Energy Governance in Belgium

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Abstract

This chapter reviews the conditions, policies, and institutions of energy governance in Belgium. Except for coal, Belgium has no indigenous energy sources. Nuclear energy accounts for around half of Belgium's electricity generation but all nuclear power plants are scheduled to phase out by 2025. Energy governance

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in Belgium is characterized by a lack of a strategic and coherent vision. The responsibilities for energy policy in Belgium are shared among the federal government and the three regions (Flanders, Wallonia, and Brussels). The distribution of competences is very heterogeneous and creates coordination problems. The main drivers of policy initiatives are European directives and international agreements. Belgium is currently not on track to meet its 2020 goals for energy efficiency and emission reductions. A major part of the explanation for Belgium's weak performance is the dominant role of energy corporations in the Belgian energy sector.

Keywords
Belgium · Energy policy · Federal state · Nuclear phaseout · Energy governance · Low-carbon transition

Introduction

Belgium is a small, open economy located in the heart of Northwestern Europe. Except for coal, Belgium has no indigenous energy sources. Coal mining in Belgium is unprofitable since the 1960s (Verbruggen 1989) and ended in 1992. Belgium now imports all of the fossil fuels it consumes. While fully dependent on crude oil imports, Belgium is a net exporter of refined products from its large refining complex in the port of Antwerp. With multiple gas interconnections, including a liquefied natural gas (LNG) terminal in the port of Zeebrugge, Belgium has also developed to a significant gas transit hub.

Nuclear energy accounts for around half of Belgium's electricity generation. Belgium has seven nuclear reactors with a combined capacity of about 6000 MW. These reactors were commissioned in the 1970s and 1980s. A law enacted in 2003 prohibited the construction of new nuclear plants and mandated the gradual closure of the existing ones as soon as they reached a lifetime of 40 years (Law of 31 January 2003). Under the 2003 law, the oldest reactors (Doel 1, Tihange 1, and Doel 2) should have been closed in 2015, but a new law in 2015 extended their lifetime to 50 years. All nuclear power plants are now scheduled for closure between 2022 and 2025.

In parallel to the nuclear phaseout, Belgium attempts to pursue a low-carbon transition. Belgium is currently not on track to meet its European Union target for energy efficiency (18% reduction in primary energy consumption by 2020 relative to 2007), while it has also become increasingly doubtful that it will meet its goals for greenhouse gas emissions (15% reduction in 2020 compared to 2005 for sectors not covered in the ETS) (EEA 2016, 2017).

The country performs better with regard to its target for renewable energy (13% by 2020). The share of renewable energy in total energy supply went up from 2.6% in 2004 to 7.6% in 2014 (IEA 2016, pp. 117–118). At the end of 2017, Belgium had the world's third-largest installed solar PV capacity per capita, behind only Germany and Japan (REN21 2018). However, this boom was driven by lavish and ill-designed

support schemes, giving rise to financial transfers (Verbruggen 2009; El Kasmioui et al. 2015). In Flanders, part of the financial burden was accumulated on the accounts of the distribution network utilities.

The responsibilities for energy policy in Belgium are shared among the federal government and the three regions (Flanders, Wallonia, and Brussels). This means that a country as small as Belgium has no less than four energy ministers. The federal competence includes broadly all aspects relating to the security of supply of oil and gas, nuclear matters, tariff regulation, electricity transmission (>70 kV), and offshore wind in the North Sea. The regions manage the distribution of electricity and natural gas, energy efficiency, renewables (except offshore wind), and nonnuclear energy research and development (R&D). This heterogeneous distribution of competences creates coordination problems, as illustrated by the protracted negotiations over the allocation of the 2020 EU renewables target. It took no less than 6 years of discussions before an agreement was finally found on 4 December 2015 (NCC 2015), just in time for COP21 in Paris.

General Conditions of Energy Governance in Belgium

Path Dependencies

The structure of Belgium's energy system has been heavily influenced by its once abundant reserves of coal, which were a vital factor in its early industrialization. In the first half of the nineteenth century, Belgium was the largest coal producer on the continent, ahead of Germany and France. The rich coal reserves enabled Belgium to become the first country to industrialize in continental Europe (Hens and Solar 1999, p. 195). Coal extraction itself became uncompetitive in the 1960s, and the last coal pits were closed in 1984 (Wallonia) and 1992 (Flanders). The remaining coal deposits hold a technical potential for coal-bed methane, but the license to explore the Campine Basin, awarded in 2013, expired in 2015 (Van de Graaf and Timmermans 2013). Belgium is now mainly a service-driven economy, but it has maintained a strong manufacturing base with several energy-intensive sectors, such as chemicals, refining, and iron and steel (IEA 2016, p. 17).

The coal and heavy industries were long controlled by the *Société Générale de Belgique* (SGB), founded in 1822 by King William I of the Netherlands. The *Société Générale* developed into a powerful holding with controlling shares in the majority of large companies in nearly every industrial sector. The gas and electricity assets later became one of the crown jewels. In 1988, the French holding company Suez obtained a 55% majority share in the *Société Générale*. The decision center over the Belgian power sector shifted from Brussels to Paris. Suez integrated its Belgian assets slowly but extracted billions from mainly the power sector, i.e., the Belgian low-voltage customers, to finance its industrial expansion. After consecutive restructuration, the multinational company ENGIE emerged in 2015 as a major player in the European power and gas markets.

Beyond coal, Belgium has no indigenous fossil fuel reserves, yet it has developed significant infrastructures and industries around oil and natural gas. In the Antwerp harbor, petroleum refining and lubricant fabrication started before World War II. After the war, large-scale refinery activities were deployed by the Belgian oil company Petrofina and by some oil majors (e.g., Esso and BP in Antwerp, Texaco in Ghent). When crude oil ships became too large to reach Antwerp, in 1971, the RAPL pipeline began to supply crude oil from Rotterdam. In the 1960s, oil substituted coal as the basic fuel for industry, commerce, and heating.

The low price and versatility of oil spurred the decentralization of activities and the sprawling of human settlements (mainly in Flanders). By 1961, urban planning became mandated, but poor practices and indulgent enforcement prevailed. The scattered spatial planning (characterized by suburbanization and ribbon development) thwarts efficient public transport and creates high (commuting) transport needs. Located at the heart of Europe, Belgium has developed into an important logistical hub with a dense network of roads, railways, waterways, airports, and harbors (including Antwerp, the second largest seaport in Europe) (Belgium Federal Government 2017, p. 29). The country also has a relatively old and poorly insulated building stock: 61% of existing buildings were built before 1970 (Statbel 2017), which is one of the reasons why Belgian homes use almost 40% more energy than the European average (calculated with data on total energy consumption per square meter in residential buildings at normal climate, from http://www.entranze.enerdata.eu). These factors go a long way to explaining why Belgium's energy intensity, though decreasing, is above the EU-28 average.

The history of gas in Belgium started with town gas. Already in the nineteenth century, public and office buildings and mansions of the wealthy in the major cities were connected to city gas networks for lighting, cooking, and heating. The gas came from coal gasification in coke plants. In 1966, the import of natural gas took off. The old gas networks and the end-use gas equipment were overhauled. The gas transport company Distrigaz (°1929) revived with participation of Shell and public companies. New transport lines were built. During the 1970s major investments for LNG import from Algeria were made: liquefaction plants, large LNG tankers, and a receiving terminal with storage and decompression. Zeebrugge at the North Sea coast was the receiving harbor and developed to a significant gas hub. Due to the expansion of the gas distribution networks and the higher efficiency of end-use conversion equipment, natural gas substituted for oil in many industrial and building facilities. The EU Directive on gas market liberalization (1997) imposed the unbundling of the gas activities: Distrigaz kept the trade and supply activities, and a new company Fluxys came to own and operate the physical stock (Zeebrugge gas terminal, transport lines, storage facilities). Gas distribution occurs parallel with electricity distribution by the same network companies (1 July 2018, Eandis and Infrax merged to Fluvius).

Belgium has a long industrial history in the nuclear sector. Because the Belgian company Union Minière delivered uranium ore from mines in Congo as well as from stockpiles in Olen (Belgium) to the USA just before World War II for its "Manhattan Project," the country was promised special access to nuclear technology for civil

purposes in the postwar era (Groves 1962, p. 170). Without access to Belgium's uranium, the USA would probably not have been able to drop the atomic bombs on Hiroshima and Nagasaki (72% of the uranium used in the bombs originated from Belgian Congo) (Barbé 2005, p. 2). While the USA did not honor the promise to share nuclear know-how with Belgium, the country got a financial compensation for its uranium deliveries. This money was used to finance research into nuclear energy, which would allow Belgium to become one of the pioneers of nuclear research in Europe.

It led in 1952 to the establishment of SCK-CEN (Studiecentrum voor Kernenergie – Centre d'Etude de l'Energie Nucléaire – Belgian Nuclear Research Centre), a study center for nuclear research, in Mol. This center trained the first nuclear scientists, built the first experimental and commercial reactors, and attracted other activities to the region, such as nuclear fuel rod manufacturing (FBFC, Belgonucléaire), reprocessing (Eurochimique), and specialized labs (Govaerts et al. 1994). Following a joint venture with French EDF in the Chooz A nuclear plant, the first commercial nuclear reactor in Belgium, Doel 1, was commissioned in 1974. Six more were connected to the grid in the ensuing decade (Table 2). This resulted in one of the highest nuclear dependencies in Europe and globally, with nuclear accounting for 53% of Belgium's electricity generation in 2016 (IEA 2016).

The construction of a series of new 1300 MW units was proposed in 1976 by a specially installed, experts commission (Commissie van Beraad inzake Kernenergie) and reiterated in the power sector capacity plans of 1981, 1982, and 1983. The state reform law of 1980 imposed 1 month during hearings about submitted plans on power generation expansion. Independent experts enlarged the scope of the planning process and suggested alternatives for the nuclear option. The government did not accept the submitted plans of 1981 and 1982. In February 1985, the plan of 1983 was accepted, i.e., Belgian participation of 25% in two new 1390 MW plants in Chooz B and a later Belgian construction of 1390 MW (N8 = Doel 5), with an announced 50% share for France in it (Verbruggen 1986). Due to nuclear overcapacity, France did not lift this option.

Yet, in the wake of the nuclear accident of Three Mile Island and by the catastrophe of Chernobyl, support for nuclear waned. The 1988 capacity expansion plan, asking the permit to build Doel 5, was rejected by the Belgian government declaring for the first time that priority should be given to nonnuclear scenarios, partly inspired by the overcapacity in take-or-pay contracted gas imports. Doel 5 was shelved indefinitely (Verbruggen et al. 1988). In 1999, the green parties AGALEV and ECOLO participated in a federal coalition government with liberal (VLD and PRL) and socialist (SP and PS) parties. The coalition agreement included the nuclear phaseout, enacted into law on 31 January 2003 (Laes et al. 2007a). This crucial political decision has since dominated the public debate on energy in Belgium.

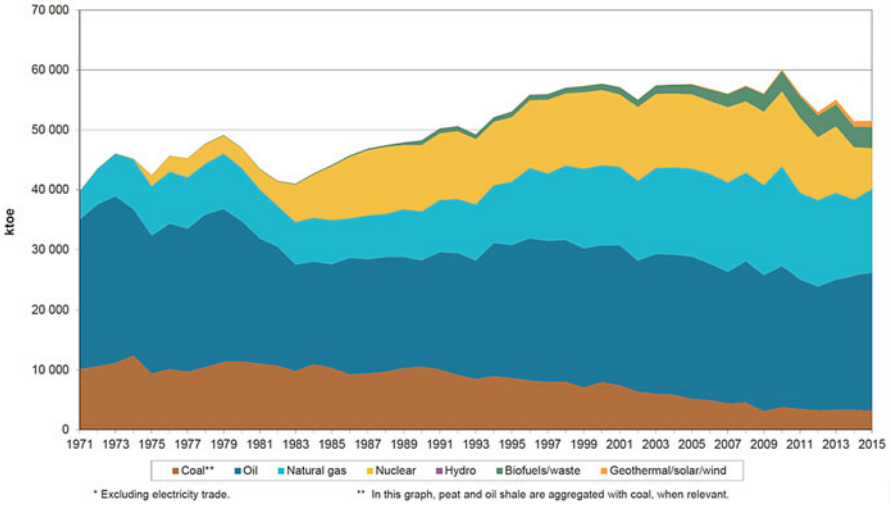
As a small, rather flat country located in a moderate and rainy climate belt, harnessing Belgium's renewable energy potential is more expensive than in most other European countries. Belgium also has one of the highest population densities in Europe (World Bank 2017). Even so, it is technically possible for Belgium to switch to 100% renewable energy by 2050 (VITO et al. 2013). In the VITO study,

offshore wind (with a realistic potential of 8 GW installed in the Belgian exclusive economic zone of the North Sea), onshore wind (with a theoretical potential of 20 GW installed), and PV (with a theoretical potential of 50 GW, assuming 250 km^2 of available rooftop surface) have the highest potentials among renewable energy sources.

Composition of the Energy Mix

Belgium's total primary energy supply (TPES) was 53.3 million tonnes of oil equivalent (Mtoe) in 2015. Energy supply peaked at 60.4 Mtoe in 2010, after consistently growing for over 25 years. From 2010 to 2015, TPES declined by 11.8% (Fig. 1). Fossil fuels accounted for 77.9% of TPES in 2015, including oil (44.6%), natural gas (27.1%), and coal (6.2%). Nuclear power accounted for 13.2% of TPES and renewables for 8.9%. Renewables are mainly made up of biofuels and waste (6.8%), followed at a distance by geothermal, wind and solar (2%), and a negligible share of hydro (0.1%).

In the electricity mix (Fig. 2), nuclear energy is Belgium's primary source. In 1975, Doel 1 and 2 and Tihange 1 started to generate commercial power. Between 1982 and 1985, four additional plants were commissioned. Since 1984, nuclear electricity has covered more than 50% of total production (with a peak of 68% in 1986). From the end of the 1980s, following the de facto moratorium on new investments in nuclear (the initial rejection of the proposed construction of the Doel 5 unit in the 1988 capacity plan due to reasons explained earlier was extended



Source: IEA (2017a).

Fig. 1 Belgium's total primary energy supply, 1971–2015. (Source: IEA 2017a)

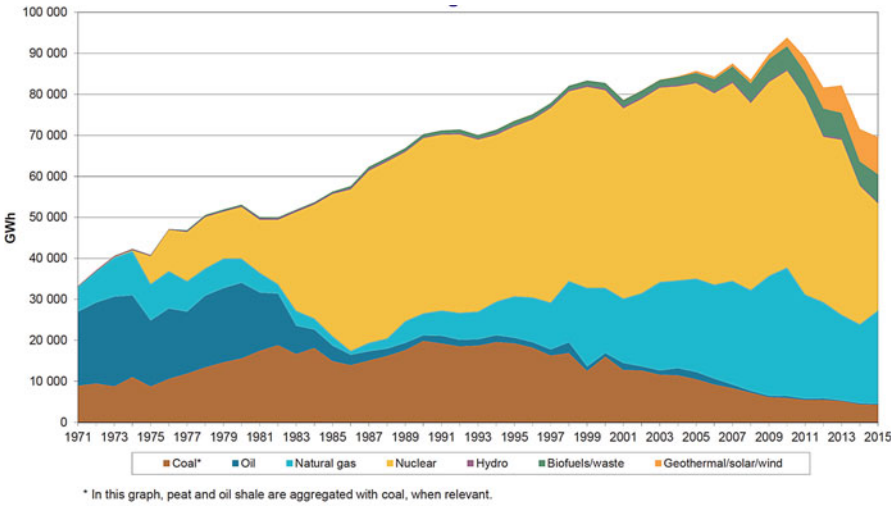


Fig. 2 Belgium's electricity generation by fuel, 1971–2015. (Source: IEA 2017a)

by subsequent governments), this proportion has progressively declined, to around 55% during the 2000s.

The share of coal has seen a steady decline, since its final top in 1994 at 27% of the country's electricity generation (IEA 2017a). By closing the last coal-fired plant in Langerlo in April 2016, the once coal-dependent Belgium effectively phased out coal for power generation.

Natural gas was squeezed out of the electricity mix in the 1980s due to the rise of nuclear and European restrictions on gas use in power generation, due to (unfounded) fears about the exhaustion of supplies (EEC 1975). Those restrictions were lifted in 1991 (EEC 1991). Some years before, the Combined Cycle Gas Turbine (CCGT) was introduced with conversion efficiencies beyond 55%. Since then, gas-fired power generation increased to a peak of 31.4 terawatt-hours/year (TWh) in 2010 (33.5% of the total). Afterwards, gas use in electricity generation has fallen to 27.4%, as imports from other countries (partly from new coal power) and wind and solar powers have gained ground (IEA 2016).

Discourse on Energy Issues

Since the early 1970s, Belgium's overall energy policy has focused on security of supply based on diversification of geographical sources and fuels, energy efficiency, transparent and competitive energy prices, and environmental protection (IEA 2001, p. 20). Currently, the federal government has adopted the "triple bottom line" discourse on sustainable development, indicating that it wants to reconcile the three goals of energy security, cost competitiveness, and a low environmental

impact. Regarding the latter, Belgium adheres to the EU climate policy agenda of moving toward a low-carbon economy in 2050. However, the inter-federal "energy pact" signed in March 2018 only contains shopping lists of policies and measures (Belgian Federal Government 2018). It however lacks a clear implementation strategy for reaching the ambitious goal of lowering GHG emissions by 80–95% in 2050 compared to 1990 levels. Concerns regarding cost competitiveness are dealt with in a much more concrete way. In particular, the government of Prime Minister Michel, in office since 2014, wants to ensure that Belgian energy prices remain competitive with prices of neighboring countries. Also, the present government pledged that all nuclear power plants would stop running by 2025. Hence, the Michel government seeks to improve the overall energy market investment climate for the construction of baseload capacity and sees demand-side management and interconnections with neighboring countries as clear priorities (Belgian Federal Government 2014b).

Energy security was long the dominant frame in energy policy, with politicians emphasizing and supporting domestic sources of energy. In the immediate aftermath of the World War II, Europe faced a significant shortage of coal that threatened economic recovery. In contrast to the French, German, and Dutch mines, the Belgian coal pits were not severely damaged during World War II. The shortage in mineworkers was relieved by immigration, mostly from Italy – some 75.000 Italians went to work in the Belgian collieries between June 1946 and December 1949 (Leboutte 2005).

In 1962, the Belgian government presented its first energy plan to parliament. The Minister of Economic Affairs emphasized that energy sources had to be selected in consultation with the industry. The plan contained preparatory studies for the construction of four nuclear reactors. In 1962, Westinghouse granted a license to build its pressurized water reactor to the SGB. The view that Belgium should develop a comprehensive nuclear future was largely shared. In the postwar period, nuclear energy captured the lion share of the energy R&D budget in Belgium, typically more than 85% every year (see Fig. 3).

Concerns over competitiveness also informed Belgian energy policy. Low-priced oil (and gas) substituted for coal during the 1960s. Starting from the 1960s, Belgian coal mines were progressively closed down. Initially, this led to heavy contestation and protest by the miners threatened with naked layoffs. For instance, in 1966 a demonstration of miners of the Zwartberg site (in the city of Genk) led to a violent confrontation with the gendarmerie resulting in two deaths and several severe injuries. Over the years, conflicts were progressively pacified. On the one hand, alternative employment plans and favorable dismissal agreements for the employees of the coal mines were developed. On the other, the Belgian government agreed to participate in the management of coal mines (e.g., through the NV Kempense Steenkoolmijnen), compensating for financial losses with taxpayers' money. The 1973 oil price shock affected Belgium harder than its trade partners due to the heavy overall dependence on oil imports and the energy-intensive nature of many Belgian industries. After the crisis year 1975, the government combated the recession by an

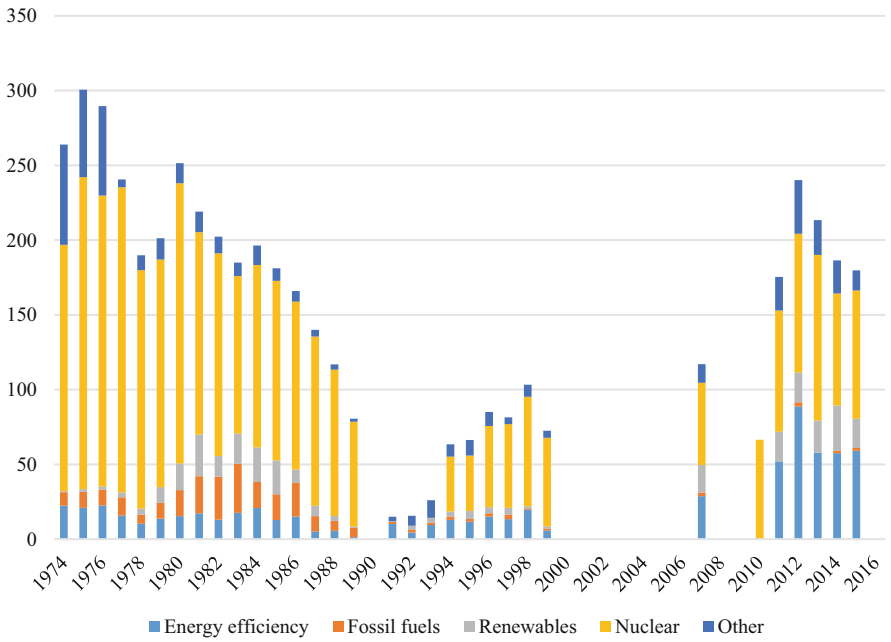


Fig. 3 Belgium's energy-related RD&D budget, 1974–2015. (Source: IEA 2017b. Notes: "Other" includes hydrogen and fuel cells, other power and storage technologies, and cross-cutting technologies. Data are missing for 1990, 2000–2006, and 2008–2009)

expansionary budgetary Keynesian policy, causing excessive government deficits, still plaguing subsequent governments to date.

The oil price crisis put security of supply on top of the energy agenda. In 1974–1975, the first three nuclear reactors were commissioned. This was important since oil had become the most important source of electricity generation (Fig. 2). In 1974, the industry got approval from the government to build two twins of nuclear reactors (of 900/1000 MW capacity). In the context of the oil crisis, nuclear was touted as a means to diversify away from the OPEC countries. Yet, the 1970s also marked the start of a public debate on nuclear energy. A small but vocal set of antinuclear activist groups began to emerge (REM-U-235, VAKS, and others), opposed to the nuclear plants (Laes et al. 2007b).

The antinuclear movement was strengthened by the Three Mile Island accident (1979) and Chernobyl catastrophe (1986). It took a local scandal with regard to the management of nuclear waste, the 1987 Transnuklear scandal, before the ecological sustainability frame would come to effectively influence the energy debate. The scandal involved illegalities in the transport of radioactive waste to and from West Germany and the reprocessing center at Mol in Belgium. A critical attitude to nuclear gradually spread to political parties other than the Green parties (the Flemish socialist party was the first to follow), and trade unions turned more critical to the

nuclear option (Laes et al. 2007b, p. 73). The scandal also made nuclear waste management part and parcel of the energy debate.

Political Institutions and Actors

Belgium is a federal state consisting of three communities (the Flemish, French-speaking, and German-speaking communities) and three regions (Flanders, Wallonia, and Brussels). The current institutional setup is the fruit of successive rounds of state reform since the 1970s, which have transformed Belgium from a unitary into a federal state. These reforms have created a heterogeneous and intricate allocation of competences between the federal government and the three regions. National legislative acts no longer have precedence over regional and community acts. Conflicts have to be decided by the Arbitration Court. EU directives are transposed by the national level or by the regional level, depending on their competences over the directives' substance.

Table 1 depicts the division of energy competences since January 2014, after the sixth phase of state reform. In principle, the federal level is responsible for those matters that require a national approach due to their technical or economical indivisibility (Special Law of 8 August 1980). For example, the federal government is responsible for large infrastructure for energy storage (e.g., the LNG terminal in Zeebrugge or the natural gas storage facility in Loenhout), transport (electricity grid >70 kV, oil and gas transport pipelines), and production (power plants >25 MW, oil refineries) (Vandendriessche 2017). The responsibility for renewable energy was transferred to the regions in 1988 (Law of 8 August 1988), except for offshore wind turbines (the North Sea is federal land), tariffs, and electricity transport, all of which remain federal competences. Since 1993, the regions have been granted residual competences over energy (Special Law of 16 July 1993), which means that all issues that are not formally attributed to the federal authorities fall under the competence of the regions. The result is a very heterogeneous division of competences.

Table 1 Division of competences for energy policy in Belgium

Federal responsibilities	Regional responsibilities
National indicative studies about security of supply	Regulation of gas and electricity retail markets
The nuclear fuel cycle and related research and development (R&D) programs	Distribution of electricity (electricity grid <70 kV) and natural gas, including distribution tariffs
Large infrastructures for the storage, transport, and production of energy	District heating equipment and networks
Transport tariffs and prices	Renewable sources of energy (except offshore wind energy)
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 coal-bed methane and blast furnace gas

Source: Adapted from IEA (2016, pp. 22–23)

Energy policy is further splintered horizontally. At the federal level, for example, there are separate ministries for energy, environment, and transport. The federal authority over offshore wind energy in the North Sea, in the current administration, is shared between a federal minister (Marie-Christine Marghem, French-speaking liberals MR) and a state secretary for the North Sea (Philippe De Backer, Flemish liberals Open VLD). There is a federal energy regulator, the Commission for the Regulation of Electricity and Gas (CREG), but 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'Energie (CWaPE); and, in Brussels-Capital, the Brugel. In addition, municipalities have a legal monopoly on electricity and gas distribution. Nearly all transferred the distribution of electricity and gas to inter-municipal companies, so-called intercommunales (IEA 2016).

The Belgian state has, in general, not chosen to pursue its energy policy through the ownership and control of firms. It did not nationalize its electricity sector in the immediate postwar period, as was done in Italy, France, and the United Kingdom (Hens and Solar 1999). Instead, Belgium chose a corporatist structure: the production of electricity and gas remained mostly in the hands of private companies. In 1955, the Federation of Belgian Enterprises (FBE) and the three official trade unions (Christian, Socialist, and Liberal with their respective links to the three then major political parties) set up in conciliation with the SGB a private regulatory body, the Control Committee for Electricity, in 1966 adding Gas (CCEG). Given the balance of power and know-how, the electricity and gas industry essentially regulated itself. The mission of the CCEG was to increase the productivity of electricity production, transport, and distribution and to allocate the benefits among the participants. SGB and its engineering contractor Tractebel fully succeeded in streamlining the activities in a strategically planned way. In the 1960s, an internally competitive dispatching system was deployed, ahead of most power systems in the world. Gold plating and overemployment were avoided. The large benefits were shared among the participants: industrial companies benefitted from low high-voltage electricity prices, trade unions were satisfied since sector personnel enjoyed some of the best salaries and working conditions in the national economy, while SGB and Tractebel were guaranteed high profit rates. The low-voltage consumers delivered the necessary cash to feed the system. Independent consumer interest organizations were excluded from the CCEG, because trade unions listed their members also as members of their in-house consumer branches. This system survived beyond the Belgian liberalization law of 1999, imposed by the European directives.

The public power generators (joined in SPE since 1978) and public distribution utilities (joined in Interregies) served the market fringe of power generation (about 5%) and distribution (about 20%). Squeezed by the oil price crisis of 1979, SPE avoided bankruptcy by adsorption to the private power sector organizations. Socialist minister Willy Claes negotiated this "Pax Electrica" of 1981. SPE took participations in the Belgian nuclear plants commissioned in the 1980s and in Chooz B1 and B2. The management committee of the electricity sector (BCEO-CGEE) had a private-public membership but clearly dominated by Tractebel. Via BCEO-CGEE

the SGB-Tractebel-Electrabel concentration reigned the CCEG: it financed the secretariat of the CCEG, also housed in Electrabel's headquarters (Verbruggen and Vanderstappen 1999).

Coordination, Instruments, and Issues of Belgium's Energy Transition

Drivers of Energy Transition

The drivers for energy policy change in Belgium appear to be mainly external and more specifically related to EU policies. The European directives on the liberalization of electricity (1996) and natural gas (1998) markets led to the first major legislative innovation in energy policy Belgium since the Electricity Act of 1925 and the Natural Gas Act of 1965. The electricity markets were entirely opened in all regions by January 2007. Yet, Electrabel, the historical incumbent, still held 66% of generating capacity in Belgium in 2014, although this share declined from 85% in 2007 (IEA 2016, p. 101).

One of the major drivers which helped to shape (the start of) the low-carbon energy transition in Belgium has been the EU Directive on Electricity Production from Renewable Energy Sources 2001/77/EC, promoting renewable energy use in electricity generation. Directive 2001/77/EC was transposed at the regional levels in Belgium and, from 2002 onwards, it opened the way to government support for renewable energies. The 2001 Renewable Energy Directive was replaced by a new version (directive 2009/28/EC), with more challenging national targets for renewable energy production. Belgium has a binding national target for renewable energy to equal 13% of gross final consumption of energy by 2020, including a separate binding national target for renewable energy to cover 10% of transport fuel demand in 2020. The responsibility for meeting the national 2020 target is shared between the regions and the federal authority. Due to Belgium's institutional structure, it took 6 years to reach a political agreement regarding the federal and regional contributions to the 2020 target (IEA 2016).

The drivers of the nuclear phaseout are both internal and external. The optimistic view on nuclear energy crumbled in the first half of the 1970s, during a conflict on siting the first NPP at the Belgian coast, leading to local protest. Hence, a moratorium was called in 1976 until the issue would be settled by a decision of parliament. This moratorium was in effect for 6 years. No decisions were taken to build new nuclear plants in Belgium. The only nuclear expansion occurred in 1984, when Electrabel and SPE together took a 25% share in the two new 1450 MW NPPs in Chooz, just across the Belgian border in France. In return, the French companies were allowed to take a 50% share in the construction of the proposed new NPP (Doel 5) in Belgium. The Chernobyl disaster in 1986, the abundance of contracted natural gas imports with the introduction of highly efficient CCGT plants and a lower-than-foreseen increase in electricity demand, led again to a moratorium in 1988 for new NPPs in Belgium.

Strategies and Instruments of Energy Transitions

Nuclear Phaseout

The political attitude toward nuclear electricity production changed in the aftermath of the federal elections in June 1999. Even though the environmental grassroots movements of the 1970s and 1980s were rather weak, they were the basis of the Green parties emerging at the end of the 1980s. Participation of the green parties AGALEV and ECOLO in the Blue-Red-Green coalition Verhofstadt I (1999–2003) was a decisive factor in phasing out nuclear power in Belgium. In January 2003, this component of the coalition agreement was transposed into Belgian law. The law included a "force majeure" clause, which stipulated a conditional invalidity in case unforeseen events beyond the control of Belgian policy-makers (e.g., international crises) threatened the security of electricity supply (Law of 31 January 2003, art. 9). The introduction of this "force majeure" clause effectively implied that upcoming governments would have discretionary power over how to enforce the law. Upcoming governments could extend the lifetime of the NPPs if the energy security of the country was threatened or if the production cost for electricity would become instable. This started a period of prolonged tergiversations on the fate of the nuclear phaseout.

By the end of the 1990s and after enacting the phaseout law in 2003, nuclear proponents deployed many initiatives to bring nuclear back on the agenda. The (media) campaigns by the Nuclear Forum painted gloomy pictures of future energy shortages, and even though the nuclear phaseout agenda was confirmed by the new government agreement of 2004, various political parties (the Flemish Christian-democratic party CD&V and its Francophone counterpart CDH, the Flemish nationalist party N-VA and the extreme right-wing Flemish party Vlaams Belang) continued to argue for postponing the shutdown of the three oldest NPPs. Expert study groups recommended to maintain nuclear power generation (e.g., the GEMIX study of 2009). The Van Rompuy Government (30 December 2008–15 November 2009) signed an agreement with GDF Suez, the parent company of the main Belgian electricity producer Electrabel, under which the three oldest reactors could stay open for a further decade in return for an annual contribution to the federal treasury. The charge was intended to reflect the extra revenue that the company would receive from being allowed to operate the depreciated reactors for longer than planned. The 2009 nuclear deal was tightly linked to the national budget issue, in the context of the banking and economic crisis. However, the agreement never became law because Van Rompuy left Belgian politics for the EU Presidency, and the government was dissolved before the necessary legislation was approved by the federal parliament.

When the next government led by Di Rupo took office in late 2011, the phaseout law of 2003 was still in place. The state secretary for energy, Melchior Wathelet, drew up a new energy plan in June 2012 (the "plan Wathelet"), which involved a compromise. The plan would shut down Doel 1 and Doel 2 in 2015, in accordance with the phaseout law of 2003, and keep Tihange 1 open for an additional 10 years (until 2025). The plan was voted into law in December 2013 (Law of 18 December 2013).

Table 2 Nuclear power plants in Belgium

Unit	Net capacity	Date of commissioning	Projected shutdown			
			2003 phaseout law	2009 agreement	Plan Wathelet (2013)	Law on life extension (2015)
Doel 1	433 MW	15 February 1975	2015	2025	2015	2025
Tihange 1	962 MW	1 October 1975	2015	2025	2025	2025
Doel 2	433 MW	1 December 1975	2015	2025	2015	2025
Doel 3	1.006 MW	1 October 1982	2022	2022	2022	2022
Tihange 2	1.008 MW	1 June 1983	2023	2023	2023	2023
Doel 4	1.033 MW	1 July 1985	2025	2025	2025	2025
Tihange 3	1.038 MW	1 September 1985	2025	2025	2025	2025

Source: Author's compilation based on the website of the Federal Agency for Nuclear Control (FANC), and the respective laws and agreements named in the table

Soon after release of the plan Wathelet, several units experienced unplanned and prolonged shutdowns. In the summer of 2012, Doel 3 and Tihange 2 were taken offline because of widening cracks in their pressure vessels. The fault indications consisted of hydrogen flakes. The two units restarted in June 2013, but shut down again in March 2014 after the operator had performed additional tests requesting more investigations. Finally, after an international peer review by experts, the two units resumed operation in December 2015. In addition, Doel 4 automatically shut down in August 2014, because release of cooling oil of the turbine axis into an underground storage tank caused wrecking of the steam turbine. By now, a univocal explanation of the accident is missing. Doel 4 was offline until December 2014. Doel 1 was shut down in February 2015, in accordance with the phaseout legislation of 2003, only to be restarted in December 2015. All in all, for almost 5 months in 2014 and most of 2015, around half the nuclear capacity in Belgium had been offline (IEA 2016, p. 131),

The government extended the operational lifetime of Doel 1 and Doel 2 by 10 years in a new law of June 2015 (Law of 28 June 2015). Hence, according to present policy, the nuclear phase out will be implemented in the period 2022–2025 (Table 2). In the context of the "federal energy pact," lobbying for a prolonged nuclear future continues. For example, the federations of electricity-intensive industries (Febeliec), technology companies (Agoria), and chemical industries (Essenscia) insist to keep Doel 4 and Tihange 3 operational for at least 10 years after 2025 (Agoria, Essenscia and Febeliec 2017). This standpoint receives backing from the N-VA, currently the largest political party in Belgium, who pleads on its website for a "realistic exit from nuclear, by 2065 at the latest" (N-VA 2018).

Renewable Electricity

Electricity generation from renewable installations on land is promoted by the three regions and from offshore installations by the federal state. In 2000, Flanders adopted the early (but, ultimately defeated) proposals of the European Commission on market-based instrument (Bollen et al. 2011). For supporting RE a tradable green

certificate (TGC) system was set up. Flemish politicians expected lean governance because the market would take over, and they were happy to skip negotiations with the federal government, which were necessary in case a price-based feed-in tariff (FIT) support (like Germany) was installed. TGC is an artificial market creation (comparable to the ETS), with green power quota obligations for electricity suppliers, rewarding one certificate per MWh generated power, classified as green by the EU. All green power sources were treated equally, because of an entrenched belief that "the market should select the technologies, not the government." Hence, the cheap but dubious sources (like domestic refuse incineration, imported bioenergy–palm oil–combustion) prevailed, cashing significant rents and windfall (excess) profits. About 2/3 of the Flemish certificate money flows over the period [2002–2007] were excess profits and rents (Verbruggen 2009). The cost of photovoltaic (PV) power was higher than the certificate ceiling price at €125/MWh. Only few PV was installed with significant investment subsidies and an exceptional €150/MWh premium during 10 years paid by the transmission system operator ELIA.

In 2006, Flanders juxtaposed a premium support for PV at €450/MWh during 20 years (i.e., the German FIT level at that time) alongside the TGC system. Because Belgian policy-makers did not adapt this (already in 2006 too high) premium value in the years after 2007, when PV costs declined continuously and significantly, a rush on PV (mostly by above average income households) quickly accumulated high financial burdens on the electricity bills of all households. Moreover, the occasioned cash drain was charged relatively more on mostly poorer households, subsidizing the richer ones. The €450MWh premium remained until January 1, 2010. Three years too late, the premiums were stepwise reduced, to €350 for 2010, from €330 to €270 in 2011, and from €250 to €90 in 2012, to finish all support for PV $<$ 10 kW in mid-2015. But in the years of excessive premium support, a large financial load until 2030 has been accumulated. In 2016, the new minister introduced a flat €100 tax per low-voltage connection; in 2017, the next new minister reduced it back to about €9, partly because two big biomass projects were cancelled. On all installed small-scale PV units with net metering, a new capacity levy was imposed differing a bit by the area where the unit is sited; in 2018 the capacity levy boils down to about €110/MWh generated solar power levy.

The other regions also set up certificate systems, different from the Flemish one, on quota obligations, granting green certificates, technology-specific support levels, calculation of minimum price levels, and duration of support and tradability. None of the TGC systems delivered in pushing technological development of renewable energy systems. For reaching the quota, too much money was drained from low-voltage consumers to feed rent skimming. More and more certificates were interpreted as direct premium support for particular projects (wind turbines, biomass conversion plants, small hydro). There is no industrial and technological innovation framework to select the most suitable and promising technologies for Belgium or its regions. Flanders has now adopted for the non-small PV renewable power projects a nongeneric regulation. Every new project (also MW-size PV fields) is financially appraised taking into account sector- and company-specific parameters. The support (still under the name of certificate) is adapted per project to make it pass the financial

acceptance hurdle typical for the case at hand. This regulation "à la tête du client" contradicts basic principles of sound regulation.

At the federal level, large-scale offshore wind projects are assigned premium support in €/MWh generated. Belgium was generous for the winners of the tenders. At the end of October 2017, some of the earlier promised support for three North Sea wind parks was reduced from €125/MWh to €79/MWh. Although the Belgian ministers touted a benefit of €3.9 billion for the electricity consumers, the remaining support is still excessive compared with practices in other countries bordering the West and North coasts of the European continent.

The many systems have put Belgium on track to achieve its 2020 renewable electricity targets. This likely achievement is paired to high financial flows: the years of running TGC systems according to textbook prescriptions generated significant excess profits for mature and dubiously green technologies (Verbruggen 2009; Bollen et al. 2011). The bills were footed to low-voltage electricity consumers. Along the rents for non-PV technologies, assignment of excessive premiums during 20 years to PV-projects in the period [2008–2010] piled billions of euro transfers across household consumers. The IEA (2016, p. 123) estimates that the support costs for renewable electricity in Belgium 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) (IEA 2016, p. 123). 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.

Heat Production

Belgium has several types of support policies for renewable heat projects. At the federal level, tax deduction for companies are foreseen concerning investments in solar collector systems and heat pumps. The regions hold legal competences for renewable heat policy and offer tax deductions to households. Especially relevant are the policies for almost energy-neutral buildings which stimulate the uptake of heating technologies using renewable energy. For instance, new buildings in the Flemish region must cover a certain share of their energy use from renewable sources since January 2014. 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.

Other policy instruments include calls for tenders for renewable heating projects. The Flemish region organizes these tenders twice a year for projects that produce renewable heat and for developing district heating from renewable sources or waste heat. Ambitions regarding district heating using renewables or waste are also high. Projects for the equivalent of 50.000 households are planned, and the Flemish distribution network company Fluvius has established "warmte@Vlaanderen" (heating company Flanders). This company is authorized to set up, control, and manage the entire chain of delivery for district heating projects, covering production, distribution, and delivery of heat as well as the construction and management of the infrastructure. Participation of other partners on a project basis is possible. Feasibility appraisals of large-scale district heating networks for the cities of Antwerp,

Ghent, Louvain, and Brussels were made between 1976 and 1984, but all were shelved immediately after publication. The surplus in natural gas import contracts, the extended gas networks, and the peculiar scattered urban settlements made and make the feasibility of district heating in Belgium precarious.

Energy Efficiency

Belgium's energy intensity remains above the EU-28 average. Energy efficiency is a regional competence in Belgium, and the regions are responsible for implementing measures and monitoring progress. Belgium's energy efficiency policy is mostly driven by EU requirements and targets. A review of Belgium's energy efficiency policies in the 1990s found that these policies were "either absent or implemented with large compliance deficits" (Fraunhofer Institute et al. 2003, p. 3). In accordance with EU directives, Belgium has set itself targets for energy savings in sectors not covered in the ETS of −18% by 2020 (Belgian Federal Government 2014a). According to the European Commission, if the trend in primary energy consumption from 2005 to 2013 continues up to 2020, Belgium may not meet its national target for 2020 (European Commission 2015).

According to the National Energy Efficiency Action Plan (NEEAP), submitted to the European Commission in 2014, the regions have, each for its own territory, implemented the "Energy Performance in Buildings" directive (Directive 2010/31/EU); promoted further energy efficiency by households and tertiary buildings through grants, compulsory audit schemes, awareness-raising programs, etc.; fostered energy savings in industry by signing voluntary agreements with industry (Flanders, Wallonia); implemented mobility measures; and promoted renewable energies and cogeneration by setting up green and combined heat and power (CHP) certificates systems (Altdorfer and Baillot 2015).

Transport is one of the main energy-consuming sectors in Belgium and represents about a quarter of the overall energy consumption. Historically, it has been difficult to uncouple strong economic growth and transport demand. With a 23% increase of GHG emissions between 1990 and 2015, together with the commercial sector it has been responsible for a 6.2% rise in Belgian emissions (offset by decreases in other sectors) (National Climate Commission 2017). These trends also demonstrate that new technologies which serve in boosting vehicle fuel efficiency are not being developed fast enough at the moment to offset the rise in energy consumption linked to increased road traffic. E-mobility is still marginal, though on the rise. At the end of 2017, about 6500 fully electric vehicles were registered (representing 0.15% of the total car stock).

Coordination Mechanisms and Multilevel Governance

The fragmentation of authority over the federal and regional levels (section "Political Institutions and Actors") has created the need for coordination. The energy policy coordination platform ENOVER/CONCERE began operating in 1992. It is a consultative body where administrations and cabinets from the regional and federal level

meet to strengthen the cooperation on energy matters between the different levels and sort out potential frictions. Plenary sessions are held monthly and working groups by sector have been created. Other relevant federal-regional coordination bodies include the Coordination Committee for International Environmental Policy (CCIEP), which has a working group on climate change, and the National Climate Commission (NCC) (IEA 2016, p. 24).

Belgium does not have a national climate policy. Rather, the federal government and the three regions each develop and implement their own climate policies in accordance with their respective competences. The necessity of dividing the Kyoto targets within Belgium was due to the fact that the regions are competent for industry and thus were responsible for the allocation of GHG emission allowances to industrial companies under the European Emissions Trading System (Happaerts 2015). After the conclusion of the first EU burden sharing agreement (Council of the EU 2002), assigning Belgium a reduction obligation of −7.5% over the period 2008–2012 (compared to 1990), much time and effort was invested in setting up intergovernmental cooperation mechanisms. The negotiations for an intra-Belgian burden sharing agreement first took place within ad hoc administrative and inter-cabinet working groups and eventually within the Interministerial Conference on the Environment (Happaerts 2015). Due to the fact that no government can ever be forced to participate in intergovernmental negotiations in Belgium (a consequence of the "principle of no hierarchy," meaning that the federal government cannot impose anything that falls within the competences of the regions), voluntary cooperation and negotiation are the only leverage for intergovernmental relations in Belgium. Applied to climate policy, this means that the regions negotiate on the GHG reduction targets they want to commit to, while the federal government fills the remaining emission reduction gap with policy measures related to its competences and by applying flexible mechanisms.

The coalition agreement of the Di Rupo Government (December 2011) marked a considerable shift in climate policy negotiation dynamics. The coalition agreement was accompanied by an institutional agreement for a new Belgian state reform, which shifted a number of competences and responsibilities to the subnational level, including some taxation instruments with an impact on climate policy, such as tax breaks for energy-saving investments. Moreover, many of the measures that the federal government had previously undertaken for climate change were abruptly abolished by the coalition agreement due to the need for budget cuts (Happaerts 2015). Belgian climate governance thus became even more dependent on regional decision making, leading to difficult negotiation dynamics between regional governments with often different ideological positions and different economic backgrounds. The protracted negotiations on a post-2012 National Climate Plan, which was only finalized just before the start of the COP21 meeting in Paris in December 2015, serve as an illustration. Overall, Happaerts (2015) concludes that the Belgian context gives each government a set of reasons that motivate why more efforts should actually be done by the other regions, and it entails no leverage to force the subnational governments into a more ambitious role. Belgian climate policy is thus characterized by inertia, both domestically and on the international stage.

Outcomes, Challenges, and Prospects of Energy Governance in Belgium

Belgian energy governance faces multiple challenges in the context of the transition to a low-carbon economy by 2050:

- Switching the electricity production system to an (almost) 100% renewable energy supply
- Decarbonizing the low-temperature heat supply for the built environment, which is currently dominated by fossil fuels, with gas as most used
- Decarbonizing industrial energy use, while Belgium hosts many energy-intensive industrial activities (e.g., iron and steel production, refineries, chemical industry) with a high economic importance for the country, and which are exposed to competition in international markets
- Decarbonizing the transport sector, while Belgium houses several logistic hubs in the dense crossings of European and international transport links

Belgium's performance toward meeting the EU's 2020 goals for renewable energy, energy efficiency, and emissions reductions is weak. The country is unlikely to meet its (non-binding) energy efficiency target, while significant additional efforts are needed for meeting its renewables target (+13%) and its greenhouse gas emissions reduction target (−15%). Ill-designed support programs for renewables through a dysfunctional tradable certificate system (Verbruggen 2009; El Kasmioui et al. 2015) and overly, generous support for solar PV when the investment costs declined fast after 2007 overcompensate the investors. The spending is charged on low-voltage customers (i.e., households and small and medium enterprises), hitting also poor customers. To avoid excessive burdens on the customers, the distribution network utilities were forced to hoard high-priced certificates. When in 2012–2014 the support for PV was adapted to the real cost of the PV technology, the installation pace slowed down, showing the lack of a solid policy for enabling the transition to renewable energy supplies. Since 2017, the PV market is recovering at a slow pace.

Energy governance in Belgium is characterized by a lack of a strategic and coherent vision. The main drivers of policy initiatives are European directives and international agreements. The latest IEA country review report stated plainly: "Belgium does not have a national energy strategy" (IEA 2016, p. 26). The only exception is the nuclear phaseout, first enacted into law in 2003, but this decision has been subject to multiple policy reversals over time (section "Nuclear Phase-Out"). It has also made the quest for a vision on the country's future energy mix much more urgent.

A major part of the explanation for Belgium's weak performance is the dominant role of energy corporates in the Belgian energy sector. Before 1989 it was the SGB holding with Tractebel and its power and gas companies. Since 1989 the strategy of the French corporates ENGIE and EDF prevail. The conflicting interests of private corporates and of public welfare caused splintered competences between the regions and the federal level. This may create deadlocks, as illustrated by the ardent and

protracted negotiations on a post-2012 National Climate Plan, which was only finalized just before the start of the COP21 meeting in Paris in December 2015. Clearly, an overarching energy vision could help to overcome the divides between the various authorities while making Belgium fit for a more sustainable future. In 2018, the Belgian federal and regional governments concluded an "Energy Pact" covering the general strategic directions and goals of energy transition policy in the coming decades (Belgian Federal Government 2018). As such, the "Energy Pact" mainly sets out the governments' intentions and does not include any details on the policies and measures to be implemented in light of the ambitious transition goals. One of the most contentious issues in the immediate run-up to the conclusion of the pact was the planned nuclear phaseout. The political party N-VA was in favor of keeping open a nuclear capacity of 2GW after 2025. In the end, the closure dates as foreseen in the law (cf. Table 2) were maintained in the final approved version of the Energy Pact, but political tensions are likely to resurface with federal elections coming up in 2019.

Cross-References

- ▶ Energy Governance in France
- ▶ Energy Governance in Germany
- ▶ Energy Governance in Italy
- ▶ Energy Governance in the United Kingdom

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