Energy transition: impact and economic stakes for firms

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Introduction

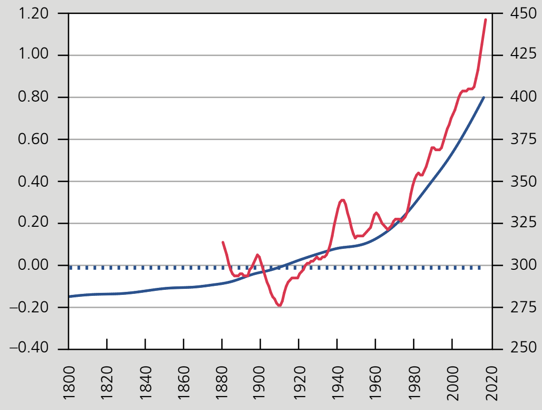
Tackling global warming is one of the main challenges facing both advanced and emerging economies. This necessarily implies transforming modes of energy production and consumption, or *energy transition*, a transition that aims to meet the primary objective of reducing greenhouse gas (GHG) emissions by limiting or reducing consumption of fossil fuels. In this general context, supplemented in Belgium by the decision to ultimately close down all nuclear power stations in accordance with the Law of 28 June 2015 [1], the Belgian energy mix is therefore bound to change considerably over the next few years.

This transition nevertheless has to be accomplished with due regard for certain economic constraints, such as safeguarding business competitiveness and ensuring security of the energy supply, so that it is not ultimately rejected by a section of the population that could become a collateral victim (through job losses in some economic sectors or an across-the-board increase in energy costs). Such considerations were taken into account in the inter-federal Energy Pact approved by the Regions and the Federal Government last March. In addition, the federal authorities have made various commitments as part of their energy strategy with a view to guaranteeing security of supply and keeping energy affordable (while respecting the Paris Agreement). They include in particular (a) defining an energy standard aimed at curbing the cost of energy (and its various components) compared with costs in the neighbouring countries, (b) establishing various monitoring systems (concerning climate change, energy prices, security of supply and nuclear safety) and a Federal Energy Committee bringing together the government, the Regions and business representatives, and (c) adopting the principle of a mechanism for remunerating electricity generation capacities so as to guarantee a robust and reliable power system. For many businesses, energy is in fact still crucial to their production process, but – like any other input – it needs to be used more efficiently.

The objective of this article is therefore to document the efforts made by companies over the last few years to reduce their ecological footprint, while highlighting some of the competitiveness issues, at both domestic and international level, associated with these developments. The first part recaps the commitments made in this area and the various policies implemented to encourage firms to adapt their business activities in line with the energy transition. The second part presents the findings of the main simulation exercises carried out at European level to assess the economic impact of the transition. However, the impact of these energy and environmental policies is not the same for all sectors and firms, and varies greatly depending on the processes they use or their level of energy efficiency. The third part begins by presenting the scale of energy costs per branch of activity before focusing on the potential consequences of the energy transition from the point of view of international competitiveness; in so doing, it compares the energy efficiency of Belgian firms

(*) The author would like to thank E. Dhyne for his valuable comments.
(1) *Moniteur belge / Belgisch Staatsblad* (2015), Law amending the Law of 31 January 2003 on the phasing out of nuclear energy for industrial production of electricity in order to guarantee security of energy supply, 6 July 2015.

CHART 1 CONCENTRATION OF GREENHOUSE GASES HAS SOARED AND AFFECTED THE CLIMATE



Sources: NASA, University of Bern, University of California.

(1) Deviation from the average over the 1880-1900 period, in degrees Celsius. Data for the period before 1880 are not available.

(2) Concentration in volume, parts per million (ppmv).

to that of their main competitors (neighbouring countries) and highlights any distortions of competition that may be caused by divergent regulations. The third part addresses the energy transition from the point of view of the constraints that it may impose on Belgian manufacturing industry, and in particular on its competitiveness, but that transition could ultimately be a source of growth since it requires the introduction of innovative technological solutions, which open up opportunities for developing new markets. The fourth part examines these aspects and the measures needed to enable Belgium to gain the maximum benefit from the transition. The fifth and final part presents our main conclusions.

1. The environmental constraints as a driving force behind the transformation of the European economy

1.1 Energy transition in a European context…

In ratifying the United Nations Framework Convention on Climate Change back in 1996 (1), Belgium opted to convert to a low GHG emission economy. That decision fits in with a wider European context of GHG emission reduction, improvement of energy efficiency and development of renewable energy sources (RES). For these three dimensions, the targets set by both the European and the Belgian authorities were in turn set out in the 2020 Climate and Energy Package launched in 2007 and in the 2030 Climate and Energy Framework adopted in October 2014.

These initiatives are in line with the EU’s long-term objectives set out in the roadmap *“for moving to a competitive low-carbon economy in 2050”*, which aims to reduce GHG emissions by at least 80 % from their 1990 level. Moreover, energy policy is identified as one of the Commission’s ten priorities for action over the period 2015-2019 (Energy and Climate Union). The legislative proposals concerning “Clean energy for all Europeans – unlocking Europe’s growth

(1) “The ultimate objective of this Convention (…) is to achieve (…) stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”

TABLE 1 TARGETS SET IN THE EUROPEAN FRAMEWORK FOR 2020 AND 2030
(in %)

	2020 Strategy		2030 Strategy
	EU	Belgium	EU
Reduction of GHG emissions from their 1990 level	–20	–15 (1)	–40 (2)
Increase in the share of RES in gross final energy consumption	20	13	30
Reduction of gross domestic energy consumption from the reference figure calculated in 2007	–20	–18	–27 to –30

Source: EC.
(1) A 15 % reduction in GHG emissions compared to their 2005 level by sectors not subject to the European emissions trading system.
(2) The effort is shared between sectors that are subject to the European emissions trading system and those that are not, with reductions of, respectively, 43 % and 30 % from their 2005 level. For the latter sectors, that meant a binding national target of a 35 % reduction for Belgium.

potential "(Clean Energy Package), put forward in November 2016, seek to "*cut CO2 emissions by at least 40 % by 2030 while modernising the EU's economy and delivering on jobs and growth for all European citizens*". They cover energy efficiency, renewable energy, organisation of the electricity market, security of power supply and governance rules. A strategy on connected and automated mobility is also proposed here, as well as several facilitation measures designed to speed up innovation supporting clean energy, to renovate buildings in Europe, to encourage public and private investment, to promote the competitiveness of EU firms and to ease the societal impact of the energy transition.

Last but not least, these various commitments dovetail precisely with the 2030 Agenda for Sustainable Development adopted in 2016 under the aegis of the United Nations, which explicitly sets out to "ensure access to affordable, reliable, sustainable and modern energy for all".

1.2 … transposed at national, regional and local levels

In the same way as for other issues, regionalisation in Belgium resulted in responsibilities relating to the energy transition being shared out among the different levels of power. While the federal State is in charge of matters "which need to be treated at national level, owing to their technological and economic indivisibility" (forecasting and security of supply, major infrastructures for energy production, storage and transport (including their pricing), and nuclear power), the Regions are responsible for local issues (local transmission and distribution of electricity and gas, heat and power networks, development of RES, and solutions for rational use of energy). There are arrangements for a dialogue between the different levels of government in order to ensure consistency between the various energy policy measures.

In practice, the energy transition centres on three focal points:

– improvement of energy efficiency, which is the best way of limiting the carbon footprint of human activities on the exploitation of the planet's resources and the associated GHG emissions;
– expansion of production of low-carbon sources of energy under affordable technical and economic conditions;
– electrification of final uses and substitution of fossil fuels by carbon-free sources of energy in intermediate and final consumption of energy [1].

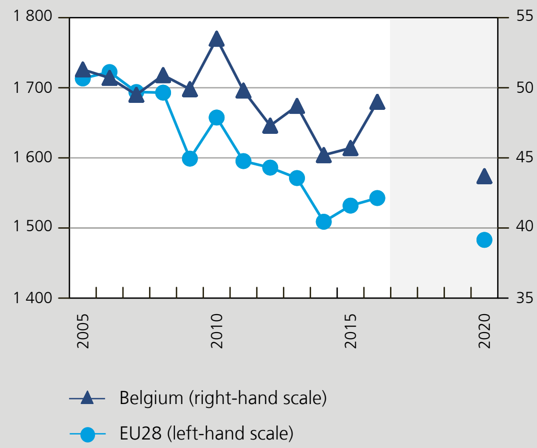
The last two points are of course crucial for achieving the targets. However, in this article we confine ourselves to analysing the first aspect. For Belgium, this means a target of reducing primary energy consumption by 18 % by the year 2020 from the reference level calculated in 2007, which implies cutting gross domestic energy consumption to 43.7 million tonnes of oil equivalent (Mtoe), converted to an indicative target of 32.5 Mtoe in terms of final consumption.

(1) The difference between primary consumption and final consumption is due to the processing of primary energy sources (nuclear, gas, solid fuels and oil), necessary to make them "usable" for consumers (mainly in the form of electricity and refined petroleum products).

Since 2005, primary energy consumption has been falling steadily in Belgium, although there was a sharp rise in 2016. In the coming years, efforts to cut energy consumption in Belgium therefore need to be maintained or even intensified, not just to honour the commitments made for the year 2020, but also to help achieve the target set by the European Parliament in January 2018 of a 35 % reduction in the EU's primary energy consumption by 2030.

CHART 2 CHANGE IN PRIMARY ENERGY CONSUMPTION OF THE EU28 AND BELGIUM AND INDICATIVE ENERGY EFFICIENCY TARGETS

(in million tonnes of oil equivalent)



Source: Eurostat.

The policies pursued by the various levels of government which rely essentially on action by companies themselves, concern measures to improve efficiency of energy use (energy audits and energy management systems) and energy supply (reinforcing rules that promote cogeneration), transversal actions in the area of approval and certification, training and information, and energy services [1]. Other actions apply more specifically to products: this concerns providing information about energy consumption of products through labelling, so as to help consumers to choose the products that use the least energy, and eco design requirements for these products, in order to limit their energy consumption throughout their life cycle.

In the Belgian institutional context, the federal government is in charge of policies regarding labelling of energy-related products, and the performance and eco design of appliances that consume energy. In regard to taxation, 13.5 % of the cost of environment-friendly R&D investment and energy-saving investment is tax deductible.

The Regions are responsible for the other policy measures. They have introduced various measures to encourage companies to adapt and improve their production processes through regulations, financial incentives and information; the implementing conditions vary according to the Region. The main instruments are:

(1) These policies come under the national energy efficiency programme and the related Directive 2012/27/EU.

– The regulatory energy audits that large enterprises [1] have to carry out every four years (in accordance with the EU Directive). In Wallonia, subsidies are available to help SMEs finance such audits. In Brussels, the obligation also applies to environmental permit applicants considered as large consumers. Companies that have set up an energy management system certified by the ISO 50001 standard guaranteeing adoption and application of a structured approach to energy management in their business activities (for processes, equipment and building infrastructures) are exempt from the audit in all three Regions. In 2016, 70 certificates covering 55 sites were granted in Belgium, the highest number since 2011 (178 certificates covering 103 sites were issued over the period from 2011 to 2016).
– The sectoral agreements on energy or voluntary branch agreements concluded between the regional authorities and business federations representing the most energy-intensive firms. Under these agreements, firms commit themselves to boosting their energy efficiency and reducing their energy consumption by drawing up – on the basis of a prior audit – an action plan identifying feasible and viable measures (in terms of estimated savings in energy consumption and investment costs), and then implementing it (obligation to deliver on commitments). In Wallonia, firms are also obliged to conduct surveys on RES potential, CO_2 mapping, and to establish a sector-specific roadmap for 2050. In Flanders, they pledge to examine the feasibility of combined heat and power, heating and cooling, and to adopt an energy management system. These agreements cover around 80 % of industrial energy consumption in both Wallonia and Flanders. In 2015, 187 Walloon entities and 334 Flemish ones were involved in such agreements and accounted for respectively 14 % and 53 % of the energy savings recorded in 2015 under the Energy Efficiency Directive (as reported to the European Commission during its follow-up to the measures). The rest of the savings are made on the basis of measures designed to improve the energy efficiency of both public and private buildings (subsidies for insulation, installation of energy-efficient boilers, etc.).
– Introducing financial counterparts to these commitments by reducing the burden on the energy bill (partial exemption from the surcharge for green power certificates), a reduction in green certificate quotas, or grants to fund audit studies. Aid for specific types of investment (biomass, cogeneration, "green heat") is also aimed at SMEs.
– Developing the market in energy-efficient solutions and the companies that provide them (known as energy service companies or ESCOs) and third-party investment formulas. These companies take charge of energy efficiency projects (design, installation, funding) over a long period of time. They bear the risk associated with the project's obligation to deliver in terms of energy savings (the result is contractually guaranteed in an energy performance contract) and are reimbursed by the beneficiary of the investment on the basis of the financial value of the energy savings made. Project stakeholders in the various types of energy service-related activities come from the banking sector, engineering companies, consultancies, and project facilitators.
– Education and training programmes, including energy counselling programmes aimed at promoting and developing energy efficiency measures.

2. Macroeconomic assessment of the impact of the energy transition

The measures guiding the economy's transition towards more energy-efficient operation with lower carbon emissions are based on various types of instruments and mechanisms : taxes, subsidies for investment or R&D, and regulatory constraints. The aim is to achieve a more energy-efficient allocation of resources which is more respectful of the environment but still preserves growth potential.

Although the ambitious targets entail costs in the adaptation of equipment and processes, the expense incurred in the short and medium term may be justified in the light of the long-term cost of failure to act in response to climate change. By becoming pioneers in less energy-intensive or more environment-friendly technological sectors, firms also gain opportunities for growth and for developing new activities and products.

The introduction of a carbon tax or any other mechanism that incorporates the environmental cost in product prices thus results in a change in the relative prices of "carbon-containing" inputs and therefore influences agents' choices : the rise in the energy bill has a negative effect on household incomes ; households respond by switching to lower carbon goods and services, though the net effect on growth depends on the scope for substitution. For firms, the unilateral adoption of such a tax has an *a priori* detrimental impact on their competitiveness ; since the tax influences the price of carbon-containing products, most of which are imported, the resulting substitution effect encourages the use of more

(1) Enterprises employing more than 250 full-time equivalents or whose turnover exceeds € 50 million and annual balance sheet exceeds € 43 million.

carbon-free (domestic) products, which in turn mitigates the negative impact on economic activity. This may even have a favourable influence on the trade balance. In the absence of any additional measures, the carbon tax nevertheless inhibits growth and has a short-term inflationary effect. However, the redistribution of the proceeds from the tax (for example, in the form of measures to reduce labour costs) helps to offset these negative effects, with a possible reduction in production costs, net job creation and an improvement in competitiveness and growth. Consequently, the economy reaps a double dividend: lower CO_2 emissions and higher GDP and employment.

More direct encouragement for the adoption of low-carbon goods and technologies can be given by schemes supporting investment (subsidies or feed-in tariffs) which benefit activity according to the multiplier effect associated with such investment. In that respect, the method of funding those measures may also influence the impact. As a rule, the impact will be smaller if the funding is provided by cuts in other government expenditure, rather than by borrowing.

A third approach entails imposing regulatory standards (emission standards, and technical standards for products or buildings) and thereby reducing the impact of pollution-creating goods and installations. These standards apply in the same way to all goods and installations, regardless of the marginal costs incurred in complying with them. However, they introduce distortion compared to a price-based approach. The end result depends on the available alternatives to polluting installations and the cost of compliance (Ouvrard *et al.*, 2014).

The macroeconomic impact studies that preceded the adoption of the various EU strategies on the subject investigated how intensified measures would affect GDP growth (and its components) and employment, including at sectoral level. The analyses and simulations were based on the use of a post-Keynesian macroeconometric model and a general equilibrium model. That made it possible to broaden the assessment of the possible implications, determine the necessary conditions, and define the conditions favourable to growth. The results of various energy policy scenarios were obtained exogenously (on the basis of the PRIMES model [1]) and incorporated in the assumptions adopted for the simulations, which also took explicit account of the investment funding issue.

In the macroeconometric model, higher prices for energy and CO_2 increase the cost of carbon-containing products, thus reducing household purchasing power and influencing business competitiveness, and hence GDP. Conversely, the increased investment needed to meet the targets contributes to the expansion of sectors such as construction or engineering services, and that supports growth, as does the replacement of some of the expenditure on fossil fuels with expenditure on "low-carbon" domestic products. As regards employment, those mechanisms lead to a reallocation of labour in favour of highly labour-intensive activities.

In the general equilibrium model, the impact on growth depends on the combination of the positive effects on domestic activity resulting from the reduction in imports of fossil fuels, the increase in (domestic) demand for "low-carbon" goods and services, and the lower costs facilitating progress along the learning curves of certain technologies. However, the substantial initial investment entailed (though subsequently offset by lower energy costs) puts a strain on household and business finances and may have the effect of displacing other investment or consumption expenditure if savings are used. In a tight labour market, the pressure on wages may likewise affect costs.

In the end, the impact assessments indicate a predominantly beneficial macroeconomic effect on growth and employment, in which the initial adverse effect on growth (change in relative prices) is later offset by the expansion resulting from the switch to low-carbon domestic products and technologies, made possible by technological progress. However, this does not mean that the growth is evenly distributed across the branches of activity, as demand is diverted away from energy-related branches. As far as the competitiveness of energy-intensive sectors is concerned, there is little change in the energy-related costs (capital costs generated by new investment, energy purchases, emission rights) expressed in terms of value added, as the capital costs are offset by savings on energy purchases (EC, 2016).

(1) PRIMES is a detailed partial equilibrium model for the energy market, developed at EU and Member State level. It models the energy system for all sectors and for all types of fuels.

The main findings of these impact studies are set out in the table below for the Reference 2016 scenario, based on the measures and provisions that have already been adopted, and for the EUCO27 and EUCO30 scenarios, which assume that additional measures are taken to reduce gross domestic consumption by respectively 27 and 30 % from the reference level calculated in 2007 (and by 24 % in the case of the Reference 2016 scenario). The negative results in terms of growth and employment projected in the general equilibrium model are related to the assumption of financing from own funds (savings, cutting consumption).

TABLE 2 **IMPACT OF STEPPING UP THE ENERGY EFFICIENCY TARGET AT EUROPEAN UNION LEVEL BY 2030**
(in %, unless otherwise stated)

	Reference 2016	EUCO27	EUCO30
Reduction of GHG emissions from their 1990 level	–35	–41	–41
Share of RES in gross final energy consumption	24	27	27
Energy expenditure in % of value added for energy-intensive industries	40.3	40.8	40.1
GDP (in € billion in 2013 and in % against the reference year 2016)			
Macroeconometric model	17 928	0.65	1.05
General equilibrium model	16 955	–0.28 to 0.04	–0.50 to 0.30
Employment (in million units and in % against the reference year 2016)			
Macroeconometric model	233.1	0.17	0.34
General equilibrium model	216.4	–0.18 to 0.09	–0.36 to 0.29

Source: EC (2016).

Impact assessments have also been carried out using microeconomic data. On the basis of individual data for French firms covering the period from 1997 to 2010 (a period marked by a sharp drop in the volume discounts granted to big industrial consumers of gas and electricity), Marin *et al* (2017) demonstrated that while a 10 % rise in energy costs for an individual establishment yields a 6.4 % reduction in energy consumption and an 11.5 % reduction in CO_2 emissions, it also reduces employment and wages by 2.6 % and 0.4 % respectively. The impact on employment is amplified if the sector concerned is energy-intensive (a significant reduction in employment of 3.2 %, compared with 1.3 % (nevertheless not significant) in other branches) or if the sector is exposed to international competition (a significant reduction in employment of 3.1 %, compared with 1.6 % in companies that are less exposed). According to the authors, the trade-off between employment and environmental protection measures via a change in relative energy prices involves three mechanisms: the rise in energy prices has an adverse effect on production and employment; more expensive energy is replaced by other inputs (capital and labour); and the innovation induced by relatively higher prices for lower-carbon products curbs the slowdown in output and opens up more scope for substitution. Theoretically, the final outcome is open-ended and depends on the scope for substitution, technological developments, and compositional adjustments between and within branches of activity (with, for instance, stronger growth and a competitive advantage for firms using fewer polluting inputs).

3. The energy transition and competitiveness

While societal choices also apply to the corporate world, the energy transition must not take place at the expense of the competitiveness of firms, and consequently that of the country's entire economic fabric. The targets for cutting energy consumption aim primarily to keep production costs under better control and reduce the energy intensity of production and consumption processes. Companies operating in fiercely competitive markets are bound to benefit from such moves to enhance their productive efficiency. However, they sometimes need incentives to change their behaviour. The best incentive for reducing energy consumption is to change relative price signals, by putting up the prices of fossil fuels and products derived from processing these energy sources.

But if some countries, sectors of activity or businesses enjoy preferential access to fossil energy sources, that approach may lead to distortions of competition that could put Belgian industrial firms at a disadvantage with their competitors, whether they are based outside the European Union or within the EU's Single Market. This part of the article documents the scale of energy inputs for Belgian industrial production and identifies the branches of activity most exposed to possible distortions of competition.

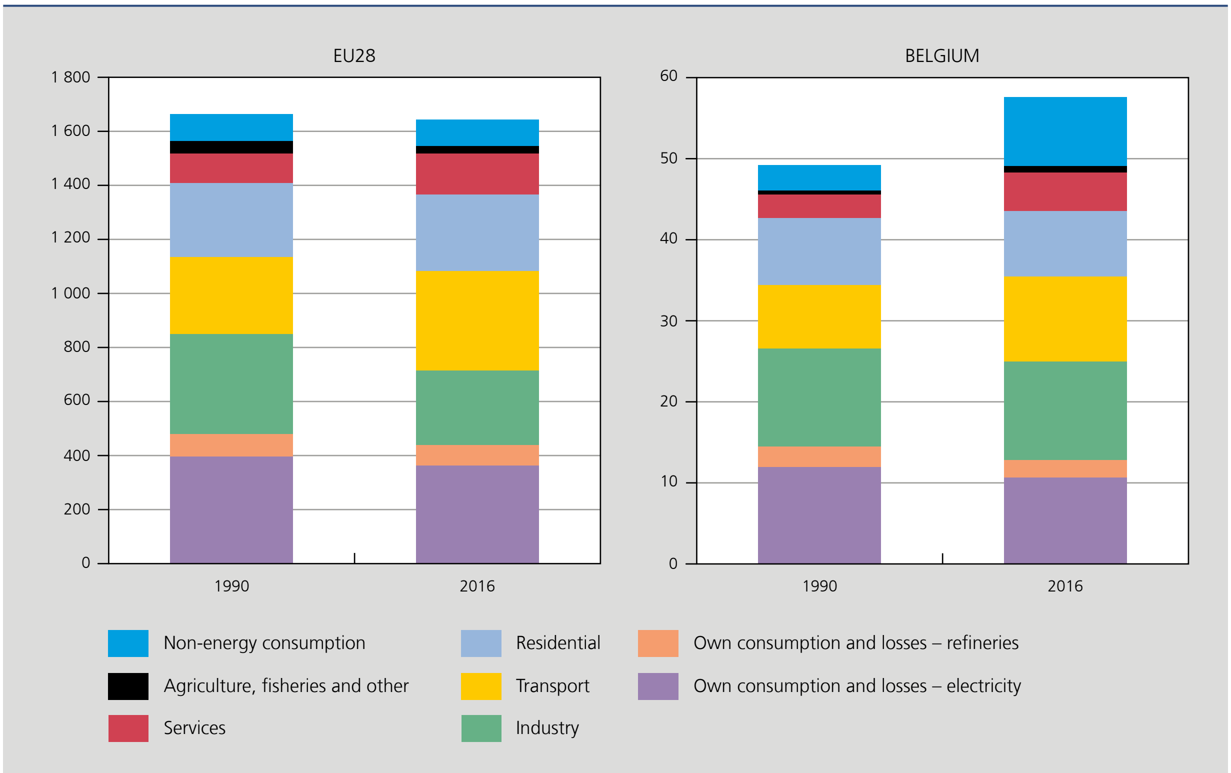
3.1 Energy consumption and energy intensity in Belgium

At global level, the improvement in energy intensity (primary energy consumption per unit of GDP) is gaining ground: since 2010, it has fallen by 2.1 % a year, compared with 1.3 % over the period from 1973 to 2010. These efforts must continue, and energy efficiency is an important lever here. In fact, since 2014, improvements in energy intensity have offset three-quarters of the impact of GDP growth on GHG emissions, while greater recourse to RES and use of alternative, lower-carbon-emission fuels have helped cover the rest (IEA, 2017).

While gross domestic energy consumption (1) declined slowly at European level between 1990 and 2016, in Belgium it rose by 18 % following the sharp acceleration of non-energy final consumption of petroleum products (which tripled) and natural gas (which doubled), used as raw materials by the petrochemicals industry. Energy consumption in the

CHART 3 BREAKDOWN OF GROSS DOMESTIC ENERGY CONSUMPTION BY BRANCH IN THE EU28 AND IN BELGIUM, IN 1990 AND IN 2016

(in million tonnes of oil equivalent)



Source: Eurostat.

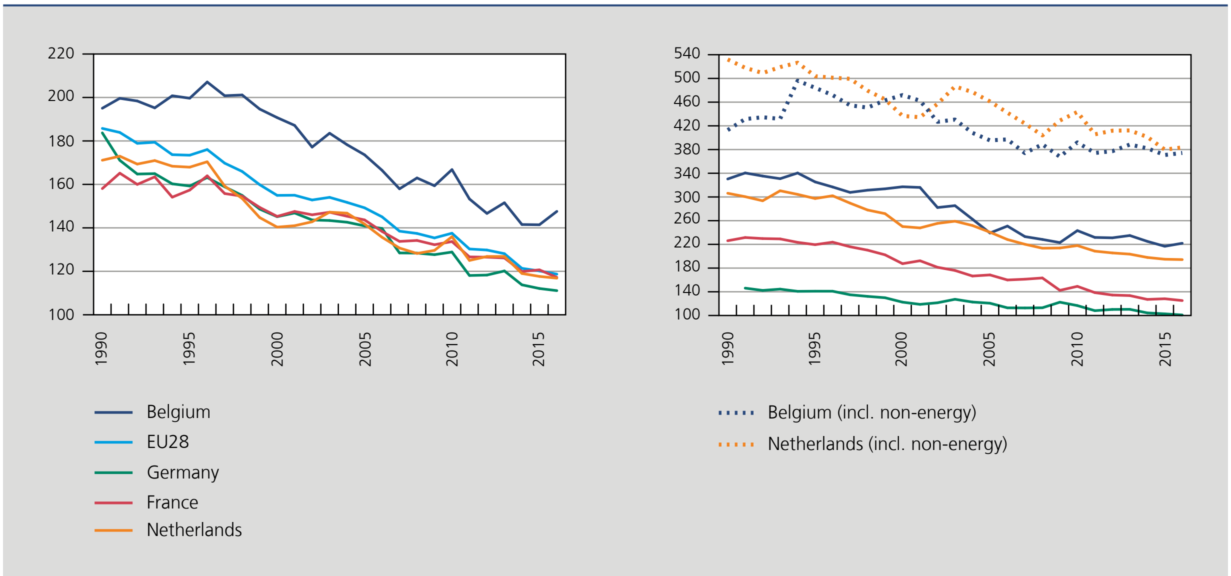
(1) Gross domestic energy consumption represents the quantity of energy required to meet the domestic energy consumption of a given country. Final energy consumption is obtained after the primary energy sources (nuclear, gas, solid fuels and oil) have been processed into forms that are "usable" for consumers, essentially electricity and refined petroleum products. The difference between the two concepts relates to processing and transport activities, which also use energy (own consumption) but which above all generate transformation losses (mainly related to power station efficiency) and transmission losses (on the gas and electricity networks). The energy available for final consumption by businesses and households is divided between final consumption for energy use and for non-energy use (energy products used as raw materials).

transport sector, for both private and business use, also recorded an increase of around 35 % as a result of expanding international transport by road and by air, while consumption attributable to inland waterways is falling. Consumption by industrial sectors (excluding non-energy use) declined by 1 %, but the trend varies from one sector to another: the sharp rise in consumption by the iron and steel industry is offset by a similar reduction in energy consumption by the chemicals/petrochemicals sector. Consumption by the – relatively energy-intensive – food, paper and timber sectors is also coming down. Structural effects caused by the shift in the domestic production network towards more service activities [(1)] cannot be excluded. Lastly, production for own consumption and transformation and transmission losses in the production and distribution of gas, heat and power have declined, but still accounted for 19 % of Belgian domestic primary energy consumption in 2016, a similar proportion to transport.

As already noted, the trend in Belgium's consumption of energy deviates from that of the EU as a whole, as its final energy consumption is still relatively concentrated on energy-intensive industrial activities, even for non-energy uses (oil and gas used as raw materials, especially in petrochemicals): in 2016, that concerned 19 % of final energy consumption in Belgium, compared with 9 % in Germany and 8 % in France. Only the Netherlands – which is also home to a major petrochemicals cluster – posted a higher share of final consumption for non-energy purposes, of almost 21 %. Trends in energy intensity in fact vary more between countries if industry is considered on its own, and mainly reflect the specific nature of the Belgian and Dutch industrial fabric.

CHART 4 ENERGY INTENSITY IN BELGIUM, GERMANY, FRANCE, THE NETHERLANDS AND AT EU28 LEVEL, FOR THE ECONOMY AS A WHOLE [(1)] AND FOR MANUFACTURING INDUSTRY [(2)], 1990-2016

(in tonnes of oil equivalent per € million of GDP and value added)



Source: Eurostat.

(1) Gross domestic energy consumption per unit of GDP in chained euros, with 2010 as reference year.

(2) Final consumption of manufacturing industry per unit of value added in chained euros, with 2010 as reference year.

The reduction in energy intensity of manufacturing industry as a whole nevertheless conceals differences in levels and trends between industrial branches, taking account of the production processes implemented and their potential for improving energy efficiency. Contrary to what is observed in the neighbouring countries, energy intensity in the food, textiles and leather, and wood and paper product industries is rising in Belgium, and remains at a higher level there. The non-metallic mineral products branch, which includes cement production, is the most energy-intensive (after chemicals, if non-energy uses are taken into consideration), including in comparison with other countries. The Belgian chemicals industry's energy intensity is fairly stable and well below that of its Dutch counterpart. Nevertheless, Belgium

(1) Where energy consumption is, moreover, on the increase.

has to contend with a specific structural effect since it is more specialised in energy-intensive branches of activity than the neighbouring countries: in terms of value added, the share of the chemicals and petrochemicals, metallurgy and non-metallic mineral product branches accounts for 27 % in Belgium, compared with 18 % in the Netherlands and 14 % in France and Germany.

However, it should be noted that, overall, Belgium's manufacturing industry seems to be more energy-intensive than that of its three main neighbours. This may indicate that Belgium is lagging behind in adopting technologies that use less energy, or that Belgian industry is positioned in the most energy-intensive segments of the European value chains. While it is difficult to distinguish the contribution of these two factors, it is worth noting that, as demonstrated by Dhyne and Duprez (2015), compared with its three main neighbours, Belgium is in fact more specialised in branches of activity that tend to be further upstream in the global value chains. Those initial stages of production generally tend to have the highest fossil fuel content.

TABLE 3 ENERGY INTENSITY OF THE MANUFACTURING BRANCHES (NACE REV. 2) IN BELGIUM, GERMANY, FRANCE AND THE NETHERLANDS, IN 2000 AND IN 2015

(in tonnes of oil equivalent per € thousand of value added)

	Belgium		Germany		France		Netherlands	
	2000	2015	2000	2015	2000	2015	2000	2015
Manufacturing industry	0.32	0.22	0.12	0.10	0.19	0.13	0.25	0.19
Manufacturing industry (including non-energy uses)	*0.47*	*0.37*	*0.18*	*0.14*	*0.27*	*0.19*	*0.44*	*0.38*
of which:								
Food, drink and tobacco industries	0.15	0.17	0.10	0.10	0.14	0.12	0.18	0.15
Textiles, clothing, leather	0.12	0.15	0.10	0.08	0.23	0.06	0.15	0.08
Wood, paper and printing articles	0.24	0.34	0.20	0.30	0.43	0.24	0.22	0.16
Chemicals, petrochemicals and pharmaceuticals industry	0.29	0.31	0.21	0.23	0.28	0.14	0.92	0.65
Chemicals (including non-energy uses)	*0.89*	*0.88*	*0.61*	*0.49*	*0.82*	*0.48*	*2.34*	*1.89*
Other non-metallic mineral products	0.57	0.57	0.43	0.43	0.45	0.44	0.38	0.35
Metallurgy	1.57	0.36	0.79	0.78	1.35	1.10	2.17	1.51
Transport equipment	0.05	0.08	0.04	0.02	0.07	0.05	0.04	0.02
p.m. Share of the most energy-intensive branches (1) in manufacturing industry's value added	*0.28*	*0.27*	*0.16*	*0.14*	*0.14*	*0.14*	*0.17*	*0.18*

Sources: Eurostat, EU-KLEMS.
(1) Chemicals and petrochemicals, metallurgy and other non-metallic mineral products.

3.2 Reducing the burden of energy costs

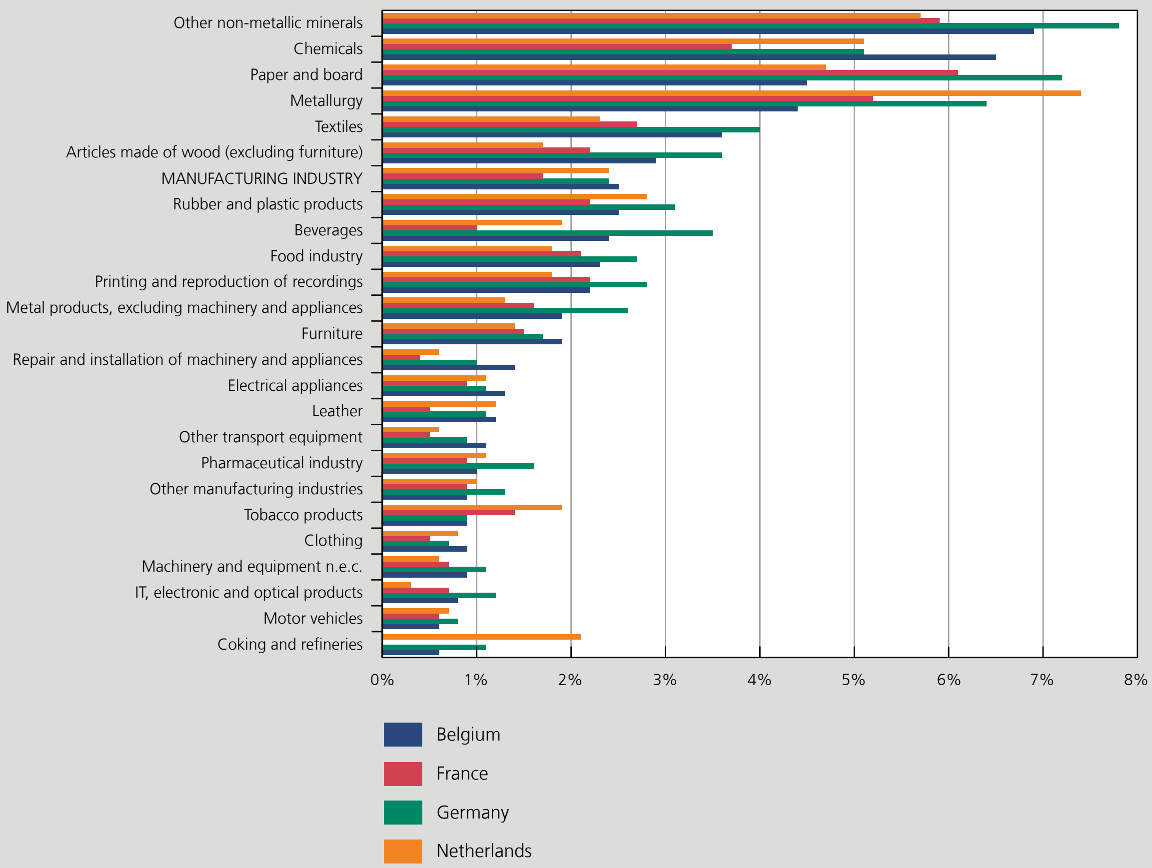
Like other costs, energy expenses are a factor in the competitiveness of some branches and firms, depending on the relative level of that expenditure. Detailed statistics for enterprises published by Eurostat provide data that may shed a different light on the relative level of these expenses for the various industrial branches (at NACE Rev.2, 2- and 3-digit level).

It appears that, on average over the period from 2008 to 2015, energy costs accounted for 2.5 % of Belgian industrial firms' expenditure on goods and services and wage bills, a similar level to that seen in Germany and the Netherlands (2.4 %), but slightly above the figure of 1.7 % for France. In manufacturing industry, these expenses are in fact relatively minor, compared for example with spending on wages (which corresponds to around 10 % of costs in Belgium).

Among the branches incurring energy costs proportionally higher than this average, the chemicals industry – which accounts for 14 % of value added and 9 % of employment in manufacturing industry – bears a much heavier energy cost burden in Belgium compared to the neighbouring countries. A similar situation, which also applies to the same branches in Germany, is true for non-metallic mineral products, textiles and wood products.

CHART 5 SCALE OF ENERGY EXPENDITURE IN MANUFACTURING INDUSTRY

(in % of costs of goods and services and wage costs, average over 2008-2015, ranked in descending order for Belgium)



Source: Eurostat.

In order to refine the analysis, we consider three branch profiles based on the (average) relative level of their expenditure on energy: branches in which companies' energy costs exceed 10 %, on average, and where energy management is critical for their competitiveness; branches where energy costs range between 5 and 10 %, where greater energy efficiency enhances competitiveness; and branches where energy costs account for less than 5 % of their expenses and are not a priority. According to the microeconomic data, energy costs account for over 5 % of total expenses for around 15 % of all firms on average in Belgium, and actually represent over 10 % of their costs for one-third of these firms. The proportion of companies concerned nevertheless declined between 2008 and 2015.

The (NACE 3-digit) branches in which energy costs represent, on average, more than 5 % of firms' expenses correspond to about 17 % of value added and 13 % of employment in Belgium (for branch details, see table in the annex). These are the highest proportions in comparison to the neighbouring countries. Branches where companies' spending on energy exceeds 10 % of their costs, on average, account for only around 1 % of Belgian manufacturing industry's employment and value added. The figure is three times as high in Germany.

TABLE 4 SHARE OF VALUE ADDED AND EMPLOYMENT IN BRANCHES [1] WHERE ENERGY COSTS ACCOUNT FOR MORE THAN 5 % OF EXPENDITURE ON GOODS AND SERVICES AND WAGE COSTS

(in % of value added and employment in manufacturing industry, average 2008-2015)

	Belgium		Germany		France		Netherlands [2]	
	Value added	Employment FTE	Value added	Employment FTE	Value added	Employment FTE	Value added	Employment FTE
10 % > Share of energy costs ≥ 5 %	15.9	12.4	6.7	4.8	7.5	6.5	11.7	7.0
Share of energy costs ≥ 10 %	1.1	0.9	3.4	3.2	1.4	1.1	2.3	2.7

Source: Eurostat.
(1) As the criterion used is the relative level of energy costs, the branches considered (at NACE Rev. 2, 3-digit level) may vary from one country to another.
(2) The figures for the Netherlands are minimum amounts as the data are not available for several branches at this level of detail.

3.3 Energy prices as a determinant of competitiveness

While energy cost management can be improved with the help of energy efficiency measures, the scale of energy expenses is also influenced by the prices charged to industrial consumers. Among the latter, producers in the chemicals sector – where no distinction can be made according to specific basic products – are particularly affected by movements in energy prices in other regions of the world in relation to prices in Belgium and in Europe. The respective situation of American, Japanese, European and Belgian industrial consumers in the face of these trends is illustrated on the basis of the index for unit values of sales to industry deflated by the producer price index for gas and electricity. There are actually very substantial variations in network energy prices between the regions, even before tax.

While gas prices displayed a predominantly upward trend for Japanese and European consumers until 2013-2014, there was a particularly marked fall in the prices charged to American consumers in 2008-2009, when increasing supplies of shale gas came onto the US market. That fall was initially also reinforced by the US authorities maintaining their gas export authorisation procedures. Moreover, the taxes levied, which vary from one State to another, are generally modest (2 to 6 %).

By contrast, from 2008 onwards, prices on the Japanese market virtually doubled in the space of five years. That reflected both tightening of the liquefied natural gas market in the Pacific Basin (where Japanese buyers get their supplies) and the steep rise in domestic demand which resulted from recourse to gas-fired power stations to replace the coal-fired plants destroyed in the 2007 earthquake, and from the Japanese government's willingness to use gas rather than coal to generate electricity. The nuclear accident at Fukushima in 2011 and the concomitant decision to suspend nuclear power generation further accentuated demand for gas and increased the pressure on prices. What is more, prices charged to industrial consumers are also driven up by a wholesale market structure that is still highly concentrated, and by cross-subsidisation in favour of Japanese residential consumers.

On the European gas market, too, there has been a slight reversal of the trend since 2010-2012, due to generally plentiful supplies (arrival on the markets of US liquid natural gas (LNG) as a result of new liquefaction investment projects), in a context of rather weak demand from both industry and electricity generating plants on the European markets. Gas-fired power stations are used less frequently than coal-fired power plants, which enjoy advantageous fuel prices.

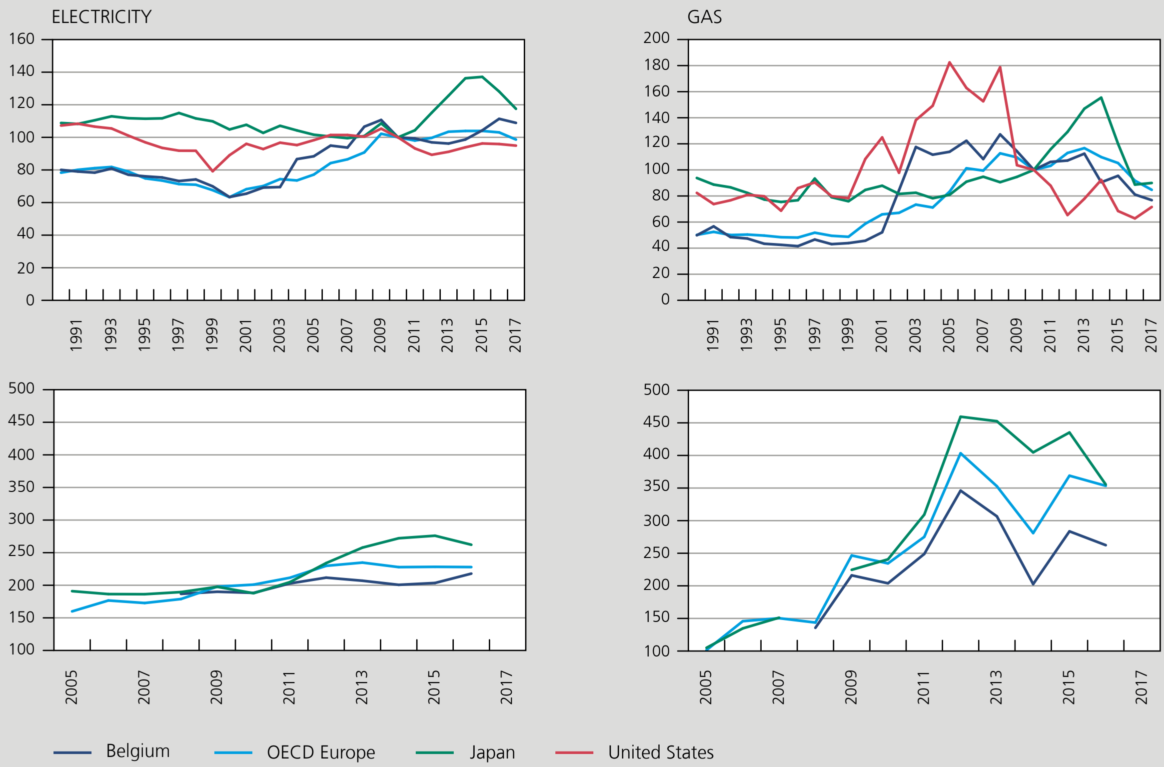
The differentials compared with prices paid by US industrial consumers narrowed a little in 2016, but European prices are still between 2 and 2 ½ times as high. The extraction of non-conventional gas (and oil) in the United States has also led to parallel production of natural gas liquids (NGLs) and condensates. These hydrocarbons comprise different molecules that are traded on diverse markets, either as fuel or as raw materials. The availability of gas and cheap NGL supplies

CHART 6 INDEX OF UNIT VALUES OF SALES OF ELECTRICITY AND GAS TO INDUSTRY IN BELGIUM, EUROPE, JAPAN AND THE UNITED STATES SINCE 1990

(index 2010 = 100)

COMPARISON BETWEEN UNIT VALUES OF SALES OF ELECTRICITY AND GAS TO INDUSTRY IN BELGIUM, EUROPE AND JAPAN AND THOSE IN THE UNITED STATES [1]

(in %)



Source: IEA (2018).
(1) Ratio calculated on the basis of unit values expressed in purchasing power parity.

therefore gives American industrialists another advantage over foreign competitors, namely for non-energy uses [1] in petrochemicals for ethylene production (used for many polymers and polyethylene, PVC and PET), or for production of ammonia-based fertilisers.

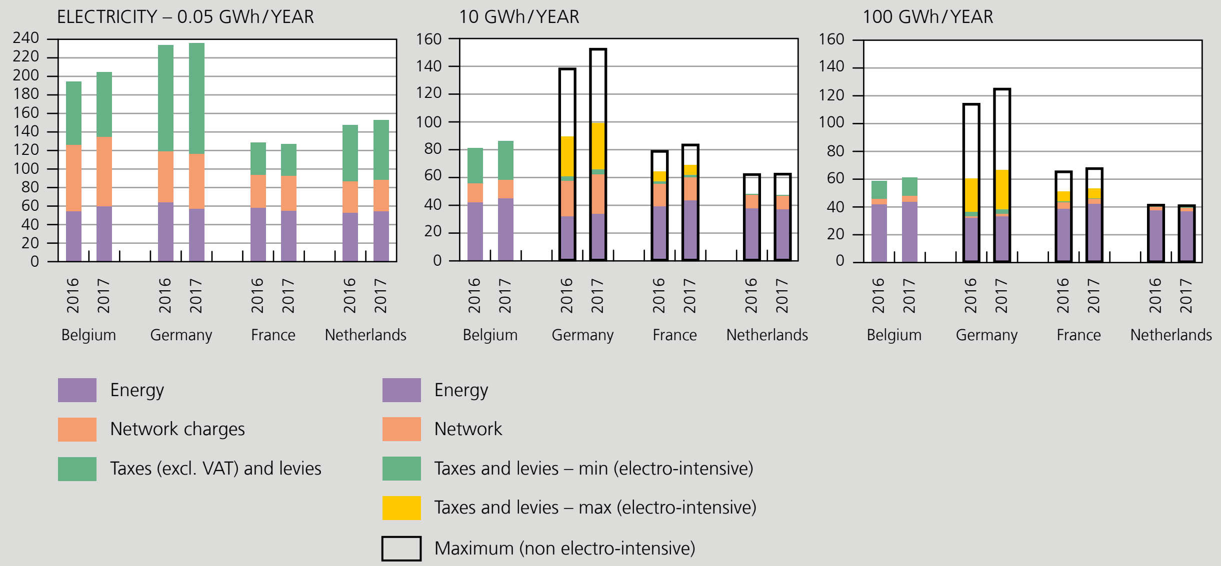
As for electricity prices, they are influenced by the structure of the production facilities (and the related production costs) and by divergent economic policy objectives (be they environmental or social), such as funding in the form of levies that may affect prices charged to the final consumer, including industrial users. The difference compared to electricity prices in Japan is due to adaptation of the production facilities, involving increasing use of gas. Electricity price differentials in relation to US industrial prices have gradually widened as a result of the increasing price advantage enjoyed by Americans thanks to the expanding production of cheap shale gas, which has replaced coal in electricity generation.

Electricity prices in Belgium differ considerably from those in neighbouring countries. Apart from energy prices as such, network charges and taxes or levies sometimes exert a substantial influence on price levels. The analysis covered the prices for three levels of consumption: annual consumption of 50 000 kWh as billed to small business users, annual consumption of 10 GWh, and annual consumption of 100 GWh.

(1) Owing to its composition, gas (methane CH_4) is often used as a source of carbon and hydrogen in chemical and petrochemical industrial processes, such as the production of ammonia or methanol. If methane is used as a chemical reagent for cracking and reforming processes in the production of ethylene, propylene, butylene, aromatics and other plastic raw materials, then it is classified as non-energy use.

CHART 7 ELECTRICITY PRICES FOR SMALL BUSINESS CONSUMERS AND INDUSTRIAL CONSUMERS, BY LEVEL OF CONSUMPTION, IN 2016 AND 2017

(in €/MWh)



Sources: CREG and PwC (2017)[1].

(1) The CREG data on small business consumers (annual consumption of 0.05 GWh for electricity and 0.1 GWh for gas) are based on a representative selection of products invoiced to the end user. This concerns a weighted average of energy prices based on the default supplier's standard offer in a particular Region, the best offer in the same Region as that supplier, and a competing offer by the second market supplier. For an objective comparison between countries, each sub-component of the electricity and natural gas prices is adjusted, if necessary, to exclude – for example – the effect of renewable energy costs included in the supplier's price, or the costs of the public service obligations imposed on the network operators, and to impute them to the surcharges.

The prices charged to large industrial consumers were recorded in January each year. The commodity prices were derived from the same combination of various prices recorded (on varying maturities) on the markets of the various countries. In the case of France, the regulated price was also taken into account.

The small business customers considered here are charged a tariff comparable (5 % lower) to that for residential customers (excluding VAT). The variations between countries are greatest in the tax and levies component: small business users in Germany have to make a large contribution (in the same way as residential consumers) towards funding the country's policy of supporting RES. Belgium has the largest network component, including in relation to neighbouring countries. The smallest differences are seen in the energy component.

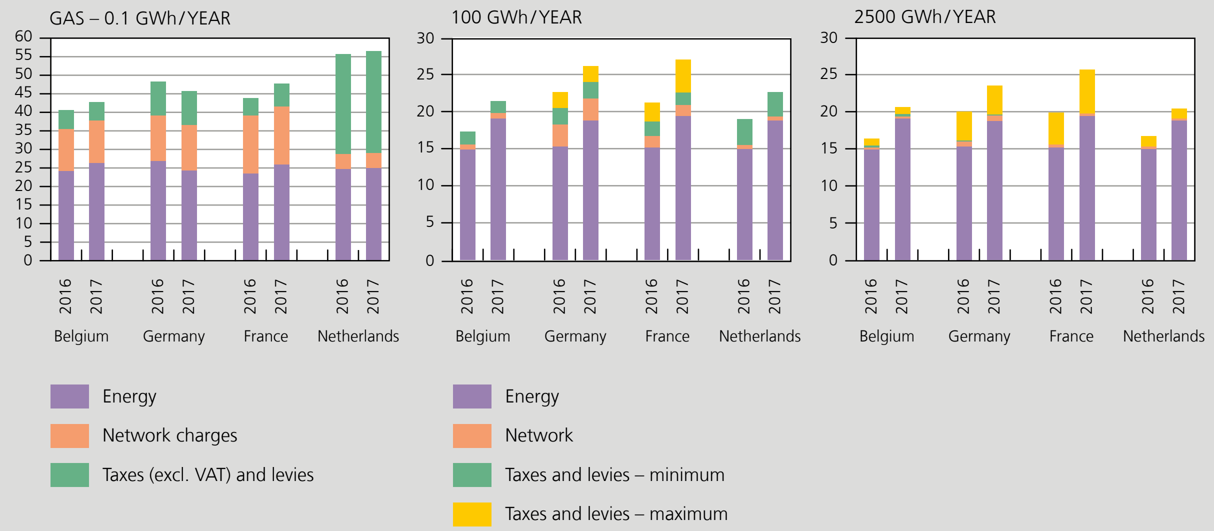
For the largest industrial consumers, the cost of the energy component is virtually identical for the various annual consumption levels[1], yet it is accounting for the existence of a competitive advantage between the various countries, consumers in the Netherlands and Germany enjoying lower market prices. There are wide variations in transport costs between countries, with particularly high charges in Germany. However, those charges decline rapidly as consumption increases: exemptions or tariff reductions enable large electro-intensive consumers in Germany, in particular, to improve their competitive position. The tax burden also declines as consumption increases, owing to the degressive nature of the taxes. In Germany, large industrial consumers which are not electro-intensive pay a hefty sum in taxes and levies. However, if the consumers are classed as electro-intensive, then the corresponding prices invoiced are much lower than in Belgium, and that applies to all countries. The neighbouring countries use a criterion for the consumers' electro-intensity for the purpose of graduating the tax levies (with exemptions that increase for more electro-intensive consumers). That is not so in Belgium, where the levies only depend on the consumption profile (and the type of grid connection).

As regards gas prices, three annual consumption levels were considered: the small business consumer using 0.1 GWh/year for whom the tariffs are similar to those for residential consumers, and the levels corresponding to large

(1) On the basis of the hourly rates for electricity outside weekends for the lower consumption level, and all hourly rates for the higher consumption level.

CHART 8 GAS PRICES PAID BY SMALL BUSINESS CONSUMERS AND INDUSTRIAL CONSUMERS, BY LEVEL OF CONSUMPTION, IN 2016 AND 2017

(in €/MWh)



Sources: CREG and PwC (2017).

industrial consumers, at 100 and 2 500 GWh/year respectively. In this last case, it is assumed that gas may be used as a raw material.

The gas price is largely determined by the commodity cost, to a greater degree than the electricity price. For small business consumers, the price is highest in the Netherlands, despite the low network charges, because the Dutch government imposes high surcharges via the *Regulerende Energiebelasting* in order to encourage energy saving and a reduction in CO_2 emissions.

For industrial consumers, the differences in commodity costs between countries are smaller than in the case of electricity, owing to a degree of market price convergence. Although the network costs plus taxes and surcharges represent a relatively small share, they are decisive for price competition between the various countries. For example, in the case of annual consumption of 100 GWh/year, Belgian industrial consumers enjoy the most competitive prices, which also benefit from low transport charges, even though – in France and Germany – exemptions may also be granted on the basis of economic criteria (such as participation in a carbon market). In all countries, very large industrial consumers (annual consumption of 2 500 GWh) qualify for volume-related tax exemptions. The taxes and levies are highest in France and Germany, and lowest in Belgium. If industrial consumers use gas as a raw material, they enjoy additional exemptions which result in a substantial reduction in the general level of taxes and levies in all countries. Nevertheless, Belgian industrial customers pay the highest taxes in that case.

4. Energy transition and growth opportunities

According to the impact analyses, it will require annual investment of around € 380 billion (1) in the EU during the period 2020-2030 to meet the set targets. That investment primarily concerns energy efficiency, RES, infrastructure and installations. By taking an active part in that process, firms therefore gain new opportunities for growth.

(1) Excluding investment in transport, namely € 736 billion in annual expenditure in 2013 (EC, 2016).

4.1 The energy transition creates new types of demand, ...

Firms need to make an effort regarding the operation and maintenance of installations and processes, especially if they are energy intensive. In that connection, the minimum energy efficiency requirements under the Ecodesign Directive 2009/125/EC apply to energy-related products in 25 categories of products and installations, such as electric motors, ventilation units, circulation pumps or hydraulic pumps. Innovation and standardisation efforts are also needed to ensure that products and equipment supplied to business customers comply with the Directive's requirements.

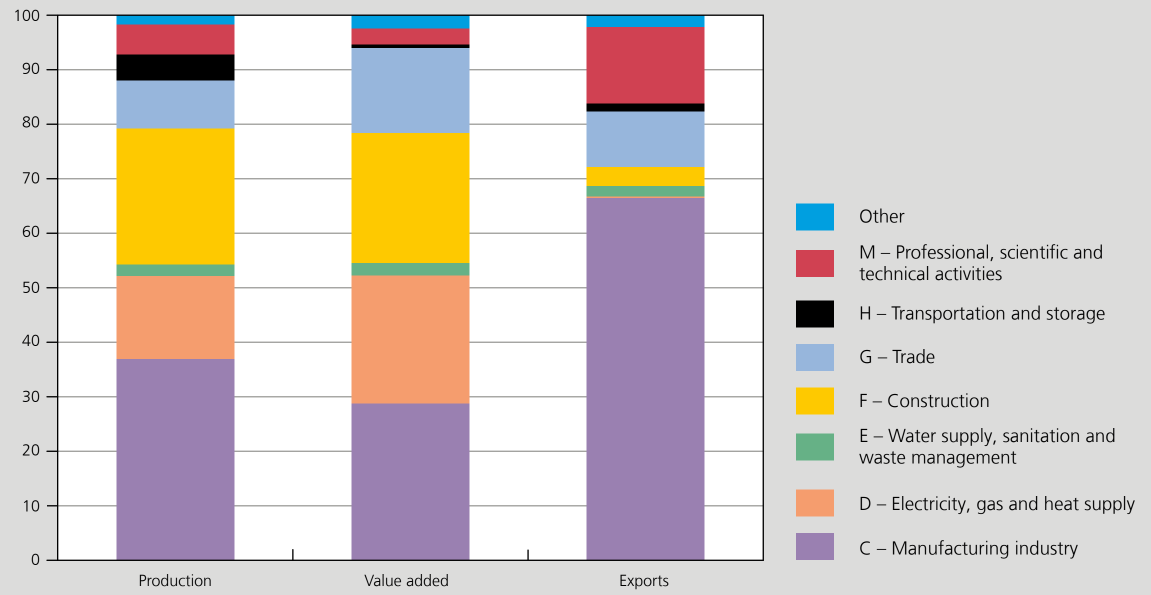
A major part of the energy efficiency policy is also devoted to improving the energy performance of the stock of buildings via Directive 2010/31/EU on the energy performance of buildings and the role to be performed by the construction industry and – upstream – the suppliers of building materials and other energy-related equipment (boilers, air conditioning, lighting).

The economic importance of activities concerning the transition to a low-carbon energy system is addressed indirectly in the environmental economic accounts drawn up by the Federal Planning Bureau. These satellite accounts of the national accounts measure the impact of human activities on the environment (namely activities aimed primarily at reducing or eliminating stress on the environment and making more efficient use of natural resources). This concerns both activities relating to environmental protection and those relating to the management of natural resources, including the management of energy sources. This last aspect covers the production of renewable energy, energy and heat saving (insulation work), and activities aimed at reducing the use of fossil energy sources as raw materials.

On that basis, firms involved in the management of energy sources have generated around 0.4 % of the gross value added generated by market activities. Their market output corresponds to roughly 0.6 % of Belgian production. Their exports also brought in almost € 1.6 billion, representing 0.5 % of Belgian exports. Firms in manufacturing industry account for most of these exports, both in the production of renewable energy and in energy saving or activities aimed at reducing the use of fossil energy sources as a raw material. The construction industry represents roughly 25 % of the value added and production resulting mainly from activities relating to energy saving and the development of RES.

CHART 9 BRANCH BREAKDOWN OF ENVIRONMENTAL GOODS AND SERVICES RELATING TO THE MANAGEMENT OF ENERGY SOURCES IN TERMS OF PRODUCTION, VALUE ADDED AND EXPORTS

(average 2014-2015, in %)



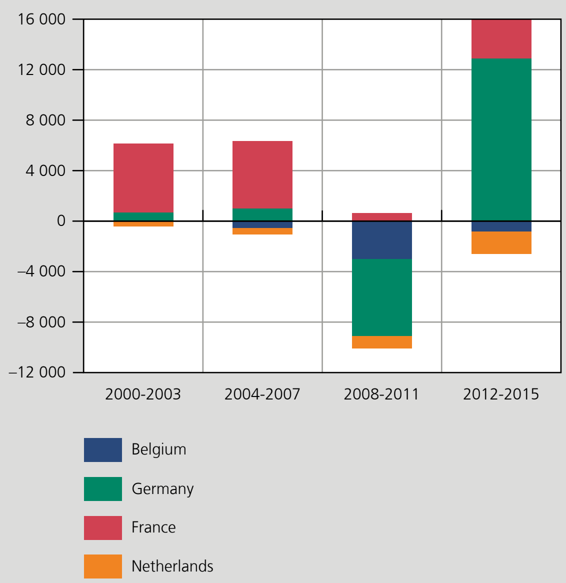
Source: FPB (2017).

The sale on international markets of products developed on the basis of low carbon energy technologies is likewise a driver of sustainable economic growth [1]. An analysis conducted for the Commission (Pasimeni, 2017) indicates that, in the EU28, exports relating to low carbon energy technologies doubled in value, from a total of € 34 billion over the period 2000-2003 to € 71 billion in 2012-2015, primarily in the wind power, heat production and energy storage sectors. EU imports more than tripled between 2000-2003 and 2008-2011 (up from € 26 billion to € 93 billion) and came to € 60 billion in 2012-2015. That is the direct result of the exponential growth of imports of photovoltaic equipment, reflected in a net deficit of almost € 62 billion for the EU28 during the period 2008-2011. It is notable that the total value (sum of exports plus imports) of trade within the EU28 relating to low carbon energy goods exceeds the figure for trade outside the EU28.

During the period examined, the net external balance of that trade was always negative for Belgium, and deteriorated sharply in 2008-2011. Among the three main neighbouring countries, France always recorded a positive balance, largely thanks to trade in equipment used for heat production, gas-fired power stations and clean coal power stations. While trade with countries outside the EU28 seems to have picked up, France's trade within the EU28 is still well below its pre-crisis level. The opposite is true of Germany, where the net external balance escalated during the recent period owing to the very favourable expansion of trade in wind power equipment (net balance of € 6.8 billion in such equipment) and equipment for storage, heat production and power stations using gas and clean coal. The deficit of € 6.1 billion in 2008-2011 reflects the net imports of photovoltaic equipment totalling around € 20.5 billion from non-European countries (China). The Netherlands did not record any surplus in low carbon energy goods overall. Nonetheless, that country is a net exporter of goods from the thermal solar energy and insulation branches and, since 2012-2015, biofuels. It is Belgium's biggest competitor in these last two branches.

CHART 10 NET EXTERNAL BALANCE FOR GOODS RELATING TO LOW-CARBON ENERGY TECHNOLOGIES FOR BELGIUM, GERMANY, FRANCE AND THE NETHERLANDS

(2000-2015, in € million)



Source: Pasimeni (2017).

(1) The technologies considered cover a much wider field than that concerning environmental goods and services alone: they also include technologies relating to nuclear power and those concerning gas and clean coal.

The European photovoltaic energy sector exposed to competition from China

The rise in imports, especially from China, has had a major influence on the EU 's foreign trade in photovoltaic equipment, whereas there has been little change in the EU28's exports. Against the backdrop of strong world demand, and partly as a result of measures to support the development of RES in Europe, China endeavoured to boost exports by its photovoltaic energy sector during the period from 2004 to 2008. The sector benefited from financial support for R&D and export credits at advantageous rates, whereas sales on the domestic market were disappointing because the Chinese authorities had given priority to developing the wind power sector.

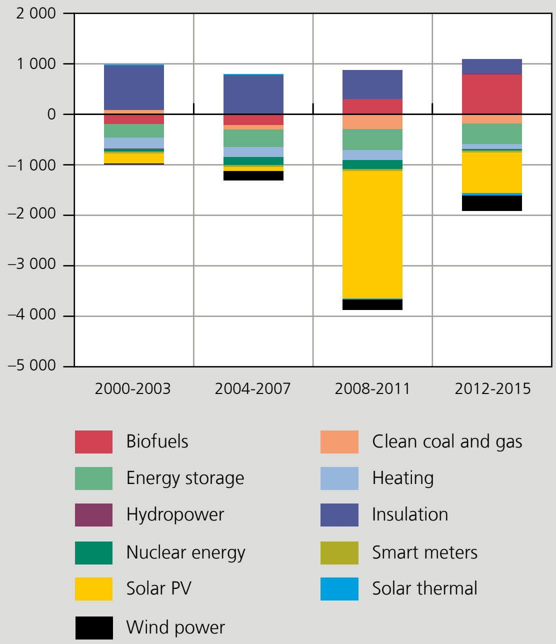
The 2008 financial crisis had a serious impact on the sector. It prompted the Chinese government to promote its development on the domestic market, but without much success, so that the result was excess capacity. That reinforced the downward trend in prices associated with technological progress and economies of scale achieved by the installation of large production units.

In 2012, the situation gave rise to a trade dispute with the EU (and the United States). As a result, the EU adopted anti-dumping and anti-subsidy duties (averaging 47.7 %) in June 2013 for a two-year period; Chinese exporters were exempt from these duties if they charged more than a set minimum price. At the end of this two-year period, these anti-dumping duties were nevertheless regularly renewed for varying lengths of time and were revised to take account of movements in market prices.

The latest extension of these measures dates from 1 March 2017 and covers a period of 18 months. So as not to penalise the European installation sector, while protecting European equipment producers, the EU authorities decided on that occasion to bring the minimum prices into line with current world market prices.

While Belgium's external trade balance for these goods is in deficit overall, intra-EU28 trade still posted a net surplus of about € 400 to € 500 million (net exports increased in the case of biofuels and photovoltaic energy, but declined for insulation products). Net imports of photovoltaic equipment from outside the EU28 also rocketed over the 2008-2011 period, to reach a cumulative sum of € 3.25 billion, partially offset by net intra-EU28 exports amounting to € 730 million. Hence, just as in the neighbouring countries, Belgium's net imports of photovoltaic sector goods from outside the EU28 have always exceeded its net exports within the EU28 (excluding the Netherlands in 2000-2003).

CHART 11 BELGIAN NET EXPORTS OF LOW-CARBON ENERGY TECHNOLOGY GOODS
(2000-2015, in € million)



Source: Pasimeni (2017).

4.2 … new R&D opportunities…

It is generally acknowledged that innovations, and even real technological breakthroughs, will be essential to ensure and speed up the transition. As a general rule, innovation entails the protection of intellectual property, support for R&D, creation of a favourable environment for innovation, and the training of properly skilled workers. Apart from support for actual R&D funding (including for demonstration projects), development of the infrastructures required for the more widespread adoption of innovative solutions can also do much to speed up the spread of new technologies: for instance, innovations in telecommunication networks complement those in the smart electric networks needed in response to the decentralisation of electricity production and consumption, and to the increasing use of electric vehicles.

In 2013, around € 20 billion was spent on R&D in fields connected with the Energy Union (1) in the EU28 as a whole, or 0.15 % of GDP. The private sector accounted for 80 % of that expenditure, which has risen by 45 % since 2007. Germany and France recorded the highest private sector expenditure, at 36 % and 13 % respectively of total expenditure in 2013, equivalent to 0.29 % and 0.17 % respectively of their GDP. Since 2010, the private sector in both countries has focused mainly on research into batteries and electric vehicles, while in the Netherlands ever-increasing amounts are being spent on research into efficiency solutions for industry.

In Belgium – in contrast to the neighbouring countries and the EU28 – private sector expenditure is lower than that of the public sector, 52 % of which is spent on nuclear safety (or 28 % of total expenditure). Private sector spending is concentrated on industrial energy efficiency and renewable energy, accounting for 22 % and 15 % respectively of R&D expenditure relating to energy in Belgium, and represents 0.09 % of GDP.

(1) This concerns R&D expenditure relating to RES, energy efficiency, flexible energy systems, smart networks and equipment, biofuels, CO_2 capture and storage, and nuclear safety.

TABLE 5 PRIVATE AND PUBLIC SECTOR EXPENDITURE ON R&D RELATING TO ENERGY IN 2007, 2010 AND 2013 (1)

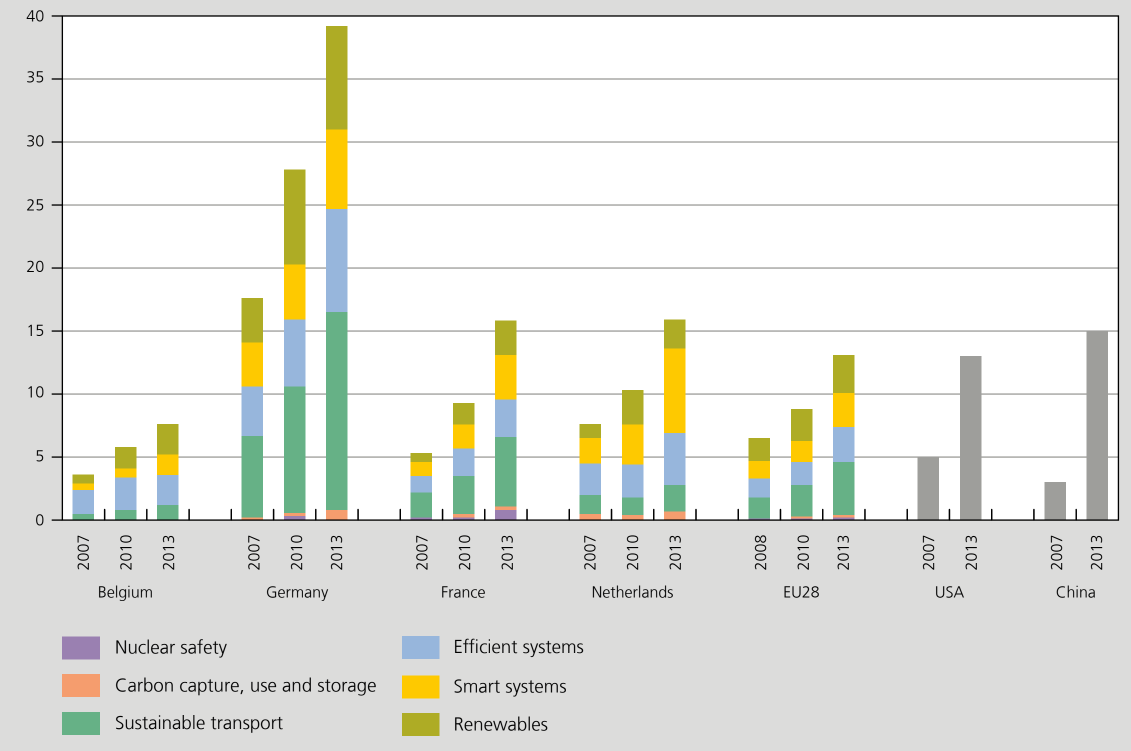
(in € billion)

	Private sector	Public sector	Total
EU28 – 2007	11.000	2.600	13.600
EU28 – 2010	16.779	4.169	20.948
EU28 – 2013	15.962	4.240	20.202
of which:			
Belgium	0.159	0.190	0.349
Germany	7.351	0.808	8.159
France	2.582	1.084	3.666
Netherlands	0.846	0.185	1.031

Sources: Fiorini *et al.* (2017), EC (2017).
(1) This concerns renewables, smart systems, efficiency-enhancing systems, sustainable transport, carbon capture, use and storage, and nuclear safety.

CHART 12 PATENTS FILED IN SPHERES RELATING TO THE ENERGY UNION

(per million inhabitants)



Sources: Fiorini *et al.* (2017), EC (2017).

Government policy on R&D is expected to promote innovation, the number of patents filed being one of the outputs. Although these statistics are a crude way of measuring technological progress (inventions are not necessarily always patented, and the content of a patent varies greatly according to the likelihood of finding an industrial application for it), they do give some idea of innovation performance. Furthermore, innovations in the field of chemicals and materials, for example, also have an influence on technologies relating to the energy transition.

In 2013, in the sphere of the Energy Union, the number of patent categories[1] filed per million inhabitants in the EU28 was equivalent to the figure for the United States and – at the moment – for China. However, it must be said that the number of Chinese patent applications increased five-fold between 2007 and 2013. For Japan and South Korea respectively, patent applications totalled 96 and 111 per million inhabitants in 2013. Germany owned 47 % of the 6 600 patents filed in the EU28, and among the individual patent categories considered it actually owned 67 % of those relating to electric vehicles. In Belgium, the number of patents filed per million inhabitants has risen slightly, but is still rather low compared with the neighbouring countries. A growing share of these patents concerns renewable energy and intelligent systems.

There remains the question of gearing these innovations to affordable transition solutions, but without creating new risks of increased environmental stress on other sectors activated by these new technologies and new products. In fact, equipment used in technologies relating to the energy transition, e.g. in the production of renewable energy (such as batteries, catalysts, magnets, optic fibres, thermal interfaces, special glass, ceramics and super alloys), entails the use of rare metals. The recycling option, often suggested as the answer to their scarcity, nevertheless has its limits: recycling is all the more difficult for applications in which these metals form complex alloys, and even impossible where they are used as dispersants (as additives) or in quantities which are too small to be recoverable. The aim of reduced dependence on imports of fossil fuels risks turning into (a new) dependence on suppliers of ores and other rare minerals.

4.3 … and jobs

Estimating the impact of the energy transition on employment, whether in the new "low-carbon" production sectors or in the implementation of energy saving measures, is a tricky exercise. Since employment statistics by branch of activity

TABLE 6 GROSS DIRECT AND INDIRECT EMPLOYMENT AND TURNOVER BY RES SECTOR IN BELGIUM, IN 2016

(in number of jobs and in € million)

	Gross direct and indirect jobs[1]	Turnover[1]
Photovoltaic energy	2 400	440
Wind power	2 300	450
Heat pumps	1 500	280
Solid biomass[2]	1 000	260
Biofuels[2]	900	240
Biogas[2]	400	100
Small-scale hydropower	400	80
Renewable urban waste	300	60
Thermal solar energy	200	30
Geothermal energy	< 100	< 1
Total	9 500	1 950

Source: EurObserv'ER (2018).

(1) The employment and turnover data refer to the main investment activity in the value chain (manufacture, distribution and installation of equipment, operation and maintenance of installations).

(2) The bioenergy sectors (biofuels, biomass and biogas) include upstream activities, i.e. the supply of fuels within the agriculture and forestry industries.

(1) The data on the patents in question concern categories of "related" patents protecting the same or similar technical content.

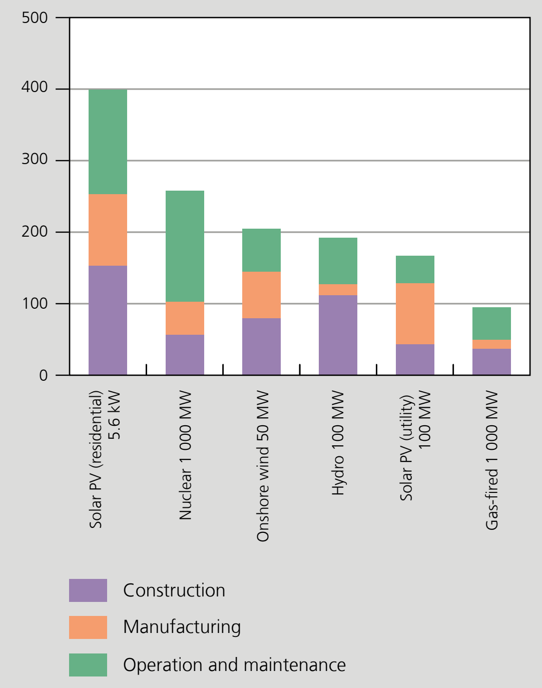
are compiled on the basis of the industrial classification of firms, it is hard to measure the impact of these activities in terms of direct jobs. However, by using the environmental economic accounts compiled by the Federal Planning Bureau, it is possible to estimate the number of direct jobs created in 2014-2015 in energy resource management at around 12 400 (full-time equivalents), which is 0.4 % of market sector employment (1) (FPB, 2017). 52 % of these jobs concerned energy management and energy saving, 32 % concerned the production of energy from renewable sources, and the remainder were created in activities aimed at reducing the use of fossil fuels as raw materials. One-third of these jobs are found in the construction sector, 26 % in manufacturing industry and 19 % in trade.

However, it must be acknowledged that the value chains associated with these new sectors extend beyond their operational activities, and may include the production of equipment and its installation on site. On this basis, in 2016, some 9 500 people were employed in RES sectors in Belgium alone, generating a total turnover of € 1.95 billion. The photovoltaic and wind power sectors employ the most workers, producing a combined turnover of € 890 million. At European level, Germany and France head the rankings, although Italy (followed by Spain) predominate in the heat pumps branch.

In its analysis of investment in the energy sectors (IEA, 2017), the International Energy Agency estimates the potential for creating new jobs (first-rank direct and indirect jobs) in the various electricity-generating sectors. It distinguishes between jobs related to plant construction, production of equipment, and operation and maintenance.

CHART 13 EMPLOYMENT RELATED TO THE PRODUCTION OF 1 TWH FROM NEW CAPACITY

(2016, in number of jobs/TWh/year (1), per sector)



Source: IEA (2017b), "World Energy Investment 2017" – adapted from figure 3.8 compiled by the IEA © OECD/IEA [2017].

(1) For the comparison by sector, cumulative jobs over the number of years of operation were standardised over 25 years for the calculation of employment per TWh of annual electricity production, taking account of the respective load factors. Example: for a wind farm with 228 MW of capacity, 500 jobs are recorded in the installation phase over five years and 40 jobs in the operational phase for 20 years. That works out at a cumulative figure of 2500 + 800 jobs over 25 years or, respectively, 100 jobs a year in installation work and 32 jobs a year in the operational phase for a 228 MW wind farm.

(1) The market sector covers non-financial corporations (S11), financial corporations (S12) and households (S14), plus a (small) part of general government (S13) and non-profit institutions serving households (S15).

The job content is highest in the residential photovoltaic energy sector, with an estimated 400 jobs created in the installation of sufficient capacity to generate an annual output of 1 TWh. The impact on employment of the equipment manufacturing phase depends more on the relative competitive edge of domestic industries over their foreign rivals, and those jobs may in some cases be outsourced. The jobs entailed in running hydro-electric power stations are concentrated on the construction phase, although that depends very much on the site. Conversely, gas-fired power stations require less manpower for that stage, as they are relatively quick to install and put into streamlined operation.

Conclusions

The fight against climate change is a major challenge for the European economies, as the European and national strategies put in place require changes and improvements in the management of energy inputs. They imply a radical transformation of modes of energy production and consumption, and that affects business activities.

To persuade the economic agents to make the required reductions in GHG emissions, to use renewable energy sources and to cut energy consumption, it is necessary to use a combination of various means, relating to energy prices, regulation, innovation and R&D, training, investment finance, etc. The impact assessments that motivated the adoption of ambitious targets conclude that the macroeconomic effects are generally favourable in terms of growth, jobs or reducing the energy bill.

However, it is important that the targets imposed on firms do not put them at a disadvantage compared to their competitors owing to the initial increase in energy costs, if the adoption of measures to protect the environment is based on a change in relative prices of energy. That impact is not the same for all sectors of activity and businesses. In Belgian manufacturing industry, which is relatively more energy-intensive than that of the three main neighbouring countries since it is positioned more upstream in the European value chains, spending on energy accounts for 2.5 % of variable costs, on average, whereas that item represents more than 10 % of expenditure on variable inputs for rather more than 4 % of firms. Energy-intensive industries and those exposed to the international environment are more specifically affected if the relative prices of their energy inputs take an adverse turn compared to those of their rivals. At international level, the differential between gas and electricity prices paid by European manufacturers compared to their American competitors increased considerably with the development of US shale gas production. Thus, the prices that Belgian industry pays for gas and electricity are on average 2 and 2 ½ times higher respectively than those paid by their American rivals. These price differentials between Europe and the United States are also accompanied by significant price differences within the EU. In comparison with the main neighbouring countries, electricity price differentials do not favour Belgian industrial consumers, even though the tax levies decline as consumption increases : exemptions or lower tariffs are granted to French, Dutch and German manufacturers, especially if they are recognised as electro-intensive. In the case of gas, price competitiveness between countries is determined by network costs plus taxes and additional levies that, in this instance, do not generally place Belgian manufacturers at a disadvantage, unless they use natural gas as a raw material. In that case, they pay the highest taxes despite the exemptions granted.

Although the ambitious targets involve costs in adapting equipment and processes, that expense is still justified in view of the long-term costs of failing to act against climate change. Establishing a position in more eco-friendly technological sectors or ones which consume less energy also offers firms opportunities for growth and scope for developing new activities and products, including on foreign markets.

A successful transition with ample growth potential is based on the implementation of significant technological improvements. That implies an innovation policy in favour of "low-carbon" goods and services, accompanied by support measures where appropriate. However, those measures must not distort competition and need to be temporary, which means they must cease as soon as the technologies are operational, or if they clearly fall short of expectations. In 2013, the EU28 devoted roughly € 20 billion to R&D in the energy field ; Belgium spent € 350 million of that, or 0.09 % of its GDP, compared to 0.15 % for the EU28.

These adjustments to the economic fabric will undeniably also affect workers in the sectors concerned, leading to substantial shifts on the labour market. The success of the transition therefore also depends on worker mobility, together with the adjustment of workers' skills by means of targeted support and guidance.

To sum up, the success of the energy transition concerns much broader and more diverse spheres than just the energy sector. It requires coordination with government policy measures other than those relating to energy, such as policies on industry, mobility, urban development, industry and innovation. That is particularly true in Belgium, where the powers in question are allocated among the various federated entities. Nonetheless, these policy measures should not be defined without taking account of their European dimension. Although the commitments under the inter-federal Energy Pact may be welcomed, the implementation of a common European policy on the environment, energy and security of supply culminating in a genuine single energy market is essential to ensure that decisions taken by one party or another do not lead to distortion of competition and inefficiency.

Both the government and the private sector have their role to play in ensuring the best match between public policies and investment strategies, with the aim of providing businesses with appropriate information and incentives that encourage them to invest in the technologies with the greatest economic and technical relevance.

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Annex

ENERGY COSTS OF MANUFACTURING BRANCHES (NACE REV. 2, 3-DIGIT) IN BELGIUM, EMPLOYMENT AND NUMBER OF FIRMS CONCERNED, AVERAGE 2008-2015

(in % of the wage bill and expenditure on goods and services, in % of value added and in number of firms)

		Energy cost share	Energy costs / value added	Employment FTE	Number of firms in 2015
C233	Building materials, clay	15.3	20.8	1 314	62
C235	Cement, lime and plaster	15.2	41.3	2 498	19
C171	Paper pulp, paper and paperboard	9.8	34.8	3 088	40
C202	Pesticides and other agrochemicals	9.3	16.4	1 159	18
C231	Manufacture of glass and glass products	8.5	32.1	7 226	165
C201	Basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	8.1	38.5	24 565	219
C234	Other ceramic and porcelain products	7.4	11.1	363	51
C133	Finishing of textiles	7.4	22.8	866	209
C241	Iron and steel	6.4	43.8	12 896	59
C232	Manufacture of refractory products	6.2	20.5	468	20
C245	Smelting	5.4	16.9	2 096	73
C239	Manufacture of abrasive products and non-metallic mineral products n.e.c.	5.1	22.6	1125	35
C103	Processing and preservation of fruit and vegetables	4.8	22.7	7 289	152
C131	Preparation and spinning of textile fibres	4.5	22.1	844	166
C132	Weaving	3.8	12.6	3 083	114
C206	Artificial and synthetic fibres	3.8	29.6	901	25
C107	Bread and pastry products and pasta	3.7	9.9	17 507	4 049
C256	Treatment and coating of metals; machining	3.2	7.4	12 504	2 793
C139	Other textiles	3.2	11.3	11 280	670
C211	Basic pharmaceutical products	3.1	6.1	614	17
C255	Forging, pressing, stamping; powder metallurgy	3.0	12.1	1 610	–
C236	Articles of concrete, cement and plaster	3.0	9.0	10 170	430
C142	Articles of fur	3.0	9.1	25	14
C162	Articles of wood, cork, straw and plaiting	3.0	10.1	7 754	1 495
C322	Musical instruments	2.7	6.2	54	98
C161	Sawmilling and planing of wood	2.7	11.9	1 392	251
C222	Plastic products	2.6	8.8	18 610	667
C	Manufacturing industry	2.5	12.0	433 316	33 788

Source: Eurostat.