.0*	*3.1*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	*0.1*	*0.3*	*0.4*
Electricity	*8.7*	*15.6*	*17.4*	*18.0*	*18.8*	*21.2*	*22.1*
Heat	*0.9*	*0.7*	*1.2*	*1.0*	*3.9*	*4.6*	*5.1*
TOTAL INDUSTRY[6]	**16.8**	**13.6**	**18.2**	**18.2**	**16.1**	**16.1**	**16.0**
Coal	3.5	3.0	0.9	0.9	2.2	2.0	1.9
Peat	–	–	–	–	–	–	–
Oil	7.8	4.3	7.3	7.3	4.6	3.8	3.7
Gas	3.2	3.3	5.6	5.8	3.7	3.8	3.8
Comb. Renewables & Waste[1]	–	0.2	0.6	0.5	0.4	0.4	0.2
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	–	–	–
Electricity	1.9	2.6	3.5	3.5	3.7	4.2	4.3
Heat	0.3	0.2	0.4	0.3	1.5	1.9	2.1
Shares (%)							
Coal	*21.2*	*22.1*	*5.0*	*4.9*	*13.4*	*12.5*	*11.8*
Peat	–	–	–	–	–	–	–
Oil	*46.6*	*31.5*	*39.9*	*39.8*	*28.6*	*23.9*	*22.9*
Gas	*18.8*	*24.3*	*30.6*	*31.6*	*23.0*	*23.8*	*23.9*
Comb. Renewables & Waste	–	*1.4*	*3.3*	*2.9*	*2.4*	*2.2*	*1.1*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	–	–	–
Electricity	*11.5*	*19.3*	*19.0*	*18.9*	*23.1*	*25.9*	*27.1*
Heat	*1.9*	*1.4*	*2.2*	*1.8*	*9.4*	*11.6*	*13.2*
TRANSPORT[4]	**4.4**	**6.8**	**8.4**	**8.5**	**9.1**	**9.6**	**9.8**
TOTAL OTHER SECTORS[7]	**12.6**	**11.6**	**14.1**	**12.9**	**15.6**	**16.3**	**16.1**
Coal	2.2	0.5	0.1	0.1	0.1	0.1	0.1
Peat	–	–	–	–	–	–	–
Oil	8.0	5.1	4.9	4.2	5.2	4.6	4.2
Gas	1.5	3.5	5.3	4.8	6.1	6.5	6.6
Comb. Renewables & Waste[1]	–	0.2	0.2	0.2	0.2	0.3	0.3
Geothermal	–	–	–	–	0.0	0.0	0.0
Solar/Other	–	0.0	0.0	0.0	0.0	0.1	0.2
Electricity	0.9	2.3	3.5	3.5	3.8	4.6	4.8
Heat	–	0.0	0.1	0.1	0.1	0.1	0.1
Shares (%)							
Coal	*17.1*	*4.5*	*0.9*	*0.9*	*0.8*	*0.6*	*0.4*
Peat	–	–	–	–	–	–	–
Oil	*63.8*	*44.1*	*34.5*	*32.3*	*33.7*	*28.5*	*25.8*
Gas	*11.6*	*30.2*	*37.5*	*37.2*	*39.3*	*39.9*	*41.1*
Comb. Renewables & Waste	–	*1.6*	*1.6*	*1.7*	*1.5*	*1.7*	*1.6*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	*0.1*	*0.7*	*1.0*
Electricity	*7.5*	*19.4*	*24.9*	*27.3*	*24.3*	*28.2*	*29.7*
Heat	–	*0.3*	*0.5*	*0.6*	*0.4*	*0.3*	*0.3*

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2006	2007	2010	2020	2030
ELECTRICITY GENERATION[8]							
INPUT (Mtoe)	**10.0**	**17.7**	**19.9**	**20.5**	**22.1**	**21.6**	**18.0**
OUTPUT (Mtoe)	**3.5**	**6.0**	**7.3**	**7.5**	**8.2**	**9.0**	**9.3**
(TWh gross)	40.6	70.3	84.3	87.5	95.5	105.0	108.0
Output Shares (%)							
Coal	*21.7*	*28.2*	*10.9*	*9.5*	*11.2*	*19.7*	*44.1*
Peat	–	–	–	–	–	–	–
Oil	*53.7*	*1.9*	*1.6*	*0.9*	*0.9*	*2.0*	*1.9*
Gas	*23.7*	*7.7*	*27.3*	*29.0*	*30.1*	*31.4*	*37.2*
Comb. Renewables & Waste	*0.3*	*1.0*	*3.7*	*4.2*	*5.0*	*6.8*	*8.5*
Nuclear	*0.2*	*60.8*	*55.3*	*55.1*	*50.1*	*34.4*	–
Hydro	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.3*	*0.3*
Wind	–	–	*0.4*	*0.6*	*2.4*	*5.3*	*8.0*
Geothermal	–	–	–	–	–	–	–
Solar/Other	–	–	–	–	–	–	–
TOTAL LOSSES	**13.1**	**16.5**	**17.7**	**18.4**	**14.9**	**13.5**	**9.5**
of which:							
Electricity and Heat Generation[9]	6.1	11.4	11.9	12.4	11.9	10.3	6.2
Other Transformation	5.6	2.5	3.0	3.1	0.5	0.6	0.6
Own Use and Losses[10]	1.4	2.7	2.7	2.9	2.5	2.6	2.6
Statistical Differences	**–0.9**	**–0.3**	**–0.3**	**–1.0**	**–**	**–0.0**	**–0.0**

INDICATORS

	1973	1990	2006	2007	2010	2020	2030
GDP (billion 2000 USD)	127.87	187.54	258.83	265.96	275.57	335.92	393.71
Population (millions)	9.73	9.97	10.54	10.62	10.58	10.79	10.98
TPES/GDP[11]	0.36	0.26	0.23	0.21	0.20	0.17	0.13
Energy Production/TPES	0.14	0.27	0.24	0.25	0.26	0.23	0.08
Per Capita TPES[12]	4.73	4.84	5.51	5.37	5.27	5.14	4.68
Oil Supply/GDP[11]	0.22	0.10	0.09	0.09	0.07	0.06	0.05
TFC/GDP[11]	0.26	0.17	0.16	0.15	0.15	0.13	0.11
Per Capita TFC[12]	3.47	3.21	3.86	3.73	3.86	3.89	3.82
Energy-related CO_2 Emissions (Mt CO_2)[13]	132.7	107.9	109.6	106.0	104.1	109.1	126.1
CO_2 Emissions from Bunkers (Mt CO_2)	11.2	15.8	29.9	32.5	29.4	32.9	36.0

GROWTH RATES (% per year)

	73-79	79-90	90-06	06-07	07-10	10-20	20-30
TPES	1.1	-0.1	1.2	-1.9	-0.8	-0.0	-0.8
Coal	0.3	-0.7	-4.8	-11.2	4.5	2.7	5.3
Peat	–	–	–	–	–	–	–
Oil	-1.4	-3.1	1.6	-3.3	-3.7	-0.8	-0.5
Gas	4.5	-1.2	3.9	-0.5	1.0	0.7	0.6
Comb. Renewables & Waste	41.7	23.7	5.9	8.7	2.3	3.1	1.5
Nuclear	130.2	12.8	0.6	3.4	-0.2	-2.8	-100.0
Hydro	4.9	1.3	1.9	6.5	-4.2	0.7	-0.7
Wind	–	–	23.9	35.5	67.4	9.3	4.4
Geothermal	–	–	4.4	-25.0	-30.7	–	–
Solar/Other	–	–	30.4	-2.9	-29.3	16.8	3.7
TFC	0.5	-0.8	1.5	-2.7	1.0	0.3	-0.0
Electricity Consumption	4.2	2.6	2.2	0.4	2.4	1.5	0.4
Energy Production	2.7	5.1	0.3	4.3	0.6	-1.5	-11.1
Net Oil Imports	-0.7	-3.7	1.8	-7.9	-2.5	-0.8	-0.5
GDP	2.4	2.2	2.0	2.8	1.2	2.0	1.6
Growth in the TPES/GDP Ratio	-1.3	-2.3	-0.8	-4.9	-1.9	-2.0	-2.4
Growth in the TFC/GDP Ratio	-1.8	-2.9	-0.5	-5.1	-0.2	-1.7	-1.6

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 ambient heat used in heat pumps.

3. In addition to coal, oil, gas and electricity, total net imports also include combustible renewables.

4. Excludes international marine bunkers and international aviation bunkers.

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

6. Industry includes non-energy use.

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

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

9. 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 and 100% for hydro, wind and photovoltaic.

10. 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.

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

12. Toe per person.

13. "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach from the *Revised 1996 IPCC Guidelines*. 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 member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to 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, member countries 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** are 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 respect the Polluter Pays Principle where practicable.

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 member countries wish to retain

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

and improve 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. I**mproved 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 encourages 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

AAU	assigned amount unit (under the Kyoto Protocol)
AFCN	Federal Nuclear Control Agency
APETRA	Agence du Pétrole, public stockholding agency
APX	Amsterdam Power Exchange
bcm	billion cubic metres
BE PRONE	Inter-university Platform on the Reliability of the Networks
Belpex	Belgian electricity spot market
BELSPO	Belgian Federal Science Policy Office
BelV	subsidiary of AFCN
BFP	Federal Planning Bureau
BNEN	Belgian Nuclear Higher Education Network
BOFAS	Belgium's Fund for the Clean-up of Polluted Service Station Soil
bpd	barrels per day; 1 Mt/year is equivalent to about 20 000 bpd
Capsquare	Belgian-French platform for trading of secondary capacity
CCS	CO_2 capture and storage
CCGT	combined-cycle gas turbine
CDM	clean development mechanism
CEPS	Central European Pipeline System
CHP	combined production of heat and power; sometimes when referring to industrial CHP, the term "co-generation" is used
CO_2	carbon dioxide
CONCERE/ENOVER	Energy Consultation Group that includes representatives from regional and federal governments
CREG	Federal Gas and Electricity Regulatory Commission
CWaPE	Walloon Energy Regulatory Commission

DNO	distribution network operator
DSO	distribution system operator
EC	European Commission
ECOSCORE	evaluation of cars based on environmental characteristics
ECS	Electrabel Customer Solutions
EDF	Electricité de France
EEA	European Environment Agency
ELIA	electricity transmission system operator
EU	European Union
EU-ETS	European Union Emissions Trading Scheme
EUR	euro (€)
FAME	fatty acid methyl esters
FAPETRO	Fund for the Analysis of Oil Products
FEDESCO	a federal energy services company that promotes energy efficiency
Fluxys	gas transmission system operator
FORBEG	Forum for the Regulatory Bodies
FPS	Federal Public Services
FRCE/FRGE	Fund for the Reduction of Energy Costs
FWO-Flanders	Fund for Scientific Research in Flanders
g	gram
G8	Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States
GDF	Gaz de France
GDP	gross domestic product
GEMIX	expert group to examine the ideal energy mix in the medium to long term
GHG	greenhouse gas
GW	gigawatt, or 1 watt $\times 10^9$

GWh	gigawatt-hour = 1 gigawatt × 1 hour
H-gas	high-calorie natural gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IMEC	Inter-university Micro-Electronics Centre
IWT-Flanders	Flemish Institute for the Promotion of Innovation by Science and Technology
JI	joint implementation
kg	kilogram, or 1 gram × 10^3
km	kilometre, or 1 metre × 10^3
km^2	square kilometre
ktoe	thousand tonnes of oil equivalent; see "toe"
kW	kilowatt, or 1 watt × 10^3
kWe	kilowatt of electric capacity
kWh	kilowatt-hour = 1 kilowatt × one hour = 1 watt × 10^3 × one hour
kV	kilovolt, or 1 volt × 10^3
L-gas	low-calorie natural gas
LNG	liquefied natural gas
LPG	liquefied petroleum gas
m_2	square metre
mb	million barrels
mcm	million cubic metres
MOX	mixed oxide fuel
Mt	million tonnes
$MtCO_2$	million tonnes of carbon dioxide

$MtCO_2eq$	million tonnes of carbon dioxide equivalent; these values include other greenhouse gases converted to CO_2-equivalents based on their global warming potential
Mtoe	million tonnes of oil equivalent; see "toe"
MW	megawatt, or 1 watt $\times$ 10^6
MW_e	megawatt of electric capacity
MWh	megawatt-hour = 1 megawatt x one hour
NATO	North Atlantic Treaty Organization
NEA	Nuclear Energy Agency, OECD
NESO	National Emergency Sharing Organisation
NGO	non-governmental organisation
NIMBY	"not in my backyard"
NO_x	oxides of nitrogen
NOB	National Oil Board
NUC1	one of two nuclear scenarios of the BFP
NUC2	one of two nuclear scenarios of the BFP
OCGT	open-cycle gar turbine
OECD	Organisation for Economic Co-operation and Development
ONDRAF/NIRAS	National Agency for Radioactive Waste and Enriched Fissile Materials
OPEC	Organization of the Petroleum Exporting Countries
PJ	petajoule, equivalent to about 280 GWh
PPS	Federal Public Planning Services
PRIS	Power Reactor Information System
PSO	public service obligation
PV	photovoltaic
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well

RON	research octane number
RWMO	Radioactive Waste Management Organisation
SCK.CEN	National Nuclear Research Centre
SME	small and medium-sized enterprise
SO_2	sulphur dioxide
SO_x	sulphur oxides
SSD	Science for Sustainable Development
TFC	total final consumption of energy
toe	tonne of oil equivalent, defined as 10^7 kcal
TPA	third-party access; in some regions the term "open access" is used in place of TPA
TPES	total primary energy supply
TSO	transmission system operator
TWh	terawatt-hour = 1 terawatt × 1 hour = 1 watt × 10^{12} × 1 hour
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar ($)
VAT	value-added tax
VIB	Flanders Inter-university Institution of Biotechnology
VITO	Flemish Institute for Technological Research
VPP	virtual power plant
VREG	Flemish Electricity and Gas Regulator
VTN	Zeebrugge-Zelzate/Eynatten pipeline
WACC	weighted average cost of capital

International Energy Agency

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