PART II

Chapter 4

Energy transition: Towards a low-carbon economy

This chapter examines the progress made by France in integrating energy and environmental policies. It analyses changes made to the strategic, institutional and legislative framework in order to meet national and supranational energy and climate targets, and presents the 2015 Energy Transition for Green Growth Act. It highlights changes in energy supply and demand and the main environmental impacts thereof, especially in terms of greenhouse gases and atmospheric pollutants. The chapter also analyses the effectiveness of measures designed to promote renewable energy and energy efficiency, the cost of support schemes and the importance of integrating European networks. Measures to fight against energy poverty are also covered.

1. Strategic and institutional framework for energy and environmental policy

France has, for the last ten years, been on the path to an energy transition that places the environment at the heart of energy policy. In line with the country's international and European energy and climate objectives, this process led to the adoption in August 2015 of the Energy Transition for Green Growth Act (Energy Transition Act), designed to pave the way to an economy that is less reliant on fossil fuels and to set up a new, more sustainable, energy model in response to the energy supply challenge, price trends, the depletion of resources, the need to protect the environment, and above all climate change. The energy transition's objectives are not only environmental, but also economic and social: job creation, the development of green industries that drive growth, the preservation of business competitiveness and the fight against energy poverty.

The implementation of this new model has come up against barriers raised by the current energy model, which is largely based on nuclear power. It is also governed by a relatively complex legislative and institutional framework, with overlapping remits at the various regional levels – France's famously multi-layered administration – and which, until the adoption of the Energy Transition Act, housed a plethora of legal texts and industry objectives with differing deadlines, making it hard to co-ordinate and track progress on energy and climate.

France's ability to reach the environmental, social and economic objectives it has set itself will therefore depend on consistency between the many political and regulatory signals sent to the various economic parties involved in the energy sector and in tax, investment, innovation, municipalities, transport and construction. For a discussion of energy and transport taxes, investment in sustainable modes of transport and steps to promote green innovation, see Chapter 3.

Increased integration of energy and environmental objectives

Increased energy self-sufficiency and economic competitiveness remain the foremost goals of energy policy.[1] The fight against climate change was declared a national priority in 2001, however, and was included alongside the preservation of human health and the environment in the objectives of the POPE Act of 2005 setting the direction of energy policy. This Act set quantitative targets for energy efficiency and the reduction of greenhouse gases (GHGs), including the so-called factor 4, which aims to cut GHG emissions by a factor of four between 1990 and 2050 (see Table 4.1).

France has supplemented its European responsibilities in terms of energy efficiency, the reduction of GHGs and promotion of renewable energy sources (the European Union [EU] energy and climate package adopted in 2008 under the French presidency of the EU) with national sectoral targets for the reduction of GHGs and energy consumption, set by the Grenelle laws of 2009 and 2010 (see Chapter 2). Table 4.1 presents the energy and climate policy targets. Although it demonstrates France's ambition in this field, the multiplicity of sectoral targets with varying timeframes, and overlapping measures do not

Table 4.1. **Main goals of energy and climate policy**

International objectives		
Greenhouse gases (GHG)	Kyoto Protocol (in force since 2005)	First period (2008-12): stabilisation of the main GHGs (CO_2, CH_4, HFC, PFC, N_2O, SF_6) between 2008 and 2012 compared to 1990 levels. Second period (2013-20): contribution to the quantitative target of reducing GHG emissions by 20% on average in the EU compared to 1990 (quantified emission limitation and reduction objectives-QELRO).
	Intended Nationally Determined Contribution (INDC)	The EU's INDC consists of reducing internal GHG emissions by at least 40% compared to 1990 by 2030, with a long-term goal of an 80 to 95% reduction from their 1990 levels by 2050.
National objectives		
	Law setting the direction of energy policy (POPE Act, 2005) Energy savings commitments: system of energy savings certificates (ESCs) (articles 14 to 17 of the POPE Act)	• cutting GHG emissions by a factor of four (75%) from their 1990 levels by 2050. • Final energy intensity: 2% annual decline by 2015 and 2.5% annual decline by 2030. Mandatory energy savings for energy companies, as measured at the end user; volume defined by decree for three-year periods (54 TWh cumac [cumulated and actualised] for 2006-2008, 345 TWh cumac for 2011-2013, a transition year in 2014, and 660 TWh cumac for 2015-2017.
Energy and climate	Directives 2009/29/EC, 2003/87/EC, 2009/28/EC, 2006/32/EC	**2020 objectives:** • emissions reduction targets from 2005 levels: 21% for European Union Emission Trading Scheme (EU ETS) sectors, 14% for non EU ETS sectors (i.e. a total reduction of 17% in GHG emissions compared to 1990). • 20% primary energy savings compared to 2005 levels • 23% of renewable energies in gross final energy consumption
Energy efficiency	National energy efficiency action plan (NEEAP) (in application of directives 2012/27/EU and 2006/32/EC)	**2020 objectives:** • consumption of 131 Mtoe final energy and 236 Mtoe primary energy (excluding international air transport), compared to 155 Mtoe and 260 Mtoe, respectively, in 2013 (representing reductions of 15% and 9%) (2014 NEEAP) • 12 Mtoe targeted energy savings in 2016 at French end users (excluding EU ETS), or 9% of energy savings compared to average final energy consumption between 2001 and 2005 (2008 and 2011 NEEAPs)
Renewable energy sources	National renewable energy action plan (2010 NREAP) (in application of directive 2009/28/EC)	**2020 objectives:** • 27% of gross final electricity consumption produced from renewable sources • 10% of biofuels in transport energy consumption • 33% of renewables in heating and air-conditioning consumption • 50% increase in renewable heating (solar, geothermal)

Table 4.1. **Main goals of energy and climate policy** *(cont.)*

Sectoral objectives		
Buildings	Energy retrofit plan for the home (2013 ERPH)	• 500 000 new homes to be retrofitted by 2017
	Articles 4 and 5 of the Grenelle I Law	**Existing buildings:** • 38% energy savings and 50% reduction in GHG emissions from buildings by 2020 • 400 000 homes retrofitted every year as of 2013 • 40% energy savings in public buildings between 2012 and 2020 • 800 000 social housing units retrofitted, aiming for annual consumption of 150 kWhep/m^2 by 2020 **New buildings:** • General adoption of BBC (energy efficiency) standards (50 kWhep/m^2/year) as of 2010 for public buildings, 2012 for other non-residential buildings, and 2013 for homes (2012 RT) • Energy savings amounting to around 1.15 Mtoe in 2020, generated by the improved energy performance of new buildings. • Positive energy buildings (*bâtiment à énergie positive*-BEPOS) for all new builds as of 2020 (2018 for public buildings).
Transport	Articles 10 to 13 of the Grenelle I Law	• 20% reduction in CO_2 emissions by 2020, back to the level of 1990 • average CO_2 emissions generated by automotive traffic below 120 g CO_2/km by 2020 • development plan for urban public transport: 1 500 km of new tram and bus lines with separate lanes • Non-road and non-air freight 25% by 2022 • 2 000 km of new high-speed lines by 2020 • 2 million electric and hybrid vehicles on the roads by 2020
Renewable energies	Article 19 of the Grenelle I Law	• an additional 20 Mtoe of annual renewable energy production by 2020 • in the overseas départements: 50% of renewable energy in final energy consumption by 2020 (30% for Mayotte) and 100% by 2030
Regional targets		
Regional climate, air quality and energy plan (*Schéma régional climat, air, énergie*-SRCAE) (article 68 of the Grenelle II Law)		Since July 2011, it has been compulsory for regions to have a SRCAE setting targets and priorities for GHG emissions reduction, managing energy demand, the reduction and prevention of atmospheric pollution, leveraging the potential of renewable energies and adapting to climate change.
Regional climate and energy plan (*plan climat-énergie territorial*-PCET) (article 75 of the Grenelle II Law)		A PCET provides a framework for a region's commitment to the fight against climate change, and more particularly its GHG emissions reduction in the light of the "factor 4" drive and the reduction of the region's vulnerability to the effects of climate change. All départements, cities and agglomerations, as well as municipalities and grouped municipalities of over 50 000 inhabitants were required to adopt a PCET by the end of 2012.

Source: ADEME (2015), "Climat, air et énergie : Édition 2014", *Key figures*.

help with assessment and monitoring. This legislative complexity limits the country's ability to steer the energy transition: there is no single comprehensive overview, it is difficult to implement a consistent policy, and policy is hard to assess.

The Energy Transition for Green Growth Act is designed to give France the tools it needs to increase energy self-sufficiency by diversifying its energy sources, and to combat climate change more effectively (see Box 4.1). It sets out all energy and climate targets in a single document. These targets are still numerous and difficult to reconcile, however: reducing the proportion of nuclear power to 50% of electricity production by 2025 while also reducing energy consumption will mean setting clear rules on the lifetime of reactors and wide-scale deployment of renewable energy sources if the GHG emission targets are not to be compromised.

Box 4.1. **The Energy Transition for Green Growth Act**

The Energy Transition Act emerged from the national debate on the energy transition[2] held in 2013 and was enacted in August 2015. It sets out the main goals of the French energy model: to increase energy self-sufficiency while diversifying energy sources and fighting against climate disruption. It also aims to combat unemployment with green growth, to promote new technologies and conquer new markets in renewable energies, clean transport, sustainable construction and energy efficiency, and to improve business competitiveness.

The Conference was broken down into eight main parts:

1. **Defining common goals for the success of the energy transition, increasing France's energy self-sufficiency and economic competitiveness, preserving human health and the environment and fighting climate change**
   - cutting GHG emissions by 40% between 1990 and 2030 (and 75% by 2050);
   - cutting final energy consumption by 50% between 2012 and 2050 (and 20% by 2030);
   - cutting primary consumption of fossil fuels by 30% between 2012 and 2030;
   - increasing renewable energy to 23% of final energy consumption by 2020 and 32% by 2030;
   - diversifying electricity production and cutting the share of nuclear power to 50% by 2025 with installed capacity capped at 63.2 GW.
2. **Improving building renovations to save energy, bringing bills down and creating jobs**
   - energy retrofitting 500 000 homes a year as of 2017, at least half of which will be occupied by low-income households;
   - retrofitting all buildings to BBC standards (*bâtiment basse consommation* – low-consumption buildings) by 2050.
3. **Developing clean transport to improve air quality and protect health**
   - promoting low-emissions vehicles;
   - installing 7 million charge points for electric vehicles by 2030;
   - promoting alternative modes of transport to the private car
   - making more resources available for combating air pollution.
4. **Combating waste and promoting the circular economy: from product design to recycling**
   - increasing material productivity by 30% between 2010 and 2030;
   - cutting household waste and similar products per capita by 10% between 2010 and 2020;

Box 4.1. **The Energy Transition for Green Growth Act** *(cont.)*

- cutting the quantity of non-dangerous, non-inert waste sent to landfill by half between 2010 and 2025, and reaching 65% of material recovery by 2025;
- 70% material recovery from construction waste by 2020.

5. **Promoting renewables to diversify energy sources and leverage regional resources**
   - improving the integration of renewable energies in the grid with new forms of support.
6. **Strengthening nuclear safety and public information**
   - clarifying the operator's responsibilities under the principles of nuclear safety;
   - strengthening the role of the Nuclear Safety Authority (ASN).
7. **Simplifying and clarifying procedures to enhance effectiveness and competitiveness**
   - lifting regulatory brakes;
   - facilitating the development of renewable energies;
   - combating energy poverty.
8. **Giving people, businesses, regions and government the ability to act collectively**
   - involving all stakeholders in timetabling the energy transition—the national low-carbon strategy (*stratégie nationale bas carbone*-SNBC), multiannual energy programme (*programmation pluriannuelle de l'énergie*-PPE), national plan for the reduction of atmospheric pollutants (plan national de réduction des émissions de polluants atmosphériques-PREPA).

Source: Law No. 2015-992 of 17 August 2015 on the Energy Transition for Green Growth.

Improved co-ordination between energy and environmental policies

The merging of environmental and energy issues can be seen in the choices made by the French government: since May 2012, the Ministry of Ecology, Sustainable development and Energy (MEDDE, which became the Ministry of the Environment, Energy and Marine Affairs [MEEM] in 2016) has drafted and implemented energy policy in order to secure supply, combat global warming and promote the energy transition. It shares responsibility with the Ministry of the Economy, Industry and the Digital Sector for policy relating to raw materials and with the Ministry of Mining for policy relating to energy commodities. The Department of climate and energy (DGEC) drafts and implements policy for energy and combating climate change. It includes the Department of energy and raw materials (DGEP), which was part of the Ministry of the Economy, Finance and Industry until 2008. It is not clear whether the Ministry will retain the energy portfolio. In 2010, following a cabinet reshuffle, energy was returned to joint control of the two ministries, before being entrusted to the exclusive responsibility of the environmental authorities in 2012.

A horizontal department within the ministry, the General Commissariat for Sustainable Development (CGDD) is responsible for inter-ministerial co-operation (see Chapter 2). MEEM's remit also covers the Environment and Energy Management Agency (ADEME), for which it shares responsibility with the Ministry of Education. ADEME is a public body which co-ordinates, facilitates and carries out operations designed to protect the environment and energy management.

Some stakeholders have been over-represented in the national debate on the energy transition: the employers' organisation MEDEF was mainly represented by the nuclear sector,

excluding vast swathes of the energy transition, such as energy efficiency businesses, and most of the unions, with the exception of the CFDT, sent representatives from EDF (Électricité de France), the sector's legacy operator (Kerckhove, 2013). Many consultative bodies in the energy sector remain closed to new players in the energy transition, such as the Higher Energy Council, which issues opinions on the government's electricity and gas policies, and tracks progress in achieving the European target of 23% renewable energy by 2020.

At the end of 2008, the French government embarked on a strategy of environmental and sustainable exemplarity in the operation of its departments and public establishments (Prime Minister's circular, 3 December 2008). Average energy consumption per public official fell by 12% between 2009 and 2011, just short of the targeted 13%. In 2011, 91.5% of vehicles bought or hired by government departments produced less than 120g CO_2/km, beating the target of 85% (French government figures, 2011).

State agencies also play a significant role in improving the co-ordination of energy and the environment, in the management of their assets, their investment and city planning choices, and through the award of public contracts (DNTE, 2013a). Tools have been set up to encourage regional authorities to detail PCETs (see Box 4.2). Since the Grenelle I law was passed, PCETs have been mandatory for all municipalities of over 50 000 people, as has reporting of their GHG emissions. At 1 September 2013, 390 municipalities had filed PCETs, although only 124 were required to do so. By 1 May 2014, all regions had also set up a SRCAE.[3] These tools paved the way for the creation of communities of interest and a dialogue between the various stakeholders, without which action cannot be properly co-ordinated and local initiatives cannot emerge. They were supported locally by the regional departments for the environment, planning and housing (directions régionales de l'environnement, de l'aménagement et du lodgement-DREAL), created in 2009, which operate under the joint authority of MEEM and the regional prefects to roll out energy and climate policy on a regional level (see Chapter 2).

Many regions and local authorities remain insufficiently resourced, however, to implement projects promoting energy efficiency and renewable energies. This owes much to the steady rise in local responsibilities, such as waste management and planning, and to declining national credits for funding local action. State-region project contracts are the main tools for co-ordinating funding between central government and the regions: they finance PCETs through ADEME, which had an annual budget of EUR 76 million between 2007 and 2013 (MEDDE, 2014a). They have a term of seven years, in line with the timetable of the European Regional Development Fund (ERDF), in order to be able to draw on co-financing for the region's energy efficiency projects. For 2007-13, ecology and sustainable development were ranked third in terms of the funding allocated among the targets for these contracts, behind transport (mostly rail and river projects) and higher education (see Chapter 2). The energy transition is the second-ranked priority for the current period (2015-20), and accounts for 20% of allocated funding, or EUR 5.6 billion, behind multimodal mobility, which is in receipt of half of total funding (EUR 15 billion) (CGET, 2016).

The complexity of the French regional administration, with overlapping remits and a plethora of local plans at various levels of government hamper the visibility and implementation of these plans. The other local planning tools, such as urban travel plans (plans de déplacement urbains-PDU) and atmospheric protection plans (plans de protection de l'atmosphère-PPA) are not always consistent with the PCET and the SRCAE. It is essential to simplify the toolkit and overhaul the remits of the different levels of regional government

to increase buy-in to the achievement of national objectives among local authorities (DNTE, 2013a). This is the idea behind the Notre Act under which the French administrative territory will be reorganised (French government, 2015) (see Chapter 2).

Box 4.2. **Examples of regional and local implementation of the energy transition**

Grand Paris

Grand Paris is a project that aims to transform the greater Paris area in order to improve quality of life for the local population, level out regional inequalities and build a sustainable city. At its core is the development of a high-quality public transport network that joins economically successful centres to the main modal platforms. The Grand Paris company is responsible for the construction of an automatic metro system that connects Paris more closely to the suburbs, for an estimated cost of EUR 32.5 billion. This is also an innovative institutional project that aims to create a system of governance for Paris and the greater Paris area that breaks down barriers between municipalities and administrations. This special metropolis was established on 1 January 2016.

The third industrial revolution of Nord-Pas-de-Calais

The plan for the third industrial revolution of the Nord-Pas-de-Calais region was presented by the Lille Chamber of commerce and industry and the Nord-Pas-de-Calais Regional Council in 2013. For nine months, it mobilised all the region's public and economic players. It aims to turn the region into one of the most efficient and productive in terms of low-carbon energy by 2050, targeting complete energy self-sufficiency by that date, based on the promotion of renewable energies and energy-producing buildings, electricity storage, the development of smart grids and soft mobility, energy efficiency, the circular economy and a product-service system. In October 2014, there were 150 business proposals illustrating the commitment of the local authorities and social, academic and scientific players to the project.

Positive Energy Territories

A "positive energy territory for green growth" is a label that identifies a territory of excellence in the energy and ecology transition. The local authority pledges to reduce the energy needs of the population, and of the region's buildings, economic activity, transport and leisure. It offers a comprehensive programme for a new development model that is leaner and more economical in the following areas: energy consumption, pollution, clean transport, renewable energies, biodiversity, waste and environmental education. In February 2015, 212 territories were officially designated "positive energy territories", out of 500 applications. They will be able to claim EUR 500 000 for the action they have taken.

Pioneering decentralised energy in the regions

The Montdidier canton has set itself the goal of meeting 100% of its energy needs using renewable energies by 2020, and ultimately of contributing to energy storage and retrofitting 30% of the private rental market in order to reduce energy consumption. The canton's population of 12 500 currently meets 53% of its energy needs using electricity generated by the town's photovoltaic panels and wind turbines.

Source: C. Lepage (2015), *L'économie du Nouveau Monde*, Report submitted to Ségolène Royal, Minister of Ecology, Sustainable Development and Energy.

Improved scheduling tools

Until now, France had no fully integrated scheduling tool covering all the different pillars of energy policy. Multiannual investment programming (PPI), introduced in 2010 under the Nome Law which reorganised the electricity market, rolled out energy policy objectives, including the EU's energy and climate package targets and the national Grenelle targets, through three separate multiannual programmes (electricity, gas and heat).

The Energy Transition Act introduced a framework that is more consistent with multiannual energy programming (PPE) which sets out priority action for the management of all forms of energy in the pursuit of national targets. PPE will cover several different areas, concerning demand management, the diversification of energy sources, securing supply, the expansion of energy storage and of the grid. The first PPE will run for three years (2016-18), followed by a period of five years (2019-23). The following PPEs will be drawn up for two five-year periods, to run concurrently with the President's term of office. They must be compatible with the national low-carbon strategy (see Box 4.3).

2. Main trends in energy and environmental impacts

France's energy mix is still dominated by nuclear power. Despite making big strides, renewable energies contribute less than in most OECD countries. Since 2000, emissions of the main atmospheric pollutants and GHGs caused by the production and use of energy have fallen. Because of the weight of nuclear power in its electricity production, France has one of the lowest-carbon economies in the OECD.

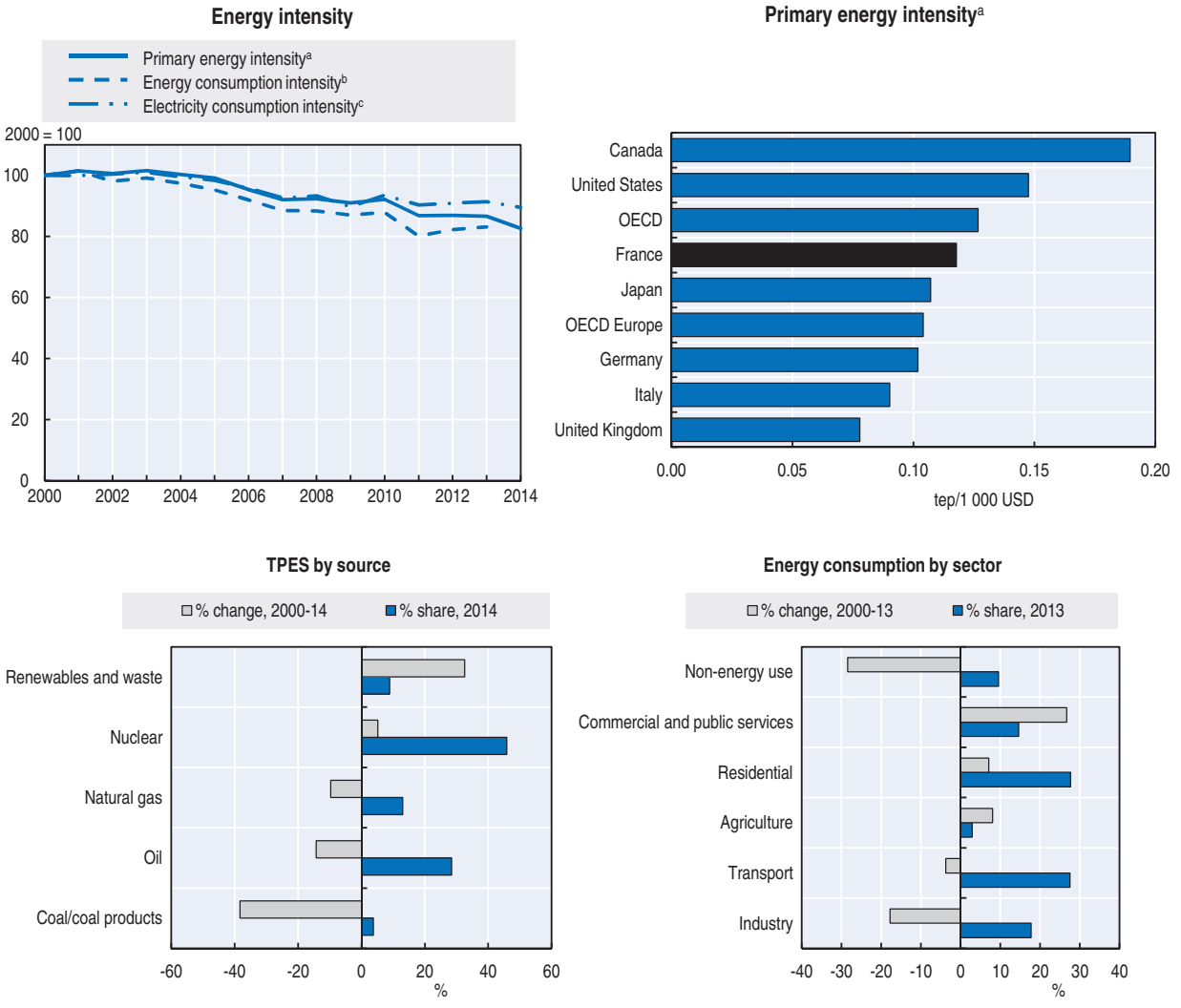
Trends in energy supply and demand

Since 2000, the share of fossil fuels in total primary energy supply (TPES) has given ground to nuclear power and renewable energies (see Figure 4.1, Chapter 1). Fracking, for the exploration and exploitation of fossil fuel reserves, was banned in 2011. Despite the implementation of an assertive policy in 2000, renewable energies only accounted for 9% of TPES in 2014, and 16% of electricity production, which is well below the average among European OECD countries (13% of TPES and 31% of electricity production) (IEA, 2015, see Chapter 1, section 3).

France's energy mix is dominated by nuclear power, which represented 47% of TPES in 2014 and 78% of electricity production. This is the legacy of the Messmer Plan, deployed in the 1970s, under which the nuclear industry spearheaded France's energy self-sufficiency, providing cheap energy that boosted business competitiveness, consumer purchasing power and a low level of GHG emissions from the French economy. The sector now has to deal with major investment needs to maintain its ageing reactors[4] and to meet the more exacting safety requirements introduced after the Fukushima incident (Cours des comptes, 2014).

The production costs of nuclear electricity are rising sharply. The reports of the Cour des comptes highlighted the sector's progress in cost transparency (Cour des comptes, 2012, 2014; OECD, 2005). According to its estimates, production costs have risen by 16% at constant prices, and came to EUR 60/MWh in 2013, a rise attributable to the growth of operating expenditure and the doubling of maintenance investment to meet safety standards and extend the operating life of the reactors. Production costs will probably continue to rise, but estimating them is complicated by the uncertainties surrounding the extension of reactors' operating lives[5] the launch of the third-generation Flamanville reactor[6] and the costs of decommissioning and waste management.[7]

Figure 4.1. **A less energy-intensive economy and increased dominance of nuclear power**



a) Total primary energy supply per unit of GDP at 2010 prices and purchasing power parities.
b) Total final consumption of energy per unit of GDP at 2010 prices and purchasing power parities.
c) Electricity consumption per unit of GDP at 2010 prices and purchasing power parities.
Source: IEA (2015), *IEA Energy Balances for OECD countries* (database); OECD (2015), *OECD National Accounts Statistics* (database).

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Cutting the share of nuclear energy to 50% of electricity production by 2025 will mean balancing reactor closures and extensions and growing renewable energies, in order to forestall the "investment cliff" threatened by a large number of reactors reaching their forty-year limit.[8] Clear decisions on the operating lives of these power stations are therefore urgently needed to give the private sector the long-term visibility it needs to plan its investments (Cours des comptes, 2014). The upper limits estimated by the company RTE (Réseau de transport d'électricité) for electricity consumption would mean the closure of over twenty reactors by 2025 to meet the 50% target (RTE, 2014; Grandjean, 2016; Dessus, 2016).

France has high energy self-sufficiency relative to its European neighbours, but it nevertheless imports most of the oil, natural gas and coal it consumes and all of the uranium required for the production of nuclear power. Reducing France's energy bill, which

came to EUR 55 billion in 2014, or around 2.5% of GDP, remains a key priority for the country's energy policy (MEDDE, 2015a).

The French economy is less energy-intensive than average for OECD Member countries. The primary and final energy intensities of the French economy fell between 2000 and 2014, under the impact of both declining energy supply and consumption and rising GDP (see Figure 4.1), although this effect is less marked than on average for OECD Member countries. The decline in final energy consumption, which began in 2005, gathered pace after the 2008 financial crisis. Consumption bottomed out in 2011, and then began to rise again in 2012 and 2013 (see Chapter 1). The most energy-intensive sectors are homes and transport, which each represent around 28% of 2013 final consumption, and therefore constitute important challenges for the energy transition.

Main environmental impacts of energy production and consumption

The main environmental issues involved in the production and consumption of energy are the risks inherent in the nuclear industry, atmospheric pollution and GHG emissions. The rise of renewable energies also poses the problem of integration into the landscape (dams and wind turbines, for example) and their effect on biodiversity, such as disturbances to bird migration and the destruction of plant life on wind turbine sites. It remains a priority, therefore, to carry out further impact assessments and strategic environmental assessments (see Chapter 2).

Environmental impacts of nuclear energy

The dominance of nuclear power in its energy mix gives France an unusual profile in terms of its exposure to risk and impact: the management and storage of radioactive waste, heat pollution of water during the cooling process that can affect ecosystems, the risk of nuclear accident. The 2005 Environmental Performance Review (OECD, 2005) recommended greater transparency in the nuclear sector, and much progress has been made. The 2006 law on transparency and safety in the nuclear industry led to the creation of the High Committee for transparency and information on nuclear safety, which is responsible for moderating a nationwide public debate, and of the Nuclear Safety Authority (ASN), an independent administrative authority responsible for the oversight of civil nuclear activity in France. The ASN reports on its activity and the state of nuclear safety and protection from radiation in France in a public annual report. There is also the public Institute for Radiation Protection and Nuclear Safety, which contributes expertise and research and publishes reports on the work it carries out.

While there has been a genuine effort to increase transparency, the means dedicated thereto have not always been commensurate with requirements. In 2014, the ASN declared that the government-allocated budget was insufficient to meet the needs of overseeing nuclear safety and protection from radiation (ASN, 2014). The Energy Transition Act strengthens nuclear safety and public information by intensifying the oversight and powers of the ASN (MEDDE, 2015b).

Energy and air quality

European standards and technical progress have brought about a steady decline in pollutants since 2000. France met every target set for 2010 by the EU directive establishing upper limits for national emissions (2001/81/EC) except for NO_x, most of which is emitted by road transport (see Chapter 1). Widespread adoption of catalytic converters, stricter

emissions caps for vehicles and the natural turnover of cars on the road have failed to offset increased traffic and uptake of diesel motorisations.

The targeted reduction of fine particle emissions ($PM_{2.5}$), set by the Gothenburg Protocol for 2020, has already been almost achieved, but France is also one of 17 European countries which have not honoured their pledge in terms of PM_{10} levels since new EU legislation came into force in 2005, and France was referred to the European Court of Justice by the European Commission for failing to take sufficient steps to reduce this pollution (see Chapter 1). One of the drivers of urban pollution is the uptake of diesel-powered vehicles, which has been encouraged by advantageous tax policies for many years (see Chapter 3). Recent measures – such as the inclusion of carbon in energy taxation, an increase in duty on diesel and a narrowing of the petrol-diesel taxation gap – are well targeted.

Atmospheric pollution connected to energy use, especially by transport, is a public health issue. The OECD estimates that the impact of air pollution on health (the cost of the 21 158 premature deaths linked to air pollution in 2013) amounts to around EUR 54 billion, or 2.5% of GDP (see Chapter 1).

Energy and climate change

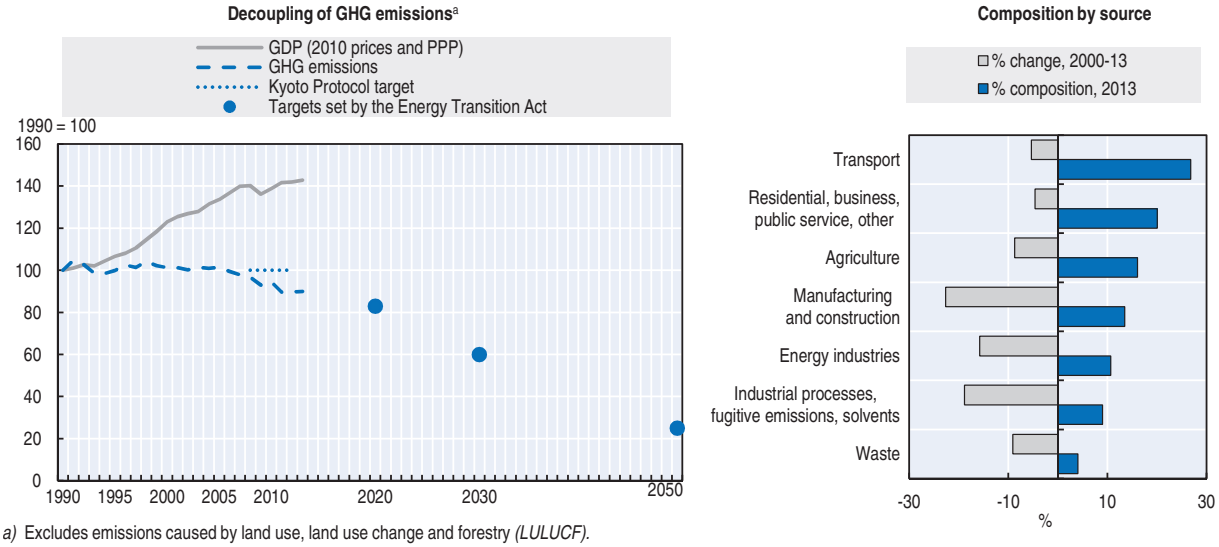
As in most OECD countries, GHG emissions in France are largely caused by the use of energy, which accounted for 72% of total emissions in 2013, excluding emissions and removals from land use, land-use change and forestry (LULUCF). Transport (27%), the housing and service sectors (20%), manufacturing and construction (13%) and the energy industry (11%) are the main sectors emitting GHG from the use of energy. Because of the high share of nuclear power in its electricity production, France's GHG emissions intensity is among the lowest of OECD Member countries, with 0.21 tonnes of CO_2 for USD 1 000 of GDP, compared to the OECD average of 0.39 tonnes (see Chapter 1). Since 2000, mitigation measures and the economic crisis have helped to break the link between GHG emissions and economic growth (see Figure 4.2).

France has surpassed its self-imposed target under the Kyoto Protocol of limiting its GHG emissions for 2008-12 to their 1990 levels (see Figure 4.2). This fall can be attributed to improved energy efficiency, the industrial slowdown brought about by the financial crisis, the arrival on the market of lower carbon vehicles and to the declining share of coal and oil in residential heating relative to gas and electricity. These welcome results should be tempered in the light of the GHG emissions related to imports to meet internal demand in France, which are not included in national inventories and which grew by 54% between 1990 and 2012, pushing the country's carbon footprint up by around 2% over the corresponding period (CGDD, 2015).

Under the EU's energy and climate package, France has committed to reducing the emissions covered by the emissions trading scheme (EU ETS) by 21% between 2005 and 2020, and emissions not covered by the EU ETS by 14%. Forecasts suggest that it is well on the way to achieving this objective (EEA, 2015).

The development of renewable energies and improvements in energy efficiency are not happening fast enough, however, and this is threatening the country's ability to reach its longer term emissions reduction targets (MEDDE, 2013; sections 3 and 4). France is not headed for a fourfold reduction in its GHG emissions by 2050 compared to their 1990 levels: emissions declined by an average annual 1.5% between 2005 and 2013, whereas meeting the target would require an annual fall of 3% between 2005 and 2050.

Figure 4.2. **Fall in GHG emissions**



a) Excludes emissions caused by land use, land use change and forestry *(LULUCF).*

Source: OECD (2014), *OECD Environment Statistics* (database); UNFCCC (2015), *2015 Submission by France to the United Nations Framework Convention on Climate Change*; UNFCCC (2014), *France's first biennial report to the United Nations Framework Convention on Climate change*; OECD (2015), *OECD National Accounts Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933406186

Reaching the long-term GHG reduction targets would require not only the strengthening of current economic, financial and regulatory instruments, such as the carbon tax, heat regulations and vehicle emissions standards (see below), but also securing their use over time, by laying the foundations of governance that can co-ordinate strategy in the long term. The proliferation of framework documents (climate plan, national energy efficiency action plans), deadlines and targets has created a situation in which the long-term vision is lacking to create a real low-carbon trajectory. The adoption of the national low-carbon strategy (Stratégie nationale bas carbone-SNBC) under the Energy Transition Act is intended to rationalise climate governance by creating a flexible framework for long-term planning (see Box 4.3). Article 173 of the Act explicitly states that France's low-carbon strategy "ensures that the national mitigation effort is not compromised by an increase in the carbon content of imports", by taking the carbon footprint as its indicator for tracking public policies; its implementation is vital for the achievement of France's objectives.

Box 4.3. **The national low-carbon strategy**

Since 2004, climate policy has been expressed in a climate plan, a strategic document that sets out the national policies to be implemented to reach France's European and international climate targets. This umbrella document includes the different plans for reducing GHG emissions in key sectors and creates the framework in which France can measure its general progress towards its climate objectives. The first plan was formulated in 2004, and was designed to ensure that targets set by the Kyoto Protocol were met (see Table 4.1). It was subsequently amended in 2006, 2009, 2011 and 2013.

The climate plan has now been replaced by the national low-carbon strategy, SNBC, adopted in 2015. The SNBC sets out the direction of sectoral and transversal policies to steer a course towards the factor 4 target, and the pledge to cut GHG emissions by 40% by 2030.

Box 4.3. **The national low-carbon strategy** *(cont.)*

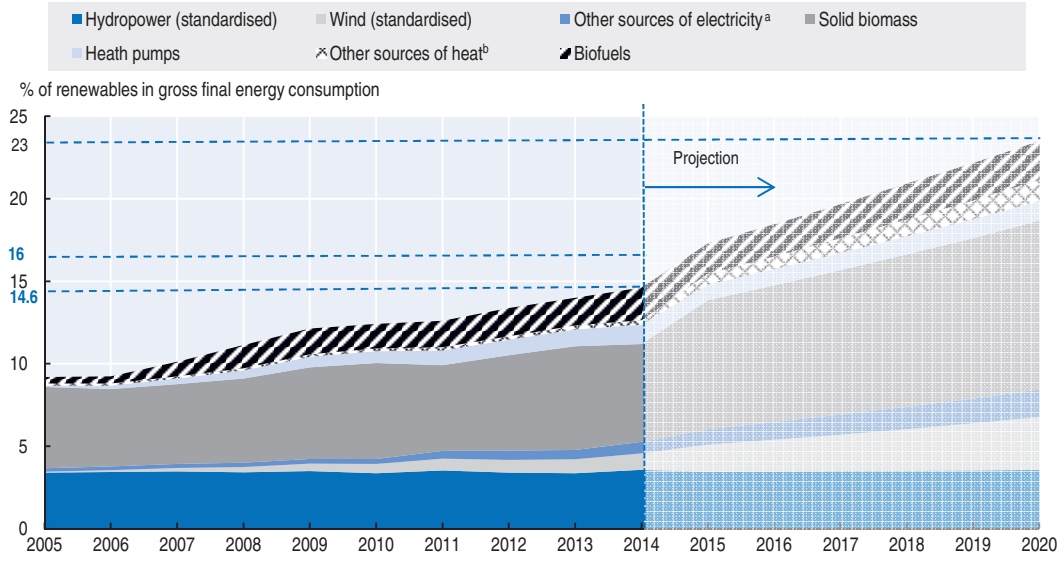
It is a steering and co-ordination tool that aims to ensure consistency throughout climate policy.

The SNBC is based on carbon budgets modelled on the British system, specifying national GHG emission ceilings. Carbon budgets are drawn up for an initial term of four years (2015-2018), then for five-year terms as of 2019, ten years in advance: the 2019-23 and 2024-28 budgets were drawn up in 2015, and the 2029-33 budget will be drawn up in 2019. The SNBC is reviewed every five years, at which point the scope of the two following budgets can be adjusted if necessary. The budgets are allocated by tranches that correspond to emissions by gas and by sector, in order to facilitate the analysis of any divergence from the targeted trajectory. It remains to be seen, however, how the budgets will be measured and checked.

3. Promoting renewable energy sources

Renewable energies are at the heart of France's energy transition strategy and they determine its ability to keep carbon low while reducing the share of nuclear power in its electricity production. They represent the fastest-growing source of energy in the energy supply, rising by 33% between 2000 and 2014. Despite the existence of an arsenal of political incentives, however, the current pace of deployment falls short of the objectives set by the National Action Plan for Renewable Energy (MEDDE, 2009). The intermediary objectives have largely been surpassed in photovoltaics, but onshore wind farms and solid biomass remain below the expected level, and offshore wind farms are worryingly far behind, since this sector has yet to take off (see Figure 4.3). There is too much of a grid connection backlog.

Figure 4.3. **Deployment of renewables falls short of targets**



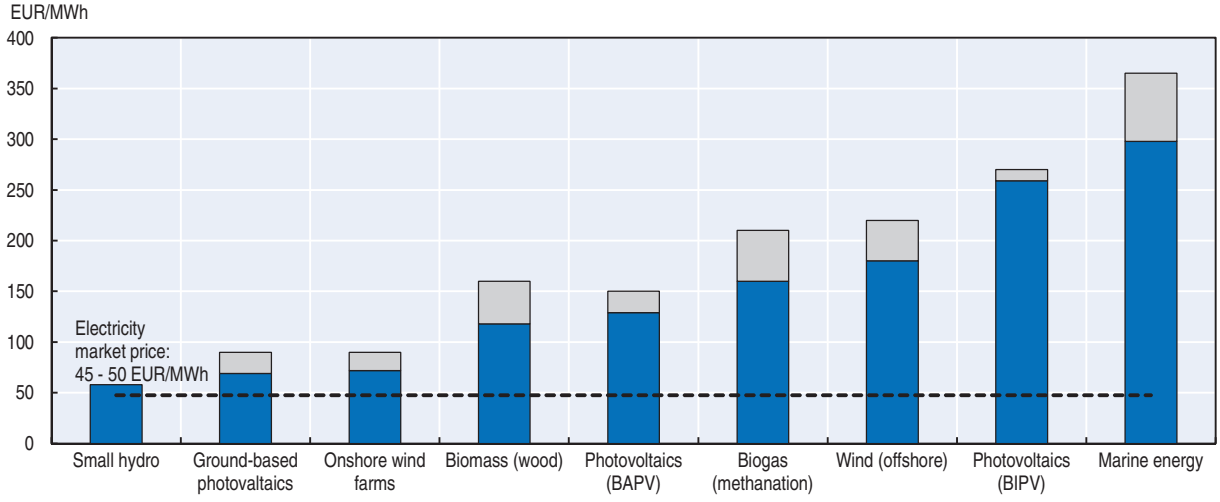
a) Solar photovoltaics, marine energy, geothermal electricity, biomass electricity (fuel wood, biogas, incinerated waste, bagasse).
b) Thermal solar power, geothermal power, biogas.
Source: SOeS, B*ilan de l'énergie* (achieved, up to 2014) and *national action plan* (projection, as of 2014).

StatLink http://dx.doi.org/10.1787/888933406190

EU objectives seem to be unattainable in the light of current policies. To reach 23% of renewable energies in France's gross final consumption by 2020, the effort made since 2005 would have to be almost tripled for renewable electricity and almost quadrupled for renewable heat between 2014 and 2020 (see Figure 4.3). The 32% of renewables targeted for 2030 in the Energy Transition Act also seems to be overly ambitious given current progress. Many barriers have hampered the deployment of renewable energies, including a lack of stability in policies supporting new technologies and excessive red tape surrounding requests for authorisation. Current schemes must be ramped up and reviewed in order to accelerate installation, while limiting deadweight effects and costs to electricity consumers, who are currently meeting the full cost of support policies.

The production costs of renewable energies remain higher than those of other energies, despite a spectacular fall in the costs of solar and wind power in the last ten years (see Figure 4.4). The deployment of renewables cannot take place, therefore, without State support, and a range of measures and incentives specific to each segment has been put in place, including feed-in tariffs, tax breaks for private investors under the CIDD scheme (sustainable development tax credit) and reduced VAT rates, and subsidies for renewable heat production installations (biomass and heat networks) through the heat fund, managed by ADEME.

Figure 4.4. **Estimated production costs for the main renewable electricity generation sources in 2014**



Notes: BAPV—Building-Applied Photovoltaics; BIPV—Building-Integrated Photovoltaics. The bars indicate the upper and lower limits of prices estimated on the basis of feed-in tariffs or calls for tenders.
Source: Medde (2015), *Panorama énergie-climat.*

Streamlining the regulatory framework supporting renewables in electricity generation

In France, the system to support the use of renewables is based on purchase obligation rates for small installations and calls for bids for larger installations:

- The obligation on electricity suppliers to purchase at a regulated rate was introduced under Law 2000-108 of 10 February 2000. The difference between the regulated rate and the market rate is refunded to the supplier by the consumer in the form of a tax (*contribution au service public de l'électricité*-CSPE). In 2015, the CSPE came to EUR 19.5/MWh, or around 15% of the average household electricity bill (CRE, 2014).

- The bidding procedure is launched if the objectives of the multiannual investment programme have not been reached in highly capital-intensive segments that need strong leadership and in which imbalanced access to information complicates the task of evaluating production costs for legislators. The Energy Regulatory Commission (*Commission de régulation de l'énergie*-CRE) is tasked with assessing the projects, and the specifications are drawn up at EU level. Several calls for projects have been launched since 2003: biomass in 2003 and 2005, combined heat and power generation (CHP) in 2006, and photovoltaics and biomass in 2009. A first call for offshore wind farm bids was launched in July 2011, for maximum capacity of 3000 MW, of which 2000 MW were allocated in April 2012. A second call for bids was launched in March 2013 to build offshore wind farms near Le Tréport in Normandy and the Île d'Yeu off the western coast, with capacity of 1000 MW (MEDDE, 2014a). In 2014, several calls for bids were launched for major photovoltaic power plants.

This process has not yet driven deployment up to a level sufficient to meet France's objectives. There is a long waiting list for the connection of renewable power plants to the grid, especially wind farms: 963 MW came onstream in 2014, but this figure would need to rise to an annual 1 647 MW to meet the targets for 2020 (Cassin, 2015). The main shortcomings of the current tools are a lack of long-term stability in investment signals, grid connection delays caused by red tape, and the high cost met solely by the consumer.

Like other European countries, France has changed its support measures several times in recent years, giving rise to some legal uncertainty over the regulatory framework. The French solar photovoltaic market overheated for a period in 2010 under the combined effects of highly incentive feed-in tariffs introduced in 2006 and the falling cost of photovoltaic panels: the number of requests for grid connection skyrocketed, and the total number of projects installed and pending in 2010 had already reached the installation target set by the Grenelle law for 2020. A report by the Inspection générale des finances (IGF) suggested that if tariffs were not cut, the photovoltaic industry would represent a major financial risk for the consumer and contribute 2% to France's trade deficit, largely because of photovoltaic panels imported from China (IGF, 2011). The unilateral announcement that feed-in tariffs were to be cut by 12% followed in August 2010, as well as a three-month moratorium on new installations. A new framework set up in March 2011 brought a further reduction in feed-in tariffs, stricter qualification criteria for these tariffs and mechanisms to adjust the tariffs to industry costs.

While these reforms may have protected the public purse from massive losses, they have had significant medium- and long-term effects on the industry (solar business collapses), investment and private-sector confidence (grid connections in solar and wind power have fallen sharply since 2011, dropping by 55% between 2011 and 2013 in solar and 33% in wind) (RTE, 2013). This episode also exposes flaws in the socio-economic evaluation of the tools implemented and a lack of control over the system, leading to deadweight effects. In 2010, solar tariffs in France were tangibly higher than the EU average, and producers could enjoy cumulated benefits sufficient to enable them to generate returns of over 20%. Increasing the link between ex ante and ex post evaluation and political decision-making is vital to bring the economic and financial impacts of the growth of these industries under control (Cour des comptes, 2013a).

In order to improve the effectiveness of support policies and reduce their cost, France began in 2015 to turn towards a system restricting purchase obligations, in line with the new EU guidelines on State aid for energy from 2014 to 2020 (see Box 4.4). These guidelines

Box 4.4. **European guidelines on State aid**

In order to incentivise the market integration of electricity from renewable sources and to limit the distortions of competition caused by State aid to energy from renewable sources, the European Commission adopted new guidelines on State aid for environmental protection and energy in June 2014, including:

- The possibility to use feed-in tariffs for wind energy installations with an installed electricity capacity of less than 500 kW or 3 MW or three generation units;
- The imposition of market premiums as a support instrument for installations with an installed electricity capacity of more than 500 kW as of 1 January 2016;
- The imposition of technology-neutral competitive bidding processes for installations with an installed electricity capacity of more than 1 MW or 6 MW or six generation units as of 1 January 2017.

Source: European Commission (2014), *Guidelines on State aid for environmental protection and energy 2014-2020*, Communication from the Commission No. 2014/C 200/01, 28 June 2014

introduce the requirement that state aid take the form of a bonus that is added to the market price. Producers must sell their electricity on the market in order to prevent deadweight and the distortion of competition between European countries. The Energy Transition Act provides for the gradual change from feed-in tariffs to "additional remuneration" for installations in mature segments over a certain size. Whether this system can offer sufficient incentive to ramp up the deployment and grid connections of renewable energies remains to be seen.

Having the consumer alone fund support for electricity produced from renewable sources (through the CSPE) is not sustainable (Cour des comptes, 2013; IGF, 2011). CSPE charges dedicated to renewable energies grew from EUR 0.6 billion in 2009 to EUR 4 billion in 2015, including EUR 2.5 billion for solar power and EUR 1 billion for wind power (MEDDE, 2015a). They could reach EUR 8 billion by 2020 (Cour des comptes, 2013a), fuelled by the growth of these segments, the increasing weight of the additional charges linked to the overly favourable feed-in tariffs granted for the first photovoltaic contracts and by the fall in the market price for electricity (on which the compensatory additional costs are based). The CSPE also funds the growth of renewable energies with the consumption of electricity alone, despite the latter's low carbon content. The Amending Finance Law for 2015 reformed the CSPE in order to bring it more firmly under parliament control and rebalance taxation between energy sectors: buy-back charges will now also be funded by part of the revenues from the increased domestic carbon tax on fossil fuel consumption. This reform should rebalance taxation between different sources of energy.

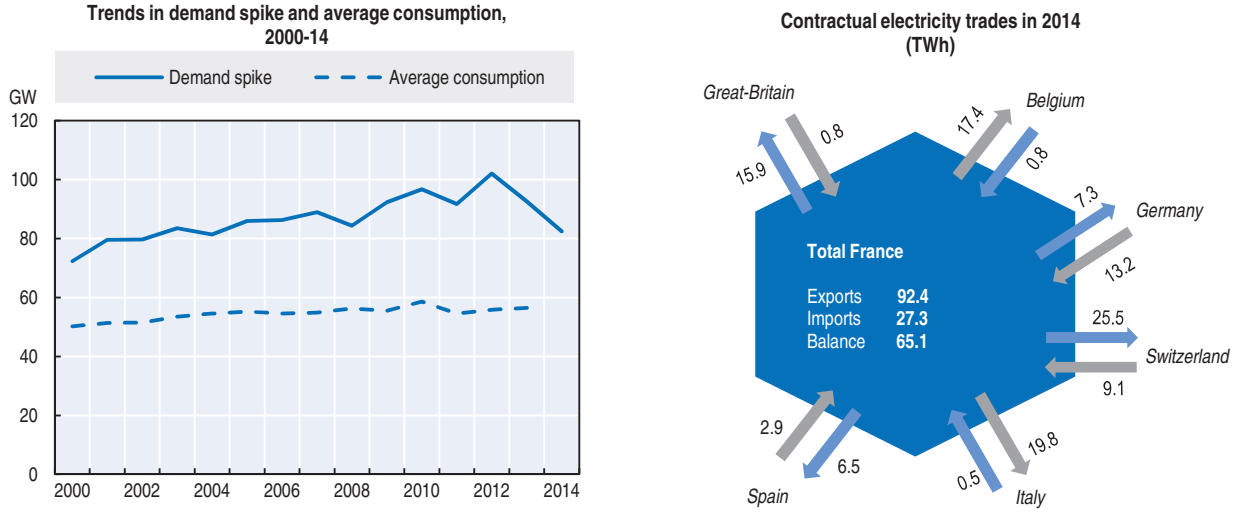
Another barrier to the development of renewable energy is the excessive red tape surrounding requests for authorisation. In 2013, it took three times longer to construct an onshore wind farm in France than in Germany, from the submission of the project to implementation (Cour des comptes, 2013a). In addition, the framework governing the development of the transmission network required to integrate renewable energy installations is equally complicated. Once approved, it can take ten years to install the power lines necessary for transferring the output of a wind plant, with most of the time spent on pre-construction procedures and two years on construction itself (RTE, 2014).

The Brottes Act of 2013 contained initial simplification measures for the wind power industry, and an ordinance in 2014 established a single permit procedure for regions with strong wind energy potential.[9] These measures led to renewed expansion in wind capacity in 2014 (RTE, 2014). The Energy Transition for Green Growth Act goes further by tackling the issue of energy transmission and imposing an 18 month deadline for grid connection, with compensation in the event of delays, and the widespread implementation throughout France of the single permit for wind turbines and biogas plants.

Demand management to cope with winter surges and the growing share of renewables

Although France is traditionally a net exporter of electricity, surges in demand during cold spells can result in risks of electricity supply disruption, as power demand in France is particularly sensitive to temperatures. This is due to the large installed base of electric convection heaters (one third of homes use electric heating, which is twice as many as 20 years ago) (ADEME, 2013a). Between 2000-10, the demand spike rose 2.5 times faster than annual electricity consumption (see Figure 4.5; MEDDE, 2015a). Growth in the spikes has slowed in recent years as the share of electric heating in new build falls as a result of new thermal regulations. Nevertheless, the risk of supply disruption remains a concern (RTE, 2015a).

Figure 4.5. **Increased risk of supply disruption due to spikes in electricity consumption**



Source: Medde (2015), *Panorama énergies-climat - Édition 2015;* RTE (2014), *Bilan électrique français.*

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If renewable energy is to account for 40% of final energy consumption by 2030, then electricity systems will not only have to be more flexible, they will also have to handle increased charging of electric vehicles and the possibility given to consumers to manage their demand. To reduce power consumption at times of peak demand and make the electricity system more flexible, France has put in place demand response capacity mechanisms whereby operators can, on a voluntary basis, choose to reduce their electricity consumption compared to their normal levels. The 2013 Brottes Act provides for a greater role for demand response through bonuses granted for the benefits for local authorities.

Strengthen European collaboration in electricity markets

The liberalisation of the electricity markets has thrown up many challenges for the European electricity markets, in particular the fact that the current market model has a negative impact on the investment climate and increases the risk of supply disruption in some Member countries (OECD et al., 2015). In the absence of a common European framework, some countries, including France, have put in place unilateral capacity mechanisms. Under the French system, all electricity suppliers are obliged to guarantee that they have energy capacity in a certain amount to cover their clients' consumption during spikes. To do so, they must either receive certification of their own capacity or purchase capacity guarantee certificates from other suppliers. This market complements the electricity market by remunerating spare capacity and demand side capacity in addition to power generated. It is scheduled for implementation in winter 2016-17.

Capacity mechanisms, while helping improve energy security at the national level, must not run counter to energy/climate objectives (by favouring the most adaptable energies, which are often fossil fuels) or create distortion of competition. Also, the increased generation capacity they create could also discourage investment in neighbouring countries, which would then have to rely on French electrical capacity, thereby, paradoxically, increasing the risk of power outages (Thomazo, 2014). Moreover, their implementation could affect Europe's ability to reach its climate targets and deployment objectives for renewable energy sources, and drive up the cost of these policies. The compatibility of capacity mechanisms with a European vision of the electricity markets remains to be proved, and there are few signs of harmonisation and co-ordination of national initiatives (Grigorjeva, 2015).

There is an urgent need to integrate energy security issues, like climate problems, at European level, and to assess them in terms of their environmental consequences beyond the national dimension. One particularly important step in the creation of a European energy union is the optimisation of the resources and infrastructures at European level. Cross-border measures (better interconnection between European networks, the coupling of European wholesale markets, regional co-operation) allow for a better integration of European electricity sectors and cost-efficient use of renewable and conventional resources.

France is interconnected with six countries, with import capacities of around 12 GW and export capacities of 16 GW (MEDDE, 2015a). These levels are insufficient given the volumes that the energy market actors would like to exchange. The bottlenecks formed by interconnections led RTE to introduce rules for capacity allocation (CRE, 2013). Increasing interconnection capacities between countries is another key factor in developing renewable energies in Europe. For example, Spain, which is a major actor in wind energy, has one of the lowest interconnection levels in the EU, thereby restricting its ability to guarantee its supply. A better connection with France would enable both countries to improve their energy security and increase the likelihood of using renewable energies. The opening of a new interconnection line in 2015 (between Baixas in France, and Santa Llogaia in Spain) has doubled interconnection levels between France and Spain, but this is not enough for Spain to respect the minimum interconnection rate of 10% recommended by the EU, meaning that further investment is required (RTE, 2015b).

The Heat Fund at the heart of renewable heat initiatives

In 2014, renewable heat represented 50% of total renewable energy consumption and 7.5% of final energy consumption (MEDDE, 2015c). The framework for support policies in

this sector is the Heat Fund, managed by ADEME, which ensures that the price of renewable heat produced is 5% lower than that obtained with conventional energy by providing aid in the form of grants for investment and/or per kilowatt-hour produced.[10]

A budget of EUR 1.2 billion for the period 2009-14 has helped the Fund boost renewable heat production projects, helping over 3 000 facilities for total annual production of 1.6 Mtoe. The support provided by the Heat Fund to biomass installations over the period 2009-13 helped prevent the emission of 2.6 million tonnes of CO_2 per year. Calls for projects also impose strict conditions with regard to the emissions of dust, CO and fine particles (ADEME, 2015a; 2015b).

Nevertheless, appropriations have remained far below initial intentions. The Heat Fund is due to be strengthened under the Energy Transition for Green Growth Act, with a twofold increase in its budget to EUR 420 million between now and 2017, an expansion of its remit and the allocation of additional financial support from the fund for the financing of energy transition.

4. Promoting energy savings

In 2005, the POPE Act set numerical energy management targets and established the guidelines of national plans. These targets were integrated into different National Energy Efficiency Action Plans (NEEAPs 2008, 2011 and 2014) which contain measures for all sectors to help the EU reach its 20% energy efficiency target by 2020 (see Table 4.2). The Energy Transition for Green Growth Act goes further by setting a target to reduce final energy consumption by 50% in 2050 compared to 2012.

After two decades of growth, final energy consumption in France fell between 2005 and 2013, in both absolute terms and in relation to GDP. Nonetheless, and despite significant measures to promote energy efficiency in all sectors, this reduction falls short of national and European objectives (see Figure 4.6). The progress made reflects a continuation of trends rather than a genuine downturn in the energy intensity of the economy. In order to meet medium- and long-term targets, the existing measures need to be reinforced, in particular in the residential and transport sectors (EEA, 2015).

Assessing the efficiency of Energy Saving Certificates

Energy saving targets were exceeded during the first two periods of implementation of energy saving certificates (ESC), and the list of "obliged sellers" has gradually been extended to fuel sellers. ESCs, which were established by the 2005 POPE Act and implemented in 2006, impose quantified three-year energy-saving targets on energy suppliers[11] (the "obligated sellers"), thereby giving them an incentive to encourage their clients – households, local authorities and businesses – to reduce energy consumption in order to generate "energy saving certificates" which can then be exchanged. At the end of the three years, the sellers have to prove that they have met their obligations by holding a number of certificates equivalent to said obligations, which they can obtain either through their own energy-saving initiatives, or by purchasing them from other obligated sellers. Failure to respect the obligations results in a full-discharge penalty payment (MEDDE, 2016).

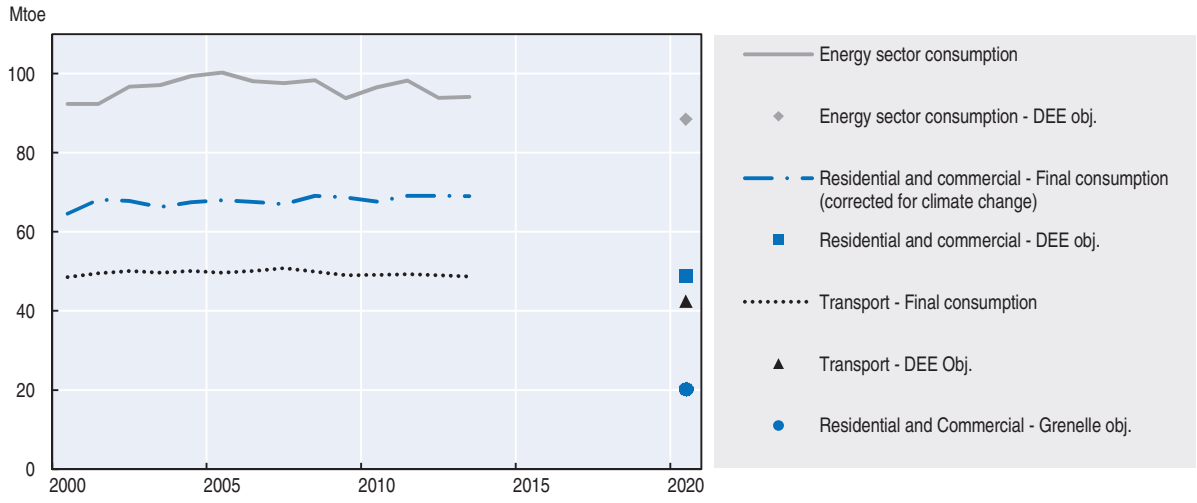
In 2013, the Cour des comptes highlighted the complexity of this scheme, the absence of any a posteriori control of realised energy savings, the lack of transparency and the need to encourage further initiatives. It also pointed to the fact that it is difficult to distinguish ESC energy savings from other incentive schemes such as the sustainable development tax credit

Table 4.2. **Main measures and expected outcomes of the NEEAP and the Climate Plan**

Sector	Objectives	Implemented	Emission reduction in 2020 (kt CO_2 eq)	Final energy saving (Mtoe)			
Transport				2010	2013	2016	2020
Measures aimed at reducing emissions from passenger cars (CO_2 labelling, scrapping premium, environmental reward/penalty scheme)	Energy efficiency in the road transport sector – light-duty vehicles	2007	9 000	0.1		1.1	2.2
kilometric eco-tax on heavy vehicles	Take into account the cost of using the non-concessionary national highway system to generate resources to finance transport infrastructure projects	No	260 to 600			0.165	0.168
National Transport Infrastructure Plan (*Schéma National des Infrastructures de Transports* - SNIT)	Investment in transport infrastructures (2 000 km of high-speed rail lines by 2020)	No	2 500				
Residential							
New Thermal Regulation (RT) 2012	Energy efficiency in new buildings	2011	3 550			0.41	1.15
Sustainable Development Tax Credit (CIDD)	Encourage private individuals to invest in home retrofits	2005	3 760		0.78	0.93	1.08
Low-interest loans to encourage residential retrofit work (Eco-PTZ)	Encourage major building renovation	2009	330		0.18	0.19	0.19
Low-interest loans for social housing (Eco-PLS)	Encourage renovation of social housing stock	2009			0.35	0.65	1.03
Energy Saving Certificates (ESC)	Promote energy saving initiatives	2006	6 200		2.5	5.17	9.29
Energy							
Heat Fund to support the development of thermal renewable energy	Develop alternative energy sources to fossil fuels to generate heat	2009	6 600				
Regulations on fluorinated gases	Reduce emissions of fluorinated gases with high global warming potential (GWP).	2007	7 170				
Support for agricultural methanisation	Reduce CH_4 emissions from the agricultural sector and perform energy recovery	2009	950				
The European Union Emissions Trading System (EU ETS)	Reduce GHG emissions from high emission plants (mainly power stations and industry)	2005					
Feed-in tariffs on renewable energy sources of electricity	Encourage development of renewable energy sources of electricity	2001	12 850				
Domestic tax on consumption of energy products (TICPE)	Tax on diesel				4.9	4.3	4.1
	Tax on petrol				0.5	0.4	0.3

Source: MEDDE (2014a) France's first biennial report under the United Nations Framework Convention on Climate Change; MEDDE (2014c), The Energy Efficiency Action Plan for France – 2014.

Figure 4.6. **Energy consumption by sector and objective**



Note: DEE - Directive on Energy Efficiency (2012/27/EU).
Source: Medde (2014), *Plan National d'Action Efficacité Energétique 2014* (database); *SOeS* (2015), *Pégase* (database).

StatLink http://dx.doi.org/10.1787/888933406214

(CIDD) and the interest-free eco-loan (eco-PTZ). A report published in 2014 confirmed these criticisms and recommended a revision of the amount (often overestimated at present) of the ESC corresponding to each standardised worksheet, greater public information through energy renovation passports on the different energy efficiency projects and their return on investment (which varies widely from household to household), and better targeting of the most energy-intensive buildings (CGEDD, IGF and CGEIET, 2014).

A third period began on 1 January 2015, containing modifications taking into account the criticisms of the previous periods. The three-year target has been doubled from the second period, which is expected to foster greater competition between the obliged sellers (Cour des comptes, 2013b). For the first time, the target is in line with the objectives of the European directive on energy efficiency. The scheme has also been simplified and made more transparent, with the introduction for example of a declarative system whereby applicants' files are considered to be implicitly accepted if they have received no response from the administration after two months. The standardised worksheets are being revised. ESCs can also be used to finance energy renovation passports and, as of 2016, energy sellers will have to allocate some of their ESCs to fighting fuel poverty (MEDDE, 2016). At present, the ESCs are also being used as a model for certificates for the economic use of phytosanitary products in the agricultural sector.

Adjusting measures to improve the energy efficiency of buildings

The role of the building sector is decisive when it comes to meeting energy efficiency targets, reducing GHG emissions and deploying renewable energy. France has adopted very ambitious objectives for energy-efficient building renovation: a 38% reduction in primary energy consumption in existing buildings between 2009 and 2020, the annual renovation of 500 000 homes until 2017, efforts to make low-energy buildings more widespread in new builds in 2013, and, in 2020, all new buildings should be positive energy buildings (see Table 4.1).

Despite a range of regulatory and economic instruments, and measures aimed at providing training and information and raising awareness (see Table 4.2), results are still falling short of objectives. In 2013, despite steadily increasing by 1.5% per year, the number of homes receiving energy retrofits stood at only 265 000, compared to the target of 500 000 renovations per year by 2017 (OPEN, 2015; CGDD, 2012). Measures are needed to simplify these schemes, extend financial initiatives and improve access to information. In addition, energy efficiency must also integrate the issue of fuel poverty, which requires specific actions targeting disadvantaged households.

Strengthening thermal regulations for existing buildings

Thermal regulations (RT) set the level of thermal performance for residential and commercial buildings. The first RT dates back to 1974 but there have been major advances in the system since 2005:

- Thermal regulations for existing buildings In 2005, thermal regulations were put in place for existing residential and commercial buildings, with the aim of ensuring that the energy performance of a building improves when work is carried out (renovation, installation of new heating equipment). Regulatory requirements differ according to the extent of the project. For major renovations, the regulations set a global performance target for the building (the Global RT for existing buildings, defined by the Order of 13 June 2008). For other renovations, the regulations establish minimum performance standards for individual categories of installation (the Element-by-element RT for existing buildings, defined by the Order of 3 May 2007).
- Thermal regulations for new buildings with increasingly stringent requirements The aim of RT 2012, adopted following the Grenelle Forum on the environment, is a threefold reduction in energy consumption by new buildings, to 50 kWh/m^2/year,[12] compared to 150 kWh/m^2/year in RT 2005, and an average of 240 kWh/m^2/year for the existing building stock (PLF, 2015). It also discourages the use of electric heating in new buildings in favour of other more efficient forms of heating.

RT 2012 is an example of good practice in thermal regulations as it focuses on performance requirements and targets rather than requirements with regards to the means used. However, the performance requirements in the RT for existing buildings are focused on the means rather than the end, resulting in a lack of visibility and consistency in terms of its contribution to the objectives. The implementation of performance requirements instead of obligations regarding the means used could increase the consistency and visibility of the current regulatory measures and pave the way for meeting objectives (Hilke and Ryan, 2012).

Simplifying and sustaining financial incentives

Since 2005, France has put in place several measures providing direct and indirect funding support for energy efficiency retrofits in existing buildings. For households, the two main instruments are the Sustainable Development Tax Credit (CIDD), created in 2005 (and renamed Energy Transition Tax Credit [CITE] in 2015), and the interest-free eco-loan (eco-PTZ), created in 2009:

- Through the CIDD, private individuals receive a tax credit when they purchase and install high-performance materials or equipment permitting energy savings. Between 2005 and 2011, over 9 million projects were declared eligible for the CIDD. The tax expenditure

over the period was EUR 13 billion, with EUR 46 billion of declared household expenditure (PLF, 2015).

- The eco-PTZ allows homeowners and landlords to finance major renovation works in their properties through "mixed works" designed to achieve a minimum overall energy performance for the property. It is financed by sustainable development savings accounts (LDD), which are regulated passbooks launched in 2007 to provide banks with a specific loan product for energy efficiency projects. Since 2009, around 235 000 eco-PTZ loans have been issued for an average expenditure on works of EUR 19 200, which is below the objective of 150 000 loans a year as of 2010 (PLF, 2015). In 2014, eco-loans represented under 3% of non-centralised outstanding LDD loans.

The impact of these two instruments has been lessened by constant revisions to the conditions governing the allocation of these aids, the eligible equipment and materials, and the significant deadweight impact (as the schemes primarily benefit wealthy households which would have carried out the work anyway). The CIDD weighs heavily on public expenditure, costing EUR 1.4 billion in 2016, making it one of the most expensive forms of tax expenditure (MINEFI, 2015). Moreover, these mechanisms have to date encouraged element-by-element retrofits, which are less efficient than complete retrofits. The cost of completed projects has fallen continuously since 2006, and only 10% of renovation projects can be considered ambitious (roof, interior or façade insulation). In 2014, a standard subsidy rate of 30% was set for the CIDD. In addition, responsibility for establishing the eligibility of requests for eco-PTZ loans has been handed to construction companies rather than local banks, which lacked the technical competence required to process said requests (Hilke and Ryan, 2012).

Third-party investment and financing mechanisms, based on the premise that retrofit investments can be financed by third parties who charge the beneficiary a fee equivalent to a part of the energy savings achieved, have been developed in the United Kingdom. This is not yet the case in France, but the situation should improve through the development of Energy Performance Contracts (EPC) which allow public and private contractors to use external organisations which guarantee a quantified improvement in energy performance by funding the work and using the income from the savings to repay the cost of the project. However, the development of EPCs has not matched expectations for the target segments (public, private and tertiary markets) as local authorities find them too complex, the transaction cost for setting up the project is high for individuals, and it is impossible to combine this scheme with other available instruments (MINEFI, MEDDE, 2013). Some of the measures in the Energy Transition for Green Growth Act are designed to remove these barriers, such as the creation of a guarantee fund for energy retrofits, financed by ESCs and the CDC's own funds, and the creation of regional third-party financing companies which can, under certain conditions, qualify for an exemption from banking monopoly rules.

Strengthening tools for training, information, documentation and awareness-raising

In 2013, the government set up a network of 450 Renovation Information Service Points (PRIS) across the country where members of the public can obtain all the technical, financial, fiscal and regulatory information they need. This one-stop approach for access to aid was accompanied by a national awareness campaign called "j'éco-rénove, j'économise" ("by eco-renovating, I save money"). The PRIS have a key role to play in boosting the profile of retrofit schemes, provided that they are manned by competent staff capable of giving property owners the guidance they require and that they are backed by a sufficiently large

network of competent contractors. The Energy Transition for Green Growth Act also introduces energy renovation passports, which will be tested in 2016 (MEDDE, 2015d).

Smart electricity and gas meters, promoted by awareness-raising measures, could also encourage consumers to invest in energy efficiency[13] and reduce households' energy consumption by 5 to 20% (CEDD, 2013). However, there are still legal uncertainties about the ownership and potential use of the data from these meters. The Grenelle II Law guarantees local authorities access to data from the gas and electricity networks under the SRCAE and PCET, but some limitations currently exist with regards to the interpretation of the use of commercially sensitive information (CSI). Discussions are required to establish the nature, level of detail and format of the data and their transmission (DNTE, 2013b). There are also practical issues to resolve, as some meters are not situated within household living areas, therefore making it difficult to follow real-time energy consumption (Que Choisir, 2013).

Efforts to boost the profile of these various incentives is also hampered by the lack of expertise in the industry, which results in significant disparities in the quality of the diagnostics and services provided (DNTE, 2013a). France has launched several projects to support training and the recognition of training, such as financing research (research and experimental programme for the energy of buildings [Prebat]), training designed to create a sector par excellence (training in energy saving for building companies and artisans [FeeBat]), and the development of information, monitoring and assessment tools for instructing parties. Accordingly, an energy performance diagnosis has been mandatory for all residential and non-residential homes since 1 November 2006, within the framework of the European directive. To counter the lack of competencies among professionals in this field, an action plan was launched in 2012 aimed at promoting transparency, improving calculation methods, and providing better training for certified individuals and better oversight of the profession.

Further structuring of the industry is required if the schemes are to be secured as, in a sector mainly comprising small artisanal businesses, few professionals invest time and money in training. The government introduced the principle of environmental conditions for financial support to encourage training. Individuals are therefore required to use businesses with an RGE quality certificate "guaranteeing environmental recognition" if they want to apply for an eco-PTZ loan (2014) or the CIDD tax credit (2015). The systematic implementation of this measure should improve professionalism within the industry.

Combating fuel poverty while respecting energy transition targets

In 2015, 5.1 million households (and 11.5 million individuals) in France suffered from fuel poverty, i.e. around 20% of the population (ONPE, 2015). The causes are complex, but are generally the result of three factors, which are low household income, poor housing energy performance and ever-increasing energy cost pressures. The government spends around EUR 3.5 billion a year on combating fuel poverty (Chancel et al., 2015) through a raft of measures at both the national and local level aimed at improving the thermal performance of homes, helping households reduce and pay their energy bill, and improving information for and communication with households in fuel poverty.

Improving the thermal performance of homes

The "Habiter mieux" programme by the French National Habitat Improvement Agency (ANAH) was put in place to help 300 000 households in fuel poverty over the period 2010-17. Between 2010 and 2015, the programme financed energy efficiency upgrades for

140 700 homes compared to the 2017 target of 300 000 homes (ANAH, 2015). One of the main difficulties in terms of implementing the programme is identifying and communicating with those eligible. Another is the amount that struggling households still have to pay. Even if the CIDD tax credit and eco-PTZ loan can be used to cover most of the retrofit costs, the potential down payment and the residual amount to be paid are often off-putting, as most households in fuel poverty only have limited access to credit. A "Habiter mieux" eco-loan was created in 2016 to provide this funding.

Financial aid with energy bills

France is testing several schemes for helping cover energy bills, which have yet to prove their effectiveness. The refund on heating oil for non-taxable households was phased out in 2009 as it encouraged energy consumption. The implementation of progressive electricity and gas pricing, adopted by the French parliament in March 2013, was rejected by the Constitutional Council for being overly complex.

The current system is based on social energy tariffs, housing solidarity funds to pay overdue bills, and communal social action centres (CCAS) which can co-finance this cost. Social energy tariffs are based on the size of the family and its consumption. However, they have two main flaws, namely the identification of the target population, due to the complex cross-referencing of data from the health insurance organisations and tax authorities, and their inequity, in that households with gas heating can combine gas and electricity tariffs. Moreover, the average amount of aid available through social energy tariffs, which is about EUR 8 per month, does not seem sufficient to provide genuine protection from fuel poverty, while the cost of implementing the scheme is prohibitive (approximately 10% of the total bill) (ADEME, 2013b; Chancel et al., 2015).

Changes have been made to legislation recently in a bid to overcome these issues. In 2012, the allocation of social energy tariffs was automated using data from the family allowances fund (CAF) and the energy suppliers. While this helped increase the number of beneficiaries from 900 000 to 1.75 million, it also allocated social energy tariffs to individuals not in fuel poverty and excluded eligible applicants without a recognised energy contract (ADEME, 2013b). The 2013 Brottes Act broadened the eligibility criteria for recipients, which helped increase the number of beneficiary households to 3 million in 2015. In 2016, social energy tariffs will be replaced by an "energy cheque" to help consumers pay their energy bills, regardless of their heating modes, or to finance energy retrofits, as long as they meet certain income conditions.

Despite the existence of different measures to combat fuel poverty, there is no global strategy to ensure overall co-ordination, and the lack of linkage between the schemes undermines their effectiveness (Chancel et al., 2015). Communication about these initiatives should be improved, especially to the most isolated households, which are often the most vulnerable. The aid available should also be readjusted to meet the requirements and financial capabilities of the target populations (Erard et al., 2015). Better data production and management is also required to better understand and diagnose fuel poverty, focus the initiatives, assess their impact and develop a global long-term strategy (Chancel et al., 2015).

Avoid overlapping measures in the industrial sector

Energy consumption in the industrial sector in France is extremely concentrated, with 1% of industrial sites responsible for two thirds of the energy consumed. The largest consumers include the chemical industry (26%), food processing (16%), steelmaking (15%),

non-metallic mineral products – cement, glass, brick, tiles – (14%) and paper/cardboard (9%) (ADEME, 2015). Between 2000 and 2013, final energy consumption in industry decreased more than industrial production, causing a 7% fall in energy intensity, which was nevertheless less accentuated than the average 19% downturn in OECD Member countries (IEA, 2015). This decline is mainly due to improved production processes (especially in chemicals and steelmaking) (CGDD, 2014). However, the economic crisis has caused improvements in energy intensity to slow since 2009 through sub-optimal use of production capacities.

French policy on energy efficiency and the reduction of GHG emissions in the industrial sector is primarily based on European directive 2003/87/EC, which establishes a cap and trade system for emission allowances (EU ETS) within the EU. During the 2005-07 test phase, and the second period from 2008-12, France established national allowance allocation plans for 964 regulated sites, which must comply every year by surrendering enough allowance to cover all their verified emissions for the year. The implementation of energy efficiency initiatives is one of the levers they can use to meet objectives.

Nevertheless, against a backdrop of relatively low energy prices in France and reduced investment capacity in businesses following the economic crisis, investing in energy efficiency is not always on the list of priorities for companies that are not intensive users of electricity. Consequently, France has put in place other measures to complement the EU ETS and encourage investment in energy efficiency (see Table 4.3):

- *Information tools to foster a better understanding of energy efficiency*: the creation of a French standard reference for energy diagnostics in 2006 (AFNOR BPX30-120); mandatory four-year energy audits for all business, except SMEs, in application of European directive 2012/27/EU on energy efficiency;
- *Incentives to support investment*: "green loans" were established under the "programme of investments for the future" to provide SMEs with subsidised rates or guarantees for carrying out energy retrofits; *Banque publique d'investissement* (BPI) provides Eco-Energy loans to SMEs and VSMEs; as well as the ESC scheme and ADEME funds for demonstration or exemplary projects, in conjunction with;
- *Measures to support research and development*: under the "programme of investments for the future", but also as part of France's industrial strategy to develop profitable industries, some 20 strategic sectors have been identified, such as smart energy networks, renewable energy for optimised industrial processes, and vehicles of the future.

The Energy Transition for Green Growth Act also provides for conditioning the access of electricity intensive industries to special rates on their undertaking to adopt better energy performance practices. However, by overlapping with the EU ETS, these measures could increase the cost of reducing emissions and move the emissions elsewhere. It is important that the additional measures also cover sectors other than those subject to EU ETS.

Table 4.3. **Main energy efficiency measures in the manufacturing sector, excluding EU ETS**

Incentive Measures	Energy Saving Certificates (ESC)	Between 2006 and 2010, around 9.2% of total ESC were issued to industry, representing annual energy savings of 5.6 TWh (NEEAP, 2011).
	Decision-making support, ADEME	Funding is mainly given to carrying out studies on energy efficiency in industry, including energy diagnostics.
	"Rational use of energy – investments" funding, ADEME	This system supports investments by businesses aimed at improving their energy efficiency. The funds are only available for demonstration or exemplary projects.
	"Green loans"	These loans, launched under the programme of investments for the future, offer SMEs and medium-sized industrial firms low rates and loan guarantees (SMEs only) for investments which will improve the competitiveness, and the energy and environmental performance, of their activities.
	"Eco-Energy loans"	The purpose of this system, designed for VSMEs and SMEs, is to finance the installation and upgrading of equipment that consumes a lot of energy (lighting, heating, air conditioning and electric motors).
Regulatory Measures	European directive on energy efficiency (2012/27/EU)	The obligation of a mandatory energy audit every four years for all business, with the exception of SMEs, and businesses without ISO 50001 certification.
	Directive 2008/1/EC concerning integrated pollution prevention and control	Requires assurance that energy is used efficiently in depollution installations and systems in respect of certain industrial activities (energy industries, production and processing of metals, mineral industry, chemical industry and waste management).
	Directive 2010/75/EU on industrial emissions	Imposes, on many operators in different industrial sectors, the implementation of the best available techniques for the reduction of harmful emissions and the increase of energy efficiency.
Information	POPE Act	It is mandatory for businesses selling energy or energy services to encourage energy savings in their advertising messages, i.e. "L'énergie est notre avenir, économisons-la !" (energy is our future so let's save it!).
	Support for innovation and calls for projects	The National Research Agency's (ANR) energy efficiency of industrial systems programme (EESI), ADEME's call for R&D projects to improve the energy performance of industrial processes and utilities (APEPI), the Ecoindustries programme (ADEME/BPi-engance/General Directorate for Competitiveness, Industry and Services), calls for interest in the ADEME/Total programme on energy efficiency, etc.

Source: MEDDE (2011), *Energy efficiency action plan for France – 2011*; *www.developpement-durable.gouv.fr/Prets-verts.html*.

Recommendations on energy transition

- Complete and implement the strategic framework for energy policy:
  - draw up the multiyear energy programme in consultation with the regions, defining road maps for developing generation capacity compatible with the national low-carbon strategy;
  - continue efforts to monitor production costs of energy industries;
  - put in place arrangements for revising implementation measurements when annual tracking indicators for the multiyear energy programme and the national low-carbon strategy stray too far from the road map.
- Ensure long-term clarity and transparency of measures to support renewables and energy efficiency; tighten monitoring to reflect changing technology costs and ensure that they do not lead to windfall profits; step up efforts to simplify and stabilise the legal framework regulating the installation and operation of renewables-based supply; strengthen efforts to develop biomass use and biogas production.
- Promote EU co-operation on the electricity market; develop interconnection capacities with EU grids to integrate renewables.

Recommendations on energy transition *(cont.)*

- Add overall building energy performance obligations to thermal regulations for existing buildings; make financial incentives for energy efficiency renovation conditional on an improvement in overall building performance.
- Encourage third-party investment.
- Structure the building renovation sector and increase training.
- Improve information on fuel poverty in order to better identify the issue and target assistance; evaluate the cost-effectiveness of such assistance.

Notes

1. As set out in the Energy Code, amended by the Energy Transition for Green Growth Act. The Energy Code, enacted in 2011, comprises all laws concerning the right to energy and includes the objectives of the POPE Act setting the direction of energy policy.
2. The debate was based on input from experts and the involvement of the public, and was completed in July 2013, with a summary document being officially presented at the Environmental Conference in September 2013.
3. These plans were introduced by the Grenelle II Law and are co-created by the regional prefects and the chairs of the general councils. They set the regional line for the fight against climate change, atmospheric pollution, air quality, demand management, renewable energies and adaptation to the 2020 and 2050 targets.
4. The average age of the reactors is thirty years, and their planned operational lifetime is forty years.
5. French regulations do not set a cap for the operating life of a nuclear power station. The Nuclear Safety Authority may, on a case by case basis, extend a reactor's operating life at the time of the ten-yearly inspection.
6. The European pressurised reactor (EPR) at Flamanville was initially expected to be launched in 2012 but this date has been pushed back to 2018.
7. The cost of the projected deep geological repository for radioactive waste has been estimated at EUR 14 to 28 billion, depending on the source.
8. Around twenty reactors will have been operating for over forty years in 2022.
9. Ordinance No. 2014-355 of 20 March 2014.
10. In the form of annual calls for projects for large scale biomass and heat facilities (> 1 000 toe/year) in the industrial, agricultural and tertiary sectors; for small scale projects, regional aid managed by ADEME at regional level.
11. Suppliers of electricity, gas, heat, cold, domestic heating oil and motor fuels.
12. Adjusted according to building use and geographic conditions.
13. 35 million meters will be installed by 2020, funded by EDF to the tune of EUR 35 million.

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