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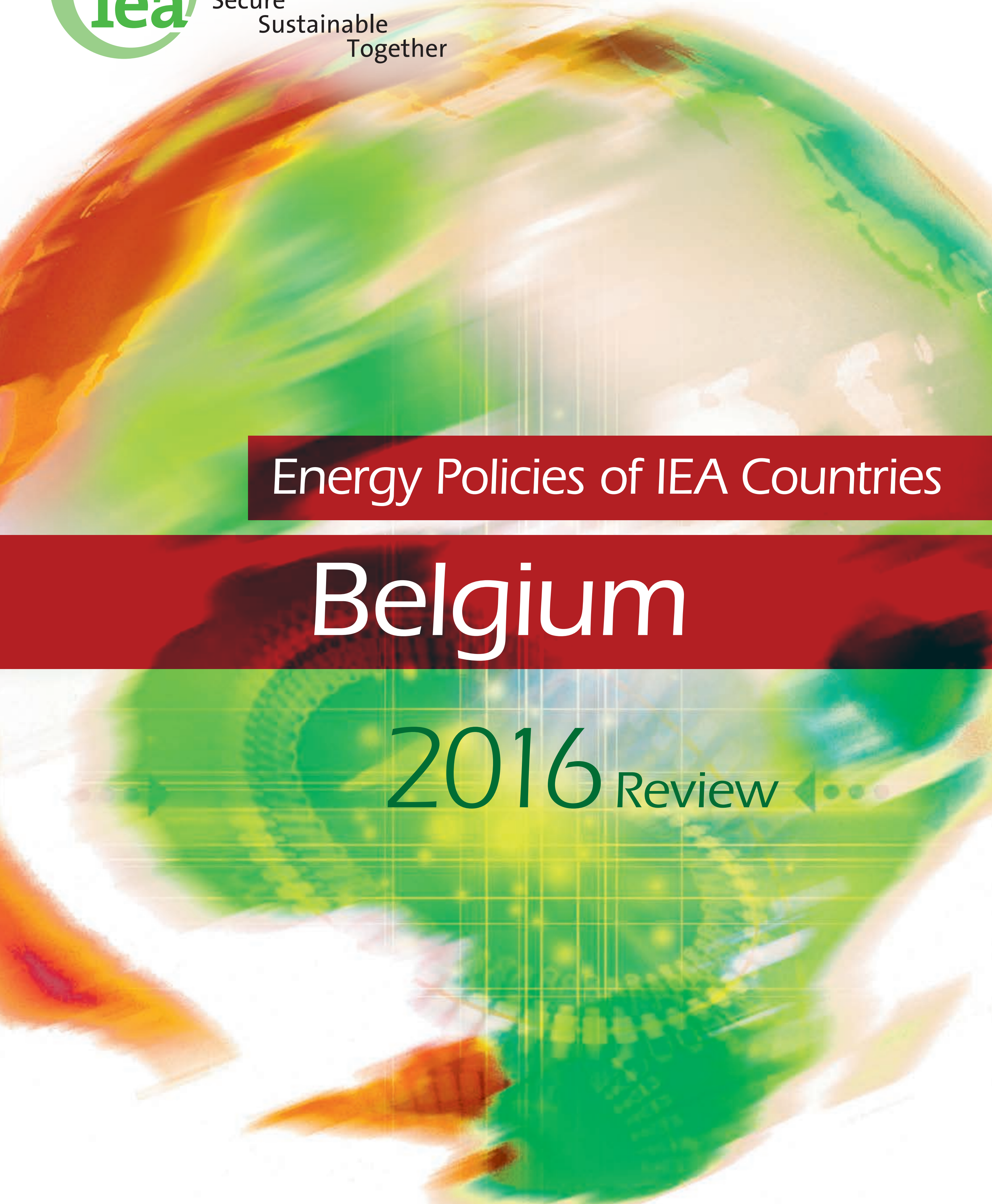

Energy Policies of IEA Countries

Belgium

2016 Review

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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- 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:

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

International Energy Agency
Secure Sustainable Together

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Since the last International Energy Agency (IEA) in-depth review of Belgium's energy policies in 2009, the government (i.e. the federal government and the regional governments) has launched a series of initiatives to meet its policy objectives and European Union (EU) obligations. These initiatives have resulted in, among others: *i*) the successful implementation of the third EU Directives on Electricity and Natural Gas Markets; *ii*) clear progress in developing renewable energy and measures to reduce energy-related CO_2 emissions; and *iii*) significant improvements in planning for emergency response and implementing oil stockholding schemes.

The government has committed itself to competitive electricity and natural gas markets, and competition in the wholesale and retail markets has clearly improved. An increasing number of suppliers have entered the market and the authorities have launched successful awareness campaigns for supplier switching. Electricity market coupling within the Central Western European (CWE) region and the rest of Europe has facilitated the efficient use of cross-border capacity which enables more competition and better security of supply at the regional level. The planned investments in cross-border capacity will improve the situation further.

The three regions of Belgium, which have broad legal authority in energy policy, have adopted numerous policies and measures, including regional climate policy plans; strategies and programmes for low-carbon energy supply; and legislation to transpose the EU Electricity and Natural Gas Market Directives into law.

As Belgium does not have a national energy strategy, the IEA encourages the government to build on these welcome achievements and continue to develop a long-term comprehensive energy policy *i*) by adopting the inter-federal energy vision and energy pact which is now being prepared; and *ii*) by following the principles of transparency, predictability and regulatory certainty in energy policy. In doing so, the government should *iii*) increase the use of models to assess the impacts of possible policy options on security of supply, prices, the economy and the environment in order to *iv*) further diversify energy supply and limit energy demand, in particular through energy efficiency, renewable energy and intensified collaboration and trade with neighbouring countries.

The long-term energy policy framework should enable market players to balance energy security, climate change goals and affordability in line with Belgium's EU and international commitments, taking into account the policy approaches of neighbouring countries. It should also help to ensure a stable investment climate for all energy supply options and energy efficiency as well as foster innovation in clean energy technologies. The federal and regional governments should engage all political parties and relevant stakeholders in jointly developing the energy vision and energy pact to increase their legitimacy.

The IEA also encourages the Belgian government to develop a long-term energy technology strategy to support the energy vision and energy pact with strong co-ordination between federal and regional governments.

The need for a long-term approach in energy policy is underlined by recent concerns over security of electricity supply and by the need to decarbonise the economy in the coming decades.

SECURITY OF ELECTRICITY SUPPLY AND THE NUCLEAR PHASE-OUT POLICY

Nuclear energy accounts for around half of Belgium's electricity generation. In December 2011, the previous government confirmed that it would close the nuclear power plants in conformity with the phase-out law of 2003. This law dictated that the first 1.8 gigawatts (GW), or 30%, of the country's nuclear capacity was to be shut down in 2015, after 40 years of operation. This prospect coincided with unforeseen long outages at two units (2 GW, or one-third of the total) from mid-2012 on. At the same time, wholesale prices were too low, and policy uncertainty perhaps too high, to trigger investments in other baseload capacity.

Security of electricity supply in Belgium thus became heavily under pressure; the previous government and, subsequently, the current one took several measures. These include setting up a strategic reserve in 2014 for the coming winters, increasing the tariff for imbalance and carrying out a national awareness campaign to save electricity. Following the approval of the Nuclear Safety Authority, the government also extended the long-term operation (LTO) of the three oldest nuclear power plant (NPP) units from 2015 to 2025, the first in 2012 and the other two in 2015. This helped alleviate immediate electricity emergency concerns and was the right thing to do. However, the underlying issue of capacity adequacy has not disappeared; it has just been postponed to 2022-25 when all NPP units in Belgium will have to shut down under current policy.

To avoid electricity security challenges in 2022-25, beginning in six years from now, clarity over power supply options is needed as soon as possible. The planned increases in interconnections and regional co-operation on electricity generation adequacy under the Pentalateral Energy Forum will help, but are not a full substitute for the baseload power that NPPs generate. At the same time, wholesale electricity prices in Belgium and the broader CWE region are expected to remain too low to attract major investments in electricity generation without subsidies.

The current policy to phase out all NPPs by 2025 does not help Belgium meet any of its energy policy goals. The government should seriously consider what would be the optimal policy for securing affordable low-carbon electricity. Allowing NPPs to run as long as they are considered safe by the regulator would ease electricity security pressure, would reduce the costs of electricity generation in the medium term and likely reduce the costs of the phase-out itself. Finally, even though electricity generation falls under the European Union Emissions Trading Scheme (EU-ETS), the government should also consider the phase-out in the context of long-term efforts to reduce greenhouse gas (GHG) emissions and decarbonise the economy.

PROMOTING RENEWABLE ENERGY

The concern over regulatory certainty also applies to renewable energy. European Union member states typically subsidise renewable electricity generation to help meet the binding national targets set for the share of renewable energy in gross final consumption of energy by 2020. In many countries, however, these subsidies have grown faster than expected which in turn has prompted politicians to rather abruptly change the compensation rules. This has also been the case in Belgium. The support programmes helped increase the share of renewable electricity from 7.8% in 2009 to 19% in 2014, but at a cost. Subsidies for renewable electricity amounted to EUR 1.7 billion in 2013 and, at EUR 157 per megawatt-hour (MWh) of renewable electricity generated, their level was the fourth-highest in the European Union, thanks to a large share of solar photovoltaics (PV) in the supply mix.

The generous green certificates systems, together with a drop in deployment costs (especially for solar PV), led to overcompensation and excess demand for installations. Consequently, the support levels were reduced several times by the different regions and at the federal level in 2012-14. Support for renewables could be subject to further revisions. The perception of regulatory risk created by the many changes has a direct impact on capital financing costs and the costs of project development, and therefore affects the whole process of developing renewable electricity capacity. The authorities were right to control the costs and focus on ensuring a given rate of return on capacity investment, instead of simply compensating for volumes generated. They now need to create and maintain clear, stable and predictable support systems.

Belgium is not as abundantly endowed with renewable energy potential as many other countries using current technologies. It has, however, relatively good resources for offshore wind and biomass (including waste), and it should also consider a stronger focus on renewable heat and transport fuels.

MEETING LONG-TERM CLIMATE TARGETS

Climate change is another policy challenge where a long-term perspective and stronger policies and measures are needed. Belgium's heavy industry and power generation fall under the EU-ETS and, therefore, limiting emissions in these sectors is not the federal or regional governments' responsibility. In the sectors outside the EU-ETS, however, work remains, especially for the post-2020 period. Those emissions will have to be reduced mainly in the transport and buildings sectors. At this moment, fiscal policies do not sufficiently stimulate the efficient use of transport and heating fuels. In particular, a clearer transport policy aimed at reducing CO_2 emissions is needed.

Energy prices give end-users important signals for using energy. In Belgium, the prices of oil, natural gas and electricity are around the IEA median, but several direct and indirect policies exist that make energy available to consumers at reduced prices. These policies include social policy measures, but also favourable tax treatment of company cars and fuel cards and tax exemptions on electricity use for industry. The IEA urges the government to abolish these subsidies and replace them with more targeted measures on citizens and companies in need. In particular, abolishing tax reliefs and other incentives on fossil fuel use helps save energy and reduce harmful emissions.

The IEA welcomes the three regions' decision to introduce nation-wide road pricing for heavy duty vehicles in 2016. This decision is a good example of harmonisation and closer co-operation across the three regions. The government should consider expanding road pricing to cover other vehicles, too. Together with its neighbour governments, it should also consider increasing transport fuel taxes in a revenue-neutral way. The current low fossil fuel prices should be seen as an opportunity to reform fossil fuel taxation and reduce their use over time. In this regard, the IEA welcomes the recent reform to gradually increase excise duties on diesel to match those on petrol by 2018.

Buildings renovation should remain a priority and its rate should be increased, as it provides large cost-effective potential for further efficiency gains and emissions reductions. Heating solutions that are not based on fossil fuels should be encouraged. Also, demand-side participation, especially market-based, could be increasingly used to drive a more efficient consumption of electricity, with climate and security benefits. Smart meters and smart grids would be essential to fulfil this potential.

SECURING OIL AND NATURAL GAS SUPPLIES

While security of electricity has been a cause for concern, Belgium has performed better in securing oil and natural gas supplies. Oil is the largest energy source in Belgium, and the country also has a significant refining sector. Oil security is therefore of critical importance. Belgium should be commended for its strong efforts to enhance its oil stockholding mechanism, and its oil stockholding agency, APETRA, has been meeting the IEA and EU oil stockholding obligations successfully since 2012. APETRA has implemented an effective policy of owning its own stocks, reducing its reliance on tickets and maintaining high stock levels of finished products.

In the retail market, Belgium continues to apply a price-capping mechanism (*Contrat de Programme – Programmaovereenkomst*). This may inhibit natural market responses needed for reducing demand in a crisis. The cap and fixed distribution margins also limit competition and stifle incentives for innovation in the sector. The IEA does not see any real benefit for the continued existence of this system and advises the government quite simply to abolish it. Belgium has also long applied a lower excise duty on diesel than on petrol. The recent reform to balance these excise duties by the end of 2018 is welcome also from the perspective of security of supply, as it will help, over time, reduce the gap between diesel and gasoline demand.

Natural gas is the second-most used fuel in Belgium – the most important source for space heating and the second-largest source for electricity. Belgium's gas market is well integrated with the neighbouring gas markets and the country has excellent gas transport infrastructure. The gas system has significant capacity for entry (113 billion cubic metres per year) and for exit (80 bcm per year) and faces no congestion. The Zeebrugge port is a key part of Belgium's gas system and important for the whole European gas system, with the liquefied natural gas terminal and direct pipeline connections with both Norway and the United Kingdom.

The government continues to see a major long-term role for gas in the energy mix. As gas-fired power generation could be an important substitute for phased-out nuclear power, the risk of a serious shortage of gas supply should be reflected in more comprehensive rules for emergency management. Another dimension of security of supply relates to the reliance on low-calorific gas (L-gas) from the depleting Groningen field in the Netherlands; it accounts for around 30% of Belgium's gas supply, mostly for households. This supply will be phased out by 2029. Belgium has already started to prepare for a shift to high-calorific gas (H-gas), but most of the work remains to be done. The government should consider whether the conversion process is flexible enough and whether it should be treated with a higher level of urgency in case production in Groningen declines faster than expected.

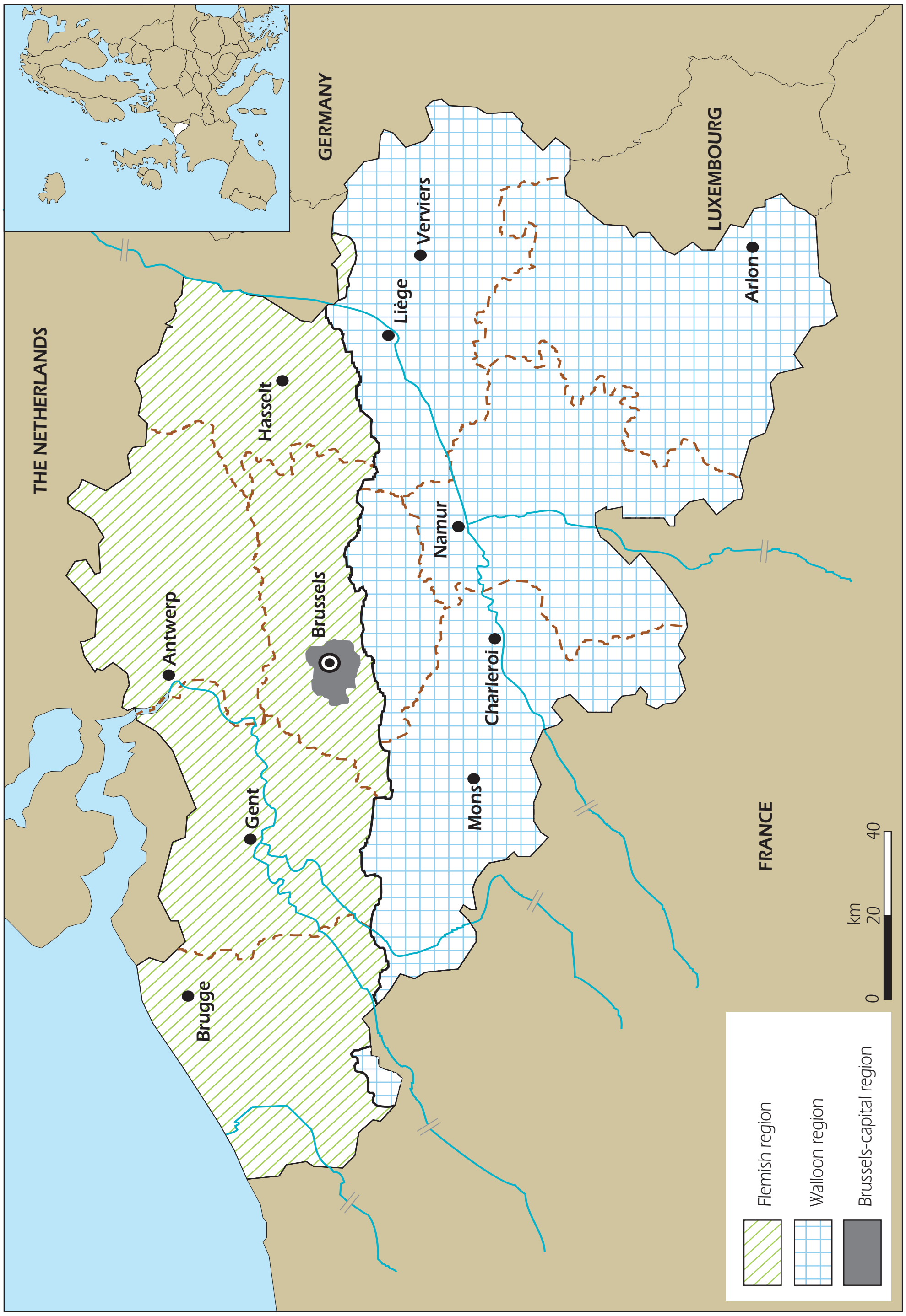
KEY RECOMMENDATIONS

The government of Belgium should:

- ☐ *Adopt a market-based long-term inter-federal energy vision and energy pact in order to provide clarity, policy consistency and investment security; engage all political parties and all relevant stakeholders in jointly developing the energy vision and energy pact to increase its legitimacy.*
- ☐ *Follow closely the principles of transparency, predictability and regulatory certainty when designing and implementing energy policy.*
- ☐ *Strengthen the measures for further diversifying energy supply and limiting energy demand, in particular through energy efficiency, renewable energy and intensified collaboration with neighbouring countries.*
- ☐ *Address as a high priority the electricity capacity shortage; clarify the role of nuclear power in the energy mix after thoroughly assessing whether an early phase-out of nuclear power over a short period of time, as currently scheduled, is feasible and reasonable from the perspective of electricity security, GHG mitigation and the costs of generating electricity.*

PART I
POLICY ANALYSIS

Figure 2.1 Map of Belgium



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

2. GENERAL ENERGY POLICY

Key data (2014 provisional)

TPES: 52.8 Mtoe (oil 42.3%, natural gas 23.9%, nuclear 16.5%, biofuels and waste 6.3%, coal 6.3%, electricity net imports 2.9%, wind 0.8%, solar 0.9%), -9.9% since 2004

TPES per capita: 4.7 toe (IEA average: 4.4 toe)

TPES per GDP: 0.12 toe/USD 1 000 PPP (IEA average: 0.13 toe/USD 1 000 PPP)

Energy production: 12.5 Mtoe (nuclear 70.1%, biofuels and waste 22.6%, wind 3.2%, solar 2.1%, heat 1.8%, hydro 0.2%), -8.9% since 2004

Electricity generation: 71.5 TWh (nuclear 47.2%, natural gas 27%, biofuels and waste 7.9%, wind 6.5%, coal 6.2%, solar 4%, heat 0.5%, hydro 0.4%, oil 0.3%), -15.3% since 2004

COUNTRY OVERVIEW

The Kingdom of Belgium (hereafter Belgium) has a population of 11.2 million and a land area of 30 500 km^2. With 366 inhabitants per km^2, Belgium is the third-most densely populated among the International Energy Agency (IEA) member countries, after South Korea and the Netherlands.

Belgium is a federal state made up of three regions (the Brussels-Capital region, the Flemish region and the Walloon region) and three linguistic communities (the Flemish-, the French- and the German-speaking communities). The main federal institutions are the federal government and the federal Parliament. The communities and regions also have their own legislative and executive bodies. The three regions have powers for territorial issues, such as public works, agriculture, employment, urban and rural planning and the environment. The linguistic communities have powers in matters such as education and culture. In energy policy, powers are divided between the federal government and the regions (see below under Institutions).

After stagnating in 2012-13, Belgium’s gross domestic product (GDP) grew by 1.3% in 2014 and by 1.4% in 2015 to reach around EUR 410 billion. Overall, Belgium’s economy has performed better than most Organisation for Economic Co-operation and Development (OECD) countries after the 2008 crisis and the growth outlook is positive. Services account for around three-quarters of the economy, manufacturing and construction for around 23% and the primary sector for 1%. Belgium was the first country to begin industrialising in Continental Europe and the country continues to have a strong manufacturing base with several energy-intensive sectors, such as chemicals, refining and iron and steel. As regards international trade, the country has a highly developed transport network and is well connected to its neighbours. The Antwerp port is one of the busiest in Europe.

In 2014, government spending was 55% of GDP and the country's public debt was 107% according to the Economist Intelligence Unit. Both figures are high by international comparison, but set to decline over the next years as a result of recent economic reforms.

Belgium is a founding member of what today is the European Union, and Brussels is host to the major European Union (EU) institutions. It has used the euro as its currency since 2002. The current federal government, led by Prime Minister Charles Michel, took office in October 2014. The next parliamentary elections are due in May 2019.

SUPPLY AND DEMAND

SUPPLY

Belgium's total primary energy supply (TPES)[1] was 52.8 million tonnes of oil-equivalent (Mtoe) in 2014. This is 5.4% less than in 2013 and 9.9% less than in 2004, a decade earlier. Energy supply peaked at 60.4 Mtoe in 2010, after consistent growth for over 25 years. From 2010 to 2014, TPES declined by 12.6% (Figure 2.2).

Fossil fuels accounted for 72.7% of TPES in 2014, including oil (42.3%), natural gas (23.9%) and coal (6.3%). Nuclear power accounted for 16.6% of TPES and renewables for 8.0%. Renewables are made up of mainly biofuels and waste (6.3%), with wind (0.8%) and solar (0.9%). Production of hydro and geothermal is at negligible levels. Net imports of electricity accounted for 2.9% of TPES.

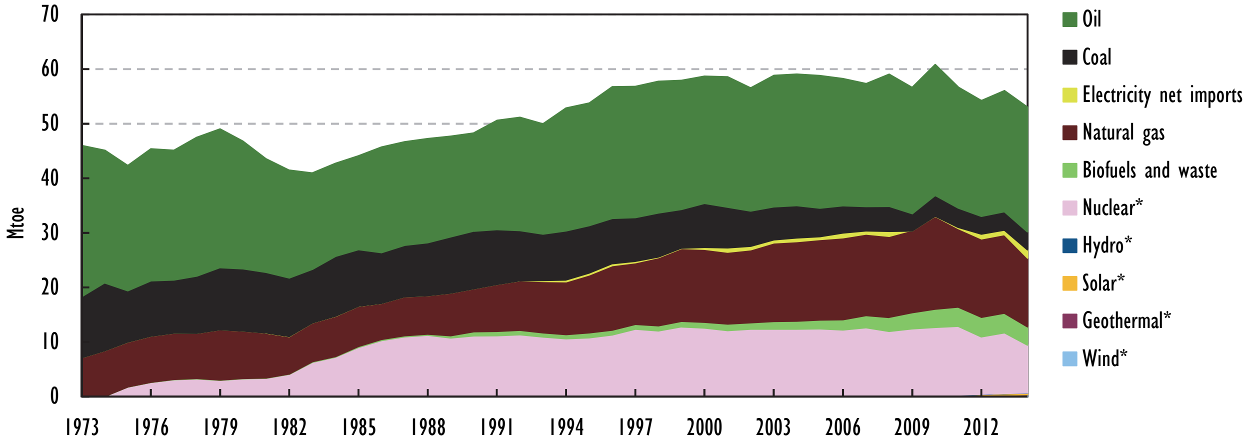
The fossil fuel share has contracted from 75.4% of TPES in 2004, while renewable energy has increased its share in TPES from 2.6%. The boost in renewables is mainly due to a 124.4% increase in the use of biofuels and waste, but also to a surge in wind and solar from negligible levels, thanks to subsidies. The nuclear power share in TPES fell from 20.9% in 2004, owing to long outages at the nuclear power plants (NPPs) in 2014.

Belgium's fossil fuels share in TPES was at a median level among IEA member countries in 2014, similar to Portugal's (Figure 2.3). The share of oil is the sixth-highest while that of coal is the fifth-lowest. Natural gas is around a median level, while net imports of electricity are the fourth-highest. The share of solar is the tenth-highest and wind is at a median level.

Belgium relies on energy imports as domestic production accounts for 23.6% of TPES. The country imports mainly fossil fuels. In 2014, it imported 58.8 Mtoe of crude oil and oil products, and exported 29.4 Mtoe. Net imports of oil and oil products have declined by 9.8% from 2004, as domestic demand for oil has fallen but exports from the country's large refining sector are growing. Natural gas imports amounted to 13.5 Mtoe in 2014, a level that is 7.5% lower than ten years earlier. Coal imports totalled 3.8 Mtoe with 0.5 Mtoe of coal products exports. Coal net imports were 43.7% lower in 2014 than in 2004.

1. TPES is made up of production *plus* imports *minus* exports *minus* international marine bunkers *minus* international aviation bunkers *plus/minus* stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (for example refining) or in final use.

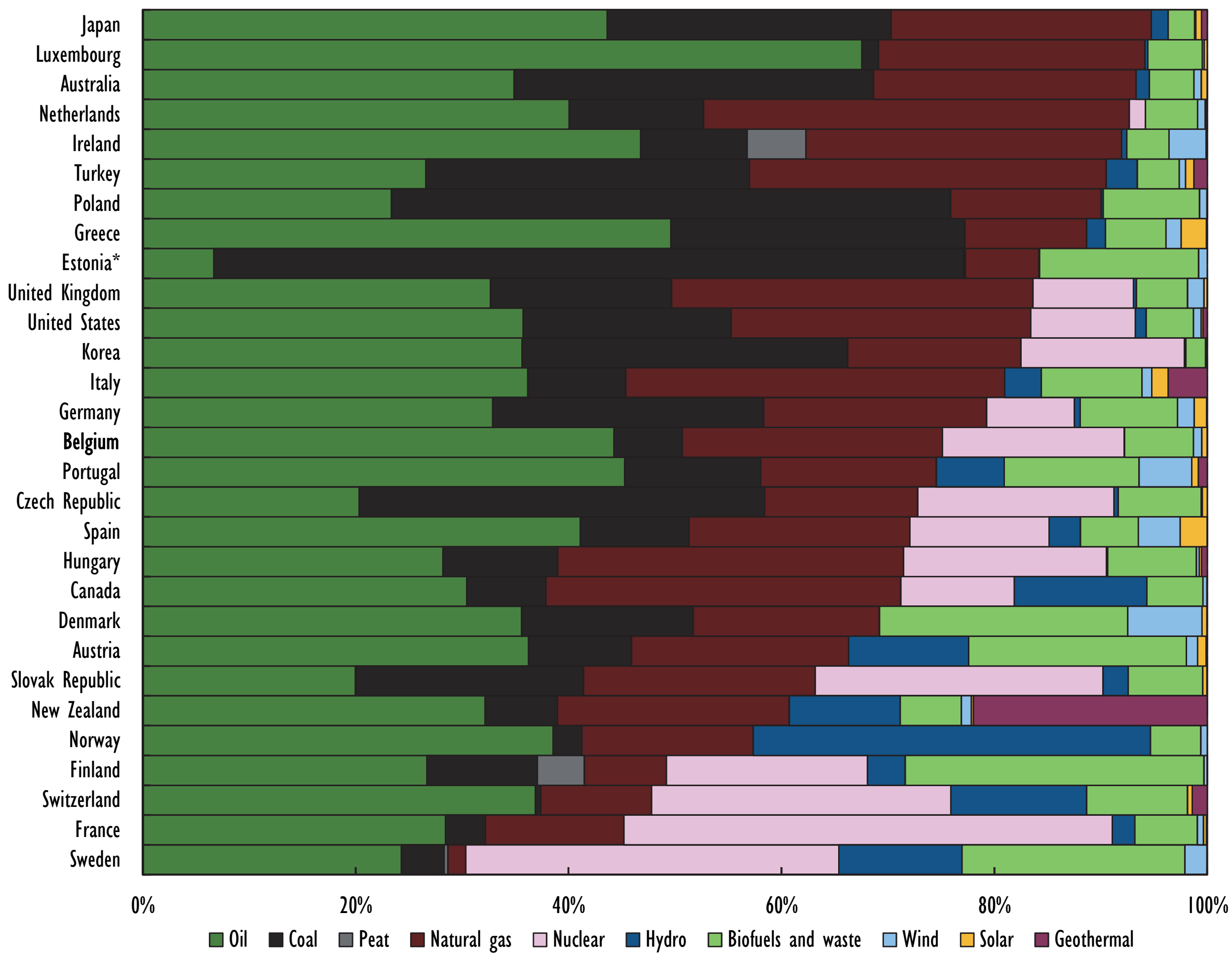
Figure 2.2 TPES, 1973-2014



* Negligible.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics.

Figure 2.3 Breakdown of TPES in IEA member countries, 2014



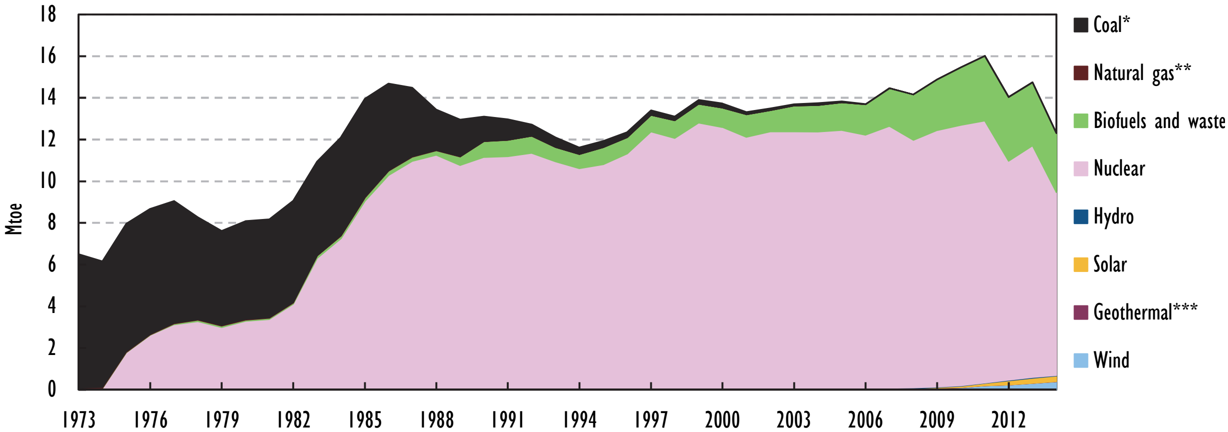
* Estonia's coal represents oil shale.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics.

Belgium produced 12.5 Mtoe of energy in 2014, out of which 70.1% by nuclear. Renewables made up 28.1% of energy production, coming from biofuels and waste (22.6%), wind (3.2%), solar (2.1%), hydro (0.2%) and negligible amounts of geothermal. Process heat accounted for 1.8%.

Energy production increased slowly from the mid-1990s to a peak of 16.1 Mtoe in 2011. Since then, production has declined by 22.1%, because of long outages at the country's NPPs.

Figure 2.4 Energy production by source, 1973-2014



* Coal production ceased in 2006.

** Natural gas production ceased in 2000 (it was negligible before 2000).

*** Negligible.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics.

DEMAND

Belgium's total final consumption (TFC)[2] amounted to 40.1 Mtoe in 2014. TFC represents around 75% of TPES, with the remainder used in power generation and other energy transformations (oil refining, iron and steel, cement). TFC has remained essentially flat since 2000, albeit with moderate fluctuations. Demand peaked at 43.5 Mtoe in 2010 (Figure 2.5) and has contracted by 5.4% since then.

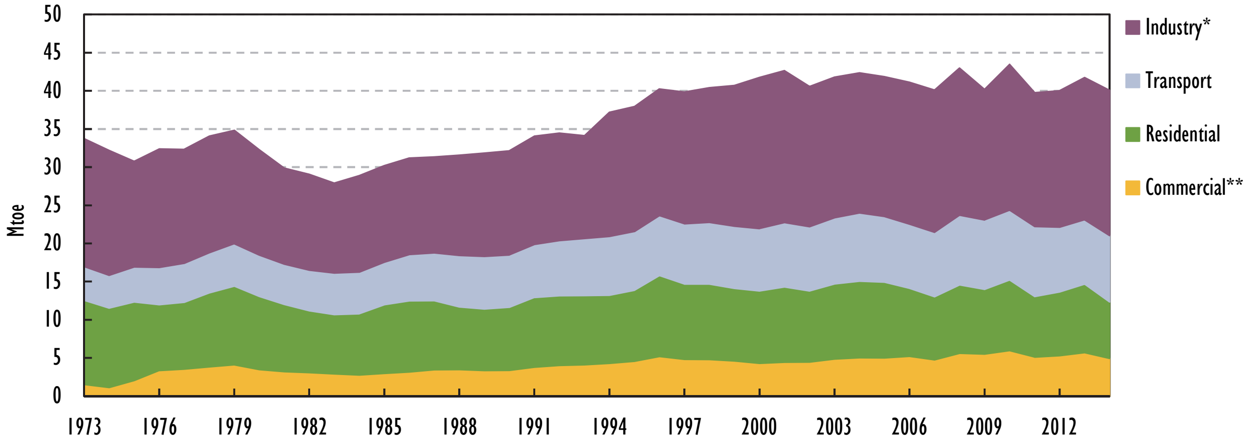
Industry is the largest consuming sector, accounting for 47.5% of TFC in 2014. Demand in industry has increased by 3.6% over the ten previous years, contracting by only 1.3% since 2008. Its share in TFC has increased marginally from 43.4% in 2004.

The transport sector accounted for 21.7% and the residential sector for 18.4% of TFC, and both have seen demand fall since 2004. TFC in households declined by 26.3% from 2004 to 2014; its share in total TFC fell from 23.7%. TFC in transport decreased by 2.7% over the same period, but its share has remained unchanged.

Final energy demand in the commercial and public services sector, including agriculture, fishing and forestry, has fallen over the past decade by 1.6%. Its share in total TFC has however grown from 11.7% in 2004 to 12.3% in 2014.

2. TFC is the final consumption by end-users, i.e. in the form of electricity, heat, gas, oil products, etc. TFC excludes fuels used in electricity and heat generation and other energy industries (transformations) such as refining.

Figure 2.5 TFC by sector, 1973-2014



* *Industry* includes non-energy use.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics.

SCENARIOS

The Reference Scenario in the 2014 *Energy Outlook for Belgium towards 2050* (Federal Planning Bureau, 2014) is the most up-to-date reference energy scenario available in Belgium. Table 2.1 synthesises its main energy and GHG indicators to 2050. The scenario assumes that the trends and policies adopted until spring 2012 will continue and that the legally binding GHG and renewables targets for 2020 will be achieved. However, it dates from before the lifetime extensions from 2015 to 2025 of the NPP units Doel 1 and 2 (866 MW) were approved.

Table 2.1 Key indicators in the Reference Scenario of the *Energy Outlook for Belgium towards 2050*

	2010	2020	2030	2050	EU 2020 targets
Primary energy consumption*, Mtoe	53.9	49.3	42.2	45.6	43.7 (indicative)
Final energy consumption**, Mtoe	36.4	35.0	34.7	37.9	32.5 (indicative)
Non-ETS GHG emissions, $MtCO_2$-eq	75.2	66.5	64.6	65.9	66.7 (binding)
Share of renewables in gross TFC, %	5.0	13.6	16.8	19.2	13.0 (binding)
Import dependence, % of TPES	76.8	75.1	88.2	85.7	
Carbon intensity of the power sector, gCO_2/kWh	197	129	176	131	
ETS sector GHG emissions, $MtCO_2$-eq	58.9	51.3	53.4	55.4	
Average cost of electricity generation, 2010 EUR/MWh	63.8	99.6	108.0	100.2	
Share of RES in net electricity generation, %	8.6	25.9	46.3	54.0	
Investment costs in power generating capacity***, billion 2010 EUR	-	18.9	12.3	31.0	

* TPES *minus* non-energy uses.

** TFC *minus* non-energy uses *plus* international aviation bunkers.

*** Cumulative figures for 2010-20, 2020-30 and 2030-50.

Source: Federal Planning Bureau (2014), *Energy Outlook for Belgium towards 2050*.

The key messages from the *Energy Outlook for Belgium* are the following:

- EU energy and climate policies, and binding targets for 2020 on reducing GHG emissions and increasing the share of renewables, are expected to improve energy efficiency significantly relative to past trends. However, they do not suffice to meet the Belgian indicative ceiling of 43.7 Mtoe of primary energy demand in 2020. This energy efficiency objective will only be achieved five years later, in 2025.
- The strong deployment of renewable energy sources triggered, notably, by the 2020 renewables targets, will continue, although at a slower pace. Beyond 2020, the development of renewables will focus on electricity generation, and renewable energy will account for 54% of total net generation in 2050.
- Despite a decrease in fossil fuel imports from 2010 to 2050, dependence on energy imports will remain a challenge for Belgium. The share of imports in total energy supply will rise to 86% in 2050 from 77% in 2010.
- The planned nuclear phase-out and the implicit ban on new investments in coal for power generation will change the diversity of electricity supply beyond 2025. The power sector will then rely on natural gas and various renewable sources. Moreover, the high share of renewables will entail considerable capital investments to cope with the variability of wind and solar, and to ensure generation adequacy. After 2030, capital investments would also be needed because of an increase in electricity demand.
- The EU-ETS and the efforts to reach the binding target in the non-ETS sectors by 2020 will reduce GHG emissions significantly from 2010 to 2020. However, in the absence of additional policies, GHG emissions are expected to by and large stabilise thereafter, increasing by 3% from 2020 to 2050.

INSTITUTIONS

Energy policy responsibility in Belgium is divided between the federal government and the three regions. Since January 2014, following the Sixth State Reform, this division is as follows:

FEDERAL RESPONSIBILITIES

- security of supply
- national indicative investment plans for gas and electricity (in collaboration with the CREG, the federal regulator)
- nuclear fuel cycles and related research and development (R&D) programmes.
- large stockholding installations for oil
- production and transmission/transport of energy (including electricity grid >70 kV), including large storage infrastructure
- transport tariffs and prices
- product norms
- offshore wind energy.

REGIONAL RESPONSIBILITIES

- regulation of gas and electricity retail markets
- distribution and transmission of electricity (electricity grid <70 kV)
- distribution of natural gas
- distribution tariffs
- district heating equipment and networks
- renewable sources of energy (except offshore wind energy)
- recovery of waste energy from industry or other uses
- promotion of the efficient use of energy
- energy R&D (except nuclear)
- use of firedamp (coal-bed methane) and blast furnace gas.

At the federal level, energy matters are handled by the **Directorate-General for Energy**, part of the Federal Public Service (a ministry) for Economy, SMEs, Self-employed and Energy. The **Ministry of Public Health, Food Chain Safety and Environm**ent is responsible for environmental issues and the **Ministry of Mobility and Transp**ort is in charge of transport policy.

In the Flemish region, the regional energy administration consists of the **Department of Environment, Nature and Energy** within the Ministry of the Flemish Community and of the **Flemish Energy Agency**.

In the Walloon region, the **Operational Directorate-General for Land Management, Housing, Patrimony and Energy** manages energy policy, including research and development issues, for the latter issue with the **Operational Directorate-General for Economy, Employment and Research.**

In the Brussels-Capital region, the **IBGE/BIM** (Institut Bruxellois de Gestion de l’Environnement/Brussels Instituut voor Milieubeheer) is responsible for all environmental and energy matters, including electricity and gas regulation.

REGULATORS

The federal energy regulator is the **Commission for the Regulation of Electricity and Gas (CREG)**. The regional governments have set up their own regulatory institutions: in Flanders, the **Vlaamse Regulator voor Elektriciteit en Gas (VREG)**, in Wallonia, the **Commission Wallonne pour l’Énergie (CWaPE)** and in Brussels-Capital, the **Brugel**. In addition, municipalities have a legal monopoly on electricity and gas distribution. Nearly all municipalities have transferred the distribution of electricity to inter-municipal companies called “inter-municipalities”, which are compensated for their investments by means of income-regulated tariffs.

FEDERAL-REGIONAL CO-ORDINATION ENTITIES

The three regions and the federal government work together closely on a permanent basis on energy and climate policy. This work is conducted in various co-ordination arenas, notably:

- the federal-regional co-ordination platform on energy policy **ENOVER/CONCERE**
- the **Co-ordination Committee for International Environmental Policy (CCIEP)**
- the **National Climate Commission (NCC)**.

The Federal-Regional Energy Consultation Group ENOVER/CONCERE

The energy policy co-operation group began operating in 1992. Its main tasks are:

- To gather and exchange information between the regions and the federal government.
- To support all policy measures, including those involving both federal and regional authorities.
- To select and give mandates to Belgian delegations to international meetings.

The group's tasks are designed to protect the autonomy of all parties. Its powers deal essentially with non-binding advice and recommendations. Plenary sessions are held monthly and several sectoral working groups have been created. The federal Energy Directorate-General provides secretarial assistance to the group, which does not have an independent budget or permanent staff.

CCIEP

The CCIEP, set up in 1995, enables Belgium to put forward concerted views on environmental matters in international organisations and bodies. It is the result of a co-operation agreement on international environmental policy between the federal state and the regions. The CCIEP includes several steering and working groups on specific themes, including climate change.

NCC

The NCC was established in 2002 and started operating in December 2003. Its main tasks include:

- Approving official reports related to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and EU climate obligations.
- Evaluating federal and interregional co-operation and co-ordination as well as the state of implementation and the impact (environmental, social and economic) of policies and measures on the basis of the National Climate Plan.
- Advising CCIEP and the Interdepartmental Commission for Sustainable Development.

MAIN ENERGY POLICY CHALLENGES

Belgium is committed to the IEA three "E"s (***e***nergy security, ***e***conomic growth and ***e***nvironmental sustainability) in its energy policy. At the same time, many of Belgium's energy policy objectives are derived from the European Union. For example, EU law sets requirements for electricity and natural gas markets, and for energy efficiency in appliances and buildings. European Union targets for 2020 on GHG reduction, renewable energy and energy efficiency are shaping Belgium's energy policy. In October 2014, the

Union adopted GHG and renewable energy targets for 2030, but these targets have not yet been allocated among the member states.

Since the 2009 IEA in-depth review, the federal and regional governments have launched a series of initiatives to meet their policy objectives and EU obligations. These initiatives, which are explained in detail in the other chapters of this report, have resulted in, among others, *i*) the successful implementation of the third EU Energy Package, fully unbundling of the distribution and supply of gas and electricity; *ii*) impressive progress in developing renewables and measures to reduce energy-related CO_2 emissions; *iii*) significant improvements in planning for emergency response and implementing oil stockholding plans; and *iv*) work to establish a long-term Energy Vision and an Energy Pact. In addition, the regions have adopted numerous policies and measures, including regional climate policy plans; strategies and programmes for low-carbon energy supply; and legislation to transpose the third EU Directives on Electricity and Natural Gas Markets.

Securing electricity supply has been a major challenge for the authorities since 2012. At the heart of the matter stands the country's reliance on nuclear power and its nuclear phase-out policy. Under normal conditions, nuclear power provides around half Belgium's electricity supply. The 2003 law on nuclear phase-out dictated, however, that the first 1.8 GW (or 30%) of the country's nuclear capacity was to be shut down in 2015, after 40 years of operation. This prospect coincided with long outages at two other units (2 GW, or one-third of the total) from mid-2012 on. At the same time, wholesale prices were too low, and policy uncertainty perhaps too large, to trigger investments in other baseload capacity.

Concern over sufficient electricity generating capacity prompted the previous government to approve in 2013 a plan to ensure security of electricity supply in the short, medium and long term (the so-called Plan Wathelet). The plan indicated several major challenges which go beyond the electricity sector. For example, legal powers over energy policy between the federal state and the regions were divided but a clear medium- and long-term vision was lacking. Security of electricity supply was under heavy pressure, and market signals were not strong enough to encourage investments in capacity, nor did the markets offer the intended benefits to all consumers.

The plan also underlined the need to invest more in modernising the electricity infrastructure (generation, transmission, distribution, storage) and in R&D for clean energy. High energy costs in Belgium were deemed to reduce the competitiveness of its economy. The plan also identified a need to focus more on European and international energy issues.

One concrete outcome of the plan was a successful information campaign in late 2013 to encourage consumers to switch energy supplier. A similar campaign was carried out in 2014. Before the plan was fully implemented, however, a general election took place in spring 2014. The priorities of the current government, in office since October 2014, reflect the challenges mentioned above and can be summarised as follows:

- Pursuing secure, affordable and sustainable energy supplies for businesses and families.
- Guaranteeing the security of supply in the context of sustainable and affordable energy. At the government's initiative and following the approval by the Nuclear Safety

Regulator in 2015, the long-term operation (LTO) of Doel 1 and 2 NPP units was extended to 2025.

- Contributing to completing the internal European energy market. The government will ensure that the transmission system operators work on the development of strategic and interconnected European energy networks. Particular focus will be the investment climate for basic production assets, demand-side management and interconnections.
- Providing a stable and favourable investment climate through transparent and innovative conditions.
- Guaranteeing the affordability of energy for industry and citizens.
- Establishing an inter-federal long-term energy vision and energy pact.

ENERGY PACT

Belgium does not have a national energy strategy. For this reason, the federal government has initiated work to prepare an energy vision and a subsequent energy pact covering the next 20-25 years to render the country's energy system more sustainable and climate-friendly. The energy vision and energy pact can be seen as a national energy strategy and energy action plan.

The long-term energy vision will be jointly developed by the federal and the regional governments. Once the energy vision is adopted, stakeholders will be invited by the governments to join in the drafting of an inter-federal energy pact.

The energy pact will contain concrete measures for implementing the energy vision. It will incorporate global trends in energy demand, costs and technology development. It will also incorporate the EU long-term energy and climate targets.

As an EU member state, Belgium will have to develop a low-carbon development strategy (an obligation under the international climate change regime) and also, within the framework of the EU's Energy Union, a national integrated climate and energy plan for the period 2021-30, with a perspective to 2050 (see Chapter 3, "Climate Change").

ASSESSMENT

The IEA encourages the government to build on the recent achievements in energy policy and continue to develop a long-term comprehensive energy policy *i*) by creating/adopting an inter-federal energy vision and energy pact; and *ii*) by following the principles of transparency, predictability and regulatory certainty. In doing so, the government should *iii*) increase the use of models to assess impacts of possible policy options on security of supply, prices, the economy and the environment in order to *iv*) further diversify energy supply and reduce energy demand, in particular through energy efficiency, renewable energy and intensified collaboration and trade with neighbouring countries.

The inter-federal energy vision and pact should pave the way to a long-term energy policy framework which enables market forces to balance energy security, climate change goals and affordability in line with Belgium's EU and international commitments, taking into account the policy approaches of neighbouring countries. It should also help to ensure a stable investment climate for all energy supply options and energy efficiency, as well as foster innovation in clean energy technologies. The federal and regional governments should engage all political parties and relevant stakeholders in jointly developing the energy vision and energy pact to increase their legitimacy.

The complex partition of competences between federal and regional levels can be seen to challenge the coherence and cost-effectiveness of energy policies and measures. A federal structure provides the opportunity for its entities to try out different measures and to let regions learn from other regions' best practices. On the other hand, a certain fragmentation of energy policy is unavoidable, as, for example, responsibilities for security of supply are set at the federal level, whereas responsibilities for renewables and energy efficiency are set at the regional level. The IEA commends Belgium´s institutions and practices for co-ordination and knowledge transfer, such as the co-ordination platform on energy policy (ENOVER/CONCERE), CCIEP and NCC. In some cases, the federal government and the regions could try to further harmonise policies and measures if this lowers transaction costs for enterprises and households.

Belgium, as many other countries, needs substantial investments in infrastructure for energy production, particularly from renewable sources, and transmission grids. Despite some progress, the permitting procedures and legal cases often take years to resolve. In addition, these projects – as is the case for many infrastructure projects – often encounter a low degree of acceptance by the general public. The government should therefore streamline permitting procedures and work towards increasing public acceptance of energy infrastructure investments.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Enhance the use of robust models and projections of possible policy options, and assess their impacts on supply security, price level, welfare and the environment, in order to support decision making on future energy policies; consider engaging academia more closely in these activities.*
- ☐ *Strive to further co-ordinate policies and measures at federal, regional and local levels.*
- ☐ *Streamline permitting procedures and work towards increasing public acceptance of energy infrastructure investments.*

References

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3. CLIMATE CHANGE

Key data (2013)

GHG emissions without LULUCF: 119.4 $MtCO_2$-eq, -18.8% since 1990*

CO_2 emissions from fuel combustion: 89.1 $MtCO_2$, -16.1% since 1990

CO_2 emissions by fuel: oil 47%, natural gas 35.4%, coal 13.8%, other 3.8%

CO_2 emissions by sector: transport 27.3%, power generation 20.3%, residential 20%, manufacturing and construction 15.5%, commercial and other services including agriculture 10.5%, other energy industries 6.3%

*Source: UNFCCC, 2015.

GREENHOUSE GAS EMISSIONS

Belgium is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and a party to the Kyoto Protocol. Its international commitment was to reduce its average annual greenhouse gas (GHG) emissions by 7.5% below the base year: 1990 for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); 1995 for F-gases (hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride).

For the first commitment period (2008-12), Belgium reduced its emissions by 12.4%. The average of 2008-12 total GHG emissions without land use, land use change and forestry (LULUCF) was 119.4 million tonnes of carbon dioxide-equivalent ($MtCO_2$-eq) compared to 143.0 $MtCO_2$-eq in the base year. With LULUCF, the average of 2008-12 GHG emissions was 124 $MtCO_2$-eq, or 12.7% less than the 142.1 $MtCO_2$-eq in the base year. From 2012 to 2013, emissions remained practically unchanged.

According to Belgium's 2015 national inventory report to the UNFCCC, CO_2 accounted for 85.1% of total GHG emissions excluding LULUCF in 2013, followed by CH_4 (7.4%), N_2O (4.9%) and hydrofluorocarbons (HFCs, 2.1%). Perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 0.5% of the total. From 1990 to 2013, emissions of CO_2 decreased by 15.9%, while CH_4 dropped by 30.6%, N_2O by 39.7% and fluorinated gas emissions (from 1995) by 44.6%.

ENERGY-RELATED CO_2 EMISSIONS

EMISSION TYPES

The UNFCCC data show that Belgium's energy sector accounted for 82% of total GHG emissions in 2012, particularly CO_2, CH_4 and N_2O, showing 16% lower from its 1990 levels. Industrial processes are the second-largest source of emissions, contributing 9.7% in 2012 of all six direct gases. The agriculture sector accounts for 8% with CH_4 and N_2O as major sources. Waste (1.3%) and solvent and other product use (0.2%) represent the rest with the benefits from LULUCF of 1.2%.

SOURCES OF CO_2 EMISSIONS

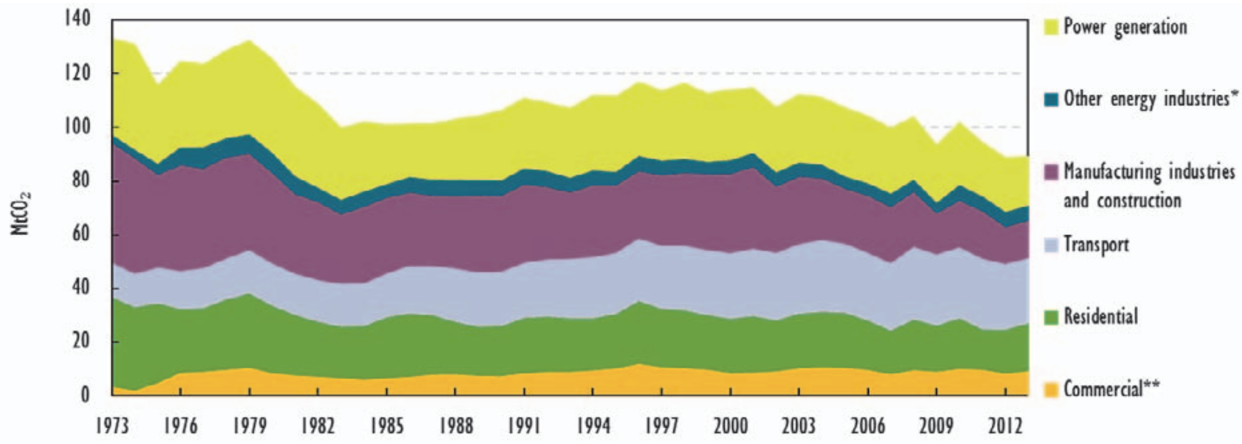
Energy-related CO_2 emissions from fuel combustion are estimated at 89.1 million tonnes (Mt) in 2013, which is 16.1% lower than 106.2 Mt in 1990 and 23.7% lower than a local peak of 116.8 Mt in 1996. Compared to 2003, CO_2 emissions have declined by 20.7% (Figure 3.1).

The largest CO_2 emitting sector in Belgium is transport, representing 27.3% of the total. Power generation accounts for 20.3% and households for 20%, while manufacturing industries and construction together emit 15.5% and the commercial and public services sectors (including agriculture, forestry and fishing) emit 10.5% of the total. Other energy industries (including refining) account for the remaining 6.3%.

The decline in emissions since 1990 is mainly due to a decline in emissions from the power generation sector (25.9 Mt to 18.1 Mt, a decrease of 30%) and from the manufacturing and construction sector (28.1 Mt to 13.8 Mt, a decrease of 50.8%). Both sectors have experienced some volatility in emissions over the 1990-2013 period because of variations in output. The share of power generation in total emissions has fallen by 24.4% and that of industry by 26.5% (the largest at the time) below 1990 levels.

Emissions from the transport sector increased by 19.7% during 1990-2013, from 20.3 Mt to 24.3 Mt. Transport's share in total emissions has also increased from 19.1%. Emissions peaked in 2008 at 27.2 Mt and have declined by 10.3% since.

Figure 3.1 CO_2 emissions by sector, 1973-2013



* *Other energy industries* includes other transformations and energy own-use.

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

Source: IEA (2015), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

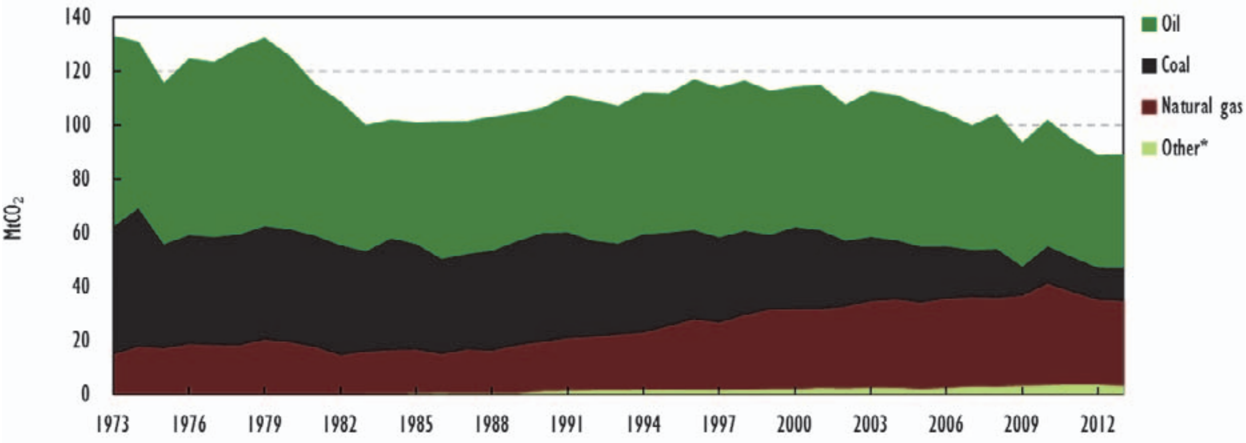
Emissions from households and the commercial sector have also increased compared to 1990, up by 8.5% and 24.4%, in that order. Their share in total emissions was 17.5% and 7.1% respectively. However, both sectors have reduced emissions compared to 2003, down by 12.4% for households and 10.5% for the commercial sector.

Other energy industries, including refining, emitted 2.2% less in 2013 than in 1990, with a relatively consistent level of emissions over the past 20 years.

In 2013, nearly half CO_2 emissions from fuel combustion were from oil, namely 47% of the total, while natural gas accounted for 35.4%, coal for 13.8%, and waste for 3.8%.

Since 1990, emissions from oil and coal have declined by 9% and 69.6%, respectively, while emissions from natural gas and waste were up by 72% and 135.5%, in that order. In 1990, most emissions came from oil (43.4%) and coal (38%), with gas and waste representing 17.3% and 1.3%.

Figure 3.2 CO_2 emissions by fuel, 1973-2013



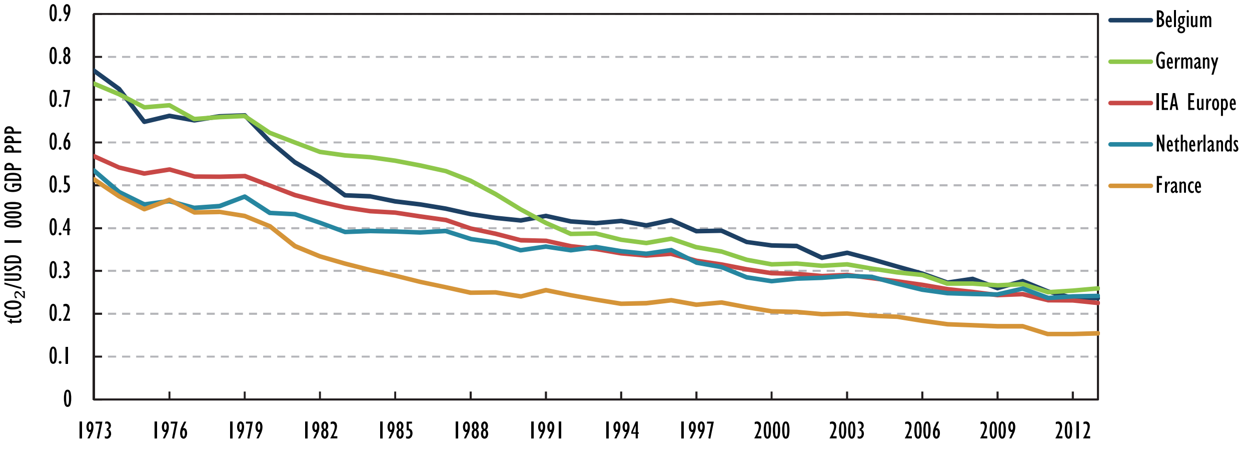
* *Other* includes industrial waste and non-renewable municipal waste (negligible).

Source: IEA (2015), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

CARBON INTENSITY

Belgium's carbon intensity, measured as CO_2 emissions by real gross domestic product adjusted for purchasing power parity (GDP PPP), amounted to 0.24 tonnes of CO_2 per USD 1 000 PPP (tCO_2/USD 1 000 PPP) in 2013. Belgium has the seventeenth-highest level of carbon intensity within the IEA, similar to the Netherlands (0.24 tCO_2/USD 1 000 PPP). Both are similar to the IEA Europe average of 0.24 tCO_2/USD 1 000 PPP but lower than the total IEA average of 0.3 tCO_2/USD 1 000 PPP (Figure 3.3).

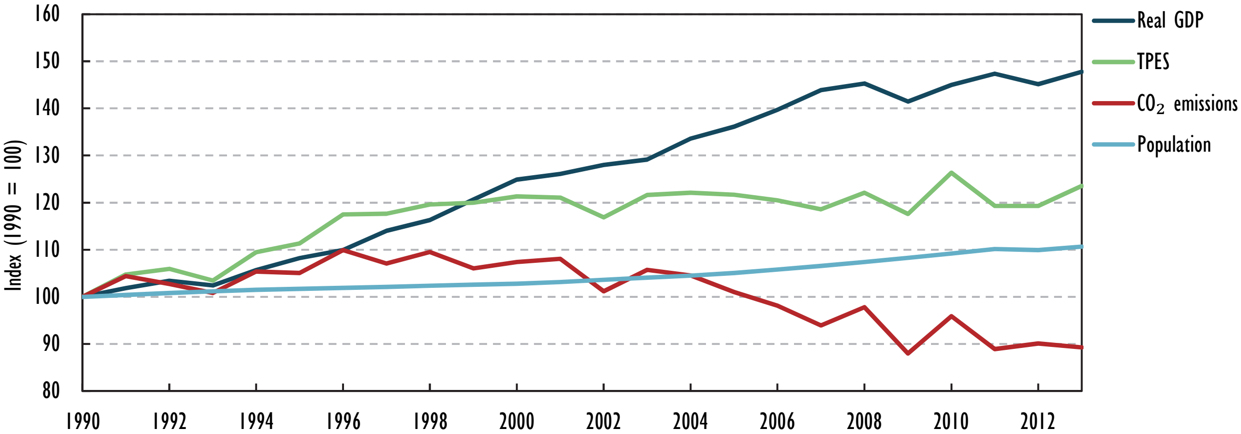
Figure 3.3 Energy-related CO_2 emissions per unit of GDP in Belgium and in other selected IEA member countries, 1973-2013



Source: IEA (2015), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

Belgium's carbon intensity has been falling over time, by 43.3% below 0.42 tCO_2/USD 1 000 PPP in 1990 and by 16.9% below 0.34 tCO_2/USD 1 000 PPP in 2003. In comparison to IEA member countries, the average IEA intensity was 22.5% lower in 2013 than in 1990 but 19.5% lower than in 2003.

Figure 3.4 CO_2 emissions and main drivers in Belgium, 1990-2013



Source: IEA (2015), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

INSTITUTIONS

Climate policy is implemented at the federal and regional levels and several bodies are involved in co-ordinating efforts. The **National Climate Commission (NCC)** is the main body responsible for implementing climate policy. The Commission is composed of federal and regional representatives. It is assisted by a permanent secretariat and thematic working groups. Belgium's national greenhouse gas inventory is operated by the **Coordination Committee for International Environmental Policy (CCIEP)**. Both the NCC and the CCIEP operate under the Inter-ministerial Conference for the Environment which brings together the federal and regional ministers for the environment. In addition, the **ENOVER/CONCERE co-ordination platform for energy** is involved in climate policy in the areas of EU 2030 targets, carbon capture and storage, and biomass sustainability, for example.

POLICIES AND MEASURES

TARGETS, STRATEGIES AND PLANS

Belgium's GHG targets are derived from the European Union's 2020 targets. As a result of the effort-sharing of the Union's target of reducing GHG emissions by 20% from 2005 to 2020, the country will have to reduce emissions from the sectors outside the Emissions Trading Scheme (ETS) by 15% from their 2005 levels by 2020. For this, it can use international flexibility mechanisms to cover an amount equalling 1% of its total GHG emissions in 2005. The sectors covered by the ETS in the European Union as a whole will have to cut emissions by 21% below 2005 levels by 2020.

The National Climate Plan (NCP) for 2009-12 was adopted by the NCC in 2009. It builds on plans at the regional level and contains some 100 policies and measures (see below).

In 2012 the NCC launched preparations for a post-2012 National Climate Plan. As of January 2016, this work remains to be finalised, as the federal and regional governments agreed on sharing the burden for the non-ETS sector for 2013-20 only in December 2015. The federal and regional governments have presented a draft national climate change adaptation plan in July 2015 (this plan has not been adopted by the NCC yet) and are analysing how to develop a national low-carbon development strategy (LCDS) to 2050. The development of this national LCDS is an obligation under the UNFCCC process, as well as under the EU Monitoring Mechanism Regulation.

Regarding the LCDS, at federal level, a study to develop scenarios for a low-carbon Belgium by 2050 was published in 2013. The Brussels-Capital region has launched a similar regional study. In the course of 2015 and 2016, a follow-up study analysing the macro-economic impacts of the transition to a low-carbon Belgium is being carried out and the results are to be published in 2016. The Flemish region also conducts its own specific research.

In the context of the Energy Union, all EU member states will have to develop national integrated climate and energy plans to meet the objectives of the EU Climate and Energy Package for 2030, such as the national non-ETS target, the EU renewable and energy efficiency target, and the electricity interconnection target. The plans focus on 2030, but they also need to provide an outlook to 2050. Belgium will start developing its national plan while ensuring coherence with the LCDS, which is being developed. The Flemish region will consult stakeholders in 2016 for developing a climate policy plan for the period 2021-30 and a vision for 2050 as part of the integrated climate and energy plan.

At the regional level, several climate action plans have been adopted. In June 2013 the Flemish region adopted the Flemish Climate Policy Plan 2013-20. The Plan comprises two sections, namely the Flemish Mitigation Plan, which includes measures for the non-ETS sector, and the Flemish Adaptation Plan. In the Walloon region, the Air, Climate and Energy Plan to 2020 was pending adoption in summer 2015. In the Brussels-Capital region, an integrated Climate-Air-Energy Plan is in the process of being adopted as of March 2016.

Beyond 2020, the European Union's target is to reduce GHGs by 40% from 1990 to 2030, as agreed by the European Council in October 2014. Emissions reductions would be 43% below 2005 levels in sectors covered by the EU-ETS and by 30% in those not included. The level of effort to be made by each member state to achieve this EU target has not yet been decided. Importantly, however, the plan is to meet the target with domestic measures alone, without any contribution from international credits. Significant investment costs are expected, but will also deliver mobility, employment and health benefits. By 2050, Belgium and other developed countries are aiming to reduce GHG emissions by 80% to 95% below their level in 1990.

EUROPEAN UNION EMISSIONS TRADING SCHEME (EU-ETS)

The EU-ETS is a mandatory cap-and-trade system covering CO_2 emissions from energy-intensive industry. It was launched in 2005 and its first commitment period ran until the end of 2007. The second phase covered the period 2008-12. Installations under the EU-ETS can meet their obligations either by reducing emissions on their own, or by purchasing allowances from other installations covered by the scheme, or by purchasing credits under the Kyoto Protocol's flexible mechanisms (joint implementation or the clean development mechanism).

From 2005 to 2012, emission allowances were allocated to the facilities on the basis of a national allocation plan (NAP). The plan was prepared by the central government following criteria set out in the ETS Directive (2003/87/EC, later amended by 2009/29/EC) and approved by the European Commission. More than 95% of the allowances in the European Union were allocated to companies free of charge. Over-allocation of allowances as well as a decline in economic activity led to a large surplus of allowances, a steep decline in their prices and a need to reform the ETS scheme.

The third phase of the EU-ETS is currently running from 2013 to 2020. It is significantly different from previous phases. National allocation plans are no longer required and a single EU-wide ETS cap is introduced. The cap is reduced by 1.74% per year from 2010 onwards, resulting in a total reduction of 21% by 2020 below the 2005 levels. More than 40% of allowances will be auctioned and electricity generation will no longer receive free allowances. For the sectors where allowances will still be given away for free, such as manufacturing industry and heat sectors, harmonised allocation rules apply, based on EU-wide benchmarks of emission performance. A separate cap applies to the aviation sector. From 2021 to 2030, the number of allowances will be reduced by 2.2% per year, and a market stability reserve of allowances is expected to be introduced from 2019.

Comparison of the volume of allowances allocated and the actual emissions from 2008 to 2012 indicates that global economic cycles, along with impacts of renewable and energy efficiency policies, have had more impact on emissions than the ETS itself. In 2008, allowances matched actual emissions perfectly, but actual emissions then collapsed for the rest of the period. As a result, in the 2008-12 period, allowances totalled 292 Mt (58.4 Mt per year, sourced from the EU Transaction Log database), but actual emissions totalled only 241 Mt (48.2 Mt per year) according to Belgium's 6th National Communication to the UNFCCC. Allowances thus exceeded actual emissions by 21%. The volume of allowances continued to exceed verified emissions also in 2013 and 2014 by a wide margin.

In the 2013-20 phase, Belgium's ETS sectors' emission allowances will gradually decrease to 50 Mt in 2020 when the cap is projected to correspond to 41% of the country's total GHG emissions of 122 $MtCO_2$-eq (EEA, 2015). The country will also gain revenue from auctioning allowances. In 2014, this revenue amounted to EUR 97 million. Since December 2015, an allocation key has been established between the regions and the federal government to distribute the auctioning revenue.

DOMESTIC MEASURES OUTSIDE THE EU-ETS

Belgium's non-ETS sectors must reduce emissions by 15% from 79.6 $MtCO_2$-eq in 2005 to 67.6 $MtCO_2$-eq in 2020. In 2014, the emissions were 11% below their 2005 levels. According to the European Environment Agency's projections from 2015 to 2035 (EEA, 2015), with existing measures, the non-ETS sector will emit 72.2 $MtCO_2$-eq in 2020, which is 4.5 $MtCO_2$-eq above the target. The major GHG emitters in the non-ETS in 2020 are projected to be transport (25.6 $MtCO_2$-eq) and the residential and commercial sector (or buildings, 23.2 $MtCO_2$-eq). In 2013, emissions in transport, with existing measures, are projected to keep increasing all the way to 2035, while emissions from buildings are projected to gradually decline over the same period, but only by 14%. As of January 2016, Belgium was yet to list any additional measures with which to reach the 2020 targets. A political agreement on internal burden-sharing of the non-ETS target to 2020 was reached between the federal and the three regional governments in December 2015, after which work on detailed policies and measures will follow.

The Flemish region adopted in 2013 a Climate Policy Plan for 2020. Following the internal burden-sharing agreement of December 2015, the Flemish region will strengthen the 2020 plan with additional measures in order to reach its 2020 non-ETS-target and to improve the starting position for its 2030 plan. Strengthening the current 2020 plan is integrated into the 2016 stakeholder consultations concerning the Flemish 2030 plan and 2050 vision (see section "Targets, strategies and plans" above).

Belgium´s existing measures to reduce energy-related CO_2 emissions focus on energy efficiency and renewable energy. They are detailed in Chapter 4, "Energy Efficiency" and Chapter 11, "Energy Technology Research, Development and Demonstration". In the renewable energy sector, measures include biofuels for transport and heat from renewable energy. In the transport sector, measures include mobility plans, promoting clean vehicles, public transport and eco-driving. In the buildings sector, energy efficiency requirements for existing and new buildings are becoming gradually stricter, while in (non-ETS) industry, voluntary energy saving agreements are widely used.

With existing measures alone, Belgium is not on track to meet its 2020 target. Unless the government takes additional measures, emissions in non-ETS sectors are set to exceed the linear trend to target from 2017 to 2020 (EEA, 2015). To meet the non-ETS target, the government can either introduce new measures or carry over the national surplus in compliance units projected for 2013-16. It can also purchase compliance units from other EU countries, as a large surplus is projected by 2020.

Cost-effectiveness is a central criterion when choosing among options to meet the target. Although policy measures often aim at several objectives at a time, Belgium has evaluated the cost-effectiveness of federal climate policy instruments and measures from a CO_2-mitigation perspective in 2014 and 2015 and can use this as a basis for decisions among future options.

In the 2013-20 commitment period, addressing oil use in transport and space heating will require more attention. Taxation has a key role here, as the use of company cars and fuel cards is widespread and encouraged by taxing it less than income from regular work. Also, diesel is taxed less than gasoline, which again leads to increasing CO_2 emissions and generally cannot be justified from an environmental perspective. To reduce, and eventually abolish, the excise duty difference between diesel and petrol, the federal government is since November 2015 gradually increasing the excise duty on diesel and gradually reducing it on petrol (Royal Decree of 26 October 2015 temporarily modifying the programme-law of 27 December 2004). At the same time, oil heating remains common and Belgium has one of the lowest heating oil prices among the IEA member countries (see Box 3.1 and Chapter 5, "Oil").

Box 3.1 The case for reforming diesel taxation in transport

In Belgium, as in all but one OECD countries, diesel fuel is taxed at lower rates than gasoline in terms of both energy and carbon content. A recent OECD study (Harding, 2014) assessed whether this difference is warranted from an environmental perspective.

Box 3.1 The case for reforming diesel taxation in transport (continued)

The report concludes that the environmental and other externalities associated with diesel and gasoline use do not support the lower tax rates that currently apply to diesel. The CO_2 emissions per litre of diesel are higher than for gasoline, implying that a tax component reflecting these costs should be higher for a litre of diesel than for a litre of gasoline. The level of most harmful air pollutants is also generally higher for diesel cars. Finally, the costs of the other main externalities associated with road use – congestion, accidents, noise and infrastructure costs – are more a function of distance travelled than of fuel volumes. Since diesel vehicles generally travel further on a litre of fuel than gasoline vehicles, this also implies a higher tax rate per litre.

Fuel taxes are not determined on environmental grounds alone. Considerations related to revenue-raising, economic growth, industry policy, competitiveness and equity matter as well. Gradual removal of the diesel differential would allow households and firms to adapt to the changing relative costs of road fuels, so that better environmental performance is attained with minimal transition costs.

To ensure that taxation of both fuels is neutral from an environmental perspective, taxes per litre of diesel should be *at least* equal to the rate applied to a litre of gasoline. For distributional and competitiveness reasons, this may be a useful first step towards true alignment with relative environmental impacts. Ideally, the tax rate would include a component per litre that is equal in carbon terms. Since the use of a litre of diesel fuel causes more air pollution and CO_2 emissions and given the need to impose a higher tax rate on diesel to reflect the higher costs associated with road use and its greater fuel efficiency (a diesel vehicle will likely drive further per litre, incurring more road use costs per litre than a gasoline vehicle), a second component should be added to the carbon component per litre of fuel. For diesel, this second component should at least be equal in energy terms to the similar component on gasoline, as a proxy for the air pollution and other impacts associated with road fuel use.

In a recent development, the federal government decided to reduce the excise gap between gasoline and diesel from November 2015 to the end of 2017 by gradually increasing the excise duty on diesel and decreasing it on petrol (*système de cliquet et cliquet inversé* plus *indexation*).[1] However, this reform does not apply to the excise duty on diesel for commercial use. For the period 1 November to 31 December 2015, the excise duty on diesel was increased by EUR 0.036 per litre and that on gasoline decreased by EUR 0.022 per litre.

INTERNATIONAL MEASURES

In the 2008-12 commitment period, Belgium used an average of 2.4 $MtCO_2$-eq of flexible mechanisms per year to help meet its obligation to reduce GHG emissions by 7.5%. In order to obtain the carbon credits, the government set up a federal programme of joint implementation (JI) projects and clean development mechanisms (CDM) hosted by the Federal Public Service, Health, Food Chain Safety and Environment. The objective was to purchase 12.2 million carbon credits. The Flemish region also purchased carbon credits through participation in several climate funds.

1. Royal Decree of 26 October 2015 temporarily modifying the programme-law of 27 December 2004, published on 30 October 2015.

The credits were obtained on both the primary market (through organising tenders for projects in 2005 and 2007) and the secondary market (through participating in a carbon fund of the German Development Bank KfW). Three main criteria were used for project eligibility: contribution to sustainable development, price, and the certainty of delivering the emission allowances. For the 2013-20 period, it is too early to estimate the need for carbon credits.

CLIMATE CHANGE VULNERABILITY AND ADAPTATION

Historical meteorological observations indicate that Belgium is experiencing increases in temperature and heavy rainfall episodes, while there appear to be no marked increases in droughts or severe storms (National Climate Commission, 2010). Looking ahead, a changing climate is likely to result in a significant temperature rise in summer (+1.5°C to +7°C by the end of this century compared to the end of the 20th century) and winter, increased frequency of water scarcity, and rising sea levels (OECD, 2013). In the energy sector, rising temperatures can reduce energy needs for heating in winter while increasing cooling demand in summer. The country's dependence on thermal (fossil and nuclear) power plants and subsequent cooling needs makes it particularly vulnerable to reduced availability of surface water with decreased summertime precipitation as well as extreme heat events. The implementation of water-efficient technologies (such as dry cooling and closed-loop cooling systems) may help reduce exposure to water constraints. On the other hand, intense precipitation patterns in winter and rising sea levels can impact energy infrastructure built along coastal and river flood-prone areas, such as the 65 kilometre-long coast and the Scheldt estuary. Belgium's transmission and distribution infrastructure also faces risks from the impacts of extreme weather events, such as high winds, heavy rains and extreme heat. Infrastructure planning and investment in consideration of future climatic changes will help build greater resiliency into new and existing energy infrastructure.

Belgium's *2010 National Climate Change Adaptation Strategy* guides climate change adaptation planning, and includes an assessment of potential impacts, existing adaptation measures, and policy guidance (European Climate Adaptation Platform, 2015). A draft *National Adaptation Plan* (2015-20) is being finalised. This plan still needs to be formally adopted by the NCC. A draft federal contribution for adaptation to climate change is also being finalised as of March 2016. It identifies 28 federal adaptation actions in ten sectors, including energy. This federal contribution has not been formally adopted yet. In June 2013 the Flemish region adopted its own adaptation plan: the Flemish Climate Policy Plan 2013-20. In the Walloon region, the Air, Climate and Energy Plan to 2020 was pending adoption in summer 2015. In the Brussels-Capital region, an integrated Climate-Air-Energy Plan is in the process of being adopted.

ASSESSMENT

Belgium has taken preliminary steps to develop a long-term climate strategy as foreseen under the EU Monitoring Mechanism Regulation, at both federal and regional levels. All current federal and regional state policies and measures are synthesised at the national level in the 2009-12 NCP, extended until a new 2013-20 NCP is deployed following the long-awaited internal Belgian burden-sharing decision in December 2015. The country will likely meet its non-ETS 2020 target thanks to the EU Effort-Sharing Decision accounting rules but, for the longer term, it needs to make more effort. It is thus important to strengthen the existing momentum to close the remaining gaps and to ensure implementation of policies and measures.

The co-ordination of policies and measures at federal, regional and local levels is ensured by the National Climate Commission. One gap still remains to be bridged: as of January 2016, there is still no national climate plan for meeting the non-ETS sector target of -15% emissions for 2020. Belgium is also encouraged to adopt the National Adaptation Plan without undue delay.

According to the EU Climate and Energy Package, Belgium will most probably have to reduce its non-ETS emissions by between 36% and 40% in 2030. Those emissions will have to be reduced mainly in the transport and buildings sectors. At this moment, fiscal policies do not sufficiently stimulate the efficient use of transport and heating fuels. In particular, a clearer transport policy directed on reducing CO_2 emissions is needed.

To reach the future 2030 non-ETS target in a cost-effective way, Belgium could also buy carbon credits from other EU member states that have a surplus. Because such purchases could be complicated and finance is needed in time, the country would benefit from timely co-ordinating these actions between the federal and regional governments.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Give priority to the development of a long-term strategy for the transition to a low-carbon economy, building on Belgium's 2030 and 2050 goals, integrating policies on GHG, renewable energy, energy efficiency and nuclear energy, so as to provide a clear and stable regulatory framework for investors and consumers.*
- ☐ *Implement as soon as possible the December 2015 political decision on non-ETS burden-sharing between the regions to ensure that the country reaches the non-ETS target of -15% set for Belgium in 2020.*
- ☐ *Allocate the future EU 2030 non-ETS targets among regions on the basis of sound emissions projections, mitigation potential assessments and cost-effectiveness of all policies and measures.*
- ☐ *Co-ordinate any possible purchases of international carbon credits between the federal government and the regions.*
- ☐ *Stimulate the shift from oil and gas space heating to more efficient and/or renewable energy technologies, such as heat pumps, solar panels and biomass.*

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4. ENERGY EFFICIENCY

Key data (2014 provisional)

Energy supply per capita: 4.7 toe (IEA average: 4.4 toe), -15.7% since 2004

Energy intensity: 0.12 toe TPES/USD 1 000 PPP (IEA average: 0.13 toe/USD 1 000 PPP), -19.3% since 2004

TFC: 40.1 Mtoe (oil 51.6%, natural gas 22.4%, electricity 17.3%, biofuels and waste 4.4%, coal 2.9%, heat 1.3%, solar 0.1%), -5.4% since 2004

TFC by sector: industry 47.5%, transport 21.7%, residential 18.4%, commercial and public services and agriculture 12.3%

FINAL ENERGY USE

FINAL CONSUMPTION BY SECTOR

Belgium's total final consumption (TFC) of energy was 40.1 million tonnes of oil-equivalent (Mtoe) in 2014. TFC was then 4% lower than in 2013 which is partly explained by milder weather and lower space-heating needs in 2014. TFC peaked at 43.5 Mtoe in 2010

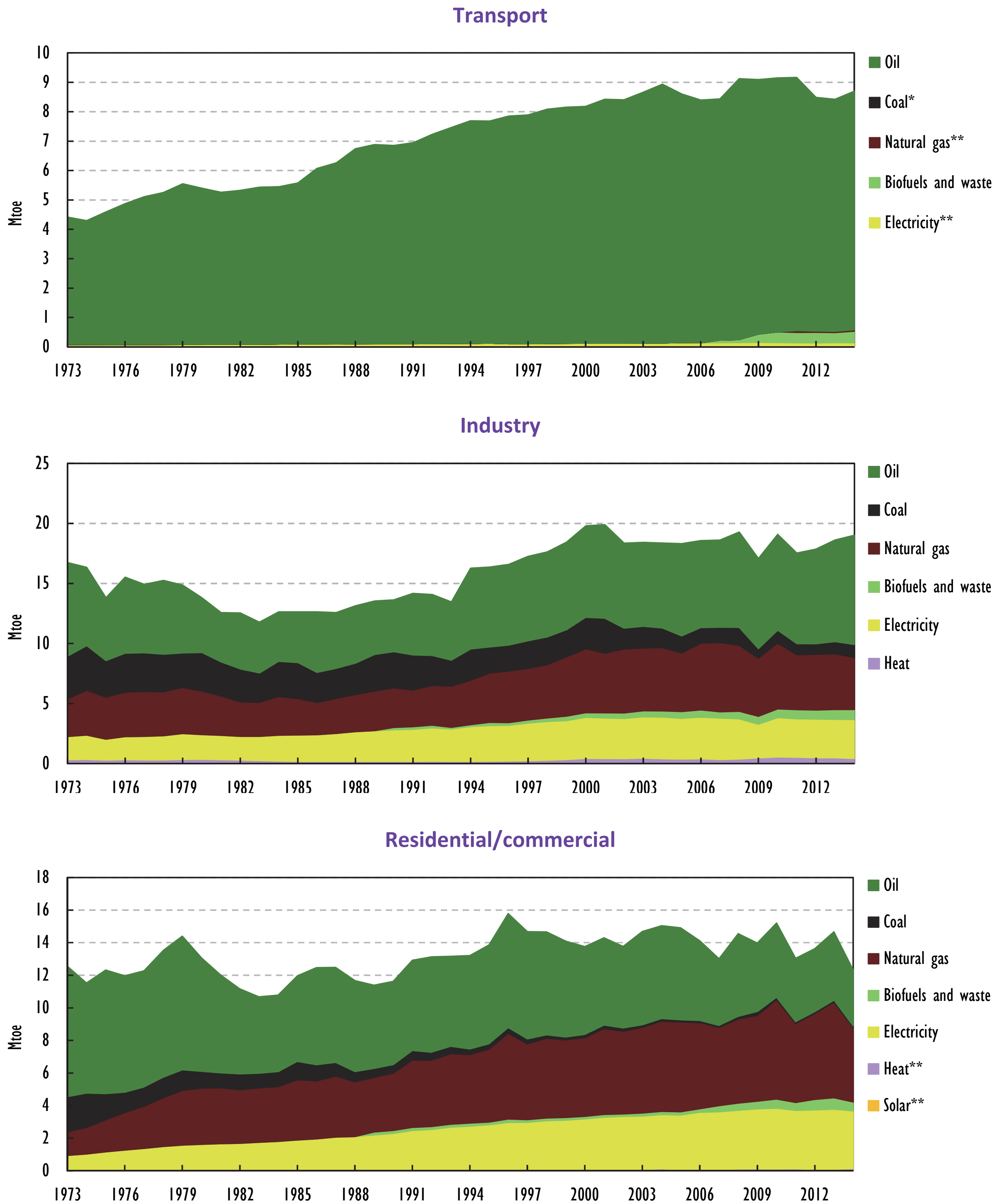
Prior to 2010, energy demand was relatively constant with moderate volatility during the 2000s (mainly in the residential and commercial sectors), averaging 41.4 Mtoe with a low of 39.9 Mtoe in 2007 and a high of 42.4 Mtoe in 2001.

Industry is the largest consuming sector in Belgium, with final consumption of 19 Mtoe in 2013 or 47.5% of TFC. In 2013, Belgium had the third-highest share among the International Energy Agency (IEA) member countries, after South Korea and Finland, and just ahead of the Netherlands. Within industry, the petrochemicals/chemicals sector is by far the largest energy consumer, accounting for 60% of industry's TFC in 2014. Around three-quarters of this is non-energy use, as the sector uses oil and natural gas as raw materials in industrial processes.

Industry demand was relatively flat from 2003 to 2008, dipping by 9.9% in 2009. Demand recovered and peaked at 19.1 Mtoe in 2010, followed by two years of decline and a less-than-full recovery in 2013. Industry demand grew faster than TFC over the past decade and its share increased from 43.9% in 2003 (Figure 4.1).

The transport sector represented 21.7% of TFC or 8.7 Mtoe in 2014. In 2013, this was the fourth-lowest share among the IEA member countries, in part reflecting relatively short average distances in the country. Energy demand in the sector was 2.7% lower in 2014 than in 2004. After growing for decades, demand peaked at 8.9 Mtoe in 2004, and declined by 5.6% over the following three years. It then reached a new high of 9.2 Mtoe in 2010 before contracting for another three years, to increase again by 3.2% in 2014 (Figure 4.1).

Figure 4.1 TFC by sector and by source, 1973-2014



* Coal use in transport ceased in 1987.

** Negligible.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

The residential sector accounted for 18.4% of TFC or 7.4 Mtoe in 2014. Since 2008[1], residential demand has been volatile because of changing space-heating needs, ranging from a high of 9.2 Mtoe in 2010 (21.2% of the total) to a low of 7.6 Mtoe in 2011 (18.5%). The commercial and public services sector (including agriculture) represented 12.3% of TFC in 2014, slightly lower than 13% in 2008 albeit with similar volatility as in residential demand (Figure 4.1).

Transport continues to be fuelled primarily by oil, but oil's share in transport TFC has declined from 98.6% in 2004 to 93.3% in 2014. Biofuels (4.6% in 2014) were introduced to the Belgian transport sector in 2007 and their use will continue to grow, thanks to a blending requirement to meet an EU obligation for a 10% share of renewable energy in transport by 2020. The share of electricity (1.6% in 2014) has remained relatively constant in recent years. Natural gas use in transport was introduced in 2011 and had a 0.5% share in 2014.

In industry, oil is the main energy source, accounting for 47.9% of the total in 2014, while natural gas had a share of 22.8%. Petrochemicals used 87% of oil and 46% of natural gas in industry. Electricity (17.1% of industry TFC) is widely used in all subsectors, while biofuels and waste (4.4%) were mostly own-used in wood, and paper and pulp industries. Coal (5.7%) is essential in iron, steel and cement production, while heat (2.2%) was used in petrochemicals, food and beverage, and pulp and paper industries. Compared to 2004, the share of oil has increased from 38.6% and that of biofuels and waste from 2.8%, while the share of natural gas has decreased from 28.7% and that of coal from 8.9%. The shares of electricity and heat have remained relatively constant in industry's TFC.

The residential and commercial sectors (including agriculture) together consume mostly natural gas (37.2%), electricity (28.7%) and oil (27.9%). Biofuels and waste accounted for 4.4% of the total, heat for 0.9%, coal for 0.6% and solar energy for 0.2%. In 2013, the share of oil was the third-highest among the IEA member countries, after Switzerland and Ireland, and reflects the prevalence of oil heating in Belgium. The main trend, however, has been the decline of oil and gas and the rise of electricity. From 2004 to 2014, oil demand decreased by 39.7%, and natural gas by 17%, while electricity consumption grew by 6.4%.

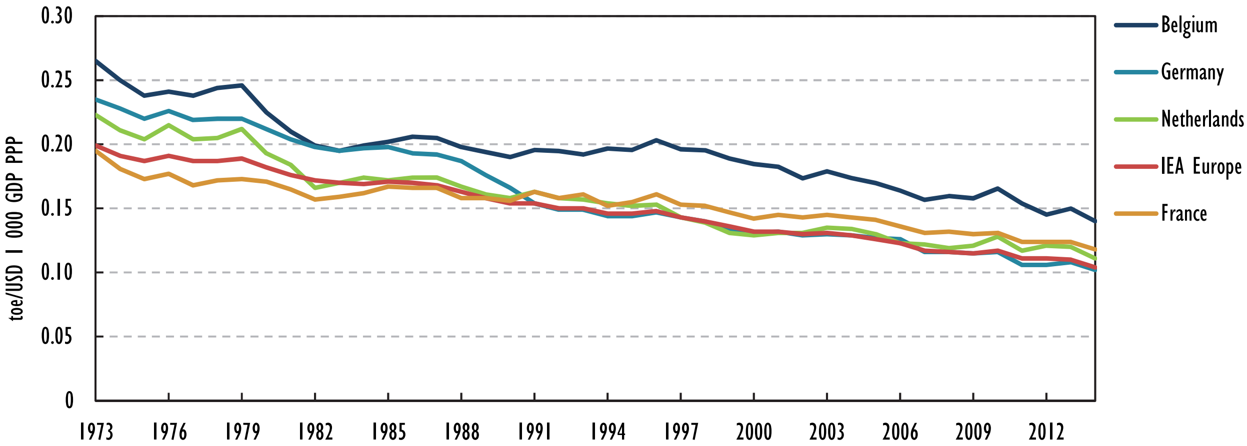
ENERGY INTENSITY

Energy intensity, measured as the ratio of total primary energy supply (TPES) per unit of real gross domestic product adjusted for purchasing power parity (GDP PPP) was 0.12 tonnes of oil-equivalent per USD 1 000 PPP (toe/USD 1 000) in 2014. The ratio is higher than the IEA Europe average of 0.10 toe/USD 1 000 PPP, in part reflecting the weight of Belgium's refining and petrochemicals complex. The country's energy intensity is ranked eighth-highest among IEA member countries. The TPES/GDP ratio declined by 19.3% from 2004 to 2014, roughly at the same rate as the IEA average (Figure 4.2).

A further common indicator for international comparisons is energy consumption per capita (see Figure 4.3). Belgium's rate of 4.8 toe per capita per year is eighth-highest among IEA member countries.

1. There was a break in the series in commercial and residential consumption between 2007 and 2008 due to revisions of the Statistical Classification of Economic Activities in the European Community (NACE), and therefore comparisons cannot be made before 2008.

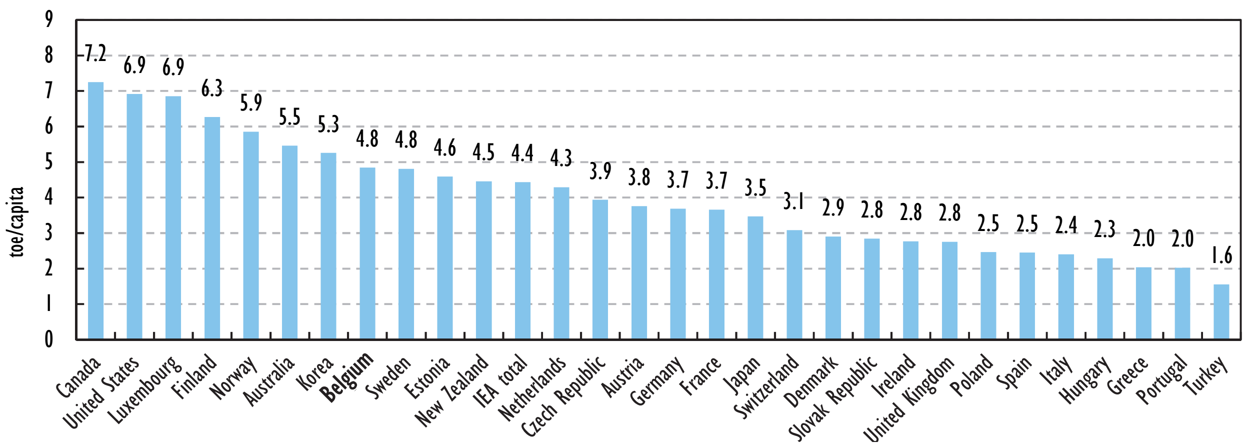
Figure 4.2 Energy intensity in Belgium and in other selected IEA member countries, 1973-2014



Note: Data for 2014 are provisional for Belgium and estimated for other countries.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 4.3 TPES per capita in IEA member countries, 2014



Note: Data for 2014 are provisional for Belgium and estimated for other countries.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

INSTITUTIONS

Energy efficiency policy falls within the competence of the regional governments, while the federal state implements some measures aimed at enhancing energy efficiency within its own competences, such as public buildings and procurement. At the federal government level, the responsible body is the **Federal Public Service of Economy, SMEs, Self-employed and Energy**, and in the Brussels-Capital region it is the **Brussels Institute for Environmental Managemen**t. In the Flemish region, it is the **Flemish Energy Agency**, and in the Walloon region, it is the Department of **Energy and Sustainable Buildings of the Walloon Public Service** (regional government).

Consultation on energy efficiency policies between the regions and the federal state takes place within the CONCERE/ENOVER group (the federal-regional co-operation group on energy matters). This group holds regular meetings and comprises several expert groups, such as the Energy Efficiency Working Group (see Chapter 2, "General Energy Policy").

POLICIES AND MEASURES

Belgium's various policies and measures to improve energy efficiency and save energy originate from both the European Union and the country itself. European Union regulations are directly applicable in all member states, while EU directives leave the member states room to decide how to implement them.

EU DIRECTIVES AND REGULATIONS

Belgium's energy efficiency policies are aligned with several EU regulations and directives. Since 2006, European policies have been designed to help reach indicative (non-binding) EU targets for energy efficiency for 2016 and for 2020. The 2016 target is to reduce final energy use in the sectors outside the EU-ETS by 9% below their levels in the early 2000s. The 2020 target, agreed upon in 2007, is to reduce primary energy use in the Union by 20% from baseline projections.

The 2016 target was embedded in the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC). The directive encourages energy efficiency through the development of a market for energy services and the delivery of energy efficiency programmes and measures to end-users. It requires member states to create national energy efficiency action plans for meeting the target. The directive also sets the framework for measures such as financing, metering, billing, promotion of energy services, and obligations for the public sector. In addition, it requires that member states oblige energy distributors or retailers to offer either competitively priced energy services, audits, or other measures to improve energy efficiency.

The Energy Efficiency Directive 2012/27/EC (EED) was developed and adopted out of concern that the European Union was unlikely to reach the 20% energy efficiency target for 2020. The EED replaces the previous directive (2006/32/EC) and strengthens many of its elements. It comprises a series of binding measures and requires each member state to:

- Set an indicative national energy savings target for the period 1 January 2014 to 31 December 2020 in line with the EU-wide 20% by 2020 target.
- Oblige energy providers to achieve cumulative end-use energy savings by 2020 equivalent to 1.5% of annual energy sales over the seven years from 2014 to 2020. Member states may pursue alternative ways to achieve equivalent energy savings.
- Carry out a comprehensive assessment of national heating and cooling systems to identify and implement the cost-effective potential for deploying highly efficient co-generation, efficient district heating and cooling, and other efficient heating and cooling solutions by the end of 2015.
- Assess the energy efficiency potential of its gas and electricity infrastructure, in particular regarding transmission, distribution, load management and interoperability, and identify measures and investments for the introduction of cost-effective energy-efficient improvements in the network infrastructure by 30 June 2015.

- Ensure that the metering and billing of actual energy consumption in all sectors occur at a frequency that enables end-users to take informed decisions about their energy consumption; and that meters are installed for all energy sources at end-users' premises, if technically possible and economically feasible.
- Develop public procurement rules ensuring that central governments purchase only highly-efficient products.
- Facilitate the development of national financing facilities for energy efficiency measures.

In addition to the horizontal EED, several sectoral EU regulations and directives to increase energy efficiency are in force.

The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC, recast as 2010/31/EU) sets requirements for energy efficiency in building codes, including minimum energy performance requirements and energy certificates. The 2010 recast requires all new public buildings to be at least "near-zero energy" by the end of 2020, and all new buildings to reach this target by the end of 2020.

The recast Directive Establishing a Framework for Setting Ecodesign Requirements for Energy-related Products (Ecodesign, 2009/125/EC) aims to improve energy efficiency throughout a product's life cycle. It applies to products that use energy and to those that have an impact on energy use, such as building components. Product-specific standards are set by EU regulations that are based on the directive.

Requirements for energy labelling of household appliances are based on several directives adopted since 1992. The recast of the Energy Labelling Directive (2010/30/EU) expands the mandatory labelling requirement to cover commercial and industrial appliances and also energy-related appliances; product-specific labelling standards are set up under this directive.

Current EU transport policies aim to reduce CO_2 emissions from new passenger cars, which in practice will lead to efficiency improvements in the car fleet. Under Regulation 443/2009, car manufacturers and importers are obliged to limit CO_2 emissions from new passenger cars to a weight-based fleet-wide average of 130 grammes of CO_2 per kilometre (gCO_2/km) by 2015 and to 95 gCO_2/km by 2020. In terms of fuel consumption, the 2015 target roughly corresponds to 5.6 litres per 100 km (L/100 km) of petrol or 4.9 L/100 km of diesel. The 2020 target equates to around 4.1 L/100 km of petrol or 3.6 L/100 km of diesel. A similar regulation for new vans was introduced in 2011 (Regulation 510/2011), with a limit of 175 gCO_2/km by 2017 and 147 gCO_2/km by 2020.

NATIONAL POLICIES AND MEASURES

Energy efficiency is primarily a regional competence in Belgium. Policies and measures for meeting the 2020 target are listed in the 2014-2020 National Energy Efficiency Action Plan (NEEAP) which was preceded by the NEEAP for 2011-2020. The NEEAP is composed of the individual EEAPs of the three regions and their respective energy efficiency targets (Table 4.1.). The regions are in most cases responsible for implementing measures and monitoring progress. Major policies and measures are outlined in the following sectoral sections.

Table 4.1 Energy efficiency targets in Belgium by region

	Final energy saving target		Final energy saving achieved or projected		Primary energy saving achieved or projected in absolute terms
	In absolute terms	Percentage (compared to ESD reference consumption)	In absolute terms	Percentage (compared to ESD reference consumption)	
2012 achieved	/	/	• BCR: 851 GWh • WR: 5 384 GWh • FR: 16 499 GWh	• BCR: 4% • WR: 5.8% • FR: 8.8%	• BCR: 860 GWh • WR: 6 528 GWh • FR: 23 660 GWh
2016 forecast	• BCR: 2 199 GWh • WR: 8 358 GWh • FR: 16 959 GWh	• BCR: 9% • WR: 9% • FR: 9%	• BCR: 2 465 GWh • WR: 9 076 GWh • FR: 27 416 GWh	• BCR: 10% • WR: 9.8% • FR: 14.5%	• BCR: 2 514 GWh • WR: 11 172 GWh • FR: 35 361 GWh
2020 forecast	/	/	• BCR: 4 617 GWh • WR:12 014 GWh • FR: 36 074 GWh	• BCR: 19% • WR: 12.9% • FR: 19.1%	• BCR: 4 731 GWh • WR: 14 894 GWh • FR: 44 736 GWh

BCR: Brussels-Capital region; ESD: Energy Services Directorate; FR: Flemish region; WR: Walloon region.

Source: Federal Public Service (FPS) Economy.

Table 4.2 Instruments for the 2020 energy efficiency target

	Primary energy, Mtoe	Final energy, Mtoe
Baseline energy consumption in 2020	53.3	39.6
Estimated savings in 2020 according to policy instruments		
Energy Services Directive 2006/32 (from 2008 to 2016)	1.91	1.66
Energy Services Directive 2006/32 (from 2017 to 2020)	0.85	0.74
EU energy-climate package impact on electricity generation	0.30	0.12
Ecodesign and Labelling Directives 2009/125 and 2010/30	2.73	1.34
Voluntary agreements with industry	1.63	1.48
Additional savings from Energy Efficiency Directive 2012/27, article 7 (2014-20)*	0.19	0.15
Impact of the economic crisis	2.00	1.59
Total savings in 2020	**9.6**	**7.1**
Share of baseline energy consumption in 2020, %,	18.0	17.8
Target for energy consumption in 2020	43.7	32.5

* The Energy Efficiency Directive (article 7) obliges all energy distributors or energy retail sales companies to save 1.5% of their energy sales to final customers in a cumulative manner over the seven-year period from 2014 to 2020 (i.e. 1.5% in 2014, 3.0% in 2015, 10.5% in 2020). The savings are counted from the average of the years 2010-12. Several requirements of the EED overlap with policies and measures implemented with other instruments.

Source: Belgian NEEAP 2014.

Belgium has created several climate funds which include the revenue from auctioning emission allowances in the ETS sector, among others. These funds are used in particular, but not exclusively, to finance energy efficiency programmes and measures. Another main energy efficiency programme is the Rational Use of Energy (RUE) public service obligations imposed on the electricity distribution system operators (DSOs). The costs are passed on to consumers through electricity prices.

To meet the EU 2020 obligation, Belgium has set an indicative target to reduce primary energy use (excluding non-energy uses) by 18% by 2020 from the baseline projected in 2007. The target level is 43.7 Mtoe of TPES in 2020, corresponding to gross final consumption of 32.5 Mtoe. According to the European Commission (EC, 2015), if the trend in primary energy consumption from 2005 to 2013 continues up to 2020, Belgium may not meet its national target.

BUILDINGS

Buildings (residential and commercial) accounted for around one-third of TFC in 2013. Belgium's building stock is relatively old and has a high share of one-family houses. The turnover rate of the building stock is slow. From 1995 to 2015, the building stock grew on average by only 0.6% per year, according to Statistics Belgium. Over the same years, the demolition rate, at 0.2% per year, was also low by international comparison.

Belgium's building stock has a floor area of around 628 million m², out of which 78% are in residential buildings, according to estimates by the Buildings Performance Institute Europe (BPIE). In the non-residential stock, total floor area amounts to 129 million m². The non-residential stock includes wholesale and retail trade (26% of total non-residential floor area), offices (24%), educational buildings (19%), hotels and restaurants (12%), hospitals (7%), sport facilities (3%) and other types of energy-using buildings (9%).

Belgium has around 4.5 million residential buildings. One-family buildings accounted for 65% of the total floor area, a high share in Europe, and the remaining 35% were multi-family buildings, according to BPIE data. Around 2.8 million residential buildings (62% of the total) were built before 1970. These older buildings are on average significantly less energy-efficient than those built after 1990, let alone those built according to the current energy efficiency requirements.

The three regions have incorporated energy efficiency requirements for new buildings into their building codes. In line with the EPBD, these requirements are based on the integrated performance of the whole building and all energy uses. Typically, the building codes include maximum U-values[2] for building components and minimum efficiency performance standards for thermal installations and lighting. The rules vary somewhat by region, however. In the Flemish region, for example, the performance standards apply to renovations only and lighting efficiency requirements apply to non-residential renovations only.

The EPBD also requires Belgium and other member states to introduce mandatory energy performance certificates (EPCs) that provide clear information on buildings' energy performance to prospective tenants and buyers. EPCs must include reference values that allow consumers to compare and assess energy performance. They must also be accompanied by recommendations for cost-effective improvement options to raise the energy performance and rating of the building. EPCs must be published at the time of advertising a building's sale or rental, purchase agreement or rental contract.

2. The U-value represents the rate of heat loss, i.e. how much energy passes through one square metre of a material by a difference of one degree of temperature. It is measured in watt (W) per degree Kelvin (K) per m^2.

Under the Energy Efficiency Directive (2012/27/EC), Belgium is also required to establish strategies for the renovation of its building stock. It is further required to improve the energy performance of 3% per year of the total floor area of heated and/or cooled buildings owned and occupied by the central government. For the buildings of the federal government, this work is the responsibility of the Régie des Bâtiments, the real estate specialist of the federal government. Since summer 2015, Belgium's Federal Energy Services Company (FEDESCO) is also part of the Régie des Bâtiments.

From the end of 2020, all new buildings in the European Union must be near-zero energy buildings (NZEB). In November 2013 the Flemish region introduced requirements for NZEB and the path towards 2020. In the Walloon region, studies to determine the most cost-effective path to NZEB are under way and will also support the region's long-term building renovation strategy.

In the Brussels-Capital region, since 2010, all new public real-estate developments must meet the passive house standard. This obligation includes a conversion to the passive standard in social housing in Brussels. Since January 2015, all new buildings must meet the maximum energy performance level of 15 kWh per m^2 per year. Implementation is monitored and evaluated under the Brussels Air, Climate and Energy Control Code (COBRACE, see Chapter 3, "Climate Change").

Regarding measures to improve energy performance of existing buildings, tax deductions on energy efficiency investments are offered to companies by the federal government and to citizens on property tax by the regions (on the Flemish side, the property tax deduction applies to new buildings only). A similar system applies to renewable energy investments.

In the Flemish region, the Energy Renovation Programme 2020 is being implemented. The programme focuses on supporting the three most important investments: insulation, high-performance glazing and efficient heating. An important source of funding comes from electricity DSOs that are under a rational use of energy (RUE) public service obligation.

In addition, a "Renovation Pact" was launched in December 2014. The objective of the pact is to develop a short- to long-term action plan to multiply the number of renovations of the building stock and raise the energy performance close to the NZEB level. Around 30 organisations are involved in developing the programme.

The Walloon region is preparing a long-term building renovation strategy that will reinforce and complement the first Job & Environment Alliance for 2009-14 (AEE in French). The Alliance had a budget of EUR 879 million for 2009-14 and aimed to make buildings more sustainable through various measures. A large part of the funding was dedicated to zero-interest loans or grants either for households or public entities for energy-efficient renovations. The Alliance also funds the renovation of more than 12 000 social housing units (flats or buildings), around 12% of the total public housing stock in Wallonia. It also included a specific programme for public buildings and training skilled workers for the building sector. The Walloon region also supports energy audits of residential and public buildings through specific programmes. Since 2006, more than 30 000 buildings have been audited.

According to the Alliance evaluation in April 2014, the AEE measures saved 2.1 GWh of final energy in 2014 (or 4.6% of targeted household-sector consumption). The final energy savings are expected to rise to 5.5 GWh by 2020.

In the Brussels-Capital region, the service sector accounts for 32% of TFC, much more than the 13% nationally. Energy audits are mandatory for non-residential buildings of more than 3 500 m², upon renewal of the environmental permit. The audits must be followed by mandatory cost-effective measures (with a payback time of less than five years). This regulation applies to 23.4 million m² of floor area and is expected to save between 6% and 19% of TFC in the service sector.

The Brussels-Capital region also offers individuals and businesses subsidies for renovation projects or for purchasing renewable energy and energy-efficient appliances. The subsidies apply to renewable energy facilities (solar boilers and photovoltaic panels), combined heat and power (CHP) production, district heating, energy audits, insulation, high-performance glazing and boilers, green rooftops or façades, ventilation, and energy-efficient appliances, such as highly-efficient refrigerators and washing machines. Zero-interest loans are available for low- or medium-income families for improving the energy efficiency of their homes.

TRANSPORT

Private cars remain the dominant form of passenger travel in Belgium (see Table 4.3). Traffic volume by passenger cars increased by 23% from 1990 to 2013, while bus use grew by 89% and railway use for passenger transport by 62%. Over the same period, Belgium's population only grew by 12%. In 2013, Belgium had 1.6 million more passenger cars than in 1990, an increase of 42%. Passenger car density has risen from 387 in 1990 to 491 per 1 000 inhabitants in 2013, equal to the EU-28 average. Road congestion in the densely populated country may partly explain why car use has grown at a slower pace than the number of cars.

Freight is mostly transported by road. It accounted for 63% of the total in tonne-kilometres in 2013, but its share has decreased in recent years, while that of inland waterways has increased to 20%. Rail and pipeline transport of goods has remained relatively flat since 2000. International haulage accounted for 42% of all haulage by heavy-duty vehicles registered in Belgium.[3] Freight volumes are generally closely linked to developments in the overall economy, and national haulage volumes have remained rather flat since 2000, despite the 44% increase in freight transport by inland waterways.

Table 4.3 Modal breakdown of passenger transport on land, 2013

Mode	Car	Buses and coaches	Train	Tram and metro
Share of passenger-km, %	76.8	15.0	7.3	0.9

Source: *EU Transport in Figures – Statistical Pocketbook 2015.*

A distinct feature of Belgium's transport sector is the high share of company cars – they account for 42% of all passenger cars registered since 2005. Belgium has relatively high income tax rates, and the personal use of company cars and company fuel cards is often taxed much less than regular employment income. According to an OECD study of 27 countries (Harding, 2014), Belgium provides the largest annual effective subsidy per

3. The statistics (EC, 2015) do not, however, indicate the volume of haulage by foreign heavy-duty vehicles in Belgium. From 2000 to 2013, international haulage by vehicles registered in Belgium declined by 56%. The statistics do not indicate either the country in which these vehicles refuel, i.e. which country's TPES, TFC and CO_2 emissions statistics show the impact.

car: EUR 2 763. The weighted average for the 27 countries was EUR 1 600. This, in turn, encourages car and fuel use, although the exact impact has not been quantified. Changing the company car system to an income tax-neutral one would require a broader reform of the income tax system.

The competence for transport policy is shared between the federal and regional governments. The federal government is responsible for railway policy and national airports. The regions are responsible for road transport policy, inland waterways and regional airports. The federal government is aware that more co-ordination between the different authorities would help improve mobility policy in Belgium. Closer consultation with the regions and stakeholders is planned for 2016, while the central government considers an integrated national mobility plan too ambitious at this stage.

A major reform and a successful example of cross-regional co-operation is the introduction in 2016 of a mileage charge for trucks. The tariff will depend on the distance travelled, load weight and environmental performance of the truck. VIAPASS, a joint interregional institution between the three regions, is in charge of organising the system. The three regions are now studying whether road charging could be extended to passenger cars.

At the federal level, the railway policy is being translated into the multi-annual public service operations contracts concluded between the Federal State and the railway operator (Société Nationale des Chemins de Fer Belges, SNCB) on the one hand and the infrastructure manager (Infrabel) on the other hand. Discussions about concluding new public service operations contracts are about to start. The challenges that the railways will have to face in the coming years are subdivided into six strategic themes that require a priority approach, and specific objectives need to be attained through these contracts, in particular punctuality, safety, capacity and availability, customer satisfaction, efficiency and corporate social responsibility.

At the regional level, the Flemish region has adopted a mobility plan which focuses on three areas: limiting the number of vehicle-kilometres by road, improving the environmental characteristics of the vehicle fleet and fuels used, and encouraging eco-driving. In addition, measures have been taken to improve inland waterway transport. More concretely, the Flemish region aims to reduce GHG emissions from transport in 2030 by 16% below 2005 levels, to meet emission ceilings for particulate matter (PM), oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and sulphur dioxide (SO_2) and increase the share of renewable energy in transport fuels.

The Walloon region has not adopted a comprehensive mobility plan, but it has taken measures to shift freight away from roads to less-polluting modes, such as waterways. In 2010, it adopted a plan to promote cycling.

The Brussels-Capital region adopted in 2012 a mobility plan for the years 2015-20 (IRIS II). The plan aims at controlling and rationalising the demand for car use, developing public transport and organising urban development according to the numbers of pedestrians and cyclists and the availability of public transport. The main targets of the IRIS II plan are to reduce traffic volume by 6% to 10% in 2015 and by 20% in 2018 below 2001 levels, and to reduce the number of roadside parking spaces by 16% from 2010 to 2020.

APPLIANCES AND EQUIPMENT

Requirements for minimum energy efficiency standards and energy labelling of appliances are based on EU law, in particular the Ecodesign Directive 2009/125/EC on energy efficiency and related product-specific regulations, and Directive 2010/30/EU on Energy Labelling. Implementing the Ecodesign and Labelling Directives is a federal competence in Belgium.

The first Energy Labelling Directive dates from the early 1990s. It rated the energy efficiency of a range of household appliances on a scale from A to G, with A being the most efficient. The current Energy Labelling Directive (2010/30/EC) defines ratings of A+, A++ and A+++ for some appliances, such as household refrigerators and washing machines, as their energy efficiency has improved significantly since the early 1990s.

The first minimum efficiency performance standards (MEPS) were applied to household refrigerators under Directive 96/57/EC from September 1996. The successor to that directive is the Ecodesign Directive (2009/125/EC), first adopted in 2005 and recast in 2009 to make provision for MEPS for both energy-using and energy-related products (e.g. windows).

Under the Ecodesign Directive, the European Union introduces product-specific regulations that apply directly in all EU member states. To date, MEPS have been developed for around 20 product groups. In addition to household appliances, the Ecodesign Directive is also applied to industrial equipment. The first four regulations under the directive were on industrial products (motors, circulators, fans and water pumps).

Wallonia has set up a EUR 13 million investment fund to help cities replace 62 000 street lights with more energy-efficient lighting. The work will be done by the distribution system operators (DSOs) which will be reimbursed by the cities.

Regarding public procurement, the federal government subscribes to the EU goal of 50% sustainable procurement procedures for all federal public procurements. There is a guide for public procurement of supplies and services available for the contracting authorities of the Federal Public Services. Voluntary guidelines and technical requirements are included in this guide to promote and improve energy efficiency.

INDUSTRY

Energy-intensive industries are regulated under the EU-ETS which, in principle, should encourage energy efficiency improvements, but the low CO_2 allowance prices in recent years have dampened that effect.

The 2012 Energy Efficiency Directive (EED) requires large enterprises to carry out an energy audit at least every four years, with the first one to be completed by December 2015. These audits should take into account relevant European or international standards, such as EN ISO 50001 (Energy Management Systems), or EN 16247-1 (Energy Audits). Under the EED, member states should also encourage the development of training programmes for energy auditors. The EED also encourages member states to offer incentives for small and medium-sized enterprises (SMEs) to undergo energy audits. In Belgium, these requirements are implemented by the regional energy agencies.

Voluntary agreements with industry have been used in both the Flemish and Walloon regions. Current agreements run from 2015 to 2020. In the Flemish region, the companies pledge to take profitable investments, with an internal rate of return (IRR) of at least 12.5% (non-ETS) and 14% (ETS). The companies will also examine the potential of cost-effective measures, conduct a CHP feasibility study and implement an energy management system. In Wallonia, the agreements are targeting 3.1 TWh (0.3 Mtoe) of savings from 2014 to 2020.

The companies under voluntary agreements will avoid additional obligatory energy-efficiency or CO_2 reduction measures. The federal government would also apply reduced excise duties on companies that volunteer to make investments in energy efficiency, but this arrangement's compatibility with the recently revised EU state-aid rules for environmental protection and energy did not seem possible. The federal government then reduced the rate of excise duty on natural gas to the EU minimum (EUR 0.54 per MWh) from 1 January 2016 on. This corresponds to about half the initial reduction of excise duties for the Flemish companies under the voluntary agreement scheme. The implementation rules for the other half of the initially planned excise duty reduction remain subject to negotiations between the industries and the federal and regional authorities.

Companies can deduct investments on energy efficiency from their taxable profits. The rate of this increased investment allowance and the categories of eligible investments are determined by the federal government. For investments made in 2013, the rate was 14.5%. Companies in the Flemish region can apply for a grant (EP-Plus) when they are investing in energy efficiency in their utilities and processes. The subsidy amount depends on the Eco-class (A, B, C or D) of the technology. To promote energy efficiency among SMEs, the Flemish government has adopted the SME energy efficiency plan (KEEP). This includes support for advice and energy investments.

COMBINED HEAT AND POWER (CHP)

In 2013, Belgium's CHP facilities had a total capacity of about 2 600 megawatts electrical (MW_e), compared with a total conventional thermal capacity of 7 559 MW_e. Out of this total CHP capacity, 1 986 MW were fossil-fired CHP units and 609 MW were biofuels and waste power plants, according to FPS Economy. CHP capacity has increased consistently from around 1 500 MW_e in 2005 when financial support for the sector was introduced through CHP and green certificates. Most of the capacity is in the Flemish region (around 2 100 MW_e) and linked to industry. The Walloon region has around 500 MW_e of CHP capacity and the Brussels-Capital region less than 100 MW_e. Heat from CHP facilities is competitive at industrial facilities. However, in space heating, large-scale use of CHP for district heating remains marginal as it typically competes with the dominant gas boiler solutions.

CHP is promoted through both investment support and green certificates in the Brussels-Capital and Walloon regions, and certificates in the Flemish region (see Chapter 9 on Renewable Energy for more details on the certificate schemes). At the federal level, investments in CHP are encouraged through tax deductions on taxable profits (see previous section on Industry).

In the Flemish region, CHP electricity accounted for 19.6% of all electricity demand in 2013. Primary energy savings derived from CHP use are around 10 TWh per year. CHP certificates are issued for primary energy savings by CHP facilities, parallel to the renewable electricity support system. The support level for CHP is differentiated by category which includes technology (engines, gas turbines, steam turbines, combined cycles) and power range. There are also different categories for new installations and for substantially refurbished installations. The level of support is evaluated every year for each category, with a focus on the appropriate return on investment.

Investment support is granted for highly-efficient micro-CHP (less than 50 kW_e) in social housing for up to 35% of the investment cost. However, for facilities with a capacity of less than 2 kW_e, the investment support is up to 45% of the costs.

In the Walloon region, CHP accounted for 9% of electricity supply in 2013, thanks to several support systems. In Wallonia's green certificate scheme, certificates are awarded on the basis of CO_2 avoided. Biofuels account for around half the fuels for CHP; while in the Flemish region, natural gas and waste account for almost all fuels for CHP. The Walloon region also offers an investment subsidy equalling 20% of eligible costs, with a cap of EUR 15 000 per individual installation, and a subsidy for up to EUR 100 000 for a district heating network.

The Brussels-Capital region supports CHP through green certificates. It also grants investment support of EUR 3 500 to 4 500, depending on the income category, and with a maximum of 30% of the relevant/eligible parts of the expenses. The region also offers an expert point of contact free of charge to advise professionals who would like to install a CHP unit or study the possibility of installing one.

ASSESSMENT

Both TPES and TFC peaked last decade and have remained rather flat since then. Energy intensity has been steadily decreasing and energy demand is thus becoming decoupled from GDP. This can be partly attributed to changes in the economic structure and activity, but also to improvements in energy efficiency. Industry is the largest energy-consuming sector, accounting for 45% of TFC in 2013, followed by households (21%), transport (20%) and others (14%).

As an EU member country, Belgium has an indicative national target to reduce TPES by 18% from the baseline projection in 2020. More efficient use of energy will bring Belgium multiple benefits. It will improve energy security, save money and build wealth, and limit GHG emissions and local air pollution, for example. When choosing between various energy efficiency measures, cost-effectiveness should be prioritised.

Energy prices give end-users important signals for using energy. The prices of oil, natural gas and electricity in Belgium are around the IEA median, but several direct and indirect policies make energy available to consumers at reduced prices. These include social policy measures, but also fuel cards related to company cars and value-added tax (VAT) exemptions on electricity use for industry. The IEA urges the federal government to abolish these subsidies and replace them with more targeted measures on social and corporate welfare. In particular, abolishing tax relief and other incentives for fossil fuel use helps save energy and reduce harmful emissions. In this context, the government should consider a broad tax reform to stimulate energy efficiency. The government should also consider using at least part of the budgetary leverage thus gained to fund energy efficiency measures.

The three regions have most of the legal responsibility for energy efficiency. Since the last in-depth review, their responsibilities have increased. On energy efficiency in buildings, the three regions have introduced several policies and measures to meet the requirements of the EU Directive on the Energy Performance of Buildings. Those requirements are gradually strengthened in order to reach the level of near-zero energy buildings (NZEB) for new buildings by the end of 2020. This long-term approach gives real estate owners and constructors clear signals. The Flanders region is already phasing in the NZEB performance requirements, while the Brussels Capital region has a particularly ambitious building code in order to promote energy-efficient new buildings. Essential for meeting the overall energy performance standards (kWh/m^2) for new buildings is to ensure an effective system for monitoring and enforcing them.

Belgium's building stock is relatively old and has a high share of one-family houses. The turnover rate of the building stock is slow, owing to low rates of construction and demolition. Therefore, buildings renovation should remain a priority and its rate should be accelerated, as it provides large cost-effective potential for further efficiency gains and emissions reductions.

In the transport sector, CO_2 emissions remain larger than in any other sector. Strong action is needed to reduce them. Belgium ranks high in attractiveness for logistics, quality of the infrastructure and speed of delivery. High volumes of freight pass through Belgium and several measures exist to support shifting freight from road to rail and waterways. In particular, the IEA welcomes the three regions' decision to introduce nationwide road pricing for heavy-duty vehicles in 2016. The road charge decision is a good example of harmonisation and closer co-operation across the three regions. In the transport sector, Belgium would benefit from a clear national policy for promoting energy savings and efficiency.

In order to stimulate efficiency gains and CO_2 emissions reductions, Belgium should consider expanding road pricing to cover other vehicles. Together with its neighbours, it should also consider increasing transport fuel taxes in a revenue-neutral way. Finally, the country's favourable tax treatment of company cars and fuel cards should be gradually phased out to help meet energy efficiency and climate policy goals.

For industry, the voluntary agreements in Wallonia and Flanders provide a fine platform for increased energy efficiency. These agreements complement the requirements on energy-efficient measures in the sector imposed under the EU Energy Efficiency Directive. Compared to mandatory measures, voluntary agreements give companies more flexibility and typically require less administration. Monitoring and enforcing the implementation of the agreements is essential, as is a regular review of their targets. The continued implementation of the agreements depends, however, on a decision by the European Commission on their compatibility with the EU state aid rules.

RECOMMENDATIONS

The government of Belgium should:

General

- ☐ *Abolish tax relief and other incentives for fossil fuel use and the reduced value-added tax rates on electricity; use at least part of this revenue to fund energy efficiency measures.*

- *Analyse options for a broad tax reform to stimulate energy efficiency.*
- *Prioritise cost-effectiveness when choosing between energy efficiency measures.*
- *Ensure robust monitoring and verification of energy savings from the various energy efficiency programmes.*

Buildings

- *Strengthen the incentives for buildings renovations, both to increase the effectiveness of energy-efficient measures and to accelerate the rate of renovation of the building stock.*
- *Ensure an effective system for monitoring and enforcing the energy performance requirements (kWh/m^2) for new buildings.*

Transport

- *Form a joint vision across all governmental levels on infrastructure and support for sustainable mobility options for passengers and freight.*
- *Phase out favourable tax treatment of company cars and fuel cards to help meet energy efficiency and climate policy goals.*
- *Consider expanding the road-pricing system for heavy-duty vehicles to other vehicles; consider increasing transport fuel taxes in a revenue-neutral way to stimulate efficiency gains and CO_2 emissions reductions.*

Industry

- *Continue the voluntary agreements with industry and ensure they are duly monitored, enforced and regularly reviewed.*

References

EC (European Commission) (2015), *EU Transport in Figures – Statistical Poketbook 2015*, Brussels.

Harding, M. (2014), "Personal Tax Treatment of Company Cars and Commuting Expenses: Estimating the Fiscal and Environmental Costs", *OECD Taxation Working Papers*, No. 20, OECD Paris, http://dx.doi.org/10.1787/5jz14cg1s7vl-en.

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PART II
SECTOR ANALYSIS

5. OIL

Key data (2014 provisional)

Crude oil production: Nil

Crude oil net imports (including NGLs and feedstocks): 32.4 Mt, -7.6% since 2004

Oil products net exports: 3.5 Mt (imports 22.3 Mt, exports 25.7 Mt), +32.2% since 2004

Share of oil: 42.3% of TPES and 0.3% of electricity generation

Supply by sector: 22.8 Mtoe (industry 40.1%, transport 35.7%, residential 10.2%, other energy 8.9%, commercial and public services and agriculture 5%, power generation 0.2%)

SUPPLY AND DEMAND

SUPPLY

Oil is the largest energy source in Belgium, representing nearly 43% of total primary energy supply (TPES). Oil supply totalled 22.8 million tonnes of oil-equivalent (Mtoe) in 2014, or 2.9% more than in 2013. Supply increased for two consecutive years since 2012, after a 12% drop from 2010 to 2012. Over the past ten years, oil supply has fluctuated moderately, finishing 5.3% lower in 2014 than in 2004.

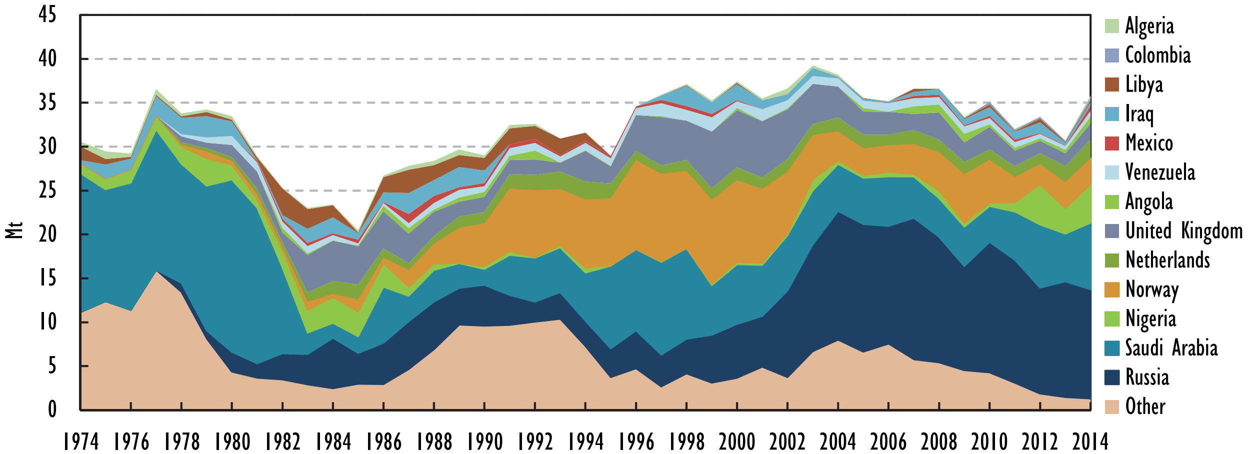
Crude oil

Belgium relies on imports for all crude oil, including natural gas liquids (NGLs) and refinery feedstocks. Imports amounted to 35.8 Mt of crude oil during 2014, 0.5 Mtoe of NGLs and 3.1 Mtoe of feedstocks. They were sourced from Russia (34.7%), Saudi Arabia (21.2%), Nigeria (12.2%), Norway (8.4%), the Netherlands (6%) and a variety of other countries (Figure 5.1).

Crude oil, NGLs and feedstocks imports are volatile year-on-year, averaging 34.4 Mtoe over the ten years to 2014, and were 6.1% lower in 2014 than in 2004. During this period, imports from Russia declined by 15.2%, while imports from Saudi Arabia increased by 41.5% and from Nigeria by 907%. Nigerian imports surged in 2011 and 2012 and imports from Colombia, Mexico, Algeria and Kuwait began to enter the market in the past five years.

Belgium exported 3.4 Mtoe of refinery feedstocks in 2014, with relatively consistent exports over the past ten years.

Figure 5.1 Crude oil imports by country, 1974-2014



Source: IEA (2015c), *Oil Information 2015*, www.iea.org/statistics/.

Oil products

Belgium produced 35.3 Mt of oil products in 2014, or 18.9% less than in 2004. For obvious reasons, oil products follow changes in crude oil imports. Refinery output varies moderately year-on-year, averaging 35.5 Mtoe from 2004 to 2014.

In 2014, Belgium's refinery production consisted of gas and diesel oil (37.9% of the total), fuel oil (15.6%), gasoline (13%), naphtha (7.3%), kerosene-type jet fuel (4.7%), bitumen (3.1%), and others. Over the past decade, the product mix has changed towards gas and diesel oil (up from 28.4% of the total) and naphtha (up from 5.3%), and away from fuel oil (down from 19.3%).

Belgium was a net exporter of oil products in 2014, with net exports of 3.5 Mt (imports of 22.3 Mt and exports of 25.7 Mt). As traded volumes are similar, Belgium fluctuates from being a net importer to a net exporter year-on-year. Over the past ten years, imports have grown by 14.3% and exports by 16.5%.

In 2014, oil products from Belgium were mostly exported to the neighbouring countries: the Netherlands (40.6%), Germany (19.7%), the United Kingdom (8.2%), France (8%) and Luxembourg (7.4%). The top five countries from which Belgium imported oil products in 2014 were the Netherlands (51.1% of the total), Russia (20%), France (5.1%), Norway (3.7%) and the United States (3.5%).

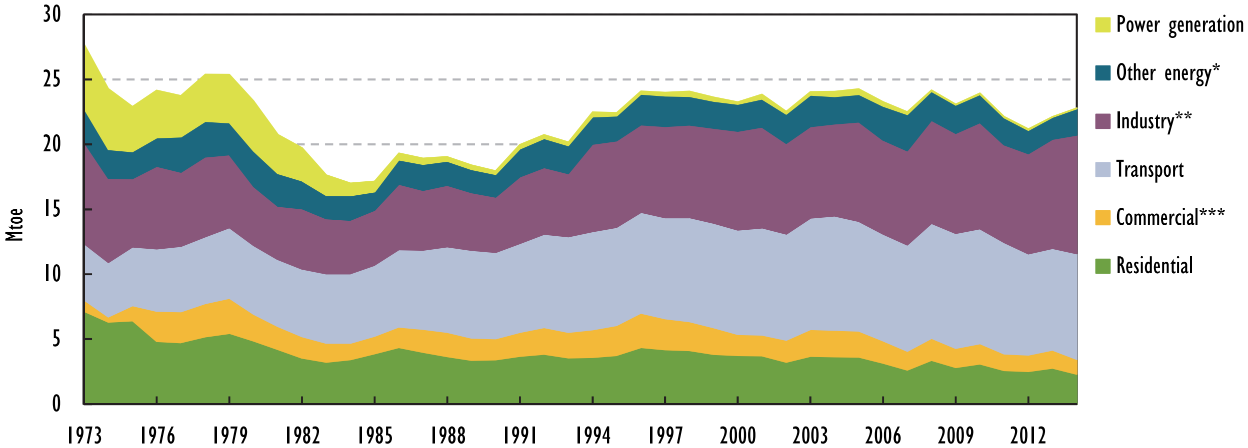
DEMAND

Industry is the largest oil-using sector, accounting for 40.1% of total demand in 2014. Transport had a share of 35.7% (Figure 5.2). The remaining 24.2% is made up of residential use (10.2%), energy own-use and further refining (8.9%), commercial and public service and agriculture (5%) and a small share of power generation (0.2%).

From 2004 to 2014, oil demand increased by 29% in industry, but decreased in the other sectors. Because of industry's demand growing strongly, its share in total consumption has increased from 29.4% in 2004, overtaking transport as the largest consuming sector in 2012.

The strongest decline was in power generation, which has nearly phased out oil consumption (a 90.3% decline since 2004). In energy own-use and refining, demand decreased by 3.6%, in the residential sector by 36.5% and the commercial sector by 44.7%. Demand from transport was 7.5% lower.

Figure 5.2 Oil supply by sector, 1973-2014



Note: TPES by consuming sector.

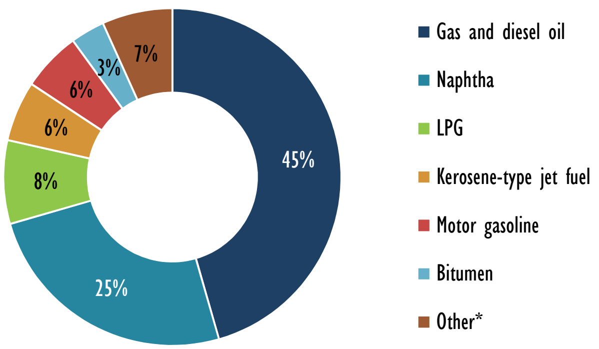
* *Other transformations* includes refineries and energy own-use.

** *Industry* includes non-energy use.

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

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 5.3 Oil consumption by product, 2014



* *Other* includes fuel oil, petroleum coke, other kerosene, lubricants, white spirit, aviation gasoline and other non-specified oil products.

Source: IEA (2015c), *Oil Information 2015*, www.iea.org/statistics/.

Gas and diesel oil are the most used oil products in Belgium, accounting for 45% of total oil products consumption (Figure 5.3). This partly reflects the structure of Belgium's vehicle fleet: freight transport by road uses almost solely diesel and, out of Belgium's 5.5 million passenger cars in 2014, 61.7% ran on diesel and 37.1% on gasoline, according to Febiac, the car industry organisation. Diesel cars overtook gasoline cars in numbers in 2005. The government has maintained excise taxes for diesel significantly lower than petrol, originally to help commercial users. On the other hand, the country's large company car fleet (accounting for 42% of passenger cars registered since 2005) is around 80% diesel, reflecting lower fuel costs per kilometre.

Although Belgium had more diesel cars than ever in 2014, the decades-long dieselisation trend seems to have stabilised, as the share of diesel cars in total passenger car stock has remained at 62% from 2011 to 2014. Also, the share of diesel cars in new car registrations has declined from the peak of 79% in 2008 to 62% in 2014. The turn in the trend can be explained by policy changes. In 2008, the purchase of low-CO_2 emitting cars was subsidised at the federal level and also in the Walloon region. All these measures favoured purchasing diesel cars, which emit less CO_2 than petrol ones. Subsequently, however, the measures have been abandoned, partly because of budget constraints, but also to avoid a strong dieselisation of the car fleet. The excise tax reform of October 2015 will also discourage the use of diesel cars, as the government will significantly increase excise duties on diesel until 2018 and, at the same time, reduce the excise duties on gasoline.

Reflecting the significance of Belgium's petrochemicals sector, naphtha accounted for 25% of oil products demand in Belgium in 2014, while liquefied petroleum gas (LPG), kerosene-type jet fuel, motor gasoline and bitumen accounted for 23%. The small remainder is made up of fuel oil, petroleum coke, other kerosene, lubricants, white spirit, aviation gasoline and other non-specified oil products. Since 2004, owing to sector-specific demand, changes brought on by a strong increase in industry demand, the products mix consumed in Belgium has also changed. The largest change has been a surge in demand for naphtha, up from a share of 18.4% in 2004, and for LPG, up from 1.5%, while the share of gas and diesel oil has contracted from 51.4% and motor gasoline from 8.4%.

INFRASTRUCTURE

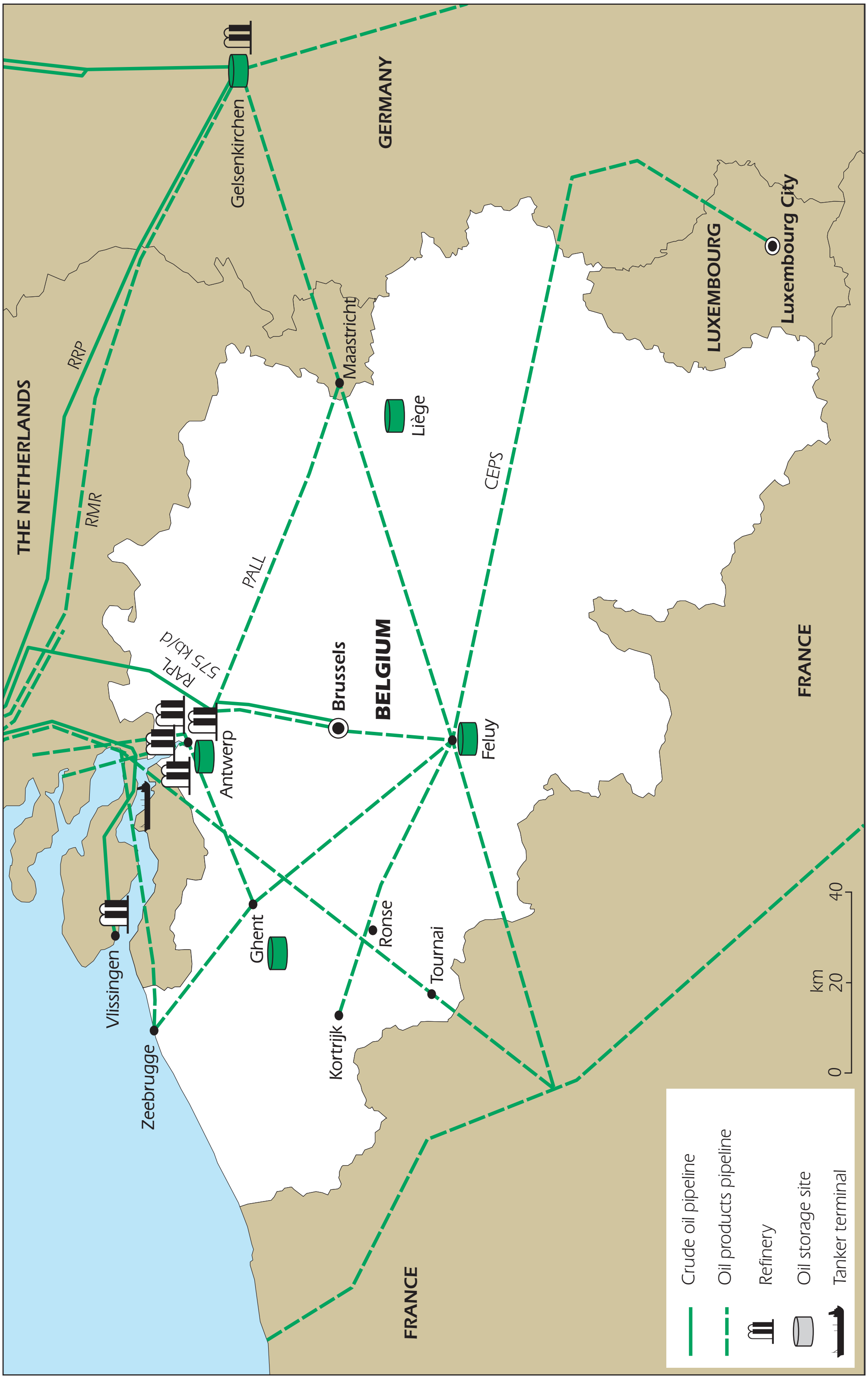
REFINING

Belgium's four refineries – all located in Antwerp – have a total crude distillation capacity of 792 thousand barrels per day (kb/d) equivalent to 39 million tonnes (Mt) per year. The most notable change in refinery activity in recent years is the increase of desulphurisation capacity, from in 32.8 Mt 2011 to 38.4 Mt in 2013. This development is a response to EU specifications to gradually reduce sulphur content for gasoline and diesel.

The two major refineries, owned by Total (357 kb/d) and ExxonMobil (307 kb/d), are among the largest in Europe and capable of producing a high yield of light and middle distillates. The third one, purchased in 2012 by Gunvor from Petroplus, is the smallest (107.5 kb/d) and least complex of the three; however, investment in hydro-treating has given it the capacity to produce 10 parts per million (ppm) diesel from a predominantly sour crude slate. The fourth refinery, recently acquired by the VTTi group, is an asphalt plant with a capacity of around 21 kb/d. Both Total and ExxonMobil are investing around EUR one billion each in their Antwerp refineries to produce less heavy fuel oil and more low-sulphur transportation fuels, such as marine gas oil and diesel.

In 2014, the country's refined products output totalled 735.7 kb/d and the capacity utilisation rate of Belgium's refineries was 93%. Belgian refineries are able to meet domestic demand for residual fuels, diesel, jet kerosene and gasoline. The production falls short on naphtha, LPG and ethane.

Figure 5.4 Map of Belgium's oil infrastructure, 2014



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

In order to consider the challenges facing the refining sector, the government has set up an informal working group, bringing together industry and representatives of both the federal and regional governments.

PORTS AND PIPELINES

The Port of Antwerp is Belgium's main sea terminal for oil trade. According to the Antwerp Port Authority, maritime cargo trade of crude oil and products reached 51 million metric tonnes (Mt) in 2014. Since 2000, trade in oil products has more than doubled from 20.0 Mt to 46.0 Mt in 2014. Over the same period, trade volumes in crude oil declined by 61% from 8.2 Mt in 2000 to 5.0 Mt in 2014.

The main crude oil pipeline serving Belgium is the Rotterdam (the Netherlands) - Antwerp pipeline (RAPL). It has a capacity of 575 kb/d.

Apart from inland waterways, a key method for transportation of oil products in Belgium is via the Central European Pipeline System (CEPS). The CEPS is a North Atlantic Treaty Organization (NATO) pipeline network in Europe comprising 6 000 km of pipeline interconnected to roughly 8.2 million barrels (mb) or 1.3 million cubic metres (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.

STORAGE

Belgium has more than 40 oil storage facilities, with a total combined capacity of just over 12 mcm or 75 mb (10.2 Mt of crude equivalent). This includes capacity used by industry for normal operations as well as storage capacity used by APETRA for strategic reserves. APETRA is the sole manager of Belgian strategic oil stocks since April 2012, taking over all obligations from industry.

Around 1.4 mcm of the capacity are reserved for APETRA, with 0.38 mcm added in 2012 and another 0.47 mcm that became operational in 2013. This additional capacity was reached both through expansion of existing facilities and the construction of new ones.

RETAIL MARKET STRUCTURE

Oil products supply is relatively competitive in Belgium. In the gasoline segment, Total had 27% of the market in 2013, Argos 17%, ExxonMobil 16%, Q8 13% and Lukoil 11%. Smaller suppliers accounted for the remaining 16%. In the middle distillates segment (gas/diesel oil, kerosene-type jet fuel, other kerosene), Total had 37% of the market. This is partly because the second- and third-largest suppliers Argos (16%) and ExxonMobil (10%) did not supply kerosene-type jet fuel. Oil was imported to Belgium by 20 companies, including majors and independents.

In the distribution segment of the market, Total is the largest company, with more than 500 of the around 3 100 filling stations in Belgium. All in all, between 700 and 800 distributors, primarily small companies delivering heating oil, operate on the Belgian market.

EMERGENCY RESPONSE POLICY

DECISION-MAKING STRUCTURE

Emergency response policy is the responsibility of the minister in charge of energy, in consultation with the Council of Ministers. Under the Minister for Energy, the General-Directorate for Energy, within the framework of the National Oil Board (NOB), serves as the core of the National Emergency Strategy 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.

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

- **Monitoring phase***:* To monitor market developments and update information required for the implementation of crisis measures.
- **Active phase***:* To propose measures to the Council of Ministers.
- **Operational phase***:* Implementation of measures and communication with other international bodies, i.e. Benelux, the European Union, the International Energy Agency (IEA) and NATO.

STOCKS

Stockholding agency APETRA

Until 2007, Belgium relied entirely on its domestic oil industry to meet its IEA stockholding obligation. In January 2006 Belgium passed legislation (the Law of 26 January 2006) which created the public stockholding entity APETRA and established a schedule for shifting stockholding responsibilities from industry to the public agency. APETRA's first year of operation began on 1 April 2007. As of this date, the obligation on industry was reduced from covering the full stockholding obligation to only 15 days of net imports, gradually reduced to zero by April 2012, at which time APETRA became fully responsible for meeting Belgium's national stockholding obligation.

APETRA's activities are financed through fees paid by oil companies on all quantities of the relevant products delivered into domestic consumption. APETRA finances its own purchases of crude/products through bank loans.

Box 5.1 Key recommendations of the IEA 2014 Emergency Response Review (ERR) of Belgium

The latest IEA ERR of Belgium was held in November 2013 and the ERR report was finalised in June 2014. Its main recommendations to the Belgian authorities are the following:

- Analyse further the maximum price mechanism involving stakeholders and industry.

Box 5.1 Key recommendations of the IEA 2014 Emergency Response Review (ERR) of Belgium (continued)

- Organise regular meetings with all relevant stakeholders to ensure good co-ordination and awareness of roles and procedures.
- Hold regular emergency response exercises.
- Explore more collaboration with APETRA to overcome resource constraints.
- Develop streamlined stock release procedures for timely and efficient release.
- Develop an updated list of essential users.
- Translate the outcome of the undertaken demand restraint study into concrete measures.

As a response to the ERR recommendations, the Minister of Energy approved an Action Plan in November 2014 with the aim to *i)* update the national oil emergency response policy; *ii)* revise the legal framework; *iii)* implement the recommendations of the IEA ERR.

For this work, a Steering Committee comprising members of APETRA and of the Belgian energy administration was set up. The committee is to update the national oil emergency response policy and to revise the legal framework. As of January 2016, the committee had drafted a new proposal for a Royal Decree to update the Belgian NESO. It had also drafted a proposal for a Royal Decree on the international and national allocation of oil and oil products stocks, and the equitable supply of available oil and oil products. These drafts were yet to be submitted for consultation to the oil sector.

Stock composition

APETRA may hold its share of compulsory stocks as either refined products or crude oil. The legislation limits the amount of crude oil held by APETRA to 50% of all owned stocks. If APETRA purchases crude oil towards its stock obligation, it must fix both refining yields and refining costs for that crude with a refinery in Belgium that will process the crude in the event of an emergency stockdraw.

As of end of July 2015, Belgium held stocks covering 180 days of net imports, of which 94 days were held by APETRA and the remaining 86 by industry. Of the total 48.9 mb of stocks, 4.3 mb were in the form of crude oil and 42.3 were products, mostly middle distillates (30.6 mb).

The calculation methodology of the stockholding obligation is of some concern for Belgium, in particular the issue of naphtha yield. When calculating their stockholding obligation, countries are allowed to deduct the refinery yield of naphtha, which is mostly used for non-energy purposes, such as in the petrochemicals industry. When the yield is under 7%, the methodology used by both the IEA and the European Union applies a 4% average fixed deduction. When it is over 7%, countries can use either their real naphtha yield percentage, or the actual volume of domestic naphtha consumption (in tonnes), whichever leads to a smaller obligation. Belgium's refineries only meet about a half the country's naphtha demand, which leads to a large difference in the country's calculated obligation depending on which methodology is used. While the IEA counts both public and industry stocks to cover the 90-day obligation – at the current level of 180 days

Belgium would not face the risk of non-compliance – the European Union only accounts for the 94 days held by APETRA. Therefore, Belgium is at risk of non-compliance towards the European Union if its obligation suddenly rises owing to a change in the calculation methodology. The government has proposed a change to the methodology which would remove this risk of sudden obligation swings and is currently in consultations with both the European Union and the IEA.

Location and availability

APETRA may fulfil its stockholding responsibilities through the oil stocks it directly owns (purchased by tender) or by obtaining stockholding (ticket) contracts with industry, either domestically or abroad under bilateral agreements.

APETRA's stocks may be held by both Belgian and foreign oil companies and retained within their normal operating systems. Up to a maximum of 30% may be kept in other EU member countries. However, crude oil stocks held underground in other EU countries are not counted as stocks held abroad.

Belgium has also bilateral agreements with France, Germany, Ireland, Luxembourg, the Netherlands and the United Kingdom. Currently, all of APETRA's crude oil stocks, which amount to 2 Mt, are held in salt caverns in the north of Germany, while the oil products stocks are held in Belgium, the Netherlands, Germany and France. Under Belgian law transposing the EU Directive 2009/119/EC on obligatory minimum oil stocks, crude oil stocks may account for at most 60% of stocks managed by APETRA.

Monitoring and non-compliance

APETRA must inform the Directorate for Energy in the Ministry of Economic Affairs and Energy of the location and composition of its stocks. This information must be reported by the 15th day of each month, describing stocks held at the beginning of that month. The minister may authorise physical checks to ensure full compliance with all the provisions of the legislation. Penalties for infringements range from fines to imprisonment for up to one year.

All of APETRA's operations are subject to direct control by the Ministry of Economic Affairs and Energy.

DEMAND RESTRAINT

Belgium does not have a specific contingency plan to implement demand restraint measures in a disruption, but has at its disposal a number of dormant decrees which the Minister of Energy could activate after deliberation by the Council of Ministers. Possible measures include speed limits, driving restrictions or a complete driving ban, rationing, and restricting exports of certain oil products.

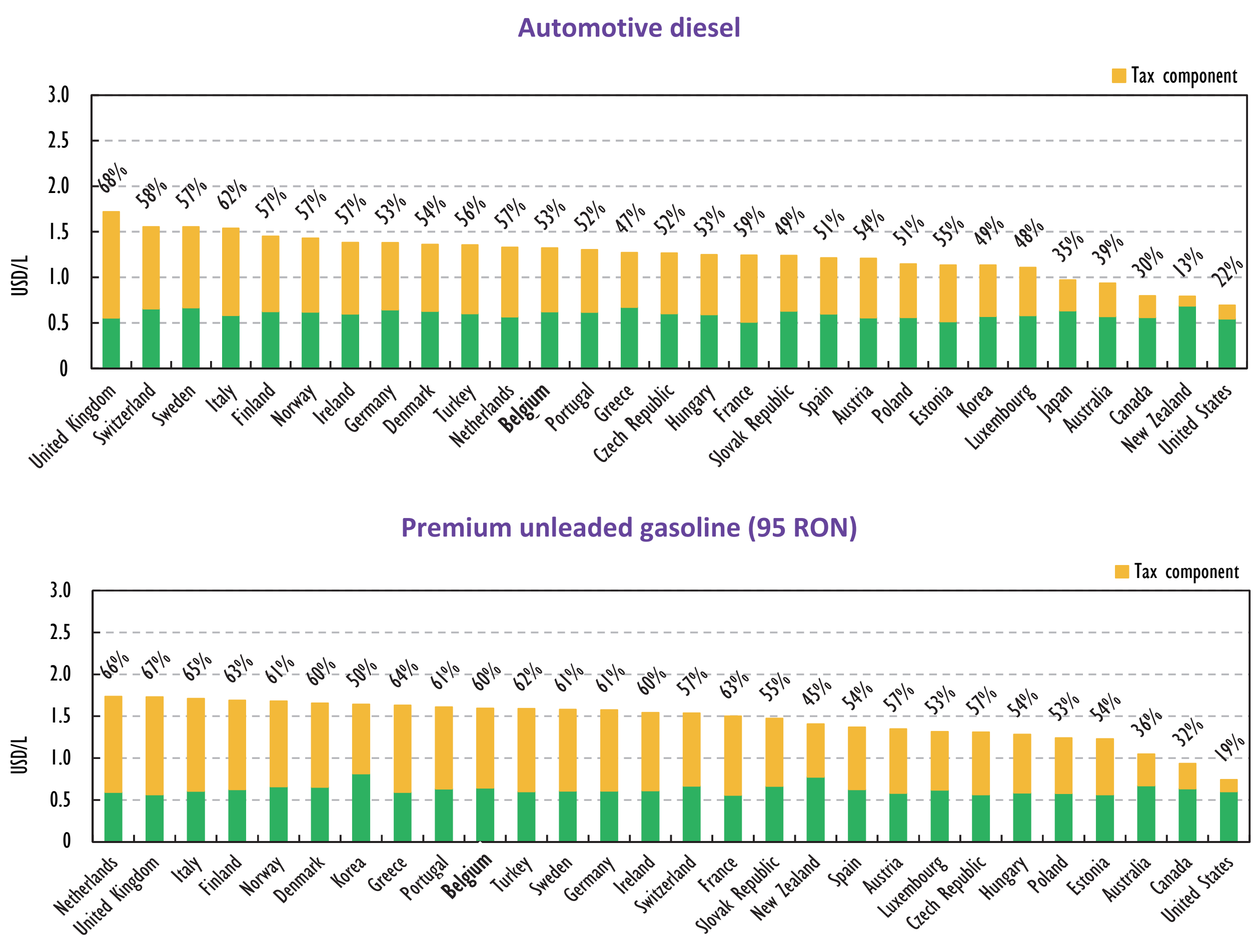
There are no volumetric estimates for each of the separate demand restraint measures, but the total impact of all measures is estimated to be less than 5% of total oil consumption.

PRICES AND TAXES

Gasoline and diesel prices are close to the IEA median in Belgium. They are typically higher than in the neighbouring Luxembourg, while the price difference with the Netherlands, France and Germany varies. Thanks to low taxes, heating oil in Belgium is relatively cheap.

Automotive diesel has long had a price advantage for consumers mostly because it is taxed less than gasoline. Since January 2015, the excise tax on diesel is EUR 0.428/litre, but EUR 0.615/litre for gasoline. The tax difference has remained practically the same since 2011. However, the federal government decided to reduce this excise gap between petrol and diesel for non-commercial users from November 2015 to the end of 2017 by gradually increasing the excise duty on diesel and decreasing it on petrol (*système de cliquet et cliquet inversé* plus *indexation*).[1] For the period 1 November 2015 to 31 December 2015, the excise duty on diesel was increased by EUR 0.036 per litre and the one on petrol decreased by EUR 0.022 per litre.

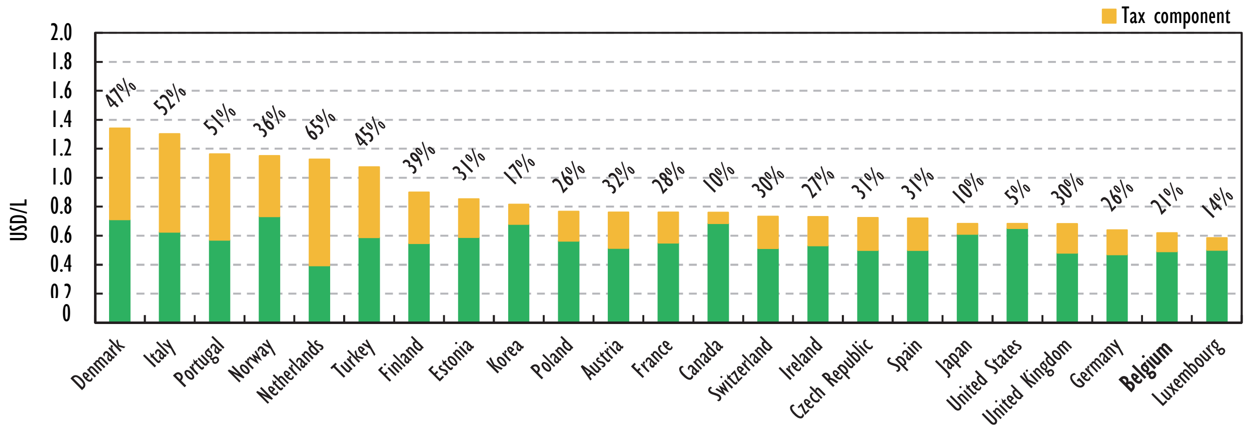
Figure 5.5 Fuel prices in IEA member countries, third quarter 2015



Note: Data not available for Japan.

1. Royal Decree of 26 October 2015 temporarily modifying the programme-law of 27 December 2004, published on 30 October 2015.

Light fuel oil



Note: Data not available for Australia, Greece, Hungary, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2015b), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

For heating oil, the excise tax is only EUR 0.01854 per litre. In addition to an excise tax, oil products are levied a value-added tax (VAT), at 21% since 1996. VAT is refunded for commercial users, i.e. industry, power generation and truckers. The average cost structure of gasoline, diesel and heating gasoil prices in Belgium in 2012-14 is shown in Table 5.1.

RETAIL PRICE CAP AND SUBSIDIES

Belgium maintains a price-capping mechanism called *le contrat de programme*. This mechanism was created in 1974 following the first oil crisis. It is a contract between the Belgian Petroleum Federation (BPF) and the Minister for Energy. The contract sets limits on prices charged to end-consumers for gasoline, heating and automotive gasoil, fuel oil and LPG. The maximum prices are calculated daily and published on a government website. If the price change for each product compared with the previous day or compared with the moving average for the previous seven 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 at the Rotterdam market, and on several other variables. To this is added a distribution margin, which is indexed every six months and comprises a uniform element for all products, and a sales margin (incorporating a fixed profit margin). The price also includes excise duties and VAT as well as the oil stockholding agency APETRA's levy (indexed every three months) and contributions to the Social Heating Fund and the Fund for the Soil Remediation of Petrol Stations (BOFAS). The formula is agreed in a three-year contract between the Belgian State and the BPF. The contract can be denounced with a one-year notice period.

The contract has never been denounced by the BPF or by the Belgian authorities. Nevertheless, in their latest memorandum submitted to the current federal government, BPF has reaffirmed its preference for a free market price. Denouncing the contract would mean a return to a less flexible mechanism for maximum price-setting under the Law of 22 January 1945 on economic regulation and prices.

Heating oil (gasoil, kerosene and propane) prices are subsidised for around 100 000 (in 2015) low-income families. The subsidies totalled around EUR 22 million in 2015, bringing the average subsidy to around EUR 215 per household, in line with the average of recent years. The maximum subsidy is EUR 300 per year, in case retail prices are substantially higher than a calculated annual reference price. The subsidy is paid out from the Social Heating Fund to which both oil industry (through oil products prices) and the government contribute.

Table 5.1 Average maximum retail price for oil products, 2012-14

	Gasoline 95 RON		Diesel		Heating gasoil	
Cost element	%	EUR/L	%	EUR/L	%	EUR/L
Product price (CIF)	34.24	0.5668	40.79	0.6025	69.91	0.5873
Distribution margin	10.31	0.1699	11.87	0.1747	8.91	0.0744
APETRA	0.68	0.0113	0.80	0.0118	1.41	0.0118
BOFAS	0.20	0.0032	0.13	0.0020	-	-
Social Heating Fund	-	-	-	-	0.19	0.0016
Excise duties	37.22	0.6137	29.06	0.4277	2.22	0.0185
VAT	17.36	0.2866	17.36	0.2559	17.36	0.1457
Maximum price, VAT included	100	1.6516	100	1.4746	100	0.8393

Source: Federal Public Service Economy, SM*Es, Self-employed and Energy*.

Box 5.2 Funds for soil remediation of petrol stations and heating oil storage tanks

Belgium has set up mechanisms for granting financial aid for tackling actual and potential soil pollution from leaking oil tanks at filling stations and oil-heated buildings.

The Fund for the Soil Remediation of Petrol Stations (BOFAS[2]) helps pay for service station clean-up projects in Belgium. For service stations closing down permanently, it carries out the clean-up project and covers all related costs. If service station activities continue at the site, BOFAS pays part of the costs. BOFAS is based on an agreement between the federal and regional governments and is financed equally by the oil sector and motor fuels consumers. BOFAS became operational in March 2004 and is expected to operate until 2019. It has a budget of EUR 400 million for the 15-year operation period. By 2019, BOFAS will have funded and executed 3 800 clean-up projects.

In addition to BOFAS, Belgium has been planning to develop another fund for the clean-up of soil polluted by heating oil storage tanks. Oil heating is common and Belgium has around 1 150 000 heating oil storage tanks, about 750 000 of which are underground. Political discussions for setting up the fund were launched in 2000, but lingered on because of technical difficulties and different regional laws and regulations until a breakthrough was finally reached in 2015.

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

Box 5.2 Funds for soil remediation of petrol stations and heating oil storage tanks (continued)

The Fund for the Soil Remediation of Heating Gas Oil Storage Tanks will be based on an agreement between the federal and regional governments and will be financed entirely by heating-oil consumers. It will have two primary tasks: to clean up soil polluted by leaking tanks and to prevent tanks from leaking in the future. The second task will be accomplished by measures including developing quality standards for heating-oil tanks, developing and promoting leak detection devices and providing information to end-users.

ASSESSMENT

Oil remains the largest energy source in Belgium. It covered 42% of TPES in 2014 which was the sixth-highest share among IEA member countries. Oil also accounted for half TFC in 2013. Total inland demand for petroleum products has decreased slightly since the 2009 in-depth review, totalling 22.6 Mt in 2013. Belgium has no indigenous crude oil production and relies entirely on imports of crude oil for its refineries. Russia remains the largest crude supplier, accounting for 35% of the total.

Belgium has four refineries with a combined output in 2014 of 736 kb/d. Since the last review, the two largest Belgian refineries (Total and ExxonMobil) have received close to EUR two billion in investment. These investments should help improve the output of middle distillates and place Belgian refining in a better position, albeit in a European refining market that faces strong external competition. Belgium’s refineries still produce a large surplus of gasoline, and diesel demand in Belgium continues to outstrip gasoline consumption significantly, despite some increases in gasoline demand in recent years. In 2013, around 8 billion litres of diesel was consumed compared with 1.6 billion litres of gasoline. The country continues to apply lower excise duty on diesel than on gasoline and balancing these excise duties could help, over time, reduce the gap between diesel and gasoline demand.

The government has developed a constructive relationship with the refining sector. In particular, an informal working group has been established that brings together industry and representatives of both the federal and regional governments, in order to consider the issues arising from the EU Refining Forum and the European Commission’s fitness check of the EU refining sector. However, industry has indicated that formalising this process may be beneficial. Such a group could be extended in future so as to bring together a wider range of stakeholders to consider broader issues affecting Belgium’s oil sector.

Belgium continues to apply a price-capping mechanism (*le contrat de programme*). This is a contract signed by the federal government and the Belgian Petroleum Federation to set a maximum price for each oil product. Smaller players in the Belgian oil market are not closely involved in the price-setting agreement. Although the price can be updated regularly, it does not reflect exactly the changes in the market price. As noted in previous in-depth and emergency response reviews, concerns remain that the price-setting mechanism may inhibit the natural market responses needed for reducing demand in a crisis. The cap and fixed distribution margins also limit competition and stifle incentives for innovation in the sector. The maximum price-setting system is an oddity among the IEA countries and it is difficult to see any real benefit for its continued existence. The government should quite simply abolish the system.

Belgium continues to subsidise the use of heating oil for low-income families. The volumes, around EUR 22 million per year, are not highly significant, but as a matter of principle, the government should phase out this subsidy for fossil fuel use and encourage energy efficiency and the use of low-carbon technologies in heating, instead.

Since the last in-depth review, the Belgian authorities have made good progress in working with industry to agree a fund for the clean-up of soil polluted by heating oil storage tanks. This has been discussed since 2000 but, in 2015, an agreement was reached. The IEA welcomes the agreement and urges the parties to start implementing it without delay.

Belgium should be commended for its strong efforts to enhance its oil stockholding mechanism, and its oil stockholding agency, APETRA, has been meeting the country's IEA and EU oil stockholding obligations successfully since 2012. APETRA has implemented an effective policy of owning its own stocks, reducing its reliance on tickets and maintaining a high level of finished products stocks. APETRA has helped in promoting the development of new oil storage capacity, through long-term storage rental agreements. However, APETRA faces a major risk of non-compliance if Belgium's naphtha yield changes; because of the calculation methodology applied by both the European Union and the IEA, Belgium could see its obligation increase substantially and suddenly if the naphtha yield drops below 7%. Given the difficulties to acquire the large quantities of oil required in a short time frame, and the consequent considerable financial impact, the government and APETRA should develop an action plan and engage in discussions with the IEA and the European Commission.

In response to the recommendations from the IEA Emergency Response Review (ERR) of 2014, the former federal State Secretary for Energy in Belgium agreed an Action Plan in 2014 to address the recommendations, including updating the existing national emergency response policy for oil. This work is ongoing, within the resource constraints also noted in the ERR. The IEA emphasises the importance of continued efforts to address the recommendations from the ERR.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Work to abolish the differential between the excise duty on diesel and that on gasoline.*
- ☐ *Formalise the working group bringing together industry and government representatives to address the broader challenges faced by the refining sector, and consider mandating the group to cover other issues in the oil sector.*
- ☐ *Abolish the maximum price-setting mechanism, in consultation with stakeholders.*
- ☐ *Agree a plan with APETRA for addressing the risks to compliance in the event of changes to Belgium's naphtha yield.*
- ☐ *Implement the recommendations of the IEA's Emergency Response Review, building on the Action Plan agreed in October 2014.*

References

IEA (International Energy Agency) (2015a), *Energy Balances of OECD Countries* 2015, OECD/IEA, Paris. www.iea.org/statistics/.

IEA (2015b), *Energy Prices and Taxes 2015*, Q3, OECD/IEA, Paris. www.iea.org/statistics/.

IEA (2015c), *Oil Information 2015*, OECD/IEA, Paris. www.iea.org/statistics/.

IEA (2014), *Energy Supply Security 2014*, OECD/IEA, Paris.

6. COAL

Key data (2014 provisional)

Production: Nil

Net imports: 4.6 Mt of hard coal, -46.2% since 2004

Share of coal: 6.3% of TPES and 6.2% of electricity generation

Consumption by sector: 3.2 Mtoe (transformations other than power generation 37.5%, power generation 34.6%, industry 24.3%, residential 3.3% and other 0.3%)

SUPPLY AND DEMAND

SUPPLY

Total supply of coal was 3.3 million tonnes of oil-equivalent (Mtoe) or 6.3% of total primary energy supply (TPES) in 2014. Coal supply has been declining since peaking at 10.6 Mtoe in 1990 (Figure 6.1). Over the ten years since 2004, supply has contracted by 45.2%, including a sharp drop of 32.1% in 2009 and a 21.4% recovery in the following year. Rapid growth in natural gas, biofuels and waste, and solar and wind energy has made up for the decline in coal use over the past two decades.

Belgium depends on imports for all coal supply since 1992 when the country's last coal mine was closed. Net imports amounted to 4.7 million tonnes (Mt) of hard coal in 2014, with 5.2 Mt of imports and 0.6 Mt of exports. Imports consisted of steam coal (3 Mt) and coking coal (2.2 Mt) while only steam coal was exported.

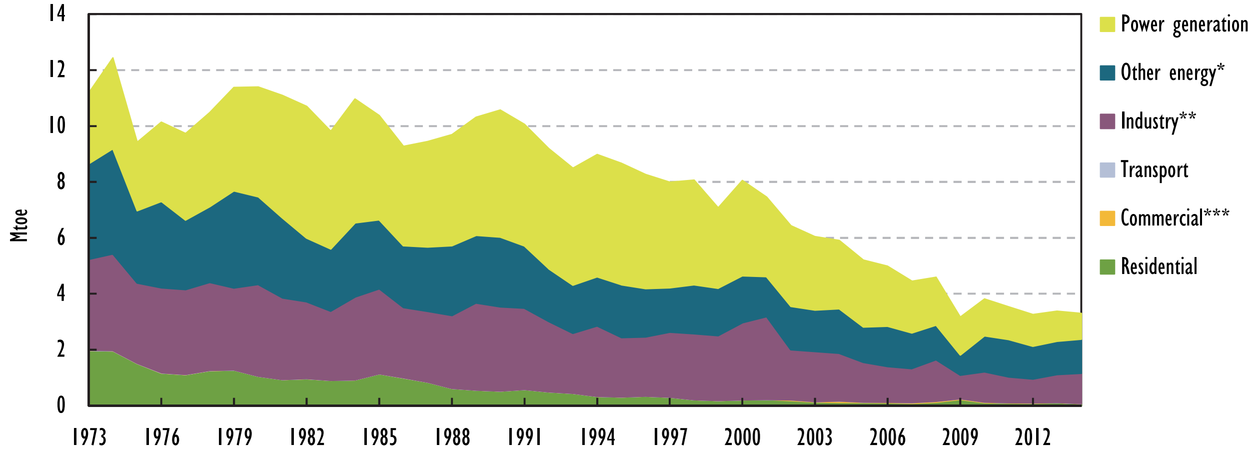
Coal imports have declined by 46.7% from 9.8 Mt in 2004 and were 64.6% lower than the peak of 14.8 Mt in 1990. In 2014, they were sourced from Russia (25% of the total), Australia (24.6%), the United States (23.4%), South Africa (8.9%), Colombia (7.2%), Germany (4%) and other countries (6.8%). Import sources vary year-on-year, albeit the four largest have dominated for decades, with growing imports from Russia and declining imports from Germany and South Africa (Figure 6.2). Belgium's small exports of steam coal are directed to its neighbouring countries.

DEMAND

Coal is mostly used in electricity generation and the production of cement, iron and steel. Practically all coal use also falls under the European Union Emissions Trading Scheme (EU-ETS). In 2014, the transformation sector (producing coke out of coking coal) accounted for 37% of total coal use. Electricity generation accounted for 32.7% of primary coal supply, while industry used 27.9% of the total.

From 2003 to 2013, coal use declined in all major sectors. Numerous coke ovens and blast furnaces in iron and steel production have been closed. Several coal-fired power plants have been either closed or converted into biomass-fired plants to comply with EU air quality requirements. As of January 2016, the only remaining main producer coal-fired power plant in Belgium is Langerlo, with 2x235 megawatts (MW) of coal power capacity. This last coal-fired power plant will also close in April 2016. There are plans to convert the Langerlo site into a biomass plant that would run on wood pellets. Coal demand for power generation has declined by 62.2% and for industry by 36.7%, while demand in the transformation sector declined by 23.2%. Some households still use coal for heating and their coal demand decreased by 39.6% from 2004 to 2014.

Figure 6.1 Coal supply by sector, 1973-2014



Note: TPES by consuming sector.

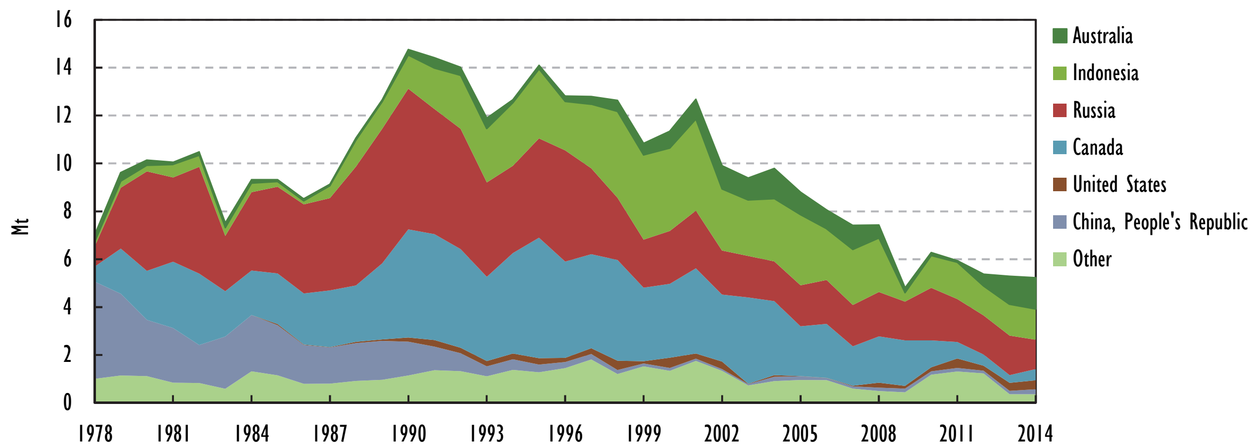
* *Other energy* includes transformations such as coke ovens, other refining and energy own-use.

** *Industry* includes non-energy use.

*** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2015b), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 6.2 Coal imports by country, 1973-2014



Source: IEA (2015a), *Coal Information 2015*, www.iea.org/statistics/.

References

IEA (International Energy Agency) (2015a), *Coal Information 2015*, OECD/IEA, Paris. www.iea.org/statistics/

IEA (2015b), *Energy Balances of OECD Countries 2015*, OECD/IEA, Paris. www.iea.org/statistics/

7. NATURAL GAS

Key data (2014 provisional)

Natural gas production: Nil

Net imports: 16 bcm, -6.2% since 2004

Share of natural gas: 23.9% of TPES and 27% of electricity generation

Consumption by sector: 15.8 bcm (industry 34.4%, power generation 25.3%, residential 22.9%, commercial and public services and agriculture 13.5%, other energy 3.5%, transport 0.4%)

SUPPLY AND DEMAND

SUPPLY

Natural gas supply amounted to 12.6 million tonnes of oil-equivalent (Mtoe) or 15.8 billion cubic metres (bcm) in 2014. The share of gas in total primary energy supply (TPES) was 23.7% and the share in electricity generation 27%. Gas supply peaked at 17 Mtoe or 20 bcm in 2010, after decades of steady growth. Supply has fallen by 25.6% since, with a 12.2% drop in 2014 alone.

IMPORTS AND EXPORTS

Belgium relies on imports for all its natural gas needs. Imports[1] amounted to 16 bcm in 2014, which is 11.6% lower than the previous year and 18.7% lower than a peak of 19.7 bcm in 2010.[2]

In 2014, imports came from the Netherlands (46.5% of the total), Norway (33.5%), the United Kingdom (10.1%), Qatar (7.7%) and Germany (2.2%). Part of the gas imported from the Netherlands and Germany comes from Russia, but the volumes are not indicated in the IEA database.

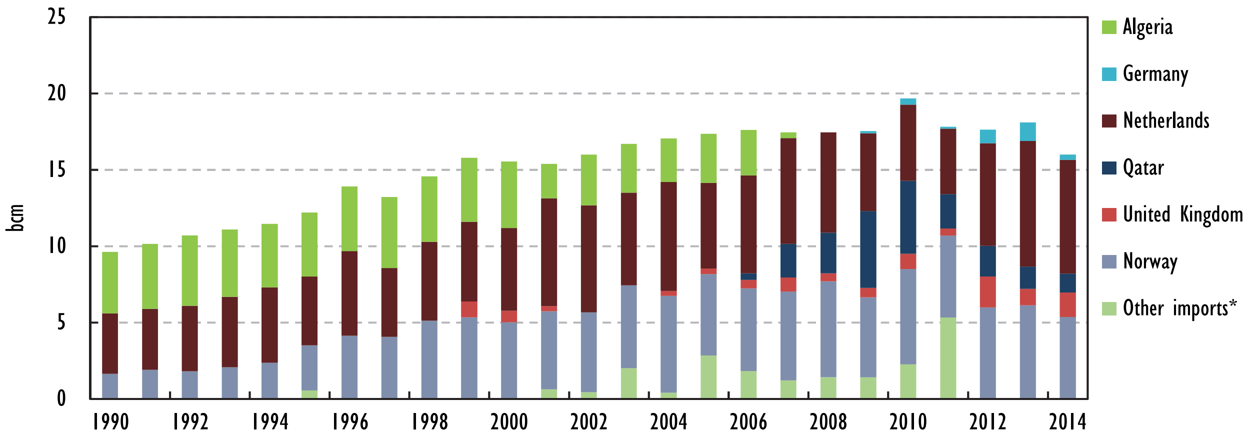
The Netherlands and Norway are the main sources of gas for Belgium, while the origin of the remaining gas sources varies year-on-year (Figure 7.1). The largest change over the past decade has been an end to Algerian imports in 2007, which averaged around 3.5 bcm in the ten previous years. The gas fields in the Netherlands and Norway are, however, depleting. In the long run, these developments will most likely increase Belgium's dependence on pipeline gas from Russia and on liquefied natural gas (LNG).

1. Imports represent the net of all import flows (16.8 bcm in 2014) and all re-export flows (0.8 bcm in 2014). Belgium imports LNG that is re-gasified and exported through pipelines, and also treated as re-exports.

2. Supply includes net imports net of stock changes, statistical differences and energy own-use. Supply is measured in Mtoe; it takes into account the varying calorific value for gas; therefore, the volume changes in supply differ from volume changes in imports, which are measured in bcm.

The issue of declining gas production in the Netherlands merits particular attention, because all Dutch gas imported in Belgium is low-calorific gas (L-gas)[3] from the Groningen field and these imports are set to end by 2029. L-gas from Groningen accounts for around 30% of all gas consumption in Belgium, and as no other source for L-gas imports exists, the Belgian government is preparing a plan to gradually shift from L-gas (see section on Infrastructure). The pace of production decline in the depleting Groningen field has, however, proved faster than expected. Production in Groningen has been halved from 54 bcm in October 2012-September 2013 to 27 bcm in October 2015-September 2016. This drop is a result of several political decisions by the Netherlands to cap production on safety concerns following seismic activity in the Groningen field. There is at the moment little visibility on the future production outlook.

Figure 7.1 Natural gas imports by country, 1990-2014



* *Other imports* include other countries and imports from unspecified sources.

Source: IEA (2015c), *Natural Gas Information 2015*, www.iea.org/statistics/, OECD/IEA, Paris.

DEMAND

Industry is the largest gas user in Belgium, with a share of 34.4% of total demand in 2014. Power plants accounted for around a quarter while households consumed 22.9% of the total and the commercial and public services sector (including agriculture, fishing and forestry) 13.5%. Petroleum refining and energy own-use represented 3.5% while 0.4% was used in the transport of gas by pipeline. Gas consumption in road/maritime transport began in 2011 and accounted for 0.02% of the total.

From peak demand in 2010 to end-2014, gas consumption declined by 35.6% in power generation, by 15.6% in industry and by 20.4% in the commercial sector (Figure 7.2). Largely thanks to mild weather in 2014, the residential sector also reduced consumption by 19.3%, after an increasing trend to 2010 led by gas networks expansions. Gas used in petroleum refining surged from negligible levels in 2010.

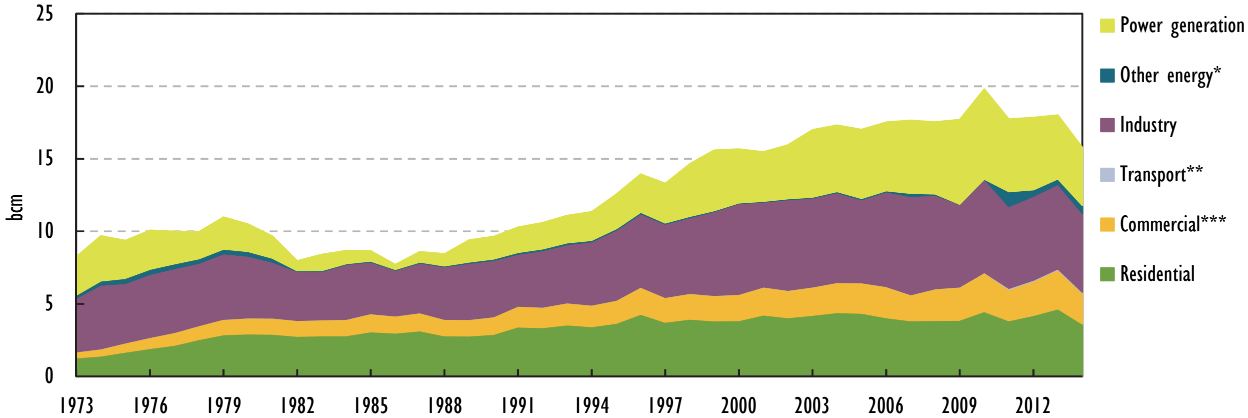
An ongoing trend is the expansion of gas distribution grids and the replacement of oil heating by gas boilers. In the Flemish region, the number of gas customers increased from 1 640 000 in January 2011 to 2 042 000 in January 2015. In the Walloon region, the number of gas customers grew from 630 000 in 2009 to 675 000 in 2013. In the Brussels-

3. The energy content of L-gas is 9.77 kWh/m³ and that of high-calorific gas (H-gas) is 11.64 kWh/m³.

Capital region, the share of natural gas heating in residential buildings rose from 65% in 2001 to 72% in 2012.

Natural gas is the largest source for space heating, and its demand from households and the commercial sector therefore varies year-on-year according to outside temperature. Gas demand peaks in winter when the heating need is at its highest. Peak daily demand can be four times higher than average daily demand, owing to a high share of household demand in total demand.

Figure 7.2 Natural gas demand by sector, 1973-2014



* *Other energy* includes petroleum refineries and energy own-use.

** Negligible.

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

Source: IEA (2015c), *Natural Gas Information 2015*, www.iea.org/statistics/.

REGULATORY FRAMEWORK

The legal basis for the functioning of Belgium's natural gas system is provided by EU regulations and national laws implementing EU directives. Since 2008, as in the electricity sector, the European Union has increased harmonisation in the natural gas sector with the aim of creating a single market.

Natural gas market integration has focused on two areas: first, integrating national and regional gas markets and co-ordinating system operations via commonly agreed network codes and, second, constructing cross-border interconnections and co-ordinating network infrastructure planning via ten-year network development plans of the European Network of Transmission System Operators for Gas (ENTSO-G) and via regional plans. Belgium's natural gas market design and interconnection developments are explained in the following sections.

The relevant EU directives and regulations for natural gas are:

- Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas, and repealing Directive 2003/55/EC ("Gas Directive").
- Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005 ("Gas Regulation").

- Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators ("ACER Regulation").

- Regulation (EU) No 1227/2011 of the European Parliament and of the Council on wholesale energy market integrity and transparency ("REMIT Regulation").

The cornerstone of the 2009 Gas Directive is to effectively separate network activities from supply, generation or production activities, so-called unbundling. The directive also strengthened the independence of national regulatory authorities from the governments and promotes their co-operation at EU level through ACER. It also increased the independence of the transmission system operators (TSOs) and their co-operation at EU level, through ENTSO-G.

Belgium transposed the Gas Directive into national legislation by amending the 1965 Gas Act. An important part in implementing the directive was the introduction in 2012 of a new transmission network access model, based on a full entry/exit system, and market-based balancing.

CREG, the federal energy regulator, certified Fluxys Belgium in 2012 as the operator of the Belgian gas transmission system. Fluxys Belgium is fully ownership-unbundled. Its major shareholders are Fluxys Holding (89.97%), listed shares (NYSE/Euronext Brussels) (10.03%) and the Belgian State (golden share). Fluxys Holding, in turn, is owned by a municipal holding Publigas (77.7%), Caisse de Dépôt et Placement du Québec (20%), SFPI/FPIM (2.1%) and employees/management (0.2%). Fluxys Belgium is also the operator of the Loenhout gas storage facility, while Fluxys LNG is the sole operator of the Zeebrugge LNG facility.

The regional governments of Flanders, Wallonia and Brussels-Capital have transposed the distribution system operators (DSOs) unbundling provisions of the Third Energy Package into their respective legislations for the 17 gas DSOs.

CREG's independence was increased by the provisions of the law of January 2012 and the decision of the Constitutional Court of 7 August 2013, which confirmed that the regulator had exclusive jurisdiction with respect to application, determination and exemption of tariffs. Since 1 July 2014, the competence for setting distribution tariffs has been transferred to the regions. Regional regulators (CWaPE in Wallonia, VREG in Flanders, Brugel in Brussels) are now responsible for the control of tariffs regarding public distribution of gas and electricity (low-voltage ≤ 70kV) or low-pressure networks.

REGIONAL INTEGRATION

The 2009 EU legislation (the Third Package) also moved the regulation of cross-border gas pipelines into an EU framework which builds on the independence and the EU-wide co-operation of the TSOs and the national regulatory authorities (NRAs).

Regional gas market integration has been developed under the regional Gas Platform which brings together energy ministries from Belgium, Germany, France, Luxembourg and the Netherlands. Two working groups operate in the framework of this Platform: one on market and competitiveness issues, and one on security of supply. The regulators and TSOs are closely involved in the work.

Belgium has also been part of the Gas Regional Initiative North West (GRI NW), which also involves the Netherlands, France, Ireland, Germany, Denmark, Sweden, the United

Kingdom and Norway (as observer). The goal of the Regional Initiative is to tackle barriers to competition, such as the lack of market integration, transparency and balancing issues.

As individual EU national gas markets have different network operation rules, the Third Package includes also a procedure to agree on harmonised technical rules through the adoption of EU-wide framework guidelines and network codes. The codes are applicable to interconnection points between entry-exit zones, either cross-border or within a country. The areas in which the FGs and NCs are to be adopted are listed by Article 8(6) of Regulation (EC) No 715/2009. These 12 areas are:

- network security and reliability rules
- network connection rules
- third-party access rules
- data exchange and settlement rules
- interoperability rules
- operational procedures in an emergency
- capacity allocation and congestion management rules
- trading rules related to technical and operational provision of network access services and system balancing
- transparency rules
- balancing rules, including network-related rules on nomination procedures, rules for imbalance charges and rules for operational balancing between transmission system operators (TSOs) systems
- rules regarding harmonised transmission tariff structures
- energy efficiency regarding gas networks.

INFRASTRUCTURE

PIPELINES

Belgium is a crossroads for important gas flows from diverse sources and routes. Fluxys Belgium, the transmission system operator (TSO), has a network of about 4 100 kilometres of pipelines with 18 interconnection points and four compression stations. Eight cross-border pipelines connect the Belgian gas market directly to France, Germany, Luxembourg, the Netherlands, Norway and the United Kingdom (see Figure 7.3). The Belgian transmission system has an entry capacity of 11 bcm per year and an exit capacity of 80 bcm per year. Belgium's gas infrastructure does not face congestion to meet national gas demand nor to transport gas from border to border to supply neighbouring countries. The country also benefits from sufficient reverse flow capacity on the connections with Germany, the Netherlands and the United Kingdom.

In 2013, the high-pressure gas network transported around 1 bcm of natural gas for consumption in Belgium and around 23 bcm for other end-user markets. The Fluxys Belgium network delivers gas directly to about 250 large industrial end-users and power stations, and supplies the grids of 17 DSOs which deliver gas to around 2.9 million households and around 100 000 small to medium-sized companies.

The transit of gas through Belgium is via the major two-way high-pressure pipeline systems connecting Belgium to its neighbours. The VTN-RTR pipeline runs from west to east, linking the United Kingdom with Germany. Pipelines also run from west to south linking the North Sea and the United Kingdom to France and from north to south, linking the Netherlands with France.

Fluxys Belgium maintains a ten-year infrastructure investment plan that it updates every year. Entry capacity to Belgium was increased in late 2015 through a pipeline from the LNG terminal in Dunkerque, France. The terminal is expected to be taken into use in 2016. The new pipeline has a capacity of 8 bcm per year and runs from Dunkerque to Maldegem, where it connects to the VTN pipeline.

L-gas network

The Belgian gas transmission grid is divided into two entry/exit zones: the H-zone (for high-calorific gas) and the L-zone (for low-calorific gas). The two zones are physically completely separate owing to technical constraints. The L-gas network covers mostly the Flemish region (925 000 connection) and the Brussels-Capital region (± 500 000 connections). In the Walloon region, it reaches around 88 000 customers. All L-gas connections need to be converted to H-gas by 2029, as imports from the depleting Groningen field in the Netherlands are set to cease.

The future supply of L-gas in Belgium is dependent, among other things, on changes in suppliers' purchase contracts and the remaining lifetime of the L-gas field in the Netherlands. Against this backdrop, the Federal Public Service Economy has set up a Task Force to consider options for converting from L-gas and related infrastructure, equipment and appliances (L-gas conversion) to H-gas while maintaining security of gas supply. The Task Force comprises Fluxys Belgium, DSOs, natural gas suppliers and the authorities. The plan for the conversion from L-gas to H-gas will be prepared and co-ordinated by an ENOVER/CONCERE working group with representatives from the federal and regional authorities. L-gas conversion is also discussed in the regional Gas Platform as, in addition to Belgium and the Netherlands, it also affects Germany and France.

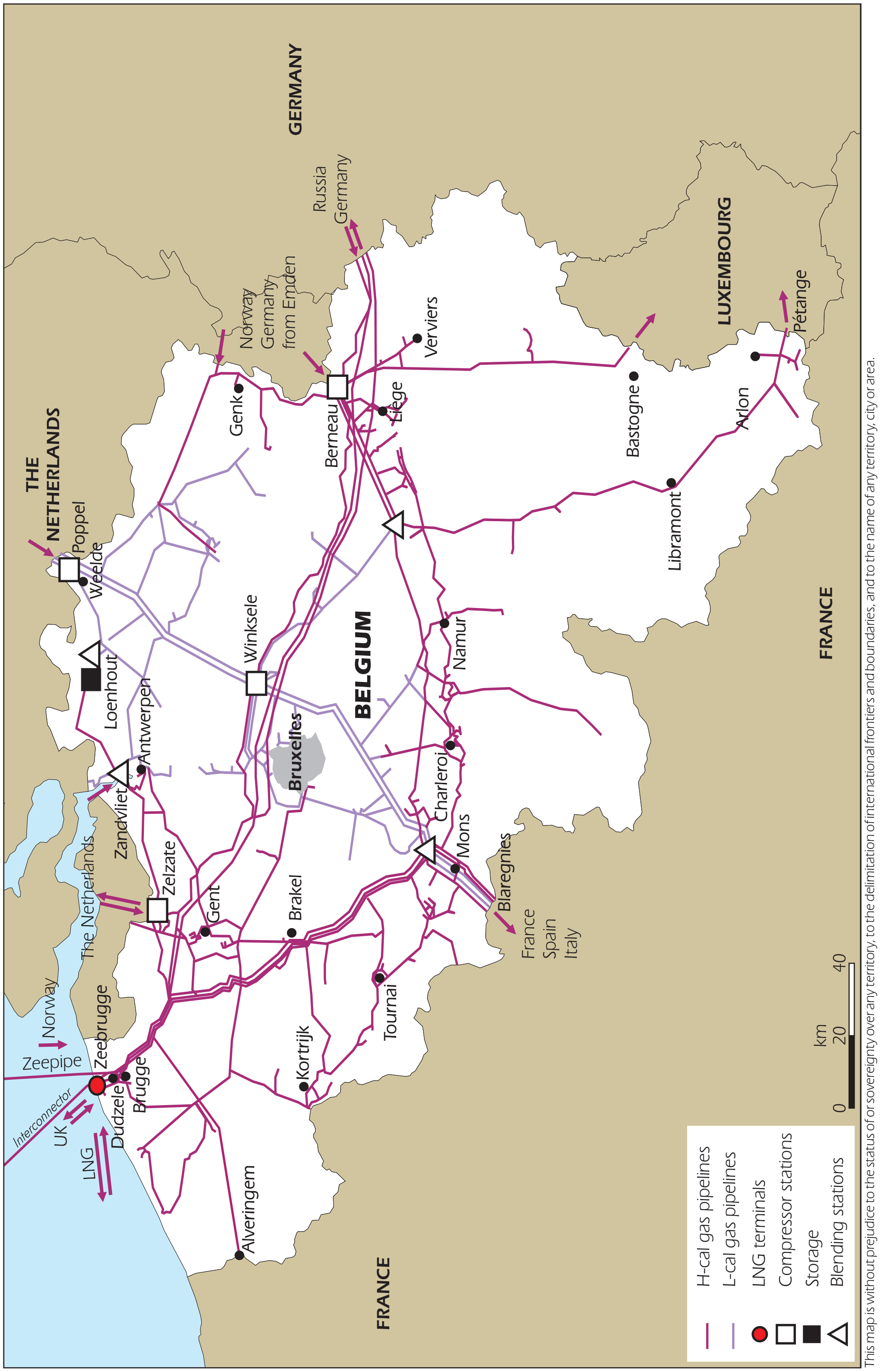
ZEEBRUGGE PORT

The Zeebrugge port serves as a crossroads of two major axes in European natural gas flows, as it hosts both the Zeepipe terminal (1 bcm/year pipeline from Norway) and the Interconnector terminal with a connection of 2 bcm/year from the United Kingdom and 25 bcm/year to the United Kingdom.

The Zeebrugge port also has an LNG regasification facility (operated by Fluxys LNG) with a capacity of 9 bcm per year. Fluxys LNG has recently expanded the terminal with a second landing stage for loading and unloading cargoes.

The Zeebrugge area has an overall throughput capacity of about 48 bcm per year. This corresponds to roughly 10% of the border capacity needed to supply the EU-28. Zeebrugge also has a key commercial role as one of Europe's leading spot markets for natural gas (see section on Market design and competition).

Figure 7.3 Map of high-pressure natural gas infrastructure, 2015



STORAGE

Belgium has one natural gas storage facility, an aquifer located in Loenhout. Its working gas capacity is 725 mcm of H-gas, of which 20 mcm is reserved for Fluxys Belgium (the storage operator) for balancing of the network. Loenhout has a peak output capacity of 15 mcm/day. Short-term storage is available at the Zeebrugge LNG terminal for the LNG terminal users.

Under normal winter conditions, the Loenhout facility can send out gas (theoretically) for 45 days at maximum send-out rates. Its available capacities are allocated on the basis of a subscription window or an open season organised by Fluxys Belgium in accordance with the provisions of the Access Code for Storage as approved by the national regulator, CREG. Capacities that are not allocated can, after the subscription window or open season, be subscribed by storage users on a "first-committed first-served" basis. In June 2011, an amendment to the 1965 Gas Act abolished the priority access to the storage facility for Belgian market suppliers.

There is no storage for L-gas. Belgium uses the ability of the Dutch L-gas fields as swing supplier and the flexibility provided in the supply contracts. In the future, with shrinking Dutch gas production, maintaining flexibility could prove more difficult or costly.

Additional storage possibilities in Belgium are limited. However, as Belgium is surrounded by countries that have sufficient gas storage possibilities and as most gas undertakings active in Belgium are also active in the neighbouring countries, gas operators can make use of the storage flexibility in several countries over the different gas markets.

MARKET DESIGN AND COMPETITION

In 2013, 72% of natural gas imports to Belgium were supplied under long-term contracts with foreign producers, while 28% of the volume was delivered under short-term contracts. The share of short-term contracts is on the increase following the launch in 2012 of the virtual Zeebrugge Trading Point (ZTP). All natural gas entering the Belgian gas system is automatically available on ZTP where suppliers can buy and sell gas via the ICE Endex Gas or Pegas ZTP exchange.

The ZTP is a notional trading point like TTF in the Netherlands. ZTP and the Zeebrugge port were operated by Huberator, a subsidiary of Fluxys, until 2015. Since 2016, the hub services are directly offered by Fluxys Belgium. Around 80 members are active on ZTP and around 66 bcm of natural gas was traded on there in 2014, roughly four times the annual consumption in Belgium. Bilateral trading is also enabled at the Zeebrugge hub.

Regarding balancing, Fluxys Belgium matches every day the volumes of gas entering the Belgian system with the volumes of gas exiting the system (either as exports or end-use). Fluxys Belgium settles any imbalances by either selling or buying gas at ZTP and then settling the transaction financially with the shipper responsible for the imbalance.

Originally, a day-ahead secondary market for gas transport capacity rights was in operation since 2008. The Capsquare trading platform was set up by Fluxys Belgium and the French TSO GRTgaz, and it covers the Belgian and French gas transportation system.

Since 2014 Fluxys Belgium offers the possibility to trade on the secondary market through PRISMA, the joint capacity booking platform of major European TSOs.

COMPETITION IN THE WHOLESALE AND RETAIL MARKETS

In 2014, 22 suppliers were active on the Belgian wholesale market (up from 20 in 2013 and 18 in 2012). The three largest ones supplied 70% of the gas: GDF Suez (31%), Eni (29%) and EDF Luminus (10%). Their combined share had dropped from 79% in 2012 and 75% in 2013. The other 19 suppliers each had a share of less than 10% of the market and 12 of them supplied less than 1% of the total. In recent years, new entrants have managed to gain market share from Eni (down from 41% in 2012) and thus rapidly reduced market concentration: the Herfindahl-Hirschman index (HHI, a widely used concentration index) declined from more than 2 500 at the end of 2012 to 2 000 at the end of 2014.

The federal government has no ownership in the natural gas sector, but still maintains a golden share in Fluxys Belgium, the TSO. It also maintains a golden share in the major supply company Eni Gas & Power. Eni acquired the gas supply business in 2008 from Suez, the historical incumbent. Suez was obliged to divest the supplier Distrigas as a condition for European Commission’s approval of the merger between Suez and GDF.

Also in the retail market, competition has increased thanks to new entrants and supplier switching. In the Flemish region, in the three years from the end of 2011 to the end of 2014, HHI based on the number of customers declined from 4 157 to 2 297. Supplier switching was very active, rising from 9.2% of customers in 2011 to 18.9% in 2012, 18.7% in 2013 and 13.9% in 2014. As a result, the share of the three largest suppliers dropped from 91.3% of the customers to 71.9% (CREG, 2015). At the end of 2014, Electrabel (owned by GDF Suez[4]) supplied 40.7% of the 2.042 million customers connected to the distribution grid, while EDF Luminus supplied 18.1% and Eni 13.1%.

In the Walloon region, HHI based on the number of customers declined from 3 652 in 2011 to 3 060 in 2014. Supplier switching was very active also in Wallonia, at 14.8% in 2011, 20.4% in 2012 and 17.2% in 2013. The share of customers of the three largest suppliers decreased from 88% to 84% (CREG, 2015). At the end of 2014, Electrabel supplied 43.4% of the 688 000 customers connected to the distribution grid, while EDF Luminus supplied 25.6% and Lampiris (an independent supplier) 15.0%.

In the Brussels-Capital region, HHI based on the number of customers declined from 7 402 in 2011 to 5 224 in 2014. Supplier switching stood at 10.5% in 2014. The share of customers of the three largest suppliers decreased only slightly, from 96.9% in 2011 to 94.6% in 2014 (CREG, 2015). At the end of 2014, Electrabel supplied 69.8% of the 426 000 customers connected to the distribution grid, while Lampiris supplied 16.6% and EDF Luminus 8.2%.

Switching rates have increased in recent years and are quite high by international comparison. Switching supplier was made easier in 2012 by modifying the energy law. The federal and regional governments and the municipalities also organised in 2012 and 2013 broad campaigns to inform consumers about price comparison and supplier switching. Public debate about electricity and gas prices was lively and helped consumers to become more price-conscious. Under the current rules, consumers can terminate supply contracts at any moment without cancellation fees (as long as the one-month notification period is respected).

4. GDF Suez changed its name to Engie in August 2015.

EMERGENCY RESPONSE POLICY

Belgium's gas security measures are listed in three documents that must, under Regulation (EU) 994/2010, be updated every two years, namely the Risk Assessment, the Preventive Action Plan and the National Emergency Plan. The documents were last updated in 2014.

In the event of a natural gas supply disruption, the Directorate-General for Energy within FPS Economy will be the lead government department for the sector. DG Energy will set up a National Emergency Sharing Organisation (NESO) to co-ordinate emergency planning and communication with government agencies and supranational institutions. The NESO also works as a liaison body between the TSO (Fluxys Belgium), the natural gas companies, government bodies, the European Commission and other EU member states.

Fluxys Belgium is given the responsibility for maintaining crisis mechanisms through a Royal Decree on public service obligations related to natural gas (23 October 2002). This 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 Belgium maintains 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, the TSO looks to balance the network by shifting gas through its various entry points. In doing this, it maintains an "interruption plan" for cutting supply to end-users for short periods of time. Fluxys Belgium estimates it is able to compensate for the full loss of gas through 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 sufficiently during that period, Fluxys Belgium would begin cutting off supplies to specific end-users based on an interruption hierarchy that takes into account safety, alternative sources, and the fastest and most efficient solution to safeguard the security of supply to all end-users as long as possible.

There are two types of interruptible contracts: supplier interruption, and transport or border-to-border interruption. Under the supplier interruptible contract, the supplier may interrupt gas supply to a customer, normally in return for a discount on price and with some notice in advance. The notice period will be specified in the energy contract. Under the transport or border-to-border interruptible contract, the TSO has the right to interrupt gas supply to interruptible-contracted customers for operational reasons under normal circumstances. Again, this will be covered in the transmission contract signed by the network user. Customers connected to the distribution grid are protected from interruption under normal circumstances.

In the unlikely event of an emergency, the safe provision of gas to domestic users and other low-volume users (all connected to the distribution network) is the top priority. Before firm customers are interrupted, emergency plans provide for the suspension of the normal market for gas. After the suspension, it will depend on how quickly gas supply and demand are balanced, before firm customers are interrupted. In this case, firm border-to-border transmission will be interrupted. Public appeals may take place asking the public to restrain gas usage but this would depend on the type of emergency.

Fuel switching possibilities are limited and exist only in the transformation sector and for a very small part in industry. Belgium does not have a programme to encourage or require gas users to switch to another fuel source in case of a disruption of gas supply. Also, the newly constructed power plants do not have the built-in capability to switch fuel.

PRICES AND TAXES

Spot prices for natural gas in Belgium are generally correlated and converged with those in the Netherlands and Germany. Spot prices in the North-West Europe region averaged around EUR 23 per megawatt-hour (MWh) in 2011 and EUR 25 per MWh in 2012. In 2014, spot prices averaged EUR 20.9 per MWh, down from 27.1 in 2013. This was the first annual decline since 2009, according to CREG. However, the major share of gas is supplied under long-term contracts typically at prices that are higher than the spot market prices. According to CREG, long-term contract prices are nearing spot prices, as they have been renegotiated and switched from oil indexation to spot gas indexation. Long-term contract prices averaged EUR 24.3 per MWh in 2014.

Natural gas prices for households have declined by 20% since the recent peak in the second half of 2012 to the first half of 2015, according to Eurostat. In the first half of 2015, the cost of natural gas for households (consuming less than 56 MWh per year) was EUR 58.4 per MWh and for industry (consuming between 2.8 and 28 GWh/year) EUR 29.4 per MWh. Among the IEA member countries, Belgian households pay median prices, while prices for industry are among the lowest (see Figures 7.4 and 7.5).

Retail prices are market-based, not regulated, and closely follow the movements in wholesale prices as, since October 2013, retail suppliers are using market-based indexation (both spot and forward). Also, price differences between retail suppliers have narrowed as the incumbents have abandoned oil-based indexation.

End-user prices include three types of levies and surcharges: a so-called contribution for energy, a tax on the usage of energy which finances the Fund for financial balance in social security, and a federal levy. The contribution for energy applying to natural gas is EUR 0.9978 per MWh since January 2016. The federal levy is EUR 0.6706[5] per MWh[6] and it is used to finance public service obligations (regulator, social assistance centres and, since 2014, the cost of the social tariffs for protected customers). End-user prices for households also include a VAT rate[7] of 21% since 1996. For commercial users, VAT is refunded.

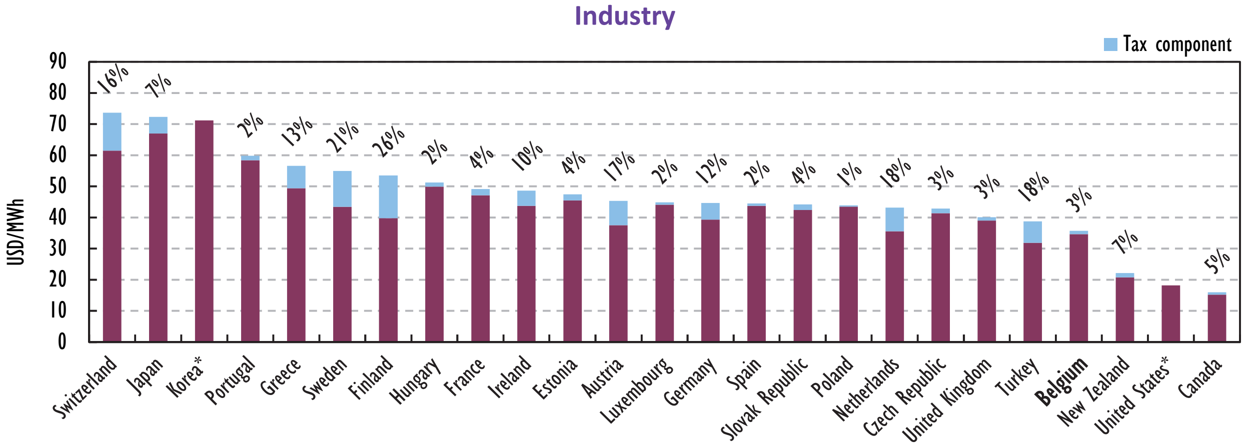
Around 254 000 low-income customers receive gas at reduced rates under a social tariff. This social tariff is set every six months by the CREG in compliance with the Ministerial Decree of 30 March 2007. It is the sum of the lowest commercial tariff and the lowest network tariff. It represents a gain of EUR 13 per MWh for the protected customer (about EUR 157 per year for an average protected client consuming about 12 MWh per year). All residential and professional clients are financing this measure through the federal levy.

5. Revised value for the period September to December 2014, see www.creg.be/fr/cotfedg.html.

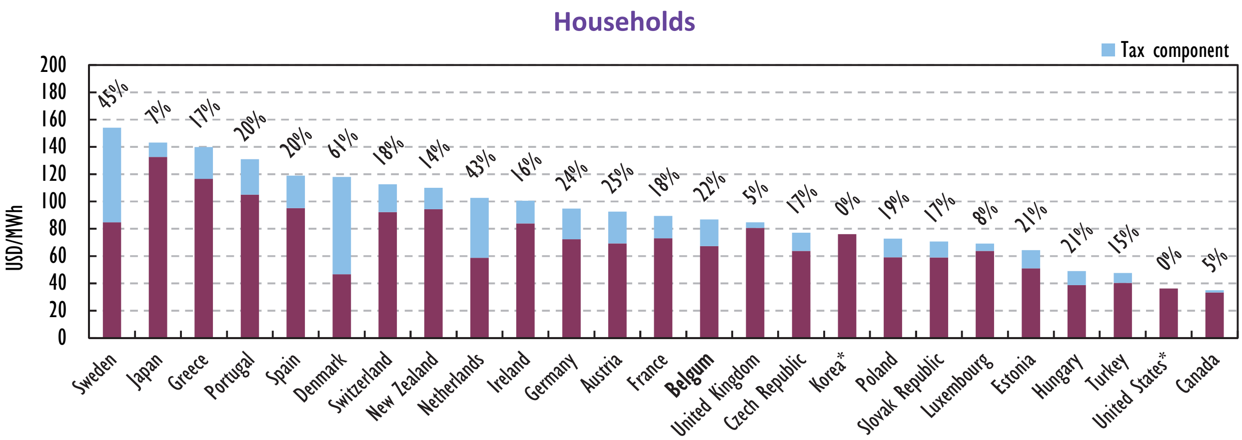
6. Industrial clients (consuming at least 20 GWh/year) pay a degressive rate for the federal levy.

7. VAT is not applicable on the federal levy.

Figure 7.4 Gas prices in IEA member countries, 2014



Note: Data not available for Australia, Denmark, Italy and Norway.

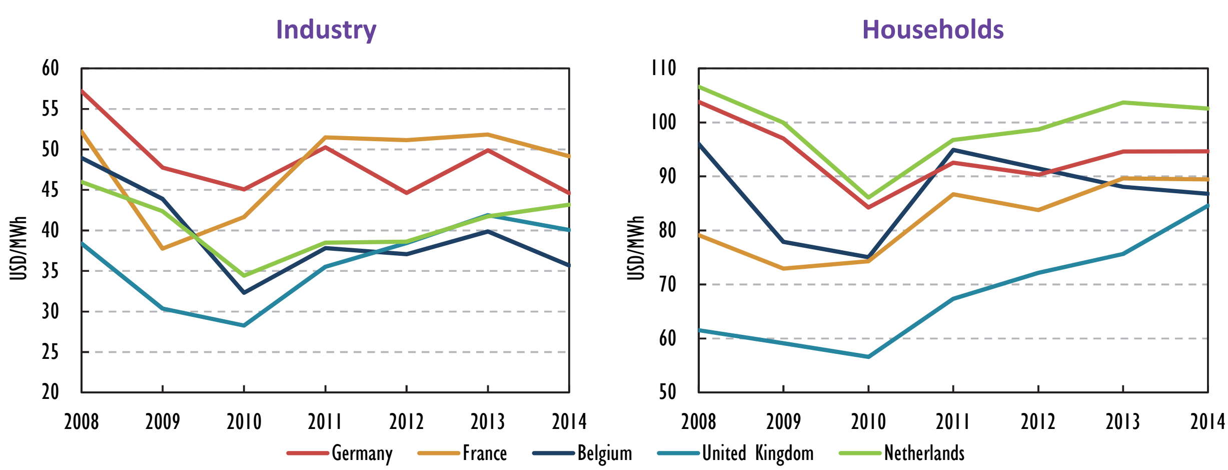


Note: Data not available for Australia, Finland, Italy and Norway.

* Tax information not available.

Source: IEA (2015a), *Energy Prices and Taxes 2015, Q3*, www.iea.org/statistics/.

Figure 7.5 Gas prices in Belgium and selected IEA member countries, 2008-14



Source: IEA (2015a), *Energy Prices and Taxes 2015, Q3*, www.iea.org/statistics/.

ASSESSMENT

Natural gas is the second-largest fuel in Belgium, providing 24% of TPES in 2014. It is also the second-largest source for electricity and the most important source for space heating.

Belgium has fully unbundled the transmission, distribution and supply of gas, thus implementing the third EU Energy Package. Its gas market is already well integrated with the neighbouring gas markets. The Zeebrugge port is a key part not only of Belgium's gas system but also of the whole European gas system, as it connects with both Norway and the United Kingdom and also has an LNG terminal. The Belgian transmission system has significant capacity for entry (113 bcm per year) and exit (80 bcm per year). The gas system does not face congestion to meet national gas demand nor to transport gas from border to border to supply neighbouring countries.

Belgium uses two types of natural gas which must be transported on separate networks: low-calorific gas (L-gas), imported exclusively from Groningen in the Netherlands, and high-calorific gas (H-gas), imported through several routes from various countries, including the Netherlands, Norway, the United Kingdom and other transits via Germany. The Dutch L-gas accounts for around 30% of gas supply in Belgium, but its production is declining. Imports to Belgium and exports to France and Germany will begin to decline from 2024 and will be phased out by 2029 by which year the conversion of the entire L-gas supply and distribution structure has to be completed.

Because of this decline, Belgium has already started to prepare for a shift to H-gas, but most of the work remains to be done. Today L-gas is mainly used for households, implying more seasonal swings, as all power plants and most of industry have already been converted to H-gas. There is no L-gas storage in Belgium and production in Groningen has declined much faster than was expected a couple of years ago, mainly as a consequence of political decisions following seismic activity and related safety concerns in the gas field. Given these safety concerns and the potential for further changes in the Dutch timetable of L-gas production and exports, Belgium should consider whether its conversion process is flexible enough and whether it should be urgently dealt with.

The challenge is hence to ensure that the conversion process takes full account of both technical safety requirements such as the establishment of a comprehensive inventory and check-up of appliances used by households, and security of supply concerns, such as the required flexibility for seasonal peak demand, the replacement required by new sources, such as LNG, and the establishment of consistent legal framework conditions.

The government continues to see an important long-term role for gas, as it is one of the potential substitutes for nuclear energy. Natural gas can indeed play an important role in the transition to a low-carbon economy because of its position as the least carbon-intensive fossil fuel, its role in heat and power generation, and its flexibility in a world of increasing intermittency. However, although gas-fired power plants generated 27% of electricity in 2014, gas demand for power generation is increasingly under pressure. If this is a lasting trend, it could affect both the future role of the gas-fired power plants and the use of the gas network, and challenge the security of electricity generation in the event nuclear power, which provides around half of the electricity supply, is phased out in the near future.

In 2012, Belgium codified its natural gas emergency response policy under one law, in compliance with EU Regulation 994/2010. The government has also adopted an emergency plan for electricity. As gas-fired power production could play an important role in ensuring the stability of power production, the risk of a serious shortage of gas supply should be reflected in more comprehensive rules for emergency management.

A welcome development is that competition in the wholesale and retail markets has increased rapidly in recent years. This success is partly explained by moving to a single entry-exit system and the creation of the virtual Zeebrugge Trading Point in 2012. Other key factors are the new entrants and supplier switching, strongly promoted by the authorities. Since late 2013, retail prices are more directly linked to wholesale prices through market indexation (both spot and forward)

Another positive change concerns the regulators. Since 2012, they have more independence from the Ministry of Economy. In particular, they are solely responsible for setting tariffs.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Continue to support the development of a liquid integrated EU gas market, especially in North-West Europe, also with a view to further strengthening diversification, competition and transparency in the gas sector.*
- ☐ *Proceed with forecasting future gas demand and supply patterns, and develop integrated plans to meet gas demand under different scenarios. Consider, in this context, a stronger role for liquefied natural gas.*
- ☐ *Ensure sound planning and implementation of the conversion from L-gas to H-gas, taking into account the required flexibility for peak demand and security of supply. In this context:*
    - *Set adequate and consistent framework conditions to ensure a smooth process of conversion with the co-operation of all stakeholders concerned, including federal and regional authorities, grid operators, gas suppliers, appliance suppliers and end-users.*
    - *Continue discussions with neighbouring countries on the process of conversion to facilitate a smooth transition from L-gas to H-gas across the entire region.*

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8. ELECTRICITY

Key data (2014 provisional)

Total electricity generation: 71.5 TWh, -15.3% since 2004

Electricity generation mix: nuclear power 47.2%, natural gas 27%, biofuels and waste 7.9%, wind 6.5%, coal 6.2%, solar 4%, hydro 0.4%, oil 0.3%

Net imports: 17.6 TWh, or 21.5% of electricity demand

Installed capacity: 20.9 GW, +33.4% since 2003

Peak demand: 12.7 GW

Electricity consumption: 82 TWh (industry 46%, commercial and public services and agriculture 27.2%, residential 23.1%, energy sector 1.9%, transport 1.7%)

SUPPLY AND DEMAND

GENERATION

Belgium's electricity generation was 71.5 terawatt-hours (TWh) in 2014, or 13.1% less than in 2013. Generation peaked at 93.8 TWh in 2010 and has been falling since. Over the four years from 2010 to 2014, electricity generation fell by 23.8%, primarily because of long and extensive outages at the country's nuclear power plants.

According to preliminary statistics released by the Belgian energy regulator, the Commission de Régulation de l'Électricité et du Gaz (CREG), power generation in Belgium in 2015 declined by 8.3%, mainly because of a 23% fall in nuclear power generation, caused by long temporary outages of around half the country's nuclear capacity (see Chapter 10, "Nuclear Energy").

In 2014, nuclear power as the primary source of electricity in Belgium accounted for 47.2% of total generation its share being relatively stable during the 2000s, at around 55%. Since 2011, the share has fallen from 54.2% to 47.2%, as total nuclear power generation declined by 30.3% over the same period because of the long outages (Figure 8.1).

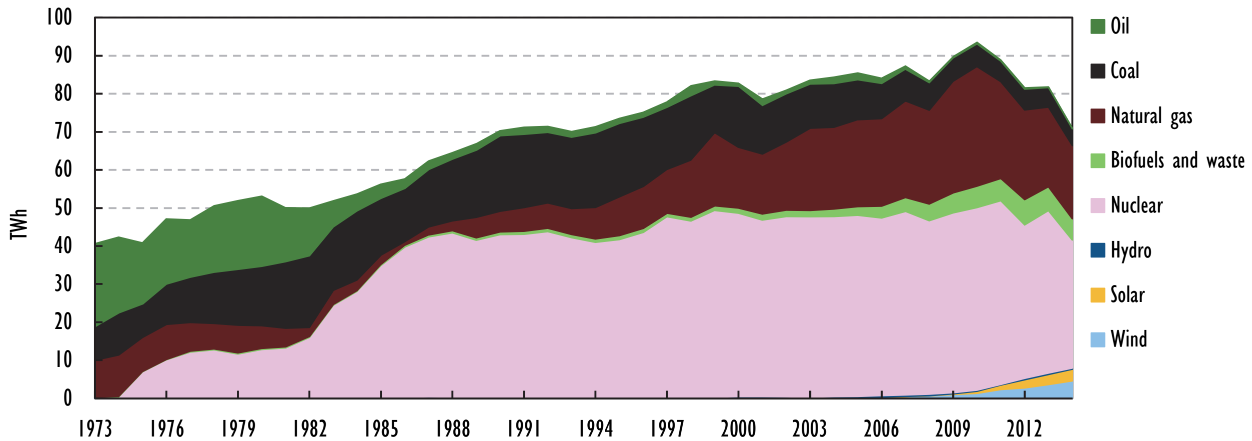
Natural gas accounted for 27% of total generation in 2014 (or 19.3 TWh). Electricity produced from natural gas grew for decades to peak at 31.4 TWh in 2010 (33.5% of the total). Since then, however, gas use in electricity generation has fallen by 38.8%, as imports from cheaper sources and wind and solar power have gained ground.

Renewables represent 18.8% of electricity production in Belgium, made up of biofuels and waste (7.9%), wind (6.5%), solar (4%) and hydropower (0.4%). The share of renewables in generation has increased from 2.9% in 2004. On average, biofuels and waste grew by 11.3% per annum over the ten years. Driven by subsidies and starting from a low absolute level, solar grew by 121.9% per year and wind by 41.6%. Hydropower generation varies year-on-year and in 2014 was 13.6% lower than in 2004.

Coal accounted for 6.2% of electricity generation and oil for 0.2%. Both fuels are being progressively phased out as electricity sources. From 2004 to 2014, oil use fell by 90.8% and coal use by 61.4%.

The several changes to long-term operation (LTO) of nuclear power plants (NPPs) over the past years have made it complicated to maintain electricity supply and demand projections up-to-date. According to the 2013 Prospective study for electricity and the 2014 *Energy Outlook for Belgium towards 2050*, by 2030, i.e. when nuclear power under current policy will have been abandoned as a power source, electricity generation in Belgium would be based on natural gas and renewable sources. Imports would be an additional major source of electricity. The scenario notes that significant investments would be needed in generating and network capacity, but does not suggest how the required investments would be financed.

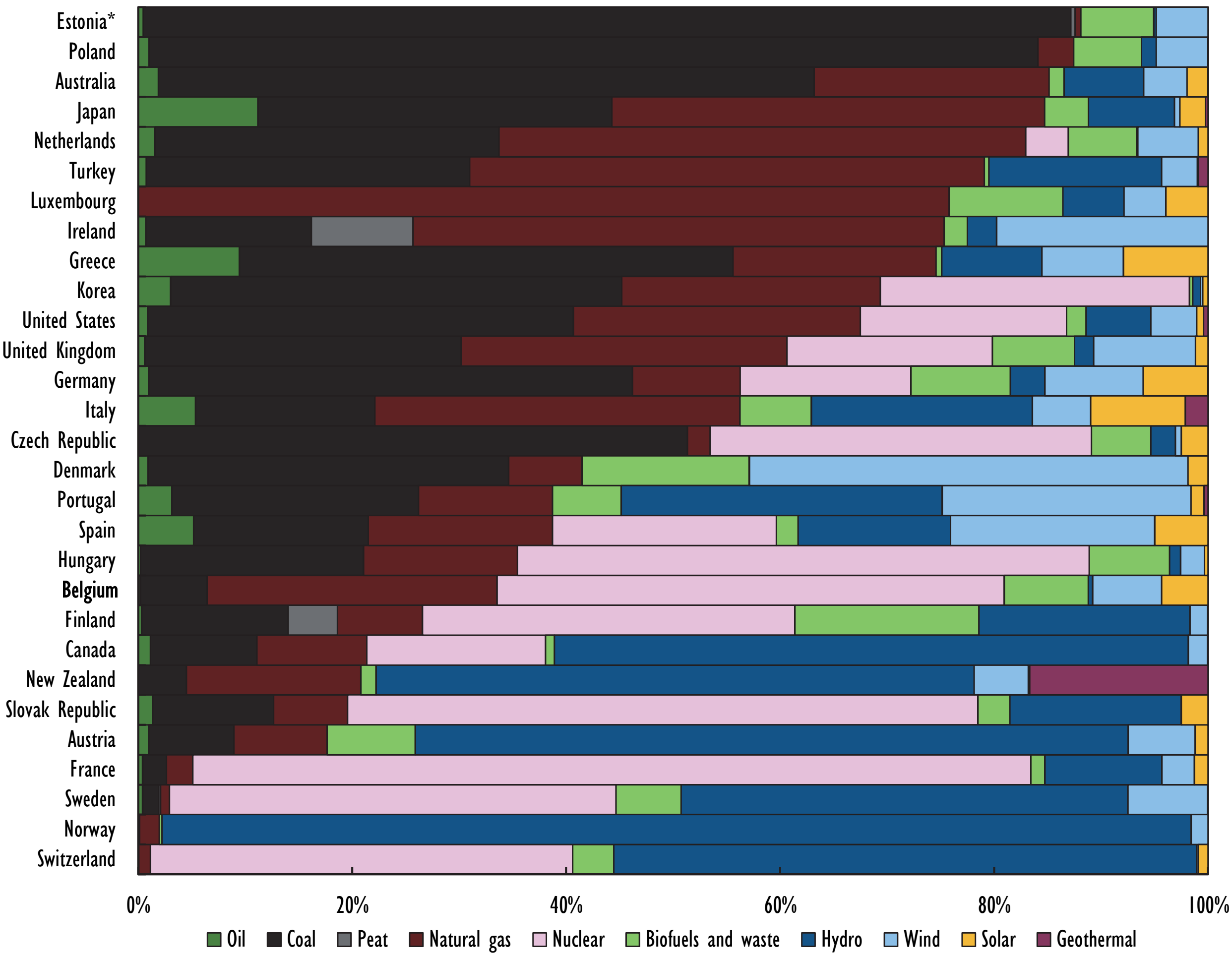
Figure 8.1 Electricity generation by source, 1973-2014



Source: IEA (2015b), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

In comparison to other IEA member countries, Belgium's share of fossil fuels in electricity generation was tenth-lowest in 2014 (Figure 8.2), with a seventh-lowest share of oil use albeit eighth-highest share of gas. Its nuclear share is the fourth-highest, behind France, the Slovak Republic and Hungary. Solar and wind shares are the fifth- and ninth-highest while the hydro share is the fourth-lowest. On average, electricity generation in Belgium produces 197 grammes of carbon dioxide (gCO_2) per kWh in 2013, the tenth-lowest among the IEA member countries (Figure 8.3).

Figure 8.2 Electricity generation by source in IEA member countries, 2014

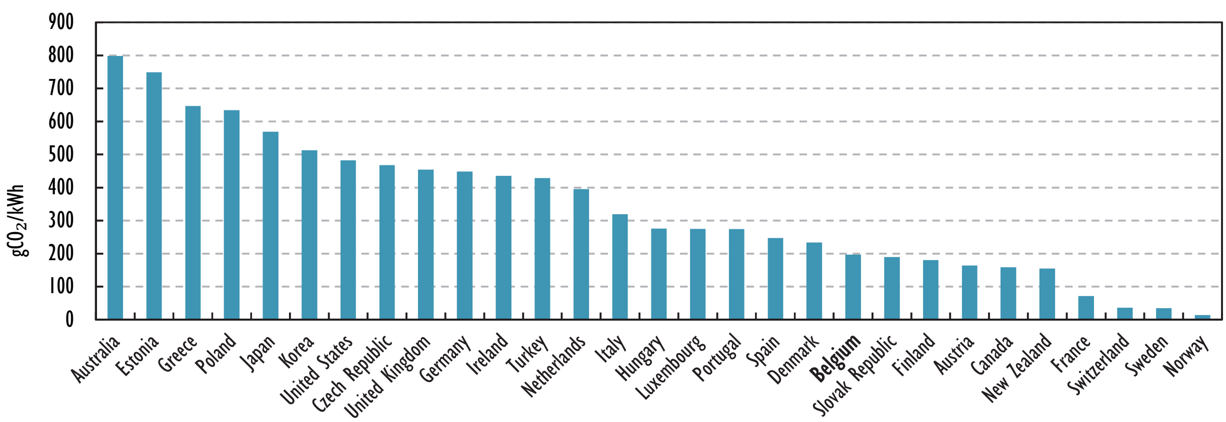


Note: Data are provisional for Belgium and estimated for other countries.

* Estonia's coal represents oil shale.

Source: IEA (2015b), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 8.3 Carbon intensity of electricity generation by IEA member country, 2013



Source: IEA (2015d), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

GENERATING CAPACITY

Since 1990, the traditional coal- and oil-fired power plants have been almost completely shut down, while natural gas has become the fossil fuel of choice for power generation. Belgium's NPPs at Doel and Tihange have seven units, all commissioned between 1975 and 1985. Their capacity has been increased, but uncertainty over their long-term operation has become a concern for security of electricity supply. Under current rules, the whole nuclear power capacity will be shut down between 2022 and 2025 (see Chapter 10, "Nuclear Energy", Table 10.1). Biofuels and waste is used at combined heat and power (CHP) plants for power and heat generation, while the capacity of solar and wind power has increased dramatically over the past ten years, thanks to subsidies. While the potential for solar- and hydropower is rather limited in Belgium, the country has a large offshore wind power potential and 1 450 megawatts (MW) of additional capacity has been licensed as of November 2015.

Table 8.1 Electricity-generating capacity by technology, 1990-2014 (MW)

Technology	1990	2000	2005	2007	2010	2012	2014
Nuclear	5 500	5 713	5 802	5 825	5 927	5 927	5 927
Solar PV	0	0	2	20	904	2 581	3 023
Gas turbine	276	1 281	1 313	1 421	2 191	2 623	2 602
Steam	6 324	4 272	3 484	3 465	4 804	3 795	2 537
Combined cycle	186	2 792	3 364	3 419	1 628	2 124	2 484
Wind	5	14	167	276	912	1 370	1 930
Hydro	1 401	1 413	1 412	1 417	1 425	1 427	1 429
Pumped storage	*1 307*	*1 310*	*1 307*	*1 307*	*1 307*	*1 307*	*1 310*
Internal combustion	169	200	433	417	638	727	742
Other	280	0	119	120	261	199	244
Total capacity	**14 141**	**15 685**	**16 096**	**16 380**	**18 690**	**20 773**	**20 918**

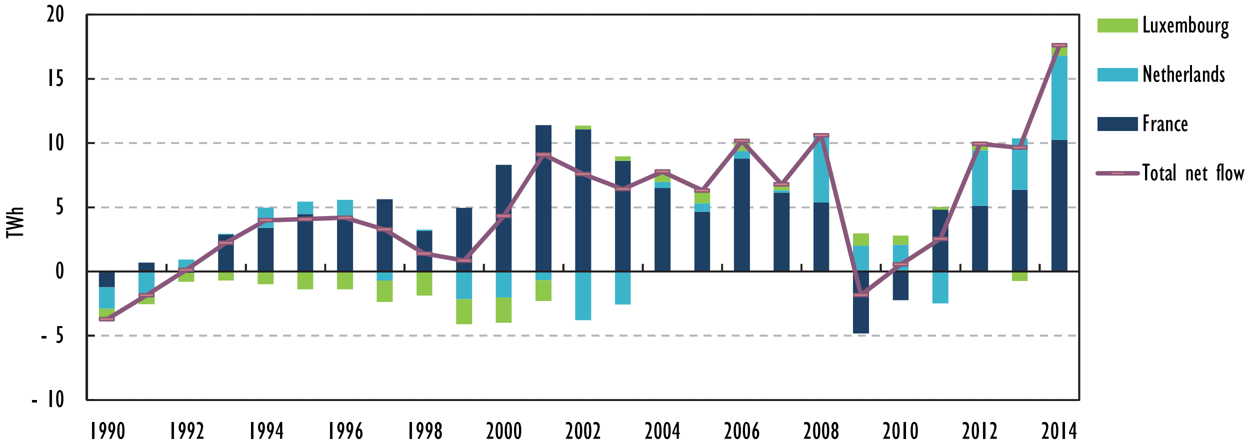
Source: IEA (2015a), *Electricity Information 2015*, www.iea.org/statistics/.

IMPORTS AND EXPORTS

In 2014, Belgium's net imports of electricity amounted to 17.6 TWh, or 21.5% of electricity demand. Imports totalled 21.8 TWh and exports 4.2 TWh.

Belgium trades electricity with France, the Netherlands and Luxembourg. It is normally a net importer, however trade has been highly volatile over the past ten years, and in 2009 the country exported 1.8 TWh more than it imported. Reflecting the decline in domestic electricity generation, from 2009 to 2014 imports grew by 120%, while exports decreased by 63% (Figure 8.4).

Figure 8.4 Net electricity imports to and exports from Belgium, 1990-2014

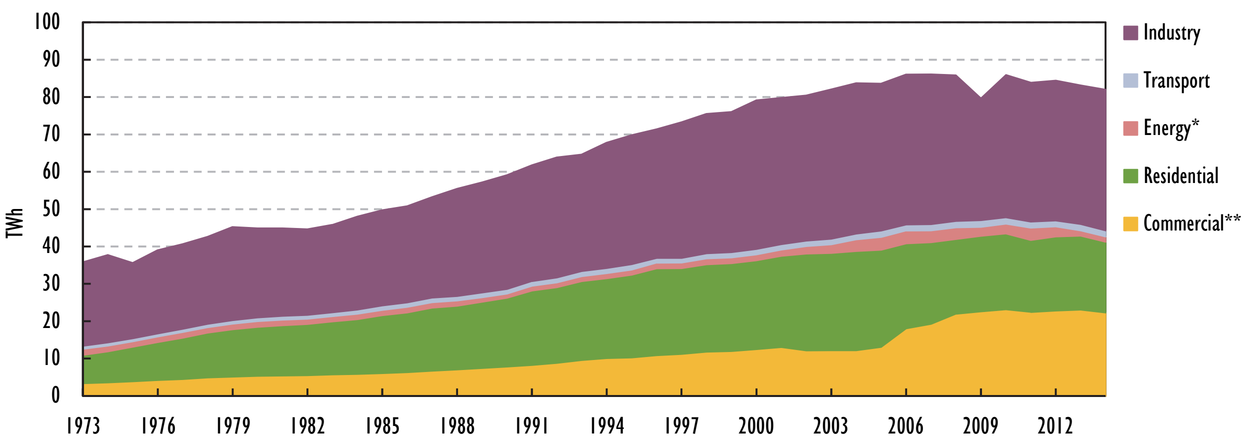


Source: IEA (2015a), *Electricity Information 2015*, www.iea.org/statistics/.

DEMAND

Belgium's electricity demand amounted to 82 TWh in 2014. Demand peaked at 86.1 TWh in 2007, after decades of growth. During 2008-09, demand fell by 7.5%, but recovered by 7.9% in 2010. Since then, demand has been relatively stable at around 83 TWh (Figure 8.5).

Figure 8.5 Electricity consumption by sector, 1973-2014



Note: Breaks in the series exist in residential and commercial consumption between 2007 and 2008 due to revisions of the NACE classifications.

* *Energy* includes coal mining, oil and gas extraction, and refining.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry. There was a break in the series in commercial and residential consumption between 2007 and 2008, due to revisions of the Statistical Classification of Economic Activities in the European Community (NACE) classifications.

Source: IEA (2015a), *Electricity Information 2015*, www.iea.org/statistics/.

Industry is the largest electricity-consuming sector, accounting for 46% of total demand. Demand in this sector peaked in 2004 at 40.4 TWh (48.2% of the total) and has been falling since. Commercial and public services (including agriculture) accounted for 27.2% of the total and the residential sector for 23.1%. Since 2008[1], demand in the

1. There was a break in the series in commercial and residential consumption between 2007 and 2008 due to revisions of the commercial/public services sector (including agriculture) has increased by 1.4% while residential demand contracted by 5.2%.

The energy sector, mainly refining, consumed 1.7% of total demand while transport consumed 1.9% in 2014. Demand from refining is volatile, averaging around 2% of total demand over the ten years to 2014. However, in the three years since 2011, its electricity consumption declined by 56.6%. Demand from transport grew until 2010, but has levelled off since.

Electricity demand peaks in winter, typically between 13 000 MW and 14 000 MW. In summer, the peak is around 2 000 MW lower. From 2007 to 2014, peak demand ranged from 12 736 MW in 2014 to 14 033 MW in 2007.

REGULATORY FRAMEWORK

The liberalisation of the Belgian energy markets began in April 1999 with the transposition of the first EU Directive on Electricity Markets. The second EU Directive (2003/54/EC) was transposed into national law in June 2005. Liberalisation was carried out gradually and the electricity market was legally fully opened as follows:

- Flemish region – since July 2003
- Walloon region (large users and business customers only) – since July 2004
- Walloon region and Brussels-Capital region – since January 2007.

The third EU Directive (2009/72/EU) was transposed at the federal level into the Act of 8 January 2012 amending the Act of 29 April 1999 on the organisation of the electricity market. The amended law increased the powers of the national regulator and the competence of regional authorities, strengthened consumer protection and introduced new unbundling rules in the sector.

For distribution activities, a legal and functional separation (unbundling) from generation and supply activities is required by law. For transmission activities, a full ownership unbundling from generation and supply activities is required by law. Elia, the transmission system operator (TSO), and the regional distribution system operators (DSOs) are legally fully unbundled from supply and generation companies since 2007.

In recent years, the EU dimension in the regulatory framework of the electricity sector has grown in importance. The development of an integrated Internal Electricity Market has become a political priority. This market integration has focused on two areas: first, integrating national and regional electricity markets and co-ordinating system operations via commonly agreed mechanisms based on the European regulations and guidelines and, secondly, constructing cross-border interconnections and co-ordinating network infrastructure planning via the European Network of Transmission System Operators for Electricity's (ENTSO-E) ten-year network development plans and regional plans. Belgium's electricity market design and interconnection developments are explained in the following sections.

Statistical Classification of Economic Activities in the European Community (NACE) classifications; therefore, comparisons cannot be made before 2008.

REGULATORS

Belgium has four energy regulators. At the federal level, the Belgian federal energy regulator, the CREG, advises the government and is also charged with:

- ensuring that the electricity and gas market is transparent and competitive
- ensuring that the market situation serves the public interest and fits into the overall energy policy
- defending the vital interests of consumers.

In January 2014, the CREG saw its independence from the ministry increase by the provisions of the law of January 2012 and the decision of the Constitutional Court of 7 August 2013, which confirmed that the regulator had exclusive jurisdiction with respect to application, determination and exemption of tariffs.

As part of the Sixth State Reform (special Act of 6 January 2014), powers to set distribution tariffs were transferred from the federal level (CREG) to the regional regulators (CWaPE in Wallonia, VREG in Flanders and Brugel in the Brussels-Capital region). The reform took effect in July 2014. The regional regulators also monitor retail market competition in their respective regions, while the federal regulator monitors competition in the wholesale market at the national level.

WHOLESALE MARKET STRUCTURE AND DESIGN

MARKET CONCENTRATION

Electrabel, the historical incumbent, held 66% of generating capacity in Belgium in 2014, although this share has declined from 85% in 2007. Importantly, Electrabel controls the country's nuclear power capacity (see Table 10.1 in Chapter 10 on Nuclear Energy). EDF Luminus has the second-largest capacity, 12% of the total at the end of 2014, while E.ON held 7% of the total. The fourth and fifth players are T-Power and Enel, each of which has a combined-cycle gas turbine (CCGT) with a capacity of just over 400 MW, or just under 3% of total generating capacity in 2014 (CREG, 2015).The Herfindahl-Hirschman index (HHI), a widely used concentration index, has declined year after year, from 7 440 in 2007 to 4 640 in 2014, still a very high figure.

Market concentration in electricity generation is not very different from concentration in generating capacity. The facilities connected to the Elia transmission grid generated almost 59.6 TWh in 2014, 11 TWh less than in 2013. This unusual decline is explained by the fact that three nuclear power plant units, Doel 3, Doel 4 and Tihange 2, were out of service for a large part of the year. Electrabel accounted for 67% of electricity generation in Belgium, while EDF Luminus generated 13% of the total and E.ON 11%. Since 2007, the share of Electrabel has declined from 86% of the total and HHI has decreased from 7 570 to 4 750, still very high. The country is well interconnected and electricity imports can be large, which has helped offset the impact of high concentration in domestic electricity generation and has increased competition in electricity supply (see section below, "Retail market structure").

MARKET COUPLING

An essential part of developing a single EU electricity market has been to connect the different, typically national, market areas both physically through cross-border interconnections and through market coupling arrangements to ensure the efficient use of cross-border capacity one day ahead of physical delivery. This market integration is also expected to increase wholesale price convergence over time.

The Belgian wholesale electricity market was first coupled with France and the Netherlands in 2006 (tri-lateral market coupling). The whole Central Western European (CWE) region, including also Germany and Luxembourg, was coupled in November 2010. The CWE region was further coupled with the North Western (Nordic) region in February 2014 and with the Iberian Peninsula in May 2014. This price-coupled area was further extended to Italy and Slovenia in February 2015. It is now called the multi-regional market coupling and it covers around 85% of electricity demand in the European Union.

The CWE region adopted in May 2015 a flow-based market coupling model where capacity is allocated though algorithms that optimise the total economic surplus of the order books of different coupled spot markets, while ensuring that the physical limits of the grid are respected.

This flow-based model is a consequence of the memorandum of understanding (MoU) of the Pentalateral Energy Forum (PLEF) in CWE, which was signed on 6 June 2007 by the governments, regulators, TSOs, power exchanges and electricity associations of Belgium, France, Germany, Luxembourg and the Netherlands. The MoU aims to improve security of supply and foster the analysis, design and implementation of flow-based market coupling between the five countries of the CWE region. In 2011, Austria joined the PLEF as a member and Switzerland as an observer. The PLEF is now focusing on further implementing the EU electricity target model for capacity allocation and calculation at day-ahead and intraday time frames, i.e. further developing the flow-based market-coupling system and implementing continuous intraday trading in the CWE region.

DAY-AHEAD MARKET

The Belpex power exchange was created in January 2006, hand-in-hand with the launch of the first market coupling between the Netherlands, Belgium and France. The physical volumes traded on the Belpex day-ahead market (DAM) keep increasing. In 2014, the volume reached a record of 19.8 TWh, or 25.6% of electricity supply in the Elia network (ACER/CEER, 2015). In 2013, the volume traded was 17.1 TWh (21.3% of the total offtake from the Elia grid), compared with 16.5 TWh in 2012. Trading volumes rose sharply mainly when nuclear power plants were unavailable. At the end of 2013, there were 42 stakeholders involved in the Belpex DAM, two more than in 2012.

On 28 January 2016 Belgium designated Belpex NV and NordPool as NEMO (nominated electricity market operator) under the European guideline on capacity allocation and congestion management.

Wholesale spot prices in the CWE region

Despite the gradual coupling of markets, prices in the CWE region remain divergent, particularly over the last two years. This is mainly explained by limited and different levels of interconnection capacity between the countries.

In general, the highest prices since 2007 were seen in 2008, the year when a long commodity boom came to an end. Average prices have dropped since then, reaching their lowest level in 2014 in all countries. Since 2011, the average annual price in the region has been the highest in the Netherlands. In contrast, since 2012, average annual prices have been significantly lower in Germany than in the rest of the region, owing to a combination of limited interconnections for exports, declining national demand and a strong increase in subsidised wind and solar power. On the Brussels Power Exchange (Belpex) and Amsterdam Power Exchange (APX), the average annual price remained practically unchanged between 2011 and 2013, but declined substantially on Powernext and EEX. In 2014, prices fell across the region.

With the exception of February 2012, an extremely cold month, Belgian and French prices converged essentially over two years from July 2010. However, from August 2012, tariff convergence lessened each month. Overall, prices in the CWE region were equal for 12.5% of the time in 2013. This is a new and significant decline compared with 2011 and 2012, when prices were equal for almost two-thirds and half the time respectively.

Table 8.2 Average day-ahead electricity prices in the CWE region, 2007-14

EUR/MWh	Belgium	Netherlands	France	Germany
2007	41.78	41.92	40.88	37.99
2008	70.61	70.05	69.15	65.76
2009	39.36	39.16	43.01	38.86
2010	46.30	45.38	47.50	44.49
2011	49.37	52.03	48.89	51.13
2012	46.98	48.00	46.94	42.60
2013	47.45	51.95	43.24	37.78
2014	40.79	41.20	34.67	32.78

Sources: CREG (2014 and 2015).

INTRADAY MARKET

Since March 2008, Belpex has also organised an intraday exchange. Table 8.3 shows that the volume traded is increasing each year. Belpex intraday exchange was implicitly coupled with the Dutch exchange in 2011, and this may have increased the volumes traded.

Table 8.3 Average Belpex intraday electricity prices and volumes, 2008-13

Belpex intraday	2008	2009	2010	2011	2012	2013
Market price (EUR/MWh)	87.8	42.3	50.1	55	51.5	51.6
Volume (GWh)	89.2	187.2	275.5	363.5	513.2	648.4

Source: CREG (2014).

The table also shows that the 2013 average price on the intraday market increased very slightly, reaching EUR 51.6 per MWh. Intraday prices are higher than the day-ahead prices, mainly because there are more intraday transactions during peak hours, when prices are inevitably higher. The traded volume increased by 19% from 2013 to 2014 and reached 0.8 TWh (ACER/CEER, 2015).

BALANCING MARKET

Elia is responsible for balancing generation and consumption within its control area. It relies on the access responsible parties (ARPs) to maintain the balance. An ARP may be an electricity producer, a major consumer, an electricity supplier or a trader. Each ARP is individually responsible for the quarter-hourly balance of offtakes and injections in its portfolio or balancing perimeter. To maintain the balance in its area of responsibility, an ARP can use a hub to exchange energy with other ARPs for the same day or the following day.

Elia monitors imbalances on its grid continuously. To rectify such imbalances, Elia can exchange imbalances with foreign TSOs via the International Grid Control Cooperation, a project launched in 2012 and involving TSOs from Austria, the Czech Republic, Denmark, Germany, the Netherlands and Switzerland. Elia can also access what are known as contractual reserves (primary, secondary and tertiary reserves); these are volumes of electricity which can be activated upward or downward as required. Finally, to cover the costs arising from imbalances among ARPs, Elia applies a tariff to any imbalances identified within the balance areas of individual ARPs.

For 2015, Elia contracted 661 MW of balancing reserve capacity, out of which 261 MW from the demand side. Since 2013, large consumers with interruptible contracts and aggregators may participate in certain reserve calls. These reserve calls have been opened up also to resources on the distribution network for a gradually increasing volume: 50 MW in 2013 and 60 MW in 2014.

TRANSMISSION AND DISTRIBUTION

TRANSMISSION

The Belgian high-voltage electricity network is owned and operated by Elia, the TSO. In 2015, the transmission system had a total length of 3 655 km, of which 891 km at 380 kV level, 302 km at 220 kV level and 2 462 km at 150 kV level. CREG certified S.A. Elia System Operator (Elia) as the Belgian TSO for electricity as fully ownership-unbundled on 6 December 2012. Elia is 45% owned by Publi T, a company representing Belgian municipalities and inter-municipal companies, and 2.5% is owned by Publipart, while the rest is free float on the Brussels stock exchange Belpex.

The investments planned by Elia for voltage levels exceeding 70 kV are set out in the Federal Development Plan 2015-2025. Investments for 70 kV or less voltage are set out in regional investment plans. Elia estimates that its investment needs will total more than EUR 2 billion for the next decade. Investments focus on interconnections with neighbouring countries (see below) and on grid upgrades necessary to connect decentralised and renewable generation. Finally, substantial replacement investments must also be made in order to address grid ageing. Transmission tariffs are collected from grid users to finance these investments. The tariffs are set by CREG and they also include costs of public service obligations, such as reduced rates for low-income consumers.

Elia participates in the biennial ENTSO-E Ten-Year Network Development Plan (TYNDP), which provides a co-ordinated strategy for integrated regional network development.

DISTRIBUTION

Distribution companies are responsible for operating, maintaining and developing the distribution network which is used by retailers (supply companies representing end-users) for delivering electricity to end-users. Each of Belgium's three regions has its own distribution system regulated by the regional regulator.

The Flemish DSOs (12 in total) are fully owned by local public authorities (inter-municipalities). There are strict unbundling provisions for these companies. Two operating companies (Eandis and Infrax) carry out the grid management for 11 of the 12 DSOs. The 12th is a Walloon DSO that also serves the Flemish municipality of Voeren. The DSOs invest around EUR 500 million per year in networks for extension, renovation and replacement. In the Flemish region, distribution tariffs are also used to finance renewable energy subsidies through certificates and other public service obligations for DSOs, such as installing meters.

In the Walloon region, 13 DSOs operate. ORES scrl was the single operator for 7 of them (IEH, Interst, Interlux, Sedilec, Simogel, Intermosane and Ideg) and was responsible for operational tasks and network operations. Those seven merged at the end of 2013 and created ORES Assets which is responsible for almost 80% of distribution in the Walloon region. Six DSOs are held by municipalities and provinces only. ORES Assets is held by municipalities and provinces (75%) and Electrabel (25%). DSOs invest about EUR 200 million per year in networks for extension, renovation and replacement. In the Walloon region, distribution tariffs are used also to finance renewable energy subsidies and other environmental and social public service obligations.

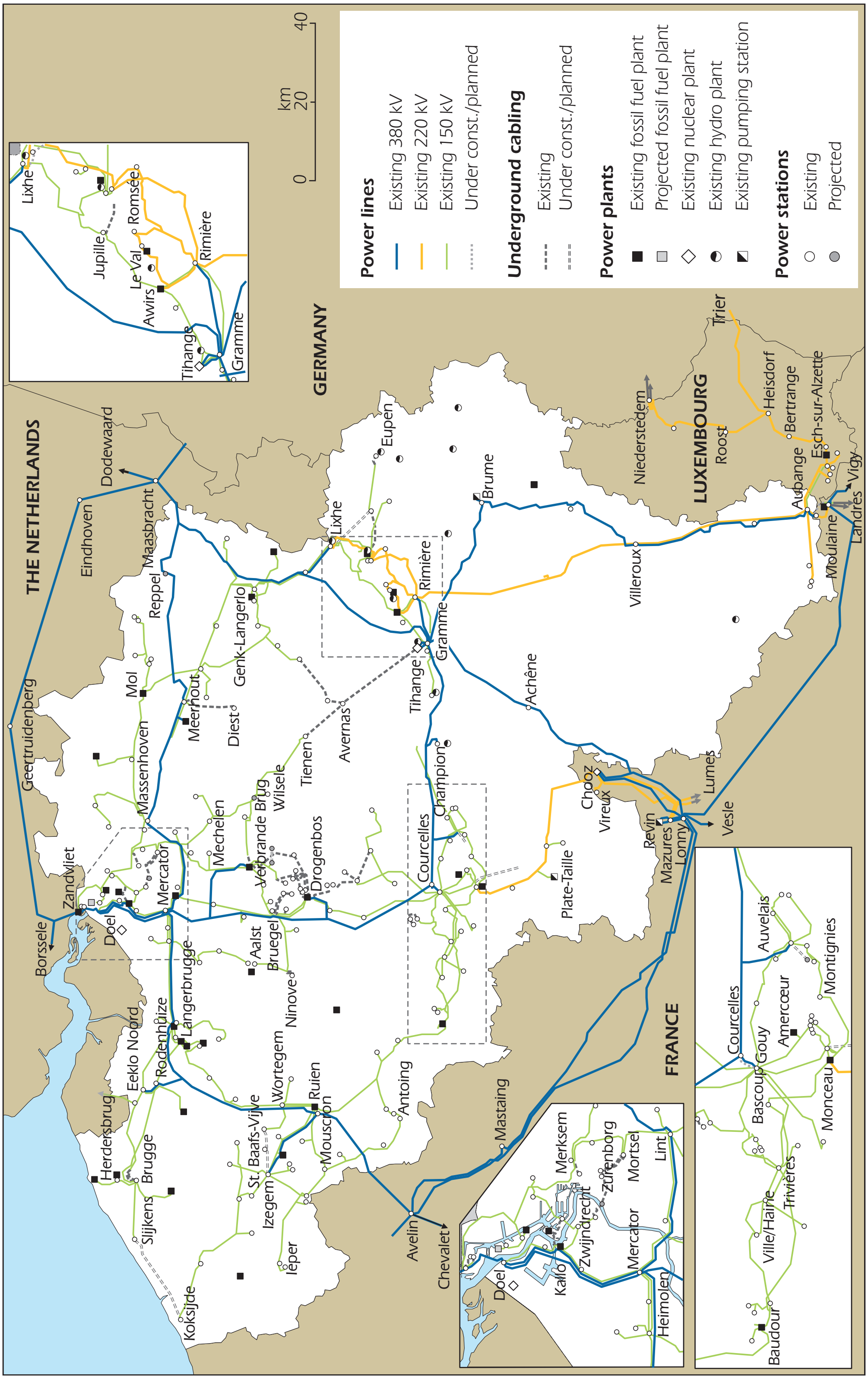
In the Brussels-Capital region, in addition to legal and accounting unbundling, the Brussels distribution network operator (Sibelga) has also been completely unbundled from production and supply companies since 1 January 2013. Sibelga invests about EUR 70 million per year for the extension, renovation and replacement of networks. In the Brussels-Capital region, distribution tariffs are used also to finance the performance of public service obligations; these include the supply of energy to protected customers at a social tariff, the installation or removal of power limiters, the construction, maintenance and supply of energy for municipal public lighting, the prevention of hazards relating to internal gas installations, and the supply of energy for fairs and festivities.

CROSS-BORDER CAPACITY

Belgium's electricity network is connected with the Netherlands, France and Luxembourg. The total commercial interconnection capacity is estimated at 3 500 MW in winter, of which around 1 400 MW on the northern border and 2 100 MW on the southern border. In summer (July and August), the capacity is estimated at 3 000 MW. This capacity is the minimum import capacity which Elia guarantees in advance for the hours of the relevant season.

Depending on the time of day, import capacity made available to the market however may exceed this limit. The daily import capacity is defined on the previous day (D-1).

Figure 8.6 Map of Belgium's high-voltage electricity grid, 2016



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Source: Elia.

From 2007 to 2014, annual export capacity averaged 2 608 MW, ranging from to 2 243 MW to 2 971 MW. In the same period, annual import capacity averaged 3 962 MW, ranging from 3 566 MW to 4 250 MW (CREG, 2015). In 2014, relevant for security of supply, maximum commercially available import capacity was 5 001 MW, or 36% of the peak demand of 13 821 MW, according to Elia. Belgium is thus well interconnected by international comparison.

In order to anticipate the net transfer capacities (NTC) between the different networks of the CWE region, the different TSOs realise in a co-ordinated manner a prediction "Y-1" to determine annual capacities at each border, in each direction, for the following year. A similar study is also performed to determine the NTC at the monthly and weekly levels.

Current projects to increase interconnection capacity are as follows:

- Brabo: A 1 000 MW interconnector with the Netherlands is expected to be commissioned in 2018. The project involves strengthening the high-voltage grid and the security of supply in the port of Antwerp.
- Nemo: A 1 000 MW direct-current (DC) interconnector with the United Kingdom is expected to be commissioned in 2019, allowing Belgium to have access to the full and expanding British electricity market.
- ALEGrO: Around 1 000 MW DC interconnector with Germany is expected to be commissioned in 2019.
- Creos: Increasing interconnection capacity with Luxembourg in two stages: 400 MW in 2015 and 700 MW in 2020.
- Avelin-Avelgem-Horta: A 1 000 MW interconnector with France is expected to be commissioned in 2021-23.

The Belgian authorities have simplified the permitting procedures for trans-European energy infrastructures, the so-called projects of common interest (PCIs), which include many electricity projects. The federal and regional authorities have agreed to adopt a co-ordinated approach regarding the administrative procedures:

- by publishing a common manual describing the authorisation procedure for PCIs
- by signing a co-operation agreement aimed at co-ordinating and rationalising their respective authorisation procedures, by creating a co-ordinating and facilitating committee for granting a permit for such infrastructures and by facilitating the exchange of information for all common projects.

ALLOCATION AND CONGESTION MANAGEMENT OF CROSS-BORDER CAPACITY

Daily capacity is allocated to the market players through an implicit allocation mechanism organised by the power exchanges through market coupling. The TSOs at the Belgian borders also offer intraday capacity. At the border with France, the allocation of intraday capacity occurs at 12 fixed times, called "windows". At the Dutch border, intraday capacity is allocated on the basis of continuous trading on intraday markets of APX-ENDEX and Belpex through the Elbas trading platform.

Congestion in interconnections creates rents. Under EU Regulation 714/2009, this revenue from allocating cross-border capacity must be used to fund investments aiming to reinforce cross-border capacity. In Belgium, congestion rents have increased sharply from EUR 33 to 37 million in 2009-11 to EUR 68 million in 2012, EUR 128 million in 2013 and EUR 97 million in 2014. This increase can be largely explained by rising imports from France to fill the supply gap left by the decline in domestic nuclear power generation. Congestion rents on the France-Belgium interconnections tripled from EUR 24 million in 2012 to EUR 75 million in 2014.

RETAIL MARKET AND PRICES

RETAIL MARKET STRUCTURE

In 2014, Belgium had 4 299 000 households electricity customers and 827 000 other electricity users (ACER/CEER, 2015). The largest electricity suppliers to end-users by volume were Electrabel Customer Solutions (29.6%), Electrabel (21.6%) and EDF Luminus (16.0%), ENI Gas & Power (6.7%), Lampiris (4.8%) and E.ON Belgium (4.0%).

Table 8.4 HHI for concentration in electricity retail markets, 2011-14

	2011	2012	2013	2014
Flemish region	4.227	3.094	2.640	2 597
Walloon region	3.886	3.587	3.334	3 209
Brussels-Capital region	7.477	6.605	5.902	5 442

Sources: CREG (2014 and 2015).

Table 8.5 Number of active electricity suppliers, 2011-14

	2011	2012	2013	2014
Flemish region	22	25	32	44
Walloon region	23	21	24	28
Brussels-Capital region	16	12	17	19

Source: CREG: Number of active suppliers of electricity on 31/12/2011, 31/12/2012 and 31/12/2013.

Competition in the retail market has increased significantly in the previous years. In the three regions, market concentration has declined and the number of suppliers increased.

Table 8.6 Rates of customers switching electricity supplier, 2011-14

	2011, %	2012, %	2013, %	2014, %
Flemish region	8.2	16.5	15.4	11.9
Walloon region	8.6	11.6	13.6	12.7
Brussels-Capital region	4.1	8.3	14.3	9.6

Source: CREG: Relative number of access points that switched energy supplier in 2011, 2012 and 2013.

Belgium has had one of the highest rates of customers switching supplier in the world in recent years, thanks to committed and supportive regulators, public awareness campaigns and active marketing. A major initial push was given by the campaign "Gas –

electricity: Dare to compare!" which took place in September 2012 at the initiative of the Minister of Economy and Customers and the Secretary of State for Energy, supported by the administration and the four regulators.

In addition to increasing consumer awareness, several legislative changes have eliminated barriers for consumers to actively participate in the retail market. For example, households, self-employed and small and medium-sized enterprises (SMEs) consuming less than 50 MWh per year can change supplier free of charge and with a one-month notice. Suppliers must also inform their customers of all changes in contract terms. To switch supplier, the customer only needs to sign a contract with a new supplier. This new supplier will then contact the previous supplier to organise the switch.

RETAIL PRICES

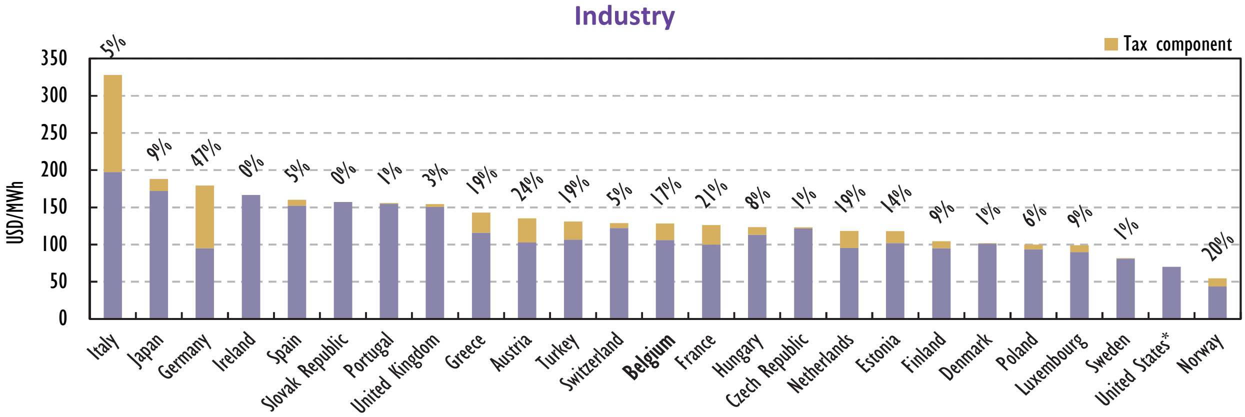
Electricity prices for industry and households in Belgium are close to the median among the IEA member countries. Wholesale electricity prices and the energy component of retail electricity prices for households declined in tandem from 2011 to 2014, and the difference between the two remained at around EUR 20/MWh (ACER/CEER, 2015). CREG, the federal energy regulator, publishes a monthly overview of electricity and gas prices in Belgium.[2]

Electricity (and gas) contracts for end-users are based on either variable or fixed pricing. Variable pricing (around 30% to 40% of contracts) was traditionally based on indexation parameters adjusted on a monthly basis. As a result, end-users saw prices change monthly within the same contract. From the beginning of 2013 until the end of 2017, so-called safety-net regulation applies to retail electricity and gas prices to address price volatility and the complexity of pricing formulas. Indexation is now subject to CREG supervision and restricted to one revision per quarter, instead of one per month in the past. CREG will be using transparent market-linked parameters when evaluating the suppliers' indexation formulas. It will also compare prices in Belgium with prices in the neighbouring countries in its evaluation.

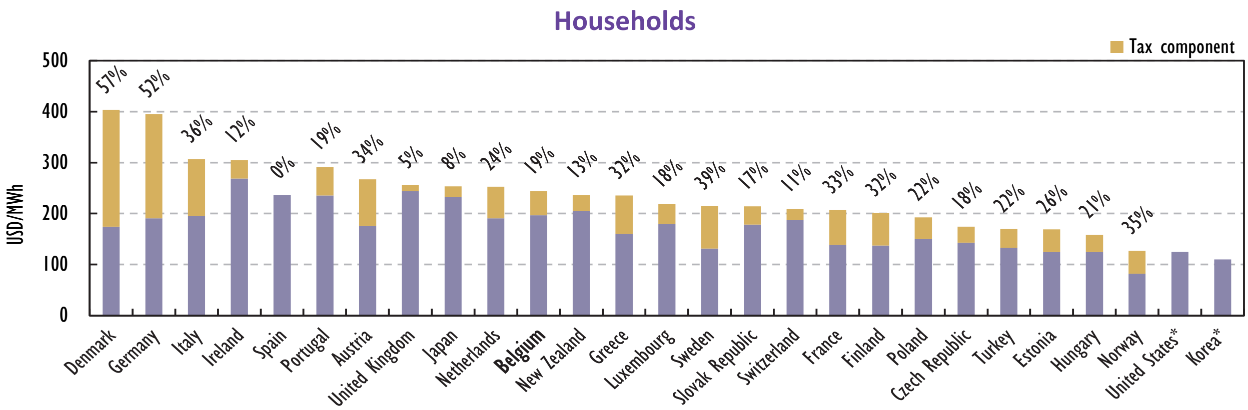
By law, certain types of low-income, or vulnerable, customers are eligible for reduced electricity (and gas) tariffs. This social tariff is the combination of the lowest energy tariff and the lowest network tariff and applies in the whole of Belgium. In 2014, the social tariff for electricity applied to 208 000 customers in the Flemish region (7.9% of all residential customers) and to 158 000 customers in the Walloon region (10% of residential customers). Information for the Brussels-Capital region was not available (CREG, 2015).

2. See www.creg.be/nl/compprixchoix.html.

Figure 8.7 Electricity prices in IEA member countries, 2014



Note: Data not available for Australia, Canada, Korea and New Zealand. Data for Spain are from Eurostat and represent the Band IC (500 MWh<Consumption<2 000 MWh) for industrial customers.

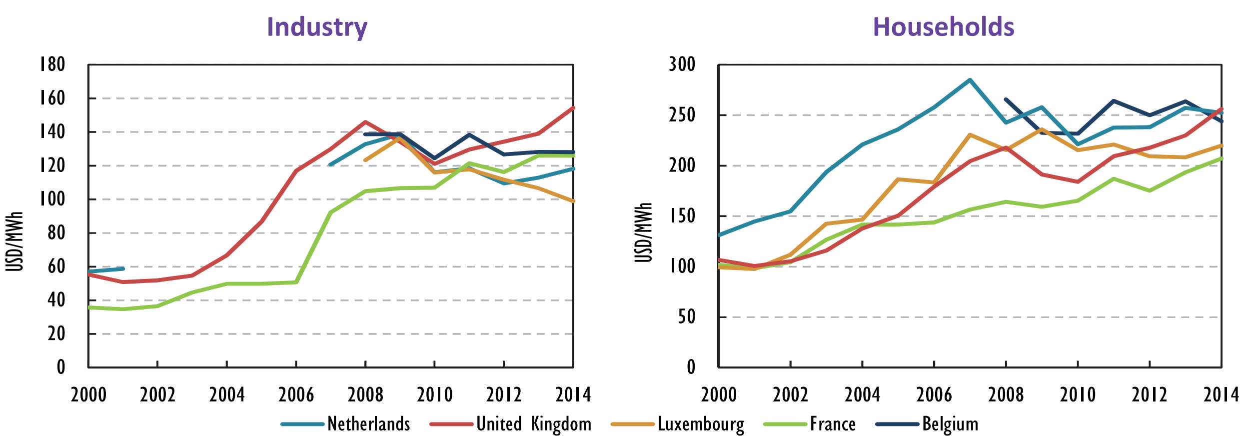


Note: Data not available for Australia and Canada. Data for Spain are from Eurostat and represent the Band DC (2 500 kWh<Consumption<5 000 kWh) for domestic customers.

* Tax information not available.

Source: IEA (2015c), *Energy Prices and Taxes 2015, Q3*, www.iea.org/statistics/.

Figure 8.8 Electricity prices in Belgium and in other selected IEA member countries, 2000-14



Note: Data for Belgium for industrial and household prices are not available for 2001-07; data for Luxembourg for industrial prices are not available for 2000-07; data for the Netherlands for industrial prices are not available for 2002-06.

Source: IEA (2015c), *Energy Prices and Taxes 2015, Q3*, www.iea.org/statistics/.

SMART METERS

The 2012 Energy Efficiency Directive (2012/27/EU) requires member states of the European Union, as of 1 January 2015, to install in all new buildings and buildings subject to major renovation works "individual meters that precisely indicate the final customer's actual power consumption and give information on the time when the power was used".

Under the EU internal electricity market rules, every member state must set a timetable for introducing smart meters. After a positive cost-benefit analysis, at least 80% of consumers shall be equipped with such meters by 2020. In Belgium, the cost-benefit analyses have not been positive, however, and there is no decision in favour of a large-scale roll-out of smart meters in existing buildings.

Smaller-scale pilot programmes exist, however. The Flemish DSOs run a pilot programme in which they have installed 42 000 smart meters (electricity and gas). They are still improving the accessibility of the meters, using different communication technologies and preparing tests of prepayment functionality. In the Brussels-Capital region, the DSO is conducting a pilot project related to deploying smart meters. The goal is to validate the chosen technology and test the business model. The DSO will install 5 000 smart electricity meters and 500 smart gas meters in 2017 and, depending on the results of the project, possibly 6 000 more smart electricity meters in 2018. In the Walloon region, pilot projects related to smart meters are also conducted to specify technologies and business models.

The Belgian DSOs are currently working on developing a new national information and data exchange interface between the DSO and the energy suppliers (a national clearing house). This updating of the functionalities of the clearing house is aimed at taking into account future market transformations, in particular the management of decentralised generation facilities and smart measurement systems. Within this framework, the implementation of a flexible market originating from distribution network users is being studied. The work is still under way since no common clear vision of the transformations to be carried out or the technological means to be favoured has emerged. The new clearing house should be operational in 2017.

ELECTRICITY SECURITY

Electricity security, more specifically generation adequacy, has been a cause of concern in Belgium over the past few years, mainly as a result of unexpected outages at the country's NPPs and low wholesale prices that do not encourage investments, but also related to the policy of nuclear phase-out.

The government has taken the following concrete measures since 2014 to guarantee the security of electricity supply in the short, medium and long term:

- A strategic reserve was created (see below).
- The tariff for imbalance was increased to EUR 4 500 per MWh.
- A new load-shedding plan was defined.
- A national awareness campaign to save electricity was launched in November 2014 by the Ministers of Economy and Energy (Off-On Campaign) to prevent a shortage or disruption of electricity supply.

- The law on the nuclear phase-out of 2003 was changed in 2015 to enable the long-term operation of the two oldest nuclear reactors (866 MW or 14% of total nuclear capacity) by ten years until 2025.
- An "energy transition fund" was launched to stimulate the development of innovative energy projects (in particular focusing on storage and renewable energy production).

STRATEGIC RESERVE

In 2014, Belgium introduced a strategic reserve into the Electricity Act of 1999, which concerns the organisation of the electricity market. The intent of the reserve was to ensure security of supply at times of short-term problems with nuclear power plants, as well as the envisaged phase-out of nuclear by 2025. In March 2014 the TSO estimated the gap for the winter 2014/15 to be around 800 MW of peak capacity. A strategic reserve of 850 MW was contracted on the basis of the Ministerial Decree of 3 April 2014. The strategic reserve comprised 750 MW of generation and 100 MW of demand-side response. The 750 MW of generation was contracted for three years. The major part of the 100 MW was made available by an aggregator who brought together around 50 Belgian companies, including large manufacturers.

For the winter 2015/16, the Minister for Energy decided in January 2015 to increase the total amount of capacity in the strategic reserve to 3 500 MW (Elia, 2015a). The gap for the winter 2015/16 was estimated in November 2014 to be around 2.75 GW of peak capacity (in addition to the 750 MW of strategic reserve already contracted). The estimate assumed that the NPP units of Doel 1, Doel 3 and Tihange 2 would not be in operation in winter 2015/16.

In early 2015, some generating capacity expected to go out of the market was returned to the market. The TSO managed to increase the available cross-border capacity. The additional capacities of strategic reserve contracted in 2015 for the winter 2015/16 were finally 427.1 MW of generation and 358.4 MW of demand-side response. A total of 1 535.5 MW of strategic reserve was thus contracted, comprising 1 177.1 MW of generation (427.1 MW + 750 MW).

The recent actions by market actors, the TSO and the authorities reduced the risk of shortage in future winters to negligible levels. For the winter 2016/17, the Minister for Energy decided not to increase the strategic reserve above the 750 MW already contracted). As all units at the Doel and Tihange NPPs are expected to be in operation in winter 2016/17, it is indeed not necessary to contract new capacities of strategic reserve.

Elia, the TSO, runs the strategic reserve tender process. Any aggregator, Elia grid user or party responsible for access (such as an electricity producer, major consumer, electricity supplier or trader) is authorised to participate in calls for tender for the strategic reserve. Generating capacity that is successfully bid into the tender must be available for five winter months each year and with a notification time of 5.5 hours. Only generation units in the Belgian control area that have already been shut down may participate in the tender. Contracted generation units will be considered to be operating off-market for the share of capacity contracted by Elia.

Contractual demand-side response, whether individual or aggregated, is allowed to participate in the tender. It is contracted for one year at a time. Two types of contract were envisaged for demand response: a contract for a four-hour duration with a gap between activations of four hours, and a maximum of 40 activations per contract; and one with a duration of 12 hours with a gap between activations of 12 hours, and a maximum of 20 activations per contract.

Each year, the Federal Minister for Energy may instruct Elia to establish a strategic reserve, following the advice of the authorities (the Directorate-General for Energy) and a statistical analysis of security of supply conducted by Elia. In the decision, the minister sets the required strategic reserve volume in megawatts, with a specific volume per year. The strategic reserve changes from year to year depending on requirements, following the same procedure. In other words, the minister decides on the required volume, while the market sets the price of the strategic reserve by means of the offers received during the tendering process.

The strategic reserve is activated once a risk of an energy shortage on the electricity market has been detected. If the results at the Belgian electricity exchange indicate a shortage in the total volume of energy on offer vis-à-vis the demand for energy, on day D-1 or in the intraday, the exchange allocates additional energy from the strategic reserve. These exchanges of energy are made at the maximum price that applies on the Belpex day-ahead market (currently EUR 3 000/MWh) (Elia, 2015b).

The TSO is assessing the need for flexibility for the years 2017-27 in collaboration with the DG Energy of FPS Economy. The results will help inform on how much flexibility (imports, demand-side response, storage, flexible generation) must be found in the electricity system. The results could be used to define a new support mechanism, the “structural reserve“, to eventually replace the rather expensive strategic reserve.

REGIONAL CAPACITY ADEQUACY

Interconnecting geographic areas helps to pool the expensive capacity resources required to ensure resource adequacy and maintain reserve margins. Ensuring access to a broader portfolio of power plants makes it easier to find the capacity needed to replace a power plant when it becomes unavailable because of planned maintenance, an unscheduled outage or safety concern. A projected increase in variable generation of wind and solar power further underlines the importance of interconnections. Co-ordinating electricity resources and demand in connected areas can reduce the measured loss of load expectation (LOLE) quite significantly.

Policy and regulatory responses to address resource adequacy need to be developed in close co-operation between all jurisdictions within the CWE to avoid undue distortions that could jeopardise market efficiency, electricity security and cost-effectiveness. The Pentalateral Energy Forum (PLEF) is an effective tool for this.

In the Forum’s working programme of June 2015, a key objective is to work on the further development of a co-ordinated approach to security of supply. The work will focus on developing a roadmap for a regional approach to adequacy concerns, which currently are primarily addressed in a national context. This will be based on a continued and improved monitoring of adequacy assessment from a regional perspective performed by TSOs. Furthermore, the Forum will continue to assess the interaction between national policy measures related to security of supply, in particular national capacity mechanisms. This work will include considerations on a market framework for cross-border participation in capacity mechanisms.

ASSESSMENT

The federal government has committed itself to competitive markets, and competition has clearly improved since the last review in 2009. In particular, the retail sector has seen improvements, with an increasing number of suppliers entering the market. The authorities have launched successful awareness campaigns with remarkable results in customer activity, such as increased supplier switching. The DSOs are also preparing to launch a common platform for the exchange of retail market data by 2018 (ATRIAS), which will further enhance the functioning of the retail markets.

The wholesale markets have seen increasing integration through market coupling within the CWE region and the rest of Europe. The CWE region introduced a flow-based method for calculating transmission capacity which should help increase cross-border capacity. New suppliers have entered the market and liquidity has improved. The planned investments in increased cross-border capacity will improve the situation further.

In order to increase demand-side participation, there are some pilot projects for introducing smart meters. It is time to move further, and draw up plans to install the meters, at least for the customers identified as those most likely to benefit from these. At the same time, network tariffs are used to collect funding for several energy and social policy objectives, which reduces the share of a market-based price component in the bill and dampens the impact of these price signals to consumers. To increase the impact of price signals on customer behaviour, cost elements that are unrelated to the supply of electricity should be removed from the electricity bill.

Capacity adequacy for electricity generation has come under serious pressure for several reasons. Most of the production fleet is at the end of its lifetime and will have to be replaced in the near future. In addition, there have been some disruptions in nuclear power generation. From summer 2012 until summer 2013, and again from March 2014 until November 2015, the Doel 3 and Tihange 2 units were taken offline by the nuclear operator, because of faults discovered in the pressure vessels by specific in-service inspections not required by procedures. In November 2015, the Belgian regulator authorised their restart on the basis of safety case reports that provided an adequate demonstration of the structural integrity of Doel 3 and Tihange 2 for up to forty years of operation.[3] The two units resumed operation in December 2015. Furthermore, the Doel 4 unit automatically shut down in August 2014 following an oil leak in its steam turbine, hence in the non-nuclear part of the facility. Work to replace the reactor's turbine took almost five months and the unit remained offline until December 2014.

However, because of the economic downturn and increased volumes of subsidised electricity generation from renewable sources across the region, wholesale electricity prices have been too low to trigger investments in new capacity. All this has made the situation extremely tight in winter time. The current policy to phase out all nuclear power plants by 2025 (for a more detailed assessment of this policy, see Chapter 10 on Nuclear Energy) does not help Belgium meet any of its energy policy goals. In contrast, it adds to the generation adequacy problem, increases CO_2 emissions and increases the costs of generating electricity. The government should consider whether the current phase-out policy is optimal for securing affordable low-carbon electricity for Belgium.

3. FANC Final Evaluation Report 2015: Flaw indications in the reactor pressure vessels of Doel 3 and Tihange 2, available at www.fanc.fgov.be/GED/00000000/4000/4027.pdf.

To secure generating capacity in Belgium, the government introduced a strategic reserve of 850 MW in 2014 and extended the reserve capacity to 1 535.5 MW (around 12% of peak demand) for the winter 2015/16**.** This capacity also included some demand response. In general, strategic reserves are useful for fixing short-term security of supply issues. By contracting old capacity that would otherwise retire, the reserves are quick and relatively simple to implement. In Belgium, however, the capacity required for the strategic reserve is rather large. The decision on its volume for the future should be based on careful analysis. This is particularly true for the demand side which could operate also in the balancing market with potentially more added value.

In addition to increasing generation within Belgium, all other possibilities to increase supply and flexibility during system stress should be exploited. Several important projects have been planned to increase cross-border capacity of the power system and help improve the power balance in Belgium by 2020. The permitting process and public acceptance appear as major barriers to implementing such projects, however. The IEA encourages the government to include this matter in public awareness campaigns related to energy and to further streamline the permitting process as far as possible within the existing constitutional framework. The creation of a "one-stop shop" entity is a first and important step in this direction. Investments in cross-border connections should be seen as a cost-effective way to address capacity problems in an integrated electricity market. They will also help increase competition in the interconnected market areas.

Demand-side participation, especially market-based, could be used more, building on many recent research projects and recent improvements in demand side to participate in certain reserves. Market participants and network operators, acting as market facilitators, should collaborate closely to define data-exchange processes in order to better exploit demand-side response from the retail market. Again, smart meters and smart grids can play an important role in encouraging the demand side to participate.

The availability of smart meters will be a fundamental prerequisite to develop innovative energy products and services, which will be a driver for energy efficiency measures. Given this important aspect, the wider economic and social benefits, notably from energy savings, should be taken into account when deciding on the large-scale roll-out of smart meters, the stimulation of demand-side response and dynamic pricing structures.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Take measures to swiftly increase interconnector capacity to enhance security of electricity supply and competition in the electricity markets.*
- ☐ *Co-ordinate measures to increase security of supply and generation adequacy with neighbouring countries and rely preferably on market-based solutions, in accordance with state-aid guidance from the European Commission.*
- ☐ *Facilitate grid infrastructure projects by further increasing co-operation between federal and regional authorities to streamline permitting processes and shorten permitting times.*
- ☐ *Continue the successful work in empowering retail electricity customers.*

- *Increase the transparency of subsidy systems and the impact of price signals on consumers by removing cost elements that are unrelated to the supply of electricity from their electricity bill.*
- *Further promote demand-side response and enhance market signals to end-users. To this end, consider a wider, cost-effective roll-out of smart meters.*

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9. RENEWABLE ENERGY

Key data (2014 provisional)

Total supply: 4 Mtoe (7.6% of TPES) and 13.5 TWh (18.8% of electricity generation), IEA average: 9.4% of TPES and 22.4% of electricity generation

Biofuels and waste: 3.3 Mtoe (6.3% of TPES) and 5.7 TWh (7.9% of electricity generation)

Wind: 0.4 Mtoe (0.7% of TPES) and 4.6 TWh (6.5% of electricity generation)

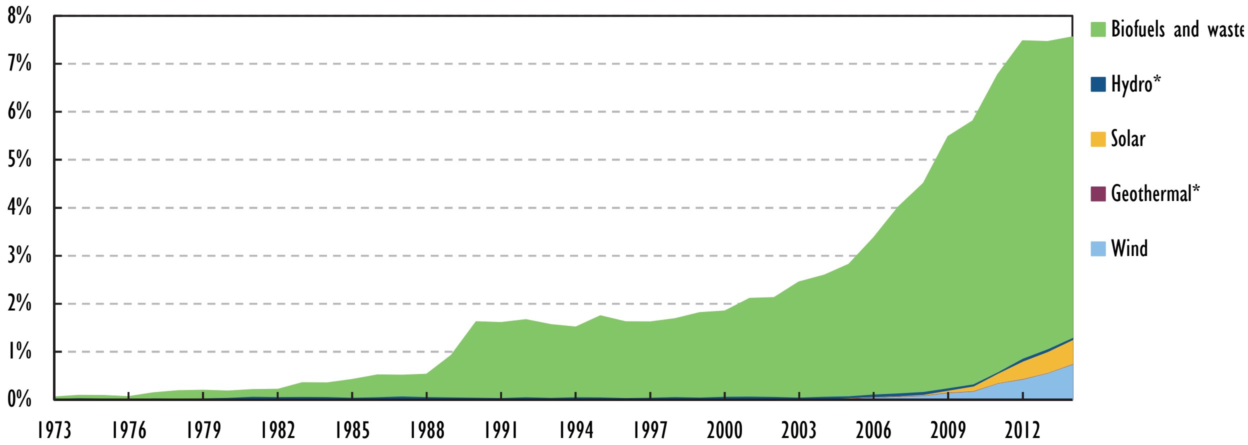
Solar: 0.3 Mtoe (0.5% of TPES) and 2.9 TWh (4% of electricity generation)

Hydro and geothermal: 0.03 Mtoe (0.05% of TPES) and 0.3 TWh (0.4% of electricity generation)

SUPPLY AND DEMAND

Renewable energy supply amounted to 4 million tonnes of oil-equivalent (Mtoe), or 7.6% of total primary energy supply (TPES) in 2014. Biofuels and waste were the main renewable source, with 3.3 Mtoe or 6.3% of TPES. In primary energy terms, the other forms of renewable energy supply were very small: wind power at 0.4 Mtoe or 0.8% of TPES, solar energy at 0.5 Mtoe or 0.9%, hydropower at 0.03 Mtoe or 0.05% and geothermal energy at 0.003 Mtoe or 0.006% (Figure 9.1).

Figure 9.1 Renewable energy as a percentage of TPES, 1973-2014



* Negligible.

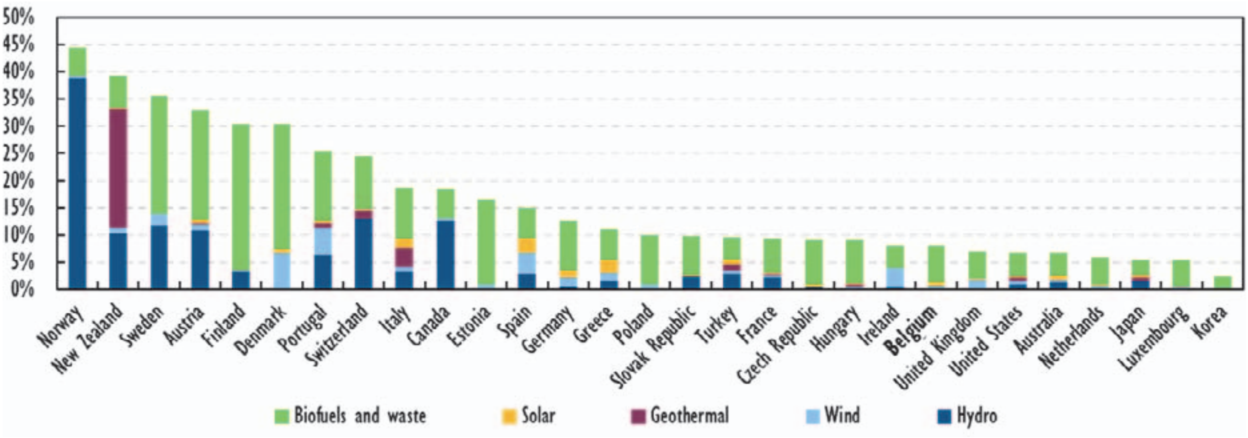
Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Renewable energy has boomed over the past decade, with the share in TPES up from 2.6% in 2004. This surge was mainly driven by robust growth in the use of biofuels and waste, which grew at an annualised rate of 8.4% from 2004 to 2014. Its share in TPES increased from 2.4% to 6.3% over the same period. Wind and solar power have grown fast since the second half of the last decade, but they still only accounted for 0.7% of TPES in 2014.

Just under half of biofuels and waste is used to generate electricity and heat at power plants (46% of the total), with the remainder used in industry (25%), households (13.7%), transport (11.9%) and commercial services (2.7%); 93% of solar energy was used for generating electricity, versus 7% for heat in the residential sector.

Renewable energy potential in Belgium is relatively low. The country is rather flat, densely populated and not particularly sunny, and large-scale use of hydro, onshore wind and solar solutions faces challenges in spatial planning and in public support. Under current technologies, biomass and offshore wind have the most potential. The first ocean (wave) energy facility (Mermaid, 20 to 61 megawatts) received a concession in 2012 and is being planned from 2019.

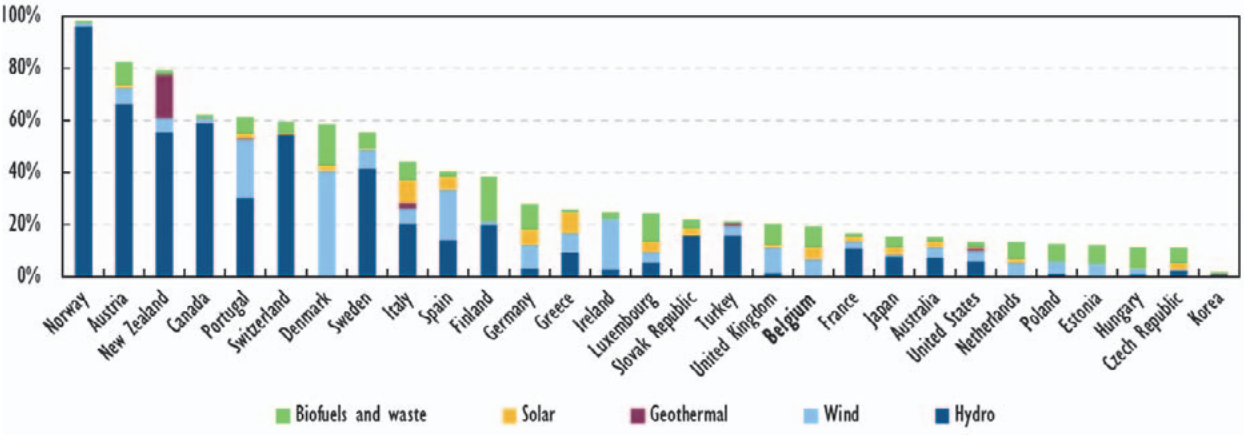
Figure 9.2 Renewable energy as a percentage of TPES in Belgium and IEA member countries, 2014



Note: Data are provisional for Belgium and estimated for other countries.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 9.3 Electricity generation from renewable sources as a percentage of all generation in Belgium and IEA member countries, 2014



Note: Data are provisional for Belgium and estimated for other countries.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Belgium has the eighth-lowest share of renewables in TPES among IEA member countries, similar to Ireland (see Figure 9.2). Its share of solar power is the tenth-highest while wind power and biofuels and waste are around the median. Reflecting the low potential, the share of hydropower is the fourth-lowest, higher only than Estonia, the Netherlands and Denmark.

Electricity from renewable sources amounted to 13.5 terawatt-hours (TWh) in 2014, or 18.8% of total generation. Renewables in electricity generation include biofuels and waste (5.7 TWh or 7.9%), wind power (4.6 TWh or 6.5%), solar power (2.9 TWh or 4%) and hydropower (0.3 TWh or 0.4%).

Table 9.1 Renewable electricity generating capacity, 1990-2014 (MW)

Technology	1990	2000	2005	2007	2008	2009	2010	2011	2012	2013	2014
Solar PV	0	0	2	20	62	386	904	1 391	2 581	2 922	3 024
Wind	5	14	167	276	324	608	912	1 069	1 370	1 792	1 930
Hydro	1 401	1 413	1 412	1 417	1 418	1 417	1 425	1 426	1 427	1 429	1 429
Pumped storage	*1 307*	*1 310*	*1 307*	*1 307*	*1 307*	*1 307*	*1 307*	*1 307*	*1 307*	*1 310*	*1 310*
Solid biofuels	26	47	294	329	442	554	640	701	678	640	553
Municipal waste	52	97	139	177	185	218	253	240	223	247	247
Industrial waste	120	139	105	111	111	111	111	111	130	62	60
Biogases	1	20	56	68	88	105	115	129	141	151	172
Other liquid biofuels	0	0	95	97	73	139	122	69	43	38	37
Biodiesels	0	0	0	0	0	0	0	12	12	12	13
Total capacity	**1 605**	**1 730**	**2 270**	**2 495**	**2 703**	**3 538**	**4 482**	**5 148**	**6 605**	**7 293**	**7 465**
Solar collectors surface (1 000 m^2)	34	41	77	139	176	319	371	420	527	570	615
Capacity of solar collectors (MW_{th})*	24	29	54	97	123	223	260	294	369	399	431

* Converted at 0.7 kW_{th}/m^2 of solar collector area, as estimated by the IEA Solar Heating & Cooling Programme.

Source: IEA (2015b), *Renewables Information*, www.iea.org/statistics/.

Electricity from renewables has increased more than fivefold over the past ten years, up from 2.4 TWh in 2004 or 2.9% of total generation. Wind power increased by 41.6% per year over the same period, while solar power progressed at 121.9% per year from negligible levels in 2004. Biofuels and waste also grew robustly at 11.3% per year. Hydropower varies year-on-year according to rainfall, but overall has remained small in the past ten years.

Among IEA member countries, Belgium has the eleventh-lowest share of renewables in electricity generation (Figure 9.3). However, its shares of solar power and biofuels and waste are fifth- and sixth-highest, respectively, while the share of wind is ninth-highest. The share of hydro is the fourth-lowest.

Thanks to favourable promotion policies, renewable electricity generating capacity increased by 229% (5.2 gigawatts) from 2005 to 2014 (see Table 9.1). The increase was mostly in solar power (58% of the total increase) and wind power (34%). Notably, Belgium's installed offshore wind power capacity (712 MW in 2014) is the fourth-highest in Europe, after the United Kingdom, Denmark and Germany. Another 1 450 MW of offshore projects has been authorised as of November 2015.

INSTITUTIONS

As with energy policy in general, the competence for renewable energy policy is divided between the federal government and the regions. The federal government is in charge of offshore wind, ocean energy and biofuels standards, while the regions are in charge of the rest. Relevant for grid integration of renewable energy, the regions are also responsible for distribution grids of up to 70 kV of voltage.

POLICIES AND MEASURES

TARGETS

Belgium's renewable energy policy is aligned with the European Union (EU) 2020 targets. For 2020, the country has a binding national target for renewable energy to equal 13% of gross final consumption of energy.[1] In addition to this overall target, Belgium and other EU member states have a separate binding national target for renewable energy to cover 10% of transport fuel demand in 2020. Beyond 2020, the EU member states have agreed on a target for a 27% share of renewable energy in energy consumption by 2030. The target is binding for the European Union as a whole only. It has not been broken down and assigned to individual member states.

Belgium's targets on renewable energy for 2020 and the policies and measures to meet them were initially laid out in the National Renewable Energy Action Plan 2011-2020 (NREAP) which was published in November 2010.

Belgium is making solid progress towards the 2020 target and is exceeding the interim targets on the path to 2020 (see Table 9.2). It has increased the share of renewable energy in gross final energy consumption from 2.3% in 2005 to 6.2% in 2011, 7.2% in 2012, 7.6% in 2013 and 8.0% in 2014. The share has grown mainly as a result of increasing biofuels use both for electricity and heat generation and in transport, but also as a result of increasing wind and solar power capacity and, since 2010, decreasing final energy consumption.

As foreseen in the 2011-2020 NREAP, the gap between the 2020 target and the 2013 levels is to be bridged by increasing efforts in all subsectors of renewable energy use. For 2020, the 2011 NREAP targets 5.4 Mtoe of gross final consumption of renewable energy, almost an eightfold increase from 0.7 Mtoe in 2005. Of this total, 2.6 Mtoe (48%) is expected to be energy for heating and cooling, 2.0 Mtoe (37%) for electricity and 0.8 Mtoe (15%) for energy in transport.

The responsibility for meeting the national 2020 target is shared between the regions and the federal authority. On 4 December 2015, these entities reached a political agreement regarding their contribution to the 2020 target. Belgium can also resort to so-

1. The EU definition of gross final energy consumption includes transmission and distribution losses and thus differs from total final consumption (TFC) used in the IEA methodology.

called co-operation mechanisms to help meet its 2020 target. These include statistical transfers between the EU member states of a specified amount of energy from renewable sources and joint renewable energy projects with other countries.

Table 9.2 Belgium's 2020 target and estimated trajectory for the share of renewable energy in gross final consumption of energy

	2005	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Trajectory, %	2.2	4.4	5.2	5.8	6.8	7.5	8.6	9.5	10.7	11.9	13.0
Historical, %	2.3	6.2	7.2	7.6	8.0						

Source: NREAP 2011-2020; FPS Economy.

ELECTRICITY

Electricity generation from renewable sources is promoted primarily through a quota obligation on suppliers (the share of electricity from renewables in total electricity supply) with tradable (or green) certificates. According to the division of legal competences over energy policy in Belgium, the federal government promotes offshore electricity generation, while the regions promote onshore generation.

Additionally, both the federal and regional authorities offer tax incentives for investments in renewable electricity capacity. At the federal level, investments in wind power, hydropower of less than 1 MW, waste incineration (and also biogas) are tax-deductible for companies. The tax deduction rate lies between 13.5% and 20.5% depending on the average development of the consumer price index. At the regional level, tax breaks for investments are available to households.

The individual green certificate systems differ in many ways between regions. They vary according to the quota obligation, the basis for granting green certificates, technology-specific support levels, calculation of minimum price levels, duration of support and tradability (see Table 9.3).

Since the 2009 in-depth review, the individual green certificate systems have been reformed to better control the increase in capacity and reflect the decrease in technology costs, especially for solar photovoltaic (PV). The main change is that the support through green certificates now aims directly at a given rate of return on capacity investment. Previously, the support was directed at the quantity of megawatt-hours (MWh) generated.

Flanders reformed its green certificate system in 2012, cutting duration and reducing the support levels, and differentiating them by technology. Support levels are reviewed annually (once every six months for PV) to ensure consistency with the targeted rates of return for each technology. The Brussels-Capital region also reformed its system in 2012, introducing a stabilisation mechanism to avoid cost and volume overruns. The Walloon region followed with an overhaul of its system in summer 2014, capping the volume of green certificates by technology for the following years and adopting a new formula for calculating the number of certificates by technology on the basis of power generation and the evolution in electricity prices, CO_2 performance of electricity generation and investment costs. The Walloon system is reviewed every two years.

The targeted return on investment differs by region and technology. In the Flemish region, the system aims at a guaranteed return on investment of 5% for solar, 8% for wind and 12% for biomass and biogas. In the Walloon region, the targeted rates are 7% for solar, wind and hydro, 8% for less than 1.5 MW biomass and 9% for 1.5 MW or more biogas and biomass. In the Brussels-Capital region, a payback time of seven years (roughly equalling a return of 10% per year) is targeted.

Regarding offshore wind power, the transmission system operator (Elia) is obliged to buy green certificates from the generators at a minimum price set by federal legislation. The purchase agreements must be approved by the regulator (CREG). This system was established in 2002 and amended in 2014 as follows:

- For installations with a financial close-up to 1 May 2014: the minimum price is EUR 107/MWh for electricity originating from the first 216 MW of installed capacity and EUR 90/MWh for volumes above 216 MW of capacity.
- For installations with a financial close-up after 1 May 2014: The minimum price is calculated as follows: minimum price *equals* levelised costs of electricity generation (LCOE) *minus* [reference wholesale price of electricity *minus* correction factor]. LCOE is equal to EUR 138/MWh; the correction factor is equal to 10% of the reference wholesale price of electricity. The purchase obligation applies for a period of 20 years. The minimum prices are reviewed every three years.

The system is reviewed every three years. Revised legislation is likely to be published in the first half of 2016.

As long as there is no market for these offshore green certificates, they remain in effect a feed-in premium and the transmission system operator (TSO) finances their purchase cost by a surcharge. The TSO is also obliged to pay one-third of the costs of the submarine cable up to a maximum EUR 25 million for a project of 216 MW or more. For smaller projects, the TSO payment obligation is reduced proportionally. Solar power systems installed before August 2012 are eligible for a federal-level price guarantee of EUR 150/MWh for ten years.

Table 9.3 Green certificate systems in Belgium

	Federal level	Flemish region	Walloon region	Brussels-Capital
Based on	MWh generated	MWh generated	CO_2 avoided	CO_2 avoided
Quota 2014, %	-	15.5	23.1	3.8
Quota 2017, %	-	19	33.0	5.8
Quota 2020, %	-	20.5	37.9	8.0
Minimum price/ certificate. Purchasing entity	EUR 90 to 107 or LCOE (maximum EUR 138)	Price varies by technology. DSOs	EUR 65. TSO	-
Duration, years	20	10 (15 for wind and solar PV)	15 (10 for solar PV)	10
Fine, EUR/ certificate not submitted	-	100	100	100
Certificates accepted	No tradability	Flemish only	Walloon only	Brussels-Capital and Walloon

Notes: DSO: distribution system operator; LCOE: levelised cost of electricity generated; TSO: transmission system operator;

Sources: Federal and regional authorities.

A special case is the support system for small solar PV (less than 10 kW). In the Flemish region, it does not receive any subsidies since 2012. In the Walloon region, the amount of green certificates (GCs) is adjusted annually according to the evolution of investment costs.

The current system in the Walloon region, the Qualiwatt plan, was introduced in March 2014. Under this system, PV installations no longer receive GCs, but an annual bonus for five years. The CWaPE (Walloon Energy Commission) recalculates the value of this bonus every six months for new installations, with the aim of ensuring a payback time of eight years. Before adopting the Qualwatt system, Wallonia reformed the support system four times between December 2011 and April 2013, reducing support levels and duration in an effort to control the costs of the system.

Costs of renewable electricity subsidies

According to Council of European Energy Regulators (CEER), in 2013 Belgium generated 10.9 TWh of renewable electricity that received subsidies (see Table 9.4). This was 13% of total electricity generation and close to the average in the CEER comparison of 22 European countries.

Table 9.4 Subsidies for renewable electricity generation by technology, 2013

Technology	Subsidised electricity generated, GWh	Total subsidy, EUR million	Subsidy level, EUR per MWh
Bioliquids	2	0.44	192.40
Landfill gas	109	9.33	85.65
Other biogas	707	74.32	105.11
Sewage sludge	29	3.14	109.45
Hydropower	375	9.03	24.11
Solar PV	2 607	962.22	369.07
Biodegradable waste	1 320	123.66	93.71
Other solid biomass	2 121	193.82	91.36
Wind offshore	1 540	161.50	104.89
Wind onshore	2 058	173.29	84.19
Total	**10 868**	**1 710.75**	**157.41**

Source: CEER 2015.

Unit-specific support for renewable electricity in 2013 ranged from EUR 24.11 per MWh for hydropower to EUR 369.07 per MWh for solar PV. The average level of support was EUR 157.41 per MWh of renewable energy generated, fourth-highest in the comparison after the Czech Republic, Italy and Greece. In 2012, the average in Belgium was EUR 155.49 per MWh.

Support costs for renewable electricity in 2013 amounted to EUR 1.7 billion, or EUR 20.8 per MWh of all electricity generated (from renewable energy sources and other sources) in 2013. In 2012, the rate was EUR 17.97 per MWh, or the sixth-highest in the CEER cross-country comparison. In the CEER comparison, the average in 2012 was

EUR 13.68 per MWh (cross-country data for 2013 were not available by the time of writing).

HEAT

Belgium has several types of support policies for heat from renewable sources. At the federal level, investments in solar collector systems and heat pumps are tax-deductible for companies. The tax deduction rate lies between 13.5% and 20.5% depending on the average development of the consumer price index. The regions, in turn, offer tax deductions for households.

The regions have the legal competence for renewable heat policy. The Flemish and Walloon regions have specific support policies, and all three regions also have policies for zero-emission new buildings which are expected to spur the uptake of heating technologies using renewable energy.

In the Flemish region, since 2013 calls for tender have been organised twice a year for projects that produce renewable heat and for developing district heating from renewable sources or waste heat. The annual budget is EUR 4.5 million.

The investment support is calculated as a percentage of the additional investment costs. The maximum support percentage varies according to the investor (SMEs, large enterprises, local governments). The projects with the lowest need for support have priority. Interest in district heating using renewables or waste is growing and projects for the equivalent of 50 000 households are planned. District heating, however, competes directly with natural gas heating, which is the established dominant space-heating form in Belgium.

For solar thermal and heat pumps at household scale, investment subsidies are granted by the DSOs. For solar boilers, the grant is EUR 550 per m², or a maximum of EUR 2 750. For heat pumps, the grant depends on capacity and efficiency.

Since January 2014, new buildings in the Flemish region must cover a certain share of their energy use from renewable sources. The minimum requirement will be gradually increased to meet, by the end of 2020, the near-zero energy buildings obligation under the Energy Performance of Buildings Directive (2010/31/EU). For residential buildings, eligible solutions include thermal solar, solar photovoltaics, biomass boilers or stoves, heat pumps, connection to a district heating or cooling system using renewable energy, or at least 10 kWh/year per m² of energy derived from renewable energy sources.

In the Walloon region, the authorities have organised project calls to promote heat from renewable energy. The first one, in September 2012, was for developing or converting individual heating systems into biomass district heating in social housing. It had a budget of EUR 5 million. In 2014, a project call was organised to support biogas projects on farms, including biogas injection into the natural gas grid; 38 projects were supported from a total budget of EUR 1.6 million, or on average EUR 42 000 per project.

TRANSPORT FUELS

The use of biofuels in transport is based on an obligation under the EU Renewable Energy Directive (2009/28/EC) to supply 10% of transport energy needs from renewable sources by 2020. The previous, but non-binding, EU target was for a 5.75% share for 2010.

The federal government has the competence over transport biofuels policy, and it has set up a quota system for biofuels use for reaching the EU target. In 2009, it exempted biofuels from excise taxes and obliged fuel suppliers to raise the share of biofuels in the total volume of annual transport-fuel sales to at least 4%. The biofuels obligation system was changed in 2013 when, under Law of 13/07/2013, a blending obligation for every registered oil company was introduced.

From 2010 to 2013, the volume of biofuels in petrol varied between 6.0% and 6.1% and in diesel between 4.4% and 4.6%. According to Eurostat, Belgium's renewable energy in transport share in 2013 was 4.3%. Over the same period, annual consumption in Belgium was around 75 kilotonnes (kt) of bioethanol and 330-350 kt of biodiesel (IEA, 2015b).

Only biofuels meeting the EU sustainability criteria qualify. Therefore, the life-cycle emissions of greenhouse gases of biofuels must be at least 35% lower than those of the fossil fuels they replace. This savings requirement rises to 50% in 2017. Also, biofuels from sensitive or carbon-rich land are excluded. From 2017 on, the use of conventional biofuels will be limited to 7 percentage points out of the 10% target. This encourages the use of more ecologically sustainable biofuels which are made of wastes and agricultural residues, and do not therefore directly compete with food and feed crops.

Compliance of the quota obligation is monitored by the FPS Economy (Federal Ministry), while meeting the sustainability criteria is monitored by the Directorate-General for the Environment. Non-compliance is subject to fines.

As for alternative transport fuels (electricity, compressed or liquefied natural gas, hydrogen), Belgium is currently developing a national policy framework as stipulated in Directive 2014/94/EU on the Deployment of Alternative Fuels Infrastructure. The national policy framework will be communicated to the European Commission by 18 November 2016. The regions are competent for most aspects of this directive. The Federal Public Service of Economy (DG Energy) and the Federal Public Service of Mobility and Transport co-ordinate the national efforts in this regard.

ASSESSMENT

Since the last IEA in-depth review of Belgium's energy policies in 2009, renewable energy has continued to gain importance in the country's energy supply. From 2009 to 2014, the share of renewable energy in TPES rose from 5.9% to 7.9% and its share in electricity generation from 7.8% to 19%. The increase is driven by an EU obligation to meet a binding target of a 13% share of renewable energy in gross final energy consumption by 2020.

Belgium is exceeding both the interim targets set out in the Renewable Energy Directive and in its NREAP. The generation of renewable electricity has been rising especially fast in recent years, supported by generous green certificate schemes, guaranteed minimum prices and a successful offshore wind development programme.

The increase in supply has come at a cost. Subsidies for renewable electricity amounted to EUR 1.7 billion in 2013 and, at EUR 157/MWh of renewable electricity generated, their level was fourth-highest in the European Union thanks to a large share of solar PV in the mix. Belgium needs to address the cost-effectiveness of its renewable energy policies and measures, as it will require more supply to reach the 2020 targets. The EU member states have already agreed to a higher target for 2030. Also, the country's current policy is to phase out nuclear power by 2025. If it decides to maintain this policy, it will have to consider how to fill in the inevitable baseload electricity supply gap.

Belgium is not as abundantly endowed with renewable energy potential as many other countries under current technologies. It has, however, relatively good resources for offshore wind and biomass (including waste), and is already increasing the use of these resources. Falling technology costs, in particular for PV, will no doubt help. The government could, however, consider a stronger focus on renewable heat and transport fuels. In the case of heat, the country still uses more than 3 Mtoe per year of oil for space heating. This is an obvious area for change, in particular from the non-ETS greenhouse gas reduction perspective: oil use for heating should be gradually phased out. Renewable energy solutions will also have a major role in new buildings, as required under the EU Energy Performance of Buildings Directive from the beginning of next decade.

In the long term, more measures need to be taken in all three renewable energy sectors (electricity, heat and transport) to enable a transition to a low-carbon economy. In the short term, Belgium should study whether raising the renewable-in-transport obligation to above the required 10% share by 2020 would be a more cost-effective solution than supporting heat and electricity generation, as planned. In 2013 Belgium introduced a biofuels blending obligation. Given the limited availability of resources for increased generation of renewable heat and power, it is especially important that the contribution of the transport sector be maximised and that at least the 10% target for renewable energy in transport be met.

Belgium can also cost-effectively contribute to meeting the 2020 renewable energy target by energy efficiency measures. It also has the option of co-operating with other countries to meet the 2020 target. One other way to reduce costs could be to harmonise the several green certificate systems.

An important matter the authorities need to address is investors' perceived lack of confidence in renewable electricity generation. The generous green certificates systems, together with a drop in deployment costs (especially for solar PV), led to overcompensation, excess demand for installations and increased distribution tariffs for electricity. Consequently, the support levels were reduced several times by the different regions and at the federal level in 2012-14. Support for renewables could be subject to further revisions. The perception of regulatory risk created by the many changes has a direct impact on capital financing costs and project development costs, and therefore affects the whole process of developing renewable electricity capacity. The authorities were right to control the costs and focus on ensuring a given rate of return on capacity investment, instead of simply compensating for volumes generated. They now need to create and maintain clear, stable and predictable support systems.

Work to remove barriers to new renewable energy projects should also continue. Such barriers include spatial planning limitations (i.e. linked to military, aeronautical or traffic-related restrictions) and lengthy permitting procedures. Lengthy legal procedures also affect the sector, for example cases where local communities have appealed against the construction of renewable energy facilities have taken years to resolve. Potentially, such legal cases could be avoided by involving the local communities more closely at the project planning stage. A positive step has nevertheless been the creation of the "one-stop shop" entity co-ordinated by the federal administration for energy, in order to simplify and speed up the licence procedures.

As the share of variable renewable electricity production increases, so does the need for flexible capacity in the electricity system. It is therefore important that the renewable electricity generators have incentives to act according to the needs of the entire electricity system and predict their production patterns. Hence, support systems should include mechanisms to take into account market price signals and the generators should also continue to ensure, directly or indirectly, their balance.

RECOMMENDATIONS

The government of Belgium should:

- *Work, both at the federal and in particular at the regional level, towards providing investors with more stability and confidence over the legal framework for the support of renewables, including over the duration and possible phasing-out of the support schemes; avoid sudden or retroactive changes to remuneration.*
- *Consider a stronger focus on heat and transport fuels from renewable sources in meeting the 2020 target in a cost-effective and environmentally sustainable manner; further consider setting an overall renewable energy target for 2030.*
- *Regularly review, at both federal and regional levels, the support systems so as to be able to accommodate changes in the development of costs and technologies so as to keep the financial support granted to a minimum.*
- *Harmonise the federal and regional green certificate systems, with the goal of establishing a national green certificate market.*
- *Continue to work, at both the federal and regional levels, on removing barriers for renewable energy deployment, including on spatial planning, and continue to simplify permitting procedures for renewable energy; shorten, where possible, litigation procedures related to the installation of new renewable facilities.*
- *Introduce strong incentives to commercial producers of renewable energy to act according to market signals.*

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10. NUCLEAR ENERGY

Key data (2014)

Number of reactors: Seven nuclear units operating at two nuclear sites

Installed capacity: 5 927 MW_{net}

Electricity generation: 33.7 TWh, -28.8% since 2004[1]

Share of nuclear: 16.6% of TPES and 47.2% of electricity generation

OVERVIEW

Nuclear power plays a key role in Belgium's energy supply, constituting about half the electricity generation and 16.6% of total primary energy supply (TPES) in 2014. In 2015, nuclear power generation fell further, to 26 terawatt-hours (TWh), according to FPS (Federal Public Service) Economy. In recent years, electricity generated from nuclear power, and consequently the share of nuclear energy in the generation mix, has significantly decreased because of long-term outages of several nuclear units. Despite that, the share of nuclear power in Belgium remains one of the highest in the Organisation for Economic Co-operation and Development (OECD) countries.

Seven units, all pressurised water reactors (PWRs), are currently operating in Belgium for a total net installed capacity of 5 913 megawatts (MW) at the end of 2015. The reactors are located at the sites of Doel, on the Scheldt estuary close to Antwerp, and of Tihange, on the river Meuse between Liège and Namur. Since the last (International Energy Agency (IEA) in-depth review in 2009, total net capacity has increased by about 100 MW_e as a result of capacity upgrades at Doel 1, Doel 4 and Tihange 3. All nuclear power plants (NPPs) in Belgium are operated by Electrabel, a 100% subsidiary of Engie since 2003. Electrabel is the sole owner of Doel 1 and 2 units, and owns 50% of Tihange 1 and 89.8% of the other four units. The remaining 50% of Tihange 1 is owned by EDF which controls also the remaining 10.2% share of the other four units (see Table 10.1).

Belgium has a long tradition in nuclear research and in civil nuclear power, dating from the early 1960s, and for many years the Belgian industry covered almost all activities in the nuclear fuel cycle. In 1962, the BR3 (Belgian Reactor 3) was the first pilot PWR connected to the grid in Western Europe. Belgium co-operated with France in the construction of the first full-scale PWR in Europe (Chooz A). The development of nuclear power in Belgium started at the end of the 1960s with the decision to build three nuclear units at the two sites of Doel and Tihange. Following the first oil crisis, another four units were ordered and connected to the grid by the end of 1985. The whole Belgian nuclear capacity has been commissioned in a relatively short period of about ten years, from February 1975 to October 1985; the lifetime of the nuclear fleet is therefore quite homogeneous, with an average of 35 years of operation. Over the course of operation,

1. Several units were temporarily shut down for a large part of 2014, see Overview for more information.

the Belgian nuclear fleet has generated about 1 420 TWh of baseload electricity and contributed significantly to the security of energy supply (see Figure 10.1). Nuclear power has also helped avoid emissions of large quantities of carbon dioxide[2], and had an important role in Belgium's efforts to reduce air pollution (sulphur dioxide SO_2 and oxides of nitrogen NO_x).

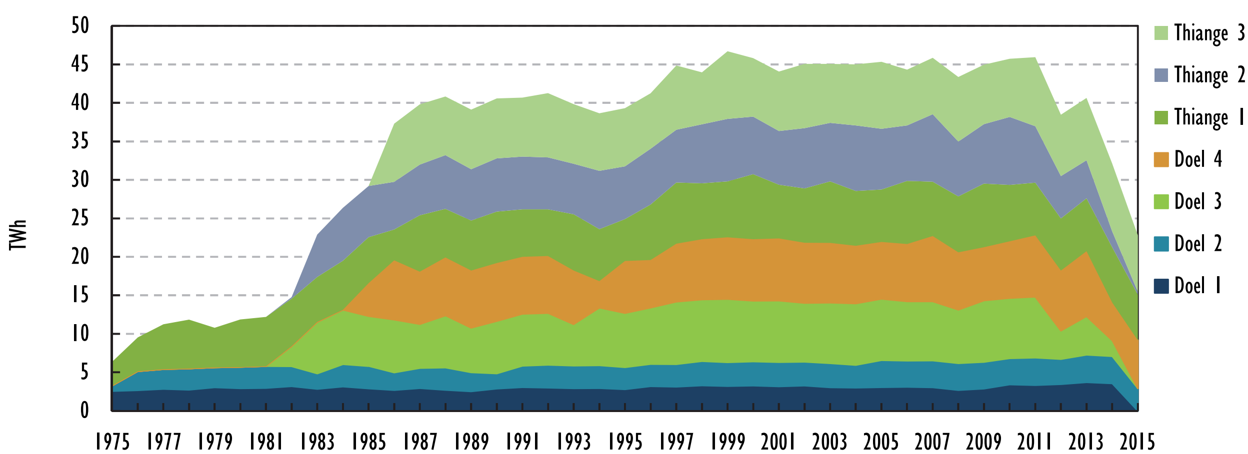
Table 10.1 Nuclear power plants in Belgium, 2015

Unit	Original design capacity, MW	Net capacity, MW	Lifetime production, TWh	In commercial operation since	Years of operation	Projected shutdown*	Owner
Doel 1	392	433	121	1975	40	2025	Electrabel 100%
Doel 2	392	433	119	1975	40	2025	Electrabel 100%
Doel 3	890	1 006	224	1982	33	2022	Electrabel 89.8%, EDF Luminus 10.2%
Doel 4	1 000	1 033	223	1985	30	2025	Electrabel 89.8%, EDF Luminus 10.2%
Tihange 1	870	962	270	1975	40	2025	Electrabel 50%, EDF Belgium 50%
Tihange 2	900	1 008	223	1983	32	2023	Electrabel 89.8%, EDF Luminus 10.2%
Tihange 3	1 020	1 038	236	1985	30	2025	Electrabel 89.8%, EDF Luminus 10.2%
Total		**5 913**	**1 416**		**35**		

* Projected shutdown date is based on the nuclear phase-out law and its amendments, which are described below.

Sources: IAEA PRIS; FPS Economy.

Figure 10.1 Electricity generated in nuclear power plants, 1975-2015



Source: OECD/NEA based on IAEA PRIS database.

2. The avoided emissions are around 1 250 Mt of CO_2, assuming coal had been used, and around 520 Mt of CO_2, assuming natural gas had been used to generate the 1 420 TWh of electricity.

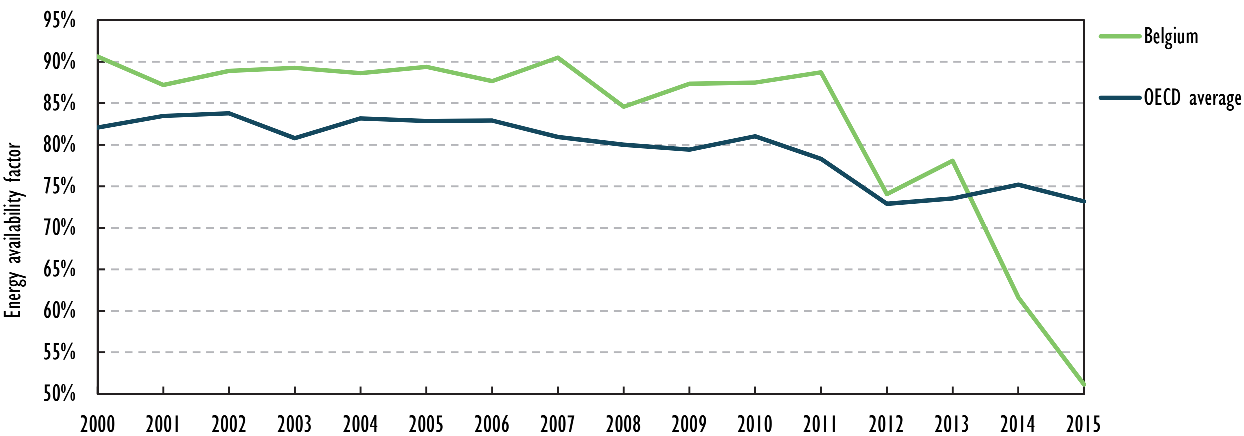
Historically, NPPs have been operated very effectively in Belgium, with availability and load factors between 85% and 90%, well above the OECD average. However, since the 2009 in-depth review, several independent events have resulted in prolonged unplanned shutdowns and in an overall reduction of nuclear plant availability and load factors (see Figure 10.2). In summer 2012, the units Doel 3 and Tihange 2 were taken offline by the nuclear operator, because of fault indications discovered in the pressure vessels by specific in-service inspections not required by procedures. Further analysis showed that the fault indications consisted of hydrogen flakes originated during steel manufacturing. The two units were restarted in June 2013, but then shut down again in March 2014 after the operator had performed additional tests requesting more investigations. Finally, after an international peer review by experts, in November 2015, the Belgian regulator authorised their restart on the basis of safety case reports that provided an adequate demonstration of the structural integrity of Doel 3 and Tihange 2 for up to forty years of operation (FANC, 2015). The two units resumed operation in December 2015.

Furthermore, the Doel 4 unit automatically shut down in August 2014 following an oil leak in its steam turbine, hence in the non-nuclear part of the facility. Work to replace the reactor's turbine took almost five months and the unit remained offline until December 2014.

Finally, Doel 1, the oldest NPP unit, was shut down in February 2015, in accordance with the phase-out legislation of 2003, foreseeing the phase-out of all Belgian plants after 40 years. The shutdown was supposed to apply in December 2015 to Doel 2 as well, but the Belgian Parliament decided in June 2015 to extend the operation of both Doel 1 and 2 by ten years (long-term operation, LTO), mainly out of security of electricity supply concerns.

At the end of 2015 and the beginning of 2016, Doel 1 and 2 (after two months of scheduled maintenance) resumed operation. All in all, for almost five months in 2014 and most of 2015, around half the nuclear capacity in Belgium had been offline. This very exceptional situation resulted from a combination of technical, security and political factors.

Figure 10.2 Energy availability factors of NPPs in Belgium and the OECD, 2000-15



Source: OECD/NEA, based on IAEA PRIS database.

NUCLEAR POLICY

Nuclear energy policy has changed in several aspects during the last decade. In 2003, the Parliament approved a law that prohibited the construction of new nuclear units intended for the industrial production of electricity by nuclear fission in Belgium and limited the operation of the existing reactors to 40 years. This timetable could however be overruled by Royal Decree, if the closure of NPPs threatened Belgium's electricity supply.

According to the 2003 law, all NPPs in Belgium should have been permanently shut down between 2015 and 2025. But since the law was passed, several studies have been commissioned to assess the impacts of the nuclear phase-out on the electricity sector, on the security of electricity supply and on the capacity to achieve EU climate policy targets. In 2008, the Belgian government commissioned an expert group study (the GEMIX study) on the ideal generation mix for Belgium in the medium and long term. Following the recommendations of this study, the government agreed in 2009 to postpone the phase-out of the three older units by ten years and to extend the operation of the other four units by 20 years (LTO), so that the gradual phase-out of nuclear energy would not start before 2025. However, before the Parliament ratified this agreement, a new general election was held following which, in December 2011, the new government confirmed that the NPPs will be closed in conformity with the phase-out law of 2003.

In yet another turn of events and owing to concerns over the security of electricity supply, in July 2012 the government agreed to grant a 10-year operational extension to the Tihange 1 unit (conditional on the approval of the Federal Agency for Nuclear Control), while maintaining the phase-out decision for the two first units at Doel. These decisions were approved by the Parliament in December 2013[3], while at the same time it eliminated the possibility to invoke *force majeure* to change the timetable for the nuclear power phase-out by Royal Decree, in case Belgium's security of supply were threatened.

Concerns over the security of electricity supply persisted, and following the approval by the nuclear safety authorities, in June 2015 the Parliament approved a 10-year operational extension for the Doel 1 and Doel 2 units.

In 2008, the Belgian government introduced for the first time a levy on nuclear power generation, announcing that nuclear operators would have to make a combined one-off payment of EUR 250 million for their nuclear activities. However, in 2009, as part of the negotiations for postponing the nuclear phase-out, the government imposed an annual contribution of EUR 215 to 245 million over the period 2010-14; these revenues will partially be used for funding renewable energy and energy efficiency projects. The level of the imposed contribution was then doubled in 2012. Nuclear operators appealed against the levy, but the court rejected their appeals in 2014 and 2015. Finally, in 2015, the government agreed on the LTO of Doel 1 and 2, conditional on a supplementary annual contribution of EUR 20 million until 2025. The contribution was consequently adapted and set at EUR 200 million for 2015 and EUR 130 million for 2016. From 2017 to 2019, this contribution will be at least EUR 150 million per year. It will be calculated on the basis of generating costs, volume of electricity generated and wholesale prices.

3. Law of 18 December 2013 amending the law of 31 January 2003 on the gradual phase-out of nuclear energy for the industrial production of electricity.

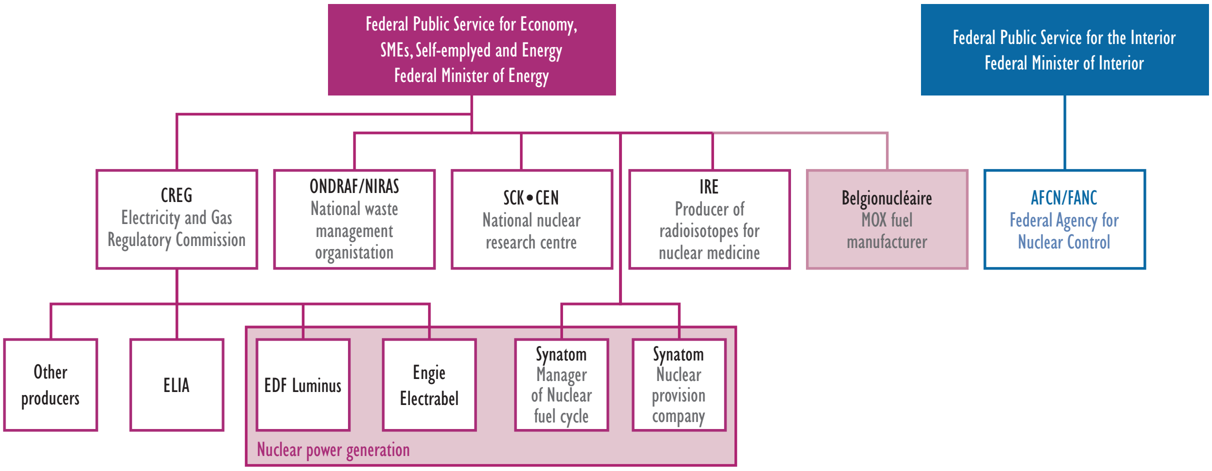
According to the current schedule of nuclear phase-out provided in Table 10.1, the shutdown of all Belgian NPPs is expected to occur in a very short time frame, between 2022 and 2025. A rapid phase-out of the nuclear units, which currently represent around half the electricity generation, would be extremely challenging and would have a significant impact on energy supply, on the level of electricity prices and on the country's ability to meet its long-term GHG emission targets. It could also have an adverse impact on the financing of regulatory bodies, which is currently ensured by a levy on nuclear installations. It would also have an effect on the funding of the provisions for waste management and decommissioning.

A recent OECD study has shown that the LTO of nuclear plants is the lowest-cost option available for power generation (OECD, 2012). Several utilities in OECD member countries have already obtained the licence to operate their nuclear plants beyond 40 years or are in the process of submitting applications to the safety authorities. The nuclear operator has estimated that investments of EUR 600 million are needed for the LTO of Tihange 1, and EUR 700 million for the long-term operation (LTO) of both units 1 and 2 at Doel.

INSTITUTIONS

The federal government has the sole competence over nuclear activities in Belgium. Policies related to the nuclear sector, the nuclear fuel cycle, waste management and nuclear research in both nuclear fission and fusion are the responsibility of the Federal Public Service (FPS) for Economy, SMEs, Self-Employment and Energy. Licensing, controlling and surveillance are the responsibility of the Federal Agency for Nuclear Control, which is supervised by the Federal Ministry of the Interior. Figure 10.3 shows the organisational chart of all relevant bodies governing the nuclear sector.

Figure 10.3 Organisational chart of nuclear sector institutions



Source: FPS Economy.

The **Federal Agency for Nuclear Control (FANC/AFCN)**, a semi-governmental institution with legal personality, is the regulatory authority in the field of radiation protection, nuclear safety and radiological surveillance. FANC is responsible for supervising all nuclear activity in Belgium and reports to the Minister of the Interior. Among its competences are licensing, inspection and surveillance of all nuclear installations, including waste management facilities. In case of non-compliance, FANC may impose disciplinary measures or sanctions. It is also responsible for the radiological surveillance of the Belgian territory and participates in the establishment of a national plan for nuclear emergency and preparedness. The FANC budget comes from fees paid by nuclear facility users and operators. FANC is a member of the European Nuclear Safety Regulators Group (ENSREG).

Bel V, a subsidiary of FANC created in 2008, is in charge of the regulatory control and inspection of nuclear installations. It took over these responsibilities in 2008 from the Authorised Inspection Organisation AVN. Bel V is the technical support/safety organisation of FANC and a founding member of the European Technical Safety Organisations Network (ETSON).

Synatom is responsible for the front- and back-end of the nuclear fuel cycle: procurement, conversion, enrichment and fuel fabrication, and the management of all activities in connection with spent nuclear fuel. It is a private company, wholly owned by Electrabel, but the Belgian government holds a "golden share" in the company and appoints two representatives to its Board of Directors. Synatom is the "exclusive owner" (as defined by the EURATOM Treaty Article 87) of the nuclear fuel from its fabrication to its transfer to ONDRAF/NIRAS (see below) when declared as radioactive waste. In addition since 2003, Synatom is entrusted by law with the management of the provisions for dismantling the Belgian NPPs and for the costs related to their spent fuel.

The National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS), an autonomous public body, is responsible for the transportation, treatment, conditioning, as well as for the temporary and final disposal of all radioactive waste produced in Belgium.

ONDRAF/NIRAS has also several responsibilities in the field of decommissioning. It has to elaborate an inventory of all nuclear installations and all sites containing radioactive substances within the country. It is responsible for evaluating and approving decommissioning programmes of nuclear installations, and executing decommissioning programmes at the demand of third parties or in the case of failure of an operator. It also has to verify that there are sufficient funds for the decommissioning and remediation programmes.

According to its mission, ONDRAF/NIRAS must work on a cost-price basis; the financing of the National Agency's activities is supported by the producers of radioactive wastes, according to the OECD polluter-pays-principle. ONDRAF/NIRAS also has the main responsibility for research and development (R&D) on radioactive waste management and disposal.

Belgoprocess, a subsidiary of ONDRAF/NIRAS, offers integrated nuclear services in the areas of waste management, dismantling and decommissioning, and serves as storage facility for conditioned waste of all categories.

Founded in 1952 by the government, the Belgian Nuclear Research Centre (**SCK•CEN)** is one of the largest research institutions in Belgium, with more than 700 employees. The main area of research is the safety of nuclear installations, the management of radioactive waste and the human and environmental protection against ionising radiations. SCK•CEN's site in Mol has significant research infrastructure: the experimental reactors BR1, BR2 and VENUS are used for materials testing, nuclear fuel research and production of medical radioisotopes. The underground laboratory HADES is dedicated to experiments on a permanent deep geological repository, while the forthcoming multipurpose research facility MYRRHA will be dedicated to research on the innovative nuclear systems of the future. SCK•CEN has also a role in maintaining a centre of competence in the domain of nuclear energy and ionising radiations, and has an important role in communication, education and training. It is a main contributor to the Belgian Nuclear Education Network (BNEN) which pools the resources of the Belgian universities for nuclear education at Master's and PhD levels.

NUCLEAR SAFETY

The safety of Belgium's nuclear installations 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 Agency for Nuclear Control (FANC/AFCN, see above).

INCIDENTS OF NOTE

The International Nuclear Event Scale (INES)[4] has been used in Belgian NPPs and in the major nuclear facilities for about 20 years, and since 2010 its use has been extended to all activities involving the use of radioactive sources and the transport of radioactive materials. In particular, the FANC has been promoting a systematic use of the INES scale as a tool to communicate to the public the importance of accidental events in the nuclear facilities. The FANC publishes a notice on its website for every event of level 1 or higher, and reports them in the annual report.

Since 2009, 11 events were classified as level 2 of the INES scale; one occurred in 2011 at the Doel 4 NPP, while the other 10 occurred in other nuclear installations. During the last five years, 38 INES-1 level events were reported at the Belgian NNPs, and 36 in other nuclear installations.

Box 10.1 Results of EU stress tests

Following the accident at the Fukushima-Daiichi nuclear power plant on 11 March 2011, the European Council requested that a comprehensive safety and risk assessment of operating reactors and spent fuel storage facilities be performed, under the co-ordination of the European Commission and the European Nuclear Safety Regulators Group. These "stress tests" focus on lessons learned from the accident in three main areas: natural external hazards (including earthquakes, tsunamis and extreme weather events); the loss of safety systems/design issues (loss of electric power, including internal and external power supply, and loss of the ultimate heat sink); and severe accident management (means to prevent and mitigate the consequences of the loss of core and spent fuel storage cooling functions and containment integrity). A key issue is the ability to maintain cooling without either off-site electricity supply or on-site backup power.

4. The INES scale was introduced by the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency (NEA) in 1990 and comprises seven levels of severity, from 1 (anomaly) to 7 (major accident), each level representing an accident around ten times more severe than the previous level. Level 0 indicates events with no safety significance. When originally conceived, the INES scale was constructed so that about one INES-1 and ten INES-0 events would be expected per year in a "normal" NPP. The IAEA requires the reporting of events of level 2 or above on the INES scale.

Box 10.1 Results of EU stress tests (continued)

The scope of stress tests covers all seven Belgian nuclear units, including the associated spent fuel pools, and the dedicated spent fuel storage and waste management facilities at both Doel and Tihange sites. In addition, the government requested the licensees of all nuclear installations of class I to perform similar analysis: the SCK•CEN, Belgoprocess, the Institute for Radioelements (IRE) and the Institute for Reference Materials and Measurements (IRMM) also underwent similar stress tests. The Federal Agency for Nuclear Control (FANC) concluded that the Tihange and Doel power plants have an adequate level of protection under extreme conditions, as have the other installations tested. The FANC and the licensee have established a follow-up plan with specific measures, and progress in their implementation is monitored every year.

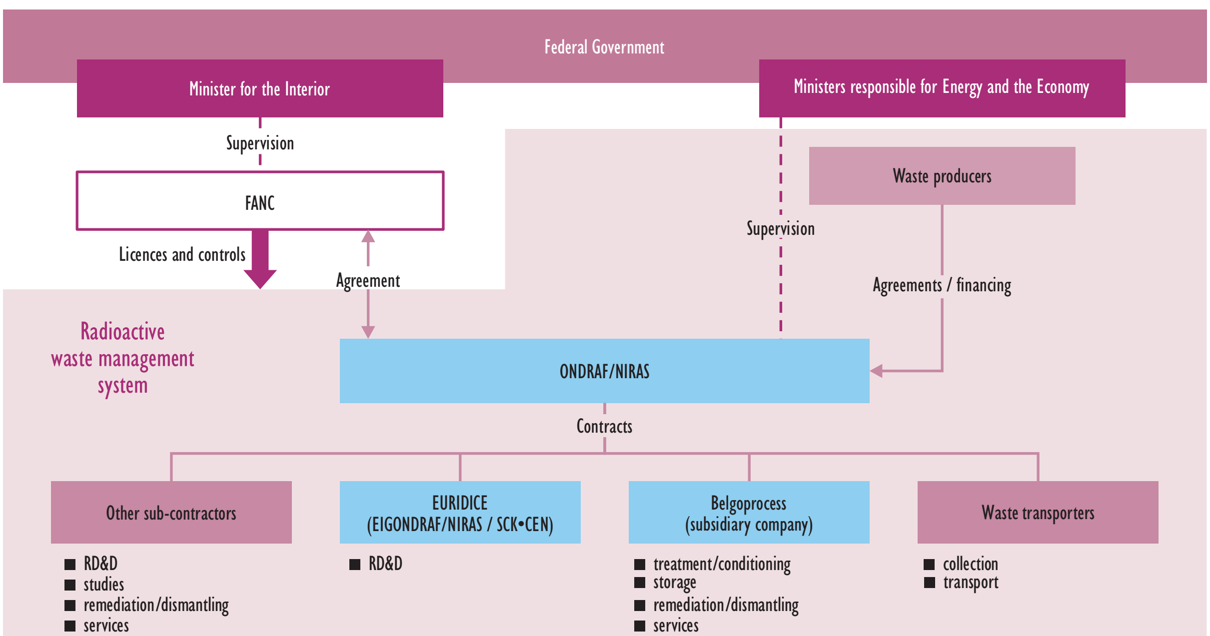
Detailed results of the EU stress tests can be accessed at: www.ensreg.eu/EU-Stress-Tests.

NUCLEAR FUEL CYCLE, RADIOACTIVE WASTE AND DECOMMISSIONING

POLICY AND LEGISLATION

In Belgium, three separate bodies, under the supervision of the federal government, play a role in the nuclear fuel cycle, radioactive waste management and decommissioning of nuclear installations: Synatom, ONDRAF/NIRAS and FANC (see Institutions above). Figure 10.4 shows the structure of nuclear waste management activities in Belgium.

Figure 10.4 Organisation of radioactive waste management in Belgium



Source: ONDRAF/NIRAS (2011), *Waste Plan for the Long-Term Management of Conditioned High-Level and/or Long-Lived Radioactive Waste and Overview of Related Issues*.

The government has adopted a policy of reprocessing the spent nuclear fuel of its reactors. The first industrial reprocessing pilot plant, Eurochemic, was founded in

December 1957 by an international consortium of twelve OECD countries, in partnership with the private sector.[5] Eurochemic's plant was in operation from 1966 till 1974 in Dessel, near Mol. The site is now part of Belgoprocess and used for waste handling and storage.

Starting in 1976, five reprocessing contracts were signed between Synatom and Cogéma (now AREVA) for reprocessing the irradiated fuel from Belgian reactors in the factory of La Hague (France). The first four contracts were fully executed and the reprocessing took place in several steps between 1981 and 2000.

However, in 1993 the Belgian Parliament imposed a moratorium of five years on further reprocessing of spent fuel. Synatom therefore suspended the fifth reprocessing contract which it signed in 1991 with Cogéma and which covered reprocessing during the period 2001-10. In 1998, the government ordered the cancellation of the fifth reprocessing contract and postponed the debate about spent fuel management pending the results of ongoing technical and economic studies. Since then, the fuel discharged has been stored at dedicated facilities at the NPP sites.

The Doel unit 3 and Tihange unit 2 used mixed oxide (MOX) fuel from 1995 to 2010, when the amount of separated plutonium coming from the reprocessing was exhausted.

A formal decision regarding the back-end of the fuel cycle has not yet been taken and Belgium continues to compare the economics of open and closed fuel cycles. Belgium is also particularly active in the R&D on fast spectrum systems dedicated to the transmutation and incineration of high-level nuclear waste, and the multipurpose facility MYRRHA is intended to be a major contributor to the research.

The fuel discharged from the reactors is first cooled in the spent fuel pools of each unit and then transferred in a common dedicated facility at each site: a specific building with eight pools at Tihange and in dry containers at Doel. At the end of 2014, 2 663 spent fuel elements were stored in 90 containers at Doel and 2 495 elements in the wet storage building at Tihange. Additional storage facilities are under construction, in particular considering the LTO already decided.

Since the last IEA in-depth review of Belgium in 2009, the country has made progress in defining and implementing radioactive waste management policy. The Directive 2011/70 of Euratom, which requires the definition of management policies for all radioactive waste and spent fuel, has been completely transposed into the law of 3 June 2014. The licence has been obtained for the construction of a long-term surface disposal for nuclear waste of category A. ONDRAF/NIRAS has proposed a solution for the permanent storage of category B and C radioactive waste.

FRONT END OF THE CYCLE

Belgium has no uranium resources that could be mined economically. In 2008, Synatom formed a partnership with the Canadian mining company Powertech Uranium to develop uranium-mining projects in the United States, but sold its participation in 2013.

Synatom secures the supply of natural uranium through medium- and long-term contracts with several uranium exporters from Australia, Canada, Kazakhstan, the United States, Russia and South Africa. The investment approach and the diversification of

5. The twelve partners were: Germany, France, Belgium, Italy, Sweden, the Netherlands, Switzerland, Denmark, Austria, Norway, Turkey and Portugal, to be joined by Spain in 1959.

suppliers aim to secure long-term fuel supply at stable prices. Synatom also maintains a strategic reserve of uranium adapted to the industry's needs.

Regarding the other activities of the front-end of the fuel cycle, Belgium has currently no conversion, enrichment and fuel fabrication capabilities. Synatom used to own 11% of the Eurodif enrichment facility of Tricastin in France, but the facility ended its operations in June 2012. In the past, Belgium also used to have two fuel-manufacturing facilities, both in Dessel. One of the two, Belgonucléaire, operated a 32 tonnes/year MOX fuel-manufacturing facility from 1986 to 2006. The other facility in Dessel was owned by FBFC (Franco-Belge de Fabrication de Combustible), a subsidiary of AREVA. It produced 500 tonnes of UOX and 500 tonnes of MOX fuel per year for both pressurised and boiling water reactors. This facility ceased to operate at the end of 2015.

WASTE MANAGEMENT: RADIOACTIVE WASTE CONDITIONING AND INTERIM STORAGE

All radioactive waste generated in Belgium is processed and conditioned either on-site by the operator or by Belgoprocess at the centralised facility in Dessel. Belgoprocess operates a number of treatment and conditioning facilities for low-, intermediate- and high-level solid and liquid radioactive waste. These facilities are equipped with incinerators, super-compactor and cementation technologies. The transport of radioactive waste to the site of Dessel is the responsibility of ONDRAF/NIRAS, under the authorisation and control of FANC.

The interim storage facilities for all categories of radioactive waste are centralised at the Dessel site and operated by Belgoprocess. Low-level waste is stored in three separate buildings for a total capacity of about 18 200 m^3. The construction of a new building for the interim storage of low-level waste is planned for 2017. The medium-level waste storage (Building 127) was built in 1978 and expanded in 1988 to reach the current total capacity of 4 650 m^3. At the end of 2014, the building contained 3 887 m^3 of medium-level waste, or about 85% of its capacity. No shortage of space is expected in the next years.

Medium-level waste, with long lifetime, and high-level waste are stored in two structures: Building 129 has a capacity of 250 m^3, while Building 136 has a capacity of 590 containers of high-level waste and 1 000 m^3 of medium-level waste. High-level radioactive waste consists mostly of vitrified waste transported back to Belgium following reprocessing in France of used fuel elements from the Belgian NPPs, but also from reprocessing of BR2 (a high-flux reactor) spent fuel. At the end of 2014, around 430 m^3 of waste was stored in Buildings 129 and 136, and no significant volumes are expected in the near future, since all waste from La Hague and Dounreay sites was transferred to Dessel in mid-2015.

Commercial spent fuel is separately stored in dedicated facilities at the NPP sites. The amount of high-level waste will strongly depend on the strategy chosen for the back-end of the fuel cycle: ONDRAF/NIRAS estimated in 2011 that the volume of category C[6] waste would range from 600 m^3 if the reprocessing of spent fuel is pursued, to 4 500 m^3 if direct disposal is chosen.

6. Category A wastes represent wastes with low- or medium-activity level and short-live. Category B wastes are those of low- or medium-activity level and long-live, while category C level includes all high-level activity waste.

WASTE MANAGEMENT: LONG-TERM DISPOSAL

In 2006, at the request of the federal government, ONDRAF/NIRAS began work on building a near-surface facility for final disposal of category A waste in Dessel (cAt project). In January 2013, ONDRAF/NIRAS applied to FANC for a licence for the cAt project, and the licensing procedure is ongoing. Construction is scheduled to start in 2017 and operation in 2020. A continuous broad social dialogue between ONDRAF/NIRAS, the local authorities and the local population has been maintained throughout the entire decision process.

With respect to the disposal of long-lived medium- and high-level wastes (categories B and C), at the beginning of the 1980s ONDRAF/NIRAS established a long-term R&D programme in collaboration with SCK•CEN (in particular the HADES underground laboratory). Most of the research has been focused on the final disposal in deep geological formations of clay, Boom Clay as reference and Ypresian Clay as an alternative. In July 2002, on the basis of research carried out in the years 1989-2000, the SAFIR 2 report concluded positively on the technical maturity, feasibility and safety of a waste repository in poorly indurated clay. After a long period of preparation and broad public consultations, in September 2011 ONDRAF/NIRAS adopted and presented to the government a Waste Plan.[7] The Plan recommends geological disposal in poorly indurated clay in a single underground facility on the Belgian territory. The Waste Plan is accompanied by an assessment of other options: this covers both technical aspects and economic aspects as well as ethical and societal considerations.

The federal government is yet to take decisions on general policy or guidance regarding the long-term management of those waste categories. Whatever the long-term disposal option chosen, it will take several decades to become operational. The process will be open and participative for all stakeholders. From a scientific and technical viewpoint, the construction of a geological repository would take 10 to 15 years after the licence is granted. This is also why the Waste Plan recommends a decision to be taken as soon as possible, given due consideration to scientific, technical, societal and regulatory constraints (ONDRAF/NIRAS, 2011).

DECOMMISSIONING

Decommissioning activities are well advanced or completed in several early nuclear facilities, and the Belgian industry has acquired considerable expertise in various chemical and mechanical dismantling techniques, as well as in the management of resulting radioactive and non-radioactive wastes.

BR3, a PWR of 10 MW_e that was operational from 1962 to 1987, was selected as a pilot project in Europe for complete dismantling and decommissioning. The SCK•CEN has completed the fuel removal and the dismantling of major components of the reactor. The decontamination and dismantling of all buildings on-site is well advanced. SCK•CEN has also been strongly involved in managing the dismantling of the Thetis research reactor at Ghent University and in dismantling the former MOX fuel fabrication plant in Dessel. Both projects are approaching their end. Belgoprocess has almost completed the dismantling and decommissioning of the Eurochemic reprocessing facility in Dessel

7. *Waste Plan for the Long-Term Management of Conditioned High-Level and/or Long-Lived Radioactive Waste and Overview of Related Issues*.

(FANC, 2014). The dedicated facility (PAMELA) used for the vitrification of the high-level liquid waste coming from the reprocessing at Eurochemic has also been dismantled.

FUNDING

Belgium has a well-defined system for establishing and managing the funds to cover future liabilities, decommissioning and radioactive waste management. Before 2003, electricity generators were responsible for decommissioning and waste management. With the liberalisation of the electricity market, the government created a separate entity, Synatom, to guarantee the availability and adequacy of funding. The law of 2003 also created the Commission for Nuclear Provisions, composed of three representatives of Synatom and six high-level representatives from the government, the national bank NBB/BNB and the federal regulator CREG, with FANC and ONDRAF/NIRAS as observers. The Commission supervises and controls over the existence, adequacy and availability of the provisions. Every three years, Synatom and Electrabel reassess the amount of provisions, the investment strategy as well as the amount and timing of future liabilities, and submit the outcomes to the Commission. At the end of 2014, provisions amounted to EUR 7.6 billion, 41% of which is related to dismantling and decommissioning, and the remaining 59% to nuclear waste management (Synatom, 2015).

In practice, Synatom collects the provisions from nuclear power generators in the form of a levy on each kWh of electricity sold; the levy is part of the electricity production costs and is passed on to the customers, according to the OECD polluter-pays principle. A hurdle rate of 4.8% is assumed as a rate of return of the fund, and the electricity producers are required to settle the balance with Synatom, if the return on investments is different from the assumed hurdle rate or in case of a revision of the future liabilities. Up to 75% of the fund can be lent back to electricity producers, depending on their solvency, credit rating and upon approval of the supervising committee, while the remaining must be invested in a broad range of well-diversified assets. The fund emerged unscathed from the difficult market conditions following the 2008 financial crisis.

RESEARCH AND DEVELOPMENT, OTHER NUCLEAR INFRASTRUCTURE

Nuclear R&D policy on both fission and fusion is the exclusive responsibility of the federal government, and is co-ordinated by the Federal Public Service Economy, SMEs, Self-Employed and Energy (FPS). Most of the activities in Belgium are carried out at the National Nuclear Research Centre SCK•CEN in Mol. Nuclear fission research focuses mainly on supporting the safe operation of NPPs, developing sustainable solutions for managing nuclear waste, future dismantling and decommissioning of nuclear installations, and research on nuclear medical applications.

Research on the safety of NPPs is performed in collaboration with FANC and industrial partners such as Electrabel and Tractebel Engineering. It includes R&D on the behaviour of materials under irradiation, damage modelling and ageing processes, as well as thermo-mechanical performances of fuel under irradiation. SCK•CEN also performed, in collaboration with ONDRAF/NIRAS, a comprehensive analysis on the characteristics of clay, and research into the long-term durability of concrete. SCK•CEN has also studied the potentials of partitioning and transmutation to reduce the long-term impact of radioactive waste. In this context, it is planned to build, in collaboration with the European Union, the MYRRHA (Multipurpose Hybrid Research Reactor for High-tech

Applications) research reactor in Mol. In a first phase, it will be a sub-critical fast-spectrum reactor coupled with an accelerator of protons to demonstrate the feasibility of an accelerator-driven system (ADS) for transmuting nuclear waste. It may further be used as a critical reactor for fuel and material research for Generation-IV reactors. A third axis of the research of SCK•CEN is on the area of the effects of ionising radiations on humans and on the environment. Several laboratories are active in research on radiobiology, microbiology and radioecology, as well as on the behaviour of radioactive materials in the biosphere.

Belgium is a key player in the area of nuclear medical applications: the high-flux reactor BR2 provides about 10% to 15% of the world supply of medical radioisotopes.[8] BR2 is also used for other industrial applications, such as silicon doping and the production of other radioisotopes used in other industrial applications.

Belgium is also strongly active in the training and formation of qualified personnel for the nuclear sector. Since 2002, the SCK•CEN, in collaboration with six Belgian universities, created the Belgian Nuclear Education Network (BNEN). This academic programme in nuclear engineering combines lectures at the universities with experimental work at the SCK•CEN nuclear facilities and laboratories. Also in 2012, the SCK•CEN Academy for Nuclear Science and Technology was founded, the objective being to foster the transfer of nuclear knowledge, skills and attitudes towards students and young professionals in the nuclear field.

ASSESSMENT

Belgium has a long tradition in nuclear energy, dating from 1962 when BR3 was the first pressurised water reactor connected to the grid in Western Europe. Nuclear energy accounts for around half the country's electricity generation and 15% to 20% of total primary energy supply. It thus effectively helps diversify energy supply and is critical for the security of electricity supply. Nuclear power has also significantly helped avoid CO_2 emissions and had an important role in Belgium's efforts to reduce air pollution (SO_2 and NO_x).

Today, seven units are operated at the two sites of Doel and Tihange, for a total net generating capacity of 5.9 GW_e. This nuclear capacity was commissioned over a relatively short time, from February 1975 to October 1985. Nuclear power plants have been operated very effectively in Belgium, with availability and load factors between 85% and 90%, well above the OECD average. However, since the last IEA in-depth review in 2009, several independent events have resulted in prolonged unplanned shutdowns of reactors and in an overall reduction of their availability and load factors. During almost five months in 2014 and most of 2015, around half the nuclear capacity in Belgium was offline. With the long-term operation of Doel 1 and 2 units, and the restart of Doel 3 and Tihange 2, the full nuclear capacity is again available in early 2016.

Nuclear energy policy has changed in several aspects over the past decade. In 2003, the Parliament approved a law to phase out nuclear energy for electricity generation: the law prohibited the construction of new nuclear units in Belgium and set a 40-year limit on the operation of existing reactors. With this decision, the closure of the NPP units

8. The National Institute of Radioelements (IRE), a public utility foundation, accounts for one-fourth of the global supply of radiochemical and radiopharmaceutical products used in nuclear medicine for diagnostic and therapeutic purposes.

would be spread out between 2015 and 2025. In 2009, following the recommendations of the GEMIX expert group, the government agreed to postpone the phase-out of the three older units by ten years so that a gradual phase-out of nuclear energy would only begin in 2022, but this proposal was never ratified by the Parliament. In December 2011, the new government confirmed that it will close the NPPs in conformity with the phase-out law of 2003. However, because of concerns over the security of electricity supply, the government agreed to grant a ten-year operational extension to the Tihange 1 unit in June 2012 and to the Doel 1 and 2 units in June 2015. With these decisions, the closure of the NPPs would be concentrated in a short time frame of 2022 to 2025. These decisions were not supported by analysis on whether it would actually be feasible to replace around 50% of power generation volume over such a short time frame.

Such a rapid phase-out of the source of almost half all electricity generated in the country will be extremely challenging from both financial and technical viewpoints and will have a significant impact on energy supply. It will raise the costs of generating electricity and weaken the country's ability to meet its long-term GHG mitigation targets. It can also have an adverse impact on the financing of regulatory bodies, which is currently ensured by a levy on nuclear installations.

The current tight phase-out schedule is partly the result of addressing imminent electricity supply concerns in Belgium by extending the operation of the three oldest units by 10 years from 2015 to 2025. To avoid electricity security challenges in 2022-25, investments in power supply options are needed soon. The planned increases in interconnections will help, but are not a full substitute for the baseload power the NPPs generate. At the same time, wholesale electricity prices in Belgium and the broader Central Western European region are expected to remain too low to attract major new investments in electricity generation without subsidies.

To help ensure security of electricity supply and to limit the costs of the phase-out, the government should reconsider the current phase-out policy and opt for a more gradual approach. A better option would be to allow NPPs to run as long as the regulator considers them safe. The IEA recommends the government to simply avoid a phase-out as it is currently envisaged.

A recent OECD study has shown that extending the long-term operation of nuclear plants is the lowest-cost option available for power generation. Several utilities in OECD member countries have already obtained the licence to operate their nuclear plants beyond 40 years or are in the process of submitting an application to the safety authorities. Permitting an increase of the LTO for the four relatively recent NPP units (commissioned in 1982-85) would allow for a more gradual phase-out from nuclear energy, would reduce the costs for electricity generation in the mid-term and would help meet long-term GHG reduction targets.

In 2008, the government introduced a substantial levy on nuclear power generation. The contribution level has been revised several times; on average, the contribution volume has been more than EUR 200 million per year. Nuclear power generation is subject to several kinds of taxes and levies in more countries, probably because it is a relatively easy source of revenue: the plant operator cannot just shut down operations or move to a more favourable jurisdiction. The absolute level of contribution needs to be carefully considered, however. In general, limiting the utilities' profits reduces their options for investing capacities in the LTO and/or other much-needed low-carbon capacity, and leads to a greater need for governments to encourage such investments, also financially.

This, in turn, leads to a stronger dependence on government policies for the profitability of the electricity sector and, by definition, increases political risk for investors.

Levies on nuclear power generation partly to finance investments in renewable energy and energy efficiency also send an inconsistent message, as nuclear power, the largest source of low-carbon electricity, serves the same decarbonisation objectives as renewable energy and energy efficiency. The government should consider using the levied contribution for promoting low-carbon technologies at the expense of fossil fuels use, thereby killing two birds with one stone: discouraging generation from fossil sources and promoting renewable sources.

In general, a stable energy policy and predictable regulatory framework is necessary for the utilities to evaluate the economic viability of operational extensions in a competitive electricity market and to plan the necessary investments and upgrades to meet the required safety levels. Stability is particularly important for Belgium as it has such a substantial share of nuclear in its electricity mix. In this context, the government should also ensure the availability of qualified manpower for the nuclear sector and adequate funding for regulatory bodies throughout the phase-out period.

Since the 2009 IEA in-depth review, Belgium has advanced in defining and implementing radioactive waste management policy. The interim storage facilities for all categories of radioactive waste are centralised at the Dessel site and operated by Belgoprocess. The construction of a new building for the interim storage of low-level waste is planned for 2017. Commercial spent fuel is separately stored in dedicated facilities on the sites of the NPPs, where extensions are also to be built. Since 2006, ONDRAF/NIRAS has been working on the realisation of a near-surface facility for final disposal of category A waste in Dessel (the cAt project). The licensing procedure is ongoing and the construction is scheduled to start in 2017. Operation is expected to begin in 2020. With respect to category B and C wastes, after a long period of preparation, including long-term research in a dedicated underground *in situ* laboratory, and broad public consultations, ONDRAF/NIRAS adopted a Waste Plan in September 2011 recommending the long-term geological disposal in poorly indurated clay in a single underground facility. The government should continue its efforts to establish and implement a national policy on long-term management of radioactive waste and on final disposal of high-level waste.

Belgium has a well-defined system for establishing and managing the funds dedicated to cover future liabilities in decommissioning and radioactive waste management. Following the polluter-pays principle, nuclear power generators pay a levy to the fund for every kWh of electricity sold. Up to 75% of the fund can be lent to electricity producers, upon approval of the supervising committee, while the remaining must be invested in a broad range of well-diversified assets. Capping the share of funds that can be lent to electricity producers to a lower level would reduce the financial risk of the fund and align it with the level in other OECD countries.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Thoroughly assess whether an early phase-out of nuclear power over a short period as currently scheduled is feasible and reasonable from the perspective of electricity security of supply, GHG mitigation and the costs of generating electricity.*

- *Amend the phase out policy quickly if this assessment indicates the need to do so by clarifying the role of nuclear energy and provide a stable and long-term framework to allow for adequate planning and an overall reasonable return for the necessary investments in long-term operation.*
- *Ensure the availability of qualified human resources for the nuclear sector and the adequate funding of regulatory bodies throughout the phase-out period.*
- *Continue the efforts to establish and implement a national policy on long-term management of radioactive waste and on final disposal of high-level waste.*
- *Regularly review that the funding set aside for dismantling and spent fuel management is adequate and, following international best practice, ensure a higher level of diversification for the dedicated fund.*

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PART III
ENERGY TECHNOLOGY

11. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT AND DEMONSTRATION

Key data (2013)

Government spending on energy R&D: EUR 190 million

Share of GDP: 0.48 units of GDP per USD 1 000 (IEA median*: 0.35)

R&D per capita: EUR 17.1

Share of energy in total R&D: 2.2%

* Median of 23 IEA member countries for which data are available.

INSTITUTIONAL ORGANISATION AND POLICY

Publicly funded energy technology research, development and demonstration (ETRDD) in Belgium aims to support the general energy policy objectives of sustainability, security of supply and competitiveness. At the same time, it also aims to stimulate innovation in Belgian energy technology companies and thus to help increase their competitiveness. ETRDD policies in Belgium are closely linked to European Union (EU)-level strategies and priorities.

Responsibility over ETRDD policy is shared between the federal government, the three regional governments and the governments of the linguistic communities. The federal government is responsible for nuclear ETRDD (fusion and fission, see Chapter 10) and offshore energy, while the regions are primarily responsible for developing and implementing policies for non-nuclear energy ETRDD. The linguistic communities are responsible for developing and implementing policies for research carried out within universities.

THE FEDERAL LEVEL

At the federal level, the Minister of Energy is responsible for nuclear energy, including research, and for renewable energy research in the North Sea, together with the State Secretary for the North Sea (full title is State Secretary for Combating Social Fraud, Privacy and the North Sea, attached to the Minister of Social Affairs and Health). The Federal Public Service for Economy, SMEs, Self-Employed and Energy is the main public authority responsible for managing and funding nuclear energy research programmes and renewable energy research programmes in the North Sea.

Despite the nuclear phase-out policy, the federal government acknowledges the importance of research on nuclear fission. Most of the nuclear research is carried out at the National Nuclear Research Centre (SCK•CEN), located in Mol. SCK•CEN prioritises research on nuclear power plant (NPP) safety and on managing the disposal of medium- and high-level radioactive wastes. Its high-flux testing reactor (BR2) plays a crucial role in supporting the long-term operation of the Belgian NPPs. SCK•CEN also analyses the societal aspects of nuclear technology, in particular public participation in the decision-making process, and develops the multipurpose nuclear research project, MYRRHA, identified within the European ESFRI roadmap and within the European Sustainable Nuclear Industrial Initiative (ESNII) of the Sustainable Nuclear Energy Technology Platform (SNETP) in support of the European Strategic Energy Technology (SET)-Plan. The federal government is also involved in international co-operation in developing nuclear fusion, mainly through the Belgian Fusion Association and the International Thermonuclear Experimental Reactor (ITER) project.

In addition, the State Secretary for Science Policy (full title is State Secretary for Combating Poverty, for Equal Opportunities, for Disabled People and for Science Policy, in charge of Larger Towns, attached to the Minister of Finance) determines priorities for science and technology policy linked to the areas of competence and research in the federal scientific institutes. The minister also develops activities of national and international interest in agreement with the regions and municipalities. Other ministries are responsible for activities related to research and scientific services in their respective policy areas. The federal government supports non-nuclear ETRDD through policy support research programmes, such as Science for Sustainable Development, and programmes related to carbon capture and storage (CCS). These programmes are typically managed by the Federal Public Planning Service (PPS) for Science Policy, also known as the Belgian Federal Science Policy Office (BELSPO). This office is also responsible for funding the federal research institutes.

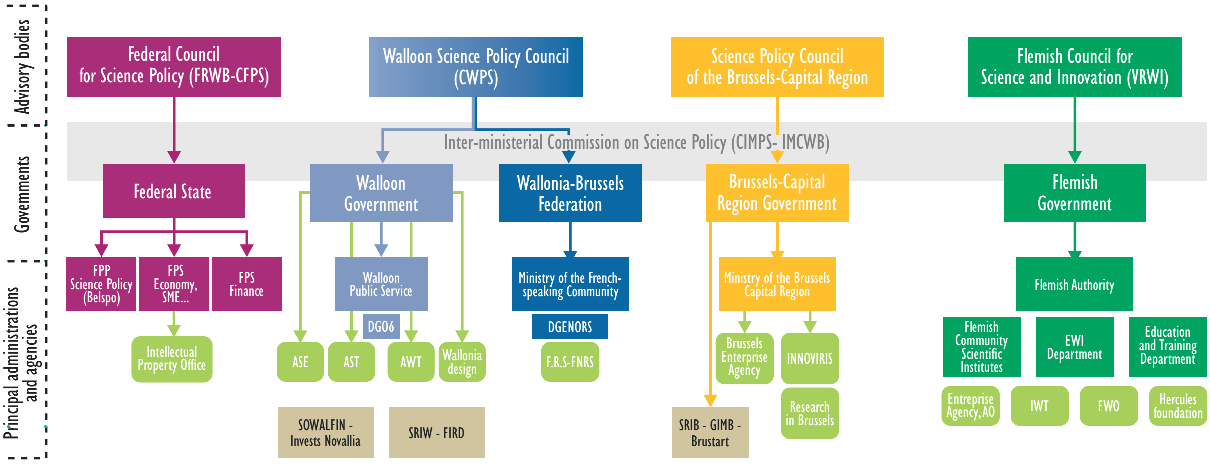
THE FLEMISH REGION

The Flemish Minister for Work, Economy, Innovation and Sports is responsible for research and innovation programmes, administered by the Flemish Department of Economy, Science and Innovation (EWI). The department is responsible for the policy preparation, monitoring and evaluation in the fields of economy, science and innovation.

The main entities in charge of implementing ETRDD policy are the Research Foundation Flanders (FWO, basic research) and the Institute for Innovation by Science and Technology (IWT). FWO and IWT carry out bottom-up programmes without thematic restrictions. FWO funding instruments range from fellowships (PhD and post-doctoral), research grants and research projects to funding for international mobility and international collaboration. IWT has a broad portfolio of instruments and programmes to support both research institutes and companies (including an SME programme) and grants for individual researchers.

In addition, the Flemish government finances ETRDD via the Strategic Research Centres VITO (Flemish Institute for Technological Research), IMEC (Interuniversity Microelectronics Centre, the Research Institute for Microelectronics and Nanoelectronics) and iMinds (ICT Research Centre). VITO, the University of Leuven (KULeuven) and IMEC have bundled their expertise in the field of sustainable energy and intelligent energy systems in the Research Centre Energyville.

Figure 11.1 Organisation of Belgium's public energy research development and deployment (RD&D)



Source: BELSPO annual report on science and technology indicators for Belgium.

The Flemish ETRDD strategy is determined in co-operation with Flemish stakeholders in energy technology, organised in three platforms: Generaties (renewable energy), Smart Grids Flanders and WaterstofNet (programme office of the Flemish industrial cluster on hydrogen and fuel cells). In line with the SET Plan, the innovation platform Generaties, with the support of the department EWI, developed a Flemish innovation strategy for energy technology (the SET-Flanders strategy, latest version of October 2012). The priority areas for energy ETRDD are: renewable energy (solar photovoltaics, bioenergy, wind power, ocean energy and geothermal energy); energy efficiency in industry and buildings; hydrogen and fuel cells; smart grids, energy storage and smart cities.

The Flemish region has undertaken subsequent policy initiatives related to setting up a medium- to long-term ETRDD strategy. In May 2011, the Flemish government adopted a concept note on innovation policy "Innovation Centre Flanders" which focuses on major economic and societal challenges. It identified green energy as one of the six areas for developing a specific medium-term innovation strategy. This strategy work was co-ordinated by the Flemish Research Council. The SET-Flanders strategy was updated and fully integrated into this exercise. The green energy innovation strategy was published at the end of 2012 (including the SET-Flanders strategy).

From May 2012 to May 2014, a foresight exercise was performed to identify areas in which Flanders has good opportunities to develop a leading position in science, innovation and economic growth by 2025 (Foresight 2025). The exercise was co-ordinated by the Flemish Research Council and seven transition areas were identified: Digital Society, Food, Health and Well-Being, Urban Planning, Mobility Dynamics and Logistics, Smart Resource Management, New Energy Demand and Delivery, and Society. For the transition area New Energy Demand and Delivery, an expert panel was set up to identify the research, technology and innovation priorities in the areas of supply, demand, storage and networks. Again, the SET-Flanders strategy was fully integrated into the exercise.

The Flemish innovation strategy for energy technology is acknowledged as an important element in the realisation of "Vision 2050", a long-term vision for Flanders published by the Flemish government in September 2015. Seven transition areas are identified, one of them the transition to a low-carbon, sustainable, reliable and affordable energy system.

THE WALLOON REGION

Energy research is in line with the European energy commitments of Wallonia. The main research areas are energy efficiency in industry, transport and buildings; renewable energy, mainly solar and bioenergy, but also wind and geothermal; and smart grids, smart cities and storage technologies. The implementation of energy research is made through calls for proposals organised and managed by the Public Service of Wallonia, DGO6 (Directorate for Research) and DGO4 (Directorate for Energy). The topics of the DGO4 calls are aligned with the priorities of the SET-Plan and consider the potentialities of the Walloon scientific and industrial community.

Moreover, competitiveness clusters, set up since 2005, where industries and research centres work in partnership, have defined priorities and propose projects to the public authority for funding. The clusters gather actors of the same sector, i.e. BIOWIN (for the life sciences), SKYWIN (for aeronautics and space), WAGRALIM (for agro-industries), LOGISTICS IN WALLONIA (for logistics), MECATECH (for mechanical engineering) and GREENWIN (for environmental technology, notably green chemistry and sustainable materials (including their applications in zero or near-zero energy buildings)).

Other transversal thematic clusters have been set also for networking, for example TWEED concerning renewable energy and CAP 2020 concerning energy efficiency/eco-construction of buildings.

THE BRUSSELS-CAPITAL REGION

The Brussels-Capital region, where buildings account for close to 75% of energy consumption, focuses on eco-construction and energy efficiency in ETRDD. The sustainable construction cluster Ecobuild plays a key role here. In the renewable energy sector, the joint initiative of the Brussels Universities ULB and VUB (Brussels Wind Energy Research Institute – Bruwind) is a driver for innovation.

In 2006, the region set up a Regional Plan for Innovation (RPI) which was updated in 2012. The plan includes several concrete short-term actions (for 2013-14) and directions for 2014-20. It has three thematic priorities: information and communication technologies (ICT), healthcare and the environment (including green technology related to energy). A new Regional Plan for Innovation is to be voted in March 2016. The three thematic priorities remain unchanged.

As part of the priority sectors, energy efficiency in the building sector, sustainable mobility and renewable energy benefit from several kinds of support to innovative entrepreneurship, such as financing and seed funding, services to innovative companies and incubators, strengthening the availability of human capital, and stimulating demand for innovative goods and services through innovative public procurement. They also benefit from support in setting up and implementing successful European projects, with a focus on the participation of SMEs.

FUNDING

In 2013, total public spending on ETRDD amounted to EUR 190 million. This equalled 0.048% of GDP, or the eighth-highest share among the IEA member countries (see Figure 11.2). From 2011 to 2014, public funding allocations focused on nuclear energy (47% of the total) and energy efficiency (29%), with smaller amounts budgeted for electricity generation/networks (11%) and renewable energy (11%).

For the Flemish region, the total BERD (Business Expenditure on R&D) figures are published yearly in *STI in Flanders – Figures 2015* and in more detail in *Vlaams indicatorenboek 2015*, but without a subdivision by thematic areas.

The Flemish participation in the European Research and Innovation Programme (including nuclear research) is monitored on a yearly basis. The conclusions of the 7th Framework Programme for Research and Technological Development (FP7) are published in *STI in Flanders – Figures 2015* and in more detail in the Flemish publication *Vlaamse deelname aan Europese financieringsprogramma's 2007-2013*.

Since 2009, federal government funding for nuclear fission and fusion research more than doubled, rising to an estimated EUR 107 million in 2015. Almost a third of this amount is dedicated to light-water reactors (SCK•CEN), and one-fifth each to nuclear waste management (ONDRAF/NIRAS), nuclear supporting technologies (SCK•CEN) and the multipurpose hybrid research reactor for high-tech applications (MYRRHA, operated by SCK•CEN). Finally, close to EUR 6 million is dedicated to nuclear fusion. The MYRRHA project has been the single largest ETRDD investment programme in the country since 2009, with a budget of EUR 95.6 million for 2010-15.

Fiscal incentives to promote R&D provide indirect federal government funding through two types of tax exemptions. First, researchers in both public and private sectors are, under certain conditions, eligible for an 80% exemption from income tax (totalling EUR 696 million in 2013 and EUR 761 million in 2014). Second, taxes on patent income are also eligible for an 80% deduction (amounting to EUR 193 million in 2012, the latest year for which data are available).

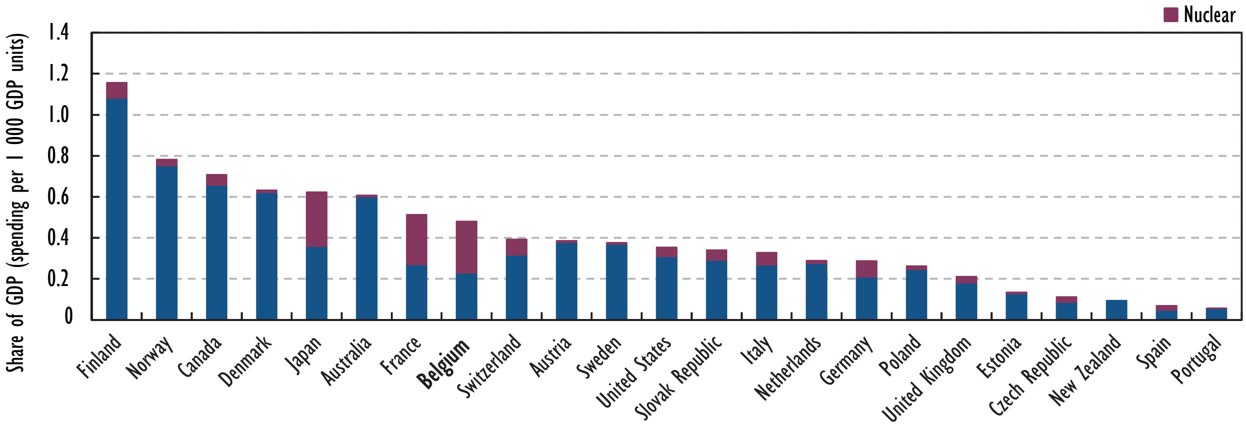
In the Flemish region, public funding increased by 40% of its level in 2007 (EUR 25 million) to more than EUR 35 million in 2013 (see Figure 11.4). At its peak in 2011, funding exceeded EUR 45 million. Energy efficiency is traditionally the largest recipient, while projects on renewable energy and power and storage also receive substantial public funding.

In the Walloon region, public funding increased from EUR 25 million in 2007 to nearly EUR 45 million in 2013, or by around 80% (see Figure 11.5). At its peak in 2012, funding exceeded EUR 60 million. Similar to the Flemish region, energy efficiency is the main recipient of public funding, while renewable energy and power and storage receive most of the remainder. In more detail, public funding for ETRDD on renewable energy focuses on bioenergy and solar energy, each allocated close to 40% of the total budget for ETRDD on renewables. One part of the Walloon region's public funding was the contribution of EUR 2.85 million to the "Broader Approach" supporting the ITER project. This amount was dedicated to support Walloon companies collaborating to the project.

To a larger extent, the amount of research spending for all sectors in Wallonia was EUR 2.664 billion which represents 2.85 % of gross domestic product (GDP).

The Brussels-Capital region does not have any funds earmarked for ETRDD, but in 2016 the largest financing programme of Innoviris, BRIDGE, is dedicated to energy efficiency, with a total budget of EUR 6 million over three years.

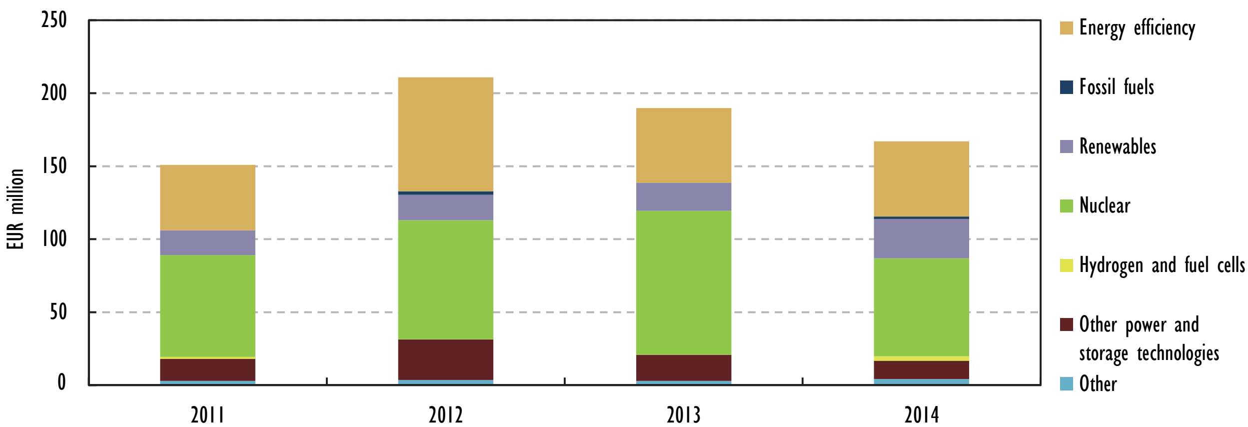
Figure 11.2 Government ETRDD spending as a ratio of GDP in IEA member countries, 2013



Notes: Includes demonstration. Data are not available for Greece, Hungary, Ireland, Korea, Luxembourg and Turkey.

Source: IEA (2015), "RD&D Budgets", *IEA Energy Technology RD&D Statistics* (database), www.iea.org/statistics/.

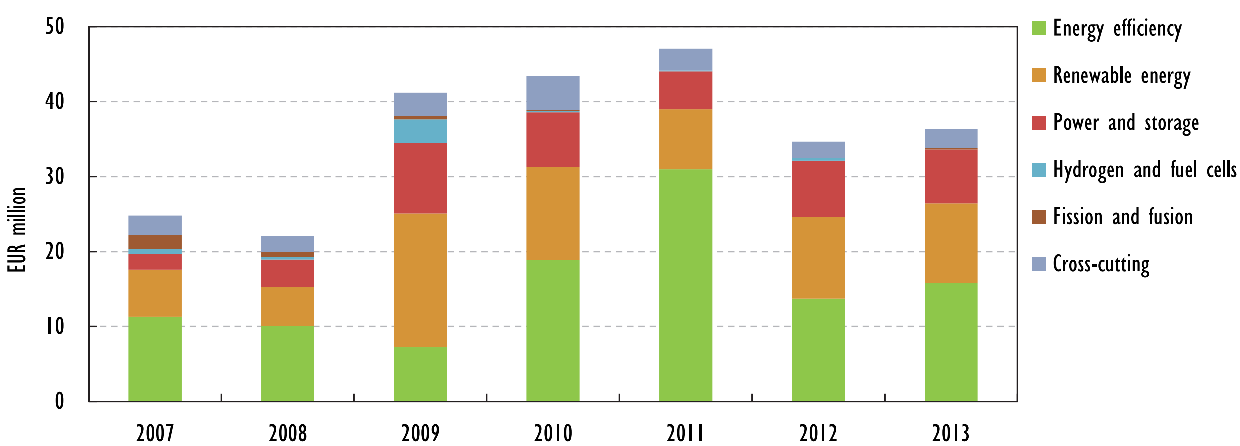
Figure 11.3 Government ETRDD budgets in Belgium, 2011-14



Notes: Includes demonstration.

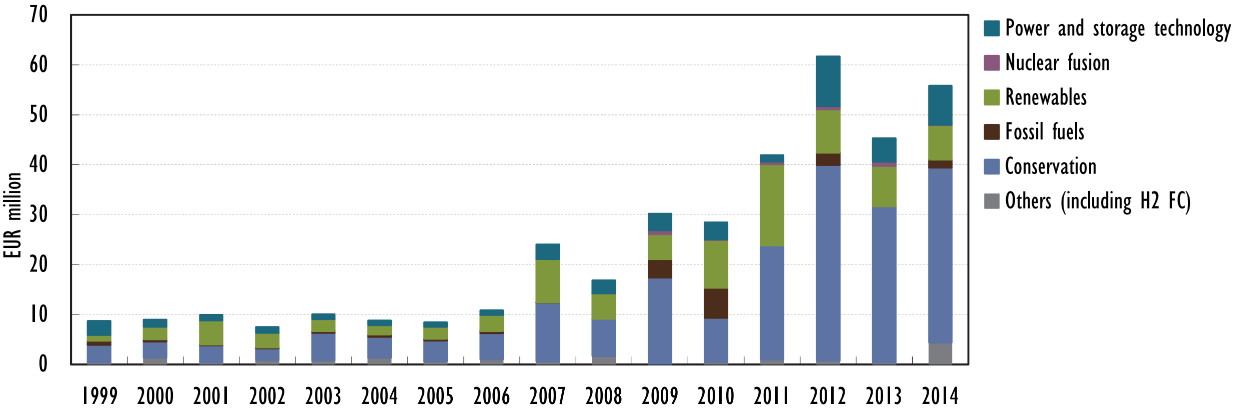
Source: IEA (2015), "RD&D Budgets", *IEA Energy Technology RD&D Statistics* (database), www.iea.org/statistics/.

Figure 11.4 ETRDD budgets of the Flemish regional government, 2007-14



Source: The Flemish region (EWI department).

Figure 11.5 ETRDD budgets of the Walloon regional government, 1999-2014



Note: H_2 FC = hydrogen and fuel cells.

Source: The Walloon region (DGO4).

INTERNATIONAL COLLABORATION

Belgium participates in several regional or international collaborative efforts, particularly those focusing on energy efficiency and renewable energies. Belgium also participates in 12 IEA Technology Collaboration Programmes (TCPs) focusing on energy-efficient end-use, renewables and modelling. It is worth noting that the three regions participate in the TCP focusing on modelling (the Flemish Institute for Technological Research, the Public Service of Wallonia, and Brussels Environment. Belgium also participates in the TCPs focusing on fusion indirectly through the European Atomic Energy Community (Euratom). As a member state of the European Union's Joint Undertaking for the International Organisation ITER and the Development of Fusion Energy, and as a voluntary contributor to the "Broader Approach" between the European Union and Japan, Belgium also contributes to the development of fusion energy which aims to start producing carbon-free electricity in 2050.

The European Strategic Energy Technology (SET) Plan is an important reference framework for ETRDD in Belgium, at both federal and regional levels. Belgium participates in several European Research Area Networks (ERA-NETs). ERA-NETs are networks of national science and technology funding organisations in Europe the aim of which is to co-ordinate national and regional activities and research programmes. Participants in the ERA-NET projects can be co-funded via the EU Framework Programme for Research, Technological Development and Demonstration activities. Belgian industry and research bodies are relatively well represented in the European energy RD&D platforms and/or associations.

In the Flemish region, both funding agencies FWO and IWT co-operate in EU programmes and support the participation of their RTDI actors in these programmes (ERA-NETs, EUREKA, Horizon 2020) by advising and/or co-funding ETRDD projects. FWO promotes international collaboration via several instruments (international mobility, international collaboration and international contacts). IWT promotes international collaboration through an additional premium support of 10%. In addition, Flemish participants collaborate in projects of the Fuel Cells and Hydrogen Joint Undertaking (FCH JU).

In the context of the European SET-Plan, the Flemish region is active in both the European Technology Platforms (ETPs) and the European Industrial Initiatives (EIIs). ETPs and EIIs will merge into European Technology and Innovation Platforms (ETIPs).The Flemish region also participates in IEA TCPs focusing on *inter alia* efficient buildings and hybrid and electric vehicles.

The Walloon region participates in five IEA TCPs, primarily focusing on energy efficiency (buildings, industry, transport), renewables and modelling. The Walloon region is also an active member of the Belgian delegation at several European Energy Industrial Initiatives (EII) of the SET-Plan (Solar EII, Bioenergy EII, EII Electrical Grid, EII Wind, EII Smart Cities) and JTI Fuel Cells. The Walloon region participates also through several funding instruments dedicated to the SET-Plan, i.e. through the organisation of European calls like ERA-NET Plus. The Walloon region also co-operates in EU programmes and supports the participation of RTDI actors in the programmes Horizon 2020 and EUREKA. From 2009 to 2013, the Walloon region contributed to the "Broader Approach", the agreement between EURATOM and Japan on nuclear fusion (ITER).

In the Brussels-Capital region, universities, companies and other organisations participate in ETRDD-related calls for European programmes such as Horizon 2020. In addition, Innoviris (the Brussels Institute for Research and Innovation) is currently launching several web-based ERA-NET R&D platforms with European partners that allow for the funding of energy-related R&D projects (for example in the field of "smart energy"). Examples of this are the ERA-NET "Smart Cities and Communities" and "Smart Urban Futures".

ASSESSMENT

Under the Belgian federal system, nuclear ETRDD policy falls under the responsibility of the federal government while non-nuclear ERTDD policy is led by the regions. The three regions in Belgium are responsible for the development and implementation of their respective energy technology strategies and policies.

Since the previous IEA in-depth review of Belgium in 2009, both federal and regional governments have made some progress in setting ETRDD priorities. The federal government has, in line with the decision to phase out nuclear power, mainly focused on the safety of NPPs, and on the solutions for the long-term management of radioactive waste. Regional governments have many energy research and innovation priorities, including energy efficiency in buildings and industry (common themes for all regions), renewable energy (PV, wind, bioenergy, hydrogen/fuel cells, geothermal, and ocean energy), smart grids, smart cities, and energy storage. While each region may have a particular strategic focus, taken together the priorities of the regions result in a very broad range of energy technology priorities for Belgium as a country.

The federal and regional governments are implementing short- to medium-term R&D programmes, with a rather limited level of national co-ordination or any linkage to a long-term energy vision. Nevertheless, the IEA welcomes the Flemish government's *Foresight 2025* published in May 2014, which describes science, technology and innovation priorities up to 2025 for the transition and includes New Energy Demand and Delivery as one of the seven priority areas.

Experience in many IEA member countries shows that energy technology policy objectives can be achieved cost-effectively when a long-term strategy is established, implemented, and regularly revised through close feedback from research and business communities. The IEA encourages Belgium to develop a long-term energy technology strategy to support the Energy Vision and Energy Pact with strong co-ordination between federal and regional governments.

Even under the budget constraints since the 2008 global economic crisis, public funding for ETRDD has remained relatively stable in Belgium and actually increased from 2010 to 2012. Except for the nuclear sector, governments (both federal and regional) support for ETRDD was below the IEA average in 2013. In order to encourage private-sector investment, the federal government strengthened its fiscal measures, including an 80% exemption from income tax for researchers, and an 80% deduction from the patent income. With limited overall funding for diverse energy technology priorities, the Belgian government needs to narrow its strategic focus and align the ETRDD programmes accordingly to ensure cost-effective outcomes without any duplication. In the longer term, the "energy transition fund", as mentioned in the federal government agreement of November 2014, could be a solid source for increased funding.

Both federal and regional governments are actively involved in the international ETRDD co-operation, including the European Strategic Energy Technology Plan, Horizon 2020, and the IEA Technology Collaboration Programmes. The IEA welcomes this commitment. In addition, enhanced international co-operation on ETRDD would provide new opportunities for competent young researchers, and contribute to the transition to a low-carbon society.

RECOMMENDATIONS

The government of Belgium should:

- ☐ *Establish a medium- to long-term national ETRDD strategy, in close co-ordination with the regional governments, and build on the strengths of the research community.*
- ☐ *Increase the level and strategic focus of ETRDD funding.*
- ☐ *Encourage private-sector investment in energy technology research through fiscal and financial incentives.*
- ☐ *Continue to support participation of Belgian researchers in European and international ETRDD programmes and initiatives in order to strengthen competences.*

Reference

IEA (International Energy Agency) (2015), "RD&D Budgets", *IEA Energy Technology RD&D Statistics* (database), www.iea.org/statistics/.

VRWI (Flemish Council for Science and Innovation) (2014), *Foresight 2025*, VRWI, Brussels, www.vrwi.be/en/publications/study-26-vrwi-foresight-study-2025.

PART IV
ANNEXES

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

REVIEW TEAM AND PREPARATION OF THE REPORT

The IEA in-depth review team visited Belgium from 18 to 22 May 2015. The team met with government officials, energy suppliers, interest groups and other organisations. This report was drafted on the basis of these meetings, the team's preliminary assessment of the country's energy policy, the government response to the IEA energy policy questionnaire and other information. The members of the team were:

IEA member countries

Dr. Kurt Bisang, Switzerland (team leader)

Dr. Dagmar Balve-Hauff, Germany

Mr. Maurits Blanson Henkemans, the Netherlands

Ms. Marie Claesson, Sweden

Mr. Tatu Pahkala, Finland

Mr. David Rolfe, the United Kingdom

IEA key partner countries

Dr. Rebecca Maserumule, South Africa (observer)

European Commission

Mr. Joao Heredia

OECD Nuclear Energy Agency

Dr. Marco Cometto

International Energy Agency

Mr. Kijune Kim

Mr. Miika Tommila

The team is grateful for the co-operation and assistance of the many people it met throughout the visit. Thanks to their kind hospitality, openness and willingness to share information, the visit was highly informative, productive and enjoyable. The team wishes to express its gratitude to Mr. Jean-Marc Delporte, President of FPS Economy, and Ms. Nancy Mahieu, Director-General for Energy, and the staff at the FPS Economy. In particular, the team wishes to thank Ms. Karen Geens and Mr. Lenhard Vanhoorn for their professionalism displayed throughout the review.

Miika Tommila managed the review and drafted the report, with the exception of Chapter 10 on Nuclear Energy drafted by Marco Cometto. Sonja Lekovic and Soyeon Park drafted the supply and demand sections of the report.

The report was prepared under the guidance of Aad van Bohemen, Head of Country Studies Division. Helpful comments were provided by the review team members and the following IEA staff: Manuel Baritaud, Jan Bartos, Ute Collier, Rebecca Gaghen, Takashi Hattori, Costanza Jacazio, Caroline Lee, Pharaoh Le Feuvre, David Morgado, Rodrigo Pinto Scholtbach, Carrie Pottinger, Sam Thomas and Christelle Verstraeten.

Sonja Lekovic, Soyeon Park and Bertrand Sadin prepared the figures. Roberta Quadrelli and Zakia Adam provided support on statistics. Muriel Custodio, Astrid Dumond and Katie Russell managed the production process. Viviane Consoli and Therese Walsh provided editorial assistance.

ORGANISATIONS VISITED

Agoria

APERe

APETRA

Belgian Institute of Natural Sciences

Belgian Petroleum Federation

BELSPO

Bond Beter Leefmilieu

Brafco

Brugel

Brussels Agency of Innovation (Innoviris)

Brussels-Capital Administration (IBGE)

Commission for the Regulation of Electricity and Gas (CREG)

Commission wallonne pour l’énergie (CWaPE)

EDORA

Elia

FEBEG

FEBELIEC

Federal Energy Ombudsman

Federal Planning Bureau

Federal Public Service Economy

Federal Public Service Environment

Federal Public Service Foreign Affairs

Federal Public Service Mobility

Flemish administration (LNE, EWI)

Flemish Energy Agency (VEA)

Fluxys

Greenpeace

ODE Vlaanderen

Synergrid

Testaankoop / Test achat

University of Antwerp

University of Brussels

University of Ghent/Itinera Institute

University of Leuven

Université de Louvain-la-Neuve

VBO/FEB

Vlaamse Regulator voor Elektriciteit en Gas VREG

Walloon Administration (DG04, AWAC)

ANNEX B:

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1980	1990	2000	2010	2013	2014
TOTAL PRODUCTION		**6.5**	**8.1**	**13.1**	**13.7**	**15.5**	**15.0**	**12.5**
Coal		6.4	4.7	1.2	0.2	-	-	0.0
Peat		-	-	-	-	-	-	-
Oil		-	-	-	-	-	-	-
Natural gas		0.0	0.0	0.0	0.0	-	-	-
Biofuels and waste[1]		0.0	0.1	0.8	0.9	2.8	3.0	2.8
Nuclear		0.0	3.3	11.1	12.6	12.5	11.1	8.8
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind		-	-	0.0	0.0	0.1	0.3	0.4
Geothermal		-	-	0.0	0.0	0.0	0.0	0.0
Solar/other[2]		-	-	0.0	0.0	0.1	0.4	0.5
TOTAL NET IMPORTS[3]		**39.5**	**39.5**	**34.8**	**43.8**	**45.0**	**41.3**	**40.8**
Coal	Exports	0.8	0.9	1.1	1.1	0.7	0.6	0.5
	Imports	5.3	8.0	10.7	8.5	4.4	3.8	3.8
	Net imports	4.6	7.2	9.6	7.3	3.7	3.2	3.4
Oil	Exports	14.9	17.8	19.0	23.3	23.9	27.2	29.4
	Imports	46.4	44.2	41.2	52.9	56.7	56.9	58.8
	Int'l marine and aviation bunkers	-3.6	-2.8	-5.0	-6.8	-9.0	-7.4	-6.7
	Net imports	27.9	23.6	17.3	22.7	23.9	22.2	22.7
Natural Gas	Exports	-	-	-	-	2.8	0.8	0.7
	Imports	7.1	8.9	8.2	13.3	19.5	15.3	13.5
	Net imports	7.1	8.9	8.2	13.3	16.8	14.5	12.7
Electricity	Exports	0.2	0.8	0.7	0.6	1.0	0.7	0.4
	Imports	0.1	0.5	0.4	1.0	1.1	1.5	1.9
	Net imports	-0.1	-0.2	-0.3	0.4	0.0	0.8	1.5
TOTAL STOCK CHANGES		**-0.0**	**-0.8**	**0.1**	**0.5**	**-0.2**	**-0.5**	**-0.5**
TOTAL SUPPLY (TPES)[4]		**46.0**	**46.8**	**47.9**	**58.1**	**60.4**	**55.8**	**52.8**
Coal		11.2	11.4	10.6	8.1	3.8	3.4	3.3
Peat		-	-	-	-	-	-	-
Oil		27.7	23.3	17.6	22.7	23.4	21.7	22.3
Natural gas		7.1	8.9	8.2	13.4	17.0	14.4	12.6
Biofuels and waste[1]		0.0	0.1	0.8	1.0	3.3	3.6	3.3
Nuclear		0.0	3.3	11.1	12.6	12.5	11.1	8.8
Hydro		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind		-	-	0.0	0.0	0.1	0.3	0.4
Geothermal		-	-	0.0	0.0	0.0	0.0	0.0
Solar/other[2]		-	-	0.0	0.0	0.1	0.4	0.5
Electricity trade[5]		-0.1	-0.2	-0.3	0.4	0.0	0.8	1.5
Shares in TPES (%)								
Coal		*24.3*	*24.4*	*22.0*	*13.9*	*6.3*	*6.1*	*6.3*
Peat		-	-	-	-	-	-	-
Oil		*60.2*	*49.9*	*36.7*	*39.1*	*38.8*	*38.8*	*42.3*
Natural gas		*15.5*	*19.0*	*17.0*	*23.0*	*28.1*	*25.8*	*23.9*
Biofuels and waste[1]		-	*0.1*	*1.6*	*1.8*	*5.5*	*6.4*	*6.3*
Nuclear		-	*7.0*	*23.2*	*21.6*	*20.7*	*19.9*	*16.6*
Hydro		*0.0*	*0.1*	*0.0*	*0.1*	*0.0*	*0.1*	*0.0*
Wind		-	-	-	-	*0.2*	*0.6*	*0.8*
Geothermal		-	-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Solar/other[2]		-	-	*0.0*	*0.0*	*0.2*	*0.8*	*0.9*
Electricity trade[5]		*-0.1*	*-0.5*	*-0.7*	*0.6*	*0.1*	*1.5*	*2.9*

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
TFC	**33.7**	**32.3**	**32.1**	**41.8**	**43.5**	**41.7**	**40.1**
Coal	5.7	4.2	3.5	2.8	1.2	1.1	1.2
Peat	-	-	-	-	-	-	-
Oil	20.2	16.9	16.2	21.1	21.2	20.6	20.7
Natural gas	4.6	7.1	6.8	10.2	11.6	10.6	9.0
Biofuels and waste[1]	-	-	0.4	0.5	1.6	1.8	1.8
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	0.0	0.0	0.0	0.0	0.0
Electricity	2.9	3.7	5.0	6.7	7.2	7.0	6.9
Heat	0.3	0.4	0.2	0.5	0.6	0.6	0.5
Shares in TFC (%)							
Coal	*16.9*	*13.1*	*11.0*	*6.8*	*2.8*	*2.7*	*2.9*
Peat	-	-	-	-	-	-	-
Oil	*59.8*	*52.2*	*50.4*	*50.5*	*48.8*	*49.3*	*51.6*
Natural gas	*13.6*	*21.9*	*21.2*	*24.3*	*26.7*	*25.3*	*22.4*
Biofuels and waste [1]	-	-	*1.2*	*1.3*	*3.8*	*4.4*	*4.4*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*
Electricity	*8.7*	*11.5*	*15.5*	*16.0*	*16.5*	*16.8*	*17.3*
Heat	*0.9*	*1.2*	*0.7*	*1.2*	*1.5*	*1.3*	*1.3*
TOTAL INDUSTRY[6]	**16.8**	**13.8**	**13.6**	**19.8**	**19.1**	**18.6**	**19.0**
Coal	3.5	3.2	3.0	2.6	1.1	1.0	1.1
Peat	-	-	-	-	-	-	-
Oil	7.8	4.6	4.3	7.6	8.0	8.5	9.1
Natural gas	3.2	3.6	3.3	5.3	5.5	4.7	4.3
Biofuels and waste[1]	-	-	0.2	0.4	0.7	0.8	0.8
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	-	-	-	-	-
Electricity	1.9	2.1	2.6	3.4	3.3	3.2	3.2
Heat	0.3	0.4	0.2	0.4	0.5	0.5	0.4
Shares in total industry (%)							
Coal	*21.2*	*23.2*	*22.1*	*13.2*	*5.6*	*5.5*	*5.7*
Peat	-	-	-	-	-	-	-
Oil	*46.6*	*33.1*	*31.7*	*38.5*	*41.8*	*45.5*	*47.9*
Natural gas	*18.8*	*26.3*	*24.2*	*26.9*	*28.7*	*25.0*	*22.8*
Biofuels and waste [1]	-	-	*1.4*	*1.9*	*3.8*	*4.3*	*4.4*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	-	-	-
Electricity	*11.5*	*14.9*	*19.2*	*17.3*	*17.2*	*17.2*	*17.1*
Heat	*1.9*	*2.6*	*1.4*	*2.2*	*2.9*	*2.6*	*2.2*
TRANSPORT[4]	**4.4**	**5.4**	**6.9**	**8.2**	**9.2**	**8.4**	**8.7**
OTHER[7]	**12.6**	**13.1**	**11.6**	**13.8**	**15.2**	**14.7**	**12.3**
Coal	2.2	1.0	0.5	0.2	0.1	0.1	0.1
Peat	-	-	-	-	-	-	-
Oil	8.0	7.0	5.1	5.4	4.6	4.2	3.4
Natural gas	1.5	3.4	3.5	4.8	6.1	5.9	4.6
Biofuels and waste[1]	-	-	0.2	0.2	0.6	0.7	0.5
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	0.0	0.0	0.0	0.0	0.0
Electricity	0.9	1.6	2.3	3.1	3.7	3.7	3.5
Heat	-	0.0	0.0	0.1	0.1	0.1	0.1
Shares in other (%)							
Coal	*17.1*	*7.9*	*4.5*	*1.4*	*0.9*	*0.8*	*0.6*
Peat	-	-	-	-	-	-	-
Oil	*63.8*	*53.3*	*44.0*	*39.2*	*30.0*	*28.6*	*27.9*
Natural gas	*11.5*	*26.4*	*30.2*	*35.1*	*40.2*	*40.1*	*37.2*
Biofuels and waste [1]	-	-	*1.6*	*1.1*	*3.7*	*4.8*	*4.4*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	*0.1*	*0.1*	*0.2*
Electricity	*7.5*	*12.1*	*19.4*	*22.6*	*24.6*	*25.1*	*28.7*
Heat	-	*0.3*	*0.3*	*0.5*	*0.6*	*0.5*	*0.9*

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	10.0	12.6	17.7	19.7	21.1	18.0	15.1
Output (Mtoe)	3.5	4.6	6.0	7.1	8.1	7.1	6.1
Output (TWh)	40.6	53.1	70.3	82.8	93.8	82.2	71.5
Output Shares (%)							
Coal	*21.7*	*29.4*	*28.2*	*19.4*	*6.3*	*6.3*	*6.2*
Peat	-	-	-	-	-	-	-
Oil	*53.7*	*34.7*	*1.9*	*1.0*	*0.4*	*0.2*	*0.3*
Natural gas	*23.7*	*11.2*	*7.7*	*19.3*	*33.5*	*25.5*	*27.0*
Biofuels and waste [1]	*0.3*	*0.6*	*1.0*	*1.6*	*6.1*	*7.6*	*7.9*
Nuclear	*0.2*	*23.6*	*60.8*	*58.2*	*51.1*	*51.9*	*47.2*
Hydro	*0.4*	*0.5*	*0.4*	*0.6*	*0.3*	*0.5*	*0.4*
Wind	-	-	-	-	*1.4*	*4.5*	*6.5*
Geothermal	-	-	-	-	-	-	-
Solar/other [2]	-	-	-	-	*0.6*	*3.2*	*4.0*
TOTAL LOSSES	**13.1**	**14.4**	**16.1**	**16.0**	**16.3**	**14.2**	**12.7**
of which:							
Electricity and heat generation[9]	6.1	7.7	11.4	12.0	12.2	10.5	8.6
Other transformation	5.6	3.3	2.1	1.3	1.2	1.0	1.3
Own use and transmission/distribution losses[10]	1.4	3.5	2.7	2.8	2.9	2.7	2.8
Statistical Differences	**-0.9**	**0.1**	**-0.3**	**0.3**	**0.6**	**-0.2**	**0.1**
INDICATORS	**1973**	**1980**	**1990**	**2000**	**2010**	**2013**	**2014**
GDP (billion 2005 USD)	193.80	232.95	284.24	355.04	412.18	420.46	424.95
Population (millions)	9.73	9.86	9.97	10.25	10.88	11.11	11.16
TPES/GDP (toe/1000 USD)[11]	0.24	0.20	0.17	0.16	0.15	0.13	0.12
Energy production/TPES	0.14	0.17	0.27	0.24	0.26	0.27	0.24
Per capita TPES (toe/capita)	4.73	4.74	4.81	5.67	5.55	5.02	4.73
Oil supply/GDP (toe/1000 USD)[11]	0.14	0.10	0.06	0.06	0.06	0.05	0.05
TFC/GDP (toe/1000 USD)[11]	0.17	0.14	0.11	0.12	0.11	0.10	0.09
Per capita TFC (toe/capita)	3.47	3.27	3.22	4.08	3.99	3.76	3.59
CO_2 emissions from fuel combustion ($MtCO_2$)[12]	133.0	125.5	106.3	114.0	105.4	93.4	87.4
CO_2 emissions from bunkers ($MtCO_2$)[12]	11.3	8.9	15.9	21.6	28.7	23.7	21.3
GROWTH RATES (% per year)	**73-80**	**80-90**	**90-00**	**00-10**	**10-12**	**12-13**	**13-14**
TPES	0.2	0.2	1.9	0.4	-5.6	3.6	-5.4
Coal	0.3	-0.7	-2.7	-7.2	-7.6	3.6	-2.3
Peat	-	-	-	-	-	-	-
Oil	-2.4	-2.8	2.6	0.3	-6.0	4.8	3.1
Natural gas	3.2	-0.9	5.0	2.4	-8.1	0.2	-12.5
Biofuels and waste[1]	30.2	29.5	3.2	12.4	3.8	0.1	-7.4
Nuclear	107.1	13.0	1.2	-0.0	-8.3	5.8	-21.0
Hydro	6.9	-0.4	5.7	-3.9	7.2	6.5	-27.3
Wind	-	-	-	60.2	46.1	33.8	25.2
Geothermal	-	-	4.1	2.9	-13.4	-	-
Solar/other[2]	-	-	-	62.1	59.0	42.1	9.1
TFC	-0.6	-0.0	2.7	0.4	-4.1	4.3	-4.0
Electricity consumption	3.4	3.0	2.9	0.7	-1.0	0.0	-1.5
Energy production	3.2	4.9	0.5	1.2	-4.6	5.6	-16.2
Net oil imports	-2.4	-3.1	2.8	0.5	-7.3	8.6	1.8
GDP	2.7	2.0	2.2	1.5	0.9	0.3	1.1
TPES/GDP	-2.4	-1.7	-0.3	-1.1	-6.3	3.3	-6.3
TFC/GDP	-3.2	-2.0	0.4	-1.1	-4.9	4.1	-5.0

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes tide, wave and ambient heat used in heat pumps.
3. In addition to coal, oil, natural gas and electricity, total net imports also include peat, biofuels and waste and trade of heat.
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 includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
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 solar thermal, 10% for geothermal and 100% for hydro, wind and solar 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 2005 prices and exchange rates.
12. "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach from the 2006 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 2013 and applying this factor to forecast energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX C: 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 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. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and 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 the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

ANNEX D: GLOSSARY AND LIST OF ABBREVIATIONS

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

ACER	Agency for the Cooperation of Energy Regulators
APETRA	National Stockholding Agency
APX	Amsterdam Power Exchange
BCR	Brussels-Capital region
BPF	Belgian Petroleum Foundation
CCGT	combined-cycle gas turbine
CCIEP	Coordination Committee for International Environmental Policy
CCS	carbon capture and storage
CDM	clean development mechanism (under the Kyoto Protocol)
CEER	Council of European Energy Regulators
CHP	combined heat and power production (or co-generation)
CREG	Commission for the Regulation of Electricity and Gas
CWaPE	Commission Wallonne pour l'Énergie
CWE	Central Western Europe
DAM	day-ahead market
DSO	distribution system operator
EED	Energy Efficiency Directive 2012/27/EU
ENTSO	European Network of Transmission System Operators (electricity and gas)
EPBD	Energy Performance of Buildings Directive 2010/31/EU
EPC	energy performance certificate
ETRDD	energy technology research, development and demonstration
ESD	Energy Services Directive 2006/32/EU
ETS	Emissions Trading Scheme (EU)
FR	Flemish region
GC	green certificate
GHG	greenhouse gas
HHI	Herfindahl-Hirshman index: it measures competition, taking into account the size of firms in relation to the industry

IAEA	International Atomic Energy Agency (in Vienna)
JI	joint implementation projects (under the Kyoto Protocol)
LCDS	low-carbon development strategy
LNG	liquefied natural gas
LTO	long-term operation
LULUCF	land use, land-use change and forestry
NAP	national allocation plan
NCC	National Climate Commission
NCP	National Climate Plan
NEA	Nuclear Energy Agency (OECD)
NEEAP	National Energy Efficiency Action Plan
NGL	natural gas liquids
NPP	nuclear power plant
NREAP	National Renewable Energy Action Plan
NWE	North Western Europe
NZEB	near-zero energy building
PCI	project of common interest
PLEF	Pentalateral Energy Forum
PRIS	Power Reactor Information System
PV	photovoltaics
PWR	pressurised water reactor
R&D	research and development
RD&D	research, development and deployment
RUE	rational use of energy
SMEs	small and medium-sized enterprises
TFC	total final consumption of energy
TPES	total primary energy supply
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change

Units of measure

bcm	billion cubic metres
GWh	gigawatt-hour
kV	kilovolt
kWh	kilowatt-hour
mb	million barrels
mcm	million cubic metres
Mt	million tonnes
$MtCO_2$-eq	million tonnes of CO_2-equivalent
MW_e	megawatt of electric capacity

MW_{th}	megawatt of thermal capacity
toe	tonne of oil equivalent
TWh	terawatt-hour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Energy Policies of IEA Countries

Belgium

In recent years, Belgium has made clear progress in increasing competition in the electricity and natural gas markets. It has also managed to reduce the use of fossil fuels and increase the use of renewable energy. The country's economy is becoming less energy intensive.

Belgium has excellent gas transport infrastructure, and its gas market is well-integrated with those of its neighbours. The country's emergency oil stock levels are also high.

As in all IEA member countries, a major challenge for Belgium is to decarbonise the economy while ensuring security of supply and affordability of energy. A long-term approach is required, and, given that responsibility for energy policy is divided between the federal and regional governments, the authorities must work decisively together to form a national energy strategy.

Nuclear energy accounts for around half of Belgium's electricity generation. The current policy is to close all nuclear power plants between 2022 and 2025, but this would seriously challenge Belgium's efforts to ensure electricity security and provide affordable low-carbon electricity. The phase-out schedule should be relaxed to let the plants run as long as the regulator considers them safe.

To attract critical investments in the energy sector – especially in electricity generation – the government should follow closely the principles of transparency, predictability and regulatory certainty.

Under any scenario, energy supply needs to be further diversified and energy demand further limited. Transport and buildings hold a large potential for efficiency and climate gains, and fiscal incentives and price signals could be used more frequently in order to reap them.