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Book

Towards a just transition: coal, cars and the world of work

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Edited by
Béla Galgóczi

etui.

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Introductory overview

Two faces of (a) just transition: the coal story and the car story

Béla Galgóczi

1. The climate emergency and the importance of these two sectors

Time is running short for us to have a realistic chance of getting climate change under control and preventing it from becoming irreversible and self-sustaining. Talking about the climate emergency has become widespread and, due also to the successful campaigns of the youth movements 'Fridays for Future' in Europe and the 'Sunrise Movement' in north America, public awareness has been rising fast in the last couple of years. New scientific evidence on the expected effects of climate change, ever more dramatic, appear on a weekly basis. Without higher levels of ambition, an IPCC report (2018) already foresees a 1.5°C warming by the mid-2040s, while scientists find that global sea level rise could reach an average of 65cm by 2100, double that previously forecast (NASA 2018). Scientists also warn that global warming may reach a certain threshold in the very near future, one that triggers a sudden, violent shift in the climate system and catalyses a domino effect of dramatic new climatic changes via feedback mechanisms (Green *et al.* 2019).

In the wake of the Paris agreement, it has become increasingly clear how national commitments are falling short of the necessary targets, the result being a huge emissions gap. National pledges would be likely to deliver a temperature increase of at least 3°C by 2100 and would only bring one-third of the reduction in emissions required by 2030 to be on track towards climate targets (UNEP 2017). In the absence of significantly greater ambition, the carbon budget behind a 2°C scenario will be almost depleted by 2030. At the same time, an IPCC (2018) report ahead of the COP24 Katowice Summit pointed to the dramatic difference between 2°C and 1.5°C warming scenarios, making a strong case for sticking to the more ambitious target.

Climate policy ambition thus needs to be stepped up and radical change is, of course, necessary in order to reach a net-zero carbon economy at global level in the second half of the century. In its Communication, the European Commission (2018a) set the long-term objective of a climate-neutral Europe by 2050. This means that, between 2030 and 2050, cuts in greenhouse gas (GHG) emissions will be required at a level twice as deep as Europe is likely to achieve between 1990 and 2030.

Transition to a net-zero carbon economy is thus a compelling necessity and the clock to get climate change under control is ticking.

Meeting the Commission's ambitious objective will not be possible without the timely phasing-out of unabated coal from energy generation. Coal still accounts for one-third of all energy used worldwide and 38 per cent of electricity generation and is responsible for 44 per cent of global CO_2 emissions (IEA 2018). Also, the transport sector, and road transport in particular, is one of the remaining sectors in the European economy in which emissions have not decreased in recent decades and where the pressure to change this course is mounting. These two key sectors will have a deciding effect on whether climate change can be held at bay.

This book focuses on the main policy objectives and trends in the transformation in both the energy sector and the automobile industry. It analyses the main drivers of the transformation, the likely employment and regional effects and the role played by actors' strategies, taking both the common elements and the main differences into account. The first part of the book is devoted to the coal transition, while the second part addresses the challenges faced by the automobile industry. 'Just transition' has become the main concept and strategy tool for managing the transformation towards a net zero-carbon economy in a way that is both balanced and fair, but it is also clear that this concept is developing in a too broad and general, and often even over-stretched, manner. In order to discuss it meaningfully, we need to turn to specific case studies. Coal-based energy generation on the one hand and the automobile industry on the other do not only represent two sectors that are responsible for a large part of total GHG emissions, they also illustrate what is really meant by the different contexts of just transition.

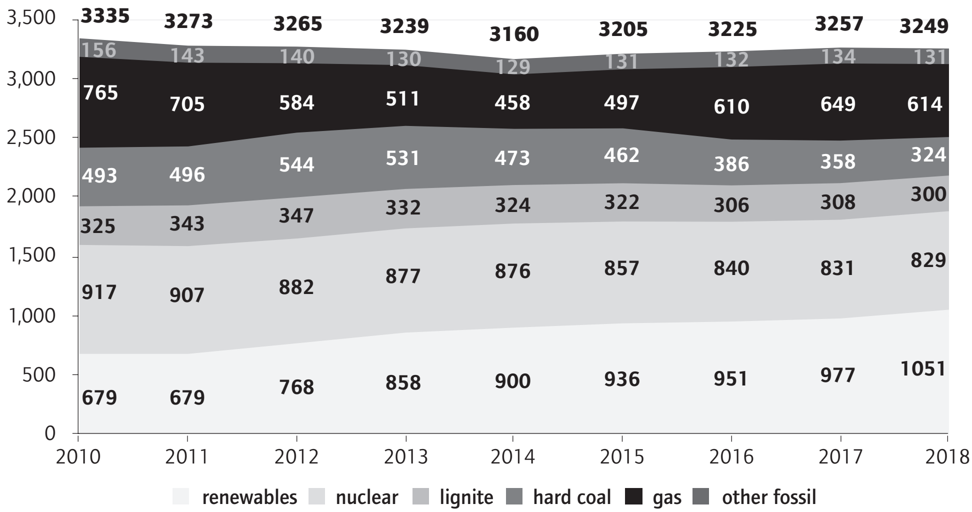
After framing the main challenges in the introductory overview, part 1 of this book deals with the coal transition in key EU member states, with part 2 then discussing the challenges faced by the European automobile industry. Four chapters in the first part cover Poland, Germany, France and Italy, while chapter 5 analyses the importance of regional policy in managing the coal transition. Part 2 delivers an account of the revolutionary change taking place in the automobile industry, proceeding from a European overview (chapter 6) to insights both from France (chapter 7) and from Germany, the latter with its central eastern European supply chains (chapter 8). Chapter 9 then gives the view of IG Metall, a trade union which has a key role in managing change in the automobile industry in an active and forward-looking way.

2. The shrinking role of coal in the European economy

The composition of electricity generation in the EU28 in 2018 shows that renewables provided 32.4 per cent of total electricity, followed by nuclear energy (25.5 per cent), hard coal and lignite (19.2 per cent) and gas (18.9 per cent). Renewables other than hydro made up 21.8 per cent, just above coal and gas (Agora Energiewende and Sandbag 2019).

The EU's share in global coal-based electricity generation was just seven per cent (2017) and, while the world on average still had a 38 per cent share of coal in generating electricity, in Europe it was just above twenty per cent (IEA 2018). In 2016, there were 128 coal mines in twelve EU member states and 41 regions, with a total annual output of 500 million tonnes making up sixty per cent of gross EU coal consumption. The

Figure 1 **Electricity generation by fuel type and changes in composition (2010-2018), EU28 in terawatt hours (TWh)**



Source: Eurostat; Agora Energiewende and Sandbag (2019).

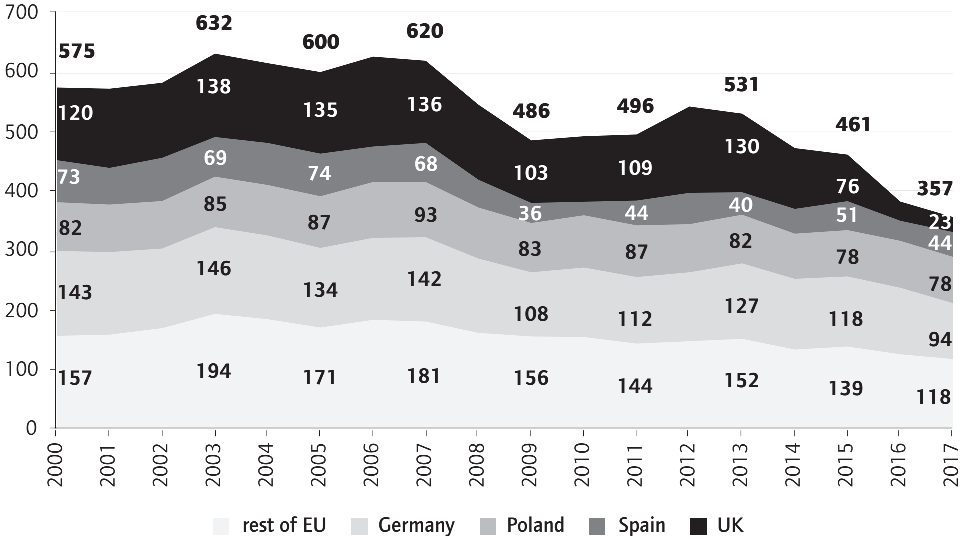
other forty per cent of the gross consumption of solid fuels (almost entirely hard coal) in the EU was covered by imports, making up 4.9 per cent of the EU's total energy imports (Eurostat 2018). There were 207 coal-fired power plants in operation in 21 member states in 103 regions, with a total capacity of 150 gigawatts (GW), making up fifteen per cent of total European power generation capacity. Coal infrastructure was thus present in 108 European regions (Alves Dias *et al.* 2018).

Taking 2010-2018 into account, coal generation is on the retreat in the EU as Figure 1 illustrates. The period between 2010 and 2012 showed a strong increase in coal, but there has since been a clear declining trend.

Total coal use in electricity generation in the EU28 fell by six per cent in 2018 and was 24 per cent below 2010 levels. For hard coal, the respective falls were nine per cent and 34 per cent; while for lignite, the declines in 2018 compared to 2010 were a mere 2.5 per cent and eight per cent (Agora Energiewende and Sandbag 2019).

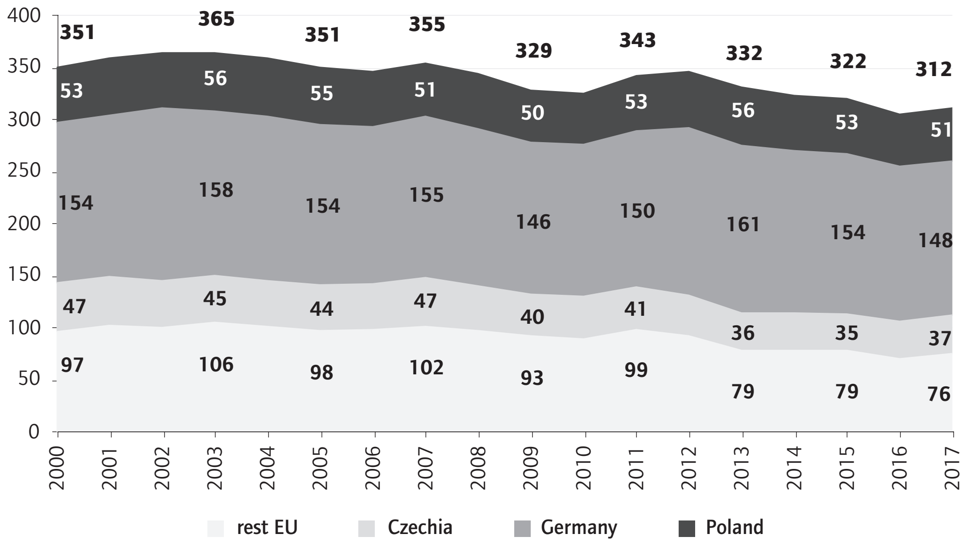
As regards how the role of coal has changed in those member states with the strongest usage traditions, the differences are quite significant. In order to illustrate the different patterns of change, Figure 2 (hard coal) and Figure 3 (lignite) show the role of coal in electricity generation in the EU over a longer perspective, between 2000 and 2017, indicating the trends in the top five coal-dependent member states. It is important to note that the role of coal-based energy generation in the EU still grew until 2007 and that only thereafter did it start to decrease.

Figure 2 **The role of hard coal in electricity generation in the EU (2000-2017), TWh**



Source: Eurostat; Agora Energiewende and Sandbag 2018.

Figure 3 **The role of lignite in electricity generation in the EU (2000-2017), TWh**



Source: Eurostat; Agora Energiewende and Sandbag 2018.

While electricity generation by hard coal fell by 38 per cent between 2000 and 2017 in the EU28, generation by lignite – a greater pollutant – fell by only eleven per cent in this seventeen-year period. The data also clearly show the dominant role of a small number of member states in burning coal. In 2017, Germany, the UK, Poland and Spain made up 67 per cent of EU electricity generation from hard coal. The UK managed a spectacular reduction in the use of hard coal (by 2017 this was down by eighty per cent compared to 2000), while Spain saw a forty per cent reduction and Germany 35 per cent. In Poland, however, the use of hard coal in energy generation has remained practically the same over the last 17 years.

Turning to the use of lignite in electricity generation, it was Germany, Poland and Czechia that made up 76 per cent of the EU total in 2017. Most worrying is that, for the two dominant users of lignite, Germany and Poland, usage did not change significantly over the last seventeen years (in Germany, it fell from 154 TWh in 2000 to 148 TWh in 2017; for Poland, the change in this period was from 53 to 51 TWh).

The first part of this book shows how the transition process to a coal-free economy is being managed at national level, providing insights also into company and regional level strategies. Chapter 1 discusses how Poland is trying to manage its coal transition by adjusting its energy system to cope with EU policy targets while, at the same time, not giving up coal in the foreseeable future. Chapter 2 gives an account of Germany's long and difficult farewell to coal, based also on the recommendation of the national Coal Commission to the federal government, while setting a positive example of how social and civil dialogue can shape the framework of a difficult restructuring process, albeit one that still falls short in its level of ambition. Chapter 3 discusses the case of France, concerning how it is itself embarking on a just transition away from coal in an ambitious, but conflictual, way. Chapter 4 delivers an account of the Italian energy transformation with particular emphasis on the 'best practice' case of how ENEL, its biggest energy firm, is re-inventing itself to become the first carbon-neutral energy multinational in the world. Furthermore, chapter 5 discusses the importance of regional policy in managing the coal transition.

3. The automobile industry: out of the crisis, but now facing disruption and renewal

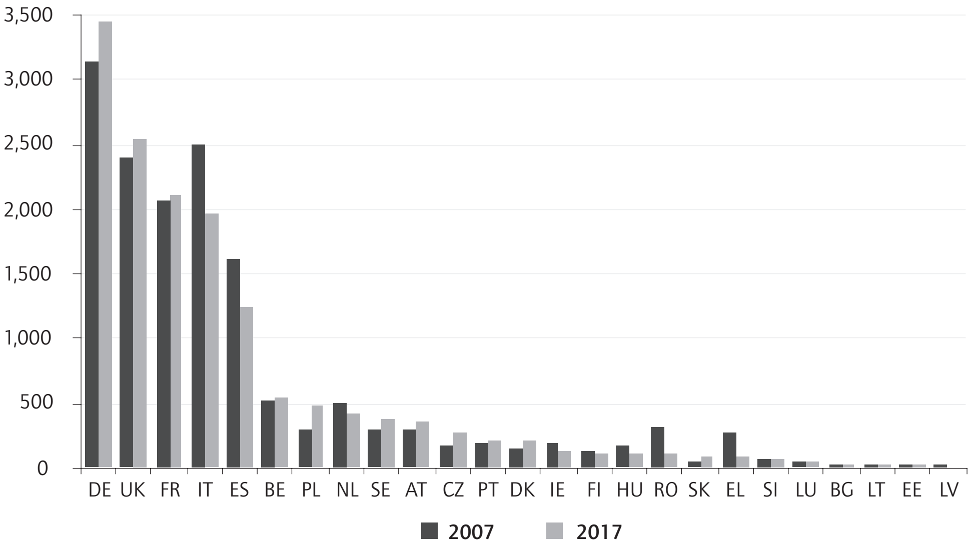
As of 2017, with 3.5 million quality jobs in automobile manufacturing (2.6 million direct and 0.9 million indirect), and with a total of 13.8 million jobs in the broader European automotive sector, the industry is a key employer in Europe (ACEA 2019). With digitalisation and decarbonisation, the industry faces unprecedented challenges in the near future that will re-write its entire business model, redefine work and redraw its value chains. Managing this change requires innovative approaches from the main actors and new forms of relationships between the actors.

Chapter 6 of this publication discusses the challenges of the automobile industry at European level, while also presenting forecasts for the next decade. Chapter 7 describes the situation of the French automobile industry, establishing empirical insights into developments in employment and restructuring. Chapter 8 provides an analysis of the German automobile industry and its value chain in central eastern Europe. Chapter 9 gives an evaluation of the European and German car industry from the point of view of IG Metall, sketching also the main strategy of Europe's biggest trade union in dealing with the challenges.

By 2018, the European automobile industry finally seemed to have surpassed the effects of the crisis of 2008/2009. Mitigating the long-standing issues of overcapacity and pressures on prices and costs, sales and production volumes began to pick up from 2013, while both the trade surplus and employment are growing and profitability among the major assemblers and suppliers is again on the rise.

Despite the ending at macroeconomic level in 2013 of the double-dip recession that followed the 2008 financial crisis, total sales in the European automotive sector nevertheless re-attained their pre-crisis peak only in 2017, although with great differences by individual member state (Figure 4).

Figure 4 **New passenger car registrations in EU member states, 2007 vs. 2017**



Source: see Anne-Gaëlle Lefeuvre, chapter 6 of this publication.

Over the past decade, the European automotive industry has witnessed significant transformations. To take just a few examples, the emergence of central and eastern Europe as a manufacturing powerhouse, large-scale product diversification (alongside a shift towards premium market segments with the soaring rise of SUVs or sport utility vehicles) and the unquestionable market (and, increasingly, technological) dominance of China on a global level – none of these were exactly defining features of the industry before the Great Recession.

In 2018, there was thus no perception of having an economic crisis in the automobile industry that would trigger a transformation process; the order books were full. Even the 'diesel scandal' seemed to have calmed down, as indicated by the results of the main manufacturers that were implicated. Business was going particularly well even in those areas that are set to be affected most severely by the upcoming transformation. Small and medium-sized suppliers manufacturing highly-specialised components in combustion technology are currently benefiting from the worldwide boom in private transport. In terms of organisational theory, therefore, one cannot speak today about a crisis-induced transformation of the automobile industry. However, downwards risks did appear in the second half of 2018 with regulatory changes appearing on the horizon (new emission measurement standards and partial diesel bans in a number of cities).

Even so, 2018 was also the year in which the main European manufacturers realised that the future of the industry will be radically different and that the forthcoming changes are going to be sweeping. Especially important in this respect is the switch to electrified powertrains, which affects over thirty per cent of the value added in a car, and under which process certain products and activities could be completely eliminated precisely in those fields where the European automobile industry (in particular the German, but also the French) has particularly strong competence.

4. Drivers of change in the two sectors

Decarbonisation in both the automobile and the power sector is driven by climate and environmental regulation at European and national level and by changing consumer preferences.

4.1 Towards the end of coal

Stricter regulation on emissions and changing profitability patterns due to technological progress making renewables cheaper, as well as a turn of investment decisions away from coal, mark the stages of coal's retreat and will lead to the closure of mines and power plants with substantial employment losses in the near future.

At a time when Europe needs radically to step up its climate policy efforts to meet the COP21 objectives, and when coal is responsible for two-thirds of the CO_2 emissions of the power sector, coal-fired power plants are facing growing regulatory pressures to reduce greenhouse gas emissions and air pollution.

With the adoption in 2017 of its 'Best Available Technique' conclusions for Large Combustion Plants, the European Commission (2017) set new standards for these plants in line with the Industrial Emissions Directive (IED). These limits will be the point of reference in the future under which the continuing operation of large thermal power plants in Europe will be permitted, and underpinned by the 'best available techniques reference document' (BREF). BREF sets, among other things, new upper limits for the emission of oxides of nitrogen and sulphur (NO_X and SO_X) by large installations burning carbon-based fuels like coal and lignite. All coal-fired power plants in the EU need to meet these standards by 2021 but, in 2017, 82 per cent of such installations exceeded them (Wynn and Coghe 2017). This includes eighty per cent of German and virtually all Polish coal power plants.

As part of the package of 'clean energy for all Europeans' (European Commission 2016), the Commission's 2018 proposal for a recast of the Electricity Regulation is another crucial regulatory initiative affecting the lifespan of coal-fired power plants. The proposal sets stricter principles for national capacity mechanisms, i.e. the subsidies paid by several EU member states to power plants for making available stand-by power generation capacity to meet demand peaks.

Phasing out coal is also looking increasingly feasible and economically affordable in large parts of the world. Renewable energy sources, such as onshore and offshore wind and solar photovoltaics (PV), are constantly improving in terms of cost competitiveness with coal. The cost of renewables is plunging faster than forecasters anticipated even a few years ago, with technologies such as large wind turbines appearing on the market. Bloomberg New Energy Finance (BNEF) predicts two 'tipping points' at which the cost of renewables will make power generation fuelled by natural gas and coal increasingly unattractive. PV and wind are already cheaper than building new large-scale coal and gas plants. The next tipping point could come by the mid-2020s, when the operation of existing coal and gas plants could become more costly than taking power from wind and solar. Compared to 2017 levels, the cost of an average PV plant is estimated to fall 71 per cent by 2050. Wind energy is also getting cheaper and BNEF expects the cost to drop 58 per cent by 2050 (BNEF 2018).

The governance mechanism of the Energy Union and Climate Action initiative (European Commission 2018b) obliges member states to come up with national energy and climate plans (NECP). Specific plans for 2030 must quantify the planned national contributions towards achieving the EU's 2030 targets on renewable energy and energy efficiency (see the details of the national plans by Poland, Germany, France and Italy in chapters 1, 2, 3 and 4, respectively, of this publication). These plans will deal with the future composition of energy generation and the lifespan of existing coal-fired power plants. Phasing out coal in energy generation is an explicit policy target for most member states. All EU15 member states are planning to phase out coal by 2030 at the latest, with Germany having announced a later phase-out of coal by 2038. These 'phase-out countries' have been responsible for almost all of the fall in hard coal generation in the last decade. Western Europe may therefore be phasing out coal, but most of the new member states in central and eastern Europe – led by Poland – are sticking to it.[1] The exceptions here are Latvia and Lithuania, which are coal-free, and Hungary and Slovakia where coal phase out is planned for 2030 and 2023, respectively. Figure 5 shows the status of coal phase-out plans by member state.

1. Estonia, while not having coal-fired power plants, burns an even more polluting solid fuel, oil shale, and has no phase-out plan.

Figure 5 **The status of coal phase-out in the EU (as of October 2019)**

Source: Europe Beyond Coal (2019) and national sources. Note: Cyprus, Belgium, Latvia, Lithuania, Luxembourg and Malta have no coal-fired plants.

4.2 Re-inventing the automobile (industry)

There are no such policy objectives as phasing out the automobile, although several countries are planning, and having discussions, on the possible end of the combustion engine.

The automotive industry is undergoing three simultaneous transformations (see further details in chapters 6 and 9 of this publication). First, regulatory change aimed at fulfilling climate policy objectives and at improving environmental performance and public health is pushing the industry toward powertrain electrification with the potentially imminent disappearance of the internal combustion engine. Second, a 'mobility revolution', made possible by extensive digitalisation and vehicle electrification, entails the development of services and service provision functions alongside new connectivity and autonomous features. Such change is truly revolutionary since it has the potential for overhauling vehicle usage and ownership, along with the industry's traditional business model. Third, digitalisation across the automotive value chain promises to stretch further the physical limits of flexible production and this is likely to have a considerable impact in terms of working environments. Intelligent production systems are building the interface between production machines and employees through an integrated communication network also encompassing other devices, employees, products and even other production sites. In addition to the new automation potential which is opening up, this will also facilitate comprehensive control of the production process.

The paradigm change in mobility and transport will also have a disruptive effect on earlier established globalisation patterns in the industry. Emerging automobile producers in China were unable to gain market access in global and European markets in the most recent decades, but in the new future world of electromobility this might become possible. The same is true for start-ups in Silicon Valley. Established incumbent car manufacturers in Europe will need to face these challenges as they will re-write existing business models and globalisation patterns with wide-ranging changes throughout the entire value chain.

The most important driver of the changes in automobile production is climate and environmental regulation. In the context of the commitments of the COP21 Paris Agreement, the transport sector now stands out as the one that has, so far, not contributed to the reduction of greenhouse gases. Cars contribute over sixty per cent of CO_2 emissions in the transport sector and thus constitute a source of very considerable leverage for emission reduction strategies. The pressure on manufacturers to cut emissions is therefore high.

At European level, debates in late 2018 were taking place on the post-2021 scenario of CO_2 emission limits for the average fleet, i.e. the average of all the cars registered by a manufacturer in one year. After the European Commission set the scene in November 2017 with a proposed fifteen per cent reduction by 2025 and thirty per cent by 2030 (compared to current emission standard limits), the Environment Committee of the European Parliament put forward a proposal for a reduction level of 45 per cent on average by 2030. The Council of Environment Ministers then reached a compromise on a 35 per cent reduction in carbon emissions (European Council 2018). In the end, the European institutions agreed on a reduction scenario of fifteen per cent by 2025 and 37.5 per cent by 2030. Several member states are discussing the introduction of further measures to regulate mobility behaviour (including city charges, speed limits and bans on certain categories of cars in low-emission zones).

By 2021, phased in from 2020, the fleet average to be achieved by all new cars is 95 grams of CO_2 per kilometre. For European manufacturers, the average is currently 118.5g/km (2017), set to rise for the first time since 2000 due also to declining registrations of diesel vehicles. Based on the 95g/km target by 2021, EU manufacturers will have to pay a penalty of €95 per registered vehicle and gram of CO_2 by which their fleet exceeds the limit.

Emissions reduction can, ultimately, be regulated via two levers: increasing the efficiency of classic combustion engines and via the market ramp-up for electric cars. The potential offered by new technologies (including downsizing, cylinder deactivation, automatic transmission, mild hybrid technology and lightweight construction) is estimated to have a reduction effect of between ten per cent and 18 per cent. The rest must, therefore, be achieved through registration quotas for electric cars.

5. Employment effects

In the coal-based power sector, a majority of the jobs that still exist will disappear in a decade and the regional effects will be harsh, as revealed by the regional employment developments and forecasts by the Joint Research Centre of the European Commission (Alves Dias *et al*. 2018). For the car industry, the exit from the combustion engine and the electrification of the powertrain, together with the effects of digitalisation and automation, will affect each individual job while employment loss both in the medium- and long-term is also projected. Different competences, skills and work organisation patterns will have a substantial impact on the previously-established comparative advantages of nations and manufacturers. We refer here to employment forecasts along different scenarios based on the ELAB 2 study by the Fraunhofer IAO Institute (Bauer *et al*. 2018) and on the study and forecasts made by Transport and Environment (2017), with details presented in chapters 6 and 9 of this publication.

5.1 Coal

In the early 1960s, coal mining secured the employment of millions of people in Europe (the UK and western Germany each had 600 thousand coal mining jobs, while even Belgium had 175 thousand at its peak). Since then, however, the number of coal mining jobs in Europe has been in rapid and continuous decline.

Based on the most recent Eurostat data, Table 1 shows employment in coal mining (hard coal and lignite) over the last decade. In 2017, the number of coal mining jobs was just below 130,000 in the EU, less than one-half of the 2007 level with a loss of 142,000 jobs during the decade. In 2017, almost two-thirds of European coal mining jobs were in Poland, followed by Czechia and Germany some way behind.

Looking at broader employment in the coal industry, the latest data available are from 2015. In that year, the number of total jobs in coal mining was 185,000.[2] Based on national data, it is estimated that around 52,700 people worked in coal-fired power

2. Employment data are based on the estimates of the JRC 2018 expert report that draws upon national information and on estimates by Euracoal (Alves Dias *et al*. 2018). These data are presented here in order to gain an overview of the entire coal sector (including also power plants). Consequently, the data do not exactly correspond to Eurostat data, which only refer to coal mining, and are also more recent. At the same time, even the 2015 figures from Eurostat are different to the ones presented here (185,000, in comparison to the number of jobs in coal mining as reported by Eurostat of 159,000). The biggest difference between the two sources appears in the case of Romania.

plants across the EU in 2015, putting the number of direct coal industry-related jobs (in coal mines and in power plants) at c. 237,700 in the EU28 (Alves Dias *et al.* 2018). In coal mining, the share of the total held by Poland alone is above fifty per cent. Employment in coal-fired power plants is less than one-third of the level in mining and it is spread more evenly across the EU, although Poland has the highest number here, as well, followed by Germany and Czechia. Even so, almost three-quarters of this total number of 237,700 direct coal-related jobs in 2015 were concentrated in ten EU NUTS-2 regions, four of which are located in Poland, two in Germany and two in Czechia.

Table 1 **Employment in the mining of coal and lignite in the EU27***

	2007	2017
European Union – 27 countries	271,800	129,748
Bulgaria	14,289	10,300
Czechia	24,265	15,145
Germany	42,440	14,465
Poland	135,905	82,036
Romania	20,908	953
Spain	8,515	923
United Kingdom	5,944	1,420

Note: for UK, 2007=2008 and 2017=2016; for Czechia, 2007=2010.
Source: Eurostat 2019 [sbs_na_ind_r2]; *EU27: including UK, but excluding HR.

Several coal mines have been closed in the recent past due to a lack of competitiveness (27 mines in the 2014-2017 period, including mines in Germany, Poland, Czechia and Romania). Spain has closed its last 26 coal mines due to losses and the end of public subsidies, sustaining in 2018 a loss of 2,000 jobs that saw the end of the coal mining era in that country. In 2018, Germany completed its phase-out of the mining of hard coal, although lignite mining still continues.

Experts from the JRC research centre (Alves Dias *et al.* 2018) have forecast cumulative job losses of c. 27,000 in coal mining and the power sector by 2020. In the next decade, the closure of coal mines will be mainly aligned with the decommissioning rates of coal-fired power plants. With a view to the stricter regulations on emissions and state aid, and considering also their age and technological level, 35 per cent of Europe's coal-fired plants will be engaged in a first wave of retirements between 2020 and 2025, with an estimated direct job loss in power plants of up to 15,000. Related job losses in coal mining could reach a further 35,000 in that period. A second decommissioning wave between 2025 and 2030 could result in the loss of another 18,000 jobs in power plants and over 35,000 in coal mining. Altogether, 130-140,000 direct jobs could be lost by 2030, leaving only a few tens of thousands in the entire EU. Energy-intensive industries that rely on coal-based energy inputs might also be affected. For example, coking coal is a critical input in the European iron and steel sector as it constitutes 37 per cent of its raw material needs.

Based on these data, estimates that include indirect jobs dependent on the coal cycle across the EU put the total number of direct and indirect coal-related jobs in the EU at just over 450,000 in 2015. Given that direct coal mining jobs were, by 2017, already down by 25 per cent compared to 2015, one can assume that the total number of coal-dependent jobs may also have decreased to a similar extent (i.e. to a total figure of c. 330-350 thousand). It can also be expected that many of these jobs will become redundant in the next decade, both in direct and indirect coal activities. In comparison, Eurostat data also reveal that the total number of people employed in the EU27[3] was 215.0 million in 2007, falling to 209.4 million during the crisis (2013), but then, overcoming the losses, growing to 219.8 million by 2017. During the entire period, the number of manufacturing jobs fell from 32.0 million to 28.5 million. Although the total number of coal-dependent jobs makes up only a small fraction (c. 0.15 per cent) of European employment, and much greater job losses occurred during the crisis, the challenge is that these are concentrated on a small number of regions with wide-ranging effects on the local and regional economy. In many of these regions, the livelihood of a large part of the population is dependent on the continuation of a coal-based economy.

The emerging low-carbon economy is expected to compensate for the unavoidable job losses in carbon-intensive activities across the whole economy, but these jobs will not necessarily appear at the same time and in the same place where jobs are being lost.

Tackling these structural mismatches should be one of the aims of properly-designed just transition policies to balance the burdens of the necessary transformation. This is why comprehensive regional development plans and targeted just transition policies tailored to coal-intensive regions will become crucial in facing these challenges, as chapter 5 of this publication demonstrates.

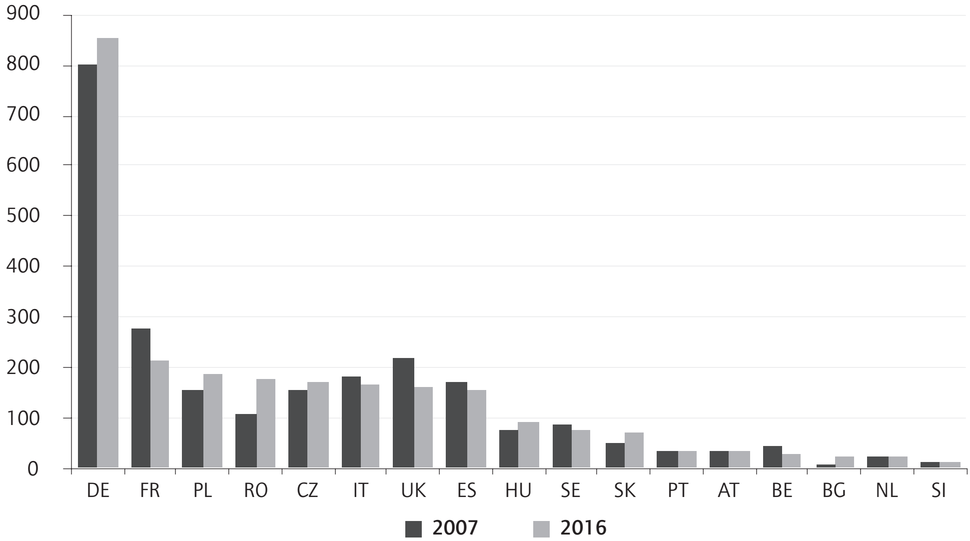
5.2 Automobile

Unlike the coal sector, that has already lost most of its employment in recent decades, employment in the automobile industry is now near its peak level over the last two decades. The ACEA employment data points to the automotive industry being a key employer in Europe (ACEA 2019), while the industry is now facing unprecedented challenges which will require fresh approaches and mindsets from all who are involved in it.

With the increase in production for export, especially in the value-added premium segment, manufacturers in particular have been able to build up employment in Germany despite the impact of relocation initiatives. The case of France is slightly different as a result of its specialisation in the more cost-sensitive mass market segment. Employment gains have been widespread in CEE countries, while France, Italy, the UK and Spain have seen a downwards trend in automobile employment in the last decade, as shown by Figure 6.

3. Including UK but excluding Croatia, for the 15-64 age group.

Figure 6 **Employment in the automotive industry in key EU member states, 2007 vs. 2016**



See: Lefeuvre and Guga, chapter 6 of this publication.

Unlike coal, future employment changes in the automobile sector are much less straightforward and much harder to forecast. The only certainty is that the changes will be massive and that almost all jobs in the industry will be affected to some extent. There are many simultaneous factors at work – climate and environmental regulation (that not only shapes production but also market demand), digitalisation of the production process and the advance of autonomous and connected vehicles – all of which are likely to have a fundamental impact on employment in both quantitative and qualitative ways. Technological change will re-shape international value chains while globalisation patterns may also change, posing uncertainty for the future viability of any geographical location, including long-established manufacturers in Europe.

One thing has crystallised in the last couple of years: the main pathway of the transformation will be the electrification of the powertrain and the parallel phasing-down of the internal combustion engine (ICE). Battery electric vehicles (BEV) consist of fewer components than the traditional combustion engine and require less labour input. This is because the car runs on an electric motor that has a much lower depth of added value while even the production of the battery cell, the most cost-intensive component of electric drivetrains, is highly automated and hence will not require much human labour. In production, the simplification of manufacturing processes is likely to lead to a decline of employment both in OEMs and in suppliers although, as Anne-Gaëlle Lefeuvre and Ștefan Guga state in chapter 6, the extent of this will depend on the pace of the transition from ICE to BEVs. They also point to the possibility that, in the interim phase with the co-existence of BEV and ICE engines on the basis of the hybrid bridging technology combining both, the demand for labour and employment may even rise.

In recent years, studies have published various figures on the question of how many jobs will be lost in the event of a market ramping-up of electric cars (PA Consulting 2018), as referred to in detail in chapter 6. Maximilian Strötzel and Christian Brunkhorst also discuss in chapter 9 the results of the ELAB 2.0 study, commissioned by IG Metall and the Fraunhofer Institute for Labour Economics and Organisation (Bauer *et al.* 2018), with employment forecasts based on the real production figures of the members of the study consortium. These include all German manufacturers and major suppliers. In the most realistic scenario, that assumes 25 per cent battery electric vehicle and fifteen per cent plug-in hybrid vehicles (PHEV), 70,000 jobs will be lost in the production of powertrains by 2030.

In the short-term, however (i.e. until the mid-2020s), the prospect of stricter environmental and climate policy regulation will boost investment in new ICE technology and hybrid powertrains, alongside the continuing shift from diesel to petrol motorisation. These should all have a neutral, or even slightly positive, impact on employment in production.

Chapter 6 also documents that the extent of medium- and longer-term employment decline is also likely to depend on the capacity of the European industry to develop electrochemical operations related to battery development, which could take up between four and seven per cent of automotive employment in the future.

The specific evidence presented by Michel Sonzogni and Sebastian Schulze-Marmeling in Chapter 7 on recent developments in the French automobile industry portrays a conflicting scenario with mounting pressure on employment. Car manufacturers in France are reacting to market and regulatory pressures by stepping up their demands for labour force flexibility, creating greater uncertainty and vulnerability. Figures from the Syndex database on employment in the powertrain industry in France show that, between 2014 and 2016, permanent jobs in the French powertrain sector fell by five per cent while the number of temporary workers grew by 100%, now taking the larger share of jobs in the powertrain sector.

On the other hand, Martin Krzywdzinski in Chapter 8 reports balanced employment patterns in German car manufacturers and suppliers, in contrast with those in the CEE locations of the same German companies. According to a plant-level empirical study conducted by the author, German plants tend to have lower shares of fixed-term contracts, a high share of skilled workers and high R&D propensity. Employment levels are on the increase in CEE locations, but the share of fixed-term contracts are significantly higher than in the case of German plants. According to the survey results, only fifteen per cent of German plants report more than ten per cent of employees being on fixed-term contracts whereas this was the case for 49 per cent of CEE plants. In 21 per cent of the CEE automotive suppliers surveyed, the share of fixed-term contracts even exceeded thirty per cent (compared to less than one per cent of suppliers based in Germany).

6. Two faces of a just transition: the lessons from two carbon-intensive sectors

'Just transition' was an early trade union demand for managing the transformation towards a net-zero carbon economy and this approach has now become a mainstream policy tool referred to by international institutions and treaties. This is a major success, but concerns are growing that the term is getting too broad with the danger of being hollowed-out and over-stretched.

In this context, trade union organisations need to make a pragmatic return to the original interpretations of what just transition means in practice as regards the development of a net-zero carbon economy: i.e. a transformation which achieves change in a balanced and fair way.

From a functional point of view, just transition has two main dimensions: in terms of 'outcomes' (the new employment and social landscape in a decarbonised economy) and of 'process' (how we get there). The 'outcome' should be decent work for all in an inclusive society with the eradication of poverty; the 'process' should be based on a managed transition with meaningful social dialogue at all levels to make sure that burden-sharing is just and that nobody is left behind. The 2015 ILO Guidelines (ILO 2015) broaden the horizon and highlight the need to secure the livelihoods of all those who might be negatively affected (directly or indirectly) by the green transition and also stress the need for societies to be inclusive and provide opportunities for decent work for all.

From the 'process' perspective, just transition has two main pillars (Galgóczi 2018): one that deals with the distributional effects of climate policies (for example, how a higher carbon price or electricity price affects different income groups and what forms of compensation should apply) and one that deals with the management of employment transitions. The latter should not only be directed to employees whose jobs are being lost or fundamentally transformed during the green transition, but also to those whose livelihood depends on those activities. This includes active regional restructuring practices with industrial policy and regional development initiatives.

Beyond theoretical and systematic analysis, the different approaches of just transition strategies can best be shown through empirical evidence and best practice in key sectors. This book is an attempt to demonstrate the main challenges and provide some insight into such practices in two key sectors. Phasing out coal in energy generation and managing the epochal change towards a new mobility paradigm both present huge challenges to the world of work. These two transitions also demonstrate how just transition practices can differ from sector to sector and from country to country. The case studies in this book mostly address the 'process' dimension of just transition, with a focus on dealing with employment change and job transitions.

There is a major difference between the two sectors in both the nature and the magnitude of the challenge, as the two parts of the book clearly demonstrate: coal has no future but the automobile does have one (at least, as we all believe), albeit in quite a different form than the one we have currently come to know. However, even though coal itself does not have a future, workers in the sector and their families, as well as those depending on the sector in the surrounding region, must have one. Employment in the coal sector makes up just 0.15 per cent of European employment but, with its high concentration, the sector is of vital importance for individual regions. On the other hand, with its more than five per cent share of total European employment, the broader automobile sector is a key employer. Both sectors have higher than average wage levels and outstanding trade union organisation with high collective bargaining coverage.

Given these differences in the challenges facing employment and labour relations in the two sectors, it is no wonder that just transition approaches in the European energy sector are quite different from those that are emerging in the automobile industry. However, country differences are also substantial.

The main focus of just transition policies in the coal sector is to stretch the phase-out as long as possible, with defensive strategies such as income protection and early retirement as the dominant employment policy tools. The cases of Germany and Poland – the two countries that generate nearly one-half of hard coal-based, and nearly two-thirds of lignite-based, electricity in the EU – clearly demonstrate this. At the same time, they also highlight important country-specific differences.

For Poland, Aleksander Szpor in chapter 1 shows how the key domestic stakeholders of energy policy – trade unions and the private sector – are concentrating their efforts on preserving a status quo in which the state protects the coal mining sector and a coal-based energy system against EU climate and energy policy. The lack of a genuine climate policy in Poland is seen as legitimate in the domestic political environment. The result is that, on the domestic political agenda, strategic documents related to the energy and coal sector do not tackle the problem of reducing the number of coal mines or jobs as this would be instantly opposed by the trade unions and could endanger the stability of any government. The main goal of Polish energy strategy until 2040 (for details, see chapter 1) is energy security while ensuring the competitiveness of the economy and energy efficiency alongside the reduction of the energy sector's impact on the environment. According to this, hard coal will still remain the single most important source of electricity production in Poland in 2040.

Given the policy instruments that exist in the protection of the status of coal in the Polish economy, such as the special pension system for miners or the capitalisation of coal mining by state-controlled companies, it is difficult to hold the sector accountable and to push ahead with change.

Given the lack of pressure for more radical change, active transition management is not being seen as necessary. There is no policy framework for managing employment transitions and the 'contingency measures' addressed to miners are rather limited. They embrace traditional monetary instruments like mineworkers' pensions, early retirement and redundancy payments (although the latter two have recently been used only on a limited scale). There are virtually no schemes for re-employment in alternative workplaces and only a very limited number of projects are addressed to miners' families and local communities.

In Germany, the number one coal burner in Europe, a cautious, gradual and consensual way of phasing out coal has been chosen. Building on sixty years of experience in transforming the Ruhr coal and steel region into a modern energy and knowledge-based economic region (Galgóczi 2014), Germany's coal phase-out applies three main elements of a just transition approach: slow and gradual transition with a high level of social dialogue; active labour transition management; and engagement in industrial and regional development (for this aspect, see also chapter 5 by Stefan Gärtner).

Philipp Litz in chapter 2 analyses both outcome and process. In 2018, the federal government established the Commission on Growth, Structural Change and Employment (often referred to as the 'Coal Commission') to provide recommendations on a gradual reduction of the capacities of existing coal-fired power plants in Germany. The Commission consisted of policy-makers at different levels of governance and all major stakeholders including employers, trade unions, NGOs and experts. The recommendations aim at a gradual and steady reduction in the greenhouse gas emissions of the power sector. The last coal-fired power plant should be phased out by 2038 (with the option of an earlier exit by 2035), marking the longest farewell to coal by an EU15 member state. At the same time, the Coal Commission has followed the concept of a just transition in various dimensions. First, social dialogue has been exemplary; second, with a phase-out stretched over almost two decades, both the regions and energy and industry companies have been given a reasonable amount of time to transform; and, thirdly, the proposal foresees the provision of comprehensive financial support to the stakeholder groups affected. The declared aim is to replace the gradual loss of gross added value and employment with new jobs and gross added value by industrial producers, and to the same level.

The Commission's recommendations stipulated that coal regions should be developed into modern energy regions. At the same time, investment in transport and digital infrastructure, as well as in local research and innovation, should aim to strengthen the regions' locational advantages and innovation potential.

The recommendations also ensure that the phasing-out of coal-fired power generation is as socially acceptable as possible. Extensive labour market policy measures are proposed for those still employed in the coal industry today, including the exclusion of redundancies in the course of the phasing-out of coal-fired power generation. Furthermore, it is recognised that there will be a need for further training measures for employees as well as targeted re-employment in suitable positions, within and outside the sector, for those affected in lignite mining.

All these measures are to be implemented with financing for the coal regions of €40bn over the next twenty years. The forward-looking element of coal transition policies are the regional and industrial policy initiatives to revitalise coal regions after coal phase-out; these make up the main strength of the German case.

The stakes in the automobile industry are much higher and the transformation is also a more complex one as, besides decarbonisation, the digitalisation of both the production and the product and a reconfiguration of the global supply chains of the industry are proceeding simultaneously. There are also several unknown elements in this transformation, such as what engine technology will finally prevail, how radical changes in mobility patterns will be and what role individual vehicle use will have in the future.

Given this complexity of the transformation, it is often not even recognised as a case for just transition, with the main focus of demands at this point being the mobilisation of resources regarding transiting from the combustion engine towards electric vehicles and how this process can be shaped and facilitated. Chapters 6, 7, 8 and 9 of this publication reveal that such a paradigm change inevitably includes massive alterations in employment patterns as no job in the sector will remain unaffected.

At policy level, automobile industry stakeholders have been playing a controversial role over a long period in lobbying for lighter regulation on car emission standards, while some manufacturers also took the step of implementing fraudulent practices. However, after the diesel scandal, they have (since 2017) at least launched radical restructuring and investment programmes towards electrification.

While climate policy ambition was not the strength of automobile industry actors, they are now focused on managing the radical transformation in a balanced way. Co-operative industrial relations and co-determination practices in the main European manufacturers (above all in Germany and France) are great assets to facilitate employment transitions in an advanced-looking and innovative manner. In the German case, as Maximilian Strötzel and Christian Brunkhorst describe in chapter 9, the main task for the trade union IG Metall is to shape location, employment, innovation and investment strategies; conclude agreements to safeguard production locations; and find a development perspective for every plant. At plant level, works councils are focused on securing the core interests of employees with further agreements on collective bargaining, company pension schemes and profit-sharing. In return, they support the restructuring process.

A number of best practice cases are examined by the authors. The General Works Council of Daimler has reached an agreement on *Projekt Zukunft* ('Project Future') under which job security for all Daimler employees is extended from 2020 to 2030, including those in logistics and branch offices. Within the work of the company's innovation committees, the works council is to be advised of future product strategies by plant management and has the right to make proposals in response. Investment commitments of €35bn have been made in German locations over the next seven years dedicated to the areas of e-mobility, mobility services, connectivity and autonomous driving. Meanwhile, Volkswagen is anticipating extensive job cuts as a result of the introduction of new technologies and products. As part of its 'Future Pact', 25,000 jobs will be eliminated although 9,000 will also be created. Back in 2016, the works council had already been able to negotiate a job security plan up to 2025, so the reduction in employment will therefore be achieved in a socially acceptable manner. This includes part-time work for older employees, which is set to be significantly expanded. At the same time, commitments have been made to locate new e-mobility products at German sites. In this way, each department has been given a development perspective over the next few years. Management's plans to outsource certain products and logistics, or to relocate all new e-components abroad under specific termination plans, could thus be fended off. There have also been strategic agreements in the supplier sector which relate specifically to the transformation process. At Schaeffler, an agreement on the future (*Zukunftsvereinbarung*) has been reached that goes beyond normal employment agreements. Suppliers' products are relatively independent of brand identity in the end product, so they can position themselves more flexibly within the new drive and mobility concepts than end manufacturers. In this way, business models beyond the private ownership of cars are also of great interest here.

In the French automobile sector (see chapter 7), company trade unions are also in the position of negotiating on the issues arising from the company's strategic orientation in the medium-term. Unions may seek to negotiate on the types of job categories threatened by economic or technological change; on the implementation of employee mobility; on the sustainable training and inclusion of young people in the company; on the employment of older workers; etc. This negotiation framework, together with works council consultations on strategic orientation, offers the tools with which to achieve a shared vision of a company's strategy and outlook, and to formulate together alternative proposals and identify secure development paths. These tools deserve to be used broadly by companies within the powertrain sector in France and in Europe more generally. Where they are well utilised, such information/consultation practices provide the opportunity to discuss the opportunities for diversification and the detailed skills, training and employment adaptations that they will require.

The main lesson to be drawn from the cases presented in this book is that just transition is not an abstract concept, but a real practice in real workplaces. It is this 'on the ground' perspective that really matters. While the green transition itself is an imperative, only a just green transition will deliver. Decarbonisation itself is a common objective, but concrete transitions take place in work environments that are, farther on, determined by the capital-labour relationship. The overall objective is in common, but conflicts of interest during the transition are inevitable. This is where the role of trade unions and social dialogue is key. It may well be true that some of the approaches that have worked well in some of the scenarios outlined in this book are geographically, and even culturally, specific to the companies, actors and settings which prompted and encouraged them, and which built on the advantages conferred by these into forms of resolution that could be acceptable to all. Nevertheless, there are others which are surely more generic in tone and, therefore, appropriate in a wide range of contexts. Among them would seem to be these:

— workers' commitment to change is a prerequisite if it is to happen in a way that causes least disruption, but this will not take place without purposeful and practical engagement through dialogue. However, this must not reflect simple routine: dialogue must be both genuine and open if it is to result in honest and supportable outcomes; and, additionally, innovative change will require innovative relationships and new ways of working with and listening to each other. Furthermore, dialogue must be specific rather than abstract, and directed towards action plans;

— companies therefore need to take responsibility for instigating programmes of workplace education around the science of climate change and providing forums for workers to discuss the issues with experts and to develop considered responses. Trade unions have a role here, too, in ensuring that the issues raised by climate change are on the workplace agenda;

— even if policy must necessarily be global, its implementation must, equally necessarily, be local. Not only workers in plants but regional parliaments and assemblies must be at the forefront of change and active partners in it. Comprehensive regional development plans are essential in delivering the sustainability of regions and the revitalisation of local economies into the future. Especially in the light of the heavy concentration of certain types of industrial and energy production, local authorities must be committed in the search for replacement industries and jobs, and funding, that deliver a similar skillbase and which ensure a minimisation of the knock-on effects. Here, the engagement of expert staff will be key and authorities need to be open to specific secondments where necessary;

— the green transition will have major implications for workers' skills. The transition must be to a future which places at least an equal premium on skills as current technology. Industry R&D must, therefore, look specifically for opportunities to establish technological leadership which will, in turn, create opportunities for upskilling. In this, technical institutes and NGOs will have a key role in advising on future requirements; public sector agencies will have a key role here too as well as in providing backing in the form of genuine retraining programmes. At the same time, it is absolutely clear that greater use of temporary work relationships, and extending the 'gig economy' into the sectors that are at the heart of the green transition, will undermine workers' buy-in and that such forms of employment must be rejected. Cross-border solidarity also demands that eyes are not closed to the rise of precarious forms of labour elsewhere in Europe even while more standard forms of employment are preserved domestically;

— intelligent forms of production and feedback loops developed out of digitalisation and automation raise issues of data privacy and personal rights, including in the workplace. These must be resolved on the basis of the protection of users' personal rights to their data and this must also apply right across the workplace.

Ultimately, a transition that results specifically from public policy, rather than changes in consumer taste, market decline or some or other corporate mis-step, requires public policy to take lead responsibility in providing the conditions to assist workers in the transitional restructuring that results. Europe needs to be ambitious in its proposed outcomes; yet deeply traditional as regards the processes in which it engages to achieve them. We commend the broad framework of dialogue and deep, structured engagement with workers that we outline here to policy-makers across Europe. Without that, and without the foresight to commit investment finance to particular areas with a view to replacing outdated, even if still highly serviceable, technology, Europe will not be able to make a success of the green transition. And time is continuing to run short.

References

ACEA (2019) Employment trends, Brussels, European Automobile Manufacturers' Association. https://www.acea.be/statistics/tag/category/employment-trends

Agora Energiewende and Sandbag (2018) The European power sector in 2017: state of affairs and review of current developments, London, Sandbag. https://sandbag.org.uk/wp-content/uploads/2018/01/EU-power-sector-report-2017.pdf

Agora Energiewende and Sandbag (2019) The European power sector in 2018: up-to-date analysis on the electricity transition, London, Sandbag. https://www.agora-energiewende.de/en/publications/the-european-power-sector-in-2018/

Alves Dias P. *et al.* (2018) EU coal regions: opportunities and challenges ahead, Luxembourg, Publications Office of the European Union. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/eu-coal-regions-opportunities-and-challenges-ahead

Bauer W., Riedel O., Herrmann F., Borrmann D. and Sachs C. (2018) ELAB 2.0 Wirkung der Fahrzeugelektrifizierung auf die Beschäftigung am Standort Deutschland, Stuttgart, Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO. https://www.iao.fraunhofer.de/lang-de/images/iao-news/elab20.pdf

BNEF (2018) New energy outlook 2018, New York, Bloomberg New Energy Finance. https://about.bnef.com/new-energy-outlook/

European Commission (2016) Proposal for a Directive of the European Parliament and of the Council on common rules for the internal market in electricity, COM(2016) 864 final. https://www.actu-environnement.com/media/pdf/news-27990-directive-marche-electricite.pdf

European Commission (2018a) Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank - A clean planet for all: a European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy, COM(2018) 773 final. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0773&from=EN

European Commission (2018b) Governance of the Energy Union. https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union

Europe Beyond Coal (2019) Overview: national coal phase-out announcements in Europe. https://beyond-coal.eu/wp-content/uploads/2019/10/Overview-of-national-coal-phase-out-announcements-October-2019.pdf

Galgóczi B. (2014) The long and winding road from black to green: decades of structural change in the Ruhr region, International Journal of Labour Research, 6 (2), 217-240. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/publication/wcms_375223.pdf

Galgóczi B. (2018) Just transition towards environmentally sustainable economies and societies for all, ILO ACTRAV Policy Brief, Geneva, International Labour Office. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/publication/wcms_647648.pdf

Green J.K., Seneviratne S.I., Berg A.M, Findell K.L, Hagemann S., Lawrence D.M. and Gentine P. (2019) Large influence of soil moisture on long-term terrestrial carbon uptake, Nature, 565, 476–479. https://www.nature.com/articles/s41586-018-0848-x

IEA (2018) Coal 2018, Paris, International Energy Agency. https://www.iea.org/topics/coal/

ILO (2015) Guidelines for a just transition towards environmentally sustainable economies and societies for all, Geneva, International Labour Office. http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

IPCC (2018) Global warming of 1.5°C: an IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty, Summary for Policymakers, Geneva, Intergovernmental Panel on Climate Change. https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/

NASA (2018) New study finds sea level rise accelerating. https://climate.nasa.gov/news/2680/new-study-finds-sea-level-rise-accelerating/

PA Consulting (2018) Driving into a low emissions future. https://www.paconsulting.com/insights/2017/the-co2-emissions-challenge/

Transport & Environment (2017) How will electric vehicle transition impact EU jobs? https://www.transportenvironment.org/publications/how-will-electric-vehicle-transition-impact-eu-jobs

Wynn G. and Coghe P. (2017) Europe's coal-fired power plants: rough times ahead - Analysis of the impact of a new round of pollution controls, Cleveland, Institute for Energy Economics and Financial Analysis. http://ieefa.org/wp-content/uploads/2017/05/Europe-Coal-Fired-Plants_Rough-Times-Ahead_May-2017.pdf

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Part I

Phasing out coal

Chapter 1
The changing role of coal in the Polish economy – restructuring and (regional) just transition

Aleksander Szpor

Introduction

Poland is often referred as the *enfant terrible* of EU climate and energy policy. The pertinent question remains: is it going to change? Poland's traditional reliance on coal in the energy sector, its famous unilateral vetoes of the EU 2050 Roadmap and the controversial coal exhibition in the Polish pavilion during the COP24 in Katowice are building an image of the country as the main saboteur of an ambitious EU climate policy.

Indeed, the key domestic stakeholders of energy policy – trade unions and the private sector – hold dear the status quo in which the state protects the coal mining sector and a coal-based energy system against EU climate and energy policy. Instruments of protection, such as the special pension system for miners or the capitalisation of coal mining by state-controlled companies, makes it difficult to hold the sector accountable and transparent. Even so, these public policies still appear to be politically justified as climate concerns in Polish society remain relatively low while issues such as energy prices or energy security, as limitations of ambitious climate goals, continue to prevail.

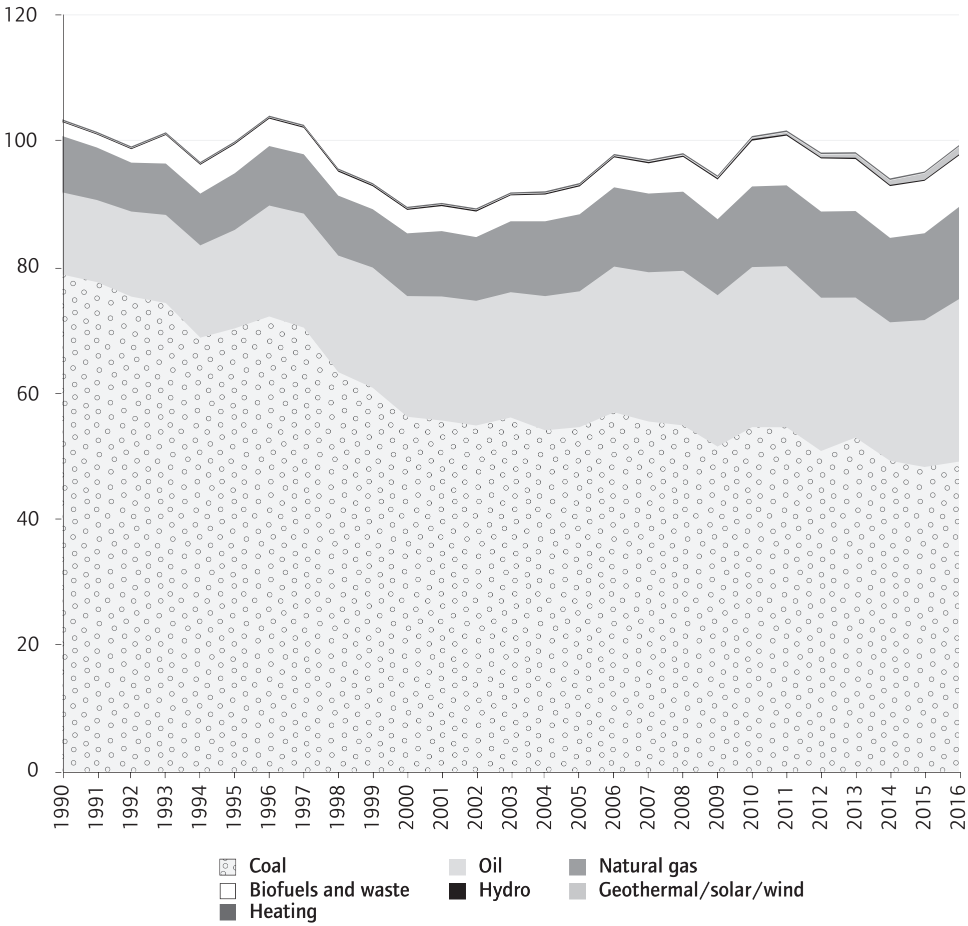
In this chapter, we first explain the historical background of Polish coal mining and the coal-based energy sector as it is key to understanding the current position of Poland with regard to climate policy. We go on to outline different perspectives on the impact of the coal-based energy system on CO_2 emissions to highlight Polish weaknesses in terms of climate targets but, at the same time, we also show how this (non-)policy regarding climate goals reflects social beliefs. In the next part, we explain some of the miners' motivations and ways of defending their jobs in the coal sector. Then, we characterise coal regions and look at the factors which may determine their resilience to the possible phasing out of coal. We then summarise the current government's strategies regarding the energy sector and CO_2 emissions and discuss the challenges in the context of EU targets before concluding with suggestions of possible solutions for a faster and more effective transformation.

1. The historic role of coal in the Polish economy

Historically, coal has played a role as a guarantor of economic wealth and development in Poland. For the Silesia region – the main coal mining region in Poland – it was also a trigger of different, positive processes such as industrialisation, urbanisation and the propagation of social rights movements. The decline of the sector began with a delay compared to other coal-producing countries such as the UK, France or Germany. In Poland, this decline was strongly influenced by the inefficient central planning system under the communist regime established after World War II. With the fall of communism in 1989, the sector became one of the key challenges for the economic and political transformation of the country (Szpor and Ziółkowska 2018).

In the last three decades, the domestic consumption of coal (including lignite) and also its production has been decreasing, but it is still the main component of the Polish energy mix, currently representing one-half of the Total Primary Energy Supply (TPES), as Figure 1 shows. The decrease in the role of coal has been driven mainly by the transformation of the economy (improvements in energy efficiency and the development of services at the expense of industry). The increase in oil supply during this period is related to the development of transport.

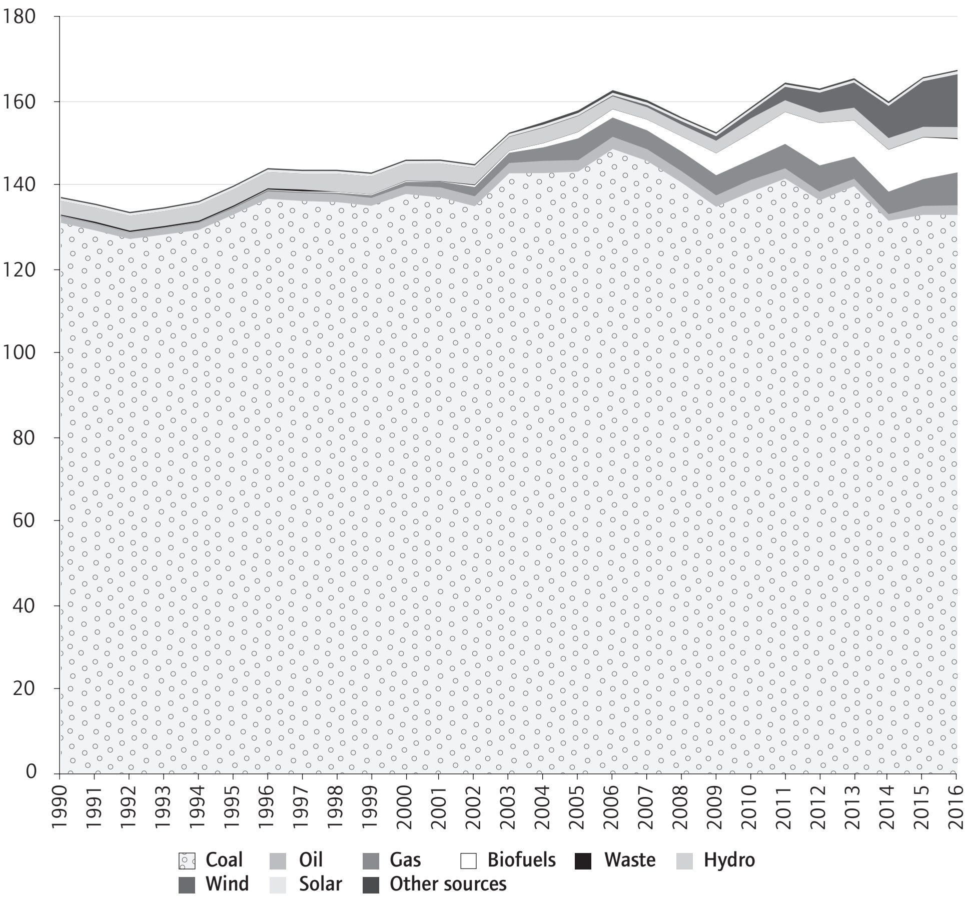
Figure 1 **Total primary energy supply (Mtoe), 1990-2016**



Source: IEA (data for 1990-2014 – IEA (2016); data for 2015-2016 – IEA (2018). No data for heat in 2015-2016).

Coal played – and still plays – an even more important role in electricity production, as shown in Figure 2. Until the late 1990s, it was responsible for almost the entirety of electricity production. Under the influence of the EU, the use of renewable energy sources (RES) has increased, with biomass (the majority being biofuels) and wind, in particular, being implemented on a larger scale since the 2000s. In 2016, all RES combined represent around fourteen per cent of total electricity production. It is also noteworthy that coal-based energy generation, in terms of absolute value, remained practically at the same level (131 TWh in 1990 and 133 TWh in 2016) during the whole of this 26-year period, as Figure 2 also shows. With some ups and downs, the contribution of other fuels (wind, biofuels, gas) covers roughly all the increase in electricity production over the period.

Figure 2 **Electricity production (TWh), 1990-2016**



Source: IEA. Data for 1990-2014 – IEA (2016); data for 2015-2016 – IEA (2018). No data for 'other sources' in 2015-2016.

The role of coal and lignite mining in the total economy has fallen rapidly during the last few years. Between 2005 and 2017, the gross value added (GVA) of coal and lignite mining in industry decreased from 6.9 per cent to 3.7 per cent. In nominal terms, this meant a growth of 10 per cent, whereas the GVA of industry as a whole doubled in the same period.[1]

For many years, Polish reliance on coal was justified by the limited availability of alternatives. Poland has never developed nuclear power and, unlike in many EU15 countries, the 'dash for gas' option was not seen as viable due to the geopolitical risks related to Russia. The existing gas infrastructure does not allow the import of gas from other countries, while a reliance on Russia could repeat politically motivated gas switch-offs or price setting. Poland has extensive domestic coal reserves and only limited domestic resources of gas, so this policy seemed to be reasonable from an economic viewpoint. However, in recent years, the gas infrastructure, thanks to the European Strategic Energy Technology Plan, has substantially enhanced interconnections with neighbouring countries as well as securing a new LNG terminal. It is expected that, as long as the price of emissions allowances does not radically increase the costs of this fuel, it could, together with biofuels, cover the necessary baseload and thus allow the wider deployment of intermittent RES in Poland.

The mining of coal and lignite in Poland is state-controlled and highly concentrated. The majority of hard coal mining takes place in four state-controlled companies: PGG in Silesia is the largest; followed by JSW (with seven, partly-integrated mines); Bogdanka (one coal mine, but a large one); and Węglokos (a large industrial company owning one coal mine). Another three hard coal mines belong to Tauron – an energy company in which the Treasury is a minority shareholder – while three coal mines are in private hands (Eko-plus, Silesia and Siltech). In the lignite sector, the major producers are PGE (a state-controlled energy company owing two mines) and ZE PAK (a private company, also owning two mines). Both companies are responsible for almost the entire domestic production of lignite. Section 4 of this chapter, Figures 11 and 12, covers the regional distribution of mines.

The concentration of the coal sector is extremely high compared to other segments of industry. Despite significant imports of coal in recent years, the price of domestically-produced coal is substantially higher. This has been possible due – among other things – to state-owned electricity power plants having concluded long-term contracts with Polish mining companies which has limited the impact of the international price.

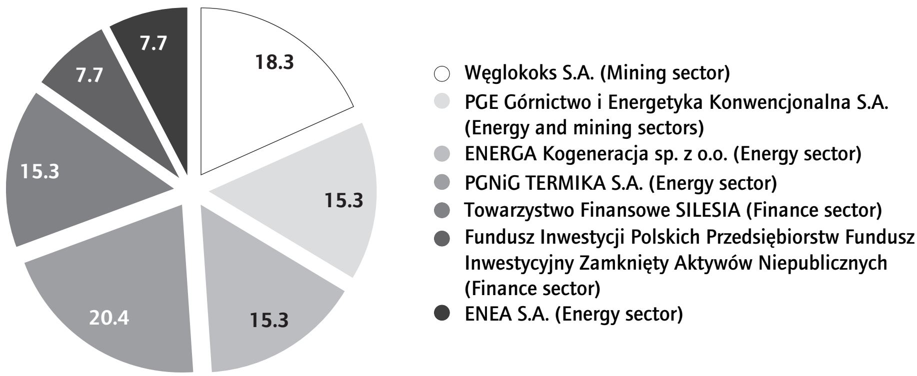
PGG, the biggest mining company in Europe and the biggest employer in the region of Silesia, with twelve partly-integrated mines,[2] is the best example of state involvement in coal mining in Poland (see its ownership structure in Figure 3). The company was created as the result of a restructuring programme which started in 2016 and under which two coal mining companies in a difficult economic situation were merged. The

1. In the same period, the whole sector of 'mining and quarrying', which includes coal and lignite but also, for instance, the much more profitable copper mining industry, grew by thirty per cent.

2. Integration of mines can take a physical and/or a legal form and is aimed at the unification of mines in order to reduce their costs (e.g. in PGG there is one mine integrating four formerly independent mines; and another two, each of which integrate two formerly independent mines).

programme included the liquidation of the least profitable mines, the organisational integration of others and the capitalisation of PGG by state-controlled companies in the sectors of energy (PGE, Energa, Enea), mining (Węglokoks, PGNiG) and finance (TFS, FIP-TFI). The total capitalisation of the company was €0.6bn from shareholders and €0.3bn from the banking sector in form of bank bonds.

Figure 3 **Holders of the share capital of PGG – the main hard coal mining company in Poland (per cent), 2018**



Source: PGG.

Furthermore, the energy sector is, to a large extent, also controlled by the state. There are four major energy companies which play an important role in energy production and distribution: PGE; Tauron; Energa; and Enea. The Treasury is a majority shareholder in three of them – PGE, Energa and Enea – while it owns directly thirty per cent of the shares of Tauron, the fourth (Table 1). In 2017, a major takeover took place by PGE and Enea of the generation assets of the French multinational companies, EDF and ENGIE. The result is that the concentration level, in terms of the installed capacity and volume of energy introduced to the grid, has grown respectively by 37 per cent and 39 per cent, facilitating its depiction as 'high' or just below 'high' (URE 2017). These movements are generally perceived as part of the broader political programme of the governing party to create national champions among state-owned or state-controlled companies, able to compete on international markets even if this is at the cost of lower competition on the domestic market.

In the recent decade, the contributions of the hard coal mining sector to the public finances have not covered state support for the sector. The report of the Supreme Audit Office (NIK 2017) states that total contributions to public finances (mainly to the state budget and to the Social Insurance Institution) reached €15.9bn between 2007-2015. In the same period, state support, directed mostly to supplementing the special retirement pension system[3] for miners), amounted to €16.1bn. Thus, even if the sector is still making a profit in economic terms, the cost of the pension system (due to the

3. Retirement is granted to a miner after 25 years of work, which means that a miner who starts work at age 18 can retire at 43 even though the regular pension age for a man is 65 years.

shorter working lives of miners) gives it a ‘neutral’ balance in respect of the public finances (or even a slightly negative one).

Table 1 **Shareholders in the other main mining and energy companies in Poland (per cent)**

		Treasury	Enea SA	TFI PZU SA**	KGHM polska miedź
The main energy companies	PGE	57.39			
	Tauron	30.06*			10.39
	Energa	64.09			
	Enea	51.50		9.96	
The main coal and lignite mining companies	JSW SA	55.17			
	ZE PAK				
	Bogdanka SA		66.00	9.76	
	KGHM polska miedź***	30.79*			

* The remaining shares belong to minor shareholders and are free floating.
** The Investment Fund Company is 100 per cent owned by the largest Polish insurance company PZU, of which the Treasury owns 35 per cent of the shares while the rest are free floating.
*** The copper mining company of which the Treasury owns 32 per cent and foreign insurance companies ten per cent, while the rest are free floating.
Source: Giełda Papierów Wartościowych, 16.03.2018.

Similarly, the trade balance of the coal sector has been rather negative in recent years. Figure 4 shows the value and volume of coal exports and imports since the mid-1990s. During the most recent decade (2008-2017), the value of coal exports has been lower than the value of imports, while the accumulated trade deficit was $2.7bn. Compared with data from the late 1990s or early 2000s, this suggests a decline in the competitiveness of Polish coal.

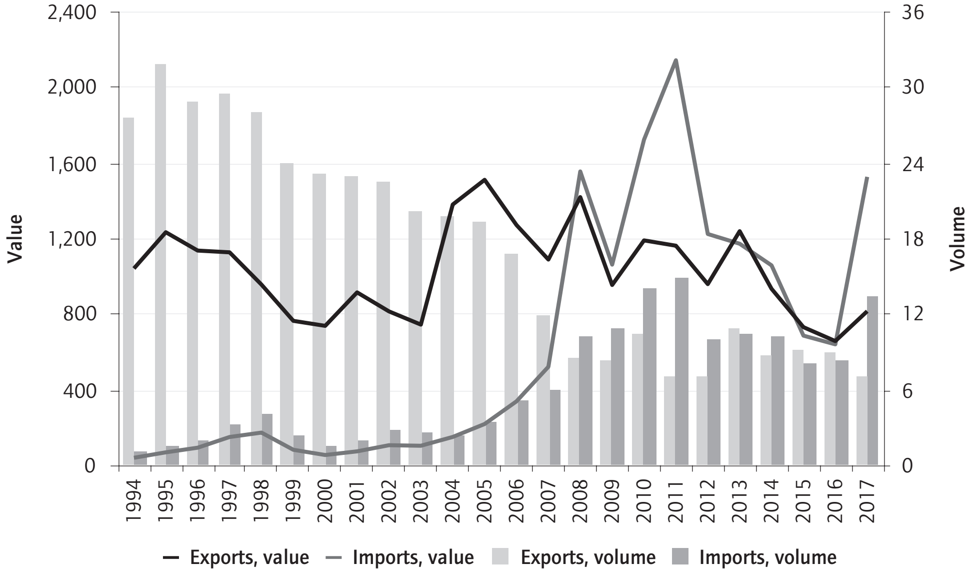
Moreover, the trade in mining equipment seems to indicate that Poland is strongly dependent on imports. Domestic production of equipment is at a level of €390m, while the export value is €658m and the import value €775m. To put this into perspective, with the value of net exports being -€117m, Poland has the largest trade deficit among coal-producing EU member states (Alves Dias *et al.* 2018).

One important economic factor supporting the role of coal is the assumed low cost of electricity produced from this fuel. According to the analysis of Strupczewski (2015), the levelised cost of electricity from coal in Poland was around $75/MWh and this was the lowest of all other fuels.[4] The next cheapest sources were nuclear, with a cost of $82/MWh and offshore wind, $93/MWh, while all other sources were above $100/MWh. Given, however, that the costs of RES have decreased since the analysis was performed, while the costs of CO_2 emissions permits have grown, the current costs of coal-based electricity are likely to be less competitive. The recent study by IRENA (2018) confirms the low levelised cost of electricity for coal as it predicts that, in 2025, it will be the

4. This is without the external costs and system costs which are also listed in the publication by Strupczewski.

second cheapest source of electricity, at €92/MWh, although overtaken by onshore wind, at €78/MWh.[5]

Figure 4 **The trade in coal: value ($m); and volume (millions of tonnes), 1994-2017**



Source: Comtrade.

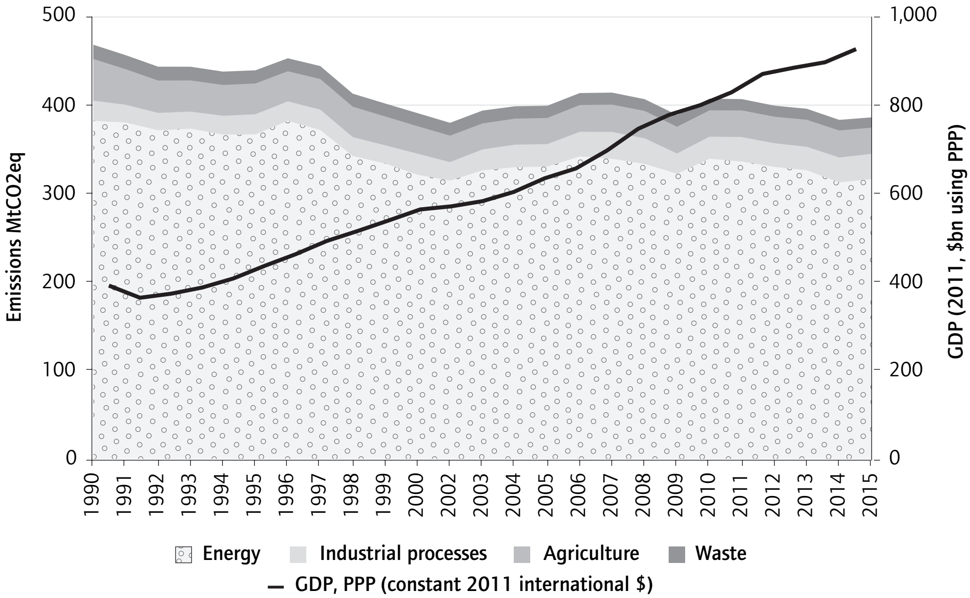
The weakness of the levelised cost of electricity analysis is that it (in this case and in the majority of other studies) does not include taxes, tax exemptions, subsidies, etc. for any energy source. Therefore, it answers only partly to the relevant policy question about the actual cost of energy derived from different fuels.

2. CO_2 emissions in Poland – recent trends and current challenges

The continued decoupling of economic growth from CO_2 emissions in Poland can be considered as a success. CO_2 emissions, at absolute level, have been reduced from 470 Mt in 1990 to 390 Mt in 2016. By 2015, emissions were down by around one-fifth, despite the economy's strong dependence on coal, while GDP grew to two and half times its 1990 level (Figure 5). Emissions decreased until 2002, when they reached their lowest level, since which point they have oscillated around the level of 400 Mt. Poland was among the six member states that, by 2016, had not achieved national emissions reduction targets under the effort sharing mechanism (EEA 2018).

5. RWE Polska had prepared a study in 2016 in which the levelised cost of electricity for coal in Poland was €67/MWh, onshore wind €80/MWh, offshore wind €150/MWh and solar €150/MWh.

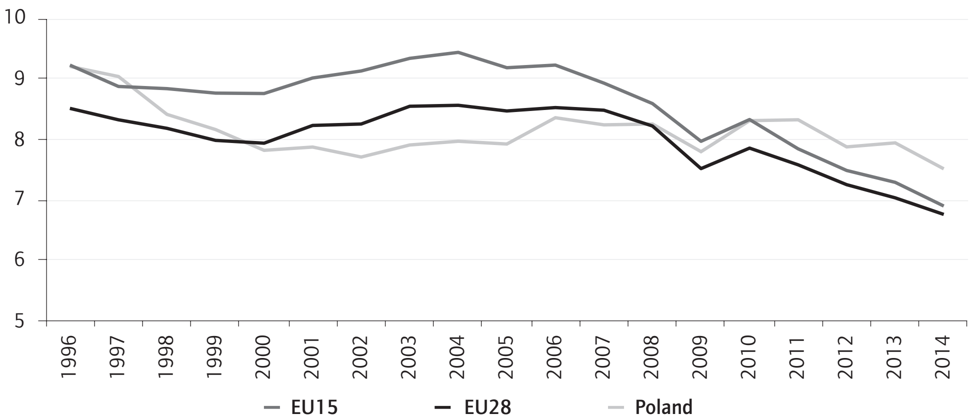
Figure 5 **CO_2 emissions (excluding land use, land use change and forestry) and GDP, 1990-2015**



Source: CO_2 emissions – KOBIZE; GDP – Eurostat.

In terms of CO_2 emissions per capita, Poland was, in 2014, slightly above the EU15 average (with seven member states having higher levels) but was more significantly above the average for the EU as a whole (Figure 6).

Figure 6 **CO_2 emissions per capita (tonnes), 1996-2014**

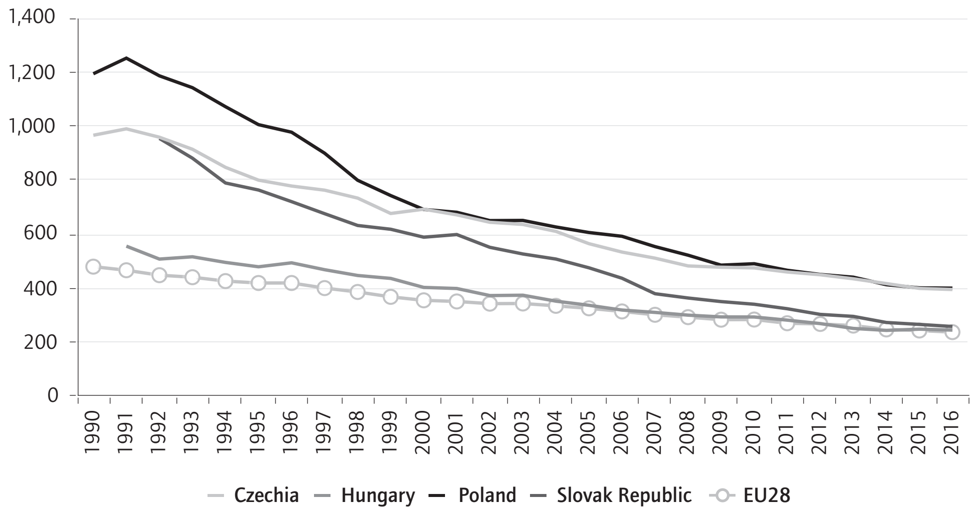


Source: World Bank.

On the negative side, Poland remains one of the most carbon intensive economies in the EU and it does not support domestic businesses in profiting from the megatrend of developing the green economy. The result is that Poland is expected to remain a weak spot in the EU's decarbonisation policy which will have negative consequences in political terms as well as in terms of lost synergies from those same EU policies.

Although the pace and scale of CO_2 emissions reduction in Poland has been the most significant among other central and eastern European countries (CEEC), it still has the highest CO_2 intensity in the Visegrad 4 group[6] and is significantly above the EU28 average (Figure 7). In the 1990s, Poland was the most carbon intensive economy (except for Estonia) in CEE, which is partly due to its lack of nuclear power (alongside, for example, the cases of Hungary, Slovakia and Czechia). As with other transformation economies, the radical downscaling of inefficient industrial facilities during the system transformation was not only an essential part of the economic transformation process but also made a large contribution to the significant reduction of emissions during the 1990s. Yet, with a rapidly growing economy, the costs of reduction were also increasing. From a political perspective, it was becoming equally difficult to keep up the pace of transformation – among the highest in CEECs – and face down the concerns of miners about the future of their sector.

Figure 7 **CO_2 intensity of economies in Visegrad countries, comparative to EU (CO_2 emissions per GDP (PPP) (kg/$), 1990-2016**



Source: GDP – World Bank; CO2 emissions – Eurostat.

The achievements of Poland in terms of CO_2 emissions reduction during the 1990s were, therefore, rather a side effect of the economic transformation than the results of a planned climate policy. Both the (non-binding) Rio targets and the Kyoto Protocol targets were achieved by Poland with a substantial surplus. According to the Rio

6. The Visegrad 4 group includes Czechia, Hungary, Poland and Slovakia.

targets, Poland was expected to stabilise its emissions level by 2000 at the 1988 level: it not only achieved that but also reduced its emissions by 33 per cent. The Kyoto targets, aiming at a reduction in emissions of six per cent between 2008-2012 with regard to the 1988 levels, were also achieved as Poland reduced emissions by thirty per cent. Even so, climate policy was never a part of any government strategy and neither were climate goals ever internalised by government strategies. Furthermore, the process of monitoring and reporting CO_2 emissions, especially during the 1990s, was clumsy and delayed (Karaczun *et al.* 2000), becoming more transparent and ordered only in the recent decade.

The lack of a climate policy in Poland is, in domestic political terms, legitimate. Opinion polls indicate some progress in terms of public awareness of climate change (although the trend is not clear) (CBOS 2018). Other research (ESS 2018), however, indicates that Poles, among 23 other mostly European countries, are below average in terms of the share of population who believe climate change to be a fact, that it is caused at least partly by humans and that it will have a bad impact.[7] More importantly, Poles (together with Russians) are the least opposed to coal and gas as a source of energy and the most sceptical about a fossil fuel tax. The result is that, on the domestic political agenda, strategic documents related to the energy and coal sector do not tackle the problem of reducing the number of coal mines or jobs as this would be instantly opposed by the trade unions and could endanger the stability of any government.

A further research study (Poushter and Huang 2019), conducted in 26 countries[8] around the world, indicates that climate change is the most feared of the presented choices in one-half of the countries in the study. Interestingly, in only three other countries (Russia, Israel and Nigeria) is climate change feared less than it is in Poland. Instead, Poland's concern over Russia's power and influence is the highest among all countries and, domestically, this concern is the highest of all the eight concerns addressed in the poll.

In the absence of a strong internally-motivated agenda for the reduction of CO_2 emissions, the main challenge for domestic policy can be formulated in terms of how to reduce the CO_2 intensity of the economy in order to comply with the EU's climate and energy policy. With 0.4 kg of CO_2 emissions per dollar of GDP (PPP), Poland is the second most carbon intensive economy in the EU. As national emissions come mostly from the energy and heating sector which in turn – again – is fuelled mostly by coal, coal mining will inevitably continue to face strong pressure from the EU for a more rapid winding down.

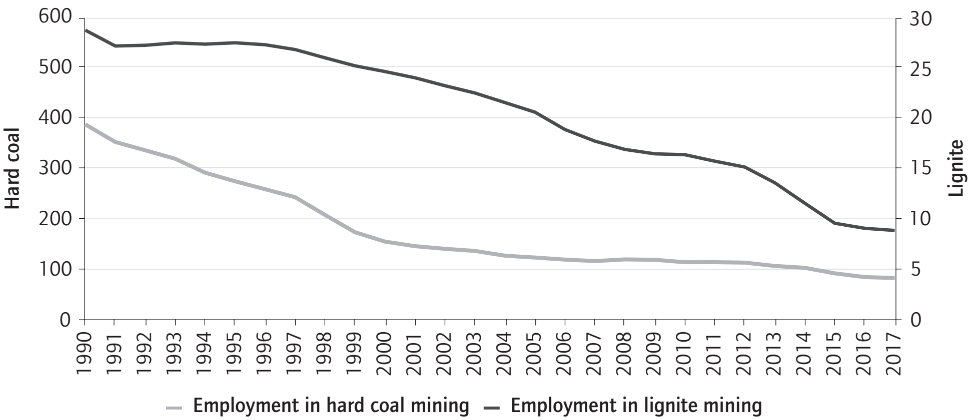
7. The list of 23 countries is: Austria, Belgium, Czech Republic, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Russia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

8. The list of 26 countries is: US, Canada, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Spain, Sweden, UK, Russia, Australia, Indonesia, Japan, Philippines, South Korea, Israel, Tunisia, Kenya, Nigeria, South Africa, Argentina, Brazil and Mexico.

3. Employment in the coal sector and related industries

Making politically-acceptable reductions in employment has been one of the main challenges in the coal sector transformation since the early 1990s. By 2017, the number of miners employed in hard coal had fallen by eighty per cent (from 388,000 in 1990 to 83,000 in 2017) and in lignite by seventy per cent (from 29,000 to 9,000) (Figure 8). The scale and the pace of employment reduction were driven by economic and political factors: the former acted in favour of employment reduction, while the latter (mostly with regard to hard coal) slowed this process.

Figure 8 **Employment in hard coal and in lignite mining in Poland, 1990-2017 (thousand)**



Source: for lignite sector – Kasztelewicz (2018); for hard coal sector – Supreme Audit Office (2017).

The reduction of employment in the coal sector (particularly in hard coal) has been achieved by different types of instruments. The first (quasi-)instrument, applied in the early 1990s, was natural attrition (i.e. the limitation of new employment and relying on the outflow of workers who had reached pension age). Since the mid-1990s, natural attrition has been reinforced by such instruments as early retirement or redundancy payments. To keep up the pace of employment reduction, more and more generous conditions for these instruments were offered, such as increasing the value of early retirement payments or reducing the age limit for eligibility. Widespread use of these instruments ended in the early 2000s, correlating with the decreasing pace of employment reduction (Szpor and Ziółkowska 2018).

The attractiveness of the mining sector is sustained by relatively high wages. Salary in hard coal and lignite mining[9] is almost fifty per cent higher than in the construction sector and almost forty per cent higher than in manufacturing and across the whole economy (Figure 9). The high salary seeks to compensate for the risk of accidents and the onset of health conditions as well as for the specific skills required in hard coal mining which are not entirely applicable in other sectors.

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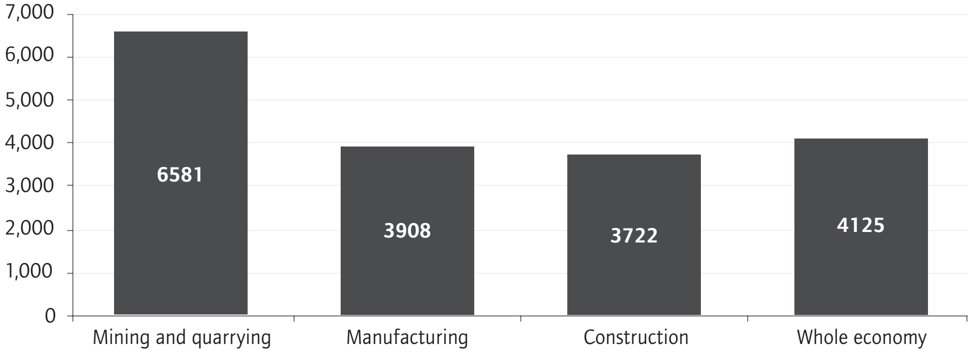
9. In 2017, around twenty per cent of workers in the sector 'Mining and quarrying' were from other industries than coal and lignite.

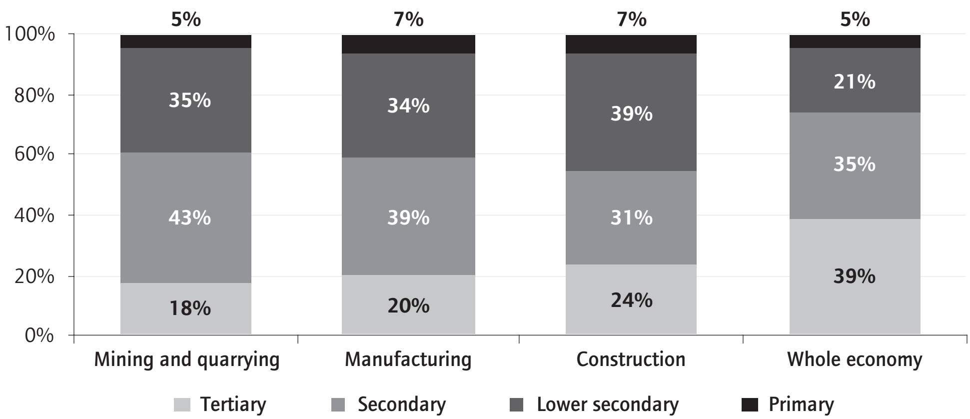
Figure 9 **Wages in mining (PLN)* and in other selected sectors (2017)**



*Average exchange rate in 2017: €1 = 4.26 PLN.
Source: Structure of Earnings Survey (2016).

Salaries in mining are indeed substantially higher although the level of education required remains comparable to that in the other sectors. The share of miners with tertiary education is lower compared to elsewhere, being one-half of that in the whole economy; yet the number of workers with secondary education is higher, as Figure 10 shows.

Figure 10 **Level of education in mining and quarrying compared to other sectors**



Source: Structure of Earnings Survey (2016).

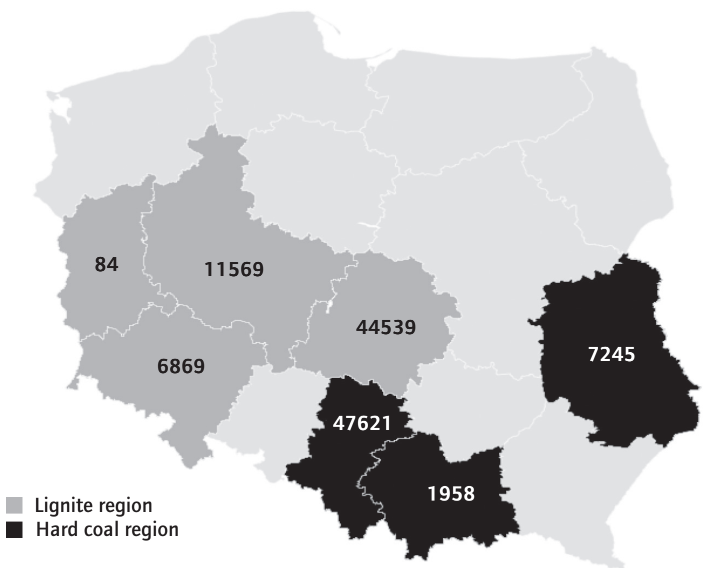
Strong trade unions are another factor preserving the employment structure in the mining sector. In some Polish mines, the level of unionisation reaches over 100 per cent (a miner may belong to more than one trade union) compared to fifteen per cent in the whole economy. Trade union strength is used – among other things – to preserve a complicated remuneration system in which a number of additional payments and benefits function for different groups within the sector. Keeping this non-transparent helps trade union leaders and company management limit the external and internal pressure on the sector.

Coal and lignite mining is also strongly supported by workers in other dependent sectors. Employment in supply chains for the coal sector was quantified in 2017 by the European Commission's Joint Research Centre (Alves Dias *et al.* 2018) in an input/output analysis. This indicated around 49 thousand jobs in intra-regional supply chains and 88 thousand in inter-regional ones.[10] Another recent study, also based on input-output analysis, shows a proportion of employees in the sector and in supply sectors of roughly 1:0.5 (Kiewra *et al.* 2019). This contradicts other estimates of proportions ranging from 1:2 to even 1:4 (Wydawnictwo Gornicze 2017).

4. The regional dimension

Despite the declining role of coal, its production takes place to varying degrees in almost one-half of Polish regions (see Figure 11). Production of hard coal (thermal and coking coal) takes place foremost in the Silesia region (48 Mt; with 27 mines), but also to a lesser degree in Lubelskie region (7 Mt; one mine) and Małopolskie region (2 Mt; two mines). Lignite is mined in four other regions – in Łódzkie (45 Mt; one mine), Wielkopolskie (12 Mt, two mines) Dolnośląskie (7 Mt; one mine) and Lubuskie (0.08 Mt; one mine). Among these coal producing regions, only in Silesia is coal being used on a wider scale in industry more generally as opposed to purely in energy generation; in other coal producing regions, either the scale of production of hard coal is insufficient or the type of coal (lignite) simply excludes this as a fuel other than in energy production.

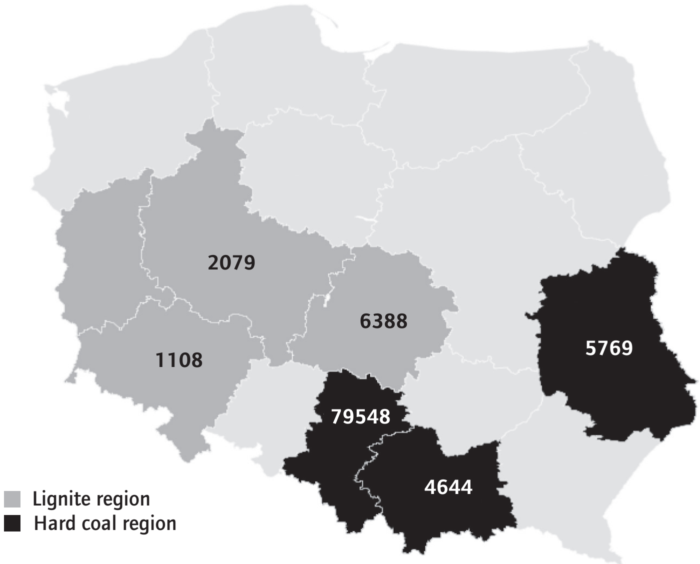
Figure 11 **Hard coal and lignite production (in kilotonnes) by region (2017)**



Source: Own visualisation based on data from PIG (2018).

10. According to the data of Alves Dias *et al.* (2018), coal-fired power plants in Poland employ thirteen thousand workers.

Figure 12 **Employment in hard coal and lignite mining sector by region (2017)**



Source: Own visualisation based on data from Alves Dias *et al.* 2018.

Polish coal-producing regions also differ greatly regarding the number of direct jobs in coal mining, as Figure 12 shows. This is related, firstly, to the number of mines in a region and, secondly, to the type of coal produced. Hard coal mining is far more labour intensive since Polish geological conditions mean that it is deep underground while lignite mining is a surface mining activity. That is why in Silesia, where the majority of coal mines exist, there are almost 80 thousand workers employed in hard coal mines. In Lubelskie and Małopolskie, employment in hard coal mining is much lower due to the number of mines (one and two, respectively). Employment in Łódzkie, Wielkopolskie and Dolnośląskie regions, where lignite mining takes place in opencast pits, is lower and fairly proportional to the quantity of coal produced. Other important factors in the scale of employment in each region relate to the individual geological conditions of the mines and to their ownership.

A simplified index of coal regions' resilience after the winding down of coal was outlined in the Joint Research Centre report (Alves Dias *et al.* 2018). The degree of regional resilience is measured in several steps. Firstly, an index, based on the ratio of regional GDP per capita to national GDP per capita, is established to assess the general economic condition of particular EU regions. In the majority of cases, it indicates the inferior position of EU coal regions as opposed to non-coal regions. In the next step, based on forecasts for the decommissioning of coal mines and coal power plants, the rate of jobs at risk is calculated as a percentage of the working population. This rate is correlated with the unemployment rate. In wealthy coal regions with low unemployment, negative shocks caused by the closure of mines and coal power plants are expected to be absorbed easier than in others.

Silesia is an example of a region whose internal strengths may help to cushion the negative consequences of a phase-out of hard coal. Of all 41 coal regions in the EU, Silesia records the highest number of jobs at risk up to 2030 (41 thousand) (Alves Dias *et al.* 2018). At the same time, its relatively high economically active population (reaching almost two million people), low unemployment (slightly above five per cent), as well as its above-average GDP in comparison with other Polish regions, gives it a chance that, with the right policy, it will manage the transformation.

Unlike in Silesia, mining activity in other mining regions is geographically concentrated in one particular sub-region. Among the existing twelve coal sub-regions, seven belong in Silesia while each of the other five lays in a different region. Their socio-economic situation, in terms of GDP per capita and unemployment, vary: the Piotrkowski and Lubelski sub-regions are prospering better than their wider regions; whereas the Oświęcimski, Jeleniogórski and Koniński sub-regions are doing rather less well than the rest of their regions. In-depth study has not been conducted into this issue, but other economic factors which may have an influence on the level of prosperity at sub-regional level are the type of coal (hard coal or lignite) which is, in turn, partly accountable in terms of other factors – diversification of the economy, level of urbanisation, transport networks, etc.

One of the examples of lignite-based economic and social monoculture is the Koniński sub-region (part of the Wielkopolska region). In this sub-region, lignite mining and lignite-based electricity production constitute the most significant economic activity.[11] Compared to some hard coal mining sub-regions of Silesia (e.g. Katowicki or Gliwicki), it is less diversified in economic terms, less urbanised and less connected with other large or medium cities. It is thus more vulnerable to the negative consequences of transformation. The decline of its mining sector, without the right preventive steps, would mean a substantial decrease in incomes for its local government and a worsening of the quality of life of local inhabitants (Kiewra and Szpor 2018). Despite the tools to resolve the problems within a region laying largely at regional level (mainly in the form of EU funds), sub-regional initiatives to engage private capital will also be necessary. Konińskie sub-region has already taken some initial steps in this direction.

5. Energy objectives and policies

There are currently two major strategic documents framing Polish energy and climate-related policies. The first document, 'Polish Energy Policy until 2040' (PEP 2040) was drafted at the end of 2018.[12] It sets long-term perspective goals for the energy sector

11. Lignite is a fuel which can be used only in electricity production and, due to high humidity, its transportation is possible only over very short distances. Hence, unlike hard coal, which can also be used in steel production or chemistry, it does not have the potential to create diversified industrial production and neither does it stimulate the development of a transport network. The impact of a lack of urban development is that vast areas are left in a rural setting, often remote, and with a number of social problems.

12. Initially, a concept for a Polish energy policy up until 2050 was drafted in 2015, yet the change of government in that year led to a re-launch of the analytical work which, under the current government, has lasted for more than three years. Interestingly, CO_2 emissions targets for 2040 are, according to both plans, set at the same level (299 $MtCO_2eq$). The differences with regard to 2030 (350 $MtCO_2eq$ and 366 $MtCO_2eq$) can be attributed to a delay in the introduction of nuclear power.

and is in line with the overarching government document, the ‘Strategy for Responsible Development until 2020’.[13] The second document is the ‘National Energy and Climate Plan for 2021-2030’ (NECP), drafted at the beginning of 2019. This has been created to respond to the EU requirement for all EU member states to share efforts with the aim of achieving EU climate and energy goals for 2030. Both documents are currently the subject of public consultation, with their final version due for adoption in 2019.

As declared in the draft PEP 2040 document, there is only limited synergy with the NECP. The major differences relate to the role of onshore wind which, in the NECP, is envisaged as being higher than in PEP 2040; and the planned winding down of hard coal power plants which, in the NECP, would be undertaken faster than in PEP 2040. The differences between the documents may come from different assumptions as well as hidden agendas. On the one hand, in 2019 there are elections both to the European Parliament and the Polish Parliament, and the strategy thus needs to take into account the strong domestic coal lobby. On the other, the NECP is to be negotiated with the European Commission and thus it also contains some assumptions that may be subject to change.[14]

The main goal of the energy policy as formulated in PEP 2040 is energy security while ensuring the competitiveness of the economy, energy efficiency, the reduction of the energy sector’s impact on the environment and the optimal use of domestic energy resources (Ministry of Energy of the Republic of Poland 2018a).

‘Directions’ for achieving PEP 2040 goals

Among the seven ‘directions’ which create the operational matrix of PEP 2040, the optimal (rational) use of domestic energy resources is the first. It insists on improving the profitability of hard coal mining and on the development of innovation both in hard coal and lignite production. It also underlines the need for the diversification of gas and oil supplies but also the search for new sources of energy. The second direction is about the development of electricity generation, based on domestic non-intermittent, flexible and environmentally-friendly technologies (other than coal). Separately, it underlines the need for increasing the share of RES and introducing nuclear. Among the other directions is enumerated the development of pipeline networks; the development of energy markets; the implementation of nuclear power; the development of heating and co-generation (universal access to heating and low-emission heat generation across the whole country); and, finally, the improvement of the energy efficiency of the economy.

Source: PEP 2040.

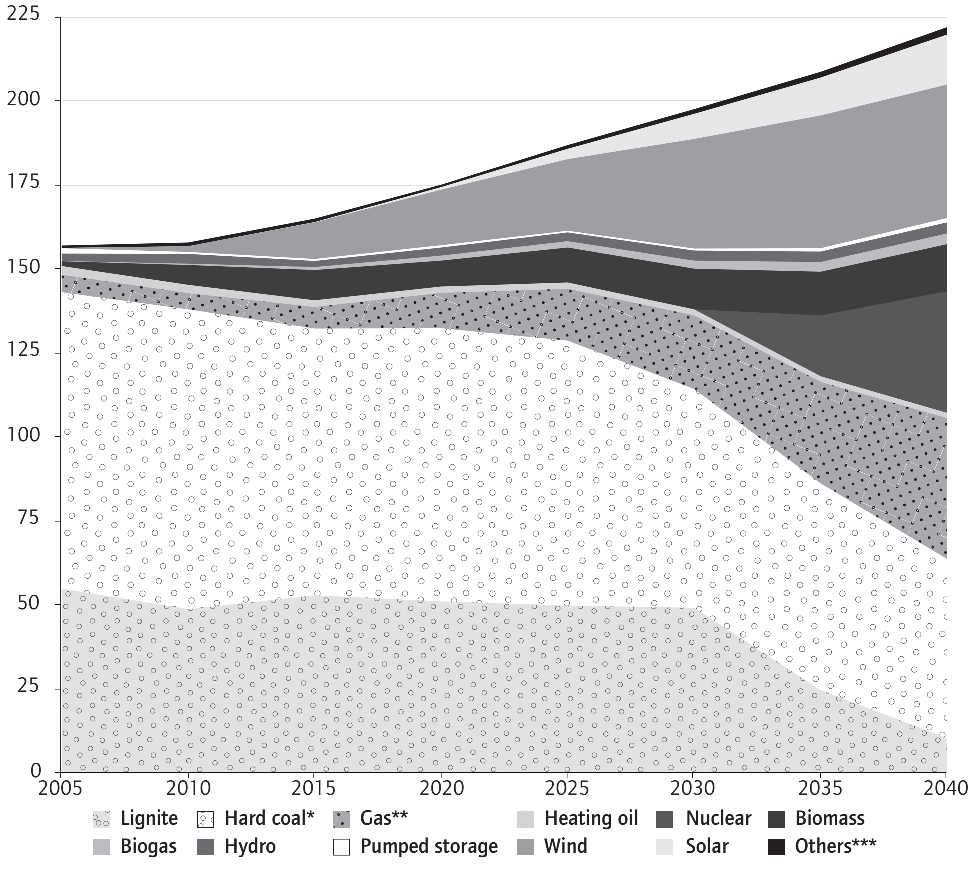
According to PEP 2040, hard coal will remain the single most important source for electricity production by 2040, although its role will be decreasing. By means of the

13. The ‘Strategy for Responsible Development until 2020 (with a perspective to 2030)’ is an overarching strategic document, set in a medium- and long-term perspective, adopted by the government in 2017. The main goal of the Strategy is ‘Creating the conditions for an increase in the incomes of Poland’s inhabitants while increasing cohesion in the social, economic, environmental and territorial dimensions.’

14. Given that the NECP was published after the consultation on PEP 2040 had been concluded, we have assumed that the data published in the NECP are more accurate and thus we have used them in this text.

modernisation of the energy sector, and thus the more efficient use of coal, it is believed possible for the quantity of electricity generated to be sustained from a declining coal production. Furthermore, its production for industry (energy and steel) will be shifting from thermal to coking coal for profitability reasons. Meanwhile, demand from the residential sector will be lowered by the promotion of district heating schemes, thus reducing consumption in individual households. This will also contribute to a decrease in energy poverty and in air pollution. In segments which are not covered by domestic production, the import of coal will be allowed to meet domestic demand.

Figure 13 **Past and projected composition of gross electricity production by fuel, according to NECP (TWh), 2005-2040**



* Together with coking gas and blast furnace gas
** Methane natural gas and nitrogen rich gas, methane drainage gas from mines, gas accompanying crude oil
*** Inorganic industrial and municipal waste
Source: NECP (2019).

Figure 13 shows the projected fuel mix of Polish electricity generation until 2040 according to the NECP. The expected growth in demand for electricity amidst the decline in the role of coal will be covered foremost by gas, wind, solar and, at a later stage, also by nuclear. In 2030, coal will still be responsible for almost sixty per cent of electricity production although, by 2040, its share will decline to just below thirty per cent. In the decade up to 2030, the share of wind and gas will become more prominent while, in the decade up to 2040, nuclear and solar energy will also contribute substantially to meeting the expected increase in electricity demand.

The postponement of goals with regard to CO_2 emissions reduction targets thus depends primarily on the development of nuclear energy, whose implementation has already been delayed by ten years and in which further delay is therefore possible.

6. Commitments and targets in response to EU climate policy

Polish greenhouse gas (GHG) emissions come mostly from the energy sector. In 2020, the sector is expected to produce 93 per cent of total GHG emissions and, twenty years later, only five percentage points fewer. Within the energy sector, the bulk of emissions are produced by what the IPCC defines as energy industries,[15] while transport, manufacturing and construction and other sectors altogether play a smaller role.[16] From the perspective of 2040, transport emissions will record the slowest decline, and emissions from energy the fastest; yet the energy sector will still be responsible for almost one-half of total emissions (Figure 14).

According to the NECP, by 2030 overall GHG emissions are to be limited by ten per cent compared to 2020; and, in 2040, by 45 per cent compared to 2020. The scale of emissions reduction in the second decade of the transformation would be larger due to a faster winding-down of coal and, at the same time, due to the introduction of nuclear and the wider use of wind and solar.

The current targets within the climate and energy policy for the EU as whole assume substantially higher goals than Poland is declaring to achieve. In the NECP, the Polish target with regard to GHG emissions is to reduce them from 468 $MtCO_2eq$[17] in 1990 to 367 $MtCO_2eq$ in 2030; that is, by 22 per cent compared with the forty per cent target at EU level. Under the Effort Sharing Regulation, this overall EU 2030 target is broken down into emissions reduction in ETS sectors of 43 per cent, and reductions in non-ETS sectors by thirty per cent, compared to the base year of 2005. For Poland, the respective 2030 targets are nine per cent in ETS sectors and seven per cent in non-ETS sectors (also on a 2005 basis). For 2040, the corresponding Polish reduction targets would be 33 per cent and sixteen per cent respectively (again compared to 2005), as Figure 15 shows. The situation of Poland as a less wealthy and historically

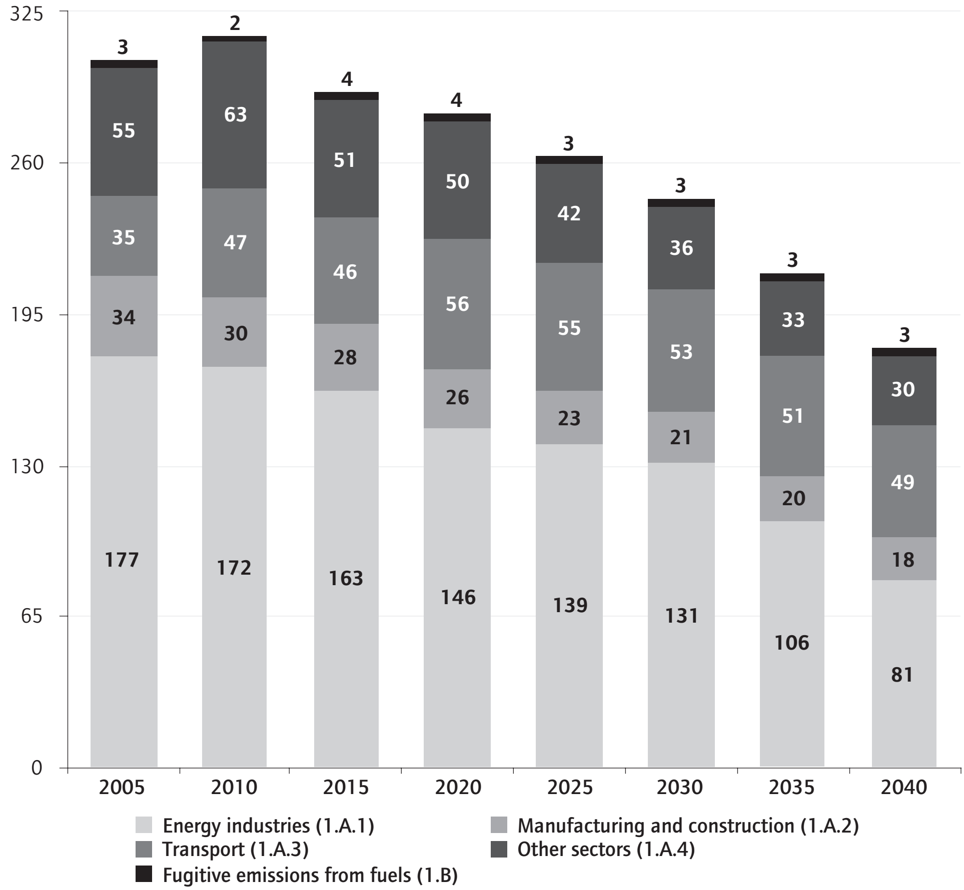
15. The basic sectoral division by IPCC includes the following sectors: 1) Energy; 2) Industrial processes; 3) Solvents and other product use; 4) Agriculture; 5) Land use change and forestry; 6) Waste; and 7) Other. The 'Energy' sector includes two sub-sectors: A) Fuel combustion activities and B) Fugitive emissions from fuels. The bulk of emissions globally, and also in the case of Poland, comes from sub-sector A, which is further divided into three sub-sections: 1) Energy industries; 2) Manufacturing industries and construction; 3) Transport; 4) Other sectors; and 5) Other not specified elsewhere.

16. Energy industries can be further broken down into three categories: 1) Public electricity and heat production; 2) Petroleum refining; 3) Manufacture of solid fuels and other energy industries. However, the first category is by far the most important (e.g. in 2016 it was responsible for 97 per cent of the emissions of energy industries).

17. Excluding LULUCF.

coal-dependent country is understood by the European Commission (and included for instance in the derogation package of the EU ETS Directive), but it is expected that the European Commission will insist on more ambitious targets in the final version of the Polish NECP.

Figure 14 **GHG emissions from energy* in the Climate and Energy Policy Scenario [MtCO2eq], 2005-2040**



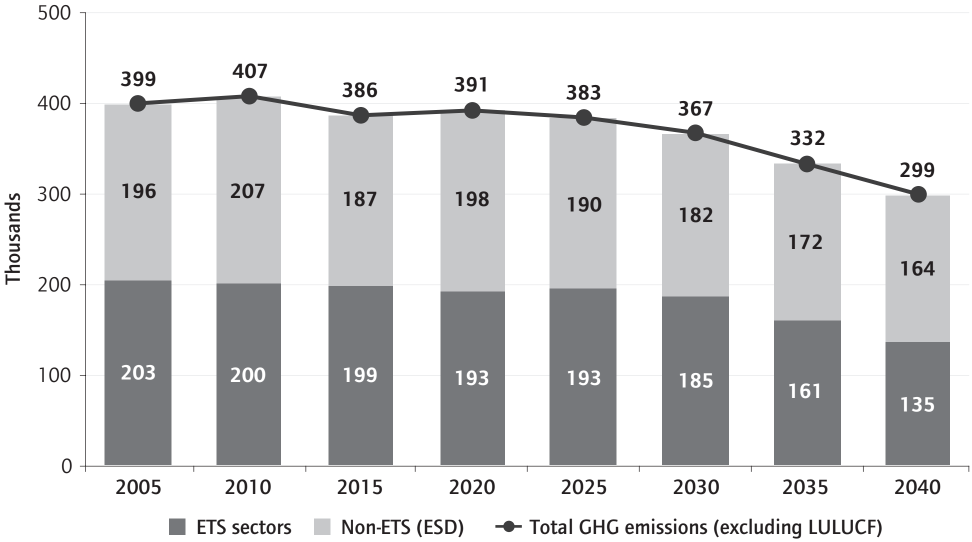
* The energy sector is composed of two categories: fuel combustion (1.A.); and fugitive emissions from fuels (1.B).
Source: simulation by ATMOTERM in NECP (2019).

The slow pace of the reduction of CO_2 emissions is correlated with a slow pace in achieving the two other targets. According to the NECP, the share of RES in 2030 will reach 21 per cent compared to 32 per cent across the EU; while energy efficiency will, according to the NECP, increase by 23 per cent compared to 32.5 per cent.[18] As some analysts have pointed out, lowering the ambitions of Polish commitments within the

18. Compared to PRIMES 2007.

Energy Union may cause unpredicted costs. The evolution of legislation over the next decade may result in the indicative targets at EU level being more directly transposed in member states and this would end for Poland with the necessity, for instance, of buying permits for CO_2 emissions abroad or importing renewable energy (Świrski 2018).

Figure 15 **GHG emissions [Mt CO2eq] by ETS and non-ETS sectors in the Climate and Energy Policy Scenario (PEK), 2005-2040.**



Source: NECP 2019.

Current EU climate and energy targets for 2030

Current targets within the Energy Union for 2030, set in 2018, include CO2 emissions reductions of forty per cent compared to 1990, which translates into a 43 per cent reduction in ETS sectors and thirty per cent in non-ETS sectors (both compared to 2005). Furthermore, the EU is to achieve a share of RES in gross final energy consumption of at least 32 per cent. Finally, the EU has set an overall target for the Union as a whole which aims at increasing energy efficiency by 32.5 per cent (compared to the prognosis from 2007). This translates into a reduction of 26 per cent in terms of primary energy consumption compared to 2005, or a reduction of twenty per cent in final energy consumption compared to the same year.

Despite the installed capacity of RES slowly, but steadily, growing in recent years, its share in electricity production is not sufficient in terms of the faster growing demand for electricity. Furthermore, it will not be enough to cover for the declining share of RES in transport. This is important since, according to the Renewable Energy Directive (2009/28/EC), the share of RES in total final consumption (that is, energy consumption from transport, heating and electricity) should rise to 15 per cent in Poland by 2020.

7. Challenges and possible solutions

The coal sector has an ambiguous position in the Polish economy. On the one hand, it provides relatively cheap fuel (although without consideration of the different forms of subsidies and taxes), contributes to energy security and ensures highly-paid jobs and payments to local governments. On the other, its low productivity translates into a decreasing contribution to GDP and – at the country level – its public support costs about the same amount as the payments it contributes to the public finances. It further creates external costs in the form of environmental, health and housing damage which, however, is not currently being assessed in a comprehensive manner.

Government policies regarding the coal sector are balanced between influential trade unions and pressure from the EU to achieve ambitious climate goals. Coal mining and energy companies are pushing towards a target between these two extremes which they see as the sector's restructuring and modernisation perspective. Meanwhile, regional but most particularly local governments are anticipating a restructuring strategy that is based on broader policies embracing not only restructuring but also issues like revitalisation and recultivation. There is a growing number of cases in which local governments, despite direct profits from mining activities, are opposing the further development of mines due to issues like damage from mining activities, air quality, water management, impacts on health, etc.

The draft strategies of the current government regarding energy and climate policy remain incoherent, but will be subject to substantial revisions over 2019 during negotiations with the European Commission. The pressure for a stronger reduction of the carbon intensity of the Polish economy, and consequently for reducing the role of coal, is inevitable. The final version of national strategies will, most probably, further reduce the use of coal in the future energy mix and, consequently, the number of jobs in the sector will also decline faster.

The expectations of coal miners that the status quo in the sector be sustained will be confronted with the conditionality of future funds for the restructuring of coal regions. A more sustainable and diversified economic structure (including the energy sector), as a direction of regional transition, has already been determined. Thanks to the activity of the Coal Regions in Transition Platform, this will, in all likelihood, materialise in a special fund set up for this purpose within future structural funds. With a view to more ambitious transformation, the expectations of the Polish government and the energy sector will, however, reach further and encompass structural funds, the Connecting Europe Facility, SET Plan, etc. The latter which, so far, has substantially supported Polish transformation, especially regarding the switch to gas, could be used to develop the internal gas infrastructure. On the other hand, funds for the deployment of RES in a future financial perspective may, however, be blocked due to the likely gap in meeting Polish RES targets.

In the face of the rather low unemployment rate in most coal regions, there is no policy framework for managing employment transitions and the 'contingency measures' addressed to miners are rather limited. They embrace traditional monetary instruments like mineworkers' pensions, early retirement and redundancy payments (although the latter two have recently been used only on a limited scale). There are virtually no schemes for re-employment in alternative workplaces and only a very limited number of projects are addressed to miners' families and local communities. A more progressive use of such schemes and projects seems to be indispensable if a just transition is to take place.

As for the workers, especially miners, the schemes need to correspond to different job skills, miners' current wages and the social and economic context. Further, they need to be elaborated with the participation of local and regional stakeholders so that the specificity of mining communities is rightly reflected and their needs and aspirations answered. It does, however, require political courage to speak openly of a further decrease in the role of coal and of the inevitable consequences that follow from such a decision.

References

Alves Dias P. *et al.* (2018) EU coal regions: opportunities and challenges ahead, Luxembourg, Publications Office of the European Union. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/eu-coal-regions-opportunities-and-challenges-ahead

CBOS (2018) Polacy wobec zmian klimatu [Poles towards climate change], Komunikat z badań 158/2018. https://www.cbos.pl/SPISKOM.POL/2018/K_158_18.PDF

EEA (2018) Trends and projections in Europe 2018: tracking progress towards Europe's climate and energy targets, EEA Report 16/2018, Luxembourg, Publications Office of the European Union. https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2018-climate-and-energy

ESS (2018) European attitudes to climate change and energy: topline results from round 8 of the European Social Survey. https://www.europeansocialsurvey.org/docs/findings/ESS8_toplines_issue_9_climatechange.pdf

IRENA (2018) Renewable power generation costs in 2017, Abu Dhabi, International Renewable Energy Agency.

Karaczun Z., Kassenberg A. and Sobolewski M. (2000) Polska wobec postanowień konwencji klimatycznej, Warszawa, Instytut na rzecz Ekorozwoju.

Kasztelewicz Z. (2018) Raport o stanie branży węgla brunatnego w Polsce i w Niemczech wraz z diagnozą działań dla rozwoju tej branży w I połowie XXI wieku [A report on the condition of the lignite segment in Poland and in Germany with diagnosis of the actions for the development of this segment in the first half of the XXI century], Kraków.

Kiewra D. and Szpor A. (2018) Transformacja węglowa w subregionie konińskim [Coal transition in the Konińskie sub-region], IBS Research Report 06/2018, Warszawa, Instytut Badań Strukturalnych.

Kiewra D., Szpor A. and Witajewski-Baltvilks J. (2019) Sprawiedliwa transformacja w regionie śląskim: implikacje dla rynku pracy [Just transition in Silesia Region: implications for the labour market], IBS Research Report 02/2019, Warszawa, Instytut Badań Strukturalnych.

Kost C. *et al.* (2018) Levelized cost of electricity: renewable energy technologies, Freiburg, Fraunhofer Institute for Solar Energy Systems.

Ministry of Energy of the Republic of Poland (2016) Informacja o funkcjonowaniu górnictwa węgla kamiennego w czerwcu oraz w okresie styczeń – czerwiec 2016r [Information on the operation of hard coal mining in June and during the period January-June 2016], Warszawa.

Ministry of Energy of the Republic of Poland (2018) Program dla sektora górnictwa węgla kamiennego w Polsce [Programme for the hard coal mining sector in Poland], Document accepted by the Council of Ministers on 23 January 2018.

Ministry of Energy of the Republic of Poland (2018a) Polityka Energetyczna Polski do 2040 r. Projekt. [Energy Policy of Poland until 2040. Draft document], Warszawa.

Ministry of Energy of the Republic of Poland (2018b) Krajowy plan na rzecz energii i klimatu na lata 2021-2030. Założenia i cele oraz polityki i działania, PROJEKT – w. 3.1 z 04.01.2019. [Including attachment 1 and 2].

Poushter J. and Huang C. (2019) Climate change still seen as the top global threat, but cyberattacks a rising concern, Washington DC, Pew Research Centre. http://www.pewglobal.org/2019/02/10/climate-change-still-seen-as-the-top-global-threat-but-cyberattacks-a-rising-concern/

Strupczewski A. (2015) Analiza i ocena kosztów energii elektrycznej z różnych źródeł energii w Polsce, Otwock, Narodowe Centrum Badań Jądrowych.

Supreme Audit Office (2017) Funkcjonowanie górnictwa węgla kamiennego w latach 2007–2015 na tle założeń programu rządowego: Informacja o wynikach kontroli [Operation of the hard coal mining sector in 2007-2015 in the light of the government programme: Information on the results of the regulation].

Szpor A. and Ziółkowska K. (2018) The transformation of the Polish coal sector, GSI Report, Winnipeg, International Institute for Sustainable Development.

Świrski K. (2018) PEP 2040: czy rozwiązuje wszystkie problemy? Szersza analiza, Konrad Świrski Blog, 25 November 2018. http://konradswirski.blog.tt.com.pl/pep-2040-rozwiazuje-wszystkie-problemy-szersza-analiza/

Urząd Regulacji Energetyki (2018) Sprawozdanie z działalności Prezesa Urzędu Regulacji Energetyki w 2017 r., Warszawa.

Wydawnictwo Gornicze (2017) Kopalnie dają pracę. http://nettg.pl/uploads/docs/2017-09/1504528306-weglowy_remanent-54-64_secured.pdf

Websites consulted:
https://www.iea.org/statistics/kwes/supply/

All links were checked on 8 August 2019.

Chapter 2
Germany's long goodbye from coal

The role of coal in Germany's energy system and economy today; and the recommendations of Germany's Coal Commission[1] for the phasing-out of coal

Philipp Litz[2]

Introduction

Around 21 per cent of Germany's primary energy consumption and around 34 per cent of its electricity generation in 2018 came from lignite or hard coal. Furthermore, coal-fired power plants still make an important contribution to the security of the supply of electricity and heating, and create economic value and employment in those regions where mining remains.

At the same time, it is obvious that Germany will not meet its climate targets for 2030 and 2050 without the gradual phasing-out of coal-fired power generation.

As a result, the political debate on the future of coal-fired power generation in Germany has intensified in recent years. In order to resolve the escalating conflicts between the political and social actors, the German federal government set up the Commission for Growth, Structural Change and Employment – or the 'Coal Commission', as it was called – in June 2018. The Commission's task was to develop a long-term exit strategy for Germany's coal industry and to identify the necessary accompanying energy, regional development and social policy measures. In January 2019, the Commission published its recommendations in the form of a final report.

This chapter first describes the objectives of the German energy transition and how this has changed and shaped the discussion on the future of coal-fired power generation in recent years. The paper then takes a detailed look at the current role of coal in the energy system and the economy (section 2). On this basis, the Commission's recommendations are then presented (in section 3); and, lastly, the recommendations are evaluated (in section 4).

1. Germany's energy transition and the discussion on coal

The transformation of the German energy system is based on a long-term energy strategy that aims to transform the existing energy system along four pillars:

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1. i.e. the Commission for Growth, Structural Change and Employment.
2. Transparency note: From June 2018 to January 2019, the author supported the work of the Coal Commission as Personal Advisor to the Chairs of the Commission.

- nuclear phase-out: by the end of 2022, Germany will have phased out the use of nuclear energy. This is anchored in the nuclear phase-out law of 2011 (German Bundestag 2011);

- reduction of greenhouse gas emissions: in accordance with its Climate Action Plan 2050 (German Government 2016), adopted by the German federal government in 2016, Germany is aiming for near greenhouse gas neutrality by 2050. To achieve this, greenhouse gas emissions are to be reduced by forty per cent by 2020 and by 55 per cent by 2030 compared to 1990 levels. For 2030, there are also specific targets in place for the individual sectors of energy industry, buildings, industry, transport and agriculture;

- expansion of renewable energies: by 2050, at least sixty per cent of gross final energy consumption should come from renewable sources. In the electricity sector, the share of renewable energies is to be increased to 65 per cent by 2030 in accordance with the current coalition agreement (CDU *et al.* 2018). By 2050, it is to be raised to at least eighty per cent (German Government 2010);

- increasing energy efficiency: by 2050, primary energy consumption is to be reduced by fifty per cent compared with the 2008 level, with electricity consumption being reduced by 25 per cent compared with the 2008 level (German Government 2010).

In addition, the energy transformation is based on the guidelines of the energy policy triangle consisting of environmental compatibility, affordability and security of supply.

By 2018, Germany had already implemented a number of measures to transform its energy system. These included, for example, a law on the phasing-out of nuclear energy; the Renewable Energy Act; and a law to support combined heat and power generation and the participation of most German power and industrial plants in the European Emissions Trading System (EU-ETS). Also, certain measures have been put in place promoting electromobility, expenditure on energy research, more efficient heating systems and regulatory efficiency standards in the construction of new buildings (Federal Ministry for Economic Affairs and Energy 2018).

Germany’s energy transition has therefore made some good progress in recent years. By the end of 2018, greenhouse gas (GHG) emissions had been reduced by around 30.5 per cent on 1990 levels. Figure 1 shows emissions reductions in the five main sectors of the economy.

- the energy industry has seen its greenhouse gas emissions fall by around 34 per cent since 1990. The main reasons for this are the age-related decommissioning of old coal-fired power plants, the transfer in 2016 of some lignite-fired power plants to a state of safety readiness, the expansion of renewable energies in the electricity sector and the increased use of combined heat and power generation;

- industry has, so far, recorded a decline in GHG emissions of 31 per cent. This has been due to the closure of industrial plants in eastern Germany in the course of unification; the greater avoidance of process emissions through improved process technology and efficiency measures; and the greater use of natural gas and combined heat and power plants (CHP) to generate electricity and heating in place of coal;

- buildings sector emissions have so far fallen by 43 per cent. The main drivers here are, in particular, the conversion of old coal stoves and oil-fired heating systems to modern natural gas plants and the greater use of district heating schemes. Building efficiency standards for new buildings, as well as the energy-efficient refurbishment of part of the existing building stock, have also contributed to reducing emissions to date.

- the transport sector has, so far, reduced its greenhouse gas emissions by only one per cent compared with 1990 levels. This is due, on the one hand, to the significant increase in freight traffic being transported by road and, on the other, to the insufficient reduction in fleet consumption.

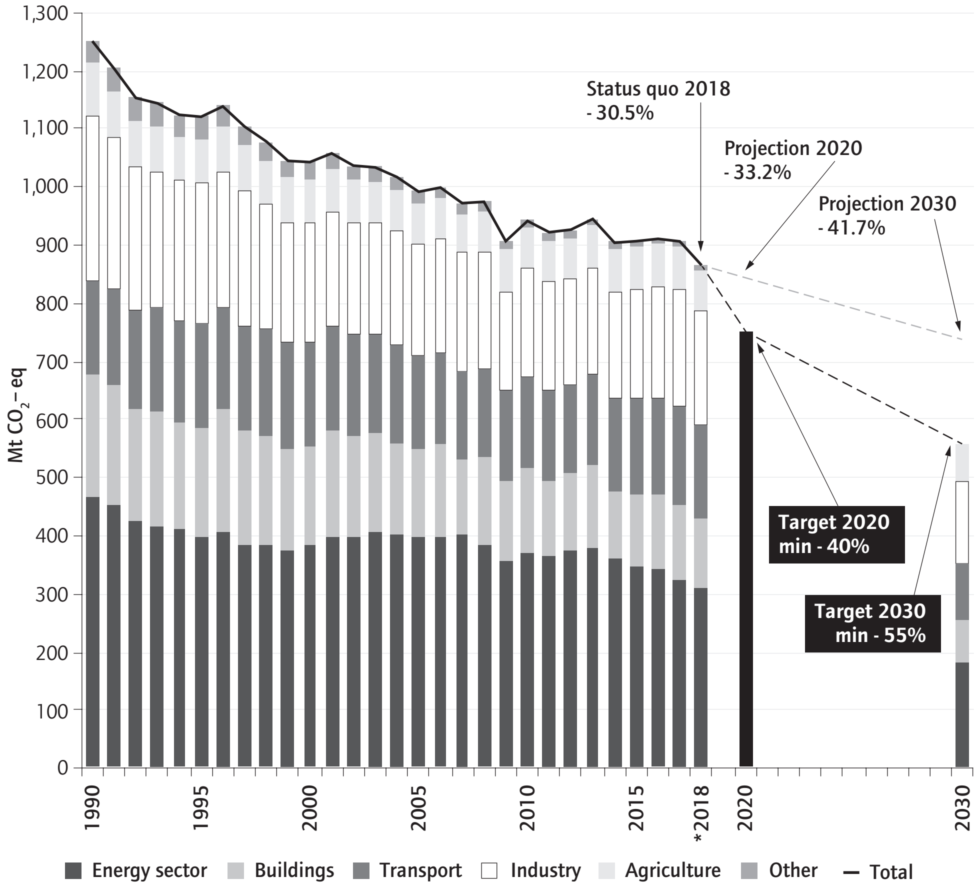
- for agriculture, greenhouse gas emissions have fallen by 23 per cent since 1990.

However, the federal government's current greenhouse gas projection report shows that Germany is likely to miss its 2020 target of a forty per cent reduction, with the projection suggesting that the already-implemented measures will ensure a reduction of only around 32 per cent by that date. A similar picture shows for the 2030 projection, where greenhouse gas emissions would be reduced by only 41.7 per cent (against the target of a drop of 55 per cent) (Ministry of the Environment, Nature Conservation and Nuclear Safety 2019).

One of the reasons for the failure to meet climate targets are Germany's high CO_2 emissions from coal combustion in the generation of electricity and heating in the energy and industrial sectors. In 2018, these accounted for around one-third of Germany's greenhouse gas emissions (Federal Ministry for Economic Affairs and Energy 2019). This clearly shows that German climate protection targets cannot be achieved without a substantial reduction in (and, in the long-term, without the end of) the use of coal.

The failure to meet the 2020 climate protection target is not surprising as it has been repeatedly announced in the German government's biennial greenhouse gas projection reports over the last couple of years. As a consequence, since the beginning of the 2010s, representatives of the civil society environmental movement, environmental associations and climate science have been calling for additional coal reduction measures in the short-term and the long-term phasing out of coal-fired power generation. The instruments proposed have included the regulatory decommissioning of power plants, additional national or regional CO_2 pricing, CO_2 limit values and annual emissions budgets for coal-fired power plants (DIW Berlin *et al.* 2019).

Figure 1 **Historical greenhouse gas emissions, 1990-2018; climate targets and projections for 2020 and 2030**



* Preliminary data.
Sources: Federal Environmental Agency (2019); Ministry of the Environment, Nature Conservation and Nuclear Safety (2019).

However, at the same time, numerous arguments against additional measures for coal, or the long-term phasing out of the industry, have been put forward in the public debate. Firstly, this has included the fundamental rejection, or at least the feared redundancy, of national climate measures, especially for sectors already regulated within the European Emissions Trading System. Secondly, there has been concern about a secure and affordable energy supply, which some actors felt would be jeopardised by the phasing out of coal-fired power generation. And, thirdly, this has included the expected negative effects on those still employed in the coal industry today and the economic impact on coal-producing regions.

In response to the foreseeable failure to meet climate protection targets, the German government therefore adopted its 'Climate Action Programme 2020' in 2014, in which it defined additional contributions for all sectors in order to reduce the expected 'climate gap' in 2020 (German Government 2014). In 2015, the proposed *Klimabeitrag* ('climate contribution'),[3] proposed by the Federal Ministry of Economics and Energy, led to major protests among utilities and trade unions, and the so-called *Sicherheitsbereitschaft* ('security reserve') was created as an alternative instrument. Formally, this is a capacity reserve for 2.7 gigawatts (GW) of old lignite-fired power plants outside the power market, for which operators are remunerated generously. This should result in additional CO_2 savings of 11 to 12.5 million tonnes of CO_2 in 2020 (German Bundestag 2016).

However, this has not been the end of the political and social debate on the future role of coal-fired power generation. On the one hand, the measures adopted have not been sufficient to ensure compliance with the climate targets for 2020. And secondly, in December 2015, the international community signed the Paris Climate Protection Agreement which represented an increase in the current level of global climate protection ambition (United Nations 2015).

With the adoption in 2016 of the 'Climate Action Plan 2050', its long-term climate protection strategy, the federal government therefore decided to convene a Commission for Growth, Structural Change and Regional Development (German Government 2016). This was intended to pacify the ever-increasing social conflict over the future role of coal in the German energy and economic system.

In March 2017, the new governing coalition of CDU, CSU and SPD confirmed the establishment of such a Commission in their coalition agreement which says: 'We will set up a Commission for Growth, Structural Change and Employment, involving actors from politics, business and environmental associations, trade unions and the federal states [*Länder*] and regions concerned, to draw up an action programme by the end of 2018 on the basis of the Climate Protection Action Programme 2020 and the Climate Protection Plan 2050.'

2. The role of coal in Germany's energy system and economy

2.1 Primary energy consumption

The importance of coal in the German energy system has gradually declined since 1990 (Figure 2). This can be explained by a variety of factors:

- falling energy demand: since 1990, overall primary energy demand has gradually declined. This is due both to direct efficiency and modernisation measures as well as to the increased use of energy sources and technologies with lower conversion losses;

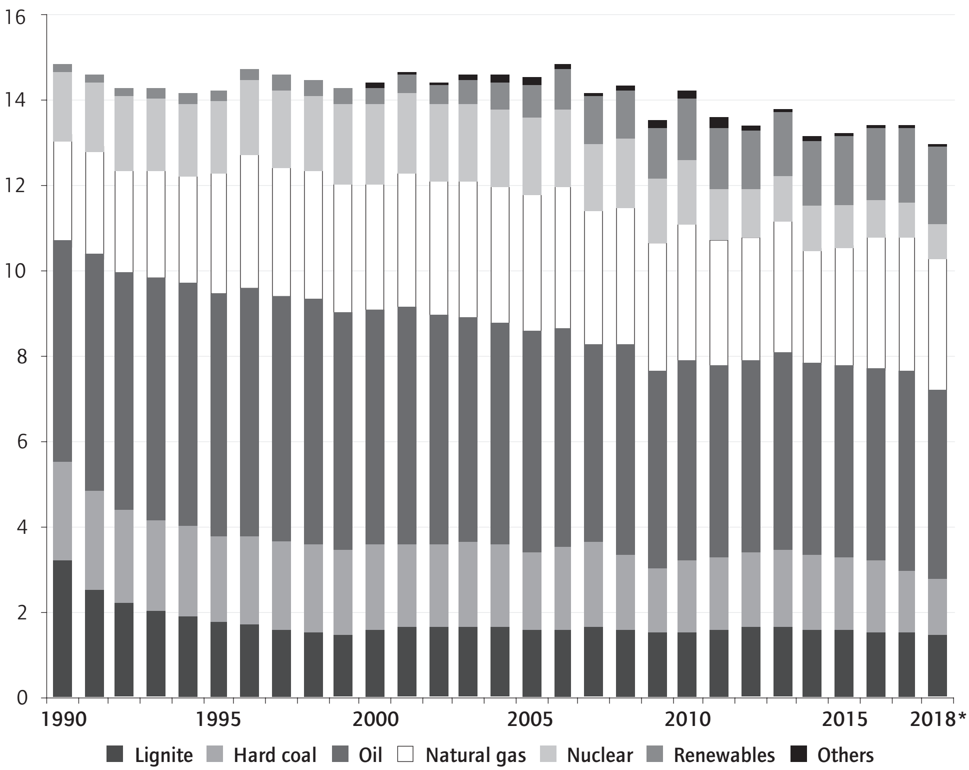
3. The proposed *Klimabeitrag* was a price-volume hybrid measure designed to target especially old lignite plants.

— increased use of natural gas: over time, the use of natural gas has increased, particularly in buildings. In addition, natural gas has also been increasingly used in power plants, replacing coal-fired production;

— expansion of renewable energies: since 2000, the expansion of renewable energies, especially in the electricity sector, has been given impetus by the Erneuerbare-Energien-Gesetz (the 'Renewable Energy Act'). In recent years, this has increasingly led to the displacement of coal-fired power plants in the electricity sector.

In 2018, primary energy consumption in Germany amounted to 12,963 petajoules (PJ). The dominant energy source was oil, with a share of 34.3 per cent. Gas followed in second place with 23.7 per cent. Coal contributed 21.3 per cent, with lignite and hard coal each accounting for about one-half of this (11.3 and 10.0 per cent of the total, respectively). The share of renewable energies was 14.0 per cent while nuclear energy contributed 6.4 per cent.

Figure 2 **Primary energy consumption, 1990-2018 (in thousand PJ)**



* Preliminary data.
Source: Federal Ministry for Economic Affairs and Energy (2019).

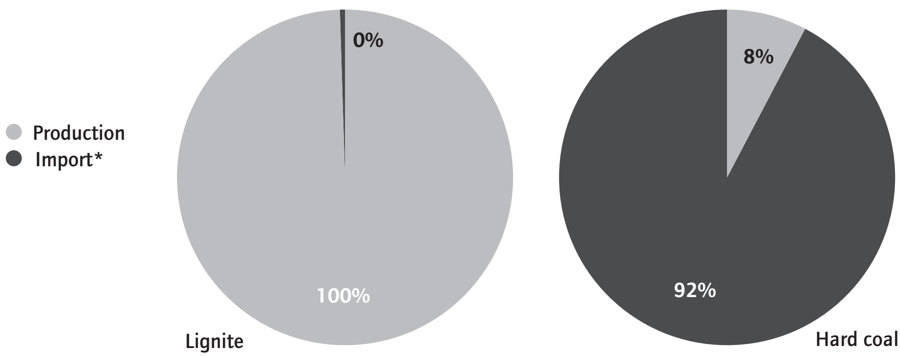
2.2 Occurrence and use of lignite and hard coal

Lignite is still mined almost entirely domestically in the three remaining lignite regions of Rhineland, Lusatia and central Germany whereas hard coal is now entirely imported (Figure 3). The share of domestic hard coal production in 2017 was still around 8 per cent but, following the closure of the last mines at the end of 2018, hard coal is no longer mined in Germany. The majority of imports in 2017 came from Russia (38 per cent), the USA (eighteen per cent), Colombia (thirteen per cent) and Australia (eleven per cent) (Federal Ministry of Economic Affairs and Energy (2019).

Lignite is currently still mined in eight opencast mines in the three areas, with the opencast mines in each area being operated by one company: the opencast mines in the Rhineland (Hambach, Garzweiler and Inden) are operated by RWE; those in Lusatia (Welzow, Nochten and Reichwalde) by LEAG; and MIBRAG is responsible for the opencast mines in central Germany (Vereinigtes Schleenhain and Profen). RWE and LEAG also operate their own lignite-fired power plants, most of which are close to opencast mines; together, these account for the majority of the lignite-fired power plant capacity still installed (Öko-Institut 2017).

Total lignite resources would be sufficient to keep power generation from lignite-fired power plants at today's level for many decades to come. However, the quantities that have been approved for operation are considerably smaller and would last from ten to 25 years, depending on the mine (Öko-Institut 2017).

Figure 3 **Occurrence of lignite and hard coal, 2017**



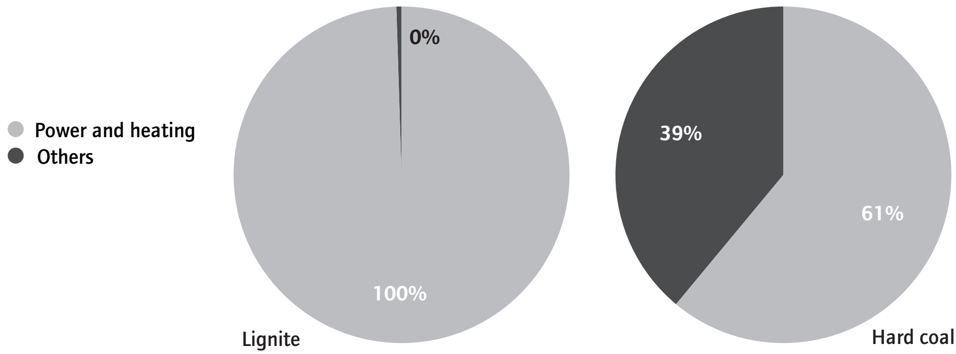
* Including inventory changes.
Source: Coal Industry Statistics (2019).

The current plans of the opencast mine operators still envisage the resettlement of eight villages, although in only one-half of cases has this already been approved. In almost all, resettlement has been rejected by parts of the local population while the other part has already signed bilateral resettlement agreements with the opencast mine operators. By 2018, a total of around 120,000 people had been resettled in today's lignite mining areas (Commission for Growth, Structural Change and Employment 2019).

Furthermore, the opencast mine operator RWE has been planning to clear the Hambach forest around the opencast mine there, which led to major protests by the environmental movement in 2018 (Bloomberg 2018).

The vast majority of lignite and hard coal is used to generate electricity and heat in power plants (Figure 4). Lignite in particular is burned almost entirely in power plants or as briquettes in heating stoves. Some two-thirds of hard coal production, on the other hand, is used in power plants to generate electricity and heat while the remaining one-third is used in particular in industry in steel and aluminium production.

Figure 4 **Use of lignite and hard coal, 2017**



Source: Own calculations based on Coal Industry Statistics (2019).

2.3 Installed generation capacity

At the end of 2018, Germany had a total installed energy generation capacity of around 222.3 GW (net). Around 110.7 GW were accounted for by variable, baseload plants and 111.6 GW by dispatchable plants,[4] corresponding in each case to about one-half of the installed generation capacity (Figure 5).

The installed generation capacity of coal-fired power plants at the end of 2018 was 44.7 GW. Of this total, 21.2 GW were accounted for by lignite power plants and 23.7 GW by coal-fired power plants. There is a total of 145 individual units with a minimum size of 10 megawatts (MW), of which 113 plants are technically capable also of generating heat in co-generation systems.

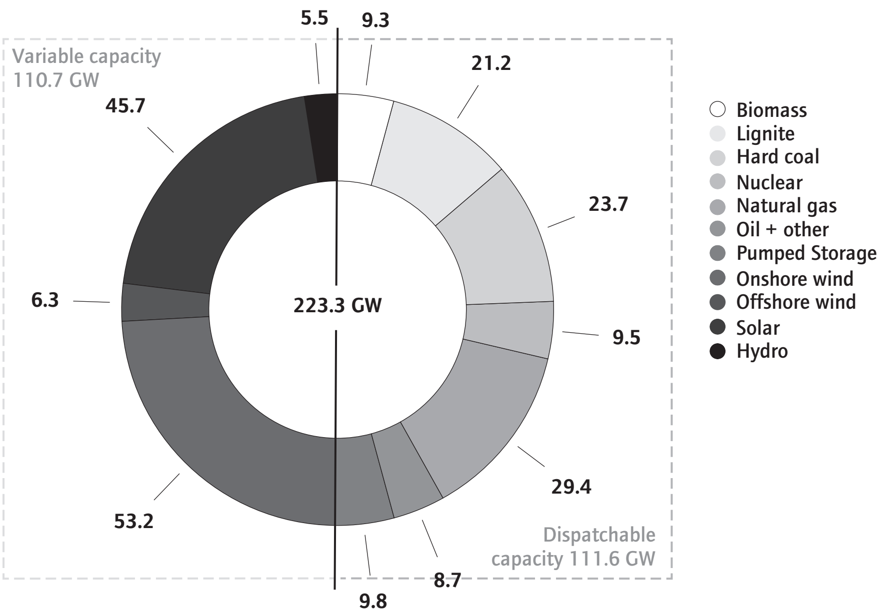
Lignite-fired power plants are mainly concentrated in lignite mining areas around opencast mines, whereas hard coal-fired power plants are more widely distributed throughout Germany. However, due to the lower transportation cost for hard coal when using waterways and the quantities of water required for cooling, these are more likely

4. 'Variable' plants are those power plants in which production is highly dependent on external weather conditions such as wind, solar or hydro. 'Dispatchable' plants are, in contrast, units in which production can be ramped up and down in a flexible way, i.e. biomass or fossil-based power plants.

to be found near larger watercourses or on the coast. However, the focus of hard coal-fired power plant sites is particularly in the federal states of North Rhine-Westphalia and Baden-Württemberg.

For reasons of dispatchability, coal-fired power plants continue to make an important contribution to the security of supply. This applies with regard to the available capacity, system stability during operation due to rotating masses and the provision of control energy or 'black start' capability (i.e. when the plant is recovering from total or partial shutdown).

Figure 5 **Installed electricity generation capacity at the end of 2018**



Source: own calculations based on Federal Networks Agency (2019).

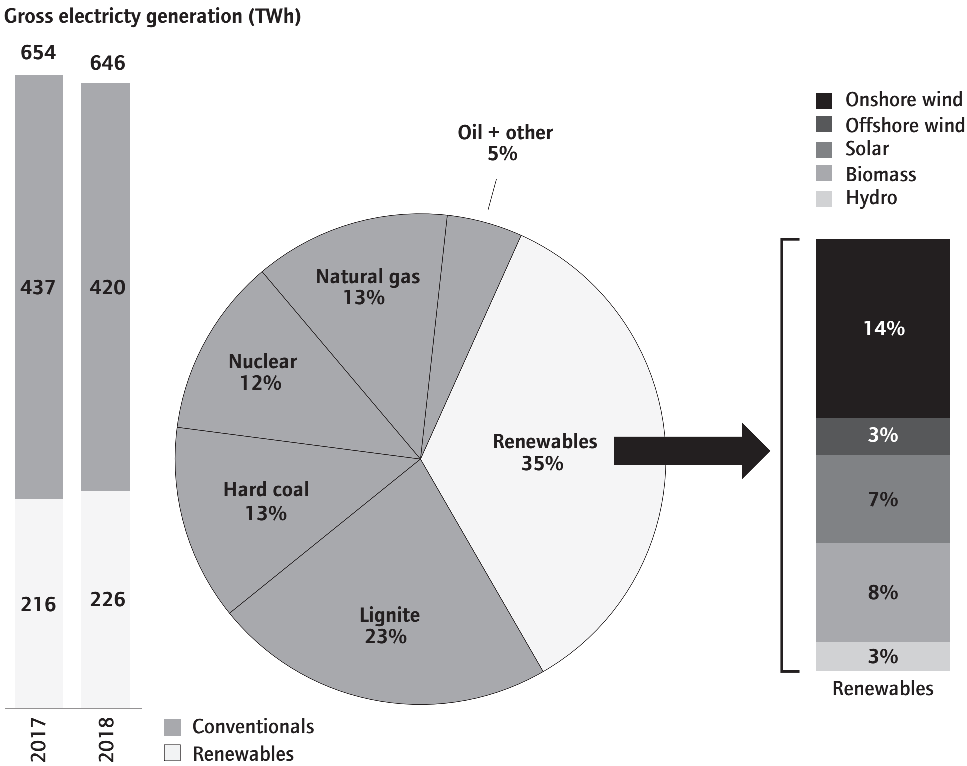
2.4 Electricity and heat generation

In 2018, total gross electricity generation in Germany accounted for 646.1 terawatt hours (TWh) (Figure 6), while gross electricity consumption was only 598.9 TWh. Thus, 51.2 TWh were physically exported to neighbouring countries.

Wind, solar and other renewable energy sources generated 225.7 TWh of electricity (34.9 per cent), while 420.4 TWh were generated on the basis of conventional energy sources (65.1 per cent). Of the latter, a total of 228.7 TWh still came from coal-fired power plants, corresponding to a share of 35.4 per cent. Lignite accounted for 145.5 TWh and hard coal for 83.2 TWh. It should be noted, however, that around eight per cent of the electricity generated by coal-fired power plants is not fed into the grid but is used to operate machinery within the plant (conveyor belts, coal mills). The actual net electricity generation of coal-fired power plants is correspondingly lower (2018: 210.4 TWh).

Heat generation from coal-fired power plants capable of co-generation amounted to a total of 46.5 TWh in 2017.[5] Of these, 33.5 TWh were attributable to public district heating schemes and 12.9 TWh to processing the supply of steam and heat to industry. This corresponds to a total share of about 3.6 per cent of the final energy consumption of heating schemes.[6]

Figure 6 **Electricity generation, 2018**



Source: own calculations based on AG Energiebilanzen (2019).

2.5 CO_2 emissions and environmental impact

The combustion of coal generates considerable quantities of CO_2. Depending on the efficiency of the plants and the quality of the coal burned, these vary from around 0.9 to 1.1 grams per kilowatt hour (electric) for lignite and 0.7 to 1.0 grams per kilowatt hour (electric) for hard coal. For coal-fired power plants with simultaneous heat generation

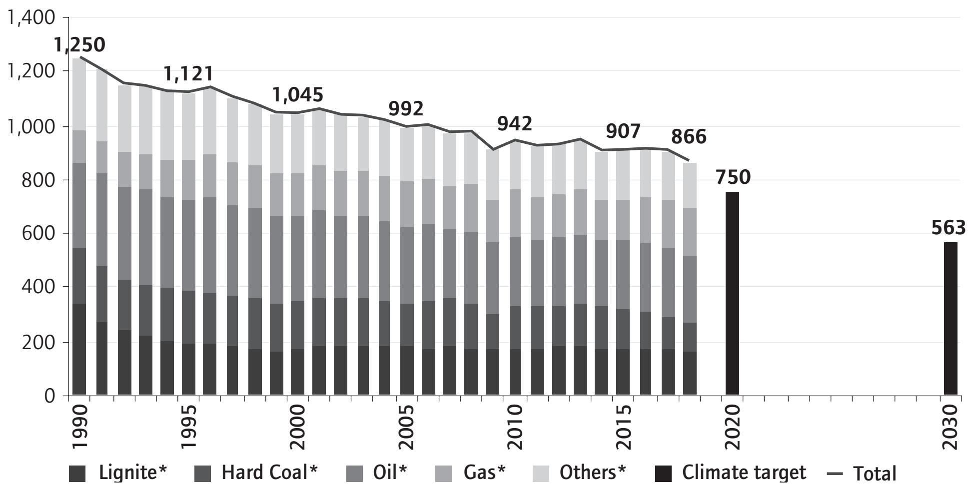
5. Heating statistics for 2018 are not yet published.
6. Own calculations based on Federal Ministry for Economic Affairs and Energy (2019).

capability, the specific emissions from electricity generation are correspondingly lower as the respective emissions are offset against both electricity and heat generation.

Although CO_2 emissions from lignite and hard coal have declined in recent years, about one-third of Germany's CO_2 emissions still originates from electricity and heat generation in coal-fired power plants (2018: 31.6 per cent). In 2018, this corresponded to 273 million tonnes of CO_2. The combustion of oil accounts for 173 million tonnes (20.0 per cent) and gas for 174 million tonnes (20.1 per cent). The remaining greenhouse gas emissions are mainly caused by industrial processes and farming (Figure 7).

In addition, the combustion of coal is associated with further, considerable pollution such as mercury, sulphur dioxide, nitrogen oxides and fine dust. Air pollutants are usually produced locally and are particularly associated with increased respiratory and cardiovascular diseases. Further environmental impacts arise in the course of opencast mining operations due to the necessary lowering of the groundwater level and, in some cases, increased iron deposits into the surrounding waters (DIW Berlin *et al.* 2019).

Figure 7 **Greenhouse gas emissions, 1990-2018 (Mio. tonnes)**



* CO2 emissions from burning fossil fuels. 2018 preliminary data.
Source: Federal Ministry for Economic Affairs and Energy (2019).

2.6 Employment and gross value added

At the end of 2018, a total of around 32,800 people were still directly employed in the German lignite and hard coal sector (Figure 8):

— lignite: the number of direct employees in the lignite industry totalled around 20,850. Of these, 15,600 were employed in opencast mining operations and around 5,200 in lignite-fired power plants

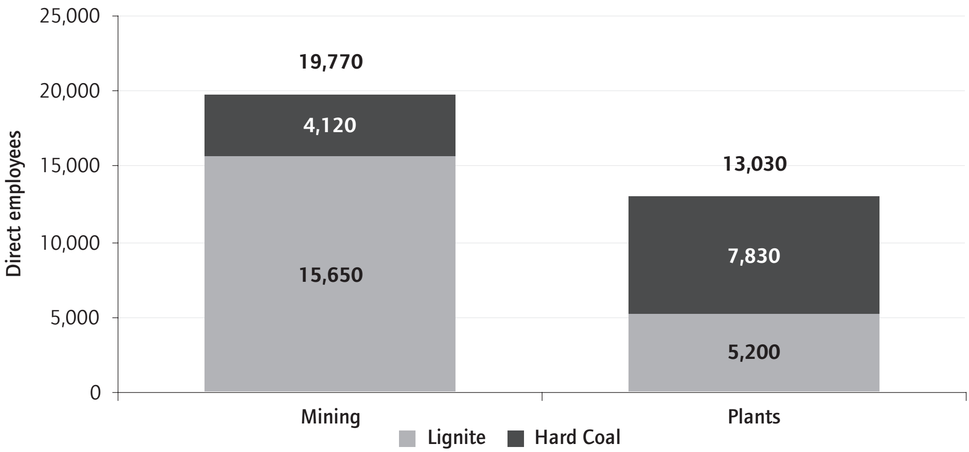
— hard coal: the number of employees in the hard coal sector totalled around 11,950, of which around 4,120 were still employed in mining. Due to the closure of the last coal mine at the end of 2018, employment in the hard coal mining sector has dwindled to only a few during 2019. The remaining 7,830 employees work in power plants.[7]

This corresponds to 0.1 per cent of the total number of employees that are subject to social insurance contributions in Germany (2018: 32.8 million) (Federal Statistical Office 2019).

At the end of 2018, up to 78,000 people were still employed directly or indirectly in the coal sector, or their employment was the result of coal sector activity.[8] In total, this corresponds to 0.26 per cent of the total number of employees subject to social insurance contributions.

In lignite mining areas, however, the share of employment is higher and reaches levels of 0.9 per cent (direct) and 1.4 per cent (direct, indirect and others) of the total number of employees subject to social insurance contributions. In addition, the average annual salaries in this sector are above average and are characterised by a comparatively high level of union organisation. The average age of direct employees is about 45 years (RWI 2018).

Figure 8 **Direct employees in the lignite and hard coal sector, 2018**



Source: Coal Industry Statistics (2019); own calculations based on enervis (2016) and Federal Networks Agency 2019.

7. There are no official statistics for employees in hard coal-fired power plants, so these have been estimated on the basis of the installed capacity (23.7 GW) and an employment factor of 0.3 employees/MW (enervis 2016).
8. There are various studies available, with different methodologies, for calculating the employment effects of the coal industry (see in detail DIW Berlin *et al.* 2019; Öko-Institut 2017; Commission on Growth, Structural Change and Employment 2019). For reasons of reducing the complexity, the Commission therefore recommended following the formula of one indirect and one further employee for each direct employee in the lignite sector. For the hard coal sector, these figures are adapted by the author to around 0.3 indirect/further employees for each direct employee due to the comparably smaller mining sector and its phase-out during 2018.

The gross value added of electricity generation in the lignite and hard coal industry is strongly dependent on developments in exchange electricity prices, commodity prices for fuels and on CO_2 certificate prices. For 2018, the direct gross value added of coal-fired power plants is estimated at a total of around €5.9bn, of which €4.2bn was created by lignite power plants and €1.7bn by hard coal power plants.[9]

The total direct gross value added of €5.9bn corresponds to about 0.19 per cent of total German gross value added (2018: €3,055bn) (Federal Statistical Office 2019). Within the mining regions, the lignite sectors might contribute up to 3 per cent of the regional gross value added. The eastern lignite mining areas of Lusatia and central Germany, in particular, are further challenged with weaker structural indicators than on average in Germany, such as lower employment and wages, lower innovation potential, lower private capital and lower infrastructure connections (RWI 2018).

3. The Commission on Growth, Structural Change and Employment

3.1 Mandate and composition

In June 2018, the federal government established the Commission on Growth, Structural Change and Employment. The Commission consisted of a total of 31 members and was headed jointly by Ronald Pofalla, former head of the Federal Chancellery; Prof. Dr. Barbara Praetorius, energy and environmental economist; and Matthias Platzeck and Stanislav Tillich, former prime ministers of two *Länder*. The other members of the Commission were representatives from the energy sector, lignite regions, industry, environmental associations, trade unions, scientists and the coalition parties; the latter with speaking but not voting rights (Figure 9). All the members of the Commission worked on an honorary basis.

The plenary sessions were also attended by representatives of the *Länder* and federal ministries concerned as well as the Federal Chancellery (Commission on Growth, Structural Change and Employment 2019). The Commission's work was supported by a secretariat attached to the Federal Ministry of Economy and Energy. The chairs of the Commission also reported regularly to the State Secretaries Committee set up for this purpose, which included representatives of eight federal ministries (Figure 10).

According to the federal government decision of 6 June 2018 to establish it, the Commission had the following mandate (German Government 2018):

— 'Development of a concrete perspective for new, future-proof jobs in the affected regions in cooperation between the federal government, the *Länder*, local authorities and economic actors (e.g. in the field of transport infrastructure, the development of skilled workers, entrepreneurial development, establishment of research facilities, long-term structural development);

9. Potential revenues from heat generation or the provision of system services are not taken into account as no data are publicly available for this purpose. However, these account for only a fraction of total power plant revenues and have therefore been ignored for this purpose. The advance payments of the mining industry are included.

— development of a mix of instruments that brings together economic development, structural change, social compatibility, social cohesion and climate mitigation and, at the same time, opens up perspectives for sustainable energy regions in the context of energy system transformation;

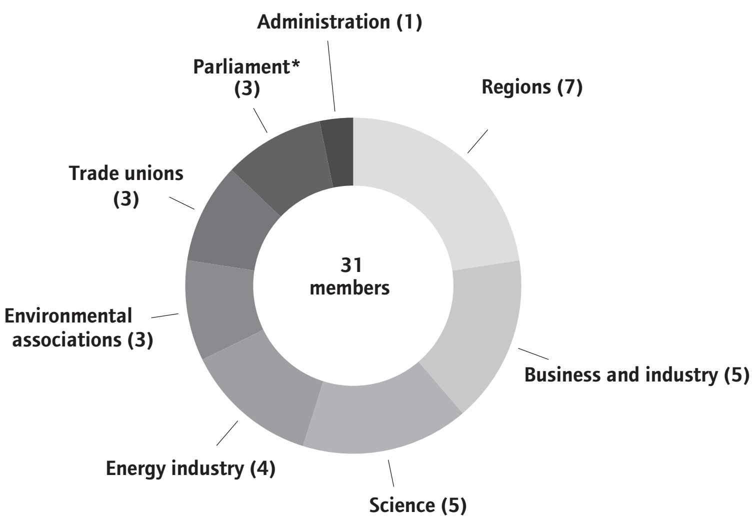
— this also includes necessary investments in the regions and economic sectors affected by structural change, for which existing federal and EU funding instruments are used effectively, purposefully and as a matter of priority in the affected regions and for which a fund for structural change, in particular from federal funds, is also used;

— measures that reliably meet the 2030 target for the energy sector, including a comprehensive impact assessment. The Climate Change Plan sets the target of reducing emissions from the energy sector by 61 to 62 per cent in 2030 compared to 1990 levels. For the contribution of coal to electricity generation, the Commission will propose appropriate measures to achieve the 2030 sectoral objective of the energy sector, to be included in the 2030 programme of measures to implement the Climate Change Plan;

— in addition, a plan for the gradual reduction and phasing out of coal-fired power generation, including a completion date and the necessary legal, economic, social, re-naturalisation and structural accompanying measures;

— also, measures on the contribution of the energy industry to reduce the gap as much as possible to reach the forty per cent reduction target. To this end, the federal government will publish a current estimate of the size of the gap to be expected in the context of the Climate Report 2017.'

Figure 9 **Composition of the Commission on Growth, Structural Change and Employment**

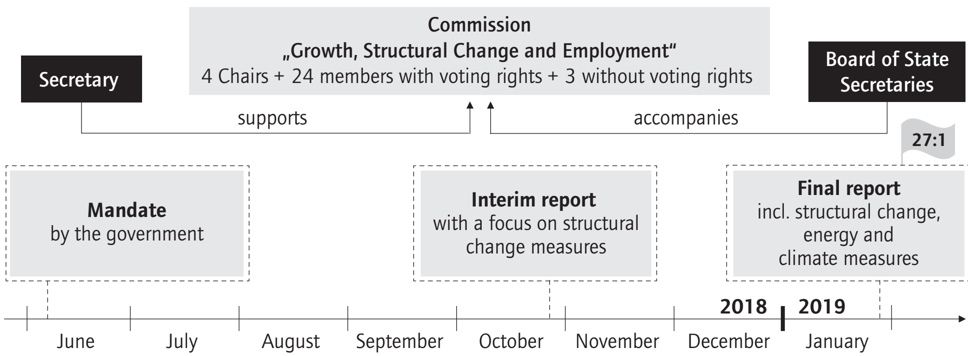


Source: own presentation based on Commission on Growth, Structural Change and Employment (2019).

The Commission held a total of ten plenary meetings. In the first part of the consultations up to autumn 2018, the Commission heard from a number of experts on regional development, climate mitigation and security of supply, as well as on cost and price effects, while the second part of the hearings focused on the negotiation of its final report recommendations. The plenary sessions were prepared by two working groups, one on 'regional development and employment' and the other on 'energy and climate'.

The final report was adopted almost unanimously by the members of the Commission in January 2019 (voting ratio: 27:1) and handed over to the federal government in February 2019 by the chairs of the Commission.

Figure 10 **Commission's organisational structure and timetable**



Source: own presentation based on Commission on Growth, Structural Change and Employment (2019).

3.2 Recommendations

In addition to a comprehensive review of the role of coal in Germany, the Commission's final report includes a strategy with five elements for the phasing-out of coal-fired power generation in Germany (Figure 11). The first element is reducing the capacity targets for coal-fired power stations in the market and phasing them out by 2038 at the latest (element A). Additionally, the Commission recommended the implementation of further measures. Current coal regions should be supported by active regional development policies to develop economic alternatives (element B); while, at the same time, the electricity and energy system must be comprehensively modernised (element C). Furthermore, there should be a cushioning against possible hardships for those directly affected by the exit from coal (element D). Finally, the phase-out and its effects are to be regularly monitored and, if necessary, readjusted (element E).

Figure 11 **Overview of the Commission's recommendations**

1 **Phase out coal to meet climate targets**	2 **Support transformation of traditional mining regions**	3 **Modernise the power system**	4 **Minimise negative effects on affected groups**	5 **Monitor and adjust measures**
Avoid new commissioning of plants and mines **Shut down existing fleet** along specific target for 2023, 2025 and 2030 until 2035/2038	Help creating new jobs by **modernising the energy regions** and kickstart investments in **infrastructure and innovation** **Secure polluter-pays-principle** for recultivation	**Ensure effective climate mitigation** with more renewables, CHP and cancelation of CO_2-certificates **Ensure security of supply** with reserves and new gas capacity **Make the power system more flexible** with more grids and storage	**Secure competitiveness of industries and affordability for households** with power price compensations **Compensate utilities** for early shut downs **Ensure a 'Just Transition'** for employees with active labour market policies	**Monitor and report the progress** in 2023, 2026, 2029 and 2032 **Take additional measures** if needed

Source: own presentation based on Commission on Growth, Structural Change and Employment (2019).

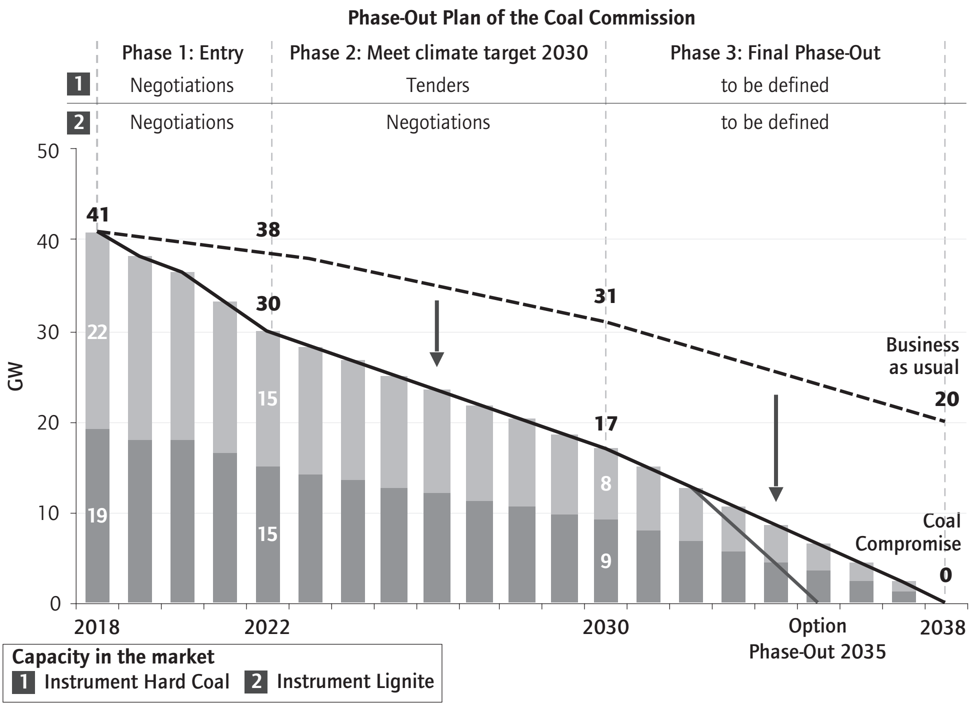
Element A: Gradually reducing and terminating coal-fired power generation

The Commission's recommendations stipulated that, if possible, no new coal-fired power plants should go into operation and that new opencast lignite mines for energy use should be abandoned in the future. Furthermore, the Commission's recommendations provided for a gradual reduction of the capacities of existing coal-fired power plants in the market (Figure 12). Accordingly, the capacity available on the market from coal-fired power plants is to be reduced to a maximum of thirty GW by 2023 (of which fifteen GW lignite and fifteen GW hard coal) and to a maximum of seventeen GW by 2030 (of which nine GW lignite and eight GW hard coal) (Figure 12). In addition, a reduction contribution of ten million tonnes of CO_2 is to be made by lignite-fired power plants in 2025. All market exits are subject to approval by the Federal Network Agency in accordance with Section 13b of the Energy Industry Act. The latter may refuse a planned decommissioning if it considers that this would jeopardise security of supply in terms of system stability.

With regard to developments in the interim years, the Commission recommended that the path be designed in such a way that the overall reduction in greenhouse gas emissions is as steady as possible. The last coal-fired power plant should be phased out by 2038 at the latest. In 2032, it will be examined whether a complete phase-out of coal is possible by 2035. The specific design of the exit timetable should be such that the forest at the Hambach opencast mine, where major protests took place in 2018 (Bloomberg 2018), can be preserved at its present size.

In order to ensure sufficient legal certainty, the Commission recommended that, as an instrument, consensual negotiation agreements, including compensation payments, be concluded with operators by 2022. These are then to be fixed by law. For the period 2023 to 2030, the Commission recommended that coal-fired power stations be put out to tender for decommissioning. For lignite-fired power plants, on the other hand, the phase-out will continue to be based on negotiated solutions. If no amicable agreement can be reached between the federal government and the power plant operators by 30 June 2020, the government should put into place a regulatory decommissioning schedule including appropriate compensation for the power plants. Agora Energiewende estimates a total cost for compensation of between €5bn and €10bn (Agora Energiewende 2019).

Figure 12 **Commission's recommended exit roadmap for coal-fired power plants and business as usual capacity development**



Source: own presentation based on Commission on Growth, Structural Change and Employment (2019) and Agora Energiewende (2019).

Element B: Support the transformation of traditional mining regions

In the Commission's view, it will be necessary to take additional structural and energy policy measures in coal regions. The declared aim is to replace the gradual loss of gross added value and employment with new jobs and gross added value by industrial producers, and to the same level.

The Commission's recommendations stipulated that coal regions should be developed into modern energy regions. This includes the increased expansion of renewable energies but also the continued use of today's power plant sites for alternative generation technologies and storage. At the same time, investments in transport and digital infrastructure, as well as in local research and innovation, should strengthen the regions' locational advantages and innovation potential. To achieve this, the regions are to be developed into regulatory model regions in which new industrial processes or procedures can be tested and further developed. In the short and medium term, several federal authorities, with a total volume of 5,000 employees, are to be located in coal regions by 2028 at the latest.

All these measures are to be implemented with financing for the coal regions of €40bn over the next twenty years. To this end, the Commission recommended that the government draft a regional development law by the end of April 2019.

A further building block is the increased use of securing services for the operation of opencast lignite mines. This is intended to reduce the risk to lignite regions of the possible bankruptcy of an opencast mine operator and the associated financial costs of re-naturalisation falling on public funds.

Element C: Modernise the electricity and energy system

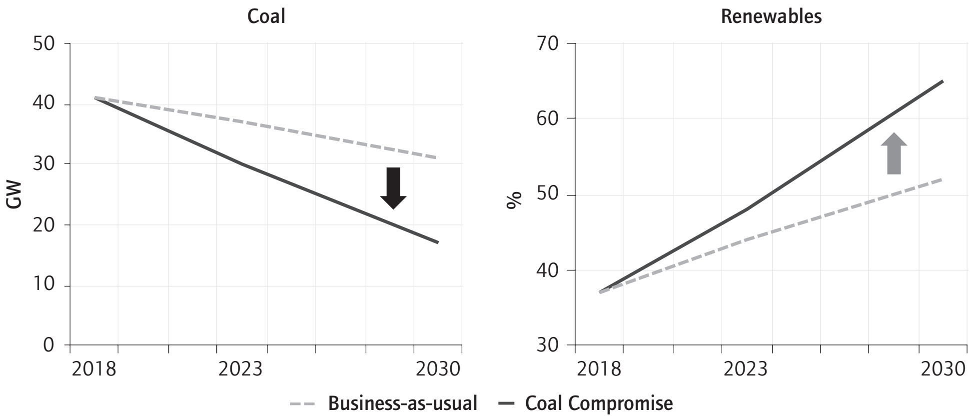
Another element of the Commission's final report is the comprehensive modernisation of the electricity and energy system. Firstly, the climate mitigation effect of the phasing-out of coal must be safeguarded. For this reason, renewable energies are to be expanded to a 65 per cent share of gross electricity consumption by 2030 and the necessary expansion quantities are to be anchored in the Renewable Energy Act accordingly (Figure 13). The continuation of the promotion of combined heat and power is also part of this (see below). To ensure that the phasing out of coal-fired power generation also has an impact within the framework of the European Emissions Trading System, and does not lead to the long-term shifting of emissions abroad, the federal government should also cancel the necessary quantity of CO_2 certificates.

Secondly, with a view to security of supply, the existing monitoring mechanisms are to be further developed. If there are short-term supply bottlenecks, the existing system of reserves is to be used. However, if the market does not show signs of sufficient investment in new plants in the medium term, the introduction of a capacity market should be examined. Furthermore, in order to secure the supply of heat at today's coal-fired power plant sites in the future, the replacement of such power plants with heat extraction needs to be promoted via an extension of the Combined Heat and Power Act until 2030. At the same time, however, the support system is to be further developed in the direction of flexible CHP systems, including heat from renewable energy.

Thirdly, the electricity and energy system should become more flexible in the course of the further expansion of wind and solar power. This includes the modernisation and better use of electricity grids through the optimisation of existing capacity, expansion and market measures. This also encompasses the promotion of storage facilities –

especially in coal regions in the form of pilot power-to-gas projects. Moreover, the existing levy system in the energy sector needs to be reviewed, as this is increasingly proving to be an obstacle to the necessary integration of energy sectors. Appropriate CO_2 pricing in sectors outside the Emissions Trading System, such as transport and residential heating, also needs to be considered.

Figure 13 **Changes in coal capacity and renewable energy shares between business as usual development and the recommendations of the Commission**



Source: own presentation based on Commission on Growth, Structural Change and Employment (2019).

Element D: Soften potential negative impacts on affected groups

In implementing the phase-out of coal-fired power generation, the Commission considered that the proposed measures could have potential negative impacts. In order to mitigate – or, if possible, even avoid – these effects, the Commission proposed a package of support and compensation measures.

This included, firstly, ensuring that the phasing-out of coal-fired power generation is as socially acceptable as possible. Therefore, extensive labour market policy measures were recommended for those still employed in the coal industry today, including the exclusion of redundancies in the course of the phasing-out of coal-fired power generation. Furthermore, it was recognised that there would be a need for further training measures for employees as well as the targeted re-employment in suitable positions, within and outside lignite companies, of those affected. For employees older than 58 years, a compensation fund is to be used to enable them to retire early without financial loss.

State governments should seek talks with residents in opencast mining regions and adjust opencast mining plans in the respective districts as promptly as possible in accordance with the Commission's recommendations. The aim is to ensure that those affected by possible resettlement receive sufficient planning security.

The competitiveness of energy-intensive industry is to be maintained by the federal government advocating the continuation and further development of CO_2 electricity price compensation at European level. In addition, commercial and industrial electricity consumers, as well as private consumers, are to be protected against a possible increase in retail prices by a lowering of transmission grid charges. The Commission anticipated that a total of €2bn a year in relief would be needed from 2023. In addition, the costs of phasing out coal-fired power generation will not be passed on to electricity consumers.

Lastly, the phasing-out of coal-fired power generation should take place in agreement with the power plant operators. This also means that power plant operators will be compensated for the early closure of capacities. The extent of the compensation is part of the federal government's negotiations with the operators or will be determined by means of a call for tenders for closures.

Element E: Monitoring

In order to ensure successful implementation in all areas, the implementation of the measures is to be regularly reviewed by close monitoring in accordance with specific criteria and recorded in progress reports in 2023, 2026 and 2029. In addition, the progress reports should be discussed in the German parliament.

Furthermore, an independent panel of experts should be entrusted with the evaluation of the implementation. If the implementation of the measures reveals any shortcomings, the federal government should make consistent adjustments.

4. Assessment and outlook

4.1 Assessment

In recent years, the phasing-out of coal-fired power generation in Germany has been intensively and controversially discussed. The recommendations drawn up by the Commission represent a pragmatic compromise between the main interest groups from industry, the energy sector, trade unions and environmental associations. Germany is thus continuing its tradition of finding joint solutions to major political conflicts, extending the analogy with the end of coal subsidies and the phasing-out of nuclear power. The almost unanimous adoption of the recommendations should give the federal government a reason to stick to the negotiated compromise. At the same time, the compromise ends the social debate surrounding the phasing-out of coal: whether Germany will phase out lignite and hard coal-fired power generation is no longer in question.

Without the implementation of the measures recommended by the Commission, electricity generation from coal-fired power stations, and thus also CO_2 emissions, especially lignite, would fall only slowly. The proposed measures will enable the energy sector to meet its sectoral targets by 2030 (Agora Energiewende 2019). Since the phase-out of coal-fired power generation is to be replaced primarily by domestic renewable energies with, additionally, the necessary amount of CO_2 certificates being cancelled, the relocation of CO_2 emissions abroad can be almost completely avoided.

The credibility of Germany's energy system transformation has suffered considerably in recent years due to the sluggish reduction of greenhouse gas emissions. In particular, the foreseeable failure to meet climate protection targets for 2020, and the persistently high level of coal-fired power generation, have contributed to this. If the Commission's recommendations are implemented, it will be possible to restore some of the credibility of the energy system transformation. However, for this to succeed completely, and for the climate target of 2030 to be safely achieved, as agreed in the current coalition agreement, considerable efforts are still needed in the building, industry, transport and agriculture sectors.

The combination of the gradual reduction of coal-fired power generation and the expansion of renewable energies to 65 per cent by 2030 will mean that wholesale electricity prices will be significantly lower than would be expected on the basis of previous energy and climate policy decisions (Agora Energiewende 2019). Energy-intensive industry, in particular, will benefit from this. For the energy industry, the further expansion of renewable energies, the modernisation of the electricity grid, the conversion from coal-fired to gas-fired power plants, some of which are associated with the further development of CHP support, and incentives for storage facilities offer new investment and growth opportunities.

The scale and long-term nature of the recommended regional development financing for coal regions and the related investments in energy, infrastructure and research may enable the regions to develop sustainably. In addition, they offer the eastern German *Länder* the possibility of compensation for some of the structural policy failures that have occurred since unification. Extending the phase-out of coal to 2038 at the latest, and actually phasing it out, will also enable coal regions to create new jobs in a reasonable amount of time. A comprehensive package of labour policy measures will create fair transition options for affected employees.

In the light of the Federal Network Agency's reservation power on decommissioning, a consensual decommissioning approach with the operators, as well as the continuation of the Combined Heat and Power Act, the further development of supply security monitoring and the existing reserve instruments shows that sufficient national instruments and measures are available to guarantee supply security even in the course of the withdrawal from coal. Even so, the model calculations show that this will require the construction of several gigawatts of new gas-fired power plant capacity by 2030 (Agora Energiewende 2019). Whether this can actually be financed via the energy-only market will have to be closely monitored by the German government in the coming years and, in case of doubt, adjusted in good time.

In total, the additional costs of the proposed measures for the federal budget until 2038 amount to between €69bn and €93bn (Agora Energiewende 2019). This corresponds to about €3.6bn to €4.9bn per year over the same period. These costs could have been significantly lower if, in recent years, the federal government had taken a more proactive approach to climate, energy and structural policy. In the interests of long-term planning security for companies, regions and employees, as well as socially-acceptable arrangements for the phasing-out of coal, the Commission's recommendations should be followed.

In summary, under its recommendations the Coal Commission has followed the concept of a just transition in various dimensions. Firstly, a high number of directly-affected interest groups were included in the political process of solution finding, ranging from coal workers to regional representatives of civil society and to environmental associations. Secondly, with a phase-out stretched over sixteen to nineteen years, both the regions and the energy and industry companies have been given a reasonable amount of time to transform. And, thirdly, the proposal foresees the provision of comprehensive financial support to the stakeholder groups affected.

4.2 Outlook

In February 2019, the federal government accepted the Commission's report and announced that it would examine its recommendations. Due to the Commission's recommendations being adopted almost unanimously by the various players from industry, the energy sector, environmental associations, trade unions and academia, the federal government is under pressure to implement them faithfully and in full.

Two central legislative projects are at the centre of implementation: firstly, there will be a regional development law whose aim is to safeguard economic development in the regions; and, secondly, there is the legal anchoring of the phase-out of coal.

In September 2019, the government has presented the respective proposals for both laws, which should enter the parliamentarian procedure before the end of 2019.

References

AG Energiebilanzen (2019) Power generation by sources 1990 - 2018. https://ag-energiebilanzen.de

Agora Energiewende (2019) The German Coal Commission: a roadmap for a just transition from coal to renewables. https://www.agora-energiewende.de/en/publications/the-german-coal-commission/

Bloomberg (2018) A Coal Mine Is Devouring a 12,000-Year-Old Forest. https://www.bloomberg.com/features/2018-hambach-forest/

CDU, CSU and SPD (2018) Coalition agreement between CDU, CSU and SPD, 19th legislative period. https://www.bundesregierung.de/breg-de/themen/koalitionsvertrag-zwischen-cdu-csu-und-spd-195906

Coal Industry Statistics (2019) Statistik der Kohlenwirtschaft e.V. [Occurence of lignite and hard coal]. https://kohlenstatistik.de/19-0-Braunkohle.html; https://kohlenstatistik.de/18-0-Steinkohle.html

Commission on Growth, Structural Change and Employment (2019) Final Report. https://www.bmwi.de/Redaktion/EN/Publikationen/commission-on-growth-structural-change-and-employment.html

DIW Berlin, Ecologic Institute and Wuppertaler Institut (2019) Phasing out coal in the German energy sector: interdependencies, challenges and potential solutions. https://epub.wupperinst.org/frontdoor/index/index/docId/7265

enervis (2016) Gutachten: Sozialverträgliche Ausgestaltung eines Kohlekonsens [Socially responsible design of a coal phase out]. http://bit.ly/2UblDPK

Federal Environmental Agency (2019) Indicator: Greenhouse gas emissions [Greenhouse gas emissions 1990 – 2018]. https://www.umweltbundesamt.de/en/indicator-greenhouse-gas-emissions#textpart-1

Federal Ministry for Economic Affairs and Energy (2018) Sechster Monitoring-Bericht «Energie der Zukunft» [Sixth «Energy Transition» Monitoring Report «The Energy of the Future»]. https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/sechster-monitoring-bericht-zur-energiewende.html

Federal Ministry for Economic Affairs and Energy (2019) Energiedaten: Gesamtausgabe [Energy data collection]. https://www.bmwi.de/Redaktion/DE/Artikel/Energie/energiedaten-gesamtausgabe.html

Federal Networks Agency (2019) Kraftwerksliste [List of Power Plants]. https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Unternehmen_Institutionen/Versorgungssicherheit/Erzeugungskapazitaeten/Kraftwerksliste/kraftwerksliste-node.html

Federal Statistical Office (2019) Volkswirtschaftliche Gesamtrechnungen, Inlandsprodukt [National accounts, domestic product statistics]. https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen-Inlandsprodukt/_inhalt.html

Federal Statistical Office (2019) Arbeitsmarkt - Erwerbstätigkeit [Labour market - employment statistics]. https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/_inhalt.html

German Bundestag (2011) Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren [Law on the peaceful use of nuclear energy and protection against its dangers], Amended on 6 August 2011. https://www.gesetze-im-internet.de/atg/

German Bundestag (2016) Aktionsprogramm Klimaschutz [Power sector law]. https://www.bmu.de/themen/klima-energie/klimaschutz/nationale-klimapolitik/aktionsprogramm-klimaschutz/

German Government (2010) Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung [Energy concept for an environmentally friendly, reliable and affordable energy supply]. http://bit.ly/2HrdwZU

German Government (2014) Deutschlands Klimaziel 2020 [Climate Action Program 2020]. https://www.bmu.de/themen/klima-energie/klimaschutz/nationale-klimapolitik/aktionsprogramm-klimaschutz/

German Government (2016) Der Klimaschutzplan 2050 [Climate Action Plan 2050]. https://www.bmu.de/themen/klima-energie/klimaschutz/nationale-klimapolitik/klimaschutzplan-2050/

German Government (2018) Einsetzung der Kommission Wachstum, Strukturwandel und Beschäftigung [Resolution on the Commission Growth, structural change and employment]. https://www.bmwi.de/Redaktion/DE/Downloads/E/einsetzung-der-kommission-wachstum-strukturwandel-beschaeftigung.pdf?__blob=publicationFile

Ministry of the Environment, Nature Conservation and Nuclear Safety (2019) Projektionsbericht der Bundesregierung 2019 [Projection report of the Federal Government]. https://www.bmu.de/download/projektionsbericht-der-bundesregierung-2019/

Öko-Institut (2017) Die deutsche Braunkohlenwirtschaft. Historische Entwicklungen, Ressourcen, Technik, wirtschaftliche Strukturen und Umweltauswirkungen [The German lignite industry], Berlin, Agora Energiewende. https://www.agora-energiewende.de/veroeffentlichungen/die-deutsche-braunkohlenwirtschaft/

RWI (2018) Strukturdaten für die Kommission 'Wachstum, Strukturwandel und Beschäftigung' [Structural data for the Commission on 'Growth, Structural Change and Employment'], Essen, Leibnitz Institute for Economic Research. https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/strukturdaten-der-kommission-wachstum-strukturwandel-und-beschaeftigung.pdf?__blob=publicationFile&v=4

United Nations (2015) Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

All links were checked on 12 August 2019.

Chapter 3
Phasing out coal in the French energy sector

Andrzej Jakubowski

Introduction

In November 2018, the French government (2018a) published a revised version of the French 'National Low-Carbon Strategy' (SNBC; *Stratégie Nationale Bas Carbone*), which targets climate neutrality by 2050. To achieve this ambitious objective, the project sets out a wide range of measures targeting cuts in emissions of greenhouse gases (GHG), including the closure of the last four remaining coal-fired power plants in France. These power plants, however, which employ a little over 1,000 workers, account for only a small share of the country's electricity production and CO_2 emissions.

Despite this, the closure of the plants remains a sensitive issue due, on the one hand, to the specificities of the French electricity production system but also, on the other, to the social concerns they have raised. According to the trade union CGT, the plants support a total of more than 5,000 direct and indirect jobs. Subsequent to the closure announcement, several strikes and protests have been organised by workers since December 2018. To address these concerns, the French government announced, also in 2018, the initial inclusion of the four sites into the pilot phase of the newly-created environmental transition contracts (ETCs) programme, which aims at implementing green economic diversification measures and social transformation schemes in regions touched by the negative effects of the transition.

This chapter will address the main challenges, policies and debates related to the phasing-out of coal in the French energy sector. Section 1 introduces the framework of the French national 'low carbon strategy', while section 2 describes the situation of the last four remaining coal-fired power plants in the country. Section 3 turns to the environmental transition contracts programme that aims to cushion the economic and social impacts of the transition and section 4 examines alternative projects that target the conversion of three of the remaining plants to biomass-fired units that have been developed with the support of workers and trade unions. Section 5 finally concludes.

1. The French national low-carbon strategy (SNBC)

Thanks to its largely decarbonised electricity mix, France ranks among the lowest greenhouse gas emitting countries in the European Union (Climate Transparency 2017). To achieve its 2050 objectives, the French SNBC targets the complete decarbonisation of the electricity production sector which, according to Eurostat, now accounts for around seven to eight per cent of France's total GHG emissions.

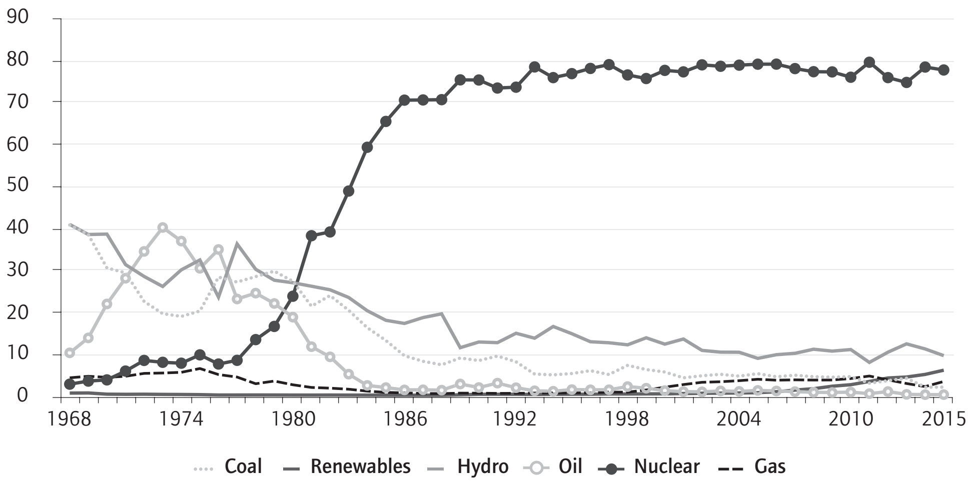
1.1 France's greenhouse gas emissions

In 2017, GHG emissions per inhabitant reached 5.8 tonnes per capita, against 10.3 in Germany and 8.3 for the G20 group (Climate Transparency 2017). At sectoral level, the main sources of emissions are transport (38 per cent), the residential/services sector (23 per cent) and manufacturing industry (22 per cent). The energy sector accounts for only 14 per cent of France's total GHG emissions (INSEE 2019).

Between 1990 and 2016, emissions dropped by 14.2 per cent (Eurostat 2019). This decrease is mainly due to a better performance in manufacturing (a drop of thirty per cent over the period, thanks to increased energy efficiency but also a reduction in industrial activity) as well as in the energy transformation sector (a drop of 42 per cent) due, in particular, to the development of renewable energy sources and the decarbonisation of heating networks. Meanwhile, emissions from the residential sector have decreased by seven per cent while emissions from transport have grown by eight per cent (INSEE 2019).

The relatively low level of emissions of the French economy is linked to the introduction, following the first oil shock of 1973, of policies targeting the reduction of energy consumption and the development of electricity production from nuclear energy.

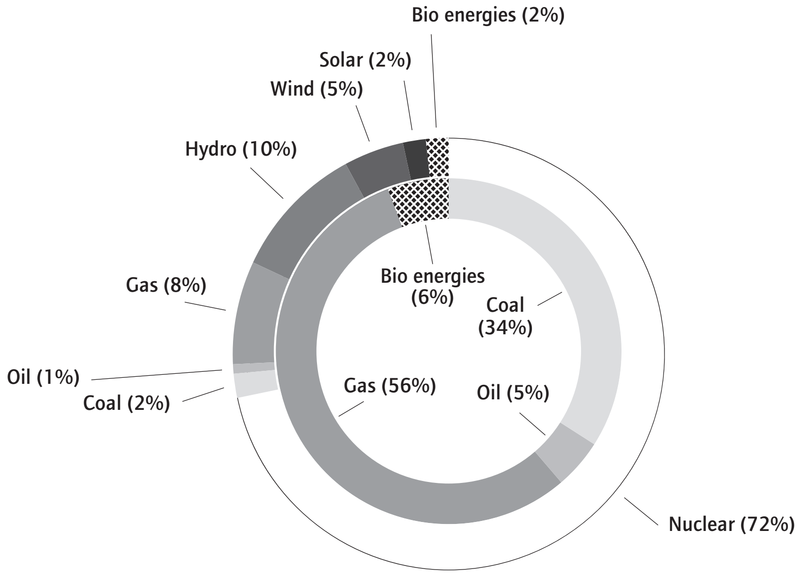
Figure 1 **France – structure of electricity generation by fuel (1968-2015, as per cent of total production)**



Source: World Bank.

As Figure 1 shows, in the last four decades nuclear energy has progressively replaced coal as the dominant source of power generation. In 2017, it accounted for 72 per cent of total electricity production, followed by renewables (nineteen per cent) and gas (eight per cent). Coal represents only between two and three per cent of annual power generation (depending on weather conditions and the availability of nuclear plants and renewable installations). Coal-fired power plants account, however, for more than one-third of the sector's GHG emissions, as shown by Figure 2 (34 per cent, against 56 per cent for gas-fired power plants).

Figure 2 **French electricity sector: structure of national production (outer circle) and CO_2 emissions (inner circle) by fuel (2017)**



Source: https://www.statistiques.developpement-durable.gouv.fr/

1.2 The French National Low-Carbon Strategy (SNBC)

The 2015 National Low-Carbon Strategy (SNBC) (French Government 2015b) was established by the Energy Transition for Green Growth Act (French Government 2015a). It aims at cutting GHG emissions by forty per cent by 2030 and by 75 per cent by 2050 compared to 1990 ('factor 4' scenario).

Recently, following the election of Emmanuel Macron as president and the adoption of Nicolas Hulot's Climate Plan,[1] a revised version, which now targets climate neutrality by 2050, was presented in December 2018 (French Government 2018a). The government has raised the country's ambitions, despite France not having reached its current short-term climate targets.

The SNBC has been based on a wide consultation process and includes measures targeting the social impacts of the transition.

1. M. Nicolas Hulot was replaced by M. François de Rugy as Minister for the Environmental Transition on 4 September 2018.

Main objectives

The amended strategy, which should be adopted by mid-2019, is based on 47 cross-cutting and sectoral recommendations. These are sweeping measures which aim, among others, at placing carbon footprint reduction at the heart of public decision-making (at national, regional and local levels); maximising the effects of government funding; promoting R&D and innovation; and raising the awareness of the public on the impact of consumption choices.

Sectoral recommendations define emissions reduction targets for seven sectors and set out a series of measures which aim at realising these objectives. At a later stage, they will be supplemented by sectoral action programmes. The targets set for the sectors concerned are presented in Table 1 below.

Table 1 **Sectoral GHG emission reduction targets by 2050 (%)**

Transport	Residential	Agriculture	Industry	Energy production	Waste	Total	LULUCF*
-97	-95	-46	-81	-95	-66	-83	64

Source: SNBC.
Note: * Land use, land-use change, and forestry.

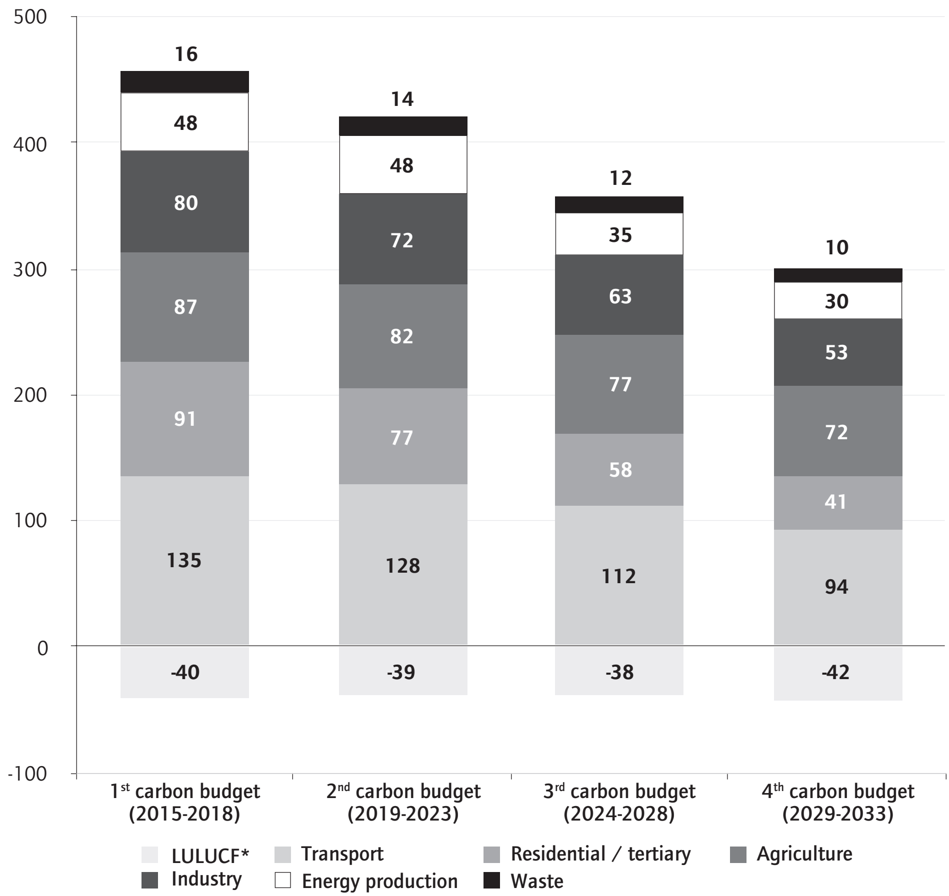
To achieve its long-term targets, France has adopted a system based on five-year national 'carbon budgets', which are tools in the monitoring and evaluation of the implementation of the strategy. The carbon budgets define GHG emission caps for the sectors covered by the strategy, as shown in Figure 3.

Regarding electricity production, the Strategy targets the development of a carbon-free power generation sector by the mid-century. It plans to achieve this through a complete decarbonisation and diversification of the energy mix (via the development of renewables including biomass, the roll-out of carbon capture and storage (CCS) technologies, etc.), supported by an overall improvement in energy efficiency (cross-sectoral measures).

In November 2018, the French government published the national Multiannual Energy Plan (PPE) for the period 2019-2028 (French Government 2018b), which sets out some initial measures aimed at realising these objectives (Mandard *et al.* 2018). The announced measures include the closure of all coal-fired plants by 2022. The government has also announced a ban on investment in new fossil-fuelled production capacities and an increase up to forty per cent in the share of renewables in the electricity production mix (against seventeen per cent in 2018), mainly based on the development of solar and wind energy. Total solar installed production capacity should grow from 8.4 GW to 40 GW, while wind energy production capacities (onshore and offshore) should reach 38 GW (against 17 GW in 2018).

Decarbonising the electricity sector will be a considerable challenge as, at the same time, the government is planning a reduction in the share of nuclear power to fifty per cent of the electricity production mix. This development will involve the shutdown of fourteen nuclear reactors by 2035, including the two reactors of the Fessenheim plant in spring 2020.

Figure 3 **Carbon budgets – sectoral breakdown ($MtCO_2eq$)**



Source: SNBC.
Note: * Land use, land-use change, and forestry.

The public debate

The National Low Carbon Strategy is based on a reference scenario developed during a modelling exercise within the Multiannual Energy Programme. This scenario highlights the different potential public policy measures that would allow France best to respect its short- and medium-term climate and energy objectives.

The scenario, as well as the main political orientations of the SNBC, have been defined through a comprehensive consultation process that has involved multiple stakeholders, including trade unions.

The core hypothesis of the SNBC was first developed under the aegis of a steering committee, made up of experts from the relevant ministries and industrial sectors. This steering committee was cross-disciplinary in nature, incorporating sector-specific sub-committees (energy, transport, construction, industry, waste management, agriculture and forestry) when necessary.

In the meantime, an Information and Orientation Committee (CIO), composed of members coming from the different organisations represented in the National Council for the Environmental Transition (a consultative body which brings together representatives of employees, employers and consumers, environmental NGOs, regional authorities and members of parliament), was also set up. Throughout the working process – i.e. from the definition of the fundamental hypotheses until the presentation of the final results – the Information and Orientation Committee (CIO) met six times, allowing civil society figures to provide input regarding the modelling decisions and to discuss the resulting out-turns.

Last but not least, an online nation-wide consultation process was also organised (French Government 2018a).

The objectives of this wide consultation process have been twofold: gather as much relevant information as possible; and gain acceptance from the largest number of stakeholders. A similar procedure was used during the revision of the Strategy, which took place during 2017 and 2018. The CIO met six times since June 2017 at each key stage of the review process (such as validating the main assumptions or the final text of the draft strategy). In addition, CIO members have also been invited to participate in the meetings of the different sectoral and cross-sectoral working groups.

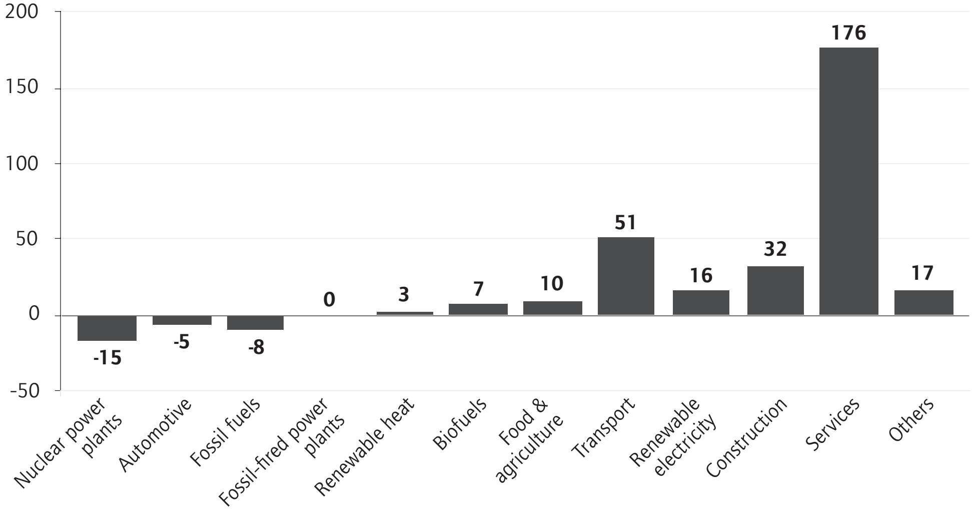
In the future, civil society representatives (including trade unions) should also be associated with the next revisions and update of the SNBC. The text of the Strategy lays down that such a revision should take place every five years. Furthermore, according to the French Law, the National Council for the Environmental Transition should be consulted by the government on any law relating to energy and climate change.

Expected impacts on employment and skills

The SNBC's macroeconomic assessment anticipates that the implementation of the Strategy would have a positive effect on growth and job creation: 300,000 to 400,000 additional jobs by 2030 and 700,000 to 800,000 new ones by 2050 compared to the baseline scenario. In the same way, it is estimated that the implementation of the measures contained in the Multiannual Energy Plan (which relates to energy issues only) would also have a positive effect on employment to the extent of 280,000 new jobs by 2030.

Important differences between sectors are expected, however, as Figure 4 shows (e.g. job creation in the environmental sector, construction, transport and services; but job losses in nuclear, automobiles and carbon-intensive sectors). The transition is also expected to have major impacts in terms of qualifications and skills (the 'greening' of certain activities implies the need for new skills and job profiles and may have effects as regards health and safety at work, etc.).

Figure 4 **Estimated employment impacts, by 2030, of the implementation of the Multiannual Energy Plan (in 000)**



Source: PPE.

As an adequate policy is required in advance, one of the cross-cutting recommendations of the SNBC facilitates the implementation of tools aimed at anticipating and managing the impacts of the transition upon employment and skills. This includes two main measures: the first is an adaptation of education, vocational training and lifelong learning structures and programmes to the needs of a greener economy; while the other is the encouragement of better integration and understanding of issues to do with the transition among sectors, companies and regional authorities, and in favour of occupational shifts, reskilling and the development of green jobs.

The latest recommendation includes awareness-raising actions as well as the development of sectoral and/or regional prospective job and skills management strategies (GPEC). To support this, several tools have been designed such as, for example:

— employment and skills management plans (PPEC; *Plan de programmation de l'emploi*) which aim at mapping employment and skills evolutions at regional level in relation to the implementation of regional climate, air and energy strategies. PPECs are to be elaborated by regional public authorities, in cooperation with social partner organisations. They relate only to the energy sector;

— sectoral prospective jobs and skills management plans (to be elaborated by the social partners, in the framework of sectoral skill councils);

— publication of a methodological toolkit aimed at supporting professional conversions within the sectors affected by the transition in terms of developing alternative career path possibilities (French Government 2019a). This guide (which has been tested in four French regions) is designed for various stakeholders such as public institutions, sectoral organisations, social partners and companies;

— environmental transition contracts (French Government 2019b), which are tools seeking the involvement of regional communities and economic actors within a global (and regional) approach to environmental, economic and social issues (see below).

2. France's last coal-fired power plants

The French government announced in December 2017 its intention to close the remaining French coal-fired power plants by 2022 (Rouaud 2019). These four units (five blocks of 600 MW) have a total installed production capacity of around 3 GW. Their planned decommissioning follows a first wave of closures that occurred between 2013 and 2015.

2.1 Location, production and employment

Four plants, four regions, two owners

The four power plants are located in different parts of France and are the property of France's EDF and Spain's Uniper. Table 2 summarises their main characteristics.

The Cordemais (EDF) power plant is the most important. It operates two 600 MW units and produces 25 per cent of the total electricity consumed in the Loire-Atlantique region (4.28 TWh). There are 462 EDF employees working at the site (which is 150 hectares), as well as 250 permanent employees of external services providers. The site also hosts fifty apprentices and trainees. Until recently, two oil-fired production units were also functional (2 x 700 MW) but these were closed in 2017 and 2018.

The Le Havre power plant (EDF) is located in Upper Normandy, in the very heart of the Le Havre agglomeration. The plant, built on a site of 33 hectares, has one remaining production unit of 600 MW, two units (250 MW and 600 MW) having already been shut down in 2013. The plant's immediate proximity to the sea allows for the unloading of coal at the quayside and the cooling of the production unit by seawater. 221 people are currently working on site. Service providers reinforce EDF staff during peak periods.

The Gardanne power plant (Uniper, 600 MW) was commissioned in 1984 and is known for having the highest chimney in France (at 297 meters). As far back as 2011, Uniper announced its intention to transform it into the largest biomass plant in Europe. Several tests have been carried out since 2016 but the project is now being questioned because of its high cost and because of environmental concerns (see below). Here, 180 jobs are under threat.

The Emile-Huchet (Uniper) plant (600 MW) is located between the cities of Saint-Avold and Carling (Moselle). Commissioned in 1981, it produces electricity from both gas and coal. More than 350 people were working at the site in 2012, but at least 100 jobs have been cut since then. According to the unions, up to 150 jobs are at risk as a result of the forecasted closure.

Table 2 **French coal-fired power plants and their main characteristics**

Site	Company	Start of operations	Installed capacity	Employment
Cordemais	EDF	1983	1200 MW	462 employees
Le Havre	EDF	1963	600 MW	221 employees
Gardanne	Uniper	1984	600 MW	180 employees
Emile-Huchet	Uniper	1981	600 MW	250 employees

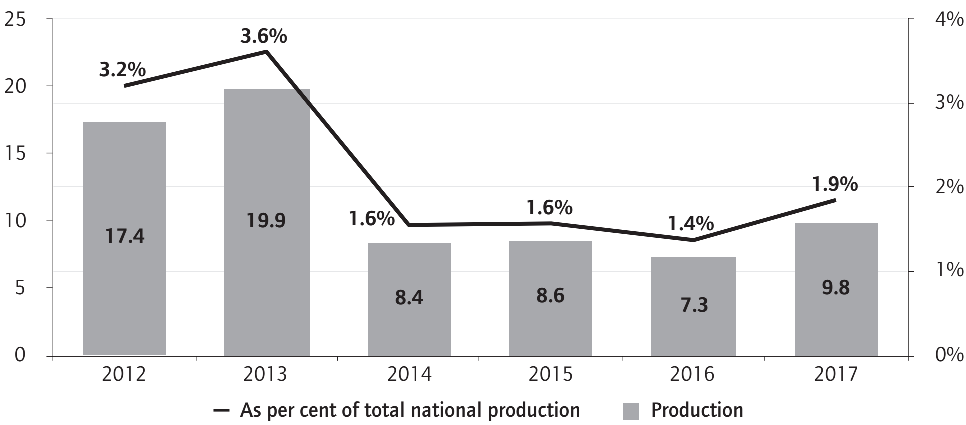
Source: EDF, trade unions and own research.

All these plants have recently been modernised in order to adapt to the emissions standards set by the Industrial Emissions Directive (IED). EDF has, for example, deployed a €480m investment plan aiming at the installation of flue gas treatment systems and dust collectors, as well as de-sulphurisation and de-nitrification facilities.

Production and sourcing

In France, coal-fired power plants, like all other fossil-fuelled production units (gas, oil) are used only and during peak periods (from September to April). During the last three years, their share of total national electricity production has ranged from 1.6 to 1.9 per cent. In 2017, their production level was relatively high (9.8 TWh), as Figure 5 shows, due to maintenance being undertaken at several nuclear facilities.

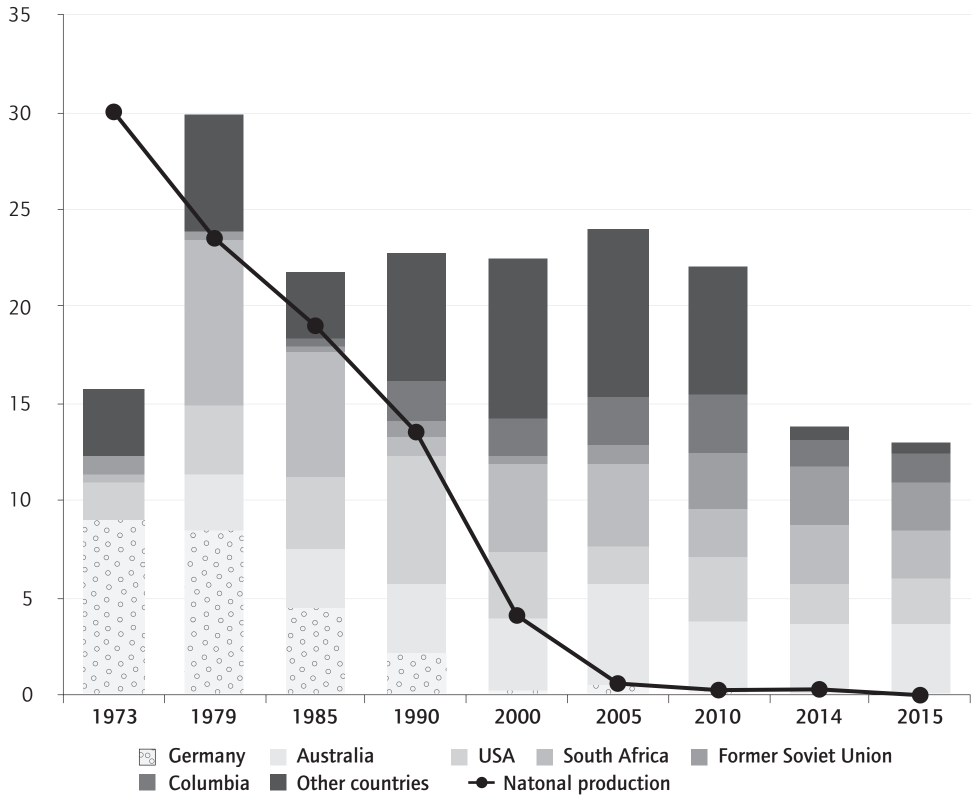
Figure 5 **French production of electricity from coal (TWh)**



Source: RTE.

The coal used to produce electricity is sourced only from imports. Figure 6 shows the development of national coal production and coal imports with their composition in the most recent decades. France closed its last coal mine in 2004. Since then, production has been limited to salvage operations from heaps, located in the Hauts-de-France, Gard and Lorraine regions. This ceased in 2015.

Figure 6 **France's national production and imports of coal per country of origin (tonnes, m)**

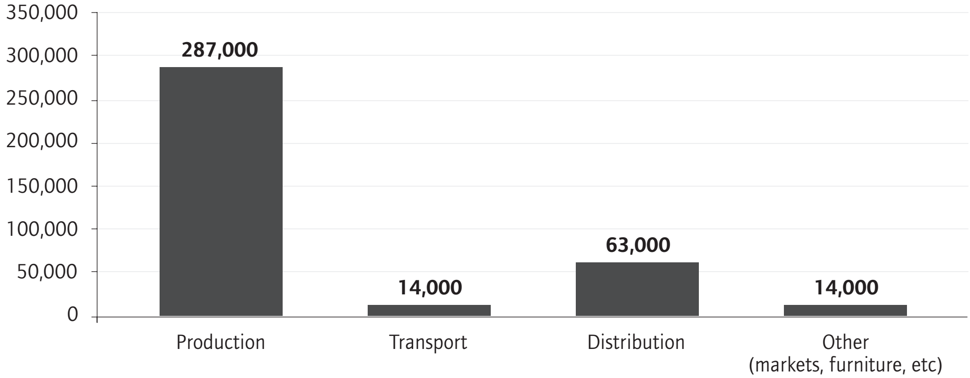


Source: INSEE.

Only a small share of employment in the sector

According to the French Electricity Union (UFE, Union française de l'électricité), employment in the electricity sector represents a total of 378,000 jobs (direct and indirect jobs) of which 75 per cent are in the production sector and twenty per cent in the transport and distribution sector.

Figure 7 **Direct and indirect employment in the French electricity sector (2016)**

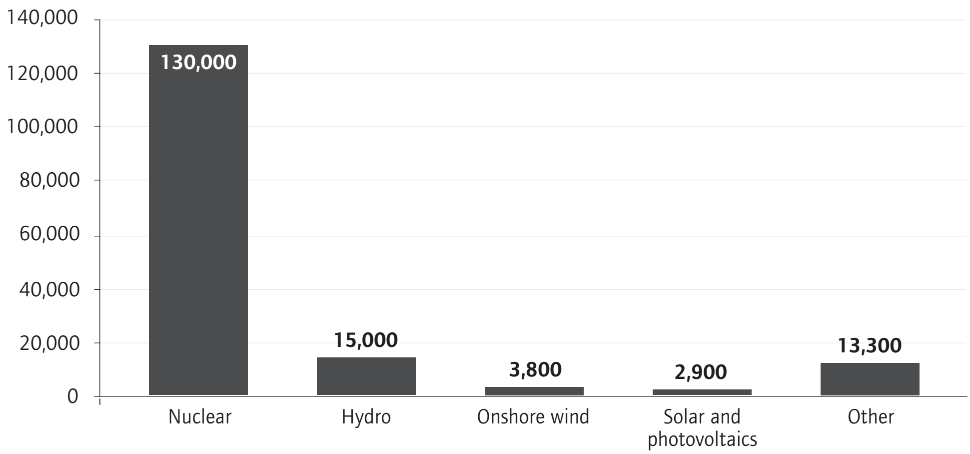


Source: UFE.

In the production sub-sector, around 165,000 jobs are associated with the exploitation and maintenance of power plants; the rest being linked to investment (construction, repowering, decommissioning), with around 40,000 jobs; and other activities (R&D, public authorities, etc.) and exports, accounting for some 83,000 jobs.

Employment in French power plants has remained stable over several decades. In 2016, nuclear power plants took the lion's share of this category (130,000 jobs), followed by hydro (15,000), wind energy (3,800) and solar and photovoltaics (2,900), as Figure 8 shows. The remaining workers (around 13,000 jobs) are employed in fossil-fuelled power plants (gas, coal and oil) and in the bio-energy sector (waste, biomass and biogas).

Figure 8 **Direct employment – exploitation and maintenance of power plants (2016)**

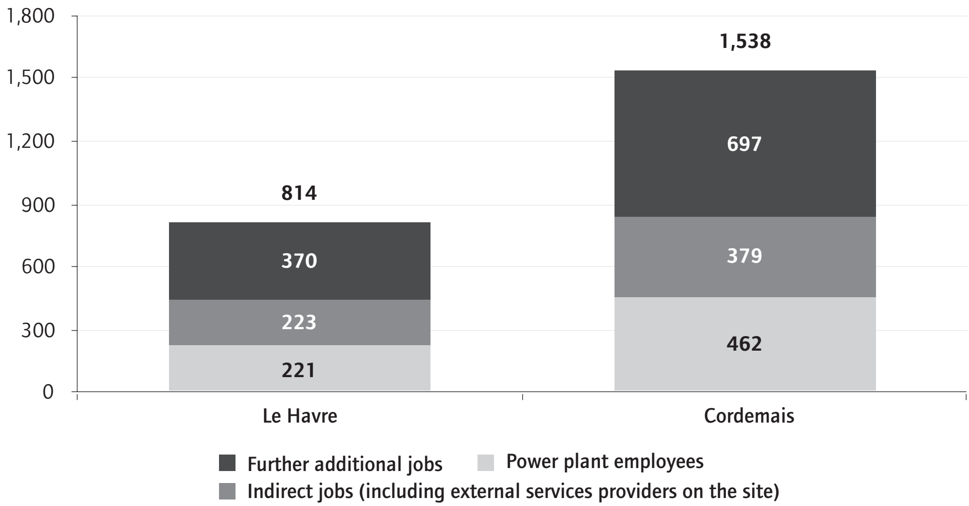


Source: UFE.

Direct employment in our four remaining coal power plants accounts for slightly above 1,000 jobs and represents therefore only a minor part of the sector's total employment.

There is no evaluation of how many indirect jobs are supported by the activity of these power plants. According to the UFE, a ratio of 2.5 indirect jobs can be associated with each direct job in a coal power plant. Following this hypothesis, some 2,500 additional jobs could directly depend on these facilities. As there are important differences between these units (location, presence of other production units, technology, etc.), this number cannot, however, be considered a precise estimate and it could indeed be understated. Recently, an internal study made by EDF has estimated that the total employment impact of the closure of its Cordemais and Le Havre plants could reach 2,300 jobs (see Figure 9). The CGT trade union assesses that around 5,000 jobs are linked directly or indirectly to the activities of the four plants.

Figure 9 **Estimate of the total employment impacts of the closure of EDF's Le Havre and Cordemais power plants**



Source: EDF.

2.2 The first wave of closures of coal-fired power plants (2013-2015)

As mentioned, the closure of these four power plants represents a second wave of closures after those that occurred between 2013 and 2015, when EDF and E.ON[2] proceeded to the closure of fifteen coal-fired production units.

These closures primarily affected the oldest production blocks (fourteen units of 250 MW and one unit of 600 MW, opened between 1958 and 1971). Table 3 below shows

2. E.ON has subsequently been transformed into Uniper France.

that there has also been an impact on sites which are still in operation (i.e. the closure of production units at Gardanne, Emile-Huchet and Le Havre).

The decision to close the units is linked both to environmental and financial reasons, with the cost of adapting the plants to fulfil the requirements of the IED Directive being seen as too high. Furthermore, the entry into force of the second phase of the EU ETS (and therefore the obligation to buy 100 per cent of the GHG emissions quotas) had seriously damaged the economic model of these facilities.

Table 3 **Coal-fired power plants affected by closure between 2013 and 2015**

Company	Name	Opened	Production	Units closed	Date of closure	Estimated direct employment
EDF	Bouchain	1970	650 TWh (2009)	250 MW	2015	65
	La Maxe	1971	1292 TWh (2009)	2 x 250 MW	2015	110
	Blénod	1963	2 820 TWh (2010)	3 x 250 MW	2014	145
	Vitry	1970	1 172 TWh (2010)	2 x 250 MW	2015	110
	Le Havre	1968	3 914 TWh (2010)	250 + 600 MW	2013	337
E.ON	Gardanne	1967	2 507 TWh (2009)	230 MW	2013	
	Emile Huchet	1958		125 + 330 MW	2015	357
	Hornaing	1970	475 TWh (2009)	235 MW	2013	86
	Lucy	1971	543 TWh (2009)	245 MW	2014	67

Source: own research.

No study or research has been made on the employment impacts of these closures. According to publicly available data (regional press, trade unions and employer sources), it can be estimated that 800 to 950 direct jobs have been cut. The closures have, however, not led to redundancies.

Both companies deployed measures intended to limit the social costs of the closure: early-retirement measures; internal mobility;[3] outplacement; and voluntary departure schemes. Some of the workers are also working on the decommissioning of the production units and/or are participating in the cleaning-up of the sites.

From a social point of view, it seems that the social transition has been easier at EDF than at E.ON facilities (Chape 2012). EDF employs 160,000 people in France and had, therefore, much better internal mobility possibilities than E.ON. Furthermore, EDF workers could benefit from the generous prospective employment and skills management scheme, signed in 2009 (Liaisons sociales 2009).

Two of the former EDF coal-fired sites have also benefited from investment in new gas-fired production facilities. In 2016, EDF inaugurated a new gas combined cycle plant of 600 MW in Bouchain. The plant already produces twenty per cent of the total electricity

3. After retraining, some EDF workers have, for example, been moved to some of the company's nuclear power plants.

consumed in the Hauts-de-France region (3 TWh in 2017).[4] According to EDF, the plant is listed in the Guinness Book of World Records for its efficiency. On 28 April 2016, its efficiency performance reached 62.22 per cent. Sixty workers are working on the site, among them being twenty former workers of the coal-fired unit. In 2011, a similar unit (438 MW) was opened in Blénot, for which EDF evaluates the total investment cost at €350m. The new production unit is used during high consumption periods and employs 45 workers, as well as thirty people engaged in the provision of external services.

3. Closing the power plants: a sensitive issue from both a social and a technical point of view

The closure of the power plants will, of course, not be an easy task due to the social concerns that this project raises and to the opposition of workers and trade unions. According to RTE (Réseau de Transport d'Electricité), the managing authority for the national transmission network, there are strict conditions that must also be filled from a technical point of view.

In order to address the social and economic consequences of the decommissioning of the plants, the French government has announced its intention to manage the transition of the four regions towards a greener economy through the adoption of environmental transition contracts.

The pilot phase of this programme started in 2018, but no ETC has, for the moment, been designed for any of the sites. At the same time, alternative projects aiming at converting the plants into biomass-fired units have emerged for Cordemais, Le Havre and Gardanne. While the two EDF plants may be allowed to extend their activity beyond 2022, the future looks much more uncertain for Uniper's workers in Gardanne, with the closure of the Saint-Avold plant within the next four years definitely confirmed in November 2018 (Lhuillier 2018).

3.1 Social and technical concerns

Strong opposition from trade unions and workers

The project to close the plants is confronted with the opposition of workers and all the major trade unions (CGT(2019), CFDT, FO (2018) and CFE-CGC), who are fighting for the extension of the lifespan of the production units and/or for the development of alternative projects.

CGT is the strongest trade union in both EDF and Uniper's plants. In Le Havre and Cordemais (EDF), CGT, FO and CFE-CGC have created a joint trade union committee

4. https://www.edf.fr/groupe-edf/producteur-industriel/carte-des-implantations/centrale-a-cycle-combine-au-gaz-naturel-de-bouchain/presentation.

to defend workers' interests. According to CFDT, trade union membership reaches around sixty per cent in these two plants.

Since the government's decision (French Government 2018a), several protests, including strikes, have been organised. In March 2018, a one-day strike was held at Cordemais and Le Havre. Entry to both sites was blocked by workers from the plants and from the two neighbouring ports (Le Havre and Nantes-Saint Nazaire). Fresh industrial action was organised during autumn 2018, with production being stopped for one day at Cordemais on 9 October. At Uniper's Saint-Avold site, twenty workers went on strike for the first time in May 2018 before again ceasing work on 22 November. On 13 December, a demonstration (following the call of CGT) was held in Paris, in front of the Ministry for the Environmental Transition. At the same time, a new strike was started by workers in the four power plants and the three ports hit by the closure project (the two already mentioned, plus Fos-Marseille). Production had restarted at Cordemais on 9 January as workers had been requisitioned by RTE due to high winter electricity demand. The strike was still ongoing at Gardanne until August 2019 when negotiations about a possible reconversion plan were started.

CGT and FO argue that the government should withdraw the closure project. According to them, the plants represent only a minor part of France's CO_2 emissions and taking them off-grid represents a threat to the French electricity system as coal-fired plants play a crucial role in responding to winter demand peaks. Both organisations have also denounced the high social costs of the closure, which could lead to up to 5,000 job losses, according to CGT.

CFDT has a more balanced approach regarding the transition. This trade union supports the decarbonisation of the energy sector but denounces the lack of visibility on the future of the sites. It also calls on the government to set employment as one of the priorities of the transition and underlines that it will be vigilant for solutions to be found for all employees concerned by the upcoming restructuring.

Naturally, all the trade unions support the conversion projects as developed by EDF and Uniper (see below).

Concerns regarding the electricity supply security

The closure of the plants is not only an environmental issue but also represents a challenge with regards to the security of electricity supply. According to RTE, ceasing electricity production from coal by 2022 is feasible, but only if certain strict conditions are met. These conditionalities apply at both national and local levels.

Supply/demand equilibrium of the national electricity grid

In recent years, the implementation of the French energy and climate strategy has already led to the closure of several electricity production units (both oil and coal-fired). According to RTE's last annual report on the national electricity balance (RTE 2018):

— Currently, there is no overcapacity left in the electricity production system. The production fleet is now dimensioned in practice and not only in theory.

— This analysis integrates the contribution of the different interconnections between France and its neighbouring countries. Even if the country remains a net exporter during most of the year, it occasionally uses imports during winter consumption peaks.

— Today, France is in an atypical situation compared to its neighbours, as the flexibility of its production fleet is very much based on hydro and nuclear power. This situation is at the source of the country's very good performance in terms of GHG emissions. Nevertheless, it entails a strong dependence on the performance of the nuclear fleet.

Considering the numerous challenges being faced by the French energy system in relation to the transition, ensuring equilibrium between supply and demand is a primary concern for RTE. The situation is all the more complex due to the different constraints and uncertainties related to the availability of the French nuclear fleet:

— A major part of it was built in the early 1980s. Despite the government's will to reduce the share of nuclear energy, a great number of the plants should see their activity prolonged above their originally foreseen forty-year period of operation. The extension of their lifespan will necessitate safety inspections and maintenance periods that will lead to their unavailability. Usually, their length goes from 100 to 200 days. Most of the time, however, the unavailability of the plants is longer than initially planned (up to sixty additional days on average). In 2016, France already had problems with the unexpected unavailability of several nuclear power plants during the winter period. This situation resulted in increased imports and important price hikes.

— On 1 February 2019, the French government confirmed the closure of the Fessenheim nuclear power plant by summer 2020 (Chhum 2019). Originally, this closure was conditioned to the start of operation of EDF's new EPR (third generation pressurised water reactor) unit in Flamanville. The Flamanville nuclear plant has, however, suffered several delays due to a string of serious technical problems. According to EDF, the reactor should be connected to the grid in the first quarter of 2020, and its commercial start at full power has now been scheduled for the second quarter of 2020. Nevertheless, further delays are possible. Moreover, as set by French regulations regarding nuclear safety issues, the plant is also planned to be stopped for a long safety inspection after 18 months of operation.

— Last but not least, it has also to be mentioned that France is currently not on track to meet its renewable energy targets, set by the Multiannual Energy Plan. Regarding wind energy, the level of additional annual capacities needed to reach the objectives was met for the first time in 2017. Additional investments are also needed in solar and offshore wind energy production.

According to RTE, the forecasted evolution of the supply-demand equilibrium does not make it possible to plan the closure of any production facility before mid-2020. During winter 2020, some limited security margins should reappear, making it possible progressively to close the coal-fired plants,[5] but only under strict conditions as listed below:

— Overall stability in electricity consumption should be secured. Increased investments in renewable energies are necessary and the development of interconnections with neighbouring countries (three new interconnection lines are to be opened in 2020 and 2021 between France and Italy and the UK) should proceed.

— A higher flexibility of the electricity system is necessary with the development of demand response mechanisms and proper and timely management of nuclear plant safety inspections.

— The start of operation of the Flamanville EPR and of the new gas combined cycle power plant planned by EDF in Landivisiau (CCGT, 400 MW) is also necessary.

Concerns over Brittany's security of electricity supply

Historically, the security of the electricity supply in the region of Brittany (near to which the Cordemais plant is located) has always been considered as 'fragile'.

This situation is linked in particular to the low production capacity installed in the region (the 'electric peninsula' situation). In 2010, an 'electricity supply pact' was signed by the French state, the Brittany regional authorities, RTE and ADEME (Compagnie électrique de Bretagne 2010). The pact sought to reinforce the security of the electricity supply in the region through increased energy efficiency, a reinforcement of the network and the development of additional production capacities (via renewables including a 450 MW offshore wind farm in Saint-Nazaire and the construction of the Landivisiau plant). Since the construction in 2017 of a high voltage underground power line, the situation is considered to have been stabilised.

Despite this, concerns remain regarding the stability of the regional electricity supply system, especially during consumption peaks. In winter, electricity imports from the UK and Belgium tend to rise. Imported electricity is transported over long distances and crosses the transmission networks not only of Brittany but also of the Loire-Atlantique and Ile-de-France regions, two regions which, similar to Brittany, are not themselves well-endowed with the means of production. Long-distance transport has the effect of causing a voltage drop that can be marked if consumption is high. In such situations of low voltage, the electricity system is weakened with the risk of a collapse of voltage that can spread to surrounding areas.

5. Two units by mid-2020, two in 2021 and the last remaining one in 2022.

The Le Havre and Cordemais power plants therefore play a key role regarding Brittany's electricity supply. According to RTE, their closure will be possible only after the Landivisiau plant has been started up.

3.2 Employment transition contracts

In 2018, the French government announced the creation of the environmental transition contracts programme to incentivise and speed up the transition towards the low-carbon economy at regional level. The pilot phase, which covers four areas, was launched in 2018 and, during 2019, eight new ETCs will be set up (French Government 2019b).

Initially, the government planned to include the sites of coal-fired plants in the first pilot phase. However, for the moment, no ETC has been designed for them which may be explained by the plants' still uncertain futures. Despite the closure announcement, no specific plan or road map has been drawn up even though projects for alternative uses are being developed.

What are environmental transition contracts?

Environmental transition contracts are strategies that take the form of binding agreements (contracts), designed for and by regional authorities and companies, which seek to advance the implementation of the economic and social transition to a low-carbon economy in French regions and territories. ETCs are based on local or regional low-carbon development initiatives and are adapted to the economic and environmental specificities of each area. Regarding their content, ETCs have the following main objectives:

— they constitute the main axis of the local low-carbon transition strategy and set the objectives to be achieved in terms of environmental gains (green energy produced, carbon emissions avoided, etc.);

— they include specific actions and investment projects to achieve the defined objectives in developing local low-carbon industry or services, as well as the role the different parties will play. They also include a monitoring procedure;

— these objectives can relate to a wide range of different measures, such as the development of renewable energies, energy efficiency projects and circular economy loops; and measures targeting agriculture, construction, urbanism, mobility or biodiversity, etc.

Table 4 below provides examples of the different measures that can be implemented.

According to the French Ministry for the Environmental Transition, ETCs are not meant to be only a list of environmental projects. Their objective is to create a 'stimulating'/'spill-over' effect across the whole area on which they are implemented through the development of the local (or regional) economic and social structure:

the development of new economic activities in relation to the selected projects; the development of local sourcing; the adaptation of educational and vocational training programmes; etc.

Table 4 **Main measures under the ETC framework**

Field	Type of measures – examples
Renewable energies	Use of industrial buildings for the production of renewable energy (e.g. the large-scale deployment of solar panels on the roofs of buildings) and the creation of economic activity around the operation/maintenance of these panels. Construction of hydrogen production units coupled with green electricity production – training/retraining programmes for employees whose activity is adversely affected by the transition. Widespread development of renewable energies in an area, correlated with the establishment of energy production cooperatives
Energy efficiency	Implementation within an industry of an energy use optimisation plan – training of employees Energy efficiency renovation plan targeting public administration buildings (or social housing) – creation of local SMEs and the hiring of long-term unemployed people
Circular economy	Development of activities linked to recycling and re-use (for example of construction materials) Collection and storage of unsold food products – development of a canning industry
Construction / urbanism	Creation of virtuous economic zones and/or areas Building renovation programmes

Source: French Ministry for the Environmental Transition.

This approach makes it necessary to establish a proper governance system but also to develop synergies between the different projects included within the ETCs to identify possible partnerships, organise the actors, identify possible means of financing and provide the parties with the necessary administrative, technical and legal support.

Who can participate?

ETCs are based on a voluntary approach which means that contracts will only be signed in those regions and by those parties which have declared their interest in participating in the programme.

ETCs are primarily designed for public bodies and companies. To be successful, a project needs, however, to gain the support of as many local stakeholders as possible. That is why, once a project has been identified, various actors – such as regional/local chambers of commerce, business organisations, trade unions and environmental NGOs – will be invited to participate. Participation implies becoming a party to the contract and, therefore, being bound by hard commitments (to advance the achievement of the overall objectives).

The development of an ETC presupposes an initial dialogue between public bodies and companies, as well as the identification of common needs and objectives. Here, networks involving businesses and state authorities play a crucial role. To encourage the development of such collaborations, the French government has set up a country-wide communications plan targeting the different local stakeholders.

As the participation of companies is critical, specific measures aiming at mobilising business have also been established. These include the following activities:

— integration within ETCs of a communications/marketing aspect intended to encourage business participation in the different projects (local communications strategies; help with getting funding; integration in the Clean Tech Network (a platform connecting innovative companies); etc.) is one of the core elements of an ETC;

— targeted communication with companies through local chambers of commerce and public regional development agencies, as well as with business associations, sectoral organisations, academia and companies that have been set up in special economic zones or that are part of an industrial cluster;

— the involvement of major French industrial groups such as EDF and Total;

— specific measures targeting the creation of 'start-ups', for example via the provision of free experimental sites, help with funding and with the organisation of partnerships through the Clean Tech Network, and the organisation of meetings between start-ups and regional and local authorities.

Approach

The establishment of ETCs is supposed to be based on a fast, three-month negotiation with the objective of maintaining the initial momentum. In this context, although the approach will obviously be adapted from location to location, the elaboration of the contract should include the following steps:

— rapid diagnosis, based on existing tools, studies and plans, of local climate, air and energy plans (*Plan Climat Air Energie*); local waste prevention programmes; other territorial projects; existing socio-economic studies; etc.);

— the quick identification of potentially-interested stakeholders, including local businesses; chambers of commerce in agriculture and trades; trade unions; and active NGOs. This phase includes a call for participation by companies and initial information meetings, as well as a call for contributions from the general public;

— the organisation of a mini-'Grenelle' conference[6] over one or two days (presupposing the participation of trade unions) to identify possible courses of action based on the projections and objectives of the existing territorial development plans. The objective at the end of this phase is to have completed the identification of the

6. The *Grenelle de l'environnement* was an open multi-party debate, held in France in 2007, that brought together representatives of national and local government and organisations (industry, labour, professional associations and non-governmental organisations), with the goal of defining the key points of public policy on issues connected with the environment and sustainable development over the following five-year period. The name 'Grenelle' comes from the first conference bringing all these players together, which took place in May 1968 in the Rue de Grenelle (https://en.wikipedia.org/wiki/Grenelle_Environnement).

strategic axes of the ETCs as well as to have identified the specific actions to be undertaken;

— the organisation on this basis of a public consultation process and a public campaign aiming at the mobilisation of citizens;

— the negotiation of the contract establishing these actions, particularly as regards their financial and regulatory aspects.

Governance

The establishment and execution of the ECT is placed under the legal and operational responsibility of an inter-town cooperation network (ECPI; Etablissement de Cooperation Intercommunale). ECPIs are groupings of towns or other local/regional authorities (counties, for instance) whose aim is to encourage intra-regional cooperation. They have the status of a public body with legal identity and are usually created for specific purposes such as territorial development issues or projects.

Once the ECPI has been set-up, a specific team in charge of the negotiation, management and follow-up of the ETC must be created. This project team is composed of the following participants:

— representatives of the aforementioned stakeholders identified for the project;

— a representative of the National General Council for Environment and Sustainable Development (CGEDD) – a national public body which provides consultancy and expertise to public authorities in the areas of sustainable development, infrastructure, transport, the energy environment and housing construction and planning;

— local representatives of various public agencies, such as the National Water Management Agency, the Regional Development Agency, the French Environment & Energy Management Agency (ADEME), etc.;

— a representative of the Deposits and Consignments Fund (CDC; Caisse des Dépôts et Consignations) – a French public sector financial institution created in 1816 and one of the government institutions under the control of parliament. Often described as the 'investment arm' of the French state, it is defined in the French Monetary and Financial Code as a 'public group serving the public interest' and a 'long-term investor'.

As regards the elaboration of the contract, specific support mechanisms may be put into place in order to help the parties during the negotiation process (approach, mechanisms intended to encourage dialogue, economic and technical evaluation of proposals, etc.).

To strengthen the efficiency of ETCs, the French state has decided to set in place a range of measures to simplify and shorten administrative procedures. The different state agencies involved (DREALs, the regional directorates for environment, urban planning and housing; DDTs, the regional area directorates; DIRECCTEs, the regional directorates for enterprises, competition policy, consumer affairs, labour and employment; ADEME, the French Environment & Energy Management Agency; the CDC; etc.) in the ETC will provide the project holders with regulatory, financial, social and administrative support. A single window procedure will be defined to facilitate the process. Furthermore, derogation procedures will be set down to simplify the administrative formalities (shorter delays, a single administrative procedure for the different environmental permits, lower administrative burdens, etc.).

Financing

No specific funding has been arranged to finance the different measures and projects which will be developed in the framework of ETCs. Instead, the French government plans to finance them through already-existing measures and funds targeting the transition: measures aimed at increasing energy efficiency and the development of renewable energies; specific funds for air or water quality improvement; heating funds (Fonds Chaleur[7]); etc. The Deposits and Consignments Fund will grant loans on the basis of its 'Green growth loans' programme while the financial agency may also participate in certain projects through direct investment.

In the field of research and innovation, companies will be supported in the search for national or European funds, including the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the various funds for research and innovation (Horizon 2020, European Fund for Strategic Investments (EFSI), the Investments for Future programme (PIA3), etc.). The French government also plans the mobilisation of private funding through the creation of financing hubs, dedicated savings schemes and the use of crowdfunding tools.

As already mentioned, participants in ETCs commit themselves to achieving specific environmental objectives. If these objectives are not met, the project holders must totally or partially reimburse the funds that have been obtained.

The social approach

Within the framework of ETCs, several tools and measures are planned to address the social aspects of the transition. In particular, a territorial analysis has to be carried out to identify the jobs that may be at risk as well as the probable need for new jobs and skills profiles. This analysis is conducted at local level, in collaboration with companies, and an action plan may subsequently be set up whose objectives will be included in the ETC (as binding commitments). Financing for this aspect will be made available from DIRECCTE through its EDEC system (a specific fund for the establishment of employment and skills management plans).[8]

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7. The Heating Fund, managed by ADEME since 2009, participates in the development of renewable heat production. It is intended for collective housing, communities and businesses.
8. https://les-aides.fr/fiche/bpBrDntGxfTeBGZeTUzZ4$Vm/direccte/edec-engagement-de-developpement-de-l-emploi-et-des-competences.html.

Other measures targeting the social aspects of the transition include the provision of free human resources consulting for businesses, such as professional support for mobility (schemes intended to encourage intra-sectoral mobility, facilitate exchanges of personnel between companies and provide assistance with geographical mobility). Support for training, at company level and through the National Employment Fund (FNE) and the National Employment Agency, is also available. Measures including the adaptation of local educational and vocational systems, or the development of 'green skills' certification schemes, are also part of the programme.

4. Alternative projects

In recent years, both EDF and Uniper have started projects to convert coal power plants into biomass-fired units. While EDF's units may see their activity extended beyond 2022, Uniper's project in Gardanne is, however, under threat given the environmental concerns that exist.

4.1 EDF: Ecocombust

EDF's Ecocombust project (EDF 2019), which began in 2016, aims progressively to replace coal burned to produce electricity with a new kind of biomass-based fuel consisting of consolidated and dried wood waste that cannot currently be used (and which is usually buried or sent to landfill). The project, in which EDF has invested around €10m so far, is being carried on at both Cordemais and Le Havre plants.

Under this programme, biomass would be sourced locally. It is then supposed to be transformed into pellets that the company plans to produce on-site and in respect of which a pellet production prototype has been started. At the same time, EDF is continuing with a complementary project (*Caméléon*) that aims to capture and recycle the residual carbon emissions still emitted by the plant (Serres 2018). This could be done through microalgae culture with the CO_2 then methanised to serve the production of biogas or fertilizers (total investment cost estimated at €70m).

The initial results of the Ecocombust project have been encouraging. According to the company, the implementation of this technology could lead to a significant reduction in CO_2 emissions (which could be divided by 25). In Cordemais, the company has run a series of tests that have allowed the powering up of the plant with eighty per cent biomass and only twenty per cent coal. The company has ensured that it is possible for biomass to reach an 87 per cent share without the need for modification of the production units. Similar tests have been conducted in Le Havre albeit with, for the moment, a much lower input of wood waste.

In January 2019, the Ministry for the Environmental Transition announced that EDF may be authorised to convert its coal-fired units and extend their lifespan up to 2026. This, however, is only as long as the concerns over Brittany's security of electricity supply continue. This potential authorisation is, therefore, linked to the possible start-up of the operations of EDF's Landivisiau gas power plant and of the 450 MW offshore wind farm at Saint-Nazaire (French Ministry for the Environmental Transition 2019).

According to the Ministry, should agreement be given, the plant would, however, be allowed to use annually only a maximum of four per cent of the quantity of coal it currently needs to function. This means the plant's activity would be reduced to 800 hours per year against 4,0005,000 hours at the moment. The project would, therefore, not allow all existing jobs to be saved since the workforce would have to be reduced proportionally.

4.2 Uniper

In 2014, Uniper converted one of the coal-fired units at Gardanne into a 150 MW biomass plant. The total investment cost is estimated at €250m. Eighty people are currently working in the new unit. The project is planned to be based, for one-half of its biomass needs (a total of 850,000 tonnes per year), on local sourcing.

The project was given the approval of the regional authorities in 2012, with the company obtaining a feed-in tariff of €115/MWh over the next twenty years (compared with a €35/MWh market price for conventional generation). According to Uniper, the success of the project could help to maintain around 150 jobs on the site as well as 1,000 indirect ones (Isnard-Dupuy 2018).

The project is, however, facing strong opposition from numerous NGOs and the National Forest Office (ONF), as well as from the managing authorities of two nearby national parks (Luberon and Verdon), because of its potential negative impact on the environment. This is because Uniper plans to fuel the power station with forest biomass, which could have a detrimental effect on the local ecosystem. At the moment, only a minor part of the biomass is sourced locally, the rest being imported from Spain and from Brazil. Pollution linked to the combustion process (fine particulate matter – PM2.5) and to the transport of biomass (thirty trucks per day) has also been pointed out (Isnard-Dupuy 2018).

In 2017, the plant's environmental permit was cancelled by Marseille's administrative court on the grounds that the plant's environmental impact study focused only on a 3km area whilst Uniper planned to source local biomass in forests located up to 250 km from the plant. Uniper appealed against the court's decision and has been granted temporary production authorisation by the regional authorities. The final decision of Marseille's administrative court is expected to occur in the second half of 2019.

In the meantime, in December 2018, the company announced its decision to sell all its French assets (which include two gas-fired units, six wind farms and two solar plants in addition to the two coal plants) to the Czech company EPH (Energetický a Průmyslový Holding), owned by Czech billionaire Daniel Kretinsky. Following this, EPH announced its willingness to negotiate with the French state the extension of the lifespan of the coal-fired plants beyond 2022 and its intention to transform all of them into biomass units. Evidently, there is no guarantee of success in this endeavour.

5. Conclusion

The newly-created environmental transition contracts can certainly be regarded as valuable instruments to promote and manage the transition towards a greener economy at regional and local levels, at the same time advancing the achievement of the targets set by the National Low-Carbon Strategy. Even though it is still a little early to claim they are going to be successful, they nevertheless constitute an interesting example of how the transition can be managed as well as a transposable experience for many European countries or regions struggling to adapt their economy. Among the different positive aspects of ETCs, three of them in particular can be highlighted:

they provide the opportunity for an integrated reflection on the future of the regional economy by encouraging the emergence of local initiatives and by linking the low-carbon transition with the development of the local economic and social structure;

their social dimension favours the implementation of a just transition for workers (green and decent jobs), as promoted by the ETUC. In this field, as in others, ETCs set specific objectives. Furthermore, they encourage the anticipation of change through the adaptation of local educational and vocational training systems while also promoting lifelong learning;

ETCs are based on the presence of wide local debate integrating all relevant stakeholders (from NGOs to trade unions). Such a level of association favours the development of common objectives and the acceptance of conversion projects. Seeking the acceptance of the largest number is of particular importance, especially in the context of the *gilets jaunes* crisis – a series of major protests initiated following a rise in the French carbon tax and which has shined a spotlight on the high costs of the transition.

Despite these positive aspects, the question of whether or not environmental transition contracts are the proper instruments for managing the closure of coal-fired power plants or their conversion into a new activity remains unsolved. Indeed, many questions arise: what kinds of new activities could be developed on the sites or close to them? As ETCs are based on a voluntary approach, what kind of companies could be interested in taking part in new projects? Will these new projects be considered suitable solutions for the plants' workers? The answer to the last question here is not so evident. Electricity production is a specific activity and workers in the sector often benefit from a status and from advantages that they may not be willing to see suppressed. In the past, EDF has managed to transfer workers from closed coal-fired power plants to its nuclear plants. This solution cannot, however, be applied in the case of Uniper's workers. Neither can sending workers on pre-retirement schemes be considered as a magic bullet fix, since this kind of solution was already applied to older workers when the first units of coal-fired plants were shut in the 2013-2015 period. In Le Havre and Cordemais, for example, the average age of workers is now estimated at slightly above forty years.

Nevertheless, the main problem is that there is no clear vision for the future of the sites. Despite the announcement of closures, no transition strategy (which should be the basis of an ETC) or plan has yet been defined by the authorities. A specific ministerial committee is at present working on the question, but no date has been given regarding the publication of its work. Converting plants to sustainable biomass-fuelled units would certainly be an acceptable solution. However, the Gardanne project is in jeopardy and, in the case of EDF's Ecocombust, the government has underlined that it will give its agreement to the project only if the problems linked to Brittany's electricity supply are not fixed. Regarding the closure of the coal-fired power plants, as it continues to face strong social opposition and the *gilets jaunes* crisis, it really looks as if the French government is walking on eggshells.

References

Centrale Emile-Huchet à Saint-Avold : les salariés de la tranche 6 en grève, Républicain Lorrain, 22 November 2018. https://www.republicain-lorrain.fr/edition-de-saint-avold-creutzwald/2018/11/22/centrale-emile-huchet-les-salaries-de-la-tranche-6-en-greve

CGT (2019) Les grévistes autorisent les essais Biomasse. https://cgt-centrale-de-gardanne.blogspot.com/2019/02/les-grevistes-autorisent-les-essais.html

Chape R. (2012) E.ON France retire son projet actuel de licenciement, Maritima Medias, 3 April 2012. https://www.maritima.info/depeches/emploi/aixMaritima-en-provence/12336/e-on-france-retire-son-projet-actuel-de-licenciement.html

Chhum G. (2019) François de Rugy a signé le projet qui prépare la fermeture de la centrale nucléaire de Fessenheim, France Bleu, 1 February 2019. https://www.francebleu.fr/infos/economie-social/francois-de-rugy-a-signe-le-projet-qui-prepare-la-fermeture-de-la-centrale-nucleaire-de-fessenheim-1549037418

Climate Transparency (2017) Brown to green: the G20 transition to a low-carbon economy. https://www.climate-transparency.org/wp-content/uploads/2017/07/B2G2017-France.pdf

Compagnie électrique de Bretagne (2010) Qu'est-ce que le Pacte Electrique Breton? http://www.landivisiau-lacentrale.com/pacte-electrique-breton/le-pacte-electrique-breton.html

Cosnard D. (2018) Le milliardaire tchèque Daniel Kretinsky achète deux centrales électriques en France, Le Monde, 24 December 2018. https://www.lemonde.fr/economie/article/2018/12/24/le-milliardaire-tcheque-daniel-kretinsky-achete-deux-centrales-electriques-en-france_5401838_3234.html

EDF (2019) Communiqué de presse, 28 janvier. https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiques-de-presse/edf-franchit-un-jalon-important-dans-la-mise-en-oeuvre-d-ecocombust

Esclauze A. (2018) À Gardanne, polémique autour de la centrale biomasse, La Croix, 13 March 2018. https://www.la-croix.com/Sciences-et-ethique/Sciences-et-ethique/A-Gardanne-polemique-autour-centrale-biomasse-2018-03-13-1200920315

European Parliament and Council (2010) Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), Official Journal of the European Union, L 334, 17 December 2010.

Eurostat (2019) Greenhouse gas emissions. https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=sdg_13_10&plugin=1 [accessed 30.01.2019]

Fermetures des centrales à charbon : la CGT se mobilise, Le Figaro, 29 March 2018. http://www.lefigaro.fr/flash-eco/2018/03/29/97002-20180329FILWWW00196-centrales-a-charbon-mobilisation-de-la-cgt-contre-leur-fermeture.php

Force Ouvrière (2018) Centrale de Cordemais, Press Release, 27 March 2018. http://force-ouvriere44.fr/communique-de-presse-centrale-de-cordemais/

French Government (2015a) Loi de transition énergétique pour la croissance verte [Energy Transition for Green Growth Act], Paris, Ministère de la Transition Écologique et Solidaire. https://www.ecologique-solidaire.gouv.fr/loi-transition-energetique-croissance-verte

French Government (2015b) France National Low-Carbon Strategy, Paris, French Ministry of Ecology, Sustainable Development and Energy. https://www.ecologique-solidaire.gouv.fr/sites/default/files/SNBC_France_low_carbon_strategy_2015.pdf

French Government (2018a) Stratégie Nationale Bas-Carbone, Paris, Ministère de la Transition Écologique et Solidaire. https://www.ecologique-solidaire.gouv.fr/strategie-nationale-bas-carbone-snbc

French Government (2018b) Multiannual Energy Programme: what are its aims? https://www.gouvernement.fr/en/multiannual-energy-programme-what-are-its-aims

French Government (2019a) L'accompagnement des transitions professionnelles. https://www.ecologique-solidaire.gouv.fr/laccompagnement-des-transitions-professionnelles

French Government (2019b) Les contrats de transition écologique. https://www.ecologique-solidaire.gouv.fr/contrat-transition-ecologique

French Ministry for the Environmental Transition (2019) Centrale à charbon de Cordemais : le ministère de la Transition écologique et solidaire met en œuvre les engagements du Plan Climat et étudie un projet de reconversion, Press Release, 11 January 2019. https://www.ecologique-solidaire.gouv.fr/communique-presse-centrale-charbon-cordemais-ministere-transition-ecologique-et-solidaire-met-en

Groupe Caisse des dépôts et consignations (2016) A €4mn Green Growth loan for Issy-les-Moulineaux. https://www.holdco-siic.fr/en/eu4mn-green-growth-loan-issy-les-moulineaux

INSEE (2019) Émission de CO2 par activité : données annuelles de 2000 à 2018, Paris, Institut national de la statistique et des études économiques. https://www.insee.fr/fr/statistiques/2015759#tableau-figure1 [accessed 30.01.2019]

Isnard-Dupuy P. (2018) Le développement des centrales biomasse, un remède 'pire que le mal' face au réchauffement climatique ?, BastaMag, 27 September 2018. https://www.bastamag.net/Le-developpement-des-centrales-biomasse-un-remede-pire-que-le-mal-face-au

Liaisons sociales (2009) La division production ingénierie thermique d'EDF met en place une GPEC, Liaisons sociales quotidien, 14 October 2009. http://www.wk-rh.fr/actualites/detail/17195/la-division-production-ingenierie-thermique-d-edf-met-en-place-une-gpec.html

Lhuillier C. (2018) Fermeture confirmée de la centrale à charbon de Saint-Avold, France Bleu, 18 October 2018. https://www.francebleu.fr/infos/economie-social/fermeture-confirmee-de-la-centrale-a-charbon-de-saint-avold-1539881247

Mandard S., Le Hir P., Allix G., Wakim N. and Malingre V. (2018) Nucléaire, renouvelables... le détail du plan du gouvernement en matière d'énergie, Le Monde, 27 November 2018. https://www.lemonde.fr/economie/article/2018/11/27/nucleaire-renouvelables-le-detail-du-plann-du-gouvernement-en-matiere-d-energie_5389319_3234.html

Moragues M. (2012) Fermeture des centrales à charbon : EON passe à l'offensive, L'usine nouvelle, 15 October 2012. https://www.usinenouvelle.com/article/fermeture-des-centrales-a-charbon-eon-passe-a-l-offensive.N183999

Muzyczka J. (2018) Carling : blocage levé à la centrale Emile Huchet, mais la production à l'arrêt, France Bleu, 29 May 2018. https://www.francebleu.fr/infos/economie-social/carling-les-salaries-en-greve-la-centrale-emile-huchet-a-l-arret-1527593801
Reuters (2018a) France to revise carbon emissions target after missing 2016 goal, Press Release, 20 January 2018. https://www.reuters.com/article/us-france-carbon-emissions/france-to-revise-carbon-emissions-target-after-missing-2016-goal-idUSKBN1FB2W0
Reuters (2018b) EDF's Flamanville reactor start again delayed to 2020, Press Release, 25 July 2018. https://uk.reuters.com/article/us-edf-flamanville/edfs-flamanville-reactor-start-again-delayed-to-2020-idUKKBN1KF0VN
Rouaud P. (2018) La France prépare la fermeture de ses dernières centrales à charbon, Le Monde, 11 February 2018. https://www.lemonde.fr/entreprises/article/2018/02/11/la-france-prepare-la-fermeture-de-ses-dernieres-centrales-a-charbon_5255168_1656994.html
RTE (2018) Bilan prévisionnel 2018. https://www.rte-france.com/fr/article/bilan-previsionnel
SDES (2019) Données et études statistiques. https://www.statistiques.developpement-durable.gouv.fr/ [accessed 30.01.2019]
Serres E. (2018) Charbon. Pour ne pas mourir, Cordemais arrête le coke et se met au vert, l'Humanité, 23 October 2018. https://www.humanite.fr/charbon-pour-ne-pas-mourir-cordemais-arrete-le-coke-et-se-met-au-vert-662533
UFE (2017) L'électricité au service d'une transition écologique et solidaire, Paris, Union française de l'électricité. https://ufe-electricite.fr/publications/etudes/article/l-electricite-au-service-d-une-transition-ecologique-et-solidaire
World Bank (2019) World Bank Open Data. https://data.worldbank.org [accessed 30.01.2019]

Websites consulted

EDF - https://www.edf.fr/
French Cleantech - https://www.frenchcleantech.com/about-us.html
INSEE - https://www.insee.fr/fr/accueil

All links were checked on 9 August 2019.

Chapter 4
Decarbonisation in the Italian energy sector: the role of social dialogue in achieving a just transition – the case of Enel

Serena Rugiero

Introduction

Over the last few years, the Italian energy sector has been revolutionised – alongside global transformations such as the climate crisis, the efficient use of natural resources and the circular economy. Important drivers of change have been in play simultaneously: policies of decarbonisation and the transition to renewable energy; the development of distributed generation; and the new role of the active user-consumer. The evolution of technologies and digitalisation is having an impact on all such processes in parallel with the evolution of the economic regulation of the sector (Ires 2012; Neirotti *et al.* 2018).

The electricity sector is therefore currently experiencing – and will continue to do so in the future – an unprecedented complexity of reorganisation processes that has profound economic and social repercussions for the competitiveness of the industrial system, the organisation of work and the employment of people and their skills.

In line with commitments undertaken internationally within the framework of a just transition,[1] the move from traditional to renewable energy sources cannot fail to take into account the effects that this might have on workers and communities that are dependent on the fossil fuel economy. The energy transition therefore has to be 'accompanied', to ensure that workers' rights are protected and that new good jobs (in terms of sustainability and quality) are made available through interventions to support employment, the promotion of workers' participation in decision-making, the training of new professionals, and the retraining and relocation of workers affected by the transition to employment in the new low-carbon economy. The proper means of transition, under which we must also respond to the three interconnected challenges of inequality, unemployment and environmental degradation, must be developed through social dialogue between governments, workers and employers, and by means of collective bargaining.[2]

1. 'A just transition' is a campaign of the global labour movement, led by the International Trade Union Confederation (ITUC), which has made it possible to ensure that social conditions are an integral part of the policy, planning and implementation of climate action. Just transition, together with decent work, was included in the Paris (COP 21) Agreement (UNFCCC 2015) and further defined in the global guidelines on the work of the United Nations International Labour Organization (ILO 2017). At COP 24, which was held in December 2018 in Katowice, with the signature of fifty-three countries and the European Commission, the 'Declaration of Silesia for Solidarity and Just Transition' was adopted, committing the signatories to take seriously the impact of climate change and climate policies on workers, their families and communities (ITUC 2018 http://www.greenreport.it/wp-content/uploads/2018/12/Dichiarazione-finale-ITUC.pdf).
2. The fundamentals to be guaranteed in just transition are: macroeconomic, sectoral and company policies to ensure jobs and dignified work; rights and health and safety at work; social protection; skills development; active labour market policies; and social dialogue and tripartism (ITUC 2017).

In this scenario, social dialogue assumes a fundamental role as a form of governance in the energy transition and a means of ensuring its quality and participatory nature.

Faced with the multi-dimensional and complex nature of sustainability, which requires multi-level governance of policies and their support measures, social dialogue can be effective in supporting the energy transition insofar as it is itself an instrument and form of governance. This is the case given the great potential, still to be fully exploited, of a possible fruitful link between the development of sustainability and social dialogue (ILO 2017; ITUC 2017).

Processes of far-reaching social change, and a radical transformation of economic, technical, institutional and social relations in the context of the 'new energy paradigm', in fact demand a form of governance that is based on agreement between all the relevant stakeholders and which is founded on a structural and integrated approach. This must go beyond a linear input/output scheme which is no longer able to deal with the complexity and urgency of the transition to a society based on a low-carbon economy (BROAD 2017).

Thanks to its ability to deal with the multidimensional conditions, complex dynamics and differential impacts of the changes underway, social dialogue – at the European, national and local level – might therefore prove to be a crucial factor in confronting the challenges arising from the transition. It might, furthermore, also be of assistance in terms of identifying and checking the consequences (both expected and unforeseen) as well as the resulting risks (regarding employment, the health and safety of workers, inequality and social exclusion, and energy security, with respect to the locational impact of redevelopment).

From this point of view, it is therefore fundamental to increase the role of social dialogue, first and foremost by strengthening its inclusive nature, through the promotion of an enlarged (multi-stakeholder) vision, based on the involvement of a wide range of potential protagonists. Above all, these must be associations representing the world of work, businesses and public institutions but, in addition, those of experts, environmental organisations and civil society.

In addition to consolidating the sense of responsibility (or accountability) of the various players involved, the practice of a form of wider social dialogue allows the partners to share their points of view and influence the policies or measures that affect them based on shared information and a clear, comprehensive awareness. On the one hand, this constitutes a prerequisite for providing guidelines and orientation while, on the other, it helps the process of arriving at shared decisions (BROAD 2017). This appears essential both in terms of forecasting and the *ex post* management and evaluation of the measures and steps put into practice, the re-orienting of actions and policies, and the dissemination of good practice and information that affects the behaviour, approach and decisions of the collective regarding energy transition.

Within this framework, the Enel case study is particularly relevant. In Italy, the decision has been taken to close thermoelectric plants which are no longer economically profitable or environmentally sustainable, to redevelop them and to relocate workers through agreements and negotiations based on a 'participative' method of ongoing dialogue between the company, the workers and their representatives (Cofacci 2018: 43).

Interest in the Enel case also stems from questions about the potential for repetition in other countries of this 'model' of tackling reconversion, in which social dialogue plays such a fundamental role. In this regard, however, it has to be noted that the success of agreements on restructuring and redevelopment in Italy, despite critical issues mainly related to the problems of the sector in question, derives in part from the solidity of the system of industrial relations and the model of social dialogue that actually operates in the Italian energy sector. The exportability of such practices, beyond inspiring principles based on the involvement of all interested stakeholders, must therefore take into consideration local specificities through the creation of *ad hoc* plans tailored to individual situations.

The research work – both desk and field – on which this chapter is based was carried out between December 2017 and November 2018.

The chapter is organised as follows. The first part analyses the general context of the energy sector in Italy (section 1) as well as the framework of energy and transition policies (section 2), in both cases featuring the rise of renewable energy. The next part is dedicated to the Enel case study (section 3); starting from the history of the company, the framework of industrial relations and social dialogue, with its national and transnational agreements, is outlined before we focus on the closure of the thermoelectric plants and the drawing up of redevelopment projects for sites facing the challenges of the relocation of workers and consequent issues in related sectors. Section 4 addresses the future challenges and concludes.

1. The national energy framework

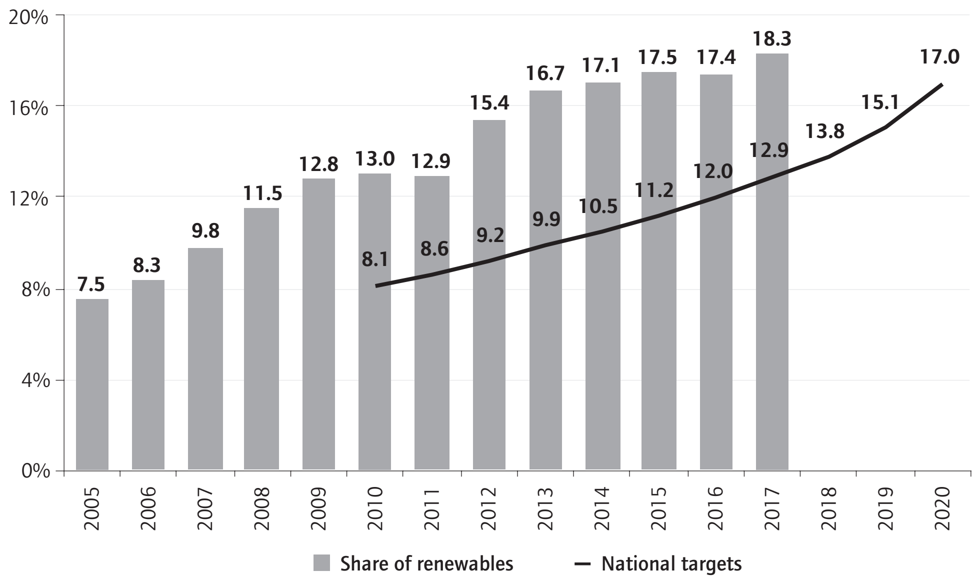
The 'energy transition' that characterises our time – understood as a process aimed at striking a new equilibrium identified with a low-carbon economy based on the centrality of renewable sources and on greater attention to efficiency and sustainability in consumption – is not the first in the history of human civilisation. It is sufficient to think of the transition from coal and steam engines to regimes based on oil and its derivatives. However, the advent of a low-carbon society is characterised by its being centred on the building of a sustainable economy, leading to a specific relationship with nature and a particular concept of social welfare favouring the growth of decentralised, low capital-intensive economies based on local supply chains and with an active role for citizen-consumers. On the other hand, it should also be noted that, in the case of the transition to renewable energy, there are also critical points related to the full realisation of the replacement of fossil fuels and the ability to combine profound social change with a new energy paradigm to guarantee the development of employment, the reduction of climate-altering emissions, the fight against poverty and the protection of workers and the locations to which they belong.

Historically, Italy has been characterised by the use of mixed resources dominated by hydrocarbons, with a major dependence on foreign supplies of oil and gas coming from four areas of production: Russia; Algeria; Libya; and the middle east. Italy also stands out by way of a higher price level for energy products compared to the other countries of the European Union, a result both of the energy mix and a higher tax burden on energy products. However, in the last ten years, the Italian energy system has seen unprecedented change in the power generation mix in favour of renewables and methane gas.

In the electricity sector, in 2017, renewable energy sources (RES) covered 35 per cent of total gross production (GSE 2018). Hydroelectric power is the main source of electrical generation from RES, while solar recorded the most significant growth (with around 19 GW of power created in 2018 by the photovoltaic sector).

Again in 2017, the share of total energy consumption provided by renewable sources was 18.3 per cent, a value higher than the 2016 figure (17.4 per cent) and above – for the fourth consecutive year – Italy's national target for 2020 (17.0 per cent) (Figure 1). Thus, Italy has surpassed the other major European economies in reaching their respective targets (GSE 2018) (Figure 2).

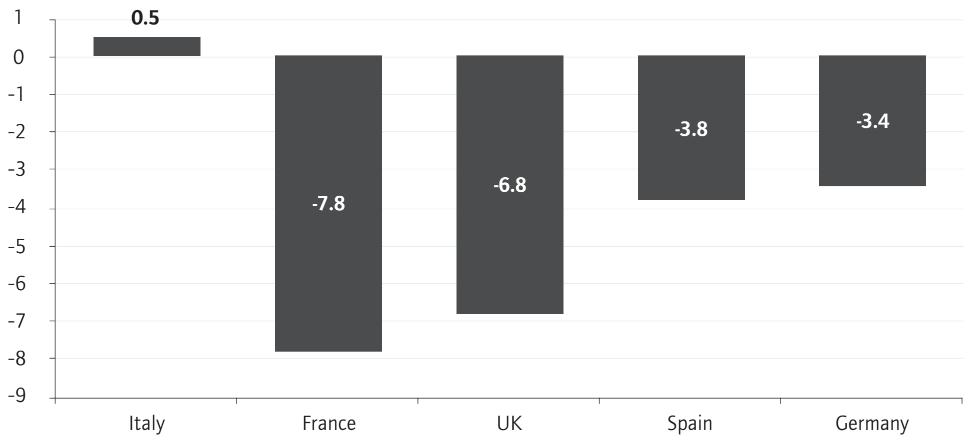
Figure 1 **Share of gross final consumption of energy from renewable sources (performance compared with the overall national target, set by Directive 2009/28/EC)**



Source: Gestore dei Servizi Energetici (GSE) (2018).

These results have been achieved thanks to generous mechanisms of public support which, however, have had an impact on energy bills in terms of system charges (Rugiero 2012).

Figure 2 **Achievement of renewable penetration targets in 2015 vs. 2020 objectives (delta %)**



Source: Eurostat.

In addition to renewable sources, the level of energy efficiency was also confirmed in 2017 as being higher than in other OECD countries. The energy intensity of GDP was around 106.7 tonnes of oil equivalent (toe) per million euros, and with a total decrease of 4.9 per cent compared to 2013. Italy have a lower energy intensity of GDP than elsewhere is undoubtedly due to the instruments adopted in Italy since the post-WWII period to counter the historically higher cost of energy in the country. Even so, the margins for improving efficiency are still wide, especially in the civil and transport sector. Currently, the three main instruments supporting energy efficiency are: tax deductions and the new *Conto Termico* ('Thermal Account') for the construction sector; and the *Certificati Bianchi* ('White Certificates') for the industrial sector.[3]

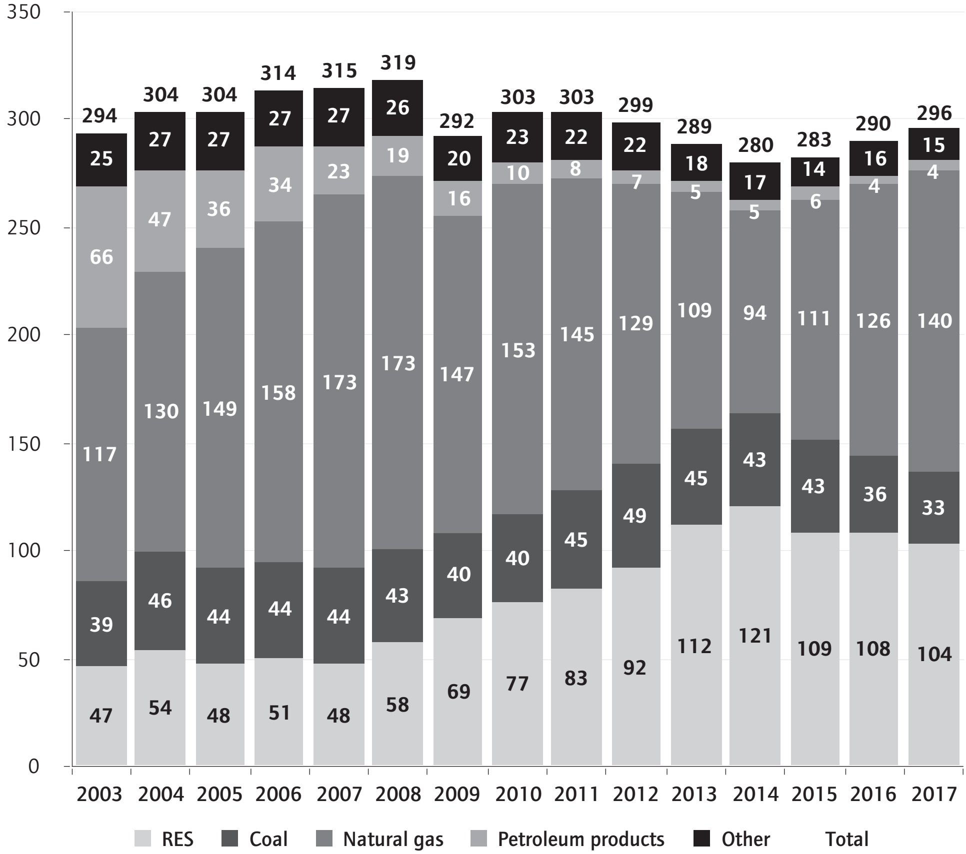
The improvement in energy efficiency has enabled significant energy savings, the reduction of emissions, a lowering of energy bills and, along with the greater impact of renewable sources, a reduction in dependence on foreign sources of supply. The share of domestic energy demand met by net imports remains high (76.5 per cent) but is lower by around six percentage points in comparison with 2010.

The demand for primary energy is being satisfied less and less by oil (which still accounts for about one-third of the total), solid fuels (6.1 per cent) and imported

3. Tax deductions for redevelopment interventions are a bonus that allows the request of an IRPEF refund of fifty per cent of the expenses incurred on specific jobs. The 'thermal account' is a package of incentives and facilities for improving the energy efficiency of buildings and encouraging the production of energy from renewable sources. The 'White Certificates', or Energy Efficiency Certificates, are negotiable securities that certify the energy savings achieved in the final uses of energy as a result of the implementation of measures to increase energy efficiency. This represents an incentive mechanism based on a mandatory primary energy saving scheme for electricity and natural gas distributors with more than 50,000 end customers. For each mandatory year, from 2017 to 2020, savings targets have been set that distributors have to achieve through the implementation of energy efficiency measures.

electricity (4.9 per cent). The contribution of gas, however, is growing and stands at 36.2 per cent (MISE 2018).

Figure 3 **Gross electrical production by energy source (TWh)**



Source: Gestore dei Servizi Energetici (GSE) (2018).

Figure 3 shows the radical change in the electricity generation mix in favour of renewables as well as the current phase of transition, with an increasing role for natural gas in covering energy needs. This requires the creation of more flexible conditions in the energy system, not least in view of the lower programming capacity of renewables. Furthermore, the development of interactive networks and the digitalisation of the sector also demand innovative measures to ensure the adequacy, safety and resilience of the energy system.

The consolidation of the penetration of renewable energy in the national energy system, as well as being a pillar of sustainable development in the country, also has significant employment and economic repercussions (Rugiero 2011a). Furthermore, it needs to be considered that, in the past, the development of technological supply chains has been insufficient while employment from renewable sources has grown mainly in the phases of the assembly, maintenance, management and production of some of the components (Rugiero 2011b).

According to the estimates of Gestore dei Servizi Energetici (GSE) (the Energy Services Operator), employees in the wind sector in 2016 (including workers employed in related activities) numbered 3,578 compared to the 11,818 employed in the photovoltaic sector; while the level of labour intensity in the photovoltaic and wind sectors is practically the same: there are thirteen permanent jobs for every €1 million spent on operation and maintenance in both the wind and the photovoltaic sectors. Similar numbers are to be found in the hydroelectric sector. This sector accounts for about 16 per cent of national electricity demand and employs around 11,500 people directly and indirectly.

In terms of biogas plants, Italy is third in the world in biogas production, after Germany and China. Employment levels in this sector were recorded in 2016 by GSE as standing at 6,443 workers. Here, employment levels are, once again, thirteen employees for every million euros spent on operation and maintenance (Neirotti *et al.* 2018).

2. The National Energy Strategy (NES) and the challenges of the energy transition in Italy

The National Energy Strategy (NES), published in 2017, is the ten-year plan of the Italian government to anticipate and manage change in the energy system. The NES is part of a broader strategy for sustainable development, in line with the Paris commitments of 2015 and the UN 2030 Agenda, which form the basis of the National Energy and Climate Plan to enter into force by 2020. The National Energy and Climate Plan is the tool with which all the member countries of the European Union will determine policies and strategies to achieve the decarbonisation goals set for 2030 by the Clean Energy Package (CEP) adopted by the EU (European Commission 2018). The main targets of the package include a reduction in CO_2 emissions by forty per cent, the development of renewable sources to take a 32 per cent share in primary consumption and an energy efficiency target of 32.5 per cent.

The NES is, therefore, a strategic document intended to show the main direction. Currently, also following the 2018 change of government, we are awaiting news on the implementation of the strategy as regards the national agenda. The main concern regarding the NES, in particular from the trade unions, lies in whether Italy will manage to achieve the extremely ambitious objectives that have been set for the transition from traditional sources to renewables – indicated below – while maintaining the security of the system and keeping manufacturing costs sustainable.

The objectives of the NES are: to improve the competitiveness of the national industrial system; to improve environmental compatibility; and to strengthen the security of the country's energy system. As a central objective, the National Energy Strategy aims to reduce Italy's high energy dependence on other countries from 84 per cent in 2010 to 65 per cent in 2020.

Compared to the objectives set by the Clean Energy Package, the goals set by the NES are particularly ambitious. By 2030, Italy intends to achieve a share of 28 per cent of renewables in total consumption, broken down into the following sub-targets:

— 55 per cent renewables in electricity generation by 2030, compared to 33.5 per cent in 2015;
— 30 per cent thermal renewables (renewables for heating and cooling: biomass; heat pumps; solar thermal; geothermal heat) by 2030, compared to 19.2 per cent in 2015;
— a 21 per cent share of renewables in transport by 2030 compared to 6.4 per cent in 2015 (with a consequent increase in biofuels and electric mobility).

These challenging objectives are considered achievable since, at 17.5 per cent in 2015, as mentioned above, Italy had already exceeded the national target of 17.0 per cent for renewables in total consumption set for 2020.

For overall emissions of carbon dioxide, the NES sets reduction targets of 39 per cent by 2030 and 63 per cent by 2050; while, in terms of energy efficiency, a reduction of energy consumption is expected from 118 mtoe in 2015 to 108 mtoe in 2030, thus lowering both energy expenditure and CO_2 emissions.

Another extremely challenging objective posed by the NES is the acceleration of the phasing out of coal – now covering 15 per cent of electricity production – which is set for 2025 rather than 2030. The acceleration of the phasing out of coal makes the objective of continuing to reduce the use of oil even more complex, by putting natural gas into a key role in the transition phase and, therefore, rendering the implementation of substitute infrastructure interventions absolutely necessary. These are made up of investments to strengthen the gas network in anticipation of the growth of the gas quota, not only as a reserve and back-up for renewable sources but also for the role of substitute fuel which it will assume with the abandonment of coal. This would require the diversification of gas supply routes as well as the greater system flexibility to which we have already alluded.

In addition to adaptation measures to address the growing contribution of non-programmable renewable sources, measures are also needed to strengthen the electricity exchange in the country between north and south, as well as the connections between the mainland and Sardinia, where energy security is particularly delicate as a result both of the closure of electricity production plants requiring a new electrical connection and of the launch of the island's methane infrastructure.

The interventions envisaged for the gas system in the transition phase towards decarbonisation are a concern not only for Italy but also for European supplies. In fact, Italy is in a position to become a strategic gas hub for the rest of Europe. Under this strategy, the completion of the TAP (Trans-Adriatic Pipeline), on which work began in the first half of 2016 to bring gas from the Caspian Sea region, is important because it will increase the diversification of supply routes throughout the European market. The

Poseidon gas pipeline will also connect new Mediterranean deposits in Greece and the EastMed Pipeline[4] with the Adriatic line.

The idea that the transition from fossil fuels to renewables requires a transition period involving the use of gas and the strengthening of the related infrastructure is a source of debate and is opposed by those who believe that the huge investments planned for gas are diverting resources from the development of renewables and who see it as a conservation of the fossil fuel system. In any case, it should be noted that the question of gas is very complex and, as mentioned above, going beyond national borders, it also represents a (thorny) issue in energy geopolitics.

Another delicate issue is employment. On the one hand, the development of renewable energy and energy efficiency has the effect of stimulating the development of the industrial system and national production chains (that were lacking in the initial phase of the growth of renewables). The NES foresees the creation of 150 thousand temporary jobs a year and 80 thousand permanent posts, even if most of these are in maintenance. On the other hand, the considerable development of renewable energy and improvements in energy efficiency, with the resulting contraction in electricity consumption, has produced the effect of a 'downsizing' in thermoelectric capacity: in 2012 alone, there was a reduction of 15 GW while reserve margins dropped from thirty per cent to ten per cent in the period 20122014.

The problem facing workers (both directly and indirectly employed) at energy sites which are being decommissioned therefore becomes central. The productive reuse of sites does not just involve the thermoelectric sector but also the refining industry which will continue to be affected by the decline in the consumption of traditional fuels, no longer as a result of economic crisis but of the demand for new environmentally-friendly fuels and new carriers. Furthermore, this implies an evolution of refineries in the direction of biorefineries and an increasing use of sustainable biofuels and LNG (liquefied natural gas) instead of petroleum derivatives.

It is precisely the context of the planning of employment and the industrial future of those sites that have reached the end of their life cycle, with the relocation of the 'excess' workers engaged in traditional generation, that the Enel case study is all about. This case study represents an attempt to build a model to deal with reconversion, based on dialogue and collaboration between the company and the trade unions.

4. A planned on-offshore pipeline system aimed at distributing natural gas present in a complex of deposits located in the easternmost area of the Mediterranean Sea (Cyprus, Greece and Israel).

3. The Enel case[5]

3.1 History: from public body to multinational company

Enel is the largest company in the Italian electricity sector and one of the leading companies in Europe in terms of installed capacity and reported EBITDA,[6] as well as one of the main integrated global operators in the electricity and gas sectors. The history of this company is an integral part of the development of industrial and social relations in Italy from the period following WWII (Leonardi and Zito 2018).

Originally an acronym for Ente Nazionale per l'energia Elettrica (National Electrical Company), Enel was founded in 1962 as a legal public entity following the nationalisation of the electricity sector, bringing together almost 1,300 local companies set up at the beginning of the twentieth century to supply energy to the cities and regions of Italy. The task was to complete the electrification of the country and connect the national electricity grid to that of the rest of Europe.

In 1953, Eni-Ente Nazionale Idrocarburi was also born as a *de facto* monopoly in energy supply (in the methane gas sector).

The objectives that contributed to the choice in favour of nationalisation, leading through the 1980s to the presence of large, vertically-integrated energy companies under public ownership and a consequent territorial monopoly, were two-fold. One was to guarantee universality of service and a single user tariff per band; the second to achieve the greatest technical and managerial efficiency with the required level of financial resources in view of the major investments necessitated by the huge growth in energy demand during the period of post-war reconstruction (Ires 2008).

Since the 1990s, these objectives having been achieved and following the trend of downsizing the public sector and the opening up to market competition of those sectors which had previously been excluded (for example, services), the processes of liberalisation and privatisation began including in the electricity and gas sectors where the public hand was particularly prevalent.

Thus, in 1992, Enel was transformed into a joint-stock company wholly owned by the Treasury and then privatised in 1999. The reasons for this choice were to make the service system as efficient and competitive as possible, but also to help the state budget through the exploitation of the assets of those economic bodies operating in public utility services (i.e. both Enel and Eni in the energy sector) (Ires 2008).

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5. In the realisation of the case study on Enel, various methods and techniques of detection were employed: analysis of legislation, of collective bargaining and of the official documents of the social partners; secondary analysis of quantitative data; and in-depth interviews with experts and key witnesses including national and local representatives of the trade unions (specifically those federations operating in the energy sector and the heads of areas and departments of the Italian General Confederation of Labour: Energy and Networks, Economy and Development) and, for the Enel group, Enel's industrial relations manager and the Enel Futur-e project manager.

6. Earnings Before Interest, Taxes, Depreciation and Amortisation.

The liberalisation of the national electricity market, governed by Legislative Decree 79/1999 (the Bersani Decree) and Law 239/2004, forced the companies to separate the various stages of their supply chains, carrying out a process of both corporate and accounting unbundling. The revolution brought about by the liberalisation processes and unbundling led to a considerable amount of reorganisation affecting the functions of buying and selling to customers, the centrality of the relationship with the citizen-consumer, a new relationship with the economic regulator and the evolution of IT systems related to electronic meters as well as smart grids, metering and billing.

In 2001, two years after the Bersani Decree regarding electricity distribution and one year after the Letta Decree regarding natural gas distribution (Legislative Decree 164/2000), and after long negotiations, the single contract for electricity and gas/water workers was born. 'A shared house for workers in the two sectors,' with the same rules for all, was the aim of the single contract as a means of avoiding competition in the energy sector becoming based on labour costs and not on the quality and reliability of services (Ires 2008: 82). The aim for the social partners was to avoid the practice of geometrically variable rights and protections, dependent on the geographical location of the companies or their properties, whether public or private (Ires 2008).

In 2001, Enel also began a process of internationalisation that led the company to expand in Spain, Brazil, the United States and Latin America. The Italian state, through the Ministry of the Economy and Finance, remained the main shareholder with 23.6 per cent of the share capital.

Currently, the Enel group is present in 35 countries on five continents; it produces energy through a managed capacity of more than 89 GW; distributes electricity and gas through a network that extends for about 2.2 million km; and has almost 73 million end-users around the world. The group produced around 249 TWh of electricity overall in 2017, distributed 445 TWh over its networks and sold 284 TWh. Its revenues amounted to €74.6bn and ordinary EBITDA came to €15.7bn. The group also sold 11.7bn cubic metres of gas.

This multinational company employs about 69,000 people all over the world, half of whom are in Italy.

Today, Enel is the most technologically diversified company operating in the global renewables sector. It manages some 43 GW of energy coming from water, wind, geothermal, photovoltaic and biomass plants. In 2008, Enel Green Power S.p.A. was founded with the aim of grouping together the worldwide interests of the Enel company in renewable energy.

Almost one-half (46 per cent) of the electricity produced by Enel has no CO_2 emissions, thus making the group one of the main global producers of clean energy (Enel 2016).

3.2 The organisational model and strategic innovation in Enel

In 2012, by virtue of the supranational dimensions of the group, Enel assumed the 'One Company' organisational model, understood as a unitary and shared production system which, while acknowledging local characteristics, allowed the construction of a common Enel identity in all the countries where the company operated. This model was aimed at the promotion of a system of relations marked by a participatory work culture based on respect for human rights, safety and a recognition of the value of workers and their representatives.

Starting in 2016, Enel then assumed a new global corporate identity, moving from the 'One Company' model to the 'Open Power' strategy. This was in response to the rapid evolution of the energy system characterised by innovation, sustainability and dynamism, embracing the concept of 'opening up' to new technologies, new investments and new partnerships. It can be seen as the keystone of the strategic and operational approach of the group and particularly capable of 'driving the energy transition', as indicated in the company's new brand strategy.[7]

In terms of innovation, it is worth pointing out that, in addition to the push towards a transition to renewable energy, digitalisation is the other key factor in the energy revolution in which Enel is also investing heavily. This includes network/asset generation, back office processes, contacts with customers and relations with stakeholders towards the development of new products and services (electric mobility, home automation) generated by the evolution of information systems and platforms.[8]

It also needs to be remembered that Enel is considered a leading company at international level for having introduced electronic meters, with the first replacements having taken place in 2004-2005. Currently, the company has already started to install a new generation of meters with the industrial plan to change 32 million by 2021 and over 40 million by 2031.

Finally, another fundamental axis of innovation on which the company is focused is the electric car in the context of the strong push towards electrification.

During its almost sixty years of history, Enel has undergone various types of restructuring: privatisation; outsourcing of certain functions and phases; plant closures; internal reorganisations; and trans-nationalisation with important consequences for employment and the management of human resources.

In particular, in recent years, after the economic crisis of 2008, Enel announced and implemented a large-scale new restructuring process and drastic downsizing with significant reductions in jobs. The main reasons for this restructuring were

7. https://corporate.enel.it/it/mdia/press/d/2016/01/lanuova-enel-un-brabd-open-power
8. On the significant implications for human resources management systems and for national and company bargaining in Italy produced by the application of digital technologies in the electrical sector at work, see Neirotti *et al.* (2018).

the reduction in demand, due to the decline in industrial and domestic electricity consumption, increased competition in the sector and the closure of obsolete plants that did not comply with recent environmental regulations. These changes had led to an 'overcapacity' in production and, consequently, the need to reduce workforce numbers.

It is in this context that a plan for the decommissioning of old thermoelectric plants was implemented. This has significantly reduced overcapacity with 23 power plants, representing a capacity of 13 GW, having been closed so far.

3.3 The Enel model of industrial relations and the role of social dialogue

The history of Enel is also important from the point of view of industrial relations.

In this regard, what stands out is the presence of a solid system of industrial relations featuring structured contractual practice, high levels of unionisation and relations that tend not to be conflictual between the parties, in part due to the search for constant dialogue both in terms of bargaining and in terms of information and consultation (Leonardi and Zito 2018).

An innovative approach and the ability to manage and anticipate change are also important, as witnessed by the new 'Open Power' operating model adopted by the group. Here, the constant commitment to reinforce the company's reputation for a strong self-image, achieved by the effective and shared management of the social, ethical and environmental impact of the production cycle on the territories and communities involved, as well as within the company itself, is also important. One key application of this approach appears in how the closure of the 23 thermoelectric power plants, due to reasons of economic and environmental sustainability, has proceeded. Enel's related 'Futur-e' project, dedicated to the redevelopment of these assets, including also the reclamation of a mining area (Santa Barbara), also reflects these values.

Over time, the Enel model of industrial relations has led to a nurtured and innovative system of agreements – elaborated below – which have made it possible to manage the economic and social questions posed by the profound and continuous changes in the energy sector, starting with the relocation and retraining of the personnel who worked in the old thermoelectric plants.

In 2012, Enel and the Italian trade union federations in the energy sector (FLCTEM-CGIL, FLAEI-CISL and UILTEC-UIL) signed a Protocol on National Industrial Relations in the Enel Group, replacing the one in force since 1 December 2003. This regulates relations between the company and the trade unions and single trade union representatives.

The new system takes decisive steps forward in terms of adapting to the changed corporate (multinational) and market contexts through:

— a major advance in the participation of the union with respect to industrial guidelines, establishing an industrial relations ‘control room’ with regard to strategic business processes;

— a strengthening of pre-emptive meetings regarding company decisions, with particular reference to reorganisation/restructuring;

— implementation of bilateralism through the establishment of specific committees on: economic and market scenarios; training and employability; safety and protection in the workplace; corporate social responsibility; corporate welfare; equal opportunities; and conciliation. At regional level, the establishment of similar safety and job classification committees is envisaged; at regional/territorial level, a committee on economic scenarios in the energy market may also be employed to resolve possible local problems/situations;

— greater involvement of the single trade union representatives, also through coordination at national and territorial level;

— strengthening the role of the trade unions in the monitoring of professional skills (a process which takes place every six months) as a part of the revision of the job classification system in order to represent more effectively the relationship between job title and activities given the rapid nature of occupational evolution.

In this new model of industrial relations, social dialogue takes place at local level through the regional secretary of the union federations in the energy sector and the single trade union representatives responsible for each individual production unit; while at corporate level it is managed by the human resources department. The agreement also emphasised the need to create an ‘International Industrial Relations Protocol’.

On 9 May 2013, given over-capacity and the announcement by Enel of about two thousand redundancies, and after long negotiations with the trade unions (FLCTEM-CGIL, FLAEI-CISL and UILTEC-UIL), the Agreement for Early Retirement and Intergenerational Solidarity was signed. This Agreement, using the so-called ‘Fornero Law’ (Law No. 92/2012) on the reform of the labour market and pensions system, provides for some sort of ‘generational relay’: incentives to leave or retire for a large number of people, in production as well as distribution areas, in order to make room for new staff (Di Nunzio and Pedaci 2015). According to the Law, the agreement establishes that the company can offer early retirement to its employees, as long as it is entirely at its own expense. In the face of these retirements without penalties, and in agreement with the social partners, a turnover in labour was expected based on the employment of workers aged between 18 and 29 through vocational apprenticeships, with these workers being allocated mainly to operational, technical-specialist and commercial positions. Between 2013 and 2014, this Agreement allowed about five thousand workers to retire early, creating the conditions for the recruitment of almost three thousand younger people.

With regard to the issue of the employment of young people, the social partner-based initiative also included an agreement defining a pilot programme for apprentices alternating between school and work, aimed at students in the fourth and fifth years of technical institutes. Signed on 13 February 2014, this has allowed the entry of additional young personnel into the company.[9]

At the same time as the signing of the agreement under Article 4 of the Fornero Law, in 2013, the complementary Agreement on the Functional, Geographical and Intra-group Mobility of Employees (Redeployment) was also signed. This aimed to ensure the internal employment stability of the Enel group in the phase of profound economic change dictated by the energy transition. It sought to regulate occupational retraining and the relocation of surplus personnel in traditional energy generation to other business units in the company.

In terms of social dialogue, redeployment is part of a national discussion with the secretaries of the union federations on the issues of business strategies and changes in the organisation of work and staff, based on various economic and transformation scenarios. This is followed by a joint analysis at local level of the skills and qualifications of individual workers and of the specific prospects for relocation to other parts of the group of the workforce in the old thermoelectric plants who are deemed surplus. Here, flexible criteria are set based on geographical proximity, propensity to change, attitudes and skills, and in order to ensure the stability of employment within the group (Cofacci 2018).

A central aspect is taken by the company's training plans, designed especially in the context of workers' lifelong learning to respond adequately to the need for the continual updating of the skills demanded as a result of technological innovation processes and the digital revolution. These have been elaborated by Enel but are the subject of discussion by the Bilateral Committee on Training and Employability envisaged under Enel's industrial relations protocol (Cofacci 2018).

To deal with the adaptation of the industrial plan to the new strategic divisions of Enel, and in respect of planning up to 2020, intense negotiations took place in 2015 on the renewal of the agreement on redeployment, giving rise to an additional set of agreements with the trade unions.

In particular, the Protocol on Competitiveness, New Energy Scenarios, Innovation and Sustainable Development, with respect to new investment needs in renewables and the 'crisis' situation in conventional generation, provides for the regular provision of

9. Regarding the 'generational relay' agreement, it should be noted that if, in the Italian scenario, the agreement represents an interesting experience that has had important positive effects, reducing the social impact of restructuring, allowing the turnover of labour, supporting youth employment and enriching via work experience the paths of study of many graduates, it has also to be emphasised that, while the workers taking early retirement are permanent employees, with permanent contracts and good working conditions, the new workers are being hired in the company on atypical contracts (three-year apprenticeship contracts) and are, therefore, a more flexible workforce, with lower salaries, than the outgoing workers. For a discussion of the Enel 'generational relay' agreement, see: Di Nunzio and Pedaci (2015).

information and the involvement of the trade unions in the joint management of the redeployment and retraining of workers. The intention is to guarantee the greatest possibility of re-employment in those company areas that have absorption capacity.

Finally, a new agreement was reached on the application of Article 4 of the Fornero Law, also for the period from 2016 to 2020, allowing for the early retirement of people who will continue to accrue pension entitlements in the four years following the termination of the employment relationship. 'This lever will allow the entry of new resources and the profitable re-utilisation within the group of all employees involved in the process of relocation and geographical/professional mobility (redeployment)' (Cofacci 2018). In this way, a recruitment plan has been defined for the timeframe 2016-2020 based on generational turnover (early retirement and new staff – again through professional apprenticeships – of about three thousand young people) which ensures a turnover in professional skills.

3.4 The transnational dimension of industrial relations and social dialogue at Enel

The culture of industrial relations, based on cooperation with workers' representatives on the issues raised by the business strategies and economic scenarios arising from the energy transition, is also applied in the transnational dimension to Enel's activities.

European Works Council (EWC)

At European level, in 2008, a European Works Council (EWC) was set up for the first time in an Italian electricity company. The EWC, for which the agreement was subsequently renewed in 2011 and then again in 2016, meets twice per year and is made up of delegates from those European Union countries in which the company is present: eleven are from Italy; four from Spain; three from Slovakia; and two from Romania. A select committee consists of a coordinator and four other members and meets four times per year. Joint training activities are planned, decided by the management and the select committee. The Enel EWC played a leading role in the signing of an international framework agreement on, and then in the establishment of, the Enel Global Works Council in 2013.

From the point of view of the European social dialogue, the declaration of the commitment of the European social partners (i.e. Eurelectric – The Union of the Electricity Industry; and IndustriAll Europe and EPSU – the European Union of Public Service Unions) on the themes of just transition and employability resulted in November 2017 on a joint statement on 'Just Transition'. This established a shared desire and commitment responsibly to manage the social impacts of transition by foreseeing employment crisis situations, investing in training and reskilling, and supporting the development of employment connected to the industrial processes of energy transition so that they are green jobs, but also decent ones. It also envisages the provision of support measures for those companies, regions and local communities that are linked to carbon-intensive activities in their process of adapting to the green agenda.

The Global Framework Agreement

On the global level, a Global Framework Agreement was reached in 2013 with the international trade union federations IndustriAll Global and PSI (Public Services International). This is currently being renegotiated with a view to an extension corresponding to the global expansion of the group after its merger with Endesa, a Spanish multinational company in the sector (including EU countries, Russia and Latin America).

The Agreement, in addition to respecting fundamental rights of work in all areas in which it operates,[10] is characterised by the centrality of the theme of industrial relations compared to those of corporate social responsibility. The Global Framework Agreement is, in fact, a system of information and consultation which integrates normal negotiating practice, expanding the scope of the issues to be examined and the achievable objectives.

In particular, the parties have agreed to implement a group-wide industrial relations policy with the following main objectives:

— to inform the trade unions when group-wide strategies are being implemented, including procedures and deadlines;
— to establish guidelines to achieve a better balance between business objectives and employee expectations in terms of clarity, ease of implementation and effectiveness;
— to prevent and manage disputes in a reasonable manner, with due respect for the responsibilities of each party, customer needs and quality of service.

The Agreement establishes guidelines for social dialogue, which is considered to be the pre-eminent approach for addressing issues affecting the interests of the company and its employees. The measures include the creation of the Global Works Council as well as multilateral committees.

The Global Works Council is a body for information and consultation representing all the employees in the Enel Group. It has no negotiating role and neither is it a second forum for issues dealt with at national level. The Global Works Council has established three thematic multilateral committees focusing on: health and safety; training; and equal opportunities. These are joint bodies whose role is to ensure the application of the principles contained in the agreements.

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10. In 2004 Enel, as a member of the United Nations Global Compact, signed the group up to the ten universal principles on human rights, labour, the environment and the fight against corruption. The Global Framework Agreement affirms the relevance of respecting these fundamental principles in line with the UN's Universal Declaration of Human Rights and its Guiding Principles on Business and Human Rights, the basic conventions of the International Labour Organization (ILO), the ILO's Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy, the UN Global Compact and the OECD guidelines on Multinational Companies and Country-Specific Regulations.

With regard to this model of transnational company agreement, the greatest challenges remain those of monitoring its concrete application at local level, especially in contexts characterised by a less advanced development of the social partners and in the social dialogue, as well as the promotion of a more inclusive representation of local unions in countries where the company is present.[11] Another problematic aspect is the risk that the tools of global social dialogue tend to become, as observed by one interviewee, 'A kind of appeal court for local issues,' given the difficulty in finding agreed solutions in local situations which have very different collective bargaining tools.

Interest in the agreements signed by Enel at global level and in Italy has led the ITUC, engaged globally on the themes of just transition, to involve the Enel group in defining guidelines for multinational companies in the management of the energy transition. This was published in 2018 on the B Team website (a network of large companies in various sectors committed to a better, more sustainable, way of doing business) and by the ITUC's Just Transition Centre.

3.5 Enel's *Futur-e* project: from the closure of plants to rebirth with new uses

In Italy, the agreements between Enel and the trade unions for a 'participatory' management of reorganisation processes in the face of the energy transition, and on the security of employment levels and employability, have found an important first application in the management of the closure of thermoelectric power plants and their redevelopment. This has been via the circular economy project known as *Futur-e* which is aimed at identifying new sustainable development opportunities on all these particular sites (see Figure 4).

Up to now, all the workers who had been employed in traditional generation in the plants which have now been closed have been relocated on a voluntary basis, thanks to the joint work of the company, the union and the people concerned.

In addition to encouraging generational change through the Agreement on Early Retirement and Intergenerational Solidarity, a sort of internal labour market for the group was created in the wake of the instruments developed on redeployment in 2013 (and renewed in 2015). Enel was faced with employment surpluses in some sectors and took the responsibility of searching, through its HR structures in all its business lines (globally, nationally and regionally), for potential relocations of these workers in branches of the business with greater development prospects. Staff transfer and re-employment are managed in such a way as to find a balance between the needs of the receiving organisation and the characteristics and expectations of the people being relocated, with the latter accompanied by a process of retraining and technical training. 'Employability' and 'lifelong learning' are, therefore, the two keystones of this relocation and redevelopment process.

11. In this regard, see the contribution by Leonardi and Zito (2018) on the group transnational agreements signed in Enel and Eni.

The internal labour market that brings together those in the group who are looking for human resources and those who are having to relocate them can, therefore, also transcend national boundaries. This is the case both by virtue of the multinational nature of the company and considering that the elevated technical and professional know-how of Enel workers represents a wealth of knowledge that is transferable to business functions abroad.

At the centre of the debate on the social consequences of the transition from traditional energy sources to renewable ones, however, there is a concern not only with the protection of 'direct' workers. Concern is also present about the impact of such decisions on satellite activities and, therefore, the problem of employment loss in local communities the development of which had been closely linked to the presence of the plants that have now been decommissioned.

The Futur-e *project*

It is this second aspect which is addressed specifically by the *Futur-e* project, launched in 2015, for the redevelopment of Enel assets that have reached the end of their useful life. Once the problem of internal workers has been resolved upstream, a site conversion programme begins based, in the majority of cases, on a 'competition project'.

The basic idea is that, for any new investment project, instead of exploring new locations to build from scratch, to consider whether it would be possible to re-use existing assets (which have the advantage of being already perfectly connected to infrastructure, waste networks and the electricity grid), through the circular concept of 'using one structure to make another'. From this point of view, according to the company, the *Futur-e* project can also be exported to other countries because it is applicable in all those situations where there is a problem of unused assets, including in other industries. What is also apparently replicable is the process which has been developed by Enel to manage the redevelopment, the main stages of which are described below.

The first step – introduced with the recent inclusion of a twenty fourth site into the *Futur-e* project, the Santa Barbara area which, as a former mining area, is a very different asset from the 23 thermoelectric power plants[12] – is to hold a preliminary phase in the project competition which aims immediately to ensure the involvement of all local stakeholders. This is represented by an initial exploration of the ideas and demands from within the area, carried out by interviews with a wide range of local stakeholders (local institutions, environmental associations, trade unions and entrepreneurs in the area), to seek suggestions from those who live in and know the territory about what they consider to be the most suitable ideas for its redevelopment. In this way, instead of basing the conversion on external ideas from participants in the competition, a bottom-up approach is used which aims to provide precise indications

12. Moreover, the inclusion of the Santa Barbara area more than doubles the portion of Italian territory involved in *Futur-e* considering that this site alone has a surface area of 1,600 hectares on top of the total of 1,300 occupied by the 23 thermoelectric plants.

in the tender on the sorts of project proposals which would be most welcomed within the community.

Subsequently, a project competition tender is launched, in which participants are asked to propose a winning idea, accompanied by a full-blown project proposal complete with business plan and an assessment of the expected social impact (in terms of jobs and related activities in the territory). The project proposals are evaluated by a judging panel including local institutions (regional and municipal), in conjunction with the local university and the Polytechnic of Milan, Enel's technical partner in the *Futur-e* project. The technical evaluation considers the suitability of the proposals based on the quality and innovation parameters of each one, as well as their application of the concepts of the circular economy and their environmental, economic and social sustainability. Only those projects found suitable at this point move to the scrutiny of economic evaluation which, if accepted, is followed by negotiations, preliminary contracts of sale and, from then on, by preparatory activities for the implementation of the redevelopment project (possible reclamation, demolition, etc).

Of the 23 thermoelectric plants in question, nine have already begun a conversion plan. With regard to the type of redevelopment project, the proposals involve various ideas for the re-use of facilities such as tourism/hospitality, biotechnology centres, multifunctional centres, exhibitions of local food and wine, recreation centres for older people, etc. Some of the sites have been reconverted internally: for example, for the Carpi site (a turbogas plant that extends over an area of 76 thousand square metres) and for part of the Trino site (a plant of about 90 hectares, of which 24 are home to the decommissioned plant), it was decided to create two centres to optimise the internal logistics of the Enel group.

Generally, however, there is a tendency to favour diversification as a means of avoiding single customers, especially in the larger areas. In this sense, going back to the examples above, for the remaining part of the Trino site a redevelopment proposal has been made for a theme park dedicated to the automotive industry – with research labs for electric cars and a dedicated area with charging stations, parks, spaces for innovation and services – to which is also added a section for innovative agriculture. Many of the sites currently included in the *Futur-e* project are also in areas characterised by a rich natural heritage, as in the case of the Piombino plant, which is a site of national interest. For its redevelopment, a multi-functional project has been envisaged: a tourism-hospitality, commercial and innovative agriculture site and, if authorisation is obtained, the redevelopment of a marina as well.[13]

According to the company, one of the most significant challenges for the *Futur-e* project, especially in its next stages and considering that the number of sites to be redeveloped will grow in Italy as well as abroad, is the need to attract a wide range of strong investors and developers, including foreign ones. In fact, this appears to be a

13. To find out about the various redevelopment proposals for the sites, which are very different to each other, the *Futur-e* website can be found at: https://corporate.enel.it/it/futur-e fundamental condition for success in redeveloping all the plants that will have to be decommissioned, bearing in mind that, in Italy, some of the most problematic plants, such as those that use coal where closure plans have been brought forward to 2025, have still to be shut down while the 'carbon zero' target involves the decommissioning of all currently active plants by 2050. However, this requirement clashes with a number of obstacles that risk discouraging potential investors, especially foreign ones, such as the long time required to obtain permissions.

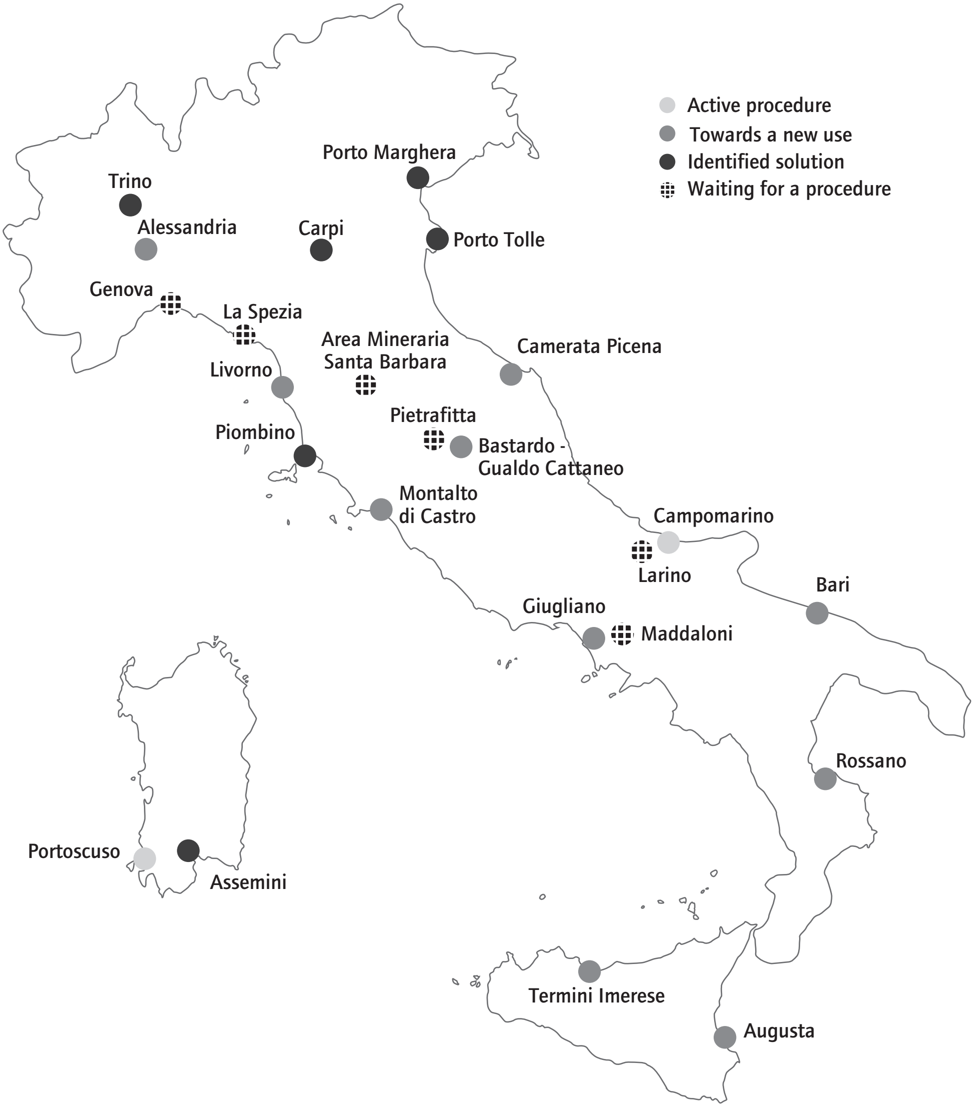
With regard to the *Futur-e* plan, the position of the trade unions has highlighted some critical issues. The trade unions have proposed a gradual programme for the shutting down of some plants and, for others, a review of the reduction/adaptation process. More generally, the trade unions have criticised a lack of information and low involvement in these processes with respect to which, as mentioned, the involvement of the locality has now been strengthened by the attempt to listen to all local stakeholders regarding their ideas for redevelopment, even in the face of possible conflicts at local level.

'To this end it is necessary, at every institutional level at which decisions are made on the matter, to define the means of participatory democracy and the active involvement of local people, workers and social partners.' (FILCTEM-CIGL *et al.* 2017: 12)

In respect of sites where functions have been reduced but not shut down, the unions have reported problems related to work overload due to staff reductions and increased health and safety risks. In addition, the trade unions have criticised the outsourcing of activities by tender. In their joint note (FILCTEM-CIGL *et al.* 2017), the unions have proposed in response:

— increased use of phased withdrawal in the process of the disposal and/or reduction/adaptation of plants;
— new investments in some plants to make them more flexible and adaptable to the needs of the market;
— the insourcing of activities;
— recruitment taking place appropriately in advance so as to allow the adequate passing-on of experience between those leaving and those starting work with Enel.

Figure 4 **Map of the existing sites included in the *Futur-e* project, as of 2019**



Source: Author's processing of a map taken from the Futur-e project website, https://corporate.enel.it/it/futur-e

4. The challenges of the near future: concluding notes

It is evident from this case study that the presence of a solid system of industrial relations, with strong unions, historically non-conflictual relations between the parties and an elevated propensity to seek negotiated solutions, is fundamental to the success of the agreements on redevelopment and restructuring in Italy. These aspects must be taken into account from the perspective of the replicability of the experiences of Enel in other contexts – something which is partly already inherent in the multinational nature of the group. The export of such practices has to take into account local specificities and be supported by *ad hoc* plans tailored to individual situations (Cofacci 2018).

However, even at national level, the energy transition path being managed by Enel has many challenges to face in the near future that could put a strain on the ongoing dialogue between the social partners that has, so far, been a positive characteristic of the reorganisation and relocation processes. Moreover, it should also be borne in mind that 2019 is likely anyway to be a very challenging year for the maintenance of the instruments and social dialogue which have been built up in Italy, since this is the year of the renewal of numerous agreements: the collective agreement in the sector, at national level; but also agreements that affect both the European Works Council and the Agreement on the global version.

The closure of all the plants, beyond those already decommissioned, has to be measured in terms of the compatibility of the plan with the problems of network security and system stability and, in particular, with the choice to bring forward to 2025 Italy's abandonment of coal. In such a case, it is the largest plants – for example Brindisi and Civitavecchia – which will have the greatest impact on the territories in which they are located, and which also represent the economic driving force behind those areas. Therefore, their disposal requires careful planning in spite of the short time available.

The commitment of the company and the trade unions up to now has demonstrated that even the use of all the possible tools available to underpin job security is not sufficient to manage the full set of consequences that plant closures have for satellite activities. This requires greater involvement at institutional level.

The success of the redevelopment processes, and of the energy transition in general, requires greater integration between company and public policies. Only complex planning, both public and private, is able fully to translate the redevelopment of entire portions of the territory of Italy into opportunities for a productive and occupational renaissance.

Within this framework, the national planning and coordination capacity of all the involved parties are fundamental factors which must accompany the transition to the new energy paradigm.

Furthermore, the complexity of the reorganisation processes involved in thermoelectric production will, on top of the reorganisation processes within the network itself, have increasingly to deal with the reorganisation of the market, considering in this regard the passage – now close – to full liberalisation with the elimination of the standard offer regime scheduled for 1 July 2020.

Ultimately, there appears to be, on the one hand, a need for the effective coordination and planning of the energy transition in the context of a clear strategy at national level; and, on the other, the strengthening of social dialogue at all levels as a decisive factor in producing a just transition, in the light of the great potential that this has as a form of governance in the transition to a low-carbon economy (ILO and ITUC 2016; ETUC 2017).

Social dialogue can, in particular, play a crucial role in ensuring that the emerging energy alternatives are inscribed in profound social change capable of combining employment development, reducing climate-altering emissions, combating poverty and protecting workers and the territories to which they belong in the transition from traditional energy sources to renewable ones.

References

BROAD (2017) Building a social dialogue for sustainable construction: final report of the transnational 'BROAD' project December, DG Employment and Social Affairs Agreement No. VS/2015/0328. http://www.fondazionedivittorio.it/sites/default/files/content-attachment/BROAD%20-%20FINAL%20REPORT%20V.1.2.pdf

Carrosio G. (2016) La transizione energetica in Italia: tra strategie di conservazione e comunità emergenti, 31 March 2016. https://www.energiafelice.it/la-transizione-energetica-in-italia-tra-strategie-di-conservazione-e-comunita-emergenti/

Cofacci C. (2018) Il ruolo del dialogo sociale nella transizione energetica, Opinioni, 5 (1-2), 40-46.

Di Nunzio D. and Pedaci M. (2015) Vulnerabilità dei giovani e contrattazione collettiva : alcune esperienze nel settore dell'energia, Quaderni di Rassegna Sindacale - Lavori, 16 (4), 93-110.

Enel (2016) Seeding Energies. Sustainability Report, Enel, Rome.

European Commission (2018) Clean Energy for all Europeans. https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

Eurostat (2015) SHARES - Short Assessment of Renewable Energy Sources. https://ec.europa.eu/eurostat/web/energy/data/shares

FILCTEM-CGIL, FLAEI-CISL and UILTEC-UIL (2017) Nota incontro Enel, Joint document of the trade unions, February 2017.

Galgóczi B. (ed.) (2012) Greening industries and creating jobs, Brussels, ETUI.

GSE (2018) Rapporto statistico 2017: energia da fonti rinnovabili in Italia, Rome, Gestore dei Servizi Energetici.

Guarriello F. and Stanzani C. (eds.) (2018) Trade union and collective bargaining in multinationals: from international legal framework to empirical research, Milan, FrancoAngeli.

ILO (2017) Guidelines for a Just Transition towards environmentally sustainable economies and societies for all, Geneva, International Labour Organization

ITUC (2017) Just Transition – Where are we now and what's next? A guide to national policies and international climate governance, ITUC Climate Justice Frontline Briefing 2017, Brussels, International Trade Union Confederation

Ires (2008) Il sistema energetico italiano: vincoli ed opportunità, Rapporto di Ricerca, Bologna, Istituto di Ricerche Economiche e Sociali.

Ires (2010) Lotta ai cambiamenti climatici e fonti rinnovabili: gli investimenti, le ricadute occupazionali, le nuove professionalità, Rapporto di Ricerca, Bologna, Istituto di Ricerche Economiche e Sociali.

Ires (2012) La trasformazione dei settori dell'energia elettrica e gas e del servizio idrico: sviluppo dei profili professionali e implicazioni per la formazione, Rapporto di Ricerca, Bologna, Istituto di Ricerche Economiche e Sociali.

Leonardi S. and Zito M. (2018) I TCA di Eni ed Enel ENI and ENEL TCAs, in Guarriello F. and Stanzani C. (eds.) Trade union and collective bargaining in multinationals: from international legal framework to empirical research, Milan, FrancoAngeli, 152-180.
MISE (2018) La situazione energetica nazionale nel 2017, Roma, Ministero dello Sviluppo Economico, Direzione generale per la sicurezza dell'approvvigionamento e le infrastrutture energetiche. https://www.mise.gov.it/images/stories/documenti/MiSE-DGSAIE_Relazione_energia_ed_appendici_2018.pdf
Neirotti P., Spaziani A. and Zaghi A. (2018) Dagli elettroni ai bit : le trasformazioni del lavoro nel settore elettrico, Torino, Politecnico di Torino. https://www.elettricitafutura.it/public/editor/Servizi/NF/2018/Dagli%20Elettroni%20ai%20Bit.pdf
Rugiero S. (2011a) Dimensioni socio-culturali dello sviluppo del fotovoltaico: un'indagine esplorativa sull'autoproduzione di energia, in Struffi L. (ed.) Crisi economica, crisi ambientale, nuovi modelli sociali, Atti del VII Convegno Nazionale dei Sociologi dell'ambiente, Trento, Università degli Studi di Trento 159-176.
Rugiero S. (2011b) Lo sviluppo delle energie rinnovabili in Italia: nuova occupazione e green jobs, in Guandalini M. and Uckmar V. (eds.) Green Italia: la rivoluzione verde è adesso, Milano, Mondadori Università.
Rugiero S. (2012) Public funding for green energy in a context of crisis: country report Italy, Report 130, Brussels, ETUI.
Rugiero S., Di Nunzio D. and Bormioli S. (2018) Building a social dialogue for sustainable construction, Rome, Ediesse.
Struffi L. (ed.) (2011) Crisi economica, crisi ambientale, nuovi modelli sociali, Atti del VII Convegno Nazionale dei Sociologi dell'ambiente, Trento, Università degli Studi di Trento.

Chapter 5
An attempt at preventive action in the transformation of coal-mining regions in Germany

Stefan Gärtner

Introduction

Regional structural policy (*Strukturpolitik*) – a cross between sectoral adjustment or cohesion policy and industrial or regional policy – is a very German concept. Regional and sectoral structural change cannot be viewed independently of one another, as industries are typically not evenly distributed across the regions. This applies especially to the lignite and hard coal areas of Germany and Europe, which are concentrated in specific regions. For example, for many years, the hard coal industry in the Ruhr area and the Saarland, and lignite coal in the three lignite-mining districts,[1] were connected environmentally, culturally and economically with their respective wider regions. The phasing out of coal will bring structural change to the regions affected. Depending on the social and political model, the state will step in to support the regions through structural policy interventions. Structural policy cannot (and will not) prevent structural change, but it does provide a framework to manage its consequences.

This chapter discusses Germany's experiences with structural policy focusing on the Ruhr area (but drawing also on the lessons of other regions) and identifies developments in structural policy and the positive and negative impacts they have had. In the following, the aims, objectives and limitations of regional structural policy are first discussed and the functioning of structural policy in Germany explained (section 1), before tracing the structural changes taking place in the Ruhr area (section 2). The third section describes the forthcoming challenges in opencast lignite mining areas in Germany, especially in remote Lusatia, next to the Polish border, and asks if structural change could be anticipated by action in advance. The differences in the requirements of shaping structural change in lignite coal areas, in contrast to those in hard coal areas, are discussed. The main difference is that change this time is not market- but policy-based. In the case of lignite, a lack of competitiveness is not the reason for the phase-out, as happened with hard coal, but political decision-making processes: the decision to phase lignite out of the energy source mix has been made by elected representatives in order to achieve climate policy objectives. We do not discuss this decision as such, but illustrate the process as an example of shared public responsibility for the areas affected. The end of mining and power generation from lignite needs to be accepted by shareholders and other stakeholders alike, and chiefly the unions, in order to facilitate

1. In Germany there are three major lignite districts: the Rhenish coal-mining district in North Rhine-Westphalia; the Lusatian coal district in Brandenburg and Saxony; and the central German coal district (around Leipzig) in Saxony and Saxony-Anhalt. A further smaller area – surrounding Helmstedt – closed down in 2016.

the perspective offered by advanced structural policy. As will be pointed out, in the Ruhr this approach was applied too late; furthermore, advanced structural policy is also more cost-efficient in the long-run.

In the last section, some points relevant both to the funding level and the local implementation level are presented.

1. The aims, objectives and limitations of regional structural policy

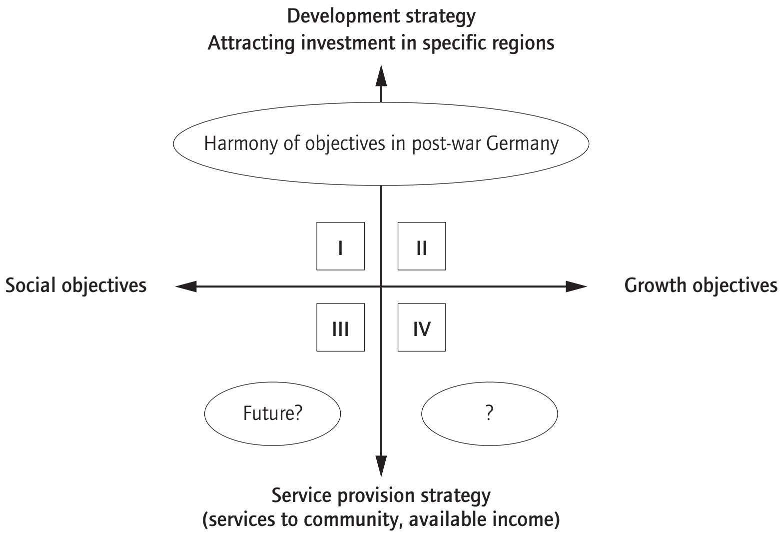
Structural change is generally understood as a change in the structural composition of an aggregate value (e.g. gross domestic product (GDP) or the workforce). From a sectoral point of view, it includes changes in the structure of industries while, from a regional perspective, it refers to shifts between individual regions.

Regional structural policy overlaps with other political topics. It is, therefore, used as a synonym for terms such as regional policy and regional economic policy (e.g. Fürst *et al.* 1976: 4; Eckey 1995: 815) and cannot strictly be separated from other policy areas. Regional structural policy has traditionally pursued the goal of balanced regional development. In Germany, securing equivalent living conditions across the federal territory (*Ausgleichsorientierte Regionalpolitik*) is enshrined in the constitution, making it a legal requirement. Article 72(2) of the Constitutional Law confers on the federal authorities the requirement to act or legislate 'If and to the extent that the establishment of equivalent living conditions throughout the federal territory or the preservation of legal or economic unity in the national interest require regulation by the federal law.' Article 106 of the Constitutional Law, which contains a provision on the financial equalisation of federal states in the event of imbalanced development, also affects the regions. Germany's Regional Planning Act similarly takes a position, with Section 1(2) requiring the establishment of 'Similar standards of living in all regions'. However, this position has been revised in one respect. After the unification of Germany, Article 72(2) of the Constitutional Law was changed from a position reflecting the *uniformity* of living conditions to one of their *equivalence* (e.g. Eickhof 2005: 2; Hahne 2005), creating greater scope for interpretation and action. It is, therefore, not a question of having the same living conditions but ones that are equivalent.

A key pillar of regional structural policy in Germany is the joint federal/*Länder* Taskforce for the Improvement of Regional Economic Development (*Gemeinschaftsaufgabe für regionale Wirtschaftsförderung*), which was introduced in 1969 for the purpose of coordinating the various levels involved in structural policy (federal, state and local government). The policy works by providing incentives to encourage investment in certain regions. As part of this policy to redirect investment, attempts have been made not only to divert investment in general towards structurally weak regions, but also to concentrate it there on particular contributors to growth (Becher and Rehfeld 1987). Since the 1980s, this policy has been expanded – as part of a policy of relying less on large corporations – by targeting the development of start-up and technology centres as well as networks between universities and research institutes.

The goal of balanced regional development towards which regional structural policy has been striving applies, as shown in the diagram below, either to socio-political or to growth objectives (along the horizontal axis). Regional structural policy can, therefore, be explained in both economic and socio-political terms.

Figure 1 **Regional structural policy aims and strategy**



Source: Gärtner 2009.

The socio-political objective (quadrants I and III in Figure 1) is the guarantee of equivalent living conditions for all citizens in all regions of Germany. When the focus is on growth (quadrants II and IV), on the other hand, the key question is in which region can the best overall economic returns be achieved. The neoclassical approach is that balanced regional development will ultimately be achieved on its own, i.e. growth in weak, backward regions will be stronger in the future, so investments in these regions would consequently produce the best overall economic effects. According to this school of thought, structural policy aimed at territorial equalisation accelerates the natural convergence process (Frey and Zimmermann 2005: 6) and is thus growth-oriented.

From the perspective of growth, another reason for establishing an equalisation-oriented structural policy is that the use of all potential resources in all areas helps achieve an optimal result for the national economy as a whole. Regional structural policy has, therefore, traditionally been focused on overcoming the urban-rural divide in the name of economic growth and social equality. Consequently, the structural development of the Ruhr area, as an old industrial agglomeration, has traditionally not been part of the focus of the regional structural policy of post-war Germany.

However, since the unification of West and East Germany – but also before this, taking the example of the Ruhr area and that of other old industrial agglomerations – a new territorial perspective has fallen within the scope of regional policy and the balance between growth and equalisation has had to be reconsidered. This has also been caused by an increase in international economic integration (in general terms known as globalisation) and by a stronger approach towards neoliberal market theory associated with the acceptance of regional inequalities and of differentiated growth patterns in agglomerations.

Generally speaking, as shown on the vertical axis of Figure 1, there are theoretically two main approaches to organising a regional equalisation policy. The first is to attract investment into structurally weak regions or to support the development of companies already operating in the area (development strategy: shown in quadrants I and II). The second is the provision of long-term support and services for people living in weaker areas and the subsidisation of central infrastructure or services of public interest, such as shops, education, health services, etc. (service provision strategy: quadrant III). Up to now, it is the development strategy approach that has dominated. As of today, however, the question remains open of whether – in respect of remote, old industrial areas like Lusatia (which is currently phasing out opencast lignite mining) – a service provision strategy (quadrant III) would be more suitable and, if so, what it would look like. If balanced regional development does not necessarily produce the best overall growth, it may be reasonable, in terms of cost efficiency, to shift to a policy of fostering development only in those areas with particularly high competitive potential (quadrant II) whilst continuing to provide long-term support for weaker areas (quadrant III). Quadrant IV is not particularly realistic since a service provision strategy will probably not by itself lead to strong economic growth in a region (hence the question mark adjacent to quadrant IV in Figure 1).

According to Lammers, regional policy is only worthwhile in national economic terms if 'The transfer it creates in the target regions produces economic returns in excess of the losses in those regions from which resources are removed' (Lammers 2004: 624). In this regard, a new understanding of equal living standards may be discussed from the proposition of increased focus on the quality of life experienced locally (Blotevogel 2006; Hahne 2005: 258). 'Equal living conditions,' according to Hübler, 'Are, however, not simply a question of jobs in industrial locations or clusters: the term "living conditions" covers a far broader set of factors' (Hübler 2005: 56; own translation).

Even so, regional structural policy has not, thus far, followed approaches that are appropriate for weaker peripheral regions, having focused instead more on quality of life and civic society. Rather, there has been a debate about the extent of the concentration of resources on regions with growth potential. Since the late 1990s, there has been a trend towards adopting new approaches and a greater focus within structural policy on growth. It is impossible to assess how fundamental this change turns out to have been in practice, or whether, in the long term, it will reduce or increase regional disparities (Blotevogel 2006). A focus on growth cannot be justified solely on the basis that weak and peripheral regions will benefit from a general growth-oriented policy or from one oriented towards metropolitan hubs via territorial spread and trickle-down effects.

There is, however, less discussion about what to do about those regions which do not have growth potential. The concept of Aring (2010), for instance, can be seen as exceptional in suggesting that regions should decide for themselves if they want to be 'guaranteed' by the state or at federal level, or if they want to become 'self-responsibility spaces'. In the latter case, a minimum level of support would be maintained, with additional services organised by the citizens themselves as well as by companies; this, in turn, would grant the regions and their populations a great deal of creative freedom to accept the offers they preferred. In contrast to Aring (2010), Kersten *et al.* (2015b) suggest a new joint federal/*Länder* taskforce, focusing on the improvement of those services which are of general interest in weak regions, and organised on a public (or civil society) basis, rather than on regional economic development. To this end, a constitutional amendment would need to be implemented on top of the tasks already jointly assumed by the federal and *Land* institutions.

Limiting regional development possibilities and, at the same time, implementing an unlimited central growth policy does not appear to be useful, particularly for a decentralised country like Germany. Moreover, the cumulative effects of this may lead to social inequalities among regions which had, so to speak, been left to their own devices and receiving no support to encourage development. Such inequalities have costs for the whole of society. Another aspect, which is often neglected, is that regions with highly-developed infrastructures, above all in the education sector, also develop the talents, skills and resources from which growth centres in particular benefit – especially through migration: 'A competitive economy should not disregard the potential of this.' (Hahne 2005: 259; own translation)

2. Lessons from structural change in the Ruhr area

Traditionally, regional structural policy was introduced in order to support remote rural communities in agricultural areas. The decline of the coal industry since the 1960s was the first time that an industrial agglomeration had been affected by economic weakness. In this case, regional policy encompassed not only social, labour market and pension policies, but also energy policy. This has to be viewed against the background of coal production, as a domestic source of energy, being of high importance in post-war Germany. As a result, the economy of the Ruhr area has always been heavily dependent on political decision-making (Dahlbeck and Gärtner 2018).

With around five million inhabitants spread over an area of 4,400 km², the Ruhr area is one of the most densely-populated regions in Europe. In the mid-1950s, the number of employees in the industry peaked at 500,000 at which point every tenth inhabitant of the Ruhr area was employed in mining. This shows the immense importance of mining to this region and the families living there, especially considering that the traditional 'sole breadwinner model', in which men were destined to pursue employment for the family income while women were responsible for the household and raising the children, was still prevalent. From then on, however, the significance of hard coal began to decrease.

The population of the Ruhr area had grown to more than five million in a very short time because of industrialisation. This made the area meaningful both economically, with a large sales market for new businesses, and also technically because it has established one of the densest research and university network landscapes on top of an infrastructure geared towards technological advance. The Ruhr area therefore enjoyed conditions which were very different to those in rural lignite mining districts in Germany or abroad. This also applies to the value chain present in the coal and steel industry, which facilitated the growth of new and distinct sectors. Starting in the 1970s, for example, the coal and steel industry gave birth to the environmental sector in the Ruhr area as a result of stricter environmental standards. This industrial sector is still present in the region today although the coal and steel industry is no longer relevant (Nordhause-Janz and Rehfeld 1995, 2012; Pizzera 2012). It should also be emphasised that the large number of unionised workers (at least in the past) formed a strong political lobby.

Various governance structures were established to manage the structural policy measures that were introduced. The Ruhr Property Fund and Business Metropole Ruhr GmbH were, for example, established in respect of the joint internal and external marketing of the Ruhr as an economic region. However, in spite of such initiatives, including also the relocation of the planning authority from the federal state to the Ruhr Regional Association, the establishment of a broad technology centre and the transfer of infrastructure and cluster management structures, there is still no political voice that speaks for the Ruhr area and is capable of developing common strategies at federal state level (Dahlbeck and Gärtner 2018).

At the onset of the crisis, various different levels of policy-makers sought to stabilise the demand for coal. Such initiatives as were attempted included the provisioning of tax subsidies for power plant operators and the steel industry using domestic hard coal and granting financial resources for social compensation in case lay-offs were necessary in the iron and steel industry (Goch 1996: 382-386; Dahlbeck and Gärtner 2019). With the introduction of the *Kohlepfennig*, or the penny for coal, in 1974, a special consumer tax on electricity subsidised sales of domestic hard coal although this was overturned in 1994 by the Federal Constitutional Court.

Many of the policies were aimed, and over a long period of time, at supporting established large coal and steel companies. The effects of this are still recognisable today, with the present focus on large companies and the resulting insufficient development and level of support for smaller companies being very much the result of past policies. This has hindered structural change at an early stage, particularly because these large companies themselves often actively blocked the further development of the region through what was known as *Bodensperre*, which can be loosely translated as a ‘land lock’: for a long time, much of the mining land that became vacant was owned by the mining companies who refused to make it available to investors in order to block efforts by new companies to relocate in the region (Bömer 2000).

Furthermore, it has to be mentioned at the outset that the regional development of the Ruhr area has been very costly: in addition to the subsidies for coal production, a substantial amount of funding has flowed into the Ruhr area over the last sixty years. It is impossible and, at the end of the day, unnecessary to judge whether the level of funding has been too high. Nevertheless, the efficiency with which those funds have been used may be viewed very critically, especially with regard to the long-term focus on large companies.

The development of the region's economy was successful, above all, in that it prioritised a focus on regional networks, the introduction of regional dialogues not only with shareholders but also stakeholders (workers, unions, etc.) and the strengthening of potential from within the region.

Consequently, the significant support which has been provided for the region has a firm context within the specific features of Germany's social market economy, with its social partner model and, in addition, a relatively supportive social system compared to other countries. We should therefore not lose sight of the contribution made during this period by the relatively full cash balances in the welfare system (prior to German unification and the demographic shifts). Germany's relatively supportive welfare system, compared to other countries, made it possible to be generous and to facilitate the absorption of the social consequences of the structural change involved with the decrease in employment in hard coal in ways that were socially-responsible, e.g. via early retirement schemes. This meant that social stability in the Ruhr area was largely maintained, while the slow, heavily-subsidised, phase-out of hard coal prevented structural upheavals.

For mining employees, due to legal and collective bargaining regulations, early retirement does not have a significant financial impact. Even today, under specific conditions, miners can retire at the age of 50 owing to their physically demanding work. Of course, the outcome of such a policy was the stabilisation of the quality of life of the workers affected.

Furthermore, due to the demand effects of higher pensions, the early retirement policy also stabilised local economies. However, it did not sufficiently fuel industrial recovery and neither did it lead to a self-supporting upturn in the regional economy. This has affected the northern Ruhr in particular because of the later onset of structural change. In the southern Ruhr, the loss of coal and steel was compensated more strongly due to the expansion of the universities and the successful establishment of several technology centres. In some areas in the southern Ruhr, a new urban quality has subsequently emerged, with high-quality services and cultural centres. In the northern Ruhr, on the other hand, multiple problems have combined with a compound effect on an already difficult situation. These include above-average unemployment rates, lower employment rates, higher income poverty, higher percentages of people receiving social benefits, a higher occurrence of health problems, a lower level of education, etc. (Bogumil *et al.* 2012; Schräpler *et al.* 2017; Neu and Dahlbeck 2017). This spatial divide is probably the major weakness of the Ruhr area with regard to its economic, social, environmental or even health aspects. Unless targeted action is taken in these areas, districts in the northern Ruhr are at risk of becoming permanently deprived economically. These districts are currently still 'stable' as a result of the relatively high pension payments to former coal and steel workers. However, it can be assumed that the pensions of the next generation will not be this high since pension entitlements are lower as a result among other things of lower wages and longer periods of unemployment (Dahlbeck and Gärtner 2018).

One important component of the Ruhr's regeneration process has been the redevelopment of former industrial sites, with one such example being the International Building Exhibition Emscher Park, a derelict and highly contaminated part of the Ruhr, which took place between 1989 and 1999. This was the last major structural, or rather regional, policy programme specifically for the Ruhr area. In addition to the renaturalisation of Emscher Park, a process which is still not yet complete, the focus here was the transformation of old industrial buildings into places of culture, art, recreation or even residential schemes. A great deal of success was achieved, making the Ruhr area more attractive as a tourism destination and enhancing the regional identity of its inhabitants, although some objectives, such as the preservation of old industrial buildings and turning them over for new uses, were over-ambitious and rather less successful (Goch 2011: 70–71; Arndt *et al.* 2015: 109-110). Nevertheless, IBA Emscher Park was innovative in both its form and its purpose. Here, socio-ecological claims were established and implemented within a regional policy programme for the first time – an important structural milestone – while the value of the region's industrial and cultural heritage was specifically acknowledged. It also contributed to environmental renewal as a result of both the rebuilding of the Emscher river system and the expansion of Emscher Park. The industrial monuments built here made it possible for the Ruhr area to be successfully awarded the title of Cultural Capital of Europe in 2010.

Rehabilitated industrial buildings often serve as backdrops for new cultural venues and there is a value that may be gained as such. However, such a structural change has mainly created service sector jobs in the creative industries. Lower demand for labour in manufacturing or the heavy industry sector cannot be compensated entirely by the creation of new jobs in the service sector and in the creative industries in all regions. In addition, salaries in the service sector have not increased to the same extent as in the industrial sector. This is mainly because rising wages – at least in the case of private companies in the service sector – are usually financed by increases in productivity and, on average, productivity gains are lower in the service sector than in manufacturing. Even though deindustrialisation has contributed to an improvement in the quality of life, individual employment biographies have become fractured because former industrial workers only partly fit the requirements of the new service industries. This also means that, nowadays, there are fewer people working in manufacturing occupations in the Ruhr area than there are even in the rest of North Rhine-Westphalia.

Consequently, it is clear that manufacturing sectors in the Ruhr area in recent years have undergone very distinct development paths, building on regional networks where present and visible. This is demonstrated, for example, in the IT and microsystems technology sector in Dortmund, where the establishment of a technology park has enabled these two technology fields to develop. Promising cluster structures can also be found in logistics and waste management in the Ruhr area (Rehfeld and Nordhause-Janz 2017: 244).

3. Acting preventively with a view to assisting peripheral regions where opencast coal mining still takes place

It is possible that the decline of a region may be exacerbated by stable, consensus-oriented institutional structures (Grabher 1990; Granovetter 1973). In some cases, dominant industries and companies are powerful enough to exert an influence on policy-making, one notable example being the introduction of the *Kohlepfennig* which subsidised German hard coal to maintain its competitiveness.

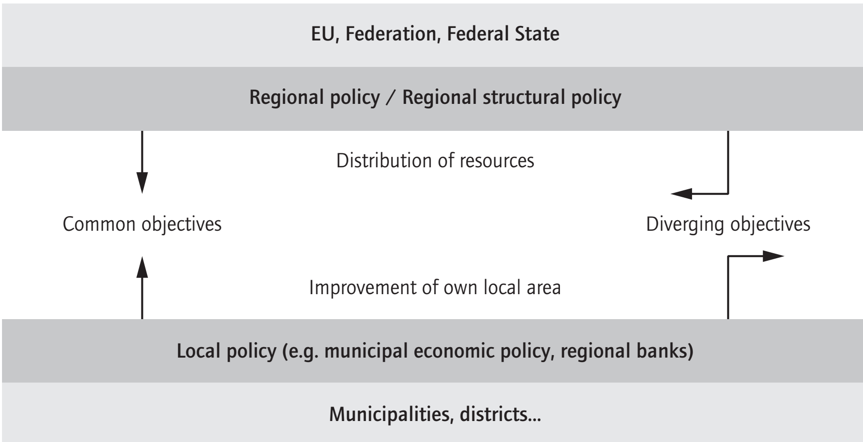
Strong industrial identity and clinging on to traditional structures can lead to a situation in which change is prevented in the short-term despite it not being stoppable in the long-run. This may be particularly detrimental to those sectors and regions that do not have the power to influence national and international policies and related regulations to their own benefit over time, or with which the harmful effects (e.g. climate damage resulting from lignite coal-fired power generation) can be clearly and easily associated. It makes more sense to accept and embrace change at an early stage than to fight it. To gain such insights, a debate must be held with all shareholders and other stakeholders.

3.1 Conflicting interests at different levels

However, there may of course be conflicting objectives: if an industry and, as a result, a region in which that industry occupies a significant position are in decline, regional policy-makers are primarily concerned with the development of the region, e.g. by paying subsidies for resettlement. It is, above all else, about supporting the shareholders and employees of predominant industries because, in established sectors, good wages are often paid while returns are high. This has to be viewed against the background of regional structural policy being multi-level and extending down from the EU, state and federal levels to the municipal level. In Germany, access to the lower level (for example) is limited for the higher levels due to local self-government being guaranteed by the constitution. This became recently evident in the context of Germany’s energy transition and the attempt to install new high voltage cables to bring wind power from the north to the south. In the case of larger infrastructure projects, the various stakeholders in a region may therefore have to be persuaded to participate in the process.

Local economic policy – a policy that focuses on the city, county or region – is pursued independently of the structural policy objectives initiated by a higher level, as shown in Figure 2. Often, the objectives of the different levels complement each other, e.g. when structurally weak regions respond to the specific, balanced regional economic development programmes of the EU or the federal state. The distinction between regional and local economic policy is by no means trivial because municipal economic development can pursue its own policy regardless of the overall regional objectives. Thus, in addition to a consensus-oriented policy, local economic policy may also result in a conflictual situation in which not everyone benefits – where, for example, certain sectors are addressed by many regions which increases competition. Strictly speaking, the same would be true for a regional policy targeted towards the equalisation of living conditions across the regions, e.g. if a wealthy region increases its prosperity through a progressive economic policy and thus contributes to a widening of the regional welfare gap.

Figure 2 **Levels of regional structural (or cohesion) policy**



Source: Gärtner 2009.

3.2 Preventive structural policy

Since the 1970s, debates have been taking place about seeking preventive cures rather than a structural policy implemented in retrospect. One of the early founders of this strategy was Dr. Josef Rembser from the German Federal Ministry of Research and Technology who articulated the need to initiate structural change on an active basis (Rembser 1977: 5). Rembser's concept of preventive structural change was not concerned with establishing and growing forecasting capacities but rather with building networks and promoting research and innovation. According to the concept, support measures should not focus on the industry but on the technologies on the grounds that these bring potential for the economy as a whole (Gärtner 2014; Rembser 1977: 39).

The issue was taken up at policy level by trade unions and employee representatives who argued that an innovation-oriented regional policy which sought to integrate state funding for science and technology with regional structural policy, and to channel it increasingly to disadvantaged regions, should be extended to become a forward-looking structural policy (Bömer and Noisser 1981). Alois Pfeiffer, the former president of the German Trade Union Confederation (DGB), proposed a forward-looking policy that 'Does not seek to rectify sectoral and regional undesirable developments retrospectively, but intends to avoid them in the first place' (Pfeiffer 1982: 623).

Thoss and Ritzmann (1984) wanted their study *An information basis for forward-looking structural policy* to represent a contribution to qualitative growth and full employment as well as the full utilisation of existing production factors and a balanced development of supply and demand at regional level. They distinguish between two structural policy strategies. First, in place of a defensive strategy, which aims to slow the pace of structural change without being able to prevent it in the long-term, they proposed a forward-looking structural policy as a second, and preferable, alternative: 'A policy of this kind would be designed to prevent negative structural developments – i.e. imbalances in supply and demand in sectors (and/or regions) well in advance – and with a view to the future' (Thoss and Ritzmann 1984: 5; own translation). Secondly, growth industries should be supported effectively and the process of withdrawing from shrinking sectors should be started at an early stage: 'In this way, the risk of misguided investments in vocational training and production facilities, which will no longer be needed in the future, could be reduced and the necessary structural change achieved with as little friction as possible' (Thoss and Ritzmann 1984: 5; own translation).

That a forward-looking structural policy was never implemented in this form is due in no small part to the forecasting problem. In addition, the fall of the Berlin Wall, the pace of German unification and the subsequent transformation took everyday politics in Germany by surprise and these issues were, therefore, given priority. This showed, on the one hand, how quickly macroeconomic and geopolitical events can appear and, on the other, how *ad hoc* measures are required that do not necessarily create the scope for a long-term perspective. Under the global market-oriented economic order, and with reference to the course of the political transformation of eastern Europe and Russia, efforts have also been made to avoid top-down political concepts that appeared to be based on planning and control (Gärtner 2014).

Additionally, it has to be kept in mind that structural policy exists on a multi-level basis with the uppermost level spending money on the development of specific regions. Traditionally, this was based on a specific regional status quo concerning the socio-economic situation and in which structurally weak regions, for example, had been supported in the past. In the case of preventive interventions, the structural weakness of a region will only become apparent in the future and this, in turn, will only come about if successful preventive action is not taken in advance. This is the fundamental challenge of prevention: if successful preventive action is taken, the original risk identified will not take place. Policy-makers would, therefore, have to be willing to finance structural change in a region that, according to the socio-economic data, does not need funding at the expense of a region that is currently structurally weak. Structural change – unlike, for example, climate change (although implementation in this area is also far behind the targets) – is not a real existential catastrophe for society as a whole. Moreover, uncertainty as to whether there will actually be a change clearly prevents any action from being taken.

3.3 The introduction of preventive programmes in brown coal regions

The finite nature of mineral resources in coal regions can generally reduce uncertainties, lead to structural change being initiated at an early stage both by shareholders and other stakeholders and create some scope for action. Over and above that, competences within the entire value chain can be developed into new competitive sectors. This is especially true in the context of the imminent phasing-out of coal, in particular due to the serious climate damage caused by lignite-fired power generation. In 2014, the parliament of the federal state of North Rhine-Westphalia requested an assessment of the question of how, and if, a forward looking-structural policy was possible in the opencast lignite mining area of the Rhineland (Gärtner 2014).

Since 2017 there has been a programme at federal level called 'Enterprise Territory' (*Unternehmen Revier)*, which was launched by the Federal Ministry of Economics and Energy (Bundesministerium für Wirtschaft und Energie 2017). Its primary objective is to support new opportunities in the four lignite mining areas of Lusatia region, Rhineland, Helmstedt (now closed) and central Germany. The amount of money (€4m per year) to support structural change in these regions is small, but this might just constitute the beginning of further mechanisms. The funds will flow annually over a period of ten years although, initially, they have been approved for four years until an interim evaluation can be made. Overall, the programme is – as far as the author is aware – the first preventive one to take place in Germany.

In order to capitalise on the local potential and actively involve local stakeholders, *Unternehmen Revier* was designed to initiate a competition of ideas and projects that could act as models. It has four priority areas that encompass a broad portfolio of traditional structural policy instruments: boosting competitiveness and enhancing the region as a business location; promoting employee skills; cluster development and innovation management; and expertise and capacity building (BAnZ 2017: 3). Regional innovation concepts (*Regionale Innovationskonzepte* – RIK) serve as the primary decision-making basis for local stakeholders. *Unternehmen Revier* aims to establish regional decision-making and implementation structures (governance), as well as to focus on the content of individual sectors or areas of expertise. As part of the development of the RIK, future fields and key projects were defined in the four regions and an organisational structure set up to implement the competitions.

The programme is still in its early, pilot stages. At this point therefore, evaluation is not possible and certainly its impact on the four coal-mining districts cannot yet be assessed. However, it is promising to see that a programme has been set up before the end of lignite mining to support and actively promote the phasing-out of coal in these districts. The programme focuses on developing endogenous potential and aims to train local stakeholders to strengthen their capabilities in order to support local structural change in the long-run.

With regard to the approximately €4m being spent annually on the preventive structural policy aspects of the programme, this is indeed just a drop in the ocean. However, in calling for the establishment of regional innovation concepts, regional organisational structures are being set up to implement and monitor the progress of preventive structural change. This is an important prerequisite for getting regional dialogue underway, but also in respect of the absorption capacity and effectiveness of the subsidies themselves.

3.4 The 2018 'Coal Commission' and the case of the Lusatia region

Other programmes and funds will follow and can be based on the ideas and structures developed in the interim. In this regard, the Commission on Growth, Structural Change and Employment (*Kommission für Wachstum, Strukturwandel und Beschäftigung*), commonly called the Coal Commission (*Kohlekommission*), is important. This was set up by the German federal government on 6 June 2018 and presented its results and recommendations in January 2019. The goal of the Commission, which was composed of a number of different civil, economic and political actors, was to develop consensus about the framing of structural change in Germany considering energy and climate policy goals. Furthermore, the Commission focused on developing real prospects for new, sustainable workplaces (*Kommission für Wachstum, Strukturwandel und Beschäftigung* 2019: 2).

The Climate Protection Plan 2050 of the German federal government, published in 2016, defines the goal for Germany to be greenhouse gas neutral by 2050. Within the different fields of action, the energy industry contributes a large part of total emissions in Germany (358 million tonnes in 2014) (*ibid*: 15-16)[2]. Consequently, a legislative package on 'Strengthening Growth, Structural Change and Employment' in lignite mining areas and coal-fired power plant sites was recommended by the Commission under which a total of €40bn will be spent on the affected regions over around twenty years. In the next ten years, the federal government will place up to 5,000 new jobs in federal institutions in lignite coal regions (Bauchmüller 2019; Heinrich-Böll-Stiftung 2019).

With the publication of the Commission's report, an entry has been made in the exit from coal. The energy industry, the trade unions and wider industry itself are committed to exit. However, political compromise has been made in that public money has been granted not only to the affected regions and workers but also to the coal mining industry.

In the case of Lusatia, the challenge is of course somewhat higher compared to the other three areas. Even if the 8,600 directly employed people are around 1,400 fewer compared to the number of mining employees in the Rhineland Area, the lignite coal economy is of dominant relevance to the regional economy. The region is less densely populated, as well as peripheral and remotely located. Moreover, there are not many industries other than coal mining and electricity generation.

It is true that old industrial cities and regions can draw potential from their perceived structural weakness. For example, industrial architectural heritage in the form of empty

2. Thereby, coal power stations account for 70 per cent of the total emissions of the power industry. It could be summarised that the Commission recommended that, by 2022, a total of 12.5 GW of coal-fired power plants should be shut down, including 5 GW of lignite and 7.5 GW of hard coal. These measures will achieve a CO_2 reduction of at least 45 per cent in the energy sector compared to 1990. In the mid-2020s, CO_2 emissions are to be reduced by a further ten million tonnes, which corresponds to about 2 GW of lignite. By 2022, a (small) third will be shut down, with another third by 2030 and the last (big) third by 2038. Exit will, therefore, be complete by 2038 although a check will be made in 2032 as to whether 2035 will be possible ('opening clause'). Source: https://www.boell.de/de/2019/02/08/ergebnisse-und-einschaetzung-zur-kohlekommission.

industrial buildings can be developed as landmarks and as points of identification having symbolic or cultural value. The importance of these spaces for hotspots on the creative scene has been acknowledged in the development of urban areas, but some potential is also evident in the case of more rural regions due to vacancies and economically under-used spaces (Flögel and Gärtner 2011). However, the dilemma is where spaces are becoming vacant in monostructured old industrial areas on the periphery (Sandeck and Simon-Phillip 2008), since new uses are more quickly found for these kinds of spaces or buildings in more prosperous areas. According to Kersten *et al.* (2015a), the argument that special opportunities arise from cycles of crises also runs the risk of deserted spaces being rebranded as 'creative zones'.

In areas with particularly pronounced crisis cycles, the involvement of civil society and the potential of skilled workers may both be eroded alongside economic development. A reversal of this trend seems to be realistic only with the help of external intervention. At the same time, however, there must be an understanding that politics cannot solve everything and that there will be regions that will shrink economically and demographically. Potentially, peripheral industrial regions will be affected more strongly than larger (old industrial) agglomerations.

4. Lessons learned?

Mining regions have always been affected by structural change: phases of economic growth are often followed by phases of structural change, for example when natural resources have been depleted or have become economically unprofitable for different reasons. These development pathways differ greatly from each other. Whether cities and agglomerations survive structural change without significant demographic decline depends, on the one hand, on their economic diversity, their size and the situation in the region; and, on the other, on the level of political willingness to support regions in the development of new competitive economic fields. The commitment to support regions is partly geopolitical and partly culturally determined. For example, it is difficult to imagine suggesting to the people of the small island of Helgoland in Germany, or the Azores in Portugal, that they move to the mainland and receive financial support, even if this would be cheaper in the long-term than implementing permanent structural policies. In Europe, and especially in Germany, the state is more willing than in many other parts of the world to counteract and mitigate the consequences of structural change.

The current allocation of funding to the four (of which only three are still active) lignite mining districts appears reasonable and, following the recommendations of the Coal Commission, will be significantly increased over the following years. However, the question arises of the extent to which policy-makers, at both regional and national level, are ready to consider a multi-layered process in view of the differing regional conditions. This would include an evaluation of the different efficiency levels of existing power plants and may also conclude that not all regions will be able to achieve re-industrialisation and a self-sustaining economic recovery, or at least a degree of stabilisation; at least in some areas there is a risk of continuing economic and demographic decline.

In this context, the question of how a regional compensation policy should be organised must be clarified. This can be achieved either by creating incentives to redirect investment into structurally weak regions, trying to establish equivalent economic development in the process; or by supporting the development of companies already resident in the regions in the interests of reindustrialisation. An alternative would be to provide permanent financial support for people living in weaker regions and to subsidise central infrastructure or public services such as shops, education, health care, etc. Traditionally, it is the incentive policy that has dominated development strategy, not least because – in addition – a growth-oriented compensation policy cannot justify permanent financial support. If, however, well-balanced regional development does not necessarily produce the best overall economic growth results, it may be economically and environmentally reasonable, when it comes to weighing the costs and benefits, to develop only those areas with excellent competitive potential and to subsidise the weaker ones.

Furthermore, it makes sense to expand local value chains in order to close the supply gaps and generate as much benefit as possible for the region. Measures range from mobilising civil society to alternative economic approaches. These approaches go hand-in-hand with a change in political and social values that focus more on a bottom-up than on a top-down approach. Of course, regions should not become disconnected from the world market, but the aim should be to try to develop sectors that are competitive outside the regional level. If the political objective is to develop regions without the potential to be competitive, these regions usually need an external development impetus, e.g. through re-locations of industries or the creation of outstanding infrastructures.

It is not easy to transfer the success factors identified for Germany or the Ruhr area to other regions or countries. In Germany, for example, the effective redistribution mechanisms contained in social insurance systems have helped to stabilise weaker areas. The respective overall conditions, in particular social security systems in the case of possible job loss, play an important role here. The social cushioning that took place in the Ruhr area would not have been possible in this form without widespread early retirement schemes financed out of statutory unemployment and pension insurance. However, there are some points of general interest for both the funding level and the local implementation level when it comes to regional restructuring processes:

Starting as soon as possible: A consistent preventive change path should begin early and slowly. For mining regions, for example, a change in direction initiated at an early stage would mean slowly reducing the industrial core of coal mining so that resources (e.g. land, staff and training, as well as research and development) become available for other aspects of development. This does not mean that industrial regions should not capitalise on their industrial-cultural basis; on the contrary, this can make a significant contribution to realignment. For regional stakeholders, this means a shift that, on the one hand, takes regional capabilities, culture and potential into account while, on the other, building a realignment supported by the involvement of higher hierarchical levels (i.e. the federal state) in spite of current functioning economic strengths.

Thinking about the long run: Established industries often generate good profits because the risks and uncertainties are low and the investments have paid off. These profits are distributed in different percentages to the shareholders (owners) and stakeholders (e.g. employees). This not only means that capital owners generally make good profits, but also that the public sector (e.g. through tax revenues), the region (e.g. through regional sponsoring projects) and employees (e.g. through appropriate collective bargaining agreements) also benefit. New sectors, on the other hand, often generate lower profits and usually start with low-paid and insecure employment. This prospect makes it difficult for trade unions, public authorities and industry federations to diverge from established paths and actively shape structural change especially since there is no guarantee that they will gain later rewards, in return for having actively initiated structural change, via the achievement of high returns which can then be distributed more or less equally.

Involving shareholders and other stakeholders: Civil society has important potential to be activated, especially in transition regions. This requires cooperation between a large number of stakeholders at different political and regional levels (local, municipal, regional, supra-regional, national and international). Multi-level governance is, therefore, required here. Companies and business owners should also be involved in the process because they, as practitioners, are very well-placed to assess the implications for the economy and employment. In addition, universities and research institutions must be involved at the project level as they are the gatekeepers of specific knowledge.

Having common goals: There must be a structural policy reference framework – i.e. commonly defined goals and guidelines – which should be drawn up collectively by the various levels (within a nation state). Within this framework, it is also necessary to agree on the importance of equivalent regional development and, if necessary, how this should be achieved. This must be seen in the context of the economic and social system and the existing settlement structure in order to be able to define realistic expectations.

Promoting regional growth and regional balance: Numerous studies (Fujita *et al.* 1999; Zimmermann 2003) have concluded that innovation is primarily created in densely-populated areas, especially in regions where there are favourable conditions for the spread of knowledge. The basic idea is to strengthen growth factors, particularly in (large) cities and densely-populated areas, to such an extent that there are spillover effects from which weaker areas will also benefit in the long-term. Since the concentration of funding in growth regions is (socio-)politically difficult to sustain, there is a risk that corresponding growth policies will be implemented broadly. Moreover, as these regions do not necessarily have sufficient competitive potential, these could turn out to be the wrong instruments for these regions. Another strategy would be to focus consistently on endogenous potential, independent of regional distribution, and to set-up specific programmes and instruments for weak regions. This might include, for example, the promotion of projects and the picking up of particular impulses, where special potential or committed individuals and companies are involved, while at the same time promoting the development of a functional and appropriate infrastructure.

Embedding structural policy into other policies and providing sufficient resources: Structural policy does not take place in a vacuum and is dependent on a political and social change of values. Cross-cutting issues, such as gender mainstreaming, environmental transformation, participation, equal opportunities and inclusion must also be supported within the framework of regional structural policy. To what extent education policy and improving the situation of socially-disadvantaged children and young people should be part of modern structural policy also needs to be discussed. On the one hand, it must be kept in mind that structural policy, which is in any case quite limited in terms of the amount of funds compared with other regionally-effective policies, could thus be overloaded; on the other, in view of demographic change and the resulting shortage of skilled workers, a policy of this kind can achieve a greater (including economic) impact than traditional structural policy. This becomes even more evident when using the term 'prevention'. After all, general 'regional fitness', i.e. well-skilled people and good infrastructure, ensures that a region is more resilient and can react better to changes.

Thinking in functional spaces: Structural change projects often require a local reference and local involvement in order to secure the commitment of stakeholders. At the same time, structural change strategies can only be considered in wider contexts in which economic and political functional factors can also be considered. However, it is not enough to expand the regional area but to define different spatial relationships and, thus, other stakeholders in respect of different issues. When considering overlapping spatial relationships, the first priority is to identify possible reference areas for different issues. The difficulty lies in a region understanding that it is dependent on the willingness and ability of the surrounding area before it can influence and shape this kind of process. This becomes especially important when civil society actors are to be involved who, in turn, have different spheres of action and reference than economic or political actors. This requires a multi-dimensional and multi-hierarchical approach.

Reflecting on new constellations of actors in structural policy: Regional development and structural policy have become more bottom-up in two respects. First, municipalities and counties – and, more recently, even districts – are called on to contribute their own development ideas and concepts and not to leave structural policy to the higher hierarchical level, i.e. federal states or the federal government. Moreover, the structural policy actors of today not only include politicians, companies and other (semi-)state institutions, but also civil society. Even if this can have great potential, for example by allowing civil society protest movements to point out shortcomings, raise awareness of conflicts and persuade politicians and institutions to act, and also to highlight social trends, the process becomes more complex while decision-making – at least if it is to be consensus-oriented – becomes more time-consuming and difficult. Furthermore, it is important that participation and the power to shape policies are not left solely to an 'elite with a voice' or to those who are pursuing their particular interests. This applies in particular to structurally weak regions, where commitment and participation are often lower.

References

Aring J. (2010) Gleichwertige Lebensverhältnisse-Inverse Frontiers-Selbstverantwortungsräume, in IBA Stadtumbau Sachsen-Anhalt (ed.) Weniger ist Zukunft: 19 Städte - 19 Themen, Berlin, Jovis Verlag, 764-777.

Arndt A., Abele E., Anderl R., Metternich J., Wank A., Anokhin O., Meudt T. and Sauer M. (2015) Effiziente Fabrik 4.0, ZWF Zeitschrift für wirtschaftlichen Fabrikbetrieb, 110 (3), 150-153.

BAnZ – Federal Gazette (2017) Modellvorhaben Unternehmen Revier.

Bauchmüller M. (2019) Nur ein Anfang: Einigung der Kohlekommission, Süddeutsche Zeitung, 26 January 2019.

Becher G. and Rehfeld D. (1987) Forschungsbericht zum Stand der Regionalplanung, Schriften der Stadt Braunschweig.

Blotevogel H.H. (2006) Neuorientierung der Raumordnungspolitik?, Raumforschung und Raumordnung, 64 (6), 460-472.

Bogumil J., Heinze R.G., Lehner F. and Strohmeier K.P. (2012) Viel erreicht – wenig gewonnen: Ein realistischer Blick auf das Ruhrgebiet, Essen, Klartext Verlag.

Bömer H. (2000) Ruhrgebietspolitik in der Krise: kontroverse Konzepte aus Wirtschaft, Politik, Wissenschaft und Verbänden, Dortmund, IRPUD.

Bömer, H. and Noisser N.H. (1981) Zum Konzept dieses Sammelbandes und Stand der Arbeit des Arbeitskreises, in Arbeitskreis arbeitsorientierte Regionalwissenschaft (ed.) Regionale Krisen und Arbeitnehmerinteressen : Materialien zur arbeitnehmerorientierten Raumordnungs- u. Regionalpolitik, Cologne, Pahl-Rugenstein Verlag, 7–25.

Bundesministerium für Wirtschaft und Energie (2017) Bekanntmachung Richtlinie zur Förderung von Maßnahmen zur Strukturanpassung in Braunkohlebergbauregionen im Rahmen des Bundesmodellvorhabens „Unternehmen Revier" vom 1. November 2017. https://www.bmwi.de/Redaktion/DE/Downloads/B/bundesanzeiger-foerderung-massnahmen-zur-strukturanpassung-in-braunkohlebergbauregionen.pdf?_blob=publicationFile&v=6 [accessed 13.05.2019]

Bundesministerium für Wirtschaft und Energie (2019) Kommission „Wachstum Strukturwandel und Beschäftigung" – Abschlussbericht, Berlin.

Dahlbeck E. and Gärtner S. (2018) Das Ende der Steinkohleförderung im Ruhrgebiet: Realistische Erwartungen an Regional-und Strukturpolitik, Forschung Aktuell 07/2018, Gelsenkirchen Institut Arbeit und Technik.

Dahlbeck E. and Gärtner S. (2019) Just transition for regions and generations: experiences from structural changes in the Ruhr area, Berlin, WWF Germany.

Eckey H.F. (1995) Regionale Strukturpolitik, in Akademie für Raumplanung und Landesforschung (ed.) Handwörterbuch der Raumordnung, Hannover, ARL, 815-821.

Eickhof N. (2005) Regional-und Industriepolitik in den neuen Bundesländern, Volkswirtschaftliche Diskussionsbeiträge 77, Universität Potsdam, Wirtschafts-und Sozialwissenschaftliche Fakultät.

Flögel F. and Gärtner S. (2011) Strukturwandel im Einzelhandel: Das Ende der B-und C-Lagen oder Chance für Raumunternehmen?, Geographische Handelsforschung, 30, 5-13.

Frey R.L. and Zimmermann H. (2005) Neue Rahmenbedingungen für die Raumordnung als Chance für marktwirtschaftliche Instrumente, disP-The Planning Review, 41 (161), 5-18.

Fürst D., Klemmer P. and Zimmermann K. (1976) Regionale Wirtschaftspolitik, Tübingen, Mohr.

Fujita M., Krugman P. and Venables A.J. (1999) The spatial economy: cities, regions and international trade, Cambridge, MIT Press.

Gärtner S. (2009) Balanced structural policy: German savings banks from a regional economic perspective, Brussels, World Saving Banks Institute.

Gärtner S. (2014) Den Pfadwandel einleiten: Von den Dilemmata präventiver Strukturpolitik, Forschung Aktuell 10/2014, Gelsenkirchen, Institut Arbeit und Technik.

Goch S. (1996) Politik zur ökonomischen, sozialen und ökologischen Bewältigung des Strukturwandels im Ruhrgebiet: ein Überblick, in Bovermann R., Goch S. and Priamus H.-J. (eds.) Das Ruhrgebiet - ein starkes Stück Nordrhein-Westfalen: Politik in der Region 1946–1996, Essen, Klartext Verlag, 380–426.

Goch S. (2011) Sinnstiftung durch ein Strukturpolitikprogramm: die Internationale Bauausstellung Emscher-Park, in Betz G.J., Hitzler R. and Pfadenhauer M. (eds.) Urbane Events, Wiesbaden, VS Verl., 67–84.

Grabher G. (1990) On the weakness of strong ties: the ambivalent role of inter firm relations in the decline and reorganizatuin of the Ruh, Berlin, WZB.

Granovetter M.S. (1973) The strength of weak ties, American Journal of Sociology, 78 (6), 1360-1380.

Hahne U. (2005) Zur Neuinterpretation des Gleichwertigkeitsziels, Raumforschung und Raumordnung, 63 (4), 257-265.

Hübler K.H. (2005) Die Schaffung gleichwertiger Lebensbedingungen in allen Teilräumen, Raumforschung und Raumordnung, 63 (1), 55-62.

Kersten J., Neu C. and Vogel B. (2015a) Der Wert gleicher Lebensverhältnisse, Fiedrich-Ebert-Stiftung, Bonn.

Kersten J., Neu C. and Vogel B. (2015b) Regionale Daseinsvorsorge: Begriff, Indikatoren, Gemeinschaftsaufgabe. Gutachten im Auftrag der Abteilung Wirtschafts- und Sozialpolitik der Friedrich-Ebert-Stiftung, Bonn, Friedrich-Ebert-Stiftung.

Lammers K. (2004) Problemregion Ostdeutschland: Was ist zu tun?, Wirtschaftsdienst, 84 (10), 623-626.

Neu M. and Dahlbeck E. (2017) Soziale und gesundheitliche Ungleichheit: empirische Befunde und Herausforderungen für regionale Akteur, in Dahlbeck E. and Hilbert J. (eds.) Gesundheitswirtschaft als Motor der Regionalentwicklung, Wiesbaden, Springer VS, 177–200

Nordhause-Janz J. and Rehfeld D. (1995) Umweltschutz «made in NRW»: eine empirische Untersuchung der Umweltschutzwirtschaft in Nordrhein-Westfalen, München, Hampp.

Nordhause-Janz J. and Rehfeld D. (2012) Wirtschaftsbericht Ruhr 2012: Leitmärkte und regionale Zukunftsfelder, Mülheim an der Ruhr, Wirtschaftsförderung Metropoleruhr.

Pfeiffer A. (1982) Vorausschauende Strukturpolitik durch gesamtwirtschaftliche Mitbestimmung, Gewerkschaftliche Monatshefte, 10/1982, 617-626.

Pizzera J. (2012) Innovationsprozesse in ehemaligen Bergbauregionen: Neue Wege der Geographie zwischen Raum- und Innovationsforschung, Saarbrücken, AV Akademikerverlag.

Rehfeld D. and Nordhause-Janz J. (2017) Integration-fragmentation-reintegration? Studying cluster evolution, regional path development and cluster policies in the Ruhr Area, in Fornahl D. and Hassink R. (eds.) The life cycle of clusters: a policy perspective, Cheltenham, Edward Elgar, 242-258.

Rembser J. (1977) Role of government in the promotion and transfer of technologies, Transactions of the American Nuclear Society, 25 (1), 98-99.

Sandeck K. and Simon-Phillip C. (2008) Destination Innenstadt: zur Entwicklung der Innenstädte in Deutschland, Die alte Stadt, Vierteljahreszeitschrift für Stadtsoziologie, Stadtgeschichte, Denkmalpflege und Stadtentwicklung, 35 (4), 303-323.

Schräpler J.S., Jeworutzki S., Butzin B., Terpoorten T., Goebel J. and Wagner G.G. (2017) Wege zur Metropole Ruhr, ZEFIR-Materialien 6, Bochum, Zentrum für interdisziplinäre Regionalforschung.
Thoss R. and Ritzmann P. (1984) Informationsgrundlagen für die vorausschauende Strukturpolitik, Münster, Institut für Siedlungs- und Wohnungswesen.
Zimmermann H. (2003) Regionaler Ausgleich versus Wachstum: eine Balance finden, Thüringer Innenministerium (ed.) Thüringer Raumordnungskonferenz, Sömmerda, 5 September 2003, 19-38.

Internet sources

Heinrich-Böll-Stiftung, Ergebnisse und Einschätzung zur Kohlekommission – Kommentar. https://www.boell.de/de/2019/02/08/ergebnisse-und-einschaetzung-zur-kohlekommission

The Platform for Coal Regions in Transition, Will it deliver for the local communities? http://www.just-transition.info/coal-platform/

Climate KIC, Innovation for climate action. https://www.climate-kic.org/

All links were checked on 13 May 2019.

Part II

A car industry beyond the combustion engine

Chapter 6
Troubled waters ahead: what's next for the European automobile industry and jobs?

Anne-Gaëlle Lefeuvre and Ştefan Guga

Introduction

As the European economy finally seems to have surpassed the effects of the crisis of 2008/2009, the continent's automobile industry appears to have recovered at least some of the buoyancy of pre-crisis times. Mitigating the long-standing issues of overcapacity and pressure on prices and costs, sales and production volumes have picked up, starting from 2013, while the trade surplus and employment are growing and the profitability of the major assemblers and suppliers is again on the rise. The German automotive industry in particular has been faring rather well due to its large domestic market and export prowess. In all other major automobile-producing countries, the return to growth in production and sales is visible but the overall situation is rather mixed as the production footprint has declined in some countries while rising in others.

Despite the ongoing diesel scandal, all German original equipment manufacturers (OEMs) have contributed to and benefited from this worldwide positive dynamic. Recovery has also proved a boon for historically more vulnerable producers like Renault, which has firmly entrenched itself as a major global player, and PSA which, through its Opel deal, has completed one of the boldest European acquisitions in decades. With Asian manufacturers also strengthening their position on the continent, competition in Europe remains strong. Further exacerbating this already highly competitive situation, the automotive world is passing through a period of technology-induced turbulence that threatens to shake the industry to its core. New powertrain requirements in response to tightening environmental regulations, the potential for new uses for and expanding functionalities of cars and a new impetus towards the reorganisation of production all point to important changes to come.

This chapter focuses on these coming changes under the pressure of rapid technological development and tightening environmental regulations.

In order to establish the context for the unfolding of these technological transformations, the first section provides an assessment of the state of the industry today and of its development in the last decade.

Section two looks into the main drivers of technological transformation, with a focus on vehicle electrification and of the expected decline of the industry-defining internal combustion engine (ICE). Europe is at the forefront of the drive toward vehicle electrification, although it has begun to lose ground to China. We discuss the impact of European emissions regulations, which are going to tighten significantly by 2030.

The significance of regulatory change for powertrain technologies is expected to be nothing short of revolutionary; it is already obvious in the unavoidable decline of diesel from the status of preferred customer choice in many European countries to the trash heap of history within the span of just a few years. In the meantime, the question of what kind of technology (hybrid, battery, fuel cell) will actually replace the classic combustion engine looms large. In manufacturing, a shake-up of the upstream supplier industry is expected, considering that electric vehicle powertrains are significantly less complex than internal combustion ones and that batteries are set to become the new major contributor of added value. This reshuffling should have an important impact on employment and skill requirements in both manufacturing and R&D.

In the third section, we discuss the parallel development of vehicle automation and the arrival of the so-called mobility revolution. In this case, scenarios for the automotive ecosystem are much more radical. Anticipating huge market growth over the next two decades, major assemblers are already making heavy commitments in order to secure their positions in the upcoming segment of mobility services. Entire value chains could witness a radical reconfiguration due to the advent of shared vehicles, which are certain to have an impact on the dominant business model, on production volumes and on employment.

Finally, section four deals with current trends in the reorganisation of production under the impact of digitalisation and plans to develop the ‘industry of the future’ (‘Industry 4.0’, ‘smart factories’, etc.). Less visible to automobile users, digitalisation and connectivity are expected to have an important impact on the internal organisation of production. 3D printing, advances in software development and a growing interest in nanoelectronics have all given renewed impetus to the ideas of extensive automation. Important changes are considered in the economics of the industry, regulation, working conditions and the quantity and quality of employment.

Our main overall purpose in looking at these three changes side-by-side is to understand the impact they could have on European production and sales volumes, on the structure of the industry’s sprawling supply chains and especially on employment, skills and working conditions.

1. The state of the European automobile industry

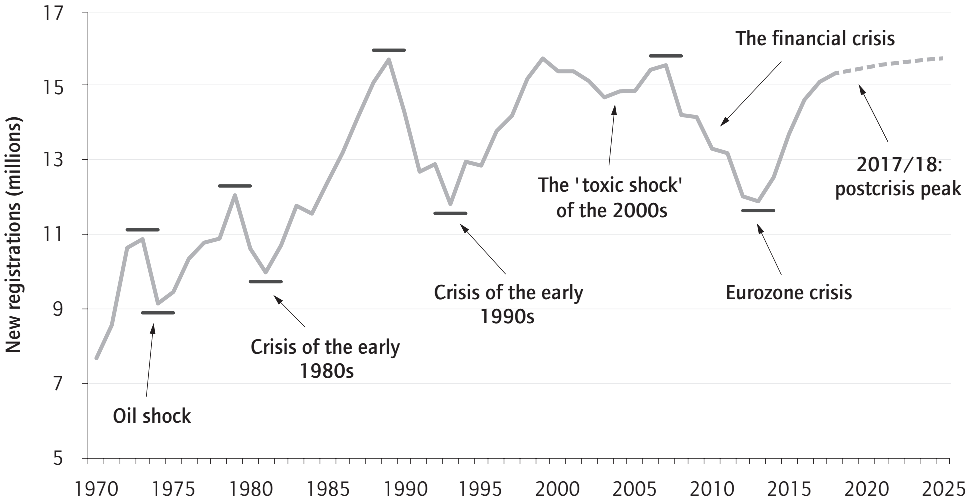
1.1 Post-crisis recovery

Despite the protracted economic crisis of the late 2000s, ostensibly ending by the end of 2013, we can only speak about the full recovery of the European automotive market starting from 2017, when sales approached their pre-crisis peak of 2007. Similar to the 1990s, the crisis lasted no fewer than ten years. There is hardly anything surprising in this given the market’s high sensitivity to cycles of economic boom and bust (Figure 1).

The European automotive industry has witnessed significant transformations over the past decade. To take just a few examples, the emergence of central and eastern

Europe as a manufacturing powerhouse, buoyant product diversification (alongside 'premiumisation' and the soaring success of sports-utility vehicles – SUVs) and the unquestionable market (and, increasingly, technological) dominance of China on a global level were not exactly defining features of the industry before the Great Recession.

Figure 1 **Cycles of boom and bust and the European passenger car market**



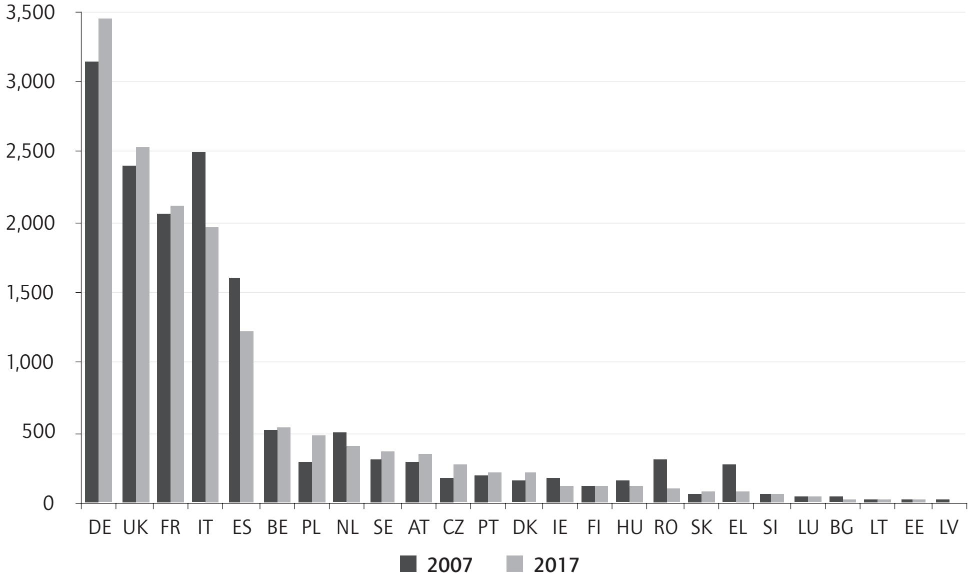
Source: Syndex calculations based on ACEA (2018) and Eurostat.

Even from a simple market standpoint, the situation in many countries is radically different to pre-crisis times and structural decline is particularly obvious in those countries hit worst by crisis and austerity (Figure 2).

Once the second largest market in Europe, Italy has witnessed a 21 per cent drop in sales since 2007, while registrations in Spain have declined by no less than 23.5 per cent. Unsurprisingly, the market in personal cars has collapsed in Romania and Greece and, apart from Czechia and Poland, sales in the new member states have stagnated regardless of their comparatively low rates of motorisation. Growth in Germany and the UK has offered only partial compensation, although this has raised their combined share of the total EU market from 36 per cent in 2007 to 40 per cent in 2017.

German OEMs have reaped the lion's share of market recovery (Figure 3). While the Volkswagen Group increased its market share from 19.5 to 22.7 per cent, premium manufacturers like BMW and Daimler now have market shares which are equivalent to volume manufacturers like Fiat (c. 7 per cent), which has witnessed a 16 per cent drop in western European sales despite the addition of the Chrysler brands (Jeep, Dodge, Chrysler). On the other hand, Renault-Nissan has emerged as a major global player, reaching almost two million European registrations in 2017 in comparison to less than 1.5 million in 2007, a result of the revival of the low-cost Dacia brand and the success of Nissan's vehicles. PSA has managed to stay ahead of Renault-Nissan only as a result of its recent acquisition of Opel. Without Opel, PSA would have seen a 24 per cent decline since 2007 and a shrinkage in its market share from 13.1 per cent to just 10.3 per cent. The recent Opel sale marked the historic exit of General Motors from Europe, following Ford's divestment of Jaguar, Land Rover and Volvo (in their turn, sales of the Ford brand declined by 21 per cent). Toyota and Honda sales have also failed to recover, while other Japanese manufacturers have struggled to maintain a foothold in the European market. In contrast, Hyundai-Kia has almost doubled its market share, from 3.3 to 6 per cent, due to a large extent to its SUV portfolio.

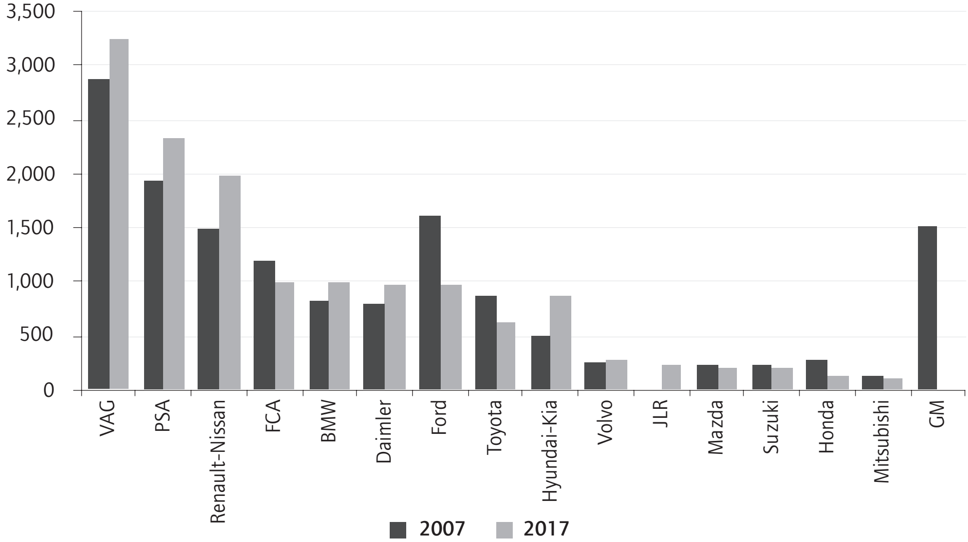
Figure 2 **The EU passenger car market, 2007 vs. 2017 (in thousands)**



Source: ACEA (2018).

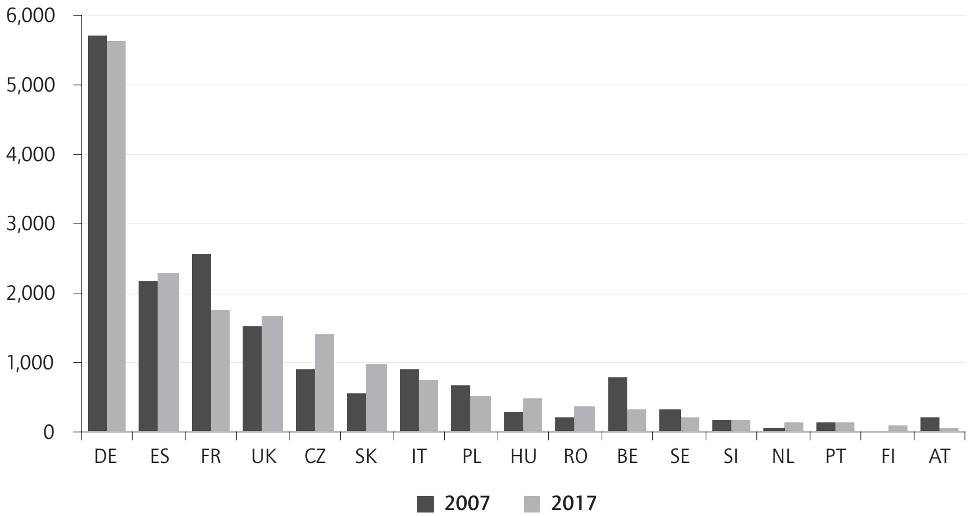
In terms of production, Germany has retained its share of 33 per cent of total EU production, further distancing itself from the rest of continent, especially since France has witnessed a 31 per cent decline (from 2.55 million cars assembled in 2007 to just 1.75 million) and has lost its runner-up position to Spain (Figure 4). Belgium, Austria and Sweden are also among the losers in western Europe while, in the south, Spain and Italy have had diverging trajectories. Poland aside, the biggest growth in production has taken place in central and eastern Europe. In Czechia, Slovakia, Hungary and Romania, the automotive industry has firmly established itself as the strongest manufacturing branch and, indeed, the most important economic sector overall.

Figure 3 **New registrations by manufacturer, EU15 plus EFTA, 2007 vs. 2017 (in thousands)**



Source: ACEA (2018).

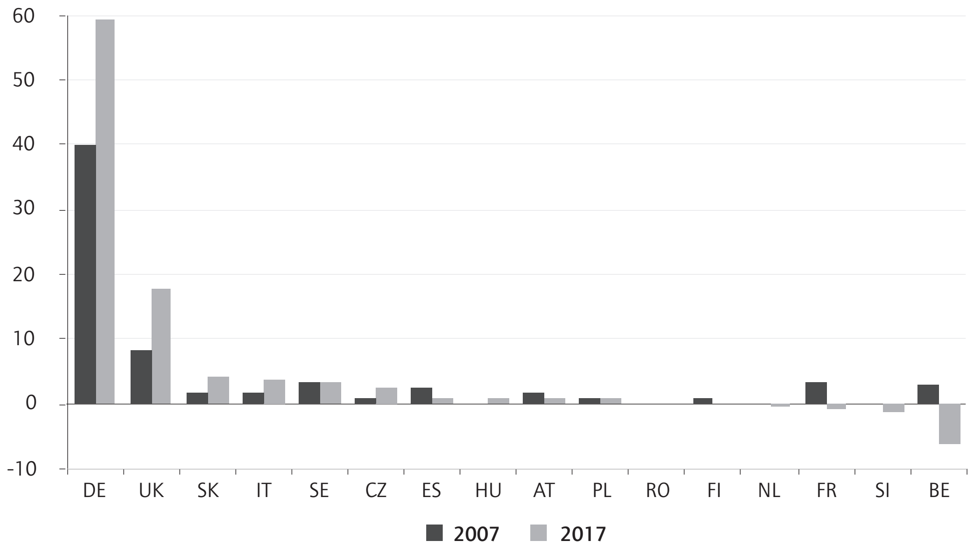
Figure 4 **EU passenger car production, 2007 vs. 2017 (in thousands)**



Source: OICA (2018).

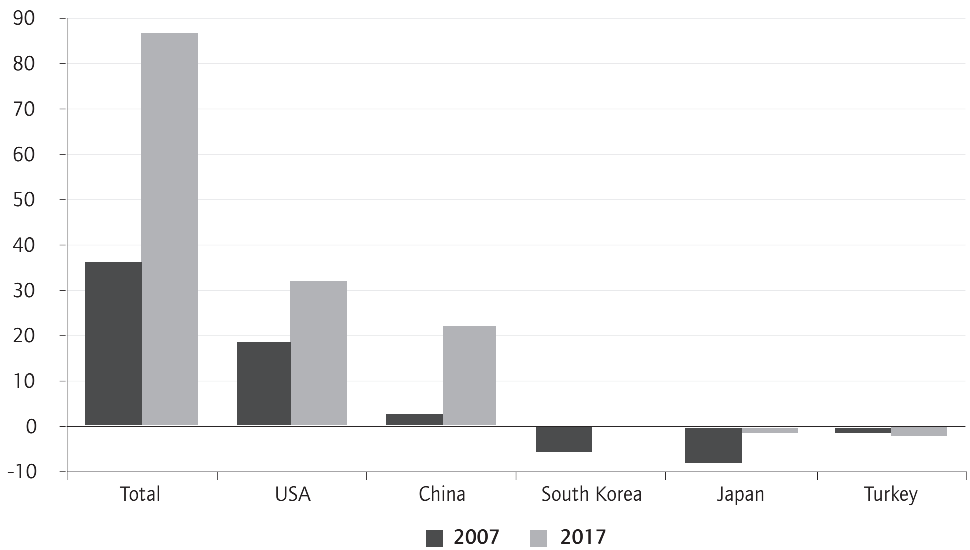
Between 2007 and 2017, the EU's trade surplus for personal cars with the rest of the world increased by 23.5 per cent, from €70.1bn to €86.6bn, largely due to an almost 50 per cent increase in the already huge German trade surplus (Figure 5).

Figure 5 **Trade surplus in passenger cars, 2007 vs. 2017 (in €bn)**



Source: Eurostat.

Figure 6 **EU trade balance in personal cars by trade partner, 2007 vs. 2017 (in €bn)**



Source: Eurostat (2019).

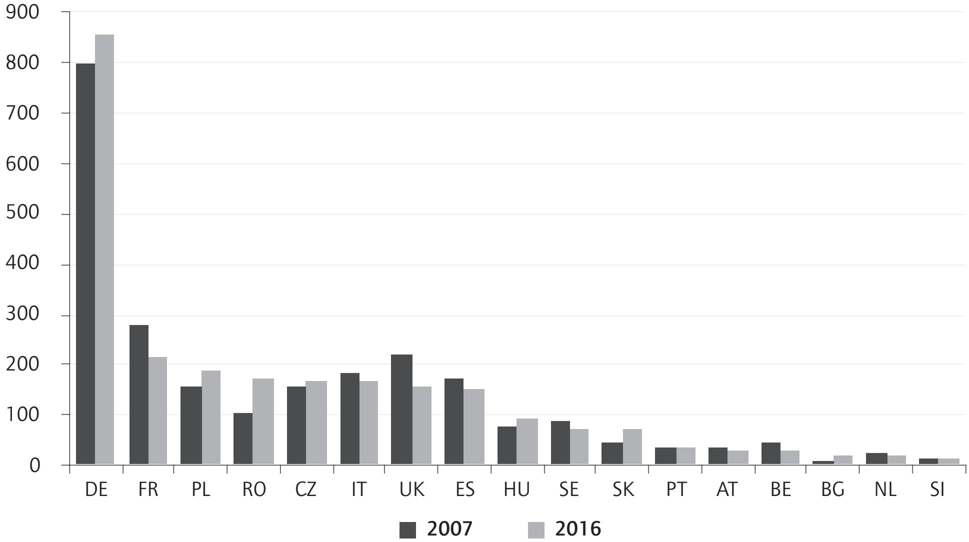
Alongside Germany, the UK, as well as Czechia, Slovakia and, interestingly enough, Italy, have all contributed to the soaring foreign success of the European automotive industry. This was, of course, made possible by the boom in the Chinese market as well as the quick recovery of sales in the United States (Figure 6). What is perhaps less expected is the growth of exports to South Korea by no less than 547 per cent, effectively eliminating the historically large trade deficit, as well as the doubling of exports to Japan coupled with a significant decline in imports, visible in the declining sales of Japanese brands.

The recovery of the European automotive industry has thus been based, to a considerable extent, on the growing export prowess of German premium manufacturers which, alongside the VAG juggernaut, have emerged as the major winners in the post-crisis recovery at the expense of volume producers like Fiat Chrysler Automobiles (FCA) and the Japanese OEMs. After GM's exit, only one of the US 'big 3' maintains large-scale operations in Europe although Ford has, likewise, significantly reduced its footprint relative to the pre-crisis period. Despite growing considerably, the situation of the two major French OEMs seems rather mixed: Renault-Nissan's production figures have stagnated, as it has become increasingly less export-oriented, while PSA's major decline in production and sales has been mitigated by its acquisition of Opel – a major move whose full consequences are, as yet, unclear. On the whole, uneven development has deepened, with Germany extending its leadership position and central and eastern Europe increasingly capitalising on cost-related competitive advantages at the expense of France and of southern Europe. For all industry players, these transformations seem to have been worth it, with revenues and profitability again on the rise for all but the most troubled companies.[1]

In terms of employment (Figure 7), the winners are, once more, Germany and the countries of central and eastern Europe, whose integration in German supply chains has strengthened significantly. France and the south are clear losers in this respect as well. The UK is a separate case as, in comparison to pre-crisis years, it produces approximately nine per cent more cars with 28 per cent fewer employees than the average for the industry as a whole. Still, the overall balance appears to be clearly positive: from 2.2 million direct and 10.3 million indirect automotive jobs in Europe before the crisis to 2.5 million direct and 10.8 million indirect jobs in 2016 (ACEA 2008: 32; ACEA 2018: 10). ACEA data indicates that the weight of direct automotive employment in the European manufacturing industry has increased from 6.5 per cent before the crisis to 8.3 per cent in 2016.

1. Opel is of course a notable exception, its negative results repeatedly making the headlines in the aftermath of its acquisition by PSA. PSA's consolidated results are nonetheless strong and, at least financially, the French group appears to have fully grabbed the opportunities provided by the recovery of the European market.

Figure 7 **Employment in the EU automotive industry, 2007 vs. 2016 (in thousands)**



Source: Eurostat database (sbs_na_ind_r2).

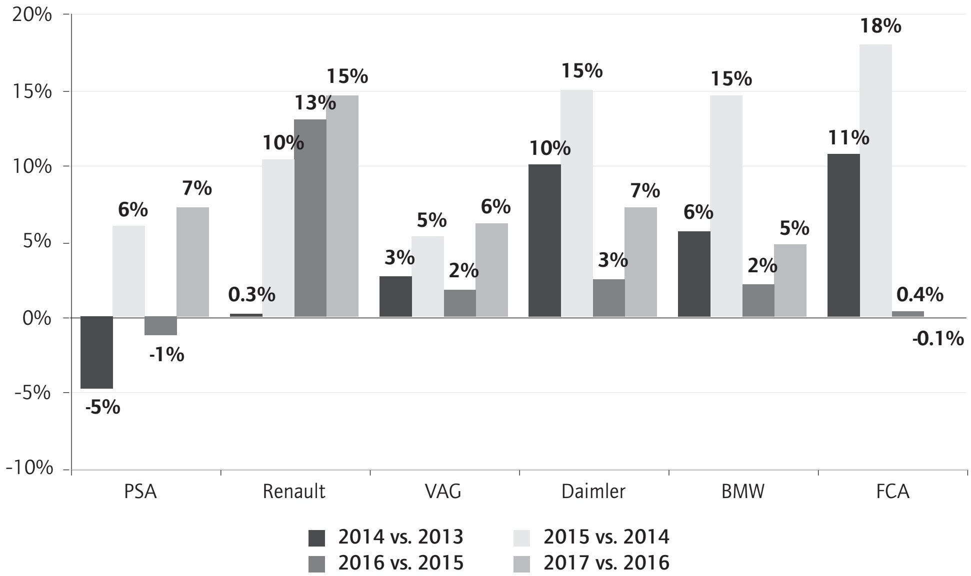
1.2 Growth and profitability for all

So far, for the main European manufacturers, recovery has meant turnover growth, high profitability rates and improving returns on equity.

Renault has registered the strongest turnover growth rates since 2013, followed by Daimler and BMW (Figure 8). With a strong presence in the NAFTA region, FCA boosted its sales in 2014 and especially in 2015. PSA's growth performance is relatively weak in comparison to other manufacturers, although its sales and market share recovered in 2017.

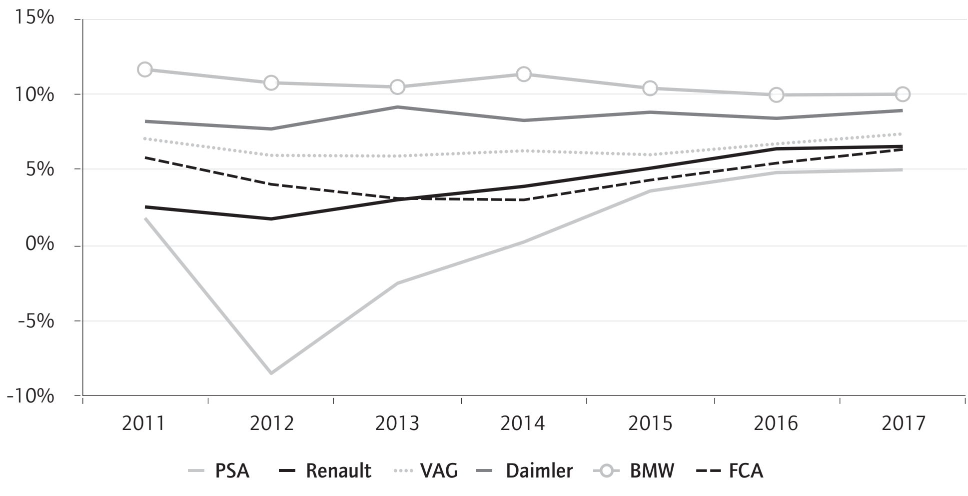
In 2017, profitability rates converged to a relatively high level, i.e. between five per cent and ten per cent for all European OEMs (Figure 9). Rates of profitability at Daimler and BMW stood at around ten per cent. FCA, Renault and PSA increased strongly, reaching levels close to that of VAG. These performances have granted OEMs some leeway to invest and develop. Consequently, the main European manufacturers have significantly increased their capital and research and development expenditures during the last three years.

Figure 8 **Global turnover growth of the main European manufacturers**



Source: Syndex.

Figure 9 **Operational profit margins of the main European OEMs (% of turnover)**



Source: Syndex.

2. The drivers of technological transformation

Notwithstanding the positive trajectory of recent years, feelings of uncertainty and the perception of an impending shake-up of the entire automotive establishment are widely shared among industry players and commentators.

2.1 Three simultaneous transformations

The automotive industry is currently undergoing three simultaneous transformations. First, regulatory change aimed at fulfilling climate policy objectives and improving environmental performance and public health is pushing the industry toward powertrain electrification with the potentially imminent disappearance of the internal combustion engine. Second, a 'mobility revolution', made possible by extensive digitalisation and vehicle electrification, entails the development of services and service provision functions alongside new connectivity and autonomous features. Such change is truly revolutionary since it has the potential to overhaul vehicle usage and ownership along with the industry's traditional business model. Third, digitalisation across the automotive value chain promises to stretch the physical limits of flexible production even further.

At the same time, the European market is expected to grow at best incrementally over the next decades (cf. Figure 1), which means no growth in volumes while costs are set to increase significantly. Scenarios developed by the European Commission's High Level Group 'GEAR 2030' estimate a drop in profit margins from approximately five per cent to two per cent in Europe between 2017 and 2030 for conventional combustion engine vehicles (European Commission 2017b: 64).

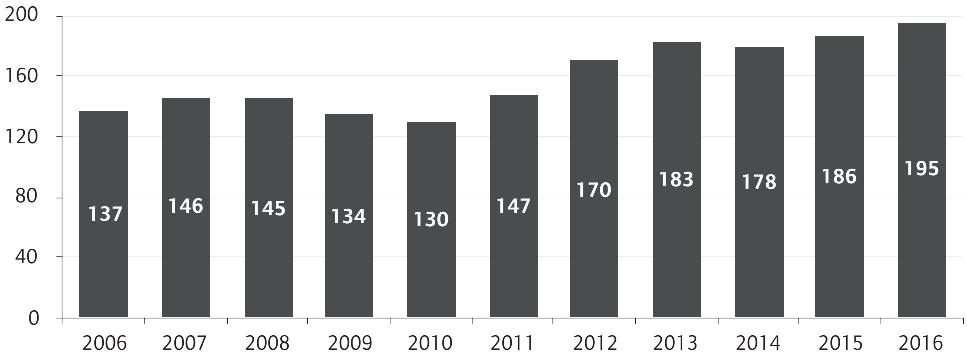
Two of the reports published by GEAR 2030 (European Commission 2017a; 2017b) emphasise the challenge of maintaining a European foothold in dynamic foreign markets given heightened global competition and the rapid advance of Chinese industrial capabilities. GEAR 2030 estimates that European players will, nevertheless, be able to grab a substantial share of the e-mobility market that is estimated to grow to $339bn by 2030 (European Commission 2017b: 114). The same goes for the market in connected autonomous vehicles which GEAR 2030 estimates at $273bn.

Such opportunities present themselves both for OEMs and for the European supplier industry. A strategy report by Continental (2018), for example, estimates that total supplier revenues from powertrain electrification and connected and autonomous vehicles will grow at a rate of 30 per cent per year between 2017 and 2030, reaching €200bn. In comparison, the established supplier business is estimated to grow at just one per cent per year over the same period. Continental singles out digitalisation as a 'key enabler' of these new opportunities, albeit at the cost of increased levels of its R&D and capital expenditure, by 83 per cent and 73 per cent respectively in comparison to 2012.

The unprecedented levels of investment – far above the pre-crisis period (see Figure 10) – are, in fact, a feature of the entire industry and there is widespread agreement that much more is needed over the following period.

Estimates indicate that $80bn has been invested in autonomous vehicles alone between 2015 and 2017, with an equal sum going into powertrain electrification for which Volkswagen has, by itself, announced investment of $86bn by 2022 (Deloitte 2018: 2). Industry analysts have already questioned the sustainability of such massive investments given the industry's persistently low profit margins and the obvious slowdown in post-crisis recovery. Further doubts arise when considering consumers' limited willingness to pay more for new technological features, the lack of short- and medium-term returns on such investments, the still-stringent requirements of operational investments and the high sensitivity of the industry to volume fluctuations during any downturn (Giffi *et al*. 2017; PWC 2017a).

Figure 10 **Combined capital spending, R&D and M&A of top ten global OEMs (in €bn)**



Source: PWC (2017a).

Cutting costs provides one way of dealing with the quandary of limited capital resources amidst growing investment requirements, and the further digitalisation of the traditional automotive value chain is one avenue of action in this regard. However, even if distribution costs can be lowered significantly and relatively easily through online sales, the digitalisation of manufacturing requires massive upfront investments on its own so it cannot function as a means to reduce financing requirements in the short-term.

One way of cutting costs is through generating economies of scale via platform sharing between OEMs, although this implies much closer collaboration than has been usual so far. A more direct approach is to enter into partnerships with the explicit aim of developing new technologies. The industry has indeed seen an unprecedented flurry of such agreements together with acquisitions, divestments and spinoffs to make the most of the available financial resources and know-how. Apart from the established players, many deals feature new entrants, including hardware and software companies, digital service providers and battery manufacturers.

However, according to the multitude of scenarios resembling futuristic literature which are currently criss-crossing the automotive world, powertrain electrification and autonomous vehicles are threatening the established automotive assemblers and suppliers in a much broader sense. Technologically-induced 'disruption' does not simply mean that large-scale investments are becoming increasingly risky, but rather that they have the potential to turn the entire industry on its head. Indeed, even though the automotive industry has been at the forefront of technological innovation since its inception, for many observers it is only now that genuine epochal change is happening, as everything from the industry's century-old business model to the car itself and its place in everyday life is expected to undergo a true test of survival in the foreseeable future.

The rest of this chapter is dedicated to the three major technological disruptions and their impacts on employment. For each of the three, we briefly describe the new technologies and the drivers behind technological innovation. We then analyse potential disruptions for the European automotive industry as well as the current knowns and unknowns that surround them. Finally, we discuss the potential scenarios for employment and for the transformation of work.

2.2 Powertrain electrification and the twilight of the internal combustion engine

Following countless announcements of tightened regulation amid the scandals surrounding diesel motorisation, it is now certain that more and more cars will be powered by electricity (or hydrogen) instead of fossil fuels and that internal combustion engines in automobiles will eventually become a thing of the past. It is also quite certain that this transformation will take several decades and that the tipping point will only be reached once charging infrastructure becomes available on a sufficient scale and electric vehicle production costs approach those of today's conventional cars. While the disruptive potential of electrification is certainly lower and more focused than that of connected and autonomous vehicles, it has major implications for how a substantial part of the industry operates and its employment impact is still subject to controversy.

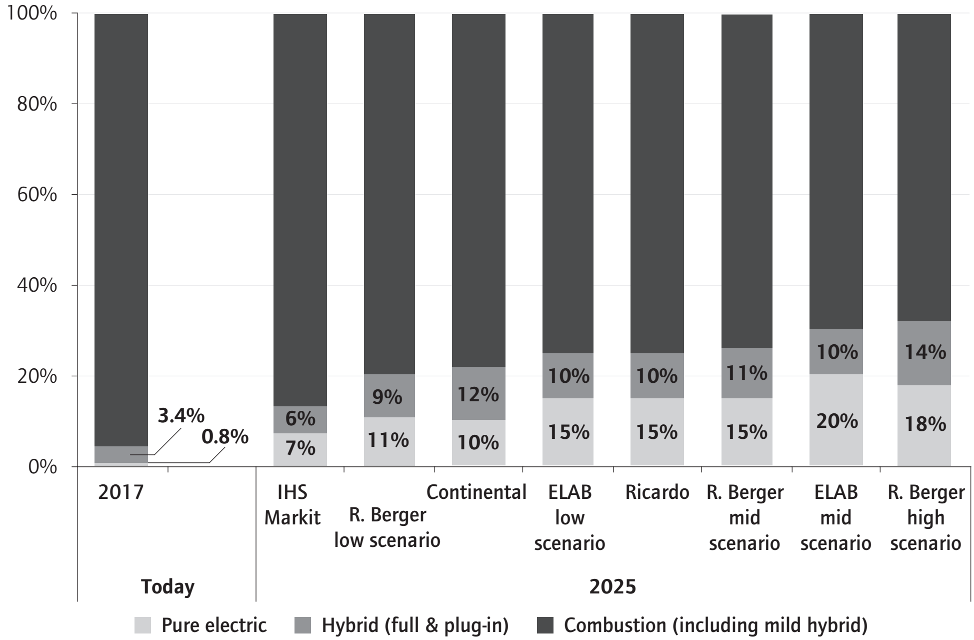
Tightening environmental regulations are the main driver behind powertrain electrification, in which regard the European Union currently maintains a clear 'regulatory lead' at global level (European Commission 2017b: 11). The European Commission expects environmental regulations to converge over the following decades, but it also believes that current EU policy is sufficient to provide a 'critical edge' to European OEMs in the rush to develop commercially viable electric vehicles.

Which energy mix?

There is a wide diversity of assessments concerning the future market share for electric vehicles. For 2025, estimates vary between twenty per cent and thirty per cent if we include plug-in hybrids, with battery-powered electric vehicles (EVs) to have a market share of ten per cent to twenty per cent (Figure 11).

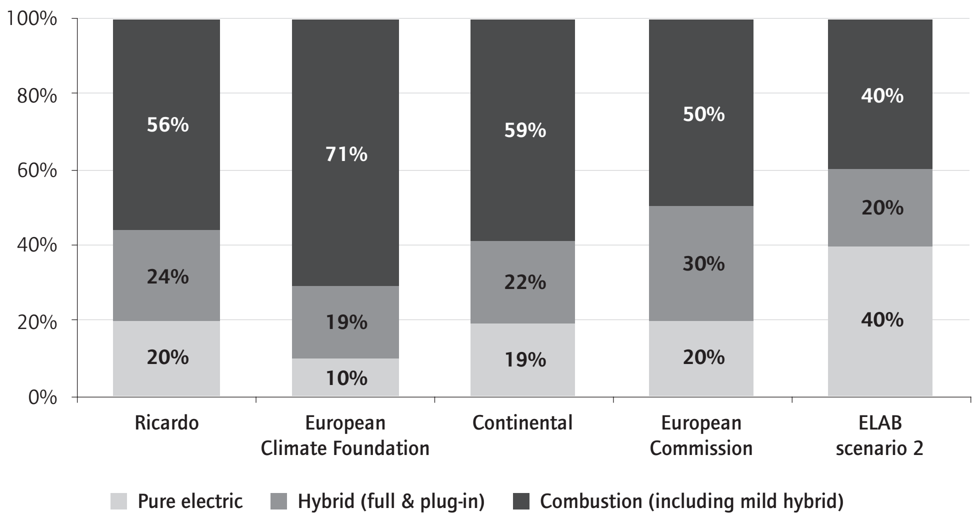
For 2030, the disparity of forecasts is naturally much larger (Figure 12). Electric vehicles could take up thirty per cent to sixty per cent of the market. The European Commission estimates the combined market share of battery electric vehicles (BEV) and plug-in hybrids (PHEV) at fifty per cent by 2030. In the long run, it is expected that BEVs will dominate all regional markets. In most scenarios, BEVs appear as the primary solution for electrification. Given the bans on combustion engines in some major European urban areas (Paris and London included) that have been announced for 2030, it is likely that hybrid powertrains will serve merely as a temporary solution, facilitating both the technological and the social transition to pure electric vehicles.

Figure 11 **Variability of market forecast for 2025 in Europe**



Source: Syndex.

Figure 12 **Variability of market forecasts for 2030 in Europe**



Source: Syndex.

Indeed, for the European Commission (2017a: 36), plug-in hybrid vehicles are expected to play a major role in the shift to purely electric automobiles and are widely regarded as 'an important transitional technology'. For OEMs, hybrids offer the opportunity to invest in both EV (required to meet future regulatory requirements) and ICE (required to secure present-day profitability) technology, although regulation will eventually make continued ICE investments unfeasible from both operational and financial points of view.

However, uncertainties concern both the technological (battery density and autonomy) and the economic aspects of battery-powered electric vehicles. At present, BEVs are still far from being as cost-effective and as usable as conventional automobiles. The high cost of batteries, which can currently take up forty to fifty per cent of the total cost of an EV (Kochhan *et al.* 2017: 4), make non-premium electric automobiles prohibitively expensive despite the incentive schemes set up by many European governments. This should not last long, as the total costs of vehicle ownership and the OEM profitability of EVs is expected to be on a par with those of conventional automobiles before 2025 even without state incentives (UBS 2017: 44). For example, Renault, the European leader in BEV development, anticipates in its most recent medium-term strategy plan ('Drive the Future') that, by 2022, the costs of the battery packs of new e-motors will decrease by thirty per cent and twenty per cent respectively.

Battery technology is expected to improve alongside declining costs, but the estimated $14bn needed in Europe just until 2025 for setting up the required charging infrastructure (UBS 2017: 16) remains a big unknown.

For the next decade, the Commission is emphasising the crucial role that regulation and rapid EV development should have in protecting the European market from low-cost foreign entrants and in securing a presence on foreign markets for European OEMs. With strong advances in EV technology, China is particularly threatening in both regards. The question of how European manufacturers will respond to these new threats is thus vital for the fate of the industry.

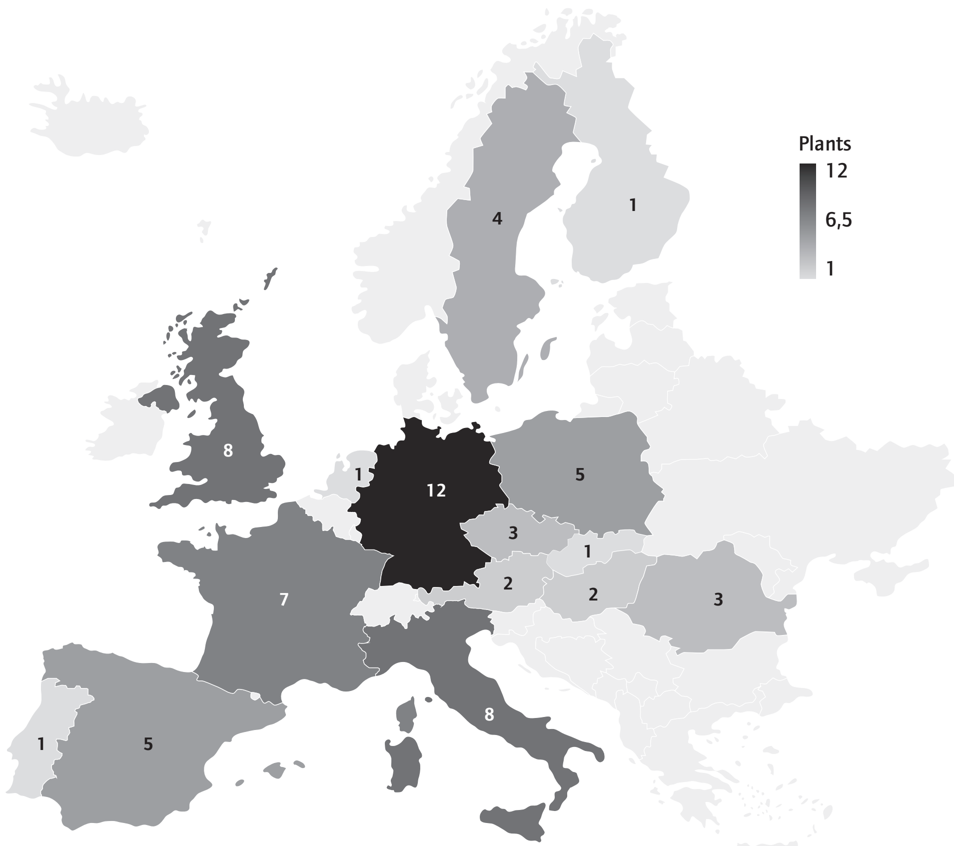
Shifting content in BEV solutions

Full powertrain electrification puts in question dozens of engine and transmission plants across Europe. According to the most recent ACEA data (Figure 13), there are 63 engine plants in Europe with the largest concentrations in Germany (twelve), France (seven), Italy and the UK (eight each).

In a BEV, the combustion engine is replaced by a battery coupled to an electric motor, while a simple one- or two-speed integrated transmission replaces the highly-complex mechanical transmission required in ICE cars. In such conditions, the sustainability of the existing powertrain industrial infrastructure is under serious threat.

While the electric motor is simple to manufacture and, as it seems, many OEMs will opt to produce it in-house, major questions still surround battery production. Even with the expected cost reductions of a rapid transition to EV dominance, long-term forecasts indicate that batteries will continue to represent 25 per cent of the total cost of a car in 2050 (European Commission 2017b: 86). It is improbable that OEMs with no previous contact with electrochemistry will invest in battery production, so battery suppliers are expected to play a major role in the EV ecosystem. Indeed, it is relatively easy for battery makers to supply not just the battery but the entire powertrain, as is already the case with the Chevrolet Bolt, where no less than 56 per cent of the car's total content comes from LG (UBS 2017). Battery commoditisation is still a possibility but, if it remains the high-tech, difficult-to-manufacture product that it is today, this could spell the end of the traditional power structure between suppliers and OEMs as the latter will find it increasingly difficult to boost margins by pressuring the former to reduce prices. The future of the battery market is difficult to predict as yet, although for OEMs this is certainly a key strategic dilemma.

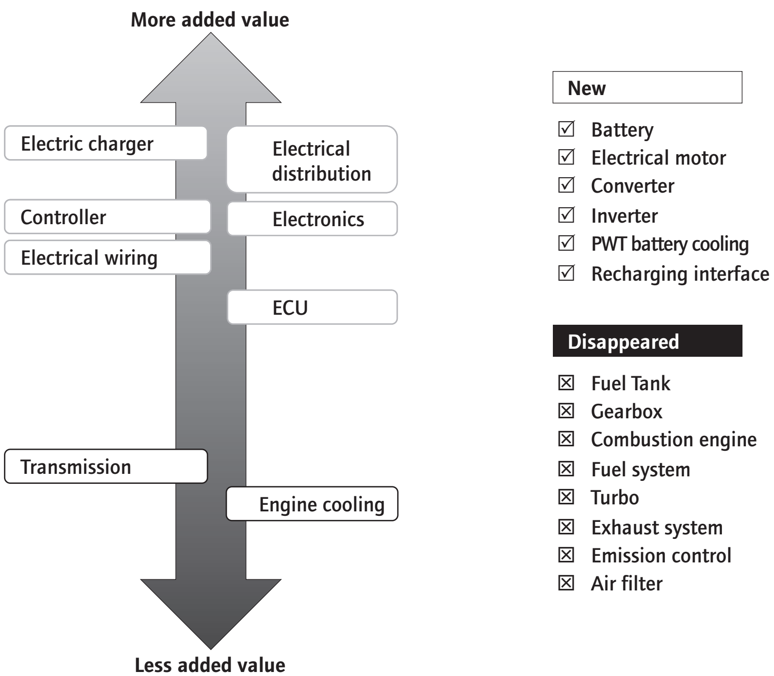
Figure 13 **Engine plants in Europe**



Source: ACEA (2018).

On the supplier side, the arrival of battery producers will be followed by the disappearance of a large array of ICE-specific components (Figure 14): a BEV has no need for a fuel tank, a fuel pump, a turbo or an exhaust system, a clutch, an emissions control system, air and oil filters, or any of the standard components of a combustion engine (valves, crankshaft, camshafts, etc.). A recent study (UBS 2017) shows that an EV powertrain has six times fewer moving parts and is thus mechanically far simpler than a standard ICE powertrain. At the same time, it is significantly more complex from an electronic point of view and contains up to ten times more semiconductor content. New major parts include converters, inverters, power distribution modules, electric drive units, motor cooling systems and chargers. As mentioned already, the transition via PHEVs will prevent a zero-sum game between ICE and EV value chains for some time to come but, in the long run, the sizable powertrain supplier industry will be overhauled by the shift to pure electric vehicles. The significant decline of spare parts and aftermarket activities resulting from the diminished number of wearable parts in the EV powertrain will further contribute to this.[2]

Figure 14 **The value chain of an electric vehicle**



Note: The ECU (engine control unit) manages the fuel injection in an ICE system.
Source: Syndex.

2.3 Employment impacts of vehicle electrification: a qualitative approach

Syndex's analysis of the situation and strategies of the main automotive OEMs and suppliers in Europe indicates that the social impact of powertrain electrification is likely to be mixed (Table 1).

2. Estimates indicate a drop of no less than sixty per cent of the revenue pool of after-market activities (UBS 2017).

In the short-term, the prospect of a tightening of regulation will boost investments in new ICE technology and in hybrid powertrains, alongside a continued shift from diesel to petrol motorisation. These should all have a neutral, or even slightly positive, impact on employment in production (for example, the new 'Euro 6d-temp' norm requires additional exhaust treatment, equipment and sensors).

Table 1 **Powertrain employment impacts: diverse and contradictory dynamics**

	Production	R&D
Today	↑ Implementation of EURO 6d-temp – new equipment ; ↑ Limited hybrid impacts on assembly activities (but complexity, intensity of work) ↔ Limited volumes of BEV, low productivity ↓ More Gasoline/Less Diesel Volumes	↑ A lot of work for powertrain teams (test + norms adaptations) ↓ Mobility (diesel/ gasoline), diesel decline ↓↑ Emergence of EV/FCEV teams + adaptation of all the vehicle functions to an electrical architecture ↑ ⟳ Diversified powertrain solutions (Full electric, Hydridized, Thermal) ↓ Divestiture (volunteer departure ; partnerships; externalisations...)
After 2021	↓↑ More BEV volumes ? Depends on the speed of electrification and the share of hydrids (MHEV, PHEV, FHEV) ? Depends on the battery production contribution ↓↑ New strategic suppliers (batteries), but shorter supply chain	↓ Decline of ICE projects ⟳↑ More EV/FCEV projects ↑ New R&D domain (next generation of battery, quantum computing...)

Source: Syndex.

In R&D, the short-term impact of the transition toward EVs should also boost employment, given the focus on adapting to new environmental regulations and tests, the emergence of dedicated EV teams, the diversification of powertrain systems (ICE, hybrid, pure electric) and the need to adapt all vehicle functions to EV architecture. On the less positive side, the transition from diesel to petrol should involve some transformation of existing competences, while the expected decline of R&D in ICE technology could lead sooner rather than later to voluntary leaver plans.

We believe that the medium-term impacts – i.e. following 2021 and the implementation of new environmental regulations – will be negative for employment. In terms of R&D, the reduction in the number of combustion engine platforms and the lack of certainty concerning future generations of plug-in hybrid powertrains will limit the need for new R&D resource allocation. In parallel, the development of electrified powertrains, and especially battery systems, will continue to grow but will require smaller R&D teams with higher technical abilities than for combustion engines. Such expertise usually lies within the purview of actors outside the automotive industry.

In production, the simplification of manufacturing processes is likely to lead to a decline of employment both in OEMs and in suppliers, although the extent of this will depend on the pace of the transition from ICE to BEVs — during the transition, the rise of hybrid vehicles will actually increase the complexity.

The extent of overall employment decline is also likely to depend on the capacity of the European industry to develop electrochemical operations related to battery development, which could take up between four and seven per cent of automotive employment in the future (see below).

For now, however, the positive employment effect of co-existing ICE and EV powertrains, with continued ICE development to keep up with environmental regulation and the shift from diesel to petrol, implies higher workloads. Given the need for OEMs to compensate for still-barely profitable EV portfolios, this situation is bound to persist at least into the first half of the 2020s.

Diverging estimates of employment impacts

Almost all the available estimates on the overall impact of vehicle electrification on employment at European level are positive (see European Commission 2017d: 51) and the forecasts of the European Commission make no exception in this regard (Table 2). Depending on the CO_2 emissions reduction scenario, by 2030 the total number of jobs in the European economy is expected to increase in a range between 18,000 and 86,000. For the automotive sector itself, the forecast employment effect becomes increasingly negative as the level of emissions reduction and powertrain electrification increase (job losses of between 3,000 and 12,000). It needs to be emphasised that both positive and negative employment forecasts are extremely modest (less than one hundredth of one per cent for the European economy and less than half of one per cent for the European automobile industry).

Far more optimistic scenarios have been published, with the European Climate Foundation (2018) estimating that 206,000 jobs will be created by 2030. The most positive scenarios involve a ‘net increase in employment across the economy of 500-850 thousand’ (Transport & Environment 2017). This is largely attributed to the redirection of a substantial part of household budgets from fossil fuel spending, freeing purchasing power for other industries and the service sector. As fossil fuels are largely covered by imports, the underlying assumption is that only four European jobs are created for each €1m of value added in the petroleum industry, in comparison to 24 jobs on average for the whole economy. Growing R&D employment and additional jobs in the infrastructure sector required for EVs are also believed to have a positive impact on overall employment levels. The same estimate indicates that maintaining current levels of automotive employment is possible and could even increase if Europe becomes a net exporter of EVs and if battery production remains local. In both regards, China represents the only potential threat at the moment. Fully importing batteries would reduce European automotive employment by six to seven per cent by 2030, according to some estimates (Transport & Environment 2017: 4) or by four per cent (100,000 jobs) in others (European Commission 2017b: 88).

Table 2 **Employees in atypical and standard jobs, 2000-2015 (in 000)**

CO_2 emissions reduction target	No change	20%	30% cars / 25% vans	40%	20%	30% cars / 25% vans	40%
	Number of jobs in the EU (thousands)	Change (thousands)			Change (%)		
Petroleum refining	151	0	-1	-1	-0.2%	-0.3%	-0.5%
Automotive	2,454	0	-3	-12	0%	-0.1%	-0.5%
Rubber and plastics	1,776	+5	+5	+7	+0.3%	+0.3%	+0.4%
Metals	4,288	+5	+5	+5	+0.1%	+0.1%	+0.1%
Electrical equipment	2,451	+5	+7	+12	+0.2%	+0.3%	+0.5%
Electricity, gas, water, etc.	2,52	+2	+2	+5	+0.1%	+0.1%	+0.2%
Other sectors	200,427	+3	+3	+69	+0.001%	+0.001%	0.03%
Total	**230,209**	**+20**	**+18**	**+86**	**+0.01%**	**+0.01%**	**+0.04%**

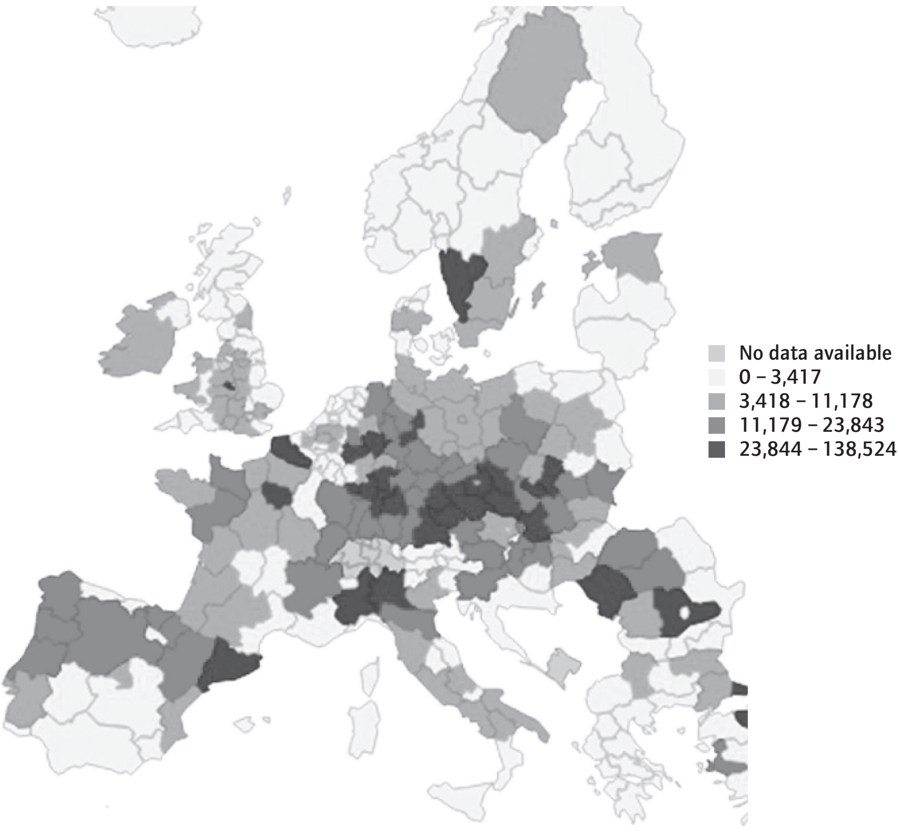
Source: European Commission (2017c: 95).

As for the automotive sector *per se*, there is a widespread consensus that the growth of EVs will lead to employment decline, especially in the long-term when the temporary positive employment effects of hybrid technology would have dissipated. The differences between optimists and pessimists are much more obvious in this regard. One recent study suggests that electrification could lead to a reduction in employment of 'around 60 per cent in powertrain, spare parts manufacturing and maintenance' (FTI Intelligence 2018: 1). Pessimistic scenarios involving a full move to pure electric vehicles have estimated job losses at around 600,000 in Germany alone (Cramer 2017), where 58 per cent of automotive manufacturing is 'dependent' on the conventional combustion engine (FTI Intelligence 2018: 2). One German OEM has indeed suggested that electric motor manufacturing requires between eighty and ninety per cent fewer employees than ICE manufacturing (FTI Intelligence 2018: 11).

The employment impact will most certainly be uneven, especially among tier 1 suppliers. Industry analysts (UBS 2017) assessing the preparedness of suppliers for the EV challenge have emphasised that some have already lost plenty of ground while others are set to emerge as major winners. Continental, for example, estimates it will have 400 per cent more content in a BEV than in a standard gasoline ICE automobile (Continental 2018). In addition, battery manufacturers could gain significant leverage by grabbing sizable parts of the upstream value chain, leaving many existing tier 1 suppliers completely outside powertrain manufacturing. Consequently, even in the more optimistic scenarios in which European automotive employment will not change significantly, it is unlikely that all of today's major players will enjoy a smooth transition.

The question of unevenness is also a spatial one, as European automotive employment is highly concentrated geographically (Figure 15; see also Figure 13). A study by FTI Intelligence (2018: 17) mentions fourteen regions in which automotive employment exceeds twenty per cent of total manufacturing employment. A strong negative impact on automotive employment will hit these regions particularly hard and important structural changes could happen even where current overall levels of employment are maintained. It must also be kept in mind that, even if the internal combustion engine is here to stay for at least two decades, both as a standalone option and as a part of hybrid powertrains, there is a risk that ICE technology will become commoditised and even shared among OEMs focused on EV development. Commoditisation could lead to the further delocalisation of ICE manufacturing to low-cost countries in central and eastern Europe. Such cases of west-east delocalisation due to ICE decline already exist, exacerbated by the diesel scandal (Tighe 2017).

Figure 15 **Number of automotive employees (FTE) by region, 2015**



Source: DG Growth cluster mapping tool.

3. Connected and autonomous vehicles and the impending 'mobility revolution'

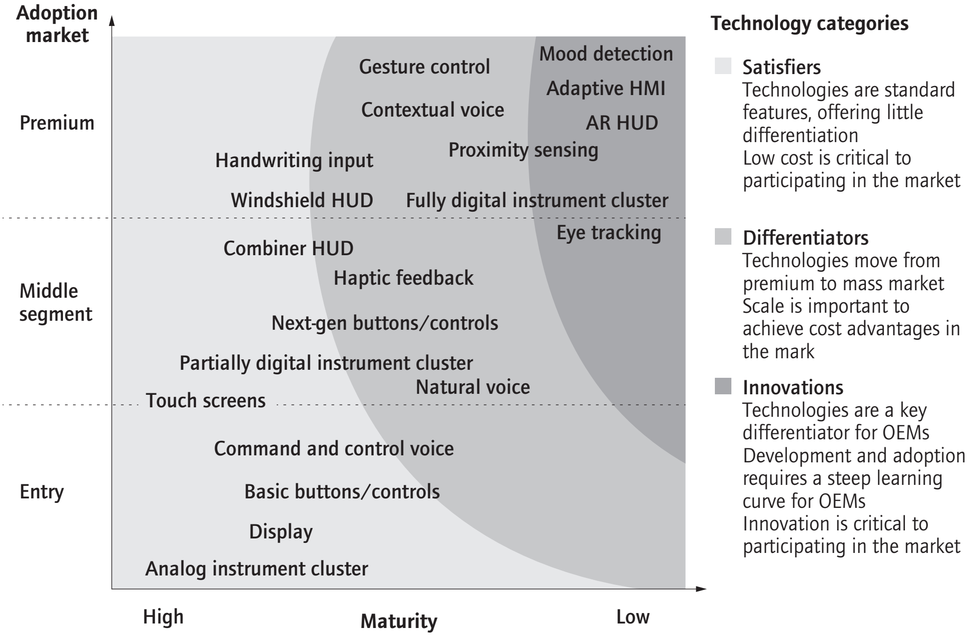
3.1 The technology landscape

The technology for connected and autonomous vehicles (CAVs) has far more disruptive potential for the automotive industry than powertrain electrification. The shift to shared and autonomous vehicles is genuinely revolutionary for an industry that has, from its inception, been dependent on the manufacture and sale of privately-owned, human-driven automobiles. In contrast to the case of EV development, where regulation is the major impetus behind technological innovation, CAV development is being pushed mainly by technological innovation while the question of workable regulatory frameworks for fully autonomous vehicles remains a big unknown. And even though the technology for autonomous vehicles might take longer to develop than that of electric powertrains, there is no technological uncertainty like those concerning EV range and charging infrastructure. The major uncertainty thus concerns the survival of the existing automotive business model, as current automotive revenues and profits would shrink in favour of mobility services while car manufacturers face increased competition from technology companies.

Existing connected vehicle technology is practically harmless and, in itself, only adds secondary functionality without threatening the industry or established ways of using vehicles. As a general principle, 'Connected cars are those that have access to the internet and a variety of sensors and are thus able to send and receive signals, sense the physical environment around them, and interact with other vehicles or entities' (PWC 2016: 10). Today's connected features include infotainment, GPS and parking assistance while those of tomorrow might include advanced human-machine interfaces (HMI) and augmented reality. Existing connected vehicles already feature complex sensors and increasingly greater processing capacity, while dedicated operating systems and in-vehicle apps are not that big an innovation in the smartphone era. Indeed, PWC (2017: 8) estimates indicate that, in 2017, 89 per cent of new cars sold in Europe, China and the US had such basic connectivity features with 100 per cent to be reached by 2022.

As connectivity technology matures, increasingly more features will become available to middle and entry market segments, becoming part of the basic price list (see Figure 16). Connectivity hardware, in particular, may well become commoditised, with falling revenues and profitability, while the market in digital services could stagnate, at least in comparison to more sophisticated connected technology like shared mobility (Figure 17). Vehicle software content is expected to increase substantially and could even replace the car's body and traditional functionality as the key differentiator between products. More software content will mean that connected cars will begin to generate massive amounts of vehicle and customer data, which could be used to provide tailored services (e.g. insurance adapted to driving style) and improved vehicle performance and usability (e.g. predictive maintenance). Although this extension of the traditional automotive value chain is already tangible, it is still uncertain whether OEMs will secure control over in-vehicle software and the data it generates. It is equally possible that they will have to give ground to technology companies looking to expand their dominance into an emerging field of activity, threatening to confine OEMs and traditional suppliers to the manufacture of increasingly commoditised vehicles and hardware.

Figure 16 **Technologies for the connected car: maturity and adoption rates**



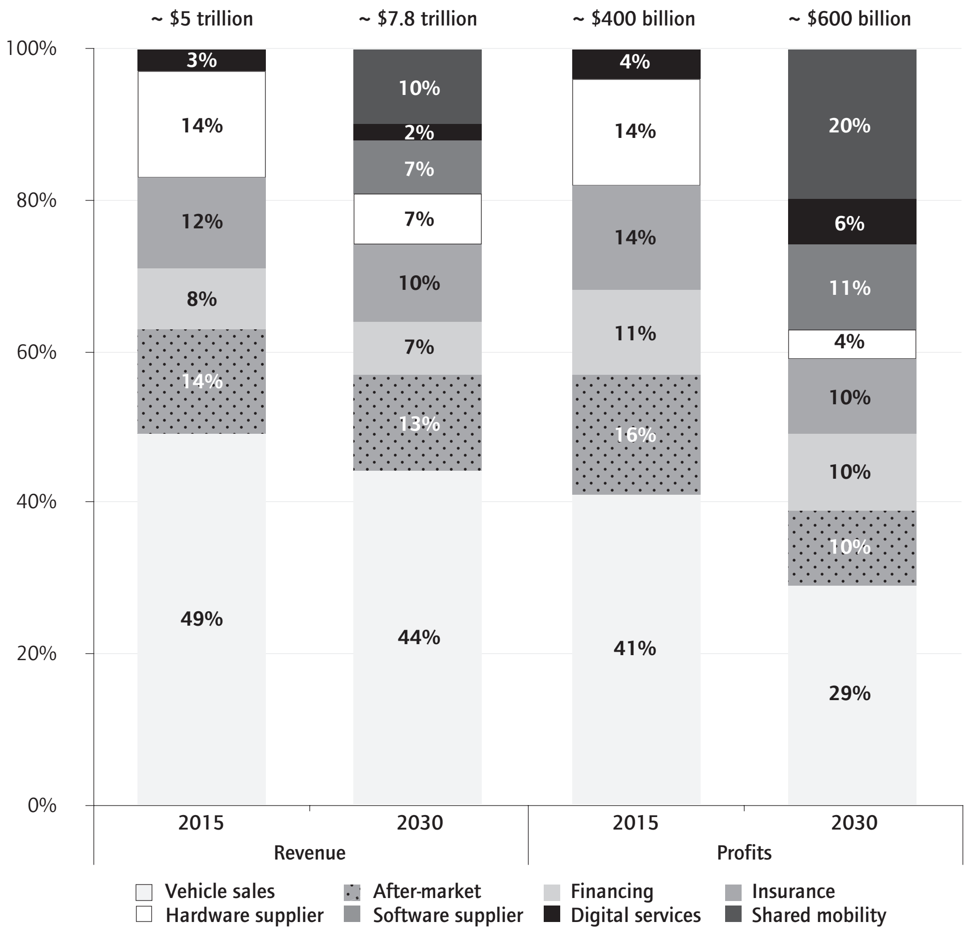
Source: PWC (2016).
Note: AR = augmented reality; HMI = human machine interface; HUD = head-up display

Connectivity between cars and their environment and interaction between cars are key elements in the development of autonomous vehicles for which integrated computer hardware and software provides anything from simple assistance (Level 1) to full automation without any intervention from users (Level 5).[3]

Leaving aside the potential for vehicle sharing, autonomous vehicles do not in themselves represent much more of a threat to established industry players and business models than connected vehicles. They require significant investments in both software and hardware (driver assistance systems, for example, require new chassis technology) and could allow technology companies to enter the automotive market, but otherwise they are not inherently threatening to the way the industry has been operating for more than a century. In these terms, the main risk is probably a result of financing competition between automation, connectivity and electrification.

3. Basic driver assistance is already available in three-quarters of new cars sold (Figure 17). Equipped with already-existing technology, partially (Level 2) and highly autonomous (Level 3) vehicles, still requiring substantial intervention from human drivers, are expected to become dominant by 2025 while fully autonomous vehicles (Level 4, where a human driver may still be required to intervene; and Level 5, where the car can operate completely driverless under all circumstances) are estimated to become available only toward the end of the 2020s.

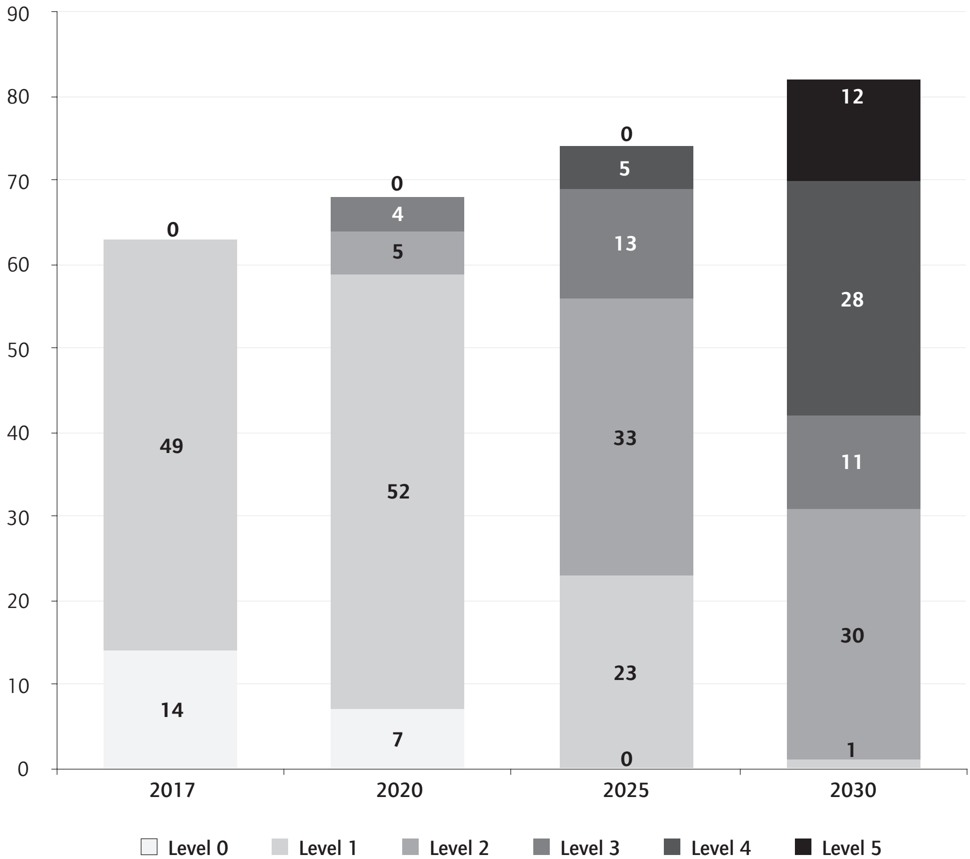
Figure 17 **Global automotive revenue and profitability forecast, 2015 vs. 2030**



Source: PWC (2016).

Fully autonomous vehicles would allow more users (including those unable or unwilling to drive) to benefit from automobility, while offering substantial cost savings largely due to eliminating the cost of the human driver's time (Figure 18; Corwin *et al.* 2015: 12). Even more significant savings could be achieved from a shift to shared and autonomous vehicles, the development of which is also a consequence of advanced vehicle connectivity: the cost per kilometre for shared autonomous vehicles is estimated at less than one-third of that of personally-owned and human-driven cars. PWC (2017b: 17) estimates indicate that, between 2017 and 2030, the development of autonomous and shared vehicles will increase the total distance driven in the EU and US combined by 23 per cent, although by 2030 the number of kilometres driven which are attributable to personally-owned and human-driven vehicles will still be less than one-half of the total (Figure 19).

Figure 18 **New car sales by levels of autonomy (EU, China and US, millions)**

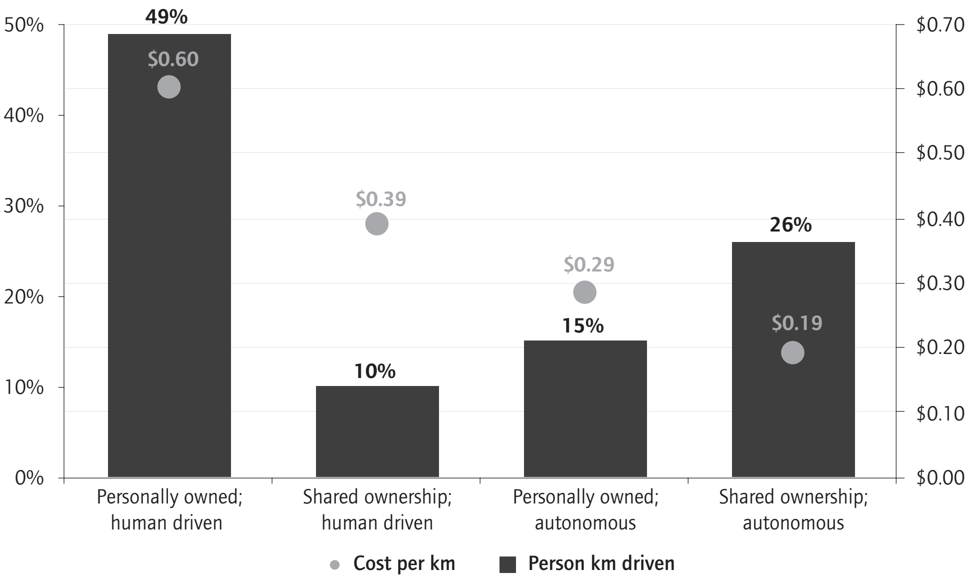


Source: PWC (2017b).

A more intense usage of shared vehicles will mean that greater distance will be covered using fewer cars, while the same source (PWC 2017b: 18) estimates a drop by 25 per cent in the number of vehicles in use in the EU and US combined (35 per cent if we consider only personally-owned, human-driven vehicles). In such a scenario, PWC estimates that vehicle sales would actually increase by 28 per cent due to higher turnover for shared vehicles, and especially for shared autonomous ones.

It might seem counter-intuitive, but many industry analysts (e.g. PWC 2018a; Roland Berger 2015) support the view that vehicle sales will go up due to the uptake of shared and autonomous vehicles. While this is not that implausible in currently highly-saturated markets like Europe given even a moderate increase in the popularity of shared and autonomous vehicles, scenarios that involve a more significant advance of these new technologies do indeed indicate a decline in sales. For example, in a '100 per cent robotaxi' scenario (in which all vehicles in use would be shared and automated), PWC (2018a: 35) estimates a drop in the number of vehicles in use to a mere 14 per cent of current levels, while new car sales would decline by no less than 50 per cent.[4] In such a scenario, the transformation of the automotive industry would be even more profound as tomorrow's 'robotaxis' have high chances of being very different from today's cars.

Figure 19 **Share of total personal kilometres driven (EU, 2030) and cost per kilometre by type of ownership and driver**



Source: PWC (2017b); cost per km adapted from Deloitte (2016).

A forecast on market structure (Roland Berger 2015) suggests that market polarisation could be pushed to the extreme by the development of shared and autonomous vehicles: non-shared vehicles would be reserved for the premium segment while the large segment of shared vehicles would comprise only nondescript 'low-cost pods'. This would squeeze existing volume OEMs and push them in one of these two directions: becoming either premium producers or simple hardware manufacturers.

CAV technology is thus expected to develop from conventional automobiles with simple in-vehicle digital services to a genuine revolution in the way cars are used and sold. Mobility services are expected to become the most dynamic and profitable side of the automotive ecosystem, with annual revenues of $467bn in Europe by 2030 (PWC 2017b: 19), in comparison to $25bn in 2017. Shared mobility, digital services and software would account for no less than 37 per cent of profits (Figure 17), while only 49 per cent would be attributable to the industry's traditional core activities (vehicle sales, finance and after-market). All this takes into account that fully autonomous vehicle technology is not expected to reach maturity until the end of the 2020s and that 'robotaxis' will not be able to gain any significant presence until then. Such scenarios are accompanied by warnings of a so-called 'Kodak' or 'Nokia' moment in the automotive world, when

4. The less pronounced decline in sales would be due to higher vehicle turnover caused by more intensive use.

traditional players fail to shift the focus of their business models from one-time product sales to mobility service provision. The risk for automotive OEMs and suppliers is that technology enterprises (whether or not they are existing mobility service providers, like Uber) will become dominant in the mobility service market while they remain confined to manufacturing predominantly low-revenue and low-profit white-label vehicles.

There is thus a high level of uncertainty regarding the ultimate outcome of these transformations and especially as to the abilities of OEMs to respond to the challenge of the much-anticipated mobility revolution.

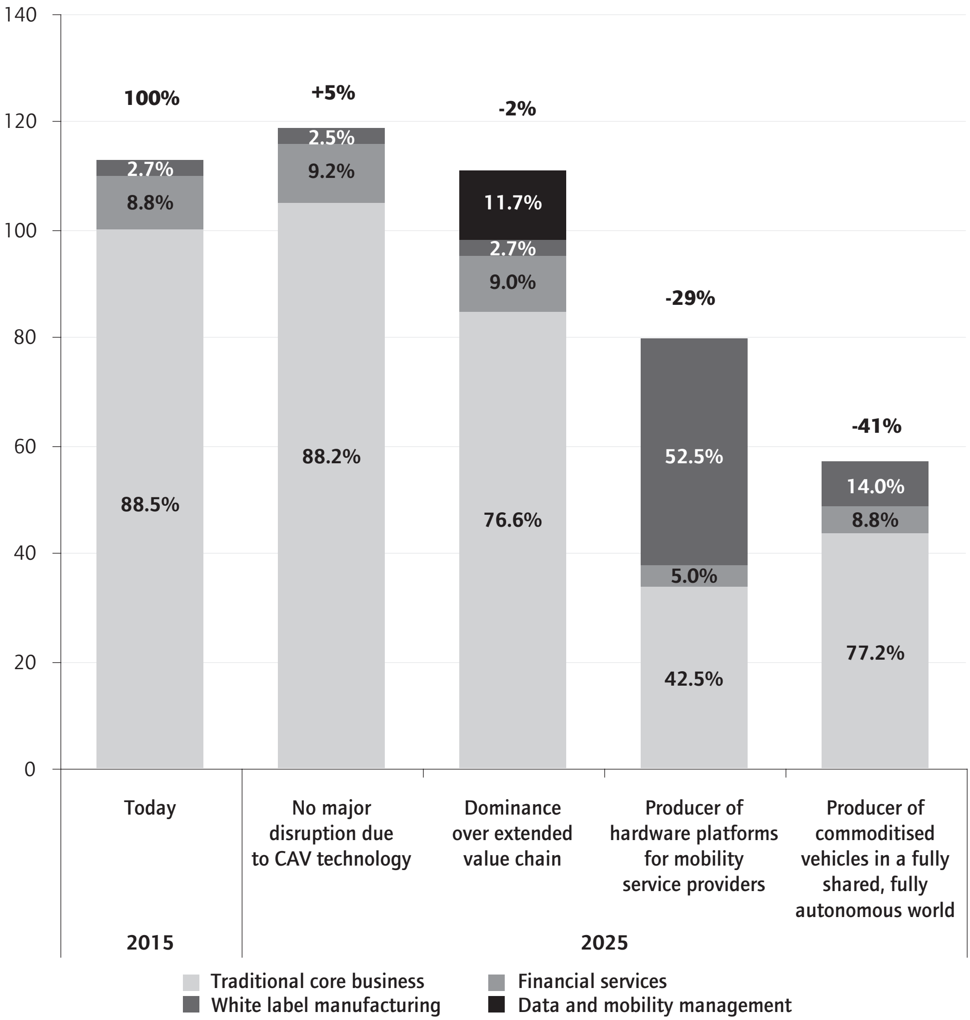
3.2 Employment impacts of the mobility revolution

The employment impact of CAV development will largely depend on the outcome of the future 'battle of the business models' (PWC 2016: 63) and reliable estimates are difficult to put together as yet. Some tendencies can indeed be discerned, although they do not necessarily point in the same direction.

The need to finance large-scale R&D investment and gain know-how in connectivity and software development has led most OEMs and many large suppliers to engage both in partnerships and in mergers and acquisitions (PWC 2016: 35-36). This has also had an important impact on employment, as both OEMs and tier 1 suppliers have begun to hire large numbers of engineers and IT specialists and even open entirely new R&D centres focused on CAV products, including connectivity, apps, driver assistance systems, artificial intelligence, etc. The employment impact of CAV technology is yet to be felt in production and will likely not play a role until the second half of the 2020s, when CAV technology and its accompanying regulatory frameworks should be advanced enough to make widespread use of shared vehicles feasible. Even so, as discussed above, the impact on automotive employment is uncertain and depends on the extent to which shared mobility services will replace conventional personal transportation and whether traditional automotive players manage to secure a position in the reconfigured mobility value chain.

A recent forecast (Deloitte 2017; Figure 20) suggests that the successful dominance of OEMs over the extended automotive value chain could mean that, by 2025, nearly 12 per cent of OEM employment could be comprised of data and mobility IT specialists with manufacturing, after-market and sales dropping to 77 per cent (from 89 per cent today, with total OEM employment dropping by two per cent). The toughest scenarios for OEMs involve them becoming primarily hardware producers focused mostly on manufacturing white-label, nondescript vehicles meant to act either as hardware platforms or basic hardware support for new mobility service providers. The advent of low-cost pods dedicated to shared mobility services could lead to a significant drop in manufacturing employment (a decline of between 30 and 40 per cent), even if overall sales increase as a result of more intense vehicle utilisation and turnover. This would be the case because manufacturing would have to become more flexible and more easily deployable according to the needs of mobility service providers, while reduced complexity and product diversity would provide a further impetus to automation in production.

Figure 20 **Business model outcomes and employment levels for automotive OEMs, 2015 vs. 2025**



Source: adapted from Deloitte (2017).

In production, the mobility revolution will have limited impact in the short-term (as Table 3 shows) but, starting with the second half of the 2020s, the advent of shared and autonomous vehicles could determine a drop in automotive employment due to reduced sales and increased automation in the manufacture of dedicated shared vehicles. R&D investment in CAV technology has already had positive effects on employment levels, although this means automotive OEMs and suppliers have to gain competences that they previously considered to be secondary at best, including in connected systems and software, data management, AI, machine learning, cybersecurity, etc. The rise of mobility services is likely have only a limited positive impact on employment since some functions (e.g. call centres) may well be outsourced and others automated. The most significant negative impact is likely to occur in sales, where physical dealerships will be increasingly replaced by virtual ones and digital sales services will gain more and more ground over traditional sales instruments.

Table 3 **Mobility employment impacts: progressive changes**

	Production	R & D	Services
Today	Limited impacts	New services, new technological modules: ADAS, software and connected systems ... Digital & Data engineering, IA, machine learning, Cybersecurity	Digital tools of commercialization Decrease of physical dealership networks New actors and solutions of mobility services, with limited job content
2022+	Shared vehicles: new constraints of production Less volume More electronic components, produced on automated lines	Weight reduction and durability issues Agile organisations	Externalisation of back office activities (call center) Sales more focused on service provision than on cars per se

Source: Syndex.

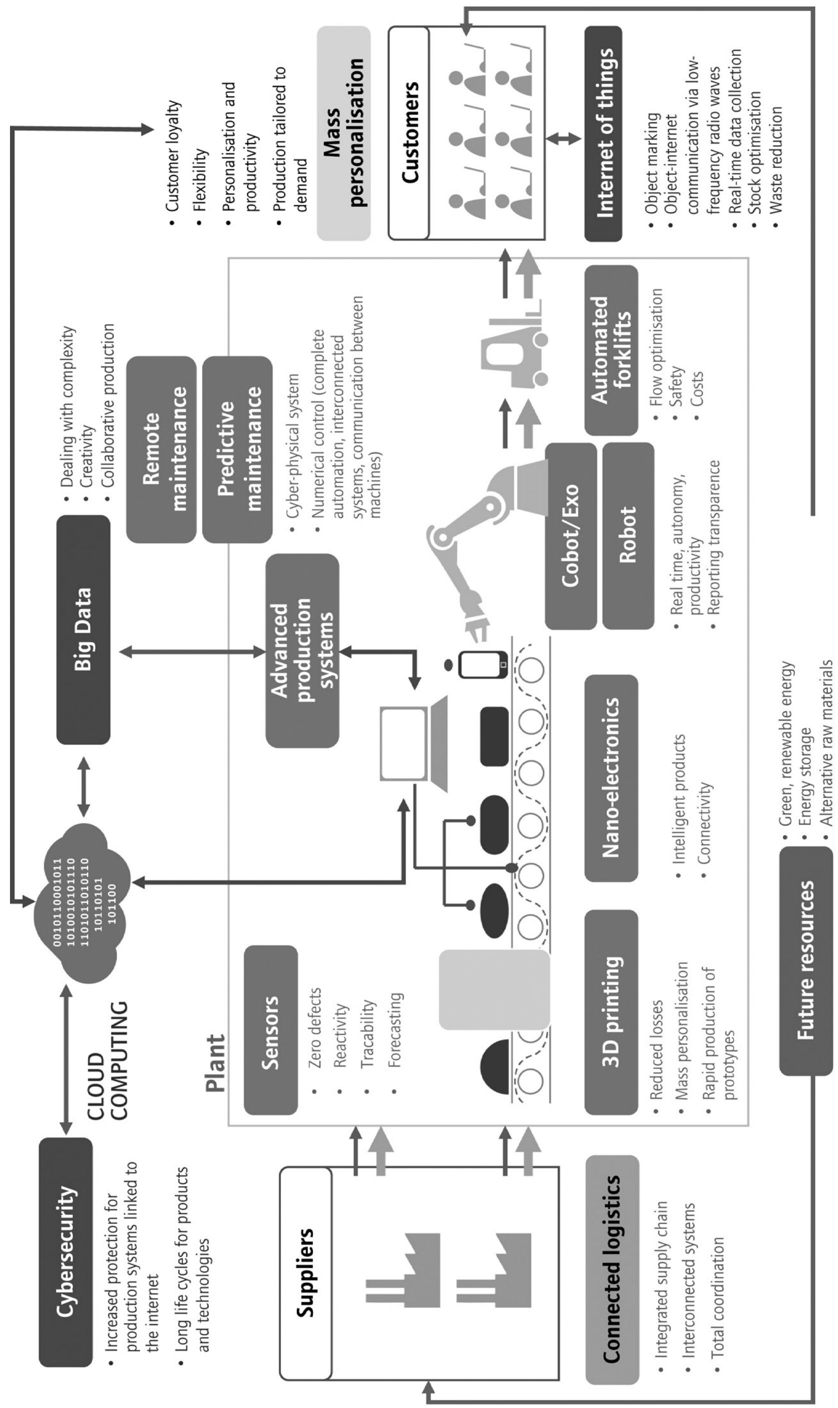
4. The digitalisation of the production process

The hype about increasingly digitalised automotive products and services embodied by CAVs has displaced manufacturing itself from the industry headlines, even though vital changes due to the digitalisation of production processes had been announced several years before connected and autonomous vehicles became a tangible reality. The by now relatively old idea of Industry 4.0, or Industry of the Future, referred to the full digitalisation of the traditional automotive value chain, from procurement and logistics to sales and after-market operations. A recent comparative assessment of industries' 'digital maturity' indicates that the automotive industry is well ahead of other manufacturing sectors although, overall, the European automotive industry appears to be less 'digitally mature' than the American or Asian ones (PWC 2018b: 15).

4.1 The plant of the future: a combination of technological innovations

Multiple technologies are being vaunted as necessary for a digitalised automotive production system (Figure 21). Connected logistics promise to take just-in-time production to a new plane, with the real-time coordination of multiple links across the value chain from incipient customer interests to upstream suppliers. It is not just by accident that this may sound highly familiar: many of the expected benefits of increased digitalisation actually concern the fulfilment of even more of the promises of so-called flexible, just-in-time manufacturing tailored as close as possible to changing customer needs.

Figure 21 **The digitalised automotive production system**



Source: adapted from Gimélec (2014).

Digital technology is supposed to contribute to even fewer defects and improved reactivity while allowing manufacturers to provide personalised goods and services to customers whose consumption needs and habits can be assessed in real time via analytics systems based on 'big data'. 3D printing should allow less material waste and a vast reduction in the manufacturing complexity of personalised goods. Production systems based on 3D printing can be highly decentralised, facilitating relocation in close proximity to customers. Furthermore, the increased pervasiveness of data created in real time would permit the forecasting of maintenance requirements and the generalisation of predictive and even remote maintenance. Improved automation technology (sensors, AI, etc.) is expected to boost the autonomy of robots in handling increasingly complex tasks. Finally, CAV technology does not exclude industrial vehicles, so the widespread use of automated forklifts and trucks could become a reality within the next decade.

One estimate (Roland Berger 2016: 7) puts the combined cost savings of digitalisation at ten to twenty per cent, with the most significant reductions in costs related to inventories (thirty to fifty per cent) and complexity (sixty to seventy per cent). Meanwhile, manufacturing, logistics and quality costs are also each forecasted to decrease by ten to twenty per cent.

4.2 Employment impacts of the digitalisation of the production process

Cutting labour content is one of the major goals of digitalisation in manufacturing. Digitalisation is explicitly associated with solving the problem of 'labour intensive, inflexible and expensive production' and is said to be necessary in addressing the permanent challenge of securing competitiveness, itself associated with lower 'labour cost shares' (Roland Berger 2016: 3). The degree of employment decline will, of course, depend on how many processes are automated and to what extent, as well as on the productivity gains although, as pointed out in Table 4, these are likely to be considerable. This remains largely unknown, despite the idea occasionally being peddled of completely automated future factories.

In production, many already visible trends are putting pressure on employment levels and on existing competences: the increased automation of assembly lines and logistics activities and the development of machinery able to handle multiple operations; the push toward polyvalence and the reconfiguration of maintenance activities; connected digital instruments for control and oversight; and organisational innovations dedicated to increased automation. In the long-term, the effects will be exacerbated by the development of connected production systems involving multiple plants, the generalisation of predictive maintenance and the advent of self-correcting interconnected machinery.

Digitalisation implies a decrease in direct manufacturing employment and an increase in employment related to support functions, including internal and external coordination or the monitoring of robots and computer programs. Such workers would handle fewer assembly and more maintenance activities, they would have to deal with an increasing number of machines and operations and they would need less mechanical and more IT skills. Therefore, the overall impact should be similar to that of EV and CAV technology, although in a much more clear-cut manner: reduced levels of employment and limited compensation via the creation of more skilled jobs. Such developments due to digitalisation are already apparent in many enterprises.

Table 4 **Strong productivity growth in production and R&D**

	Production	R&D
Today	↓ Robotisation in production lines and logistic activities ↓↑ Evolution of production support team ⟳ New organisations	↓ Automatisation of some development activities (Ex. numerical test/physical) ⟳ New tools and ways of development (virtualisation, PLM, built to print…) ⟳↑ New organisational setup (interdisciplinarity, more coordination between vehicle functions, data valuing)
Not generalised yet	⟳ Connected systems of production ↓ Predictive maintenance ↓ Smart equipments ↑⟳ More technicity to assist connected plants	

Source: Syndex.

Automation will also stretch to R&D activities (e.g. digital testing will replace at least some of today's physical testing). Growth in virtualisation, 3D printing and product lifecycle management will require new competences and these could also have a negative impact on R&D employment. This is expected to be at least partially mitigated by a renewed focus on interdisciplinarity, user experience, data management and coordination between R&D, production and sales.

5. Conclusions

As the post-crisis recovery peaks, the European automobile industry is facing several challenges and threats. It is not an exaggeration to say that the future of this core pillar of the European economy is at stake. Automobile manufacturers and suppliers are up against a technological upheaval fuelled by powertrain electrification, by the 'mobility revolution' springing from connected and autonomous vehicle technology and by continued digitalisation in production. Table 5 sums up the combined effects of the three big transformations facing the automobile industry. Compounding these, there is a stagnating internal market and an increasingly fragile position in export markets, as well as the risk of new entrants – most notably, high-tech giants and startups – capturing the lion's share of the value chain of the vehicles of the future. Addressing each of these issues will require significant efforts and capital expenditure, especially in R&D, with limited potential for synergies. Except perhaps for the digitalisation of production, these technological transformations involve considerable uncertainty regarding the future size and structure of the European automotive industry, with radical scenarios emphasising a near-total transformation of the entire automobile ecosystem (from the upstream supplier industry to the place of the passenger car in everyday life). Other scenarios emphasise a separation between connected and autonomous cars for car sharing on the one side and vehicles dedicated to particular uses – daily and long-distance trips, or both – on the other.

Table 5 **The combined effects of powertrain electrification, connected and autonomous vehicle development and the digitalisation of production in the automotive sector**

		Production	R & D	Services
Volumes	Stagnation and risks on export's volume	↓	↓	↓
Electrification	Simplification of production	↓ ⟳	↓ ↑ ⟳	↓ ⟳
Mobility	Fewer, but more autonomous and connected cars	↓ ⟳ ↑	↓ ↑ ⟳	↓ ↑ ⟳
Industry of the Future	Much improved productivity	↓ ⟳ ↑	↓ ↑ ⟳	↓ ↑ ⟳

Source: Syndex.

New major players – dedicated battery producers and mobility service providers – are already present on the scene and there is a major risk that some of today's important actors will not be around in a couple of decades' time. This is especially valid for the supplier industry, where some companies already lag behind in terms of technology. Vital questions regarding how quickly ICE technology will be phased out, how long the hybrid transition will actually last, how permissive the regulation will be concerning connected and autonomous vehicles, and what will happen to existing business models under the pressure of shared and autonomous vehicle technology, are still subject to speculation.

In terms of employment, these transformations imply fewer and different jobs compared to today. At each level – design, production, services – enterprises will have to manage departures and recruitment as well as the transformation of jobs and organisational setups.

The question of professional mobility ultimately concerns each employee to a different degree. At the least, we are dealing with changes in certain tasks and, in many cases, with changes in job content and in the level of autonomy on the job. In certain cases, reconversions will be radical, involving shifts to entirely different fields both within and outside enterprises, as well as within and outside the automotive sector. Such transformations require a comprehensive reassessment of the value of jobs and competences.

In such a shifting and complex context, anticipation and consultation constitute indispensable tools in facilitating professional mobility.

Although it will remain attractive, the automotive industry will no longer generate as many jobs as it has in the past. To mitigate the impact, rapid action has to be taken to push those regions that will be affected by the transformation of the automotive industry to seize the existing opportunities in industries tied to renewable energy.

In the field of R&D, transformations are already underway. In the face of the diversity and novelty of technologies needed for the development of the vehicles of tomorrow, R&D employment is already growing. This is especially the case in the fields of software development, data analysis, big data and powertrain electronics. Competence scarcity in these domains will push up employment costs although this will, at least partially, be compensated by a decline in the number of powertrain R&D programmes.

After 2021, we estimate that R&D employment needs will become less stringent. By then, the transition to the Euro 7 emissions standard will, in terms of R&D, be mostly complete while internationalisation, a reduction in the number of platforms and the development of increasingly simple BEVs will reduce some of the pressure on automotive R&D activities.

In production, each new platform provides the opportunity to invest in greater automation, leading to a decline in employment. In parallel, work will become more intense for manual workers (more tasks, increased versatility) while it will limit the need for supporting functions, allowing these to become more complex and more focused on the management of unforeseeable factors.

As far as service provision is concerned, digital instruments will reduce the employment requirements for many administrative tasks but, at the same time, the development of mobility solutions will force industry actors to develop their know-how and competences.

The social partners thus have multiple subjects to discuss and negotiate: strategies for the future, organisational setups, job content, new competences, approaches to valuing labour, internal training plans, time-off for external training, securing professional career trajectories...

References

ACEA (2008) The automobile industry pocket guide 2008. https://www.acea.be/publications/article/acea-pocket-guide

ACEA (2018) The automobile industry pocket guide 2018-2019. https://www.acea.be/publications/article/acea-pocket-guide

Continental (2018) Driving the future of mobility. https://www.continental-corporation.com/resource/blob/125844/42d52326ff9f2f86ff2c8021819d7722/bofaml-industrials-conference-2018-presentation-data.pdf

Corwin S., Vitale J., Kelly E. and Cathles E. (2015) The future of mobility: how transportation technology and social trends are creating a new business ecosystem, Deloitte Insights [Online], 24 September 2015. https://www2.deloitte.com/insights/us/en/focus/future-of-mobility/transportation-technology.html

Cramer A. (2017) Combustion engine ban would put 600,000 German jobs at risk, study says, Automotive News Europe [Online], 18 July 2017. http://europe.autonews.com/article/20170718/ANE/170719710/combustion-engine-ban-would-put-600000-german-jobs-at-risk-study-says.

Deloitte (2017) The future of the automotive value chain: 2025 and beyond. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-auto-the-future-of-the-automotive-value-chain.pdf

European Climate Foundation (2018) Fuelling Europe's future: how the transition from oil strengthens the economy. https://europeanclimate.org/wp-content/uploads/2018/02/FEF_transition.pdf

European Commission (2017a) GEAR 2030. Final Report – 2017, Brussels, European Commission.

European Commission (2017b) GEAR 2030 Strategy 2015-2017 - Comparative analysis of the competitive position of the EU automotive industry and the impact of the introduction of autonomous vehicles, Brussels, European Commission.

European Commission (2017c) Impact assessment accompanying the document Proposal for a Regulation of the European Parliament and of the Council setting emission performance standards for new passenger cars and for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light duty vehicles and amending Regulation (EC) No 715/2007 (recast), Brussels, European Commission.

European Commission (2017d) Annexes accompanying the document Proposal for a Regulation of the European Parliament and of the Council setting emission performance standards for new passenger cars and for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light duty vehicles and amending Regulation (EC) No 715/2007 (recast), Brussels, European Commission.

Eurostat (2019) International trade in cars. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_cars

FTI Intelligence (2018) Impact of electrically chargeable vehicles on jobs and growth in the EU. https://www.fticonsulting.com/fti-intelligence/energy/research/clean-energy/impact-electrically-chargeable-vehicles-jobs-growth-eu

Giffi C.A., Vitale J., Schiller T. and Robinson R. (2017) A reality check on advanced vehicle technologies, Deloitte Insights [Online]. https://www2.deloitte.com/content/dam/insights/us/articles/4400_a-reality-check-on-advanced-vehicle-technologies/4400_reality-check-advanced-vehicle-technologies.pdf

Gimélec (2014) Industrie 4.0 : les leviers de la transformation. https://fr.slideshare.net/Gimelec/industrie-40-les-leviers-de-la-transformation

Kochhan R., Fuchs S., Reuter B., Burda P., Matz S. and Lienkamp M. (2017) An overview of costs for vehicle components, fuels, greenhouse gas emissions and total cost of ownership. Update 2017. https://steps.ucdavis.edu/wp-content/uploads/2018/02/FRIES-MICHAEL-An-Overview-of-Costs-for-Vehicle-Components-Fuels-Greenhouse-Gas-Emissions-and-Total-Cost-of-Ownership-Update-2017-.pdf

OICA (2018) Production statistics 2018. http://www.oica.net/category/production-statistics/2018-statistics/

PWC (2016) Connected car report 2016: opportunities, risk and turmoil on the road to autonomous vehicles. https://www.strategyand.pwc.com/report/connected-car-2016-study

PWC (2017a) 2017 automotive industry trends. The future depends on improving returns to capital. https://www.strategyand.pwc.com/trend/2017-automotive-industry-trends

PWC (2017b) The 2017 strategy & digital auto report. https://www.strategyand.pwc.com/media/file/2017-Strategyand-Digital-Auto-Report.pdf
PWC (2018a) Five trends transforming the automotive industry. https://www.pwc.com/gx/en/industries/automotive/publications/eascy.html
PWC (2018b) Digital champions: how industry leaders build integrated operations ecosystems to deliver end-to-end customer solutions. https://www.strategyand.pwc.com/industry4-0
Roland Berger (2015) Automotive 4.0: a disruption and new reality in the US? https://www.rolandberger.com/en/Publications/pub_automotive_4_0.html
Roland Berger (2016) Digital factories: the time to capitalize on digital factories is now. https://www.rolandberger.com/en/Publications/pub_digital_factories.html
Tighe C. (2017) 520 jobs go at UK Delphi plant as demand for diesel falls, Financial Times, 4 August 2017. https://www.ft.com/content/edbbfb26-7931-11e7-a3e8-60495fe6ca71
Transport & Environment (2017) How will electric vehicle transition impact EU jobs? https://www.transportenvironment.org/publications/how-will-electric-vehicle-transition-impact-eu-jobs
UBS (2017) UBS evidence lab electric car teardown – Disruption ahead? https://neo.ubs.com/shared/d1wkuDlEbYPjF/

All links were checked on 5 August 2019.

Chapter 7
The French automobile industry: state of play, electromobility and employment change

Michel Sonzogni and Sebastian Schulze-Marmeling[1]

Introduction

In France, as in many other European countries, the automotive sector plays a vital role both in industry and in research and development. The specificity of the French automotive sector is that it is mainly organised around PSA and Renault development centres and plants. Within the automotive sector, powertrain manufacturing and R&D has a well-established core position. Over time, powertrain activities have fared better than full-vehicle assembly, under the double threat of relocation and market decline. These activities, on which the future of substantial industrial capacities depends, cover a wide range of mechanical components (engines, gearboxes, etc.).

This chapter describes the trends we have observed across the sector based on numerous empirical observations in the field and on our consultancy work for employee representatives. Section 1 provides an overview of the situation and the weak points of the French automotive sector as a whole. Section 2 focuses on powertrain (PWT) activities, with an emphasis on the employment and skills structure, while section 3 discusses possible economic and employment scenarios for the future of the sector in the light of electrification and decarbonisation trends. Finally, in section 4 we present what we believe to be the main challenges to making a successful just transition for powertrain-related activities and jobs in France.

1. The progressive de-integration of the French automotive industry

1.1 The French automotive sector – an overview

Some historical points of reference

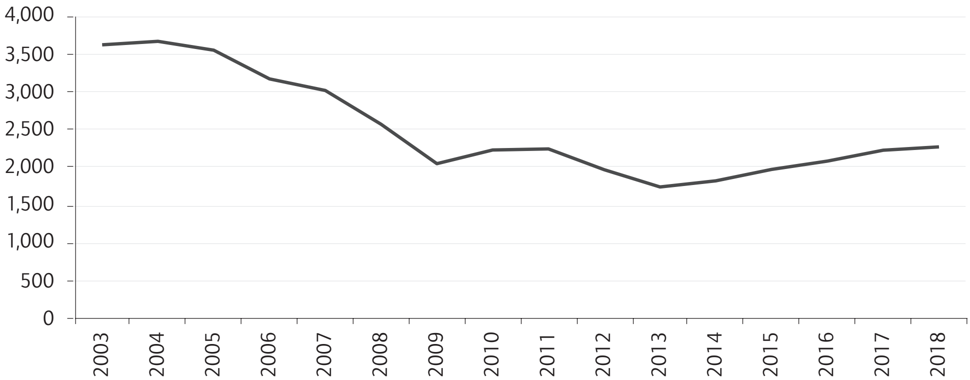
In terms of vehicle assembly, France ranks third in Europe, with around two million vehicles produced annually. It remains far behind Germany and, starting from the early 2000s, lags also behind Spain (the country where Renault and PSA produce around one million French-branded cars per year).

The French automotive sector is dominated by two manufacturers, Renault and PSA. Until the beginning of the 2000s, they registered huge successes, banking on

1. With the contribution of Anne-Gaëlle Lefeuvre.

original designs (including the first family minivan, the Espace). Since then – as they were specialising in mass market products – both manufacturers have resorted to restructuring aimed at cutting costs which has, most often, meant relocating production. This is the main reason behind the decline in vehicle assembly in the country. The 2009 crisis plunged the sector into a very difficult situation, but vehicle assembly volumes had already been declining since 2005, as Figure 1 shows.

Figure 1 **Production of light vehicles in France (in thousands)**

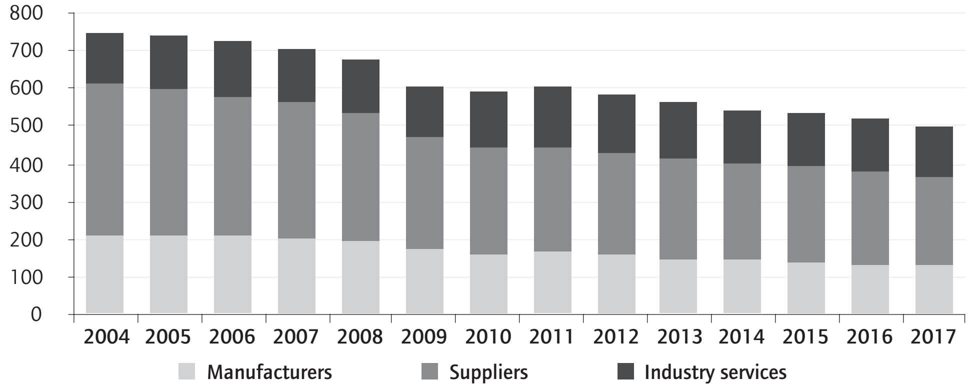


Source: CCFA (2018).

In effect, production was halved in fewer than ten years — from 3.5 million vehicles in the mid-2000s to 1.75 million in 2013-2014. Volumes have subsequently increased slightly, to over two million (including around 0.3 million vehicles from the Toyota and Smart-Daimler plants), a level forecasted to remain stable. The increase in the last couple of years has been due mostly to Renault's decision to increase its assembly volumes in France.

Of course, the trajectory of the French automotive sector cannot be summed up simply by looking at the volumes produced by original manufacturers. The sector includes many companies with a wide range of profiles, including top-tier equipment manufacturers and second-tier SMEs, which export a significant portion of their production and often play a role in the development of new products. Figure 2 shows the development of the number of jobs in the broad automobile sector and their distribution along the supplier chain. Two-thirds of industrial jobs in the upstream sector (equipment manufacturers and subcontractors) belong to foreign-owned international groups.

Figure 2 **Evolution of the number of jobs in the French automotive industry and their distribution across the supplier chain (in thousands)**



Source: Syndex, with CCFA data.

The positioning of French manufacturers across vehicle segments

The fact remains, however, that manufacturers' strategies are decisive for the whole sector. We therefore need to keep their trajectories in mind in assessing the overall dynamics of the sector. We can, however, give a broad outline of the main trends of the last decade:

— French manufacturers have been lagging behind in the upmarket segments where profitability is higher and German manufacturers are dominant. Recent relaunch attempts with the DS brand for PSA and Alpine at Renault illustrate an interest in catching up, together with the difficulty involved in regaining a market position based largely on brand awareness. Due to these difficulties, French manufacturing sites continue to compete with low-wage locations in the medium-range passenger vehicle (PV) segments. This fuels the drive to relocate industrial capacities outside the country;

— conversely, their leading positions in Europe in the field of light commercial vehicles (LCV — another segment with good margins) has allowed the two manufacturers to produce large volumes in France, in partnership with other European manufacturers. More than one-quarter of the vehicles assembled in France are light commercial vehicles. The reconversion of Renault's Sandouville site is the best illustration of this trend, with losses in the upmarket range but a resurgence of LCV production;

— in recent years, French manufacturers have also increased their PV volumes, benefiting from the rise of the sport utility vehicles (SUV) market and from a (relatively) successful range of models. Although it has lagged behind its partner Nissan, with its highly successful Qashqai, Renault has managed to catch the wave of SUV growth while PSA has had great success with its new range (including the 3008) with which it has boosted volumes at its French factories. However, although SUVs allow non-specialised manufacturers to grow and register good margins without accessing the upper segments of the PV market, the two French manufacturers are far from being ahead of their competitors in this field. SUVs make up around one-third of their volume, similar to the European average, while Nissan accounts for two-thirds of the SUVs produced in Europe.

Powertrain activities, especially diesel-related ones, are extremely important to the French automotive sector

Although the overall position of French manufacturers has witnessed major decline, it is still very significant when it comes to powertrain. The engine is a component that enhances the credibility of a manufacturer's motor vehicle range and is a major driver of technological excellence. Furthermore, it still represents around forty per cent of a vehicle's value (FIEV 2018).[2]

PSA produced 3.5 million engines in 2003-2004, a large number of which were for its partners. These partnerships have since dried up. Today, PSA has two engine plants in France, which comprised 100 per cent of its engine production, at least up to the Opel/Vauxhall takeover. The Tremery plant assembles two million engines per year, of which 75 per cent are diesel engines. The Douvrin plant (whose ownership was formerly shared 50/50 with Renault and is now fully owned by PSA) assembles some 800,000 engines per year, 75 per cent of which are petrol engines.

Renault significantly increased its production of engines in Spain (Valladolid) in the 2000s and it has done the same more recently in Turkey (Bursa), to the detriment of French manufacturing sites. It currently has an engine plant in Cléon, where it produced 900,000 engines in 2017. This factory, which had been focused on producing engine components and assembling diesel engines, started manufacturing electric engines in 2015 and is expected to continue to do so on an increasingly larger scale. The site should also begin to manufacture petrol engine components.

France is known for its strong engine and transmission industry: ten per cent of the light vehicles assembled in Europe are made in France while the figures for engines and transmissions go as high as fourteen per cent and sixteen per cent respectively (Syndex 2018b). The share of diesel engines produced in France is particularly high: in 2018, France produced 22 per cent of all diesel engines made in Europe compared to thirteen per cent for Germany, twelve per cent for Hungary and ten per cent for Poland.

In search of competitiveness: the key post-crisis challenge

The continued integration of eastern European countries in transnational automotive supply chains, along with the 2009 crisis, has led to an increased amount of benchmarking between sites. In consequence, the main companies have been focused on improving the productivity and flexibility of their French sites. In this regard,

2. FIEV is the French Federation of Vehicle Equipment Industries.

social agreements have been signed at both major manufacturers and at some of their suppliers. Through these agreements, stakeholders have been seeking greater security. Even so, the additional pressure on employment levels and flexibility has not necessarily resulted in better performance.

In parallel, new investment, which previously involved new capacities and employment growth, has been largely oriented towards boosting productivity at existing plants — by introducing more compact, flexible and automated lines and processes. At PSA, for example, these organisational changes have made the French sites very competitive relative to other European sites — a fact admitted even by its management.

1.2 A rebound in the activity of the automotive sector in the past five years

Several of the projects carried out by Syndex provide the opportunity for an in-depth observation of automotive companies and, together, they deliver a solid empirical basis for assessing production trends and social characteristics. They also provide an insight into the strategic orientations of large and small-sized automotive companies.[3]

Since 2014, we have noticed a very sharp recovery in activity. On average, revenues increased by over ten per cent between 2014 and 2017, with the exception of powertrain companies whose revenues stagnated in this phase of the European automotive industry's recovery. Profitability has been boosted significantly by this growth, jumping from an average of 4.3 per cent in 2015 to 7.3 per cent in 2017.[4] This trend is visible for almost all the companies in our panel.

This very strong recovery, with budgets exceeding expectations, has placed many players under pressure, often resulting in increased overtime coupled with work becoming both more intense and more complex. This becomes more apparent if we consider that employment has fallen significantly in our sample, by ten per cent between 2015 and 2017 for permanent staff, while the number of temporary workers has increased by fifty per cent.[5] The balance is strongly negative especially since, for the remaining employees, the use of temporary workers leads to increased workloads (Syndex 2018a).

Such a change is anything but surprising in a sector in which the major players are continually seeking productivity gains and flexibility, and are very cautious about hiring in France. This wariness is not being accompanied by increased rewards for the additional efforts demanded of employees in the name of competitiveness. Nevertheless, agreements in this direction have been signed at one-half of sites, or are otherwise the result of a national pact that aims to reduce the burden by facilitating, in return, more recruitment.

3. Based on a panel of some forty establishments (including seven manufacturing sites) covering a total of 27,000 jobs. This represents ten per cent of automotive industrial jobs in France, or fifteen per cent if we focus only on suppliers.
4. Operating income/revenue ratios.
5. In 2016, temporary workers comprised twenty per cent of employment in production. If we focus on blue collar workers, the share of temporary employees is between thirty and fifty per cent of total registered headcount.

1.3 Despite a favourable context, the situation remains difficult at several sites

Behind this general trend of recovery in activity and improvement in margins without any positive impact on employment, we can observe extremely divergent situations from one production site to another.

We have identified four typical situations, which are shared across our panel to almost equal extents, from the most risk intensive plants to ones with the most sustainable future:

Sites in great difficulty:
sites that have been restructured repeatedly, whose sustainability is clearly in question.

Sites barely investing in the future:
good fundamentals but relocation threats weigh on future projects, and investments are limited.

Promising prospects with some weak points:
good products but industrially fragile; or, inversely, a solid industrial base but no sound product prospects.

Positive outlook:
a buoyant market; company is investing in innovation, is in a leading position and/or is present across niches.

Some companies are pursuing strategies which has them more or less banking on accumulated know-how. Others, however, are more management-focused and have more prudent approaches. We believe such an assessment should not be seen as a verdict but rather as a challenge for managers to promote their sites and secure the sustainability of their activity and jobs by convincing corporate decision-makers and clients.

2. Employment in the French powertrain industry: a dense and complete chain of skills

This section focuses on powertrain activities and employment in France. As mentioned above, France's automotive industry produces some fourteen per cent of all the engines assembled in Europe. Moreover, engine manufacture has historically been characterised by relatively high employment density due to the large number of mechanical parts being manufactured and assembled.

Syndex has built a unique database on employment in the powertrain sector, covering 95 sites with a total of 56,000 employees. This gives us a strong insight into developments in the PWT sector, on which the following analysis is drawn.

We identified a slight increase in overall employment between 2014 and 2016, but our data suggest that job losses among permanent workers are largely compensated through the recruitment of temporary workers. New jobs are being recorded in the innovative parts of the sector, but their impact falls short of compensating for losses in 'traditional' activities such as foundry or assembly. Ultimately, however, it is the relatively high proportion of older workers in the sector that is likely to be fuelling the decline in employment.

2.1 A complete chain of powertrain skills

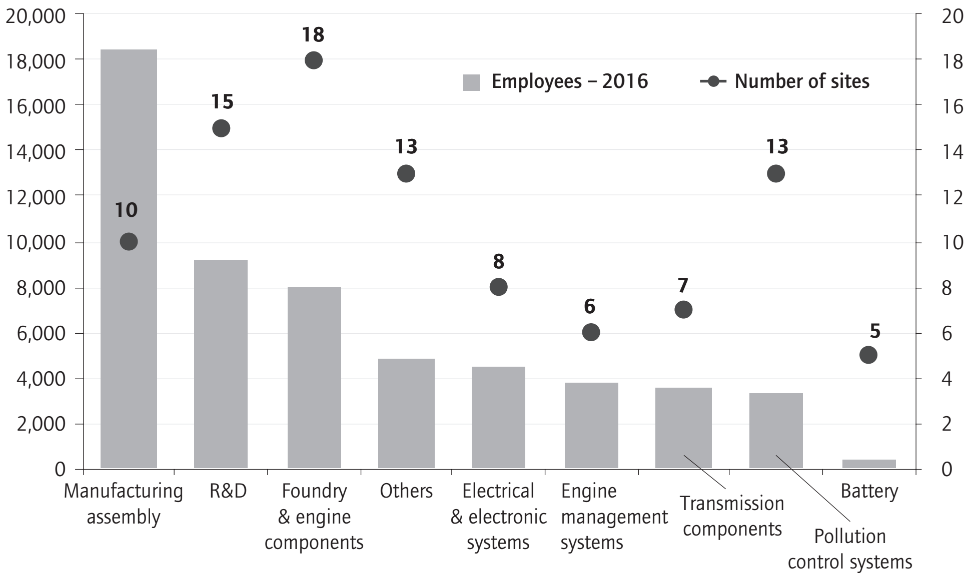
Figure 3 and Figure 4 provide an overview of employment in the French powertrain industry as at the end of 2016.

One-half of all jobs (47 per cent) remain concentrated in what can be described as the traditional activities of the sector — namely assembly (33 per cent; or almost 18,000 jobs), and foundry and engine components (fourteen per cent; with some 8,000 jobs). Additionally, R&D sites are important employers, representing about sixteen per cent of overall powertrain employment (9,000 jobs). We have identified fifteen R&D centres, mainly located at supplier sites.

Current levels of employment depend on a wide range of powertrain-related activities and products: engine management systems; pollution treatment systems; electrical and electronic systems; transmission components; and also filtering systems, turbochargers and re-building/repair activity mainly for engines and transmissions. However, we were also able to identify several small new companies assembling batteries for vehicles.

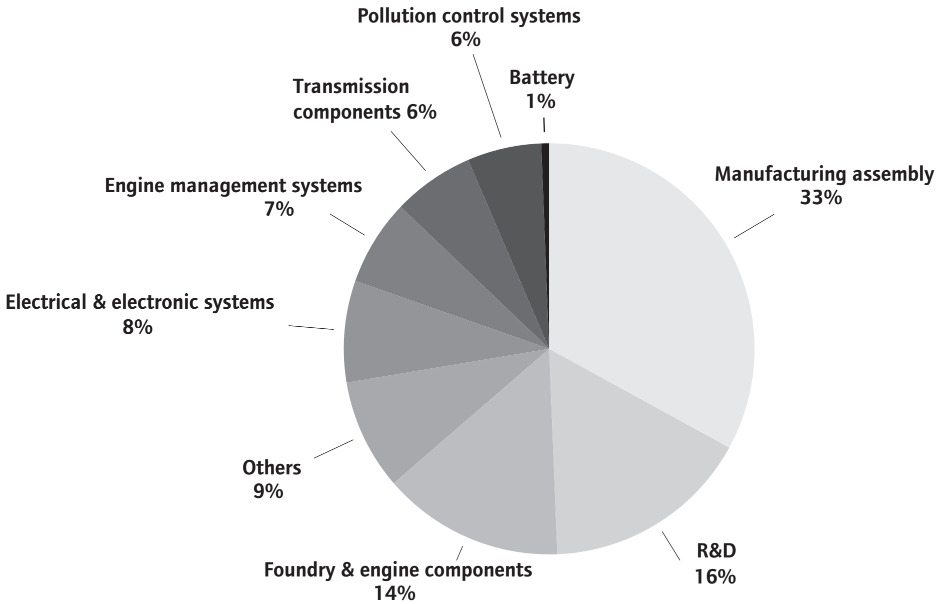
Another interesting feature reflected in our data is the distribution of employment per site. Whereas traditional automotive plants are (or were) large-scale factories with thousands of workers, the new innovative activities appear to be taking place in smaller establishments.

Figure 3 **Employment in the powertrain industry at the end of 2016**



Source: Syndex database on powertrain industry employment in France.

Figure 4 **Distribution of employment at end of 2016 (per cent)**



Source: Syndex database on powertrain industry employment in France.

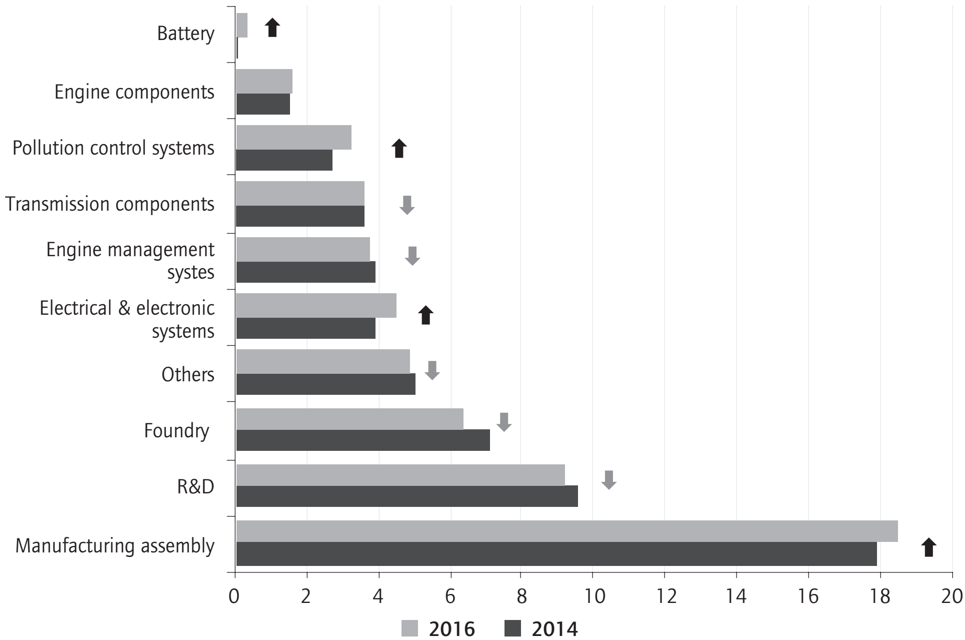
2.2 Behind employment stability: fewer permanent jobs

Between 2014 and 2016, employment in the powertrain industry has been generally stable (+1 per cent overall). Looking at the different activities (see Figure 5), however, we can observe an important disparity: employment growth in manufacturing assembly, electrical and electronic systems, pollution control systems and battery activities; but employment decline in foundry, research and development, engine management systems and other activities.

Moreover, if we look at the evolution in the number of permanent and temporary workers between 2014 and 2016,[6] we observe a five per cent decrease in permanent jobs and a boom in temporary employment (see Figure 6). Two main reasons for the rise of temporary workers can be identified. The first is that, after the 2009 crisis, and numerous restructuring plans, many companies have become more cautious about recruiting permanent workers. The second reason is the permanent cost pressure that has resulted in management targeting wages to take a decreasing percentage of revenues. These fears appear to have been stronger than concerns about hidden costs and the delayed effects of turnover fluctuation and indirect costs (costs of sub-quality production, training and management costs, disruption and delays…).

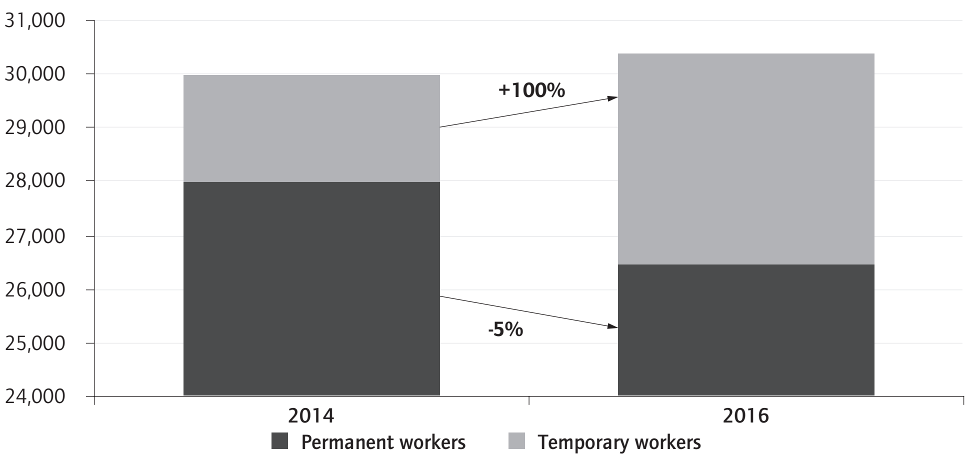
6. We obtained information on permanent and temporary workers for 55 per cent of the employment of our database.

Figure 5 **Evolution of overall employment between 2014 and 2016**



Source: Syndex database on powertrain industry employment in France.

Figure 6 **Changes in employment in the French powertrain industry from 2014 to 2016**



Source: Syndex database on powertrain industry employment in France.

Table 1 **Variation in permanent employment in powertrain activities (2016/2014)**

Engine management	7%
Electrical & electronic systems	3%
Transmission components	-1%
Others	-3%
Manufacturing assembly	-7%
R&D	-9%
Foundry	-12%
Engine components	-15%
TOTAL	-5%

Source: Syndex database on powertrain industry employment in France.

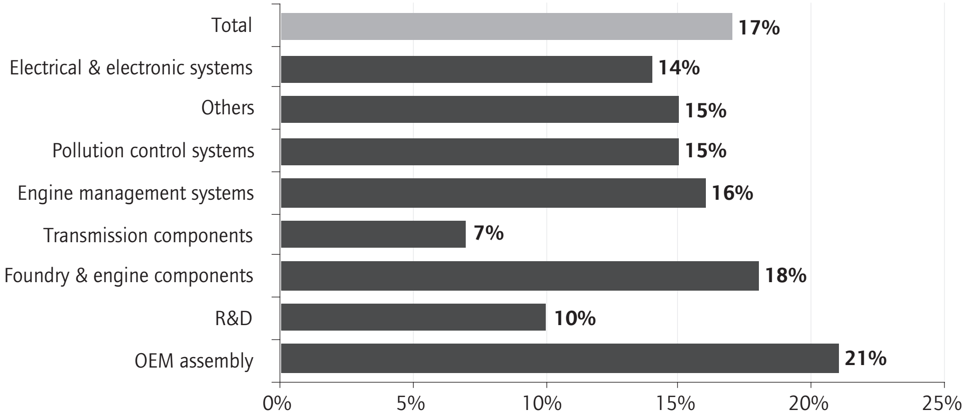
The result of this swing is that permanent employment has decreased in most powertrain-related activities, as Table 1 shows: from assembly to traditional powertrain components, foundry, and also in research & development. However, a few increases can be noticed — for engine management systems (mainly due to preparations for new powertrain regulations) and for electrical and electronic systems. There are some interesting contrasts between Table 1 and the employment change areas in general as documented in Figure 5.

2.3 A significant share of older staff

Our data suggest that the replacement rate for redundancies is relatively low and that spikes in activity are, to a large extent, being absorbed via flexible forms of employment, most notably through temporary work. Looking at the age of the workforce, we find that seventeen per cent are 55 years of age or older (Figure 7). Given that the retirement age is 62 years in France, these employees are due to leave their companies by the end of 2023 at the latest. The share of older workers is particularly high for assembly sites, where one worker in five is aged 55 or more. Sites with a focus on R&D record lower shares of older workers (ten per cent).

It is worth noting that these figures should not be regarded as entirely independent of those discussed previously. More specifically, the six per cent drop in employment in the industry between 2014 and 2016 includes cases of retirement and our data does not permit a distinction to be drawn between retirement and other reasons for leaving a company. It is likely that the number of employees reaching legal retirement age will increase significantly over the next few years: all the available evidence suggests that the automotive industry is faced with the challenge of an ageing workforce, with an increasing number of people approaching retirement age.

Figure 7 **Workers 55 years of age and above, 2016 (per cent of permanent employment)**



Source: Syndex database on powertrain industry employment in France.

3. Perspectives on the French powertrain industry: downsizing and reshaping… or outright disintegration?

3.1 Assessment of the potential decrease in employment: between -20 per cent and -30 per cent by 2025

Given the continuing change in the powertrain mix, it is clearly difficult to forecast employment needs in the engine sector since the emerging technologies, at least at present, have a small presence and are costly. However, using the projected ratios used in some companies for estimating the employment requirements of different types of powertrain systems, we can make an attempt to assess the potential impacts. Our assumptions for the composition of the fuel mix by 2025 for France and the EU are summed up in Table 2.

Table 2 **Assumptions pertaining to the fuel mix, based on 2025 estimates of engine production in France and Europe**

	2017-FR	2025-FR	2025-EU
Diesel	67%	41%	5%
Gasoline	32%	12%	25%
Hybrid - Diesel	0%	8%	15%
Hybrid - Gasoline	0%	22%	35%
Electricity	1%	16%	20%

Source: IHS (2018).

Our assumptions

Our starting point of reference for assessing employment requirements is the diesel engine (components and assembly); for petrol engines, we assume a level of sixty per cent of the diesel employment requirement. While assuming that employment requirements for assembly are more or less identical for diesel and petrol,[7] and knowing that assembly represents one-third of jobs in the sector, the employment requirements for petrol components would represent only forty per cent of those corresponding to diesel components (due to fewer parts and operations, larger tolerances and a smaller level of required precision). For small cylinder petrol engines, we assume that the petrol-diesel employment ratio is around fifty per cent (with four times fewer jobs in components).

We believe that the employment requirement for an electric engine would be only ten per cent of that of a diesel engine (assembling the electric motor is simple, with only four main operations and far fewer components). It shares some materials and operations with combustion engine manufacturing, but introduces winding.

With respect to hybrids, which are equipped with both a combustion engine and an electric one, but with the former smaller than in traditional vehicles, we assume that the employment requirements of hybrid technology is just slightly higher than that of a pure combustion engine (five percentage points higher).

Our results

With respect to engine production prospects for France,[8] the change in fuel mix would cause around twenty per cent of jobs to be lost by 2025. If we look at the European context, for which a more marked decline in diesel is forecast, the fall in labour demand in the engine sector would be around thirty per cent.

Based on an estimate of the current employment level in the powertrain sector in France of 56,000 workers, this would mean job losses of between 10,000 and 15,000. However, employment decline could prove steeper due to productivity gains resulting from the automation and digitalisation of some production processes. On the other hand, it is possible that job losses could be mitigated by diversification projects (i.e. expansion into new sectors and/or new products).

3.2 Expected employment losses in powertrain activities and possible future strategies

The assessments that we have been able to carry out on employment trends inevitably rest on schematic assumptions and do not fully take into account the particularities of each company. However, we have followed developments in a large number of the

7. The variances observed are around ten per cent.
8. Established by IHS Markit – https://ihsmarkit.com/index.html.

approximately one hundred sites in the French powertrain sector and are able to identify several types of change.

R&D sites: the first affected

Research and development sites in the powertrain industry enjoy significant levels of activity at present, but this is not likely to continue to be the case in the future. Manufacturers are currently developing the final internal combustion engine platforms, and the development of future electrical systems of propulsion are not expected to mobilise as many employees as diesel platforms.

Manufacturers have anticipated job losses through a succession of voluntary departure programmes for people beyond a certain age across their entire range of R&D activities, and not only in engine manufacturing (see PSA and Renault since 2009). However, recruitment does not seem to have benefited from the same anticipation effort and it is still difficult to acquire key skills. Given these skills shortages alongside powertrain electrification, the introduction of new electrical and electronic architectures, and stronger regulatory constraints and security challenges, the current workload of powertrain R&D teams remains particularly heavy.

In parallel, R&D teams are being reallocated and restructured. The decline of diesel has led to a transfer of staff from diesel to petrol teams. Meanwhile, the stricter control of emissions is reinforcing the importance of electronic control systems in vehicle engines — and, correspondingly, that of the software teams who need to work coherently with the systems teams. Additionally, the advent of clean mobility has also led to the emergence of new types of project: for example, the development of 'sound' expertise for electric vehicles (i.e. sound technology) by engineers at Faurecia's R&D exhaust site; or the manufacturers of traditional air and oil filters who are working on the continued use of filters beyond current engine-related uses.

Nevertheless, the overload in R&D activities should finish once the major deadline for future standards has passed (2021) and new electrical and electronic systems have been stabilised. This part of the development effort will, once the number of combustion engine platforms to be developed has been reduced, focus on battery electric vehicles (BEVs) whose development activities, excluding batteries, are far less complex.

The upshot is that, in both the medium- and the long-term, powertrain R&D staffing levels might decline both in manufacturers and in suppliers. The extent of this decline will depend on the trajectory of hybrid powertrain systems (full hybrid, mild hybrid, plug-in hybrid). Currently, the development efforts for hybridisation solutions are split up among several teams. At Valeo, for example, R&D efforts in propulsion are mainly oriented towards hybridisation,[9] but it is not clear for how long this will remain the case. Will 48V solutions and rechargeable hybrids have the expected degree of success? Is the hybrid solution itself going to prove only a temporary measure? Much will be

9. It is the Siemens Valeo eAutomotive joint venture that is focused on BEV activities; France has only R&D competence.

dependent on the commitment of powertrain manufacturers in favour of alternative technologies (fuel cells, natural gas, etc.) but, if this is the case, then the teams currently active in hybrid technology need to be switched to other activities.

Investments in vehicle connectivity and autonomous vehicle technology have already started to limit the resources available across other areas of research and development. We might even expect additional financial constraints to limit powertrain R&D activities in the future (Syndex 2019).

Finally, both manufacturers and suppliers are banking on two other levers to reduce the operational costs of their R&D teams: the sharing of tasks between high-cost and low-cost centres; and the development of software tools capable of reducing the duration of projects and, as a result, reducing development costs. The result is that powertrain R&D headcount will decrease after 2021.

The only perspective for growth is likely to be in battery development. Until recently, the resources allocated to these activities have been relatively meagre, although battery R&D teams are present in manufacturers, in the CEA,[10] in start-ups and within Blue Solutions.[11] However, it is with the Korean LG and the Chinese CATL that PSA and Renault have developed partnerships. On the other hand, this situation appears to be changing, with the French government deciding to 'Encourage R&D for 4th generation batteries and to support the growth of a French/European industrial infrastructure.'[12] On 14 February 2019, the French government announced €700m of investment aimed at producing batteries in France and supporting a Franco-German battery consortium.[13] It remains to be seen to what extent French R&D will benefit from these measures.

The transformation is already underway at most sites, albeit at a modest pace

In engine component manufacturing, many sites have invested in both diesel and petrol components, thus delaying the effects of the decline in the diesel market. Indeed, most of the sites that were fully committed to diesel have begun to reposition themselves towards petrol. This transition is far from painless, however, and generally results in a reduction of staffing needs.

The spare parts market has again become an attractive market for sites that, in the past, had wanted to get rid of low volume production activities; the traditionally high profit margins in spare parts are now attracting sites affected by dwindling volumes and margins and unused capacities.

10. Centre d'énergie atomique (CEA). The CEA has been involved in battery development since the 1990s through the Liten laboratory.
11. Blue Solutions is a company in the Bolloré Group. Blue Solutions designs and manufactures solid lithium metal polymer batteries for its Bluecars used in car sharing and in buses.
12. Contrat Stratégique de la filière Automobile 2018-2022 (Conseil National de l'Industrie 2018).
13. https://www.entreprises.gouv.fr/files/files/directions_services/conseil-national-industrie/produire-en-france-les-automobiles-de-demain-dp.pdf. In November 2018, Peter Altmaier, German Economy Minister, announced €1bn to support battery cell production in Germany.

Although powertrain electrification is at the heart of R&D concerns, at both manufacturers and suppliers, for now only a few electric production projects are being undertaken across the sector. Electric engines are manufactured in Cléon and some projects are also underway at the PSA site in Tremery in collaboration with Nidec.[14] The Forsee Power Battery site in Chasseneuil (a former piston manufacturing site) has also been launched.

At present, electric vehicle components present no major production prospects in France. Volumes are still weak and, in addition, the number of components in an electric powertrain is far lower than in a combustion engine.

There are only a few battery production projects in France (Blue Solutions, E4V, Forsee Power, etc.) and these are focused on rather marginal activities — niches and vehicle adaptations. No large-scale project is yet planned in France. In 2012, a project was envisaged linking LG Chem-Renault and CEA, but it was subsequently abandoned.

Some companies are embarking on diversification outside the automotive sector as such, as for example in the case of the Bosch site in Rodez where a joint committee is looking for non-automotive potential markets.

Several other sites are focusing their efforts on increasing productivity (on 'operational excellence', as it is sometimes put) to remain competitive. In the medium term, however, improving productivity will no longer suffice for maintaining jobs and margins.

Finally, some of the sites experiencing serious difficulties have been shut down in the last two years. They represent at least ten per cent of the sites in our database. There is no easily identifiable common profile for these sites: some are linked substantially to diesel, but others less so — for example, a turbo parts subcontractor and manufacturers of particle filters, pistons, diesel injectors, etc. A planned closure of a Ford subsidiary in automatic gearboxes has also been announced. Additionally, foundries are frequently facing closure or severe downsizing.

In production: fewer employees but increasing skill requirements

At present, it is mainly the automation of processes (production, logistics, quality) that is driving employment requirements downwards (i.e. the generalisation of assembly lines or automated manufacturing centres, the introduction of small automatic trains for logistics, camera-controlled systems for quality control, etc.). Over the following five to ten years, however, the following factors need also to be taken into account:

— even further productivity gains are expected due to the development of connected processes. Not only will the need for production operators decline, but the same will happen to the demand for support functions;

14. Nidec Corporation is a Japanese leader in the manufacture of electric engines.

— volumes are also likely to fall due to the growth of car sharing (estimated at ten per cent in 2025) and the development of pure electric vehicles (ten per cent to twenty per cent by 2025), leading to a decline in employment.

In parallel, jobs are gaining richer content and are consequently becoming more elaborate. A number of factors are involved.

First, versatility is being promoted: employees are required to be able to handle more diverse tasks, including first-level maintenance and quality operations; this trend will accelerate with digitalisation.

Second, companies are looking for line workers who are able to operate and adjust equipment, assist their team and help solve problems. This requires technical and managerial skills that rest on granting teams greater autonomy, potentially leading to fewer supervisors. We have already noticed such trends in certain plants: the renewal of lines/production cells that are far more compact (and automated, with the emerging problem of educating robots); or the management of factory sub-units (cells or lines) from computer-equipped cabins. The line operator has almost disappeared (a few controllers remain here and there), replaced by workers with two-year post-secondary studies who are managing production lines. This type of disruption means not only that direct labour demand is shrinking but also that existing line operators do not necessarily have the newly-required skills.

Third, within this increasingly complex context, the skills required by managers are changing radically and are turning the traditional hierarchical *modus operandi* upside down. Meeting performance targets requires management to turn towards supporting production staff and, consequently, to working in unison with workers on the ground. The upgrading of management skills is crucial in achieving the agility which is much sought after by automotive organisations.

Fourth, maintenance is a field receiving particular attention due to the digitalisation of equipment and production management systems. In the north of France, for example, human resources managers in the automotive sector have already been implementing new training programmes focused on maintenance jobs (automation specialists, etc.).

4. Challenges to a properly-managed transition

4.1 Avoiding the vicious circle of disintegration

Viewed from the perspective of the stagnating volumes of vehicles assembled in France (around two million vehicles per year) and of the progressive decline in the manufacture of combustion engines, the future viability of the French automobile sector is at stake. This is even more so if we consider that it has been significantly weakened by relocations and purchasing policies oriented primarily towards cutting costs. In the face of these changes, we believe the following factors will prove decisive for the future of the automotive sector in France.

Boosting the level of local integration

When a manufacturer sets up a plant in a region abroad, efforts are made to create supply networks with a local integration rate of sixty to ninety per cent. Nothing of the sort exists in France, where the integration of the sector seems to be moving in the opposite direction. Several managers have indicated to us the existence of pressure from their clients to produce in low-cost European sites, in spite of proposals for equivalent costs within France. Local integration remains the best way of serving synchronised production systems in order both to be reactive and to ensure the presence of the necessary technical skills at local level.

However, the new trend in the desire of manufacturers for synchronised production flows points to a reinforced need for the proximity of customer and supplier sites. This change should logically lead to a growth in local integration for assembly sites, even in France.

Responsible procurement policies

Driven by an alliance between PSA (with Opel/Vauxhall) and Renault (which, with Nissan and Mitsubishi, was world leader in 2017), procurement policies are focusing on large-scale players, operating internationally. The prospects for independent and/or small-sized suppliers located in France have deteriorated, regardless of whether these companies possess extensive know-how. In the face of such complex situations, the collective acumen of the sector will be put to the test. Will it be able to build solutions to consolidate and diversify activities while finding the financial resources to reinforce the potential of its isolated gems?

Mastering all the facets of tomorrow's automotive sector

Volumes, skills and value will be carried over progressively to electrified powertrain systems, alongside the new energy-storing and recharging systems, and the technologies for partially or fully connected and autonomous vehicles. Maintaining a sizable automotive sector in France presupposes a presence across all these domains. This raises strategic, economic, environmental and social challenges:

- strategic, as the sector seeks to maintain a sustainable industrial fabric stretching across the activities of the future;
- economic, because managing technology allows costs to be controlled. Furthermore, the strength of local partners maintains the competitiveness of all stakeholders in the sector;
- environmental, as local exchanges within a sector reinforce the synchronicity of flows and limit the hazards and transport times;
- social, because in the context of declining labour demand, new sources of growth are vital.

The automotive sector in France is currently on a shrinking path. However, it has several assets with which it can position itself along a recovery path. This presupposes investment not only in higher productivity but also in new activities reinforcing the links between stakeholders and helping to develop future skills — a major factor for differentiation and competitiveness both today and in the future.

4.2 Anticipation and consultation, vital for achieving a new balance

At sectoral level: creating a shared vision

In 2009, companies in the French automotive sector created a platform (PFA) that brings together 4,000 companies: manufacturers; suppliers; subcontractors; and mobility stakeholders. They have started by sharing information and defining a common roadmap and common positions on standards, for example.

Meanwhile, the Observatoire de la Métallurgie, a joint body that unites professional and labour unions, has published several prospective studies on the impact of changes in the sector on employment and skills. According to the last study (Observatoire de la Métallurgie 2018), it is estimated that 25 per cent of jobs in the powertrain sector are exposed to risk. Based on their recommendations, we would like to emphasise the following points:

— firstly, it is important to pay attention to the employment and skills imbalances of companies, at the local level, because the greatest possible number of employment changes appear there;
— in parallel, the country's stakeholders must follow, stimulate and develop their adaptation potential (training strategies, bridges between companies, support for company transformation, etc.);
— enhancing employability and raising the value of skills through professional qualification certificates should be promoted;
— there is a need to develop initial and continuing training across key jobs;
— vulnerable sites need to be supported through new strategic directions or through new financial resources.

There are two additional elements which occur to us. With respect to supporting the transition, and for nearly ten years now, Syndex has been promoting concerted approaches involving the management of companies, employee representatives and employees themselves (Meixner 2017). Considering the complexity of the matters at hand, no-one, regardless of their expert pedigree, is able to say what the future will actually be like or be able to turn their companies around by relying only on the contribution of a limited few. The level of complexity involved requires the mobilisation of all the stakeholders concerned by these transformations in order progressively to develop viable projects that are acceptable to as many as possible.

Finally, the vital involvement of local and regional structures must not take the place of industrial policy measures initiated at national or European level.

Available tools for social dialogue at the company level must be mobilised

In French companies, specific tools for anticipating change and ensuring permanent consultation with employee representatives are set in place.

Consultations on strategic orientation

Each year, the works councils[15] of companies settled in France have to be informed and consulted regarding strategic orientations and 'Their consequences for the activity, employment, evolution of jobs and skills, work organisation, use of subcontractors, temporary workers, temporary contracts and work placements. Consultation focuses, among other things, on the forward-looking management of jobs and skills, and on the orientations of professional training.'[16] In this context, managements must present fairly detailed prospects for at least three years. This represents a first step for dialogue.

Based on these consultations, the works council formulates an opinion, which is addressed to the company's board. Following this exchange, employee representatives may discuss these orientations and submit alternative plans or proposals concerning skills development or training.

Employee representatives have a legitimate right to propose possible courses of action to management. The joint commissions operating at Bosch in Rodez or at ACI in Villeurbanne have made it possible to develop analytical approaches and to elaborate potential scenarios for companies and their employees that site managers sometimes struggle to carry out on their own.

Negotiation on management paths, jobs and skills

Company trade unions may also negotiate on the issues arising from the company's strategic orientation over the three-year medium-term period. Unions may seek to negotiate on the types of job categories threatened by economic or technological change; on the implementation of employee mobility; on the sustainable training and inclusion of young people in the company; on the employment of older workers, etc.

This negotiation framework, together with the works council consultations on strategic orientation, offers the tools with which to achieve a shared vision of a company's strategy and outlook, and to formulate in common alternative proposals and identify secure development paths. These tools deserve to be used broadly by companies within the powertrain sector in France and in Europe more generally. Well utilised, such information/consultation practices provide the opportunity to discuss the opportunities for diversification and the detailed skills, training and employment adaptations that they will require.

15. Currently, the Social and Economic Committee (SEC).
16. According to the French Labour Code: Article L2323-10.

5. Conclusions

The transformation of the powertrain sector and the structural decline of the diesel market are of national significance in France and are, therefore, not just matters of concern for the French automotive industry alone. Technical engine-related skills are core competences in France and a wide range of powertrain-related activities are present in the country, both in production and in design, totalling over 56,000 jobs.

We estimate that demand for these activities could fall by twenty per cent to thirty per cent by 2025. Such a huge decline could, inevitably, raise fears that major restructuring will ensue. However, by looking at a large sample of companies active in the industry, we found that, at the end of 2016, around seventeen per cent of staff were aged 55 and over. Retirements should thus facilitate the required adaptations as long as these are tailored to the decline in the demand for labour. However, those leaving will take their skills and practical experience with them, while those remaining might have to deal with different activities, jobs or organisational set-ups.

Providing support for recruitment and mobility (including skills improvement across technical or sectoral fields, and employability) should therefore be the main challenges for powertrain companies attempting to achieve a fair social transition.

To be effective, this social transition will need the involvement of all shareholders, manufacturers, suppliers, subcontractors and local or regional authorities. Letting subcontractors become weaker risks undermining the entire French automotive sector.

The other key points will be the development of energy storage activities but also new automotive high-tech activities in software and the combination of software and hardware systems. Without the development and reinforcement of these new kind of activities and skills, the French automotive sector is condemned to be progressively marginalised.

References

CCFA (2018) L'industrie automobile française. Analyse et statistiques 2018. https://ccfa.fr/wp-content/uploads/2018/09/analyse_statistiques_2018_fr.pdf

Conseil national de l'industrie (2018) Contrat stratégique de la filière Automobile 2018-2022, 22 May 2018. https://www.pfa-auto.fr/wp-content/uploads/2018/06/DP-SCF-Automobile.pdf

Conseil national de l'industrie (2019) Produire en France les automobiles de demain, 13-14 February 2019. https://www.entreprises.gouv.fr/files/files/directions_services/conseil-national-industrie/produire-en-france-les-automobiles-de-demain-dp.pdf

FIEV (2018) Chiffres clés - 2018 - Facts & Figures. https://www.fiev.fr/upload/docs/application/pdf/2018-07/chiffrescles-fiev_2018-bd.pdf

IHS (2018) Vehicle Market Analysis: Registrations and Vehicles-in-Operation. https://ihsmarkit.com/products/automotive-market-data-analysis.html

Meixner M. (2017) Site CV: collective competencies as a resource for positive alternatives to restructuring, Confrontation Europe, Brussels, 19 December 2017.
Observatoire Prospectif et Analytique des Métiers et Qualifications de la Métallurgie (2018) Analyse prospective des impacts des mutations de la construction automobile sur l'emploi et les besoins de compétences, 28 November 2018. https://www.observatoire-metallurgie.fr/analyses-previsions/analyse-prospective-des-impacts-des-mutations-de-la-construction-automobile-sur
SYNDEX (2018a) Filière automobile : l'embellie ne profite pas à l'emploi, 23 February 2018. https://www.syndex.fr/actualites/etude/filiere-automobile-lembellie-ne-profite-pas-lemploi
SYNDEX (2018b) Une fragilisation de la filière française?, 2 July 2018. https://www.syndex.fr/actualites/etude/une-fragilisation-de-la-filiere-francaise
SYNDEX (2019) Sector embarks on a high-risk structural transformation, 11 February 2019. https://www.syndex.eu/news/case-study/sector-embarks-high-risk-structural-transformation

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Chapter 8
Globalisation, decarbonisation and technological change: challenges for the German and CEE automotive supplier industry

Martin Krzywdzinski

Introduction

The automotive industry is going through a phase of profound change. On the one hand, we can see the continuing and deepening globalisation of companies and value chains. The global rise of emerging economies as automotive markets and as locations for automobile production is having a strong impact on company strategies. This development requires companies to rebuild their location structures and supply chains, and it also puts pressure on traditional high-wage locations in Europe.

On the other hand, technological change is forcing companies to rethink their business strategies, products and processes. In particular, the increasing demand for clean propulsion technologies – and the emerging transition from the combustion engine to electric mobility – imply significant changes in the automotive industry. At the same time, technological innovation processes in the field of autonomous driving and in the area of advanced manufacturing techniques are becoming increasingly important.

These developments give rise to a number of questions about the future of employment in the German automotive industry. What are the risks of relocation processes and under what conditions can employment be safeguarded at high-wage locations? How are skill requirements changing due to new technologies and what impact will electric mobility and digitalisation have on employment?

From a German perspective, the major concerns are over the future of established high-wage locations, which will have to compete with low-wage alternatives, and the question of how to maintain technological leadership in changing conditions. From the point of view of low-wage countries, in contrast, the major issue is the potential for upgrading. Between Germany and central and eastern Europe (CEE), a closely intertwined production network has emerged. In the process, CEE plants have developed from being mere 'extended workbenches' into modern production facilities which are competing with German locations on an increasingly equal footing as far as products and process technologies are concerned. But what opportunities are there for further upgrading and how will technological change affect these locations?

This chapter differs from most existing studies in terms of its focus and approach. First, while a majority of authors focus on automobile manufacturers, here we discuss the development of automotive suppliers in the context of digitalisation processes and technological change. Second, this chapter emphasises the difference between developments at company level and those at plant level. While it is possible that technologically strong automotive suppliers will benefit from developments in the field of electric mobility or autonomous driving, it is unclear how this will affect plants in different geographical regions. Will future products be produced in high-wage locations or directly in low-wage countries?

Our analysis is based on case studies of automotive supplier companies as well as a survey of employee representatives (works councils in Germany; workplace trade union chairs in CEE).[1] In total, 145 employee representatives from German plants and 125 employee representatives from CEE plants (in Poland, Czechia, Slovakia and Hungary) participated in the survey. With regard to the mixture of plants involved by employment level and product segment, the survey was composed from a representative sample within the automotive supply industry. There is a certain bias with regard to company ownership structure: the plants included in the analysis belong overwhelmingly to multinational supplier corporations. Plants operated by local companies without operations in other countries represent a small minority (five plants in Germany; two in CEE). For more information regarding the data and methodology, see Schwarz-Kocher *et al.* (2019).

This chapter does not aim to develop scenarios or make forecasts. The direction and speed of technological change seems too uncertain to advance this, as do the shifts in automobile demand. Neither does it aim to address all the future changes facing the automobile sector. Instead, it concentrates on analysing the current situation of German and CEE automotive supplier plants, based on empirical data, in order to discuss potential future developments both in Germany and in CEE.

Section 1 discusses the processes of globalisation and technological innovation as major drivers of change in the automotive sector. Section 2 examines changes in the German automotive supply sector. It analyses the strategies of automotive suppliers and the role that German manufacturing facilities play in the introduction of new products and technologies, i.e. their innovation-related role, and discusses the relationship between these roles, skill structures and trends in employment. In Section 3, the analysis turns to developments in central and eastern Europe, which is the central low-wage region for the European automotive industry. The focus is, once again, on the role of sites in introducing new products and technologies, and features a discussion of both the extent and the limits of the upgrading of low-wage locations within Europe. Section 4 comprises the conclusions.

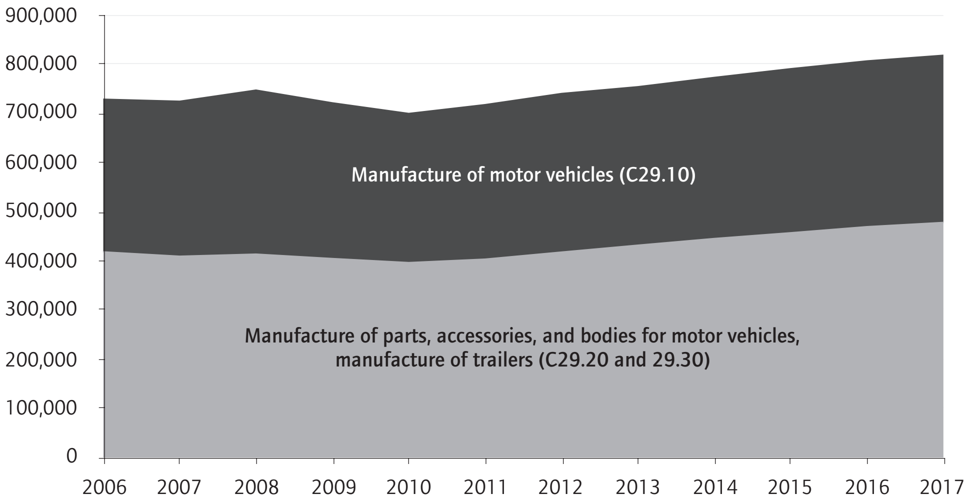
1. The analysis is based on the *Prospects of the Automotive Supply Industry* research project, implemented in 2015 and 2016. The project was conducted by Martin Krzywdzinski and Axel Schröder (WZB) along with Martin Schwarz-Kocher, Heinz Pfäfflin, Hermann Biehler, Yalzin Kutlu and Walter Mugler (IMU Institute); and Inger Korflür, Ralf Löckener and Arne Vorderwülbecke (Sustain Consult). It was funded by the Hans-Böckler-Stiftung.

1. Globalisation and technological change: the major drivers of sectoral transformation

At first glance, it seems the German automotive industry has weathered the collapse of the 2008-9 crisis. Automobile production in Germany plunged from a peak of 5.7 million vehicles in 2007 to 4.9 million in 2009; however, the number of automobiles produced once again reached 5.7 million in 2015, with production stagnating at this level both in 2016 and 2017.

Employment in the automotive industry has also recovered (see Figure 1). From 2010, the peak of the crisis, to 2017, employment in the German automotive industry increased by over 100,000 to 820,000 and has thus clearly exceeded pre-crisis levels. This increase is mainly attributable to the automotive supplier sector; employment in automotive manufacturers has remained stable. Employment trends in the German automotive industry are significantly different to those in many neighbouring countries such as France.

Figure 1 **Employment in the German automobile industry (C29*), 2006-2017**



Source: Author, based on VDA (German Association of the Automotive Industry) (various volumes).
Note: * C29 stands for 'manufacture of motor vehicles, trailers and semi-trailers' in the NACE sector classification.

However, this positive development should not lead us to overlook the many forces that are significantly changing the structure of the industry. Two important factors are changes in global market structures; and changes in mobility and environmental policies.

1.1 Globalisation

One major characteristic of the ongoing changes in market structures is that growth is slowing in European markets while it is expected to continue in China and in other emerging markets (perhaps even in the USA). The long-term effects of the economic, financial and sovereign debt crisis of 2008 and the applied adjustment policies, both at EU and member state level, have had negative effects on growth in Europe and, above all, in its southern parts.

The shift in growth markets from Europe to Asia, and especially to China, has posed major challenges for the German automotive industry's innovation and export models. Markets outside of Europe may formerly have purchased automobiles produced primarily in Germany; now, a global production and innovation network has developed that supplies regional markets with regionally-produced automobiles (Weber *et al.* 2013; Voskamp and Wittke 2012; Freyssenet *et al.* 2003). From the perspective of the German automotive industry, a shift has occurred from export-dominated vehicle production to a multi-regional network encompassing different regions of the world. This can be illustrated by the development of the German automotive industry's sales and production figures between 2008 and 2016 (VDA 2017). In this period, the total sales of German car manufacturers increased from 10.1 million to 14.7 million passenger cars. This total increase of 4.6 million passenger cars, however, took place nearly exclusively in foreign markets and was boosted by the expansion of production capacities abroad, German domestic production and export figures having remained constant during this period.

These shifts have been accompanied by structural change in the German automotive industry. The production of vehicles in the premium segment has increased significantly while the output of traditional mass producers has decreased (Krzywdzinski 2014a). Of the roughly 6.5 million premium vehicles sold worldwide in 2012, eighty per cent came from German brands, according to the VDA. In the upper class segment, it was nearly 100 per cent in 2010 (see Diez 2015). In the premium sector, there has even been a trend towards more production in German locations (Schade *et al.* 2012: 94). Up to now, products that are largely or exclusively price sensitive have been relocated abroad; high-quality and innovative products tend still to be produced in German locations, in close proximity to company headquarters.

These shifts in the global footprint of the original equipment manufacturers (OEMs) are also affecting suppliers. More than fifteen years ago (in 2003), 34 per cent of German suppliers already had overseas production facilities. There are no directly comparable recent data. This globalisation process has been driven particularly by tier 1 suppliers (see Kinkel *et al.*2004: 6). In 2012, 65 per cent of the plants of the larger German automotive suppliers (i.e. with more than 1,000 employees in total) were located outside of Germany; in the case of smaller automotive suppliers (fewer than 1,000 employees in total), it was 12 per cent (IWD 2012).

At the same time, the demand from German premium manufacturers remains an important reason for the stability and growth of employment in German automotive supplier locations. It is also true that, as a result of the strong focus on premium customers, German supplier locations very frequently produce high-end products.

1.2 Environmental regulation and technological change

Technical changes in products that are largely driven by regulatory mechanisms formed from the political environment are having a similarly huge impact on corporate strategies in the automotive industry. Global warming and its potentially catastrophic consequences have put pressure on an international community which has been struggling for years to limit the emission of greenhouse gases. At the UN Climate Change Conference in Paris in 2015, the parties agreed to limit global warming to two degrees centigrade, and preferably to 1.5 degrees. To achieve this, greenhouse gas emissions will have to be reduced to zero between 2045 and 2060. This will only be possible by shifting to renewable energy, achieving greater levels of energy efficiency and making energy savings. The EU wants to reduce CO_2 emissions by at least forty per cent by 2030 compared to 1990 levels. Furthermore, Germany wants to reduce greenhouse gas emissions by forty per cent compared to 1990 by 2020, although the country is likely to miss this target (see Kersting and Stratmann 2018), and then by 55 per cent by 2030, 70 per cent by 2040 and by 80 to 95 per cent by 2050.

The general EU policy also requires the automotive industry to achieve CO_2 savings that, from today's perspective, are very demanding – at least, if we assume the continued use of combustion engine technologies. In 2017, the fleet average of the major German car manufacturers (including Volkswagen, Audi, BMW and Mercedes-Benz) reached 120-130 grams of CO_2 per kilometre. An outlier was Porsche, with 178 grams. By 2021, the allowed fleet average of each automobile manufacturer will be 95 grams per kilometre. The goals for 2030 were subject to a lengthy debate, with the European Parliament proposing a reduction of forty per cent compared to 2021 (i.e. of 38 grams per kilometre) while the European Commission argued for a thirty per cent reduction target. In early 2019, the European institutions finally agreed on a reduction scenario of fifteen per cent by 2025 and 37.5 per cent by 2030 (European Council 2019).

Meanwhile, diesel engines, which are relatively efficient regarding CO_2 emissions and have been preferred by German manufacturers, are facing problems in meeting the increasingly stricter EU regulations on particulate matter pollution and the thresholds for NO_X emissions (see DLR and WI 2015). It seems that diesel technology has peaked and that the previously achieved savings in NO_X emissions were, at least partially, fictitious and based on fraud. The increasing demand for petrol-based combustion engines, however, creates considerable problems for German automotive companies due to the higher CO_2 emissions compared with diesel technology. If the Paris Climate Agreement is to be respected, then the transport sector will have to reduce its CO_2 emissions to around zero by 2050 (EU Commission 2018). From today's perspective, electric vehicles are the only way to achieve this goal – provided that fossil fuels also become a considerably less important component of power supply.

Despite the tightening of the environmental regulations, however, the extent to which the conversion to electric mobility will succeed remains unclear. Public subsidies have been made available to buyers of electric vehicles, yet their sales in Germany are still lower than expected. Commerzbank experts estimate that ‘a significant market for pure electric cars will not develop until 2025’ (Commerzbank 2016: 18).

The introduction of electric mobility is expected to have significant employment effects. However, it is difficult to judge how long this introduction will take and how long internal combustion engines and hybrid solutions will remain dominant. The ELAB study (Bauer *et al.* 2012) used the example of an ideal engine factory to investigate several scenarios of how the transition from combustion engines to electric mobility would affect employment. In the scenario judged most realistic by the study’s authors, hybrid vehicles will play an important role until around 2030, as pure electric mobility will gain in importance only relatively slowly due to limited battery capacity, a lack of charging infrastructure and other factors. In this scenario, employment in engine manufacturing will remain constant since both internal combustion engines and electric motors will be produced in parallel.

The ELAB study is, however, limited to examining the change in engine factories; the impacts of the shift towards electric mobility on engine component suppliers have, so far, not been systematically examined.

Another set of largely unclear consequences relates to the technological changes associated with autonomous driving and how these changes will impact employment in the automotive industry. It should be emphasised that, so far, the only autonomous driving automobiles on the road are prototypes, be they for Audi, BMW, Daimler or Volvo. Nevertheless, innovations in autonomous driving technologies are expected in the coming years (see Commerzbank 2016: 15; Roland Berger and Lazard 2016: 33). On the one hand, autonomous driving is expected to have a significant negative impact on demand for vehicles and thus on employment (Groshen *et al.* 2018); on the other, the technologies used are already well-known (radar systems, sensors, cameras) and are produced not only by the major suppliers (Bosch, Valeo, Delphi, TRW, Magna and others) but also by companies outside the automotive sector. Demand for these components can be expected to increase further and to create growth opportunities for electronics suppliers or software-oriented companies (Roland Berger and Lazard 2016: 34).

2. The automotive supplier sector in Germany: the company and the plant-level perspective

When analysing the automotive supply sector, it is important to distinguish the company level from the plant level. Available analyses of the automotive supply industry mostly use company-level data to conclude that the industry is highly competitive and innovative, with good growth prospects. However, even if companies’ growth strategies are successful overall, they may well lead to problems in certain regions and individual locations – for instance, when all of the growth is taking place in emerging economies and traditional high-wage locations have stagnated or even lost jobs. High returns and competitiveness at company level are perfectly compatible with low returns and the presence of competitiveness issues in individual plants in different locations.

For this reason, the following analysis begins by describing the general development trends in supplier companies and then turns to the situation in German locations.

2.1 The company perspective: strategies of automotive suppliers regarding globalisation and technological change

The two key challenges for automotive suppliers are to drive innovation and, at the same time, to establish themselves as global players with locations across the world and not just in Europe. For quite some time, the research literature has identified changes in the automotive industry's innovation systems, which can be described as 'The end of OEM-centred development and a shift towards network-based innovation [own translation]' (Blöcker *et al.* 2009).

In order to analyse the role of automotive suppliers in the sector's innovation systems, it is important to differentiate between the different types of innovation and their specific contexts. The OSLO Manual (OECD 2005) distinguishes between product and process innovations as well as between marketing and organisational ones. Kinkel *et al.* (2004) distinguish between product innovation, service innovation, process innovation and organisational innovation (see also Dreher *et al.* 2005; Schwarz-Kocher *et al.* 2011). In doing so, they emphasise the interdependence of the four types of innovation. A new product might require new process technology, a new service might require modifications in the product and organisation of customer service processes, and a new production technique might be better deployed if the product is modified, etc. (Porter 1996; Gerybadze 2004).

The focus of innovation activities among automotive suppliers has long been on process-related issues. The ability to use process innovations in order to capture greater value are decreasing, however, as highly-optimised production processes are now already the basic precondition for any order by an OEM. For this reason, automotive suppliers can use their process expertise to achieve better margins only to a very limited extent. Many studies therefore see the shift towards product innovations and closer links with OEM product development processes as a key success factor for suppliers (Commerzbank 2014; Roland Berger and Lazard 2013). In the case of highly innovative products based on newly-developed manufacturing concepts, suppliers can use their knowledge advantage *vis-à-vis* OEMs to achieve an additional 'innovation margin'.

Schwarz-Kocher *et al.* (2019) argue that this has led to a specific innovation type becoming more and more characteristic of the automotive supply industry: production knowledge-based product innovation. There are several reasons for this. First, innovation often focuses on product ideas that are developed directly, based on suppliers' manufacturing experience. Second, many innovation processes involve the successful integration of production knowledge into product development. These findings confirm the importance of closely linking development and production, as evidenced in various studies, but they also underline the relevance of linking these two functions with others, such as sales and procurement (Fujimoto 2000; Jürgens 2000; Lazonick 2005; Krzywdzinski 2016). Our interviewees in the automotive supplier case studies pointed out that cooperation between product development and production requires direct (and also informal) communication. Similarly, Voskamp (2005) has pointed out that the 'interdependencies between individual functions (such as product development and manufacturing)' cannot be adequately supported simply by exchanging codified knowledge.

Innovative strength is becoming increasingly important for the survival of automotive suppliers due to the increasing importance of electric mobility, autonomous driving and automobile software. In the field of engine components, suppliers are being greatly affected by the impending end of the internal combustion engine: here, jobs relating to injection systems, engine castings and other components are at risk. The diesel crisis has further aggravated this development, especially as far as Bosch is concerned. Bosch is the world's leading manufacturer of diesel injection systems. Injection systems for diesel engines are significantly more complex than for petrol engines and their production requires significantly higher staffing levels. In this respect, the shift from the diesel to the petrol engine poses a problem, even without taking electric mobility into account. All of this puts suppliers under pressure to develop new products.

However, automotive suppliers not only need to strengthen their innovation capabilities, but also master the OEM-driven globalisation process. It is clear that suppliers can only supply OEMs if they also produce globally. In addition, the emergence of OEM R&D centres outside Europe also means that suppliers have to organise their development processes globally. This is often referred to as 'following the customer'. However, once OEMs have established foreign locations, they may attract other customers and start to supply other OEMs, including local ones. While all major suppliers are being challenged by this development, smaller suppliers are often barely able to keep up with it.

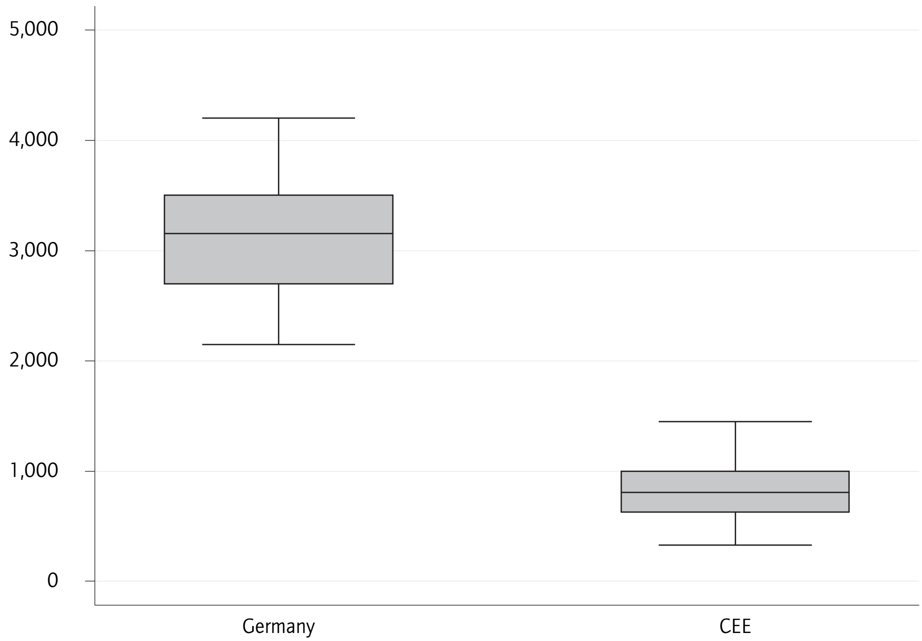
The extra- and intra-European internationalisation of production networks follows different logics. Intra-European internationalisation in the automotive supply industry is mainly driven by labour cost differences and less by 'following the customer' and market access motives. As our survey shows, the pure wage gap between Germany and CEE is still substantial today (Figure 2). The median value of wages (illustrated by the black line inside the grey boxes in Figure 2) for production workers in Poland, Slovakia, Czechia and Hungary were around 27 per cent of the German peer group (€835 compared to €3,122).[2]

There is a large variance within CEE. The lowest wages for production workers are usually paid by electronics and interior parts companies and reach around €300-400 per month. This is just above the minimum wage level in the region and is barely enough to survive on. The wages of production workers in the best-paying companies,

2. We compared gross salaries. We did not take into account differences in productivity or quality but we did allow for differences in working hours and leave entitlements.

however, go up to €1,400 per month. Substantial wage increases took place in CEE in 2017 and 2018 due to labour shortages and increased bargaining power, but the wage gap to Germany remains significant.

Figure 2 **Median value and variance of gross wages of production workers in euros in the German and CEE automotive supplier industry, 2016**

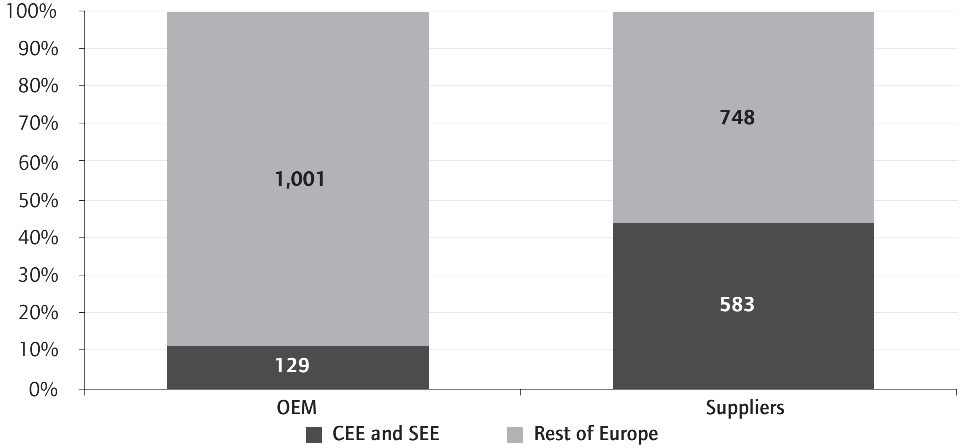


Source: Krzywdzinski *et al.* 2016. Wage levels for production workers with vocational education and five years of job tenure.

During the first waves of production relocations from Germany to CEE in the 1990s, there were many cases of failure. For instance, in 2008, Kinkel *et al.* concluded that 'every fourth to sixth offshoring is followed by a re-shoring within four to five years' (Fraunhofer ISI 2008). However, these negative experiences did not lead to the abandonment of the strategy of offshoring to CEE. Suppliers learned from such experiences and have increasingly transformed their CEE locations from 'extended workbenches' into fully-fledged production plants (Jürgens and Krzywdzinski 2010; Krzywdzinski 2016). The earlier east-west differences in product quality and productivity have, for the most part, been fully offset. In fact, CEE locations seem, in many cases, even to be at an advantage when implementing lean production concepts. This advantage is based on new factories being set up for the most part on greenfield sites and recruiting the first levels of shopfloor supervisors from among the pool of local young people with college degrees.

It is striking that automotive suppliers have opted to use the low-cost region of central eastern and south-eastern Europe much more than the car manufacturers. Only 11 per cent of intra-EU OEM employment is located in CEE countries while in the case of automotive suppliers it is 44 per cent (Figure 3).

Figure 3 **Automotive original equipment manufacturers (OEM) and supplier employment, by region, in thousands, 2016**



Source: Author, based on VDA (2016). 'CEE' includes here Czechia, Hungary, Poland, Romania, Slovakia and Slovenia; 'Rest of Europe' includes western, northern and southern European countries with a relevant automotive industry.

CEE has become the major sourcing region for parts and components for the German automotive industry. For German automotive suppliers, however, there is a tension between globalisation and innovative capability, a factor which has too often been overlooked in previous research studies. The innovative strength of suppliers has largely been based on long, historically emerging network relationships, cooperation and knowledge exchange between R&D sites in Germany, regional universities and research institutes, nearby production equipment manufacturers and suppliers' own production facilities. As production becomes globalised and is relocated from Germany to foreign locations, the question arises as to whether these cooperative relationships are breaking down and, if so, whether the ability of automotive suppliers to innovate is thus being weakened.

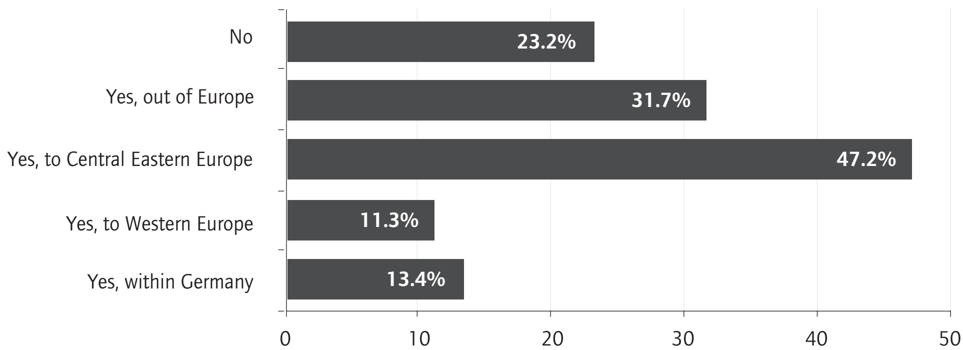
2.2 The plant-level perspective: Relocation pressure and the changing roles of manufacturing plants

How far does the situation of automotive supplier plants in Germany and CEE correspond to the overall successful development of automotive suppliers? And how are the functional roles of German production plants evolving?

There are several factors which play a role here. On the one hand, strong technological innovation dynamics seem to require the further development of plants' existing production capabilities and knowledge. On the other, the establishment of new plants in CEE countries is putting pressure on production employment in Germany. The expansion of production networks to CEE is often experienced by German production plants as a relocation of jobs even if, strictly speaking, it represents in most cases an expansion of existing production capacities rather than relocation in the narrower sense. Companies often use products' natural life-cycles to end the production of a particular product at German locations and shift it to CEE.

Nevertheless, relocations in the broader sense remain relevant. In our survey, over 47 per cent of German works councils stated that there had been relocations of production or other functions to CEE from their site in the past five years (Figure 4). Only 23 per cent of plants had not experienced any relocations in the last five years.

Figure 4 **Relocations of production from German automotive supplier plants, 2011-2016**



Source: Author, based on Krzywdzinski *et al*. 2016.

Of course, relocations do not necessarily have negative consequences for the affected plant; often, old products are relocated to make way for new ones. However, 33 per cent of surveyed works councils in automotive supplier plants in Germany indicated that there had been a reduction in jobs due to relocations.

The strong competitive pressures on German production plants explain why, despite good industry returns, concession bargaining has been evident at many automotive supplier locations. Good returns at company level do not necessarily mean high returns at the level of German production sites. Our survey shows that, over the last five years, in 46 per cent of supplier factories, wage concessions have been agreed to prevent relocations or to gain new products for the plant.

However, there are indications that a manufacturing plant's innovation-related competences have a significant impact on the extent to which it is under relocation pressure and might suffer losses of employment. In this regard, the following competences are particularly important:

- cooperation between manufacturing and R&D in the development of new product ideas;
- industrialisation and the ramping-up of new product generations or completely new product groups;
- testing and implementing new manufacturing processes and automation concepts;

— supporting other plants in the production network when introducing new products and technologies.

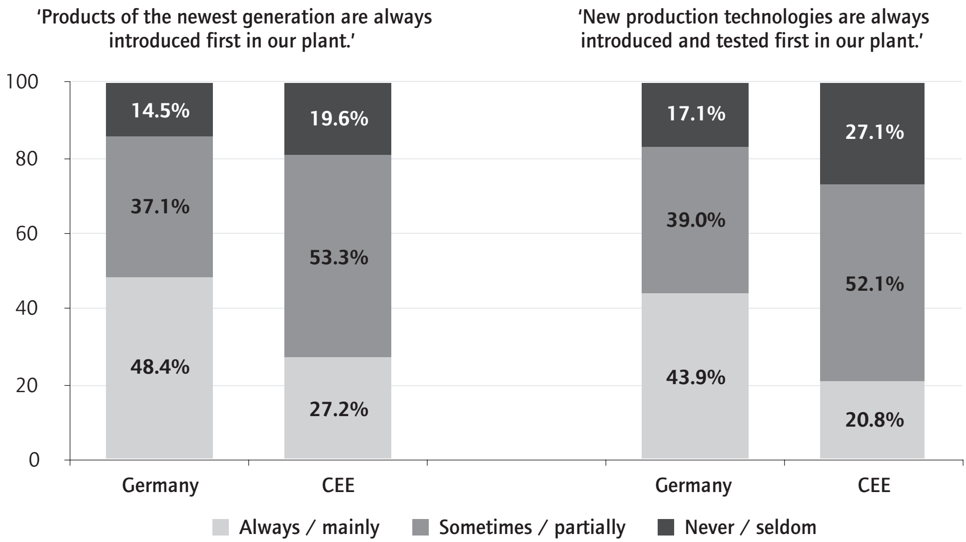
These competences emerge as a consequence of the intensive cooperation between manufacturing departments and R&D, both in formal processes and at the informal level. In some companies, these functions are described as 'lead factory' functions, while other firms do not use this term and fulfil this innovation role without any designation as a special location. Schwarz-Kocher *et al.* (2019) show that lead plant roles are associated with better financial performance and higher employment.

Both our survey and our case studies demonstrated that German sites continue to have a particular responsibility for feeding production knowledge into the product development process. There are several reasons for this: first, they are close to automotive suppliers' R&D sites; second, there is a strong innovation infrastructure in Germany; and third, the skill structures of the plants are also advantageous. The proximity of lead plants to company development centres enables quick accessibility and simple feedback, and gives engineers the opportunity to see and test processes directly (see Dispan and Pfäfflin 2014). Much product development by suppliers (and their customers, OEMs) is, therefore, still based in Germany and is likely to remain so for the foreseeable future. This is also supported by the very good innovation infrastructure, which includes technical support from universities and research institutes, but also direct contact with German production equipment companies. New automation concepts or new production technologies often require the support of equipment builders. The role of these networks in developing and implementing innovation has been widely highlighted in research. Both the industrial districts approach (Piore and Sabel 1984) and Porter's cluster approach (1985) highlight, among other factors, the importance of corporate networks and of the geographical proximity of upstream and downstream service providers and suppliers. The cluster approach, in particular, points to the significance of skill and research infrastructures, for example, to clusters in the German automotive industry (see Blöcker *et al.* 2009).

These advantages mean that German locations are more likely than CEE plants to produce new product generations and new production technologies. We asked works councils about the extent to which new production technologies and new generations of products are first introduced at their own location; Figure 5 provides the answers.

The results show a clear concentration of innovation activities at German production sites. Forty four per cent of the German works councils surveyed report that product launches are always or mostly done at their own site, while 48 per cent of German works councils report that new technologies are always or mostly implemented first at their site. These figures are around twice as high as the corresponding percentages of respondents from CEE. However, it is noteworthy that at least one-quarter of CEE locations have an innovation role comparable to that of German plants – a considerable degree of upgrading compared to the 1990s.

Figure 5 **Lead plant roles in German and CEE automotive supplier plants, 2016 (per cent)**



Source: Author, based on Krzywdzinski *et al.* 2016.

German factories are likely to become more specialised in technological lead roles in the future – on the one hand because they will face continuing competition with low-wage countries; and, on the other, because they will play a key role in the introduction of Industry 4.0 concepts. Competition with low-wage countries means that manufacturing plants in high-wage countries that do not have any innovation or lead plant function will experience relocations and job cuts. Yet, factories that play a leading role in the introduction of Industry 4.0 technologies could extend their lead over low-cost locations which, in turn, will help to secure employment. The same might apply to changes related to electrification: in the case of Volkswagen, for instance, German plants will be mainly responsible for producing the future electrical car platform.

This development will have consequences for employment, while we can expect vocational skills to grow in importance. In German plants with a lead role in introducing new products and production technologies, manufacturing employment has been stable in recent years while office employment has been increasing (Figure 6). This means that the employment structure has shifted, but employment has not declined in absolute terms. However, in enterprises without a lead plant role, manufacturing employment has fallen slightly on average while office employment has remained stable. This is an expression of the greater cost pressures, relocations and rationalisation pressures to which pure production plants will be exposed if they do not perform additional innovation-related tasks.

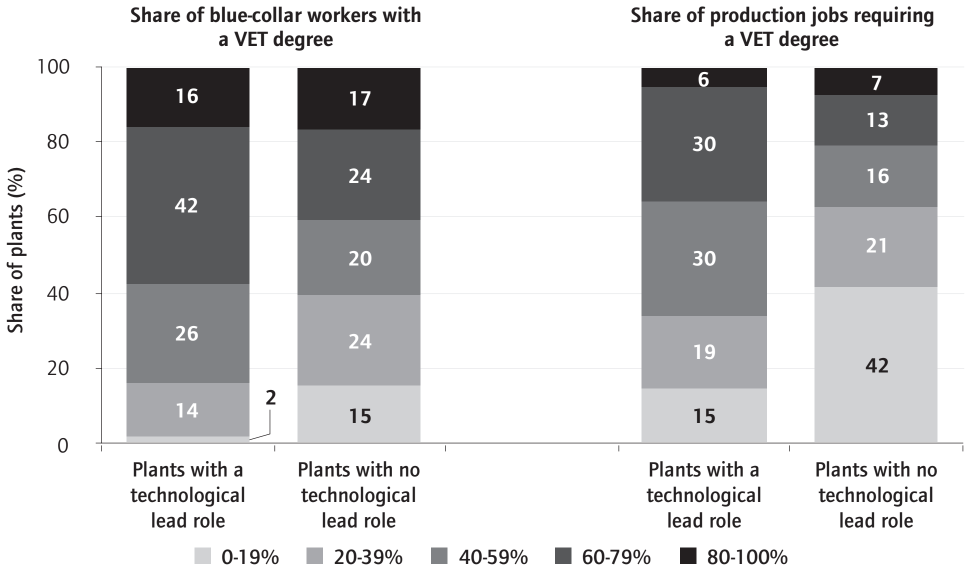
So far, the development of German manufacturing plants can therefore be characterised as one of continuous specialisation in innovation-related tasks and the assumption of lead roles in the introduction of new products and technologies. The consequence of this in terms of skill structures in the German automotive industry is the presence of an increasing proportion of highly-skilled workers. As Figure 7 shows, lead plants have highly-skilled workforces on their production lines. In an average factory that is responsible for introducing new products and technologies, 60-79 per cent of production workers have completed vocational training; in an average non-lead role plant, it is only 40-59 per cent. If we look at the educational requirements of jobs rather than the education level of workers, the numbers differ to some degree but we can still see clear differences between factories with and without lead plant roles. In an average plant with a lead role in the implementation of technology and products, 40-59 per cent of production jobs require vocational training; in average pure manufacturing operations, this is the case for only 20-39 per cent.

Figure 6 **Development of employment in German automotive supplier plants with and without lead plant roles (2011-2016)**

Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0923 (production employment); 0.0015 (office employment).

The proportion of workers with vocational training being higher than the proportion of jobs requiring vocational training points to an interesting feature; namely, the presence of 'excess' knowledge on the German factory floor. In many German manufacturing plants, we observed a considerable share of workers with vocational education diplomas working in jobs that do not formally require specialist training. This is due to managerial preferences – managers often prefer to hire skilled workers if available on the labour market – as well as pressure from trade unions and works councils to maintain existing levels of vocational training and to hire apprentices after the completion of their training. These skills tend to contribute to the organisation's problem-solving capabilities often in unnoticed ways. With regard to implementing new production technologies, these 'excess' qualifications are an advantage of German plants compared to low-wage regions in which the recruitment of skilled workers for production is becoming increasingly difficult (Krzywdzinski 2017; Jürgens and Krzywdzinski 2016).

Figure 7 **Employment structures in production areas of German automotive supplier plants with and without a lead plant role, 2016**



Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0316 (share of workers with a vocational training qualification); 0.0023 (share of jobs requiring a vocational education qualification).

All in all, this means that there is a long-term trend towards higher vocational skills and an upskilling of industrial employment. It should be noted, of course, that a large number of pure manufacturing plants without noteworthy innovation functions still exist in Germany. These plants often compete directly with low-wage locations. Where it proves impossible to escape this competition, by developing specific lead and innovation functions, there is pressure to lower wages, increase working hours and both to intensify work processes as well as make them more flexible.

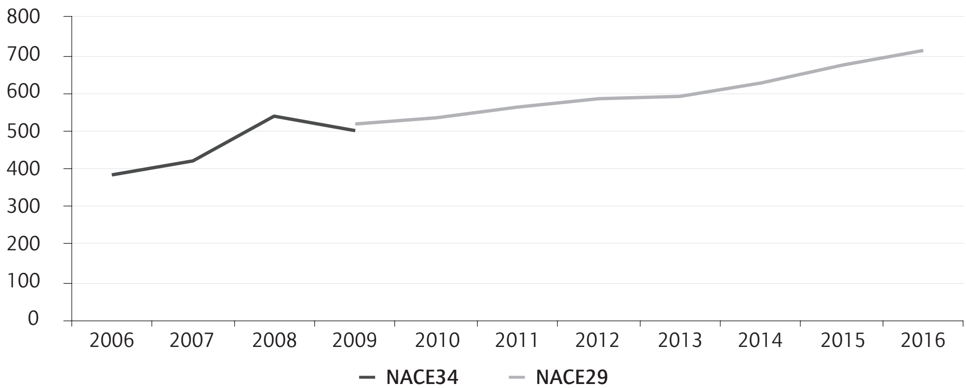
3. Automotive suppliers in CEE: limits to further upgrading?

3.1 Changing roles of manufacturing plants in CEE

For central and eastern Europe, integration into the production networks of the European and, in particular, those of the German automotive industry was a key driver for economic development. In the early 1990s, a wave of relocations and takeovers began, with between forty and seventy factory openings being reported each year by companies in the automotive industry (mainly suppliers) (Jürgens and Krzywdzinski 2010: 48). German companies were pioneers of this development.

Figure 8 clearly shows that employment in the central and east European automotive industry has grown enormously over time. The global economic crisis of 2008-09 led to only a small slowdown in employment growth. Before the crisis, automobile manufacturing employment in the CEE region had risen to around 500,000 people; by 2016, it had reached 712,000. Taking all CEE countries together, employment in the automotive industry roughly corresponds to employment in the German automotive industry – although plants in the CEE region specialise more in the production of parts and components whereas in Germany OEM locations represent a much higher share of automotive employment. This is an unprecedented success story that has contributed significantly to the positive development of the CEE labour market in terms of number of jobs.

Figure 8 **Employment in the CEE automotive industry in thousands of employees, 2006-2016**



Source: VDA (various volumes). Here, CEE includes Czechia, Hungary, Poland, Romania, Slovakia and Slovenia. Due to a change in statistical methodology, NACE 34 was used until 2009 and NACE 29 in subsequent years.

For CEE, such a development has led to the opportunity to modernise infrastructure, production technologies, products and processes (Jürgens and Krzywdzinski 2008). A number of studies have noted the increasing diversification and upgrading over time of the products of the CEE automotive industry (Domanski *et al.* 2013; Pavlínek and Zenka 2010; Jürgens and Krzywdzinski 2008).

However, the research literature also points to the limits of this process. Pavlinek and Zenka (2010) argue that the upgrading of products and processes remains very selective, affecting only parts of the CEE supplier base. Nölke and Vliegenthart (2009) emphasise that the central and east European automotive industry is largely controlled by foreign companies and is therefore highly dependent on decisions made in corporate headquarters abroad. In addition, there is a lack of local R&D centres in CEE (Pavlínek 2012): despite the massive expansion of the production capacity of the automotive industry in CEE low-wage countries, hardly any R&D facilities have been built there so far (Jürgens and Krzywdzinski 2010; Pavlínek 2012). While the globalisation of automotive companies has prompted the development of regional R&D in Asia (especially in China) and in south America (especially in Brazil), CEE – as a low-income intra-European periphery – has not benefited in the same way.

The extent to which the economic upgrading of the CEE automotive industry is being accompanied by improved working and employment conditions is also a matter for dispute. Among the political and economic elites across CEE, there was an expectation that market forces would ensure improved conditions for employees. The state, therefore, has largely limited itself to providing incentives (especially for foreign capital) and has not pursued an active industrial policy (see Jürgens and Krzywdzinski 2010: 114f). In fact, the state has been careful to keep minimum wages low and give companies far-reaching opportunities to use temporary forms pf employment (agency work, fixed-term contracts) (Krzywdzinski 2014b; Maciejewska *et al.* 2016). Unemployment insurance benefits are very low because governments want to encourage jobseekers and employees to seek employment and to strengthen the position of employers in the labour market (Adascalitei 2012; Bohle and Greskovits 2012, Bandelj and Mahutga 2010).

Recent studies argue that, in order to improve working conditions, CEE supplier plants will have to take on more innovation-related functions. Spindelndreier *et al.* (2015) expect that, particularly in Asia and CEE, the number of lead plants responsible for introducing new products and technologies will increase considerably in the next few years, mainly at the expense of German locations (see also Szalavetz 2017).

Our own survey from 2016 shows that 27 per cent of all the CEE plants surveyed were always the first in their companies to introduce the latest products (see Figure 5), and we acknowledge the clear difference here between CEE and German plants. In addition, this does not tell us which product areas are concerned: our case studies show that CEE locations are predominantly responsible for manufacturing well-established products while German locations take on more complex, high-end products. In some cases, however, management stressed that the same technologies are used and the same products are made in both German and CEE locations. Even if management decided to use a particular technology first in Germany, the time advantage over other countries is low:

> 'This is always the period of a maximum of one vehicle generation and then the technology advantage is gone. […] This effect is always less than five, six years.' (Plant manager, supplier company)

In other case studies, management stressed that new products are always introduced first in German factories:

> 'Future products and completely new technologies are implemented first in Germany, while established products are relocated to central eastern Europe.' (Plant manager, supplier company)

Nonetheless, the findings do point to the existence of an upgrading of products in the CEE automotive supply industry.

Product upgrading is also accompanied by an upgrading of the process technologies in use, where there is only a small difference between German and CEE plants. Looking at survey data on the level of automation in Germany and CEE, some differences are immediately evident. More than fifty per cent of companies in Germany report having predominantly or highly automated production, whereas in CEE this is only the case in about twenty per cent of companies. The dominant model in CEE is mixed production, with automated and manual production areas existing alongside each other. However, this difference between Germany and CEE is strongly related to the products and production volumes of the plants. Manual operations in the CEE plants are either targeted on the production of small batches that cannot be produced profitably on highly-automated lines due to the interruptions required for setup and refitting; or they manufacture components with lower precision requirements. If we compare the production of the same products at the same volumes, there is no difference between the process technologies in use in Germany and CEE. The chair of a German works council described the technologies used in CEE plants as follows:

> 'This is high-tech, these are really greenfield plants with the best machinery, the latest technology.' (Works council, supplier company)

Various factors influence the dynamics of the technological upgrading of CEE locations. An important driver in the transfer of new products and production technologies to CEE is the interaction between the high cost pressures exerted by automobile manufacturers and, at the same time, their very high demands regarding the quality and stability of manufacturing processes. Due to such cost pressures, automotive suppliers often have little choice where to locate production. In many cases, automobile manufacturers push suppliers to produce in CEE, either to supply the CEE market (on a 'follow the customer' basis) or because of lower labour costs. At the same time, they assume that suppliers can also implement standard process technologies in the selected locations. Due to the high quality requirements, suppliers therefore tend to implement the same level of technology in CEE plants as in traditional high-wage locations. In our case studies, none of the suppliers differentiated their process technology according to high-wage and low-wage locations: technology is, first and foremost, based on the customer's quality specifications. In some cases, even at the tender stage, customers make explicit demands about process technologies. For this reason, the technology gap between German and CEE locations is relatively small.

3.2 The lack of R&D capabilities

One countervailing mechanism and barrier to the diffusion of new production technologies in low-cost locations is the need for exchange and interaction between R&D and manufacturing. In many cases, both the R&D and internal tool-making functions of foreign automotive suppliers are located in their home countries. Given the dominance of German companies in the automotive sector, a major part of R&D in the sector is concentrated in Germany. This is often the main reason why German factories have a lead role in implementing new technologies.

One of the case studies examined in our project has its centralised R&D function located in Germany while, due to their proximity to R&D, prototype construction and in-house equipment construction are also located in Germany. The company itself builds much of its equipment, such as welding cells and transport systems, in its German location which means that many technologies are tried out there before they go abroad. The presence of prototype and equipment construction at the site also means that a central unit for industrialisation processes has been set up in the German factory; this unit supports the locations outside Germany. The plant manager of the German site expects foreign plants to handle product launches independently in the future, but such a level of independence is not a current reality. The works council describes the level of support for other plants during product launches as a great burden on the German plant, and one which is not appreciated enough by the company:

> 'We send our people over months to these locations – welders or operators, electricians and maintenance workers. Even our managing directors are always over there and helping out.' (Works council, supplier company)

This characterisation of the relationship between the location of product development functions and the lead role of plants in using new process technologies is also supported by data from the survey. We wanted to know whether there was any kind of product development at the location, and regardless of scope. Even though this question does not allow us to distinguish between a large R&D department and a small customisation development unit, it does enable us to examine the connection between the presence of product development tasks and the responsibility for implementing new process technologies.

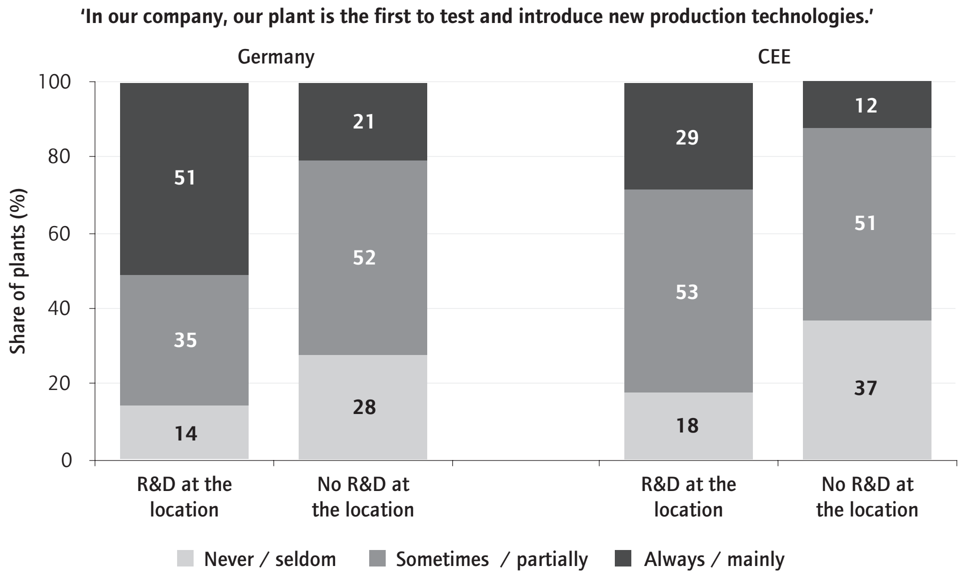
The data show a clear correlation (Figure 9). Among the German plants with on-site R&D, fifty per cent always or mostly take the lead in implementing new process technologies. Plants without in-house R&D rarely play a lead role. In CEE, too, plants with on-site R&D functions have a greater chance of being the first within the production network to implement new production technologies.

The absence of strong R&D centres in CEE is also likely to have an impact on the region's opportunities to benefit from new technological developments in electric mobility and autonomous driving. German automobile manufacturers and suppliers are likely to locate the most advanced implementation projects of new technologies in Germany.

Thus, even though the lack of R&D capabilities could hamper the future development of the CEE automotive industry, its current development is relatively robust. Relocations of production to other low-wage countries do happen but are relatively minor. Among the CEE automotive suppliers we surveyed, 63 per cent reported that they had already experienced relocation. However, most of the relocations were within the region, i.e. these were shifts between locations in CEE countries. In addition, only seven per cent of all surveyed CEE plants reported experiencing job losses due to relocation – a figure which is a lot lower than in Germany.

In addition, CEE countries are benefiting from the establishment of the battery plants of Asian manufacturers. With European governments stepping up their efforts to increase the number of electric vehicles on the roads, Asian battery manufacturers are starting to invest in Europe. In 2018, two large battery factories of the Korean conglomerates Samsung SDI and LG Chem opened in Göd (Hungary) and Wrocław (Poland) respectively; while SK Innovation is planning to open a factory in 2020 for automotive lithium batteries in Komarom, Hungary. Japanese and Chinese companies are also exploring locations for battery plants in central and eastern Europe. However, it should be noted that, in all cases, these are just manufacturing sites: product development remains in Asia and, given the lack of related research and development in CEE, it is highly probable that this will not change in the future.

Figure 9 **Lead plant roles and R&D**



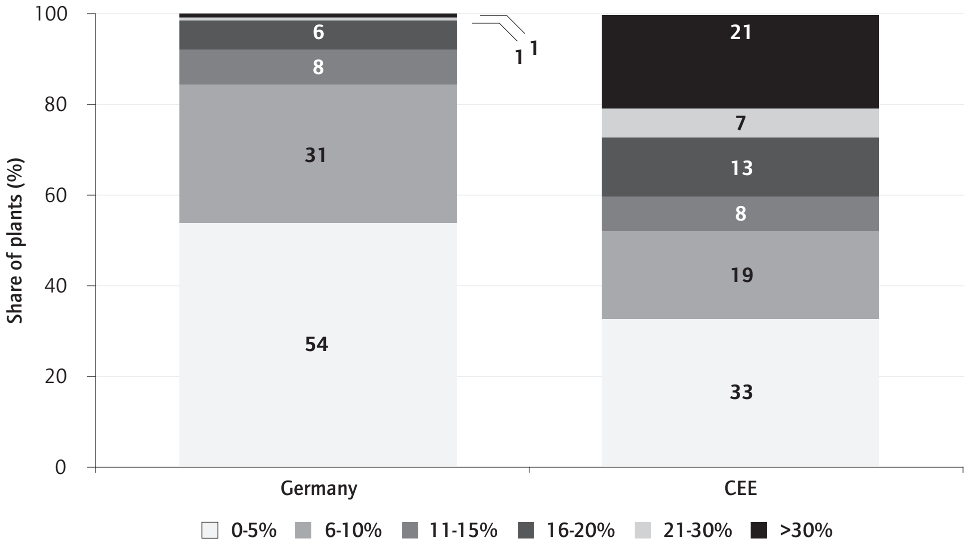
Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0038 (Germany); 0.0123 (CEE).

3.3 The social effects of economic upgrading

The last question to be discussed here is whether economic upgrading in central and eastern Europe has been accompanied by social upgrading. Barrientos *et al.* (2011) define the social upgrading of enterprises as a process of improving the rights, resources and working conditions of workers in enterprises. The most commonly used indicators of social upgrading relate to forms of employment (regular/temporary), wage levels, social protection, working hours, trade union rights and advocacy, the absence of discrimination, occupational safety and healthy working conditions (Barrientos *et al.* 2011; Rossi 2013). In the following, we look at the share taken by precarious forms of employment (fixed-term/temporary work) in total employment as an indicator of the presence of social upgrading.

As shown in Figure 10, CEE automotive supplier plants use significantly more fixed-term employment contracts than their counterparts in Germany. The average proportion (median) of such forms of employment is up to five per cent in German plants and six to ten per cent in CEE plants. In Germany, only 15 per cent of plants have more than ten per cent of employees on fixed-term contracts, but this is the case for 49 per cent of CEE plants. In 21 per cent of the CEE automotive suppliers surveyed, the share of fixed-term contracts even exceeded thirty per cent (compared to less than one per cent of suppliers based in Germany).

Figure 10 **Fixed-term contracts in German and CEE automotive supplier plants, 2015 (percentage of total employment)**

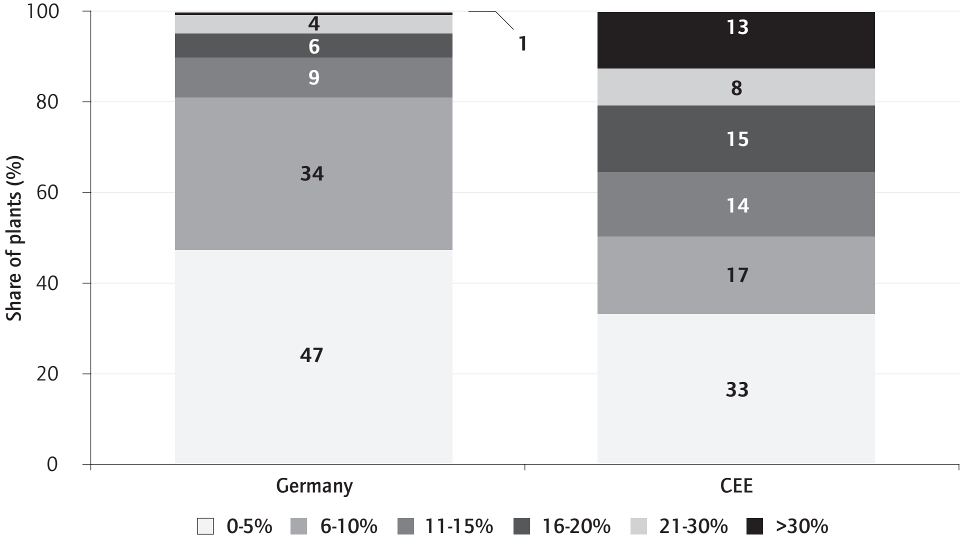


Source: Author, based on Krzywdzinski *et al.* 2016.

A similar pattern can be seen regarding the use of agency work (Figure 11). The share of agency workers in total employment exceeded ten per cent in only twenty per cent of the German plants surveyed – in central and eastern Europe, this was the case in fifty per cent of plants. In 21 per cent of CEE automotive supply plants, the share of agency workers in total employment was even over twenty per cent.

The extensive use of precarious forms of employment in CEE indicates that social upgrading in the region has, so far, been very slow. As Krzywdzinski (2017) shows, there is a connection between process upgrading and the use of precarious forms of employment in the CEE automotive supply industry. Where manufacturing is more automated and where higher skill requirements prevail, the proportion of precarious forms of employment is lower. However, this effect is relatively weak and does little to alter that the precariousness of employment in CEE is, overall, much greater than in Germany.

Figure 11 **Agency workers in German and CEE automotive supplier plants, 2015 (percentage of total employment)**



Source: Author, based on Krzywdzinski *et al.* 2016.

There are also persistent wage differences between CEE and Germany, in the light of which it is worth noting that the catching-up of wages in CEE compared to Germany came to a standstill for almost a decade in the wake of the economic crisis of 2008. Strong wage increases in CEE characterised the period from the mid-1990s to the mid-2000s (see also Onaran and Stockhammer 2006). Wages in the CEE automotive industry rose during this period from about 8-10 per cent of the German level to about 20-25 per cent (for national average wages, see Galgóczi 2017). Between 2008 and 2016, this catching-up movement stalled with wage increases in Czechia, Hungary and Poland remaining below the increases in Germany, at least if one calculates labour costs in euros. Renewed wage dynamism in CEE after 2016 has not, as yet, restored the pre-crisis levels of wage catch-up.

One reason has certainly been developments in exchange rates – as nominal wage increases have been compensated for by a devaluation of the currency. Only Slovakia has deviated somewhat from this pattern, because the country has introduced the euro and cannot respond by devaluing in response to changes in labour costs (Pavlínek 2015). In addition to the currency effects, weak wage developments in CEE countries also reflect weak unions, decentralised collective bargaining systems (Bohle and Greskovits 2012) and locational competition within CEE (Bernaciak 2010; Meardi *et al.* 2013).

4. Conclusions

The automotive industry is undergoing profound change. The globalisation of sectoral value chains is progressing while major technological changes are on the horizon in the area of powertrains (electric mobility) and autonomous driving.

The impact on employment in Germany is uncertain. Much will depend on the pace of change. How much time will factories have for transformation? What skills will be needed in the future? How will the demand for automobiles develop? A number of studies have attempted to identify what kind of transformation of skill requirements and employment will occur by assessing these technologies. However, there is great uncertainty about the validity of the scenarios used in such studies due to the complexity of the change process.

This chapter adopted a different approach. I did not seek to analyse individual technologies, but to look generally at how competencies concerning the introduction of new products and technologies are distributed in the global production networks of automotive suppliers. This question was discussed with a focus on the division of labour between German and CEE locations in the automotive supply industry.

The analysis clearly shows that German locations are under great competitive pressure. Shifts in jobs to low-wage countries are currently a bigger and more tangible threat to German plants than technological change. This is clearly illustrated by the large number of cases of concession bargaining in the German automotive supply industry.

There is, however, a clear difference between two types of plants in Germany. The pressure of cost is faced mainly by pure manufacturing plants, which have to compete with low-cost countries. Locations with lead roles in introducing new products and technologies have, in contrast, special expertise that enables them partially to escape cost competition. In these locations, we are seeing positive employment development and less concessional pressure. This process of the growth of lead plants and the shrinking of pure manufacturing plants in Germany is leading to a gradual specialisation of the German automotive supply industry. Given this specialisation, we can expect that new technologies for electric mobility and autonomous driving will be implemented first in Germany.

For central and eastern Europe, the picture is mixed. On the one hand, we are seeing very good developments in terms of jobs, with the focus of investors on intra-European low-cost locations continuing. However, the region remains mainly specialised in pure manufacturing functions. Only about one-quarter of plants perform innovation tasks such as the introduction of new products and technologies.

Nevertheless, this constellation seems to be stable. Relocations from central and eastern Europe have thus far been limited and have occurred mainly within the region rather than out of it. CEE is strongly dependent on the internal combustion engine but, at the same time, it is also the preferred investment region for Asian manufacturers when it comes to new battery plants.

On the other hand, wage differentials with Germany – in spite of recent wage dynamism – remain significant and automotive suppliers have particularly high levels of precarious employment. It seems difficult to translate positive economic growth into the improvement of wages and employment conditions. Given severe labour shortages and signs of growing bargaining power at CEE locations, however, this pattern might change in the future. Government policies that have sought to maintain comparative advantage by being a low-cost location cannot therefore offer a sustainable perspective.

References

Adascalitei D. (2012) Welfare state development in central and eastern Europe: a state of the art literature review, Studies of Transition States and Societies, 4 (2), 59–70.

Bandelj N. and Mahutga M.C. (2010) How socio-economic change shapes income inequality in post-socialist Europe, Social Forces, 88 (5), 2133–2161.

Barrientos S., Gereffi G. and Rossi A. (2011) Economic and social upgrading in global production networks: a new paradigm for a changing world, International Labour Review, 150 (3–4), 319–340.

Bauer W., Borrmann D., Brand M., Dispan J., Friedrich H., Frieske B., Herrmann F., Propfe B., Rally P., Redelbach M., Rothfuss F., Sachs C., Schmid S., Spath D. and Voigt S. (2012) Elektromobilität und Beschäftigung. Wirkungen der Elektrifizierung des Antriebsstrangs auf Beschäftigung und Standortumgebung (ELAB) – Studienergebnisse, Düsseldorf, Hans-Böckler-Stiftung.

Bernaciak M. (2010) Cross-border competition and trade union responses in the enlarged EU: evidence from the automotive industry in Germany and Poland, European Journal of Industrial Relations, 16 (2), 119–135.

Blöcker A., Jürgens U. and Meißner H.R. (2009) Innovationsnetzwerke und Clusterpolitik in europäischen Automobilregionen. Impulse für Beschäftigung, Münster, LIT Verlag.

Bohle D. and Greskovits B. (2012) Capitalist diversity on Europe's periphery, Ithaca, NY, Cornell University Press.

Commerzbank (2014) Commerzbank Group Risk Management: Autozulieferer, Branchenbericht – Corporate Sector Report, Frankfurt am Main.

Commerzbank (2016) Commerzbank Group Risk Management: Autozulieferer, Branchenbericht – Corporate Sector Report, Frankfurt am Main.

Diez W. (2015) Mittelständische Automobilzulieferer – Chancenpotenziale und strategische Optionen, paper presented at Zulieferertag Baden Württemberg, Stuttgart, 12 November 2015.

Dispan J. and Pfäfflin H. (2014) Nachhaltige Wertschöpfungsstrategie. Unternehmensstrategie im Kontext von Industriepolitik und Megatrends, Düsseldorf, Edition der Hans-Böckler-Stiftung.

DLR and WI (2015) Begleitforschung zu Technologien, Perspektiven und Ökobilanzen der Elektromobilität (STROMbegleitung), Abschlussbericht des Verbundvorhabens, Stuttgart. Deutsches Zentrum für Luft und Raumfahrt.

Domanski B., Guzik R., Gwosdz K. and Dej M. (2013) The crisis and beyond: the dynamics and restructuring of the automotive industry in Poland, International Journal of Automotive Technology and Management, 13 (2), 151–166.

Dreher C., Eggers T., Kinkel S. and Maloca S. (2005) Gesamtwirtschaftlicher Innovationswettbewerb und betriebliche Innovationsfähigkeit, in Bullinger H.J. (ed.) Fokus Innovation. Kräfte bündeln, Prozesse beschleunigen, Stuttgart, Carl HanserVerlag, 1–28.

European Commission (2018) The Commission calls for a climate neutral Europe by 2050. https://ec.europa.eu/clima/news/commission-calls-climate-neutral-europe-2050_en
European Council (2019) CO2 emission standards for cars and vans: Council confirms agreement on stricter limits. https://www.consilium.europa.eu/en/press/press-releases/2019/01/16/co2-emission-standards-for-cars-and-vans-council-confirms-agreement-on-stricter-limits/
Fraunhofer-ISI (2008) Produktionsverlagerungen rückläufig, Presseinformation [Online], 03 March 2008. https://idw-online.de/de/news249467
Freyssenet M., Shimizu K. and Volpato G. (2003) (eds.) Globalization or regionalization of the American and Asian car industry?, Basingstoke, Palgrave Macmillan.
Fujimoto T. (2000) Shortening lead time through early problem-solving – A new round of capability-building competition in the auto industry, in Jürgens U. (ed.) New product development and production networks, Berlin, Springer, 23–54.
Galgóczi B. (2017) Why central and eastern Europe needs a pay rise, Working Paper 2017.01, Brussels, ETUI.
Gerybadze A. (2004) Technologie- und Innovationsmanagement, München, Verlag Vahlen.
Groshen, E., Helper, S., MacDuffie, J. P. and Carson, C. (2018) Preparing U.S. Workers and Employers for an Autonomous Vehicle Future, Working paper, Washington D.C., Securing America's Future Energy. https://avworkforce.secureenergy.org/wp-content/uploads/2018/06/Groshen-et-al-Report-June-2018-1.pdf
IWD (2012) Zulieferer blicken in die Zukunft, Informationen aus dem Institut der deutschen Wirtschaft [Online], 16 February 2012. https://www.iwd.de/artikel/zulieferer-blicken-in-die-zukunft-20789/
Jürgens U. (2000) Communication and cooperation in the new product and process development networks – an international comparison of country- and industry-specific patterns, in Jürgens U. (ed.) New product development and production networks, Berlin, Springer, 107–148.
Jürgens U. and Krzywdzinski M. (2008) Relocation and east-west competition: the case of the European automotive industry, International Journal of Automotive Technology and Management, 8 (2), 145-169.
Jürgens U. and Krzywdzinski M. (2010) Die neue Ost-West-Arbeitsteilung. Arbeitsmodelle und industrielle Beziehungen in der europäischen Automobilindustrie, Frankfurt, Campus Verlag.
Jürgens U. and Krzywdzinski M. (2016) New worlds of work. Varieties of work in car factories in the BRIC Countries, Oxford, Oxford University Press.
Kersting S. and Stratmann K. (2018) Germany will miss its 2020 climate goals, now sights turn to 2030, Handelsblatt Today [Online], 19 June 2018. https://www.handelsblatt.com/today/politics/no-bullseye-germany-will-miss-its-2020-climate-goals-now-sights-turn-to-2030/23582460.html?ticket=ST-3959222-7mz1lzQjcgfcWl6eF6GP-ap5
Kinkel S., Lay G. and Wengel J. (2004) Innovation: mehr als Forschung und Entwicklung. Wachstumschancen auf anderen Innovationspfaden, Mitteilungen aus der Produktionsinnovationserhebung Nr. 33, Karlsruhe, Fraunhofer Institut für Systemtechnik und Innovationsforschung.
Krzywdzinski M. (2014a) How the EU's eastern enlargement changed the German productive model. The case of the automotive industry, Revue de la régulation, 15 (1), 1-61.
Krzywdzinski M. (2014b) Do investors avoid strong trade unions and labour regulation? Social dumping in the European automotive and chemical industries, Work, Employment & Society, 28 (6), 926–945.

Krzywdzinski M. (2016) Technologie, Qualifikationen und internationale Arbeitsteilung. Anmerkungen zu der Diskussion über Industrie 4.0, WZB Discussion Paper SP III 2016-301, Berlin, Wissenschaftszentrum Berlin für Sozialforschung.
Krzywdzinski M. (2017) Automation, skill requirements and labour-use strategies: high-wage and low-wage approaches to high-tech manufacturing in the automotive industry, New Technology, Work and Employment, 32 (3), 247–267.
Krzywdzinski M., Schwarz-Kocher M., Korflür I., Löckener R. and Schröder A. (2016) Standortperspektiven in der Automobilzulieferindustrie. Befragung von Arbeitnehmervertretern in Deutschland und Mittelosteuropa, Version 1.01, unveröffentlichter Datensatz, Berlin, Wissenschaftszentrum Berlin für Sozialforschung.
Lazonick W. (2005) The innovative firm, in Fagerberg J., Mowery D.C. and Nelson R.R. (eds.) The Oxford handbook of innovation, Oxford, Oxford University Press, 29–55.
Maciejewska M., Mrozowicki A. and Piasna A. (2016) The silent and crawling crisis: international competition, labour market reforms and precarious jobs in Poland, in Myant M., Theodoropoulou S. and Piasna A. (eds.) Unemployment, internal devaluation and labour market deregulation in Europe, Brussels, ETUI, 229–254.
Meardi G., Strohmer S. and Traxler F. (2013) Race to the east, race to the bottom? Multi-nationals and industrial relations in two sectors in the Czech Republic, Work, Employment & Society, 27 (1), 39–55.
Nölke A. and Vliegenthart A. (2009) Enlarging the varieties of capitalism: the emergence of dependent market economies in East Central Europe, World Politics, 61 (4), 670–702.
OECD (2005) OSLO Manual: Guidelines for collecting and interpreting innovation data, Paris, OECD Publishing.
Onaran O. and Stockhammer E. (2006) The effect of FDI and foreign trade on wages in the central and eastern European countries in the post-transition era: a sectoral analysis, Department of Economics Working Papers 94, Vienna, Vienna University of Economics and Business. http://EconPapers.repec.org/RePEc:wiw:wiwwuw:wuwp094
Pavlínek P. (2012) The internationalization of corporate R&D and the automotive industry R&D of east-central Europe, Economic Geography, 88 (3), 279–310.
Pavlínek P. (2015) Foreign direct investment and the development of the automotive industry in central and eastern Europe, in Galgóczi B., Drahokoupil J. and Bernaciak M. (eds.) Foreign investment in eastern and southern Europe after 2008: still a lever of growth?, Brussels, ETUI, 209–256.
Pavlínek P. and Zenka J. (2010) Upgrading in the automotive industry: firm-level evidence from central Europe, Journal of Economic Geography, 11 (3), 559–586.
Piore M. and Sabel C. (1984) The second industrial divide: possibilities for prosperity, New York, Basic Books.
Porter M. (1985) Competitive strategy, New York, Free Press.
Porter M. (1996) What is strategy?, Harvard Business Review, 74 (6), 61–78.
Roland Berger and Lazard (2013) Driving on thin ice, Global Automotive Supplier Study 2013, Munich, Roland Berger Strategy Consultants.
Roland Berger and Lazard (2016) Being prepared for uncertainties, Global Automotive Supplier Study 2016, Munich, Roland Berger Strategy Consultants.
Rossi A. (2013) Does economic upgrading lead to social upgrading in global production networks? Evidence from Morocco, World Development, 46, 223–233.

Schade W., Zanker C., Kühn A., Kinkel S., Jäger A., Hettesheimer T. and Schmall T. (2012) Zukunft der Automobilindustrie, Arbeitsbericht No. 152, Berlin, Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag.

Schwarz-Kocher M., Kirner E., Dispan J., Jäger A., Richter U., Seibold B. and Weißfloch U. (2011) Interessenvertretungen im Innovationsprozess. Der Einfluss von Mitbestimmung und Beschäftigtenbeteiligung auf betriebliche Innovationen, Berlin, Edition Sigma.

Schwarz-Kocher M., Krzywdzinski M. and Korflür I. (2019) Standortperspektiven in der Automobilzulieferindustrie, Study der Hans-Böckler-Stiftung No. 409, Düsseldorf, Hans-Böckler-Stiftung.

Spindelndreier D., Bauernhansl T., Beck M. and Leimeister F. (2015) The proximity paradox: balancing auto suppliers' manufacturing networks, München, The Boston Consulting Group.

Szalavetz A. (2017) Industry 4.0 in 'factory economies', in Galgóczi B. and Drahokoupil J. (eds.) Condemned to be left behind? Can central and eastern Europe emerge from its low-wage model?, Brussels, ETUI, 133-152.

VDA (2016, 2017) Tatsachen und Zahlen, Frankfurt, Verband der Automobilindustrie.

Voskamp U. (2005) Grenzen der Mobilität – Chancen für Hochlohnstandorte in globalen Produktions- und Innovationsnetzwerken, SOFI-Mitteilungen No. 33, Göttingen, Soziologisches Forschungsinstitut, 115–129.

Voskamp U. and Wittke V. (2012) Globale Qualitätsproduktion. Eine Studie zu neuen Strategien transnationaler Produktion bei Zulieferern der Automobilindustrie und im Maschinenbau, SOFI Arbeitspapier - SOFI Working Paper 2012-7, Göttingen, Soziologisches Forschungsinstitut.

Weber H., Wegge M. and Conrad R.W. (2013) Strukturwandel der Automobilindustrie: Krise und automobile "Zweiklassengesellschaft". Ergebnisse einer Befragung rheinland-pfälzischer Automobil-Zulieferer, IMO-Report 1/2013, Mainz, Institut zur Modernisierung von Wirtschafts- und Beschäftigungsstrukturen.

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Chapter 9
Managing the transformation of the German automotive industry

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Introduction

The automotive industry is undergoing radical change. Various processes are driving the transformation of this key industry, which has been a symbol of social progress for the last 120 years. In addition to the ongoing processes of automation and globalisation, which have been changing industrial production for decades, climate regulation is now having a direct impact on the core value chain of automobile production and this may lead to disruptive change. The enormous challenges posed by the necessary, and properly ambitious, protection of the climate exacerbate the urgency with which conflicts between different goals must be resolved.

This chapter outlines the transformation process of a key industry in Germany and addresses the role played by the German metalworking union (IG Metall) in managing it. In the first section, it makes the attempt to clarify what is meant by 'transformation'. Its object – the automotive industry – is described in terms of its economic significance, followed by the process of change in terms both of its dimensions and its drivers. Here, we focus in particular on one driver: climate regulation, which is currently the most prominent factor influencing the development of the automotive industry. The second section deals with the nature of the transformation in terms of its technological, economic and political dimensions. Section 3 describes the transformation perspective of IG Metall corresponding to the concept of a 'just transition', with Section 4 introducing the leading actors in the transformation and their positions and strategies. The fifth section considers the different hierarchical levels with which IG Metall is engaged in raising its demands. Finally, the results are summarised and the relevant conflicts identified between the objectives and the conditions which lie behind a successful transformation.

1. The transformation – which transformation?

1.1 The object of transformation: the German automotive industry

Regarding the impact of the global financial, economic and sovereign debt crisis in 2008/09, it has probably been the automotive industry which has contributed most to the rapid recovery of the German economy. Despite structural overcapacities, the automotive industry has continued to grow both qualitatively and quantitatively. On the production side, this means that registrations of new cars increased from 4.5 million units in 1990 to 5.75 million in 2016 (VDA 2018) while the stock increased in the same period from 30 million passenger cars to 46.5 million (KBA 2018). From a consumption perspective, the volume of traffic increased from approximately 600 billion passenger kilometres in 1990 to approximately 980 billion in 2016 (BMVI 2017: 219). In addition, new passenger car types were established, especially from 2000, including the 4-door coupé/crossover coupé, sports utility vehicles (SUV), compact SUVs, etc.

With more than 840,000 employees and an annual turnover of more than €426bn in 2017 (over six per cent more than in the previous year), and thus 14 per cent of total German value added, automobile production undoubtedly represents a key sector of the German economy. After the onset of the crisis in 2007, employment in the sector has continued to grow while earnings before interest and taxes (EBIT) margins of 6-8 per cent are very high compared to other industrial sectors. Additionally, despite the relocation of large areas of production to central eastern Europe (CEE), it has been possible to keep all elements of the value chain in Germany. Two factors are responsible for maintaining employment despite this relocation initiative: booming demand from China and other emerging markets has resulted in massive increases in the volume of exports of German-made cars; while the value of cars has also increased.

The sector also plays a key role for IG Metall: one-third of the union's members and one-third of its new members work here. The more advanced collective agreements often appear first in this sector while, in the large companies, co-determination is practised as a matter of course.

The unprecedented boom in the automotive industry in the last twenty years, from which employees have benefited with high wage increases, could now be abruptly ended by a 'new old' technology: first the electrification of powertrains; and, more recently, completely new mobility concepts. However, the concept of motorised mass mobility in Germany remains unchallenged not only in economic but also in cultural terms: despite repeated crises, structural breaks and regional differences, a united Germany remains firmly on four wheels. Even so, industrial production and employment has been in a constant state of flux as a result of the interaction of various factors (for example including, among others, increases in productivity, technology/innovation, competition and assorted crises). Decline has also featured in these changes as the prior examples of the textile and mining industries, and the current case of the steel industry, also illustrate.

In the case of current developments in the automotive industry, a number of peculiarities have come together. First of all, there is no economic crisis in the automobile industry sufficient to drive a transformation process: the order books are full. Business is going particularly well even in those areas that would be severely affected by future transformation. Small and medium-sized suppliers manufacturing highly-specialised components for combustion technology are currently benefiting from the worldwide boom in private transport. Of course, this phenomenon is very fragile but, in practical terms, it has great effects on possible 'change management' practices and change awareness on both the capital and the labour sides of a company. This also has an effect on IG Metall: the importance of the industry lies in rising turnover and good collective bargaining agreements which, in turn, lead to more members but also an increased focus on the industry. In terms of organisational theory, therefore, one cannot speak today of a crisis-induced transformation of the automobile industry.

Nevertheless, the forthcoming change is radical: the switch to electrified powertrains affects over thirty per cent of the value added in a car, and in which products and activities could be completely eliminated precisely in those fields where German industry has a particularly strong competence. Unlike in other incremental innovation processes, long transition phases are not expected under which different technologies may run in parallel (as was the case previously with, for example, automatic transmissions). IG Metall assumes that this development will be disruptive. An electrification rate of only thirty per cent in 10-12 years would force accelerated change in some segments. As we know, making running repairs is fine as long as the tear is minor – but a major tear requires a different level of intervention.

Primarily, the transformation of the automotive industry is a transformation of the drive, with a corresponding change in skills requirements. However, the technology is so new (at least in terms of mass production) that particular advantages between producers (such as Tesla or some of the Chinese brands), or among technologies (battery electric or fuel cell), could not have been established so far. In contrast, the incumbent positions of leading manufacturers in combustion technology could quickly be eroded. Even if the product strategy of the leading manufacturers is currently aimed at battery electric propulsion, the issues of raw material procurement, grid stability and additional energy requirements are factors that can slow down progress. This creates uncertainty among decision-makers: companies keep a low profile on investment issues and politicians cannot draw up regulatory strategies from this. In contrast to the turnaround in energy policy, for example, it is not yet clear which direction this transformation will take, which technologies and products will prevail and what this means for the skills of the labour force.

Finally, one has to bear in mind that transformation means very different things for the companies, operations and employees concerned. Hence, from IG Metall's point of view, when it comes to the organisation and mobilisation of the workforce behind fair change (i.e. a just transition), it is important to remember that interpretations of the scope of this change range from 'promising' to 'threatening'. The dominant concern of the workforce is not just the question of whether the technology in their plants is viable for the future but also how they might be prepared for the coming changes. The contours of these changes in automobile production can already be foreseen but, in their essential dimensions, they are still very much unknown. We can rely only partially on past experience in this new, uncharted territory.

Before we explore the various options available to IG Metall in managing this change, it is necessary to take a closer look at the nature of the transformation itself including, firstly, its main drivers and dimensions as well as the related positions and strategies of the leading political actors.

1.2 The main driver of transformation: environmental regulation

There have been two developments that have shaped the automotive industry over the past two to three decades. Following the collapse of the eastern bloc, the globalisation of value chains has increased enormously. Due to the growing importance of the so-called BRICS countries,[1] world market shares in automobile production have, since the 2000s, shifted more and more away from the automotive centres of the triad – North America, EU and Japan (Blöcker 2015). On the one hand, the export of vehicles manufactured in Germany has increased massively (1990: 55.8 per cent; 2016: 76.5 per cent); on the other, the production of German companies has become strongly internationalised. Suppliers, in particular, have built production plants in central eastern Europe, where lower labour costs combined with lower energy and property costs, along with subsidies, have offered cost benefits. Manufacturers are also increasingly deciding to produce where they sell. It was initially predicted that only control units, R&D and group management would remain in the country of origin, but this has not materialised. With the increase in production for export, especially in the value-added premium segment, manufacturers have increased employment in particular in Germany despite the relocations.

The digitalisation of production and product is the other development which has shaped the industry in the most recent period. This has had major effects in terms of change in the working environment and therefore has become subject to increasing attention from trade unions. Intelligent production systems start at the interface between production machines and employees, digitalising their communications and networking these with the communications of other devices, employees, products and even other production sites. In addition to the new automation potential opened up by this, it also enables comprehensive control of the production process.

This production-side digitalisation and automation runs in parallel to the digitalisation of the automobile as a product. The autonomous and connective (electric) car, as a product, corresponds to Industry 4.0 as a production system: in terms of its deployment after the production process, it applies the same mechanisms of software-based operation (measuring, processing, controlling and connecting) that it previously used in communications with employees and equipment during the production process. After home ownership, a car is probably the most expensive purchase in a person's life and, therefore, takes up not only financial resources but also time, i.e. in maintenance. Here, the potential for personal savings can be expected at various levels as social models of mobility change (a move from 'possessions' towards 'benefits'). This is where new business models come in, completely reorganising mobility and blurring the boundaries between private and public transport.

However, the most important driver of the changes in automobile production is environmental regulation. In November 2015, the international community agreed to limit global warming to 2°C (and possibly to 1.5°C) because, otherwise, a so-called 'tipping point' will be reached which will set in motion irreversible processes of climate

1. i.e. Brazil, Russia, India, China and South Africa.

change. More recently, the Intergovernmental Panel on Climate Change has stressed that a limit of 1.5 degrees is considered necessary and warned of the far-reaching consequences of a global temperature rise above that level (IPCC 2018). To this end, it is necessary to ensure that, by 2050, all processes across the globe produce no more CO_2 emissions (and other greenhouse gases weighted according to their harmfulness and converted into CO_2 equivalents) than can be absorbed by natural means (oceans, moors, forests, etc.). Reports contain various statements on the volume of greenhouse gases that can still be emitted until the target is exceeded. However, all serious studies, institutes and climate researchers agree that 'climate-neutral' world production must be achieved by 2050 at the latest. Transport now stands out as the sector that has, so far, contributed comparatively little to the reduction of greenhouse gases.[2] The pressure on manufacturers to cut emissions is, therefore, high.

In order to understand the context, it is worthwhile undertaking a short review of the European regulatory process in this area (see text box 1).

Box 1 **The European regulation process on CO2 emissions by new cars**

In late 2018, debates were taking place on the post-2021 scenario of CO_2 emission limits for the average fleet produced by each manufacturer, i.e. the average of all the cars registered by a manufacturer in one year. Cars contribute over 60 per cent of emissions in the transport sector, so it constitutes a very important focus for reduction strategies. After the European Commission had set the scene in November 2017, with a proposal for a fifteen per cent reduction by 2025 and thirty per cent by 2030 (compared to the 2021 baseline), the Environment Committee of the European Parliament put forward a proposal to strengthen the target with a reduction of twenty per cent by 2025 and forty per cent by 2030. During this period, environmental organisations proposed a reduction of 70 per cent by 2030 (BUND *et al*. 2018). The European Council reached a compromise position of a 35 per cent reduction by 2030 (European Council 2018).

Germany first voted for a thirty per cent reduction following long disagreements between the federal environment and transport ministries (see further below), but finally agreed with the 35 per cent target. This tense situation within the German and European institutions highlights both the controversiality of the subject as well as Germany's dwindling influence in this regulatory process.

Ultimately, the European institutions agreed on a reduction scenario of fifteen per cent by 2025 (for both cars and vans) and on a reduction of 31 per cent for vans and 37.5 per cent for cars by 2030 with the addition of an 'impact assessment' in 2023 under which the regulatory instruments should be monitored regarding their efficiency, progress and price.

2. In order to administer this target, the Federal Republic of Germany has defined interim targets for each emission source (industry sector) in its 2016 Climate Protection Plan. With 466 million tonnes of CO2, the energy sector is the most emission-intensive sector in Germany but it has already reduced emissions by 23 per cent between 1990 and 2014. Furthermore, in agriculture, building construction and industry, reductions of 18-43 per cent are recorded; only transport has maintained its emission level during this period. Car traffic is responsible for about 70 per cent of CO2 emissions in the transport sector.

In its climate protection law, expected to be introduced in Germany in the second half of 2019, further means of regulating mobility behaviour (city tolls, speed limits, etc.) are now being discussed. This is a second, very effective, lever necessary for achieving the reduction goals in the transport sector as the regulation of the emissions of cars and vans would not be sufficient by itself and neither would it solve other, space-related problems in this sector (such as traffic jams, parking management and air pollution). Acting additionally in these areas would also, however, put even more pressure on car production and factories related to the manufacture of combustion engines and drivetrains.

By 2021, phased in from 2020, the average fleet emission to be achieved by all new cars is 95 grams of CO_2 per kilometre. For European manufacturers as a whole, the latest average value (achieved in 2017) was 118.5g/km (for German fleets: 126g/km) which, in 2018, is likely to have risen for the first time since 2000 due also to declining registrations of diesel vehicles. Under this 95g/km target by 2021, EU manufacturers will have to pay a penalty of €95 per registered vehicle for each gram of CO_2 beyond the limit. PA Consulting calculates that Volkswagen would face fines of up to €1.2bn, BMW €600m and Daimler €200m per annum on the basis of a projection of the values they would reach in 2021 (PA Consulting 2017). These fines may seem sizable, but one should remember that these companies all have very successful consumption-intensive sports utility vehicles (SUVs) as a significant part of their businesses, highlighting one of the various dilemmas faced by the development units of car manufacturers.

The reduction target can ultimately be regulated (by the manufacturers themselves) via two levers: increased efficiency in classic combustion engines; and via a market ramping-up of electric cars. The potential offered by new technologies (downsizing, cylinder deactivation, automatic transmission, mild hybrid technology and lightweight construction) is estimated to have a reduction effect of between ten and eighteen per cent. The rest must therefore be achieved through registration quotas for electric cars.[3] This is precisely where the pressure on manufacturers to act comes in: in the past, it was possible to point to the inhibiting factors of e-mobilisation and blame sceptical consumers or slow progress in infrastructure development, but a slow increase in the production of electric cars in the near future will have a direct impact on manufacturers' balance sheets.

2. The main dimensions of change: technological, economic and political

Just as the drivers of the transformation work on different levels, the concept of mass mobility in terms of individual transport is also the result of cultural forces reflected by corresponding norms and regulation. In addition to its central economic significance,

3. However, another unclear factor is the role played by plug-in hybrids. Depending on the user profile, such a car can make plentiful savings of CO2 emissions from burning fuel if it is used in electric drive mode but, if it is operated in combustion mode, the higher weight due to the two drive systems also causes higher fuel consumption than in comparable combustion cars.

the car is also a symbol of the modern narrative of freedom, individuality, power and self-determination.[4]

Despite the continuing expansion of precarious employment through outsourcing, the expansion of service activities and temporary work, as well as fragmented workforces and the fracturing of trade unions (Dörre 2011), the system of regulated labour relations[5] has nevertheless managed to regain some of its lost significance following the 2008/09 financial crisis.[6] A major consumer good with a high level of added value, the motor car forms a nexus between its role as a guarantor of prosperity (jobs in the German auto industry are among the best regulated) and a central element in the fulfilment of the bourgeois promise of freedom. The transformation of the automotive industry also means the transformation of the mobility of mass society as it exists today.

An attempt to shape this discussion in purely economic or cultural terms would obstruct perspectives on the possibilities of worker representation. In the following, therefore, we would like to present the various dimensions of this transformation and, for a better understanding of the subject, briefly discuss the central technologies that materially represent the change that is underway (see text box 2).

Box 2 **Excursus on the most important technologies driving the transformation**

The *battery cell* is at the centre of the media attention that surrounds the discussion of the immediate future of automobiles. In a battery-powered vehicle, this will account for a large part of the added value (it is the electric car’s equivalent of the connecting rod and crankshaft). The high relevance attributed to this technology results more from its strategic importance than from its potential to create employment. Currently, with Samsung and Panasonic leading the way, most of the production capacity is taken up by consumer electronics companies. Politicians have repeatedly emphasised the strategic relevance of production in Europe or Germany but, Bosch, the only German company involved in this technology, decided in the spring of 2019 not to proceed with investment projects in this area. The Chinese company CATL now wants to build a factory in Thuringia.

Fuel cell technology competes with (or complements) battery-powered electric propulsion. Here, water is split using electrical energy (electrolysis) into oxygen and hydrogen. The hydrogen obtained in this way can later be converted back into electrical energy, oxygen and water in a fuel cell. Various problems that arise in the production and use of battery electric drives are eliminated. However, the production, transport and storage of hydrogen on an industrial scale is enormously energy intensive and expensive. This also applies to the fuel cell itself, for which platinum is required. Moreover, the conversion of hydrogen

4. Reflecting an agreeably non-economic view of the automotive regime via Kuhm (1997).
5. The main elements to this system are: a trade-off between labour and capital (profit and wages), wide coverage of collective agreements and a strong welfare state.
6. It is easy to find numerous reasons why the current boom may not be sustained, but the current balance of power has been stabilised, for example, by the collective bargaining agreement signed in March 2018. This took up the issue of working time, which had been locked down since 2003, and successfully implemented it in new regulations.

and oxygen back into electricity consumes a lot of energy; in comparison, the battery is much more efficient. The German automotive industry began popularising this technology as early as the 1990s, but an inadequate infrastructure of hydrogen filling stations has always prevented a breakthrough. Now this technology is attracting attention afresh – but private and public investment in infrastructure development are clearly concentrating on charging stations for battery electric cars.

A convenient solution in the sense of classical technologies would be the spread of so-called e-fuels (also *synthetic fuels* or *PowerToX* technology). When they are burned, the same amount of carbon dioxide is released as was previously bound during the formation of the synthetic fuel, making it CO_2-neutral. An enormous advantage to this technology would be that prevailing production and research capacities in the field of combustion technology could continue to be used, while the same applies to the existing infrastructure. The disadvantage is the high energy consumption of the material conversion processes, which is far higher than even that of hydrogen production. This is probably the reason why it is not expected that this technology will become part of mass transit. However, it has interesting implications for both air traffic and shipping.

As a bridge technology, the *plug-in hybrid (PHEV)* is currently of major importance, making up over 75 per cent of all registered electric cars in Germany. These vehicles include both drive systems on board: an electric motor with a battery that enables a purely electric range of 30-50 km; and a conventional combustion engine. This means that 90 per cent of the average distances travelled during the day can be covered electrically and, if necessary, the advantages of the combustion engine (range, recharging/tank time, infrastructure) can still be exploited. The dual drive means that the vehicle has high added value, including a positive employment effect, but the result is that it is both more expensive and heavier.

In addition, the *classic hybrid (HEV)* must not go unmentioned. Here, the electric motor primarily has a supporting function for the combustion engine (e.g. when starting up) so purely electric ranges are barely possible. With the Prius, Toyota has had a model with this system on the market since 1997.

With the *Mild Hybrid*, we are entering the field of consumption-reducing technologies for classic combustion systems and thus the second lever in the automotive industry's strategies for reducing emissions. This technology consists of a second on-board network that operates in the high voltage range (48V) and supports the combustion engine in certain high-load situations (acceleration, warm-up phase parallel activity of energy-intensive components). Similar to the HEV, kinetic energy is converted into electrical energy by recuperation, which can later be re-used. However, the electric motor and battery are much smaller, so much so that they have no drive-related function whatsoever.

Consumption-reducing technologies also include, for example, cylinder deactivation (micro-hybrid), lightweight construction and downsizing. These technologies can be understood as additional to the compensatory technologies, which means that they start with the classic combustion engine and do not replace existing production facilities and skills but instead supplement them. The market penetration of these technologies would thus have a rather limited effect on requirements for the further training of the workforce (e.g. in high voltage systems) and the restructuring of production processes. Their integration on the employment side can be organised via operational means of co-determination and collective bargaining (plant level works agreements). Operational and corporate strategies do not change fundamentally and the constellations of the leading suppliers on the world market are little influenced.

An essential prerequisite for achieving low-carbon mobility is the use of sensor technology and its associated connectivity, which enables *connected driving*. More and more sensors, radars and other measurement technologies are being installed in cars. The data is collected, processed and exchanged between the vehicle and the driver, the manufacturer and the vehicles themselves. This will result in the development of new business models generally related to mobility. Fields of application will be not only traffic and urban planning, but all of the data-based services that are already used in digital communications technology today.

The possibility of *autonomous driving*, also facilitated by sensors and other measurement technology, is politically regulated on a scale under which legislation in the EU and the USA differentiates between six steps of autonomy. Some studies already see full automation (Level 5) by 2030 with a market penetration of 35 per cent (Oliver Wyman 2018: 37).[7] It is assumed that the use of vehicles will change considerably if there is no longer a need for a driver. In line with the trend away from the possession of goods towards cloud-based and the 'sharing economy' use of services (for example, music streaming, among others), it is conceivable that cars will become terminal devices for mobility requirements. This puts the entire cultural significance of the automobile at risk, while consumption patterns could change fundamentally along new forms of use in fresh mobility concepts. The creation of value shifts therefore from the production of individually-owned goods to the sale and trade by mobility providers of digital movement profiles and entertainment.

Studies assume that the added value in the production of cars as mobility terminals will remain high but that the development guidelines will be set by the end provider whose business is primarily the use of the product (McKinsey 2016). Development along two paths would be conceivable: robo-taxis for everyday mobility needs; and premium cars with comprehensive driving assistance systems for individuality needs. Business models would develop differently along these paths.

In addition to the shifts in the shares of the value chain between manufacturers and suppliers, there may also be shifts in competence and control. These new actor constellations are also posing a challenge to traditional patterns of compromise-finding in plant agreements. In order not to fall behind in the distribution of new added value, Daimler and BMW have recently set up a joint venture in which all mobility services (car sharing, parking, charging infrastructure, etc.) are supported by both manufacturers. This merger is still awaiting the verdict of the trade commission, but clearly shows the new lines of conflict and their potential influence on the established players.

7. PWC even assumes 40 per cent: PWC (2017: 19).

This technology also has considerable potential from an environmental perspective: new usage patterns open up the possibility of reducing the total number of vehicles. A privately-owned car is not in use in something like 90-95 per cent of its service life. However, reverse scenarios are also conceivable: for journeys that are now covered on foot or by bicycle for pragmatic reasons, these highly flexible and possibly inexpensive (for example in a flat-rate model) methods of individual transport could be used instead.

2.1 Technological dimension

From a technology perspective, development can be roughly divided into two dimensions: the electrification of the powertrain; and autonomous and connected driving. Empirically, these two technologies overlap and shape each other, but they unfold different modes of action which is why they should be separated analytically.[8]

The electrification of the powertrain brings about major savings because it is composed of considerably fewer and simpler components than other models – crankshafts, cylinder heads, connecting rods, valves and injection nozzles, but also transmissions, exhaust systems and others, are completely omitted. Instead, the powertrain is composed of a relatively simple structure of a coil, magnets and a rotor. A car with a combustion engine has seven times more components than an electric one. This also makes the maintenance of the engine much easier: the service of a Tesla is limited to the replacement of the key battery, the replacement of the coolant and checking the track.

On the other hand, the procurement and disposal of raw materials and the additional demand for electrical energy are problematic. The electric car is dependent on a completely different infrastructure, so these questions are an increasing concern. Cobalt, which is important for the cathodes of battery cells, is largely produced in the Congo in inhumane conditions and the degradation of silicon is enormously energy-intensive. In addition, it is still unclear what an environmentally-friendly disposal and recycling concept looks like. A particular problem, however, is the cross-sectoral shift of emissions. In the case of electric cars, the current energy mix in Germany means that such vehicles can only be described as locally emissions-free. Even more serious than the additional demand for electrical power, however, is the maximum load factor of today's consumption networks.

These points make it clear that a turnaround in mobility is closely linked to a turnaround in energy and the development of new infrastructures that can ensure a reliable supply of raw materials and energy. This task falls within the responsibility of the public sector and requires transparent, coordinated decision-making processes. In addition, there is a need for a planning framework for companies.

8. Political regulation is also at different stages of development in line with technological developments. Electrification is already an important element of industrial policy today (CO2 limits and registration quotas for e-cars, state premiums, charging infrastructure, battery cells, etc.). This is not yet the case for autonomous driving.

2.2 Economic dimension

In economic terms, the transformation has the potential to produce much cheaper drives. The costs, which are still high today, are concentrated primarily on battery cells, with price developments in this technology[9] having a direct impact on the costs of electric drives.

The employment effects will be discussed in the section on the transformation perspectives of IG Metall although, at this point, we should note that it is considered unrealistic that the loss of jobs in the powertrain segment will be compensated in full through new technologies, products and services. We estimate the effect of the job cuts to be greater than can be absorbed by new markets and the 'benefit' of a shrinking labour force in an ageing society.

In addition, the lower depth of added value implied by the new technology puts pressure on the trained, skilled labour which still characterises industrial production today. This will simply be less necessary, on top of the effects of more automated production, and the result will be a savings potential for companies which will weaken the negotiating position of employee representatives. The new growth markets of mobility services are, furthermore, characterised by a strongly polarised demand for labour: highly qualified IT specialists and engineers; as well as unskilled and semi-skilled service personnel for the maintenance and operation of terminal equipment. Skilled industrial work in the manufacturing sector, the core area of IG Metall's organisational power, will decrease. Activity and skills profiles, and the corresponding remuneration framework, must first be redefined; in engaging with this, however, experience will be devalued.

Plant and inter-plant institutions of employee representation must re-define their role in an environment of industrial relations in which new production networks, the creation of value chains and market participants are developing all the time, and for which traditional patterns of co-determination and participation do not necessarily make up integrated components of economic development.

2.3 Political dimension

The transformation of this important industry also has a political dimension. Apart from the concrete regulatory effect of these requirements, the EU-level compromise within the Council of Ministers has shown that this situation has contributed to a readjustment of the balance of power within Europe.[10] The stable constellation of German dominance of the car industry in Europe over the past few decades is now being called into question by the regulatory requirements applying to the automotive

9. The world market price for a kWh storage capacity in lithium-ion batteries has more than halved from €400 (2013) to €189 (2016) within 3 years (Statista 2018).

10. At the decisive meeting of the EU Environment Council, the German representation positioned itself at the bottom of EU member states' proposals with an orientation towards the Commission's level of ambition (i.e. a 30 per cent reduction) and was thus unable to assert itself. The Coalition Committee and the Chancellor's Office have reacted differently – a clear sign of a rupture in the hegemony.

industry. It is now important at federal level in Germany that, from 2020, the first phase of the transformation will begin in which new CO_2 targets can no longer be achieved via increasing the efficiency of combustion engines. Changes in industrial relations will, of course, require appropriate regulation.

The current debate on diesel has superimposed questions about the turnaround in propulsion and mobility highlighted in recent election campaigns. In addition to dealing with driving bans in city centres, which initially addressed local air pollution problems, calls are also being made on the federal state with regard to the expansion of infrastructure for charging stations, the necessary network expansion and the establishment of battery cell production units and support for research programmes. A coherent concept for the framework of mobility (transport, environment, research and economy) would be desirable across all ministries in which reduction targets would be brought into a coherent relationship with considerations of the development of absolute transport performance, modal splits, etc. Unfortunately, the perspective of the Ministry of Transport leaves some open questions in this context.[11] The Mobility Commission 'Platform for the Future of Mobility' (NPM, formerly NPE) was established for this purpose. It has a very broad thematic and personnel base, but it is still too early to assess its work.

Now that the subject matter and the interrelationship of elements in the transformation have been introduced, we would like to present the actors on the political field as well as their positions and strategies.

3. The transformation perspective of IG Metall

What do these technological developments and the regulatory framework mean for trade unions? The first questions to be answered are whether a transformation process is technologically and economically feasible; and to what extent, under which conditions and in which areas is work going to be affected. At the heart of IG Metall's perspective is that people have three roles:

— as employees in the automotive industry, they have an interest in safe and good jobs;
— as users of mobility services, they have interest in reliable and rapid transport;
— as citizens, they want to live in a clean and healthy environment.

This leads to the task of securing future-proof jobs via a collective bargaining policy which is forward-looking. In addition, unions should seek to secure investment in the company on behalf of innovation and technology even when faced with resistance from management. Likewise, there is a need to ensure environmental rationality in the design of new processes, products and services.

11. Compared to 2010, road traffic is to increase by a further ten per cent (cars) and 38.8 per cent (vans) by 2030, according to the transport infrastructure plan (cf. BMVI 2016: 55-56).

These interests give rise to numerous conflicting goals that must be dealt with honestly. For example, the increasing scale of commuter traffic in large cities causes tension with the residents of that city. Likewise, the production of large SUVs is a major ecological problem but, at the moment, it secures profits and employment. In order to address these different levels of interest correctly, the relationship between them needs to be properly defined. The purpose of the trade union is to represent employees as a collective actor by organising their demands and requests in order to assert their interests with the employer: the interests of employees in the production process are, initially, at the centre of strategy. Under the condition of capitalist production relations, the successful representation of interests (the labour policy dimension of trade union work) is akin to the condition for the successful representation of the interests of employees as citizens, i.e. for attractive mobility offers and a wholesome environment (the socio-political dimension of trade union work). The scope and location of changes in employment is therefore the starting point of IG Metall's strategic perspective.

The development that is currently at the centre of attention – the electrification of powertrains –indicates that less labour will be needed for their production. This is because the car will run with an electric motor that has a much lower depth of added value while even the production of the battery cell, the most cost-intensive component of electric drivetrains, is highly automated and hence will not require much human labour. In recent years, studies have published various figures on the question of how many jobs will be lost in the event of a market ramping-up of electric cars (Falck *et al.* 2017; ECF 2017; PA Consulting 2018; see also Cacilo and Haag 2018 and Diez 2017 with regard to the digitalisation of production). Most of these studies are based on models for the market development of certain products and services.

With the ELAB 2.0 study, however, commissioned by IG Metall, the Fraunhofer Institute for Labour Economics and Organisation (Bauer *et al.* 2018) has now provided a contribution to the discussion about the employment impact based on the real production figures of the members of the study consortium. These include all German manufacturers and major suppliers. In the most realistic scenario (25 per cent battery electric vehicle (BEV); 15 per cent PHEV), 70,000 jobs in the production of powertrains would be lost by 2030, according to these calculations. This figure already takes into account the compensatory effects of new technologies (some 30,000 employees).[12] With just over 200,000 direct employees in powertrains, about one in two is therefore likely to be affected by the electrification of the component.

For reasons of practicability, it was not possible for the research to take into account some of the effects that could have an influence on this figure. For example, complete battery cell production was left out of this review because there is still no plant in Germany or Europe that manufactures this component, which is strategically

12. After the finalised EU regulations on CO_2 emissions after 2021, the ELAB 2.0 model was fed with the new volume of electric vehicles necessary to reach that goal (on the basis of the estimate that 50 per cent of new cars in 2030 will be BEV/PHEV). In such a case, the numbers of job losses rise to 100,000 while the number of jobs affected rises to 150,000.

important for shaping the supply chain. Meanwhile, Panasonic, Samsung and also LG – Japanese and South Korean consumer electronics companies – are emerging as new suppliers who have previously played no role in production networks. Likewise, it was assumed that the entire value chain would remain in the country and, furthermore, that the 2016 production volume would be maintained (i.e. 5.75 million drive units) with several other prevailing conditions also being repeated, including the export volume of 75 per cent of production and the presence of stable world market conditions. It is also particularly relevant for employment that, finally, some key structural effects could not be taken into account: it is conceivable, for example, that combustion-specific components (from pistons and cranks up to exhausts) only account for a small part of the turnover of a particular operating unit. If these parts are no longer demanded, it may be that the plant becomes non-profitable, even if all its other components are produced as normal.

The transformation of the automotive industry, however, is not only a transformation of the electrified drivetrain (in terms of the technical dimension), but also a transformation of the regime of accumulation in a key automotive industry (economic dimension), as well as of state regulation (political dimension) and of the traditional concept of transport (which is to say, it is also a social change). The various dimensions overlap at many points: from 2025 at the latest, the continued reduction of CO_2 emissions can no longer be achieved by gradually increasing the efficiency of combustion technology but only by manufacturing electric cars as replacements. New technologies (autonomous cars) will further call into question traditional distribution patterns in the value chain and will also open up new regulatory spaces for politics. Last but not least, the fraud scandals in the industry (e.g. with diesel NO_x emissions) have eroded corporatist arrangements between industry, ministries and licensing authorities.

IG Metall can only move successfully in this political field if it recognises the various dimensions involved in the transformation and reflects on their effects at all levels of political regulation (plant, company, state and federal level, and the EU). Conversely, the mode of transformation (by design or disaster[13]) is sensitive to the participation of IG Metall: it is the organisation for which the democratic process of co-determination and participation is part of the original principle of operation. A top-down authoritative approach concerning environmental regulation in the transport sector would directly affect tens of thousands of people's livelihoods and the interests of employees therefore cannot be ignored. Such a move would dramatically aggravate the post-democratic to anti-democratic developments of recent times and, moreover, would ultimately close off the scope for the development of environmental policy.

It would therefore be wrong to equate IG Metall's transformation perspective with that of industry ('growth, employment and prosperity'). A just transition means not cutting

13. This reflects the word game of Sommer and Welzer (2016) who claim that the transformation of the current economic, social and cultural model will happen anyway and that the question is therefore one of how it will actually happen. This points to the importance of the social and political regulation of economic structures which, at the moment, dominate the mode of transformation.

off the actors in change from the regulation of the process. Conflicting interests that complicate or impede a coherent policy are not the result of a one-sided labour-oriented perspective but can only be overcome collectively and by a successive expansion of spheres of influence into operational and entrepreneurial processes. Socio-economic change with progressive objectives (from ‘decent work’ to *buen vivir*) can fall into its opposite if objectives are politically dictated and not elaborated by the participants themselves.

4. The main actors and their positions in the transformation

4.1 Industry

Industry (ACEA[14]) is of the opinion that a twenty per cent reduction in emissions by 2030 is feasible and in line with other industry sectors (ACEA 2017). In addition to exploiting the potential for efficiency in the combustion sector, a slew of battery electric models is being deployed throughout Germany. BMW has been on the market since 2013 with its newly-developped pure electric model (i3) but is now changing its strategy and offering electric derivatives of combustion engines for the time being (X3). The reason for this is the expensive production and lightweight construction of the body area; currently, seeking weight reduction in the battery is more cost-efficient. Daimler recently unveiled its EQC, the first model in its EQ brand; Audi will sell the e-tron from 2019; while VW will offer three models of its ID family by 2022. It is, therefore, noticeable that the strategy of premium manufacturers is based on e-SUVs.

In terms of mobility policy, such a decision is relevant insofar as the development of products is still highly independent of the business of the development of new concepts in mobility. The manufacturers are thus maintaining the traditional path of space- and resource-intensive individual mobility and supplementing it with a different drive. Hence, a clear path dependency in development is evident. Any socio-political rationalities of the responsibility for resource consumption, noise and clean air, as emphasised by new mobility providers, can only be found through the filter of the promise of the freedom of unlimited flexibility and comfort. The investment sums of the manufacturers for the two topics of electromobility and autonomous driving are impressive (VW alone wants to invest €34bn before 2022).

Furthermore, it seems that the plug-in hybrid will play the role of bridging technology because model policy is moving in the direction of initially offering all combustion models with dual drive. Consequently, it is stressed that, even with an ambitious market ramping-up of electric cars, the majority of new cars will still have a combustion engine in 2030.

14. European Automobile Manufacturers‘ Association.

4.2 Federal policy in Germany

In addition to the discussions about banning diesel cars from entering the EU, the lack of agreement at EU Council level between the federal Ministries of Transport and of the Environment as regards a common position for CO_2 reduction in Germany shows how acute the conflict is between stakeholder factions. With its 45 per cent reduction proposal, the federal Ministry of the Environment[15] presented a much more ambitious position than the Commission's proposal, with which the Ministry of Transport[16] did not agree. At the German Industry Day, the Chancellor's Office expressed the opinion that industry ought not to be overtaxed by over-ambitious limit values. The compromise finally reached in the Council (a 35 per cent reduction), which was higher than Germany's preferred position, was considered feasible. However, the Transport Minister rejected it and accused the Environment Minister of having only half-heartedly negotiated.

This disagreement shapes not only the handling of the emissions problem, but also the way of organising changes in transport policy. In this situation, the Mobility Commission (NPM) has the opportunity to play a central role in the development of medium- and long-term concepts for the future of transport and mobility via its different working groups and steering committee. A subsequent legislative initiative (the Climate Protection Act 2019) is in process, but the relationship between this and the work and output of the Commission remains unclear.

Since July 2016, a premium has been offered for e-cars (€3,000 for hybrid and €4,000 for all-electric vehicles). However, funding applications are being made to a much lower degree than expected. The corresponding target of one million registered electric cars by 2020 has now been dropped by the government. In company car regulation, electric cars are given a tax credit (according to the coalition agreement of January 2019, some 0.5 per cent of the list price instead of one per cent). All in all, however, these measures are comparatively unambitious.

The design of the charging infrastructure and preferential participation in road traffic (use of bus lanes, free parking spaces, etc.) is a matter for state and local politics. The German Association of Cities and Towns looks at the problem of individual transport primarily from the perspective of air pollution and much less from the perspective of carbon emissions. Above all, however, shortage of space on the roads is the focus of the interests of the municipalities for which the goal is, therefore, to shift the modes of transport composition in favour of public transport.

15. Led by the Social Democratic Party (SPD).
16. Led by the Christian Social Union (CSU).

4.3 Environmental associations

In a joint paper, prominent representatives of environmental associations have called for a reduction of 60-70 per cent in carbon dioxide emissions by 2030 (BUND *et al.* 2018).[17] Furthermore, Greenpeace is even calling for completely decarbonised traffic by 2025 and, at the latest, by 2030, targets which are coupled with a call for a ban on the production of combustion engines within this period (DLR 2018). Meanwhile, limit values will continue to be included in the regulatory framework for emissions reduction across the entire transport sector. This makes it clear that, even though private transport is the strongest lever, the reductions required cannot be achieved simply by reducing emissions per vehicle.

The Brussels NGO Transport & Environment points out that even higher reduction levels must be seen against the background of the unrealistic test cycles that seek to measure emissions (T&E 2017). In their joint paper, BUND *et al.* (2018) point out that percentage reduction targets and an orientation towards the fleet average actually achieved in 2020 (and not towards the trigger level of 95g of CO_2 emissions per km) seem to offer loopholes. In addition to a higher reduction level, the paper argues that it is therefore necessary that test cycles be extended to include road tests; that a bonus and malus system be introduced for e-cars; and that the weight component be abolished. Further demands, such as company car privileges, new energy tax laws and toll regulations, are the subject of negotiations as regards 2019's planned Climate Protection Act).

4.4 IG Metall

IG Metall believes that there is potential to improve efficiency by between 12 and 18 per cent in the combustion sector. However, some of the technologies will only pay off in the high-price segments and less so in volume models (e.g. as a result of the lightweight construction). In line with the EU's forecasts, along with those of some consulting institutes on the market ramp-up of electric cars, an electric quota of fifty per cent in 2030 appears necessary to match the EU's new CO_2 reduction goals.[18] Together, this results in a reduction potential of about 40 per cent, due to some European markets being where we expect no ramp up for BEVs at all (because there are no resources to build up an appropriate infrastructure).

IG Metall's aim is to exploit the potential for efficiency quickly and comprehensively, and to transfer it to production: abstract reduction figures are also not the main focus

17. The demands include not only emissions targets, but also traffic-reducing measures such as city tolls, abolition of the weight component, abolition of company car privileges, an increase in mineral oil tax and a general speed limit on motorways. These measures are considered all the more necessary where the reductions in CO_2 emissions are less ambitious.

18. Based on current registration figures, this corresponds to around one million electric cars per year. Depending on how hybrid and battery electric drives are distributed, and how plug-in hybrids are actually driven (in combustion or electric mode), the emissions reduction effect of one million electric cars may accordingly be lesser. On 1 January 2018, the fleet consisted of 56,861 purely electric cars (BEV) and 230,710 hybrid vehicles (HEV and PHEV) (KBA 2018).

for the union. The balancing of existing interests is more equitable on a set of measures if technology-based possibility analyses are used to determine where cost-efficient reduction potential can be exploited, and what this means for the innovation, location and workforce skills strategies of companies and businesses. Thus, political measures, as conditions for the different levels of ambition, come to the fore.

In this context, IG Metall is working on the concept of conditioned regulation. In relation to the processes before us, this means that the target corridor is defined for 2030, but the focus will initially be on the review assessments scheduled for 2023. It is here that the scope for further reductions and improvements will be discussed. In this way, the high degree of uncertainty about the economic and technological developments that will realise the scale of the reduction – of whatever magnitude – can be taken into account.

The purpose is the organisation of a co-determined transformation process and the avoidance of operational and regional structural breaks (see Sommer and Welzer 2016).

5. IG Metall's different fields of action

5.1 EU level

IG Metall, in representing workers' interests at EU level, advises members of the European Parliament in committee procedures and in Parliament itself, drawing on its technical knowledge of works councils, by submitting position papers and comments. In addition, the union has made demands for a coordinated industrial policy (for example in battery cell production in the context of electrification). The forthcoming transformation process comprises numerous technologies that are either completely new or which are too capital-intensive for the industrial sector in Europe to develop at national level. Lead markets and suppliers are not yet located in Europe. This is a completely new situation that cannot be compared with the technology that has ensured the prosperity of the most recent decades in Germany and Europe. However, the union also believes that it is important to design the supply chains in such a way that they enable safe and good working conditions at all levels within Europe.

The challenge IG Metall faces is to prevent the constant threat of competition between locations on the basis of low wages. If new technologies are developed by companies outside Europe, and supply chains become even more flexible, global value chains can only be countered with supranational trade union work. The international umbrella organisation, IndustriAll, was founded for this purpose, bringing together over 190 industrial unions in 2012. Together, they represent over seven million members and fifty million employees working in the metal and electrical industries, textiles, chemicals and energy. This union federation has both a global and a European structure so that supply chains can be better monitored with appropriate coordination by local trade unions. The increasing pressure to relocate suppliers to central and eastern Europe requires coordination rules on tariff deviations in the automotive industry – something which is vital for an internationally-synchronised course of transformation.

In addition, the federation facilitates networking opportunities at EU level as well as the exchange of information on forthcoming legislative processes with regard to the transformation, in order that common positions might be established on which policy advice can take place in Brussels.

5.2 Federal and regional level

Federal level

The main platform for the regulation of the transport sector, with the purpose of creating a sustainable mobility system, is the so-called NPM (Nationale Plattform Zukunft der Mobilität). No less than six ministries, representatives of municipal transport companies, environmental and social associations, scientists and of course the industry and trade unions constitute six working groups regarding the various dimensions of the change process across the entire mobility sector. IG Metall participates in two of these groups: in working group 1 'Transport and climate change', which is working on possible measures of CO_2 reduction in the transport sector; and in working group 4 'Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualifications' which focuses on broad questions of industrial production and mobility, the construction of battery cell plants (infrastructure, investment, networks/hubs) and the provision of workers equipped with appropriate skills and training.

Working group 1 has recently released its interim results: it argues that the CO_2 emissions reduction goals set by the Climate Protection Plan of the federal government (of 40-42 per cent in the transport sector) are feasible, but only with the mobilisation of enormous financial and organisational resources and the acquisition of vast social legitimacy. That could only be achieved by consequent and transparent regulation at each level of the administration. In addition to powertrain electrification, the working group's report outlines the following areas of action: the promotion of synthetic fuels; the expansion of local public transport and rail for long-distance passenger and freight transport; and digitalisation. Right to the end, there were disagreements among the participants about the details of the reduction effect and the costs of single measures, such that it was unable to draw up a consensually-decided package of measures to address to the federal government. Nevertheless, the interim report has pulled together numerous facts that can serve as the basis for a transparent and effective regulation of the transport sector.

Coordinated investment and infrastructure programmes are also necessary at federal level. Regulation at EU level extends to the larger product, labour and service markets and attempts to coordinate these, whereas federal policy has the task of promoting local production, technologies and competences/qualifications and in developing their profile.

In the view of IG Metall, the challenges presented by the coming changes can only be mastered if the high innovation potential of German industry is also applied to the new technologies. However, new products are often radical innovations rather than incremental ones so companies are caught in a dilemma from a business perspective: necessary investments that tie up enormous resources over long timetables are being held back pending the initiatives of competitors. With each individual company acting in this way, the delay to investment is becoming – from an economic point of view – rather dangerous. This dilemma can only be resolved by a decisive industrial policy (start-up financing, investment funds, infrastructure investments).

IG Metall believes its role is to draw stakeholders' attention to such problems. In addition, however, the union is clear that the role of the Federal Employment Agency must be reconsidered. Some companies will have no prospects following the transformation and it is beyond the remit of such companies to retrain employees consequently made redundant. This is where the political actors must take the initiative by creating new instruments that regulate the transition between old and new employment (i.e. during the re-training period). For several years, however, work on placing people into employment has been geared towards rapid outcomes and has frequently ignored existing knowledge and skills. This has led to a gradual destruction of accumulated skills potential where job losses have occurred.

These forthcoming changes in the automotive industry and the above-average level of skills required by the new technologies are developments which are becoming increasingly explosive. With the proviso that existing skills ought to retained in a new job, IG Metall has therefore proposed the expansion of the existing 'short-time working allowance' (*Kurzarbeitergeld/KuG*) to a 'short-time transformation allowance' (*Transformation-KuG*).[19] Under this scheme, the federal agency would support the further training and retraining of employees via supplementary payments, provided that continued employment in the plant is viable. This possibility would be set for the long-term in line with the course of a plant's transformation process and clearly requires forward-looking personnel planning. This *Transformation-KuG*[20] has been made as a demand to the parties involved in the elaboration of their coalition agreement.

IG Metall is also calling for a paradigm shift in education policy. For high-quality initial training for trainees and work-placement students, the investment backlog, which is estimated at €34bn, must be dealt with first (building stock, digital infrastructure, teaching aids). In addition, the education system must focus more on being able to provide employees with new content throughout their working lives. At the interface between companies and schools, it is vital that communications channels are open for new groups of employees (non-experts, experienced companies) going beyond the

19. With this legal instrument, companies facing financial problems can apply for state support during a period of restructuring, with the state then taking over a certain percentage of the wages to be paid. However, it is designed only for cases of restructuring. IG Metall is proposing that model be adapted for transformation processes at plant level (*Transformation*-KuG).

20. In detail, s. 111(3) of the *Betriebsverfassungsgesetz* (BetrVG) covers the definition of criteria with the summary of the individual measures involved in enterprise change (*Betriebsänderung*) from which interest reconciliation can take place between employers and employees (*Interessenausgleich und Sozialplan*). In addition, the extension of s. 111 exp. 1 SGB (III) for the authorisation of a short-time allowance is intended where a successful retraining measure does not flow durably into a new activity and further work takes place in the old enterprise.

framework of training courses and also including follow-on training. To this end, a legal framework must be created that largely overlaps with the requirements of the education system in terms of content.[21]

Regional level

Regional cooperation is important for a successful transition. In May 2017, a so-called 'transformation advisory council' (*Transformationsbeirat*) was set up in Baden-Württemberg as an initiative of IG Metall. Together with the Ministry of Economics and Labour, manufacturers and suppliers, employers' associations, a municipal trade association and a state mobility agency, a forum was created out of which a specific work programme was intended to emerge. This led to a roadmap being drawn up and applying from September 2017.

In the meantime, this group has been merged into the so-called 'Automotive Industry Strategy Dialogue' (*Strategiedialog Automobilindustrie*) in which the stakeholders concerned discuss the problems and possible solutions for transformation sub-processes in continuing dialogue, translating these into specific measures and projects. This also includes events designed to make this process transparent. The specific projects include state investment in charging infrastructure; the support of investment partnerships between municipalities and companies with regard to digital infrastructure and new municipal mobility solutions; the establishment of an electromobility hub, especially for SMEs to support them in realigning their product profiles; and the establishment of a battery cell production unit in cooperation with Fraunhofer IPA. In addition, a European testing and competence centre for batteries and energy storage systems is to be established.

In the Bavarian 'Pact for the Future', the regional Prime Minister, the Association of the Bavarian Metal and Electrical Industry and IG Metall Bayern have agreed on target agreements as a means of actively tackling this process. With the vision of turning the state into a sustainable and environmentally friendly industrial location, based on secure and good employment through technological change, the necessary cornerstones have been defined which are then to be implemented in specific joint projects. In addition to the promotion of alternative drive technologies, the digitalisation of production plays a central role. The issue of education and skills is addressed particularly effectively at this level as it falls within the competences of the federal states. Accordingly, the Pact refers not only to continuing vocational training in enterprises but also to the state's responsibility in vocational education and training. The already dense network of universities of applied sciences, state technical schools and research institutions is also set to be expanded.

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21. For a start, the union has been calling in this context for the abolition of the ban on cooperation, the free use of learning materials, co-determination by works councils in the creation of course content and the integration of vocational training into the BBiG ('Vocational Training Act'). A paradigm shift, however, would require further measures in the longer-term, including: the establishment of a right to further vocational training; the establishment of a public system of further training and counselling in a network of vocational schools, universities and the Federal Employment Agency; and the right to an advance for a follow-on training course (cf. IG Metall Fact Sheet 1.1 on the 2017 federal elections).

That southern Germany is taking on a pioneering role corresponds to the existing economic structure and thus the distribution of resources among the various regions of the Federal Republic of Germany. Unfortunately, these programmes and initiatives cannot simply be taken over by structurally weak regions, not only because of the issue of financial resources, but above all because the relevant personnel are frequently not in place. The business landscape is characterised by small and medium-sized enterprises which often maintain production-only sites, with the managing directors and owners usually located in structurally strong regions or else abroad where they assume the role of the 'extended workbench'. Opportunities for co-determination within a plant are correspondingly limited. For this reason, state policy is a central addressee for employee interest representation, especially where relations based on collective bargaining have been eroded and the institutions of employee representation facing a transformation process have been left to their own devices.

5.3 Company level

Companies are the central actors in transformation: they determine product development, investment strategies and personnel planning for the future. They have the necessary economic and technical resources and are geared towards using them to achieve successful change. The perspective of employees is naturally not at the centre of these developments – on the contrary, such fundamental restructuring can result in job losses. The task of IG Metall is, therefore, to exert an influence on location, employment, innovation and investment strategies; conclude agreements to safeguard production locations; and find a development perspective for every plant. There are a number of positive examples of this in action which will be briefly outlined here as cases of good practice.

In the future, Daimler will be divided into three divisions. The General Works Council has reached an agreement with *Projekt Zukunft* ('Project Future') under which future job security was extended from 2020 to 2030. This job security applies to all Daimler employees, including those in logistics and branch offices. The second element of the agreement includes a say in the procurement of new products, electronic components and development and mobility services: within the work of the company's innovation committees, the works council is advised on future product strategies by plant management and has the right to make proposals in response. And, finally, investment commitments of €35bn have been made in Germany over the next seven years. These investments are dedicated to the areas of e-mobility, mobility services, connectivity and autonomous driving, thus making a clear commitment to the role of the core location in the transformation.

The works council has used the restructuring to secure the core interests of employees with further agreements on collective bargaining in sectoral companies, on company pension schemes and on profit-sharing. In return, it supports the restructuring process.[22]

22. Daimler General Works Council Handout.

Volkswagen is also facing major change. Group management is anticipating extensive job cuts as a result of the introduction of new technologies and products. As early as 2016, the works council was able to negotiate a job security plan up to 2025, with the reduction in employment therefore being achieved in a socially acceptable manner under the company's so-called 'Future Pact'. This includes part-time work for older employees, which is set to be significantly expanded. As part of the 'Future Pact', 25,000 jobs will be eliminated although 9,000 will also be created. At the same time, commitments have been made to locate new e-mobility products at German sites. In this way, each department has been given a development perspective over the next few years. Management's plans to outsource certain products and logistics, or to relocate all new e-components abroad under specific termination plans, could thus be fended off. To this end, the works council supports the strategy of productivity and profit maximisation.

There have also been strategic agreements in the supplier sector which relate specifically to the transformation process. At Schaeffler, an agreement on the future (*Zukunftsvereinbarung*) has been reached that goes beyond normal employment agreements. Suppliers' products are relatively independent of brand identity in the end product, so they can position themselves more flexibly within the new drive and mobility concepts than end manufacturers. In this way, business models beyond the private ownership of cars are also of great interest here. This places question marks over the traditional relationships between end manufacturers and suppliers. For suppliers, the transformation process potentially goes beyond the mere electrification of the drive and refers directly to new business models for product-related services. Accordingly, agreements must be conceptualised.

The Schaeffler agreement, therefore, provides for the following elements: works council committees must be involved in site development (new products, business models); the initial training programme (dual training) and the internal further training programme are to be expanded; work organisation should be designed in such a way that these training measures can also be deployed; and the existing agreements towards the security of sites are to be maintained and standardised, with redundancies for operational reasons being avoided. Furthermore, an innovation fund of €50m will be set up to take account of suggestions from employees and provide them with better support. Finally, the agreement formulates a clear commitment to collective bargaining – the declared goal is collective bargaining coverage across all locations. These elements will all be reviewed by a steering committee made up of equal numbers of representatives. This ensures that the employee side has a say in the entire process of transformation within the company and ensures its transparency for the workforce.

Of course, these examples can be adapted to Tier 2 or Tier 3 suppliers only to a very limited extent. The question of resources is decisive in management's room for manoeuvre and therefore also in the possibility of making concessions to the employee side. The instruments of co-determination in outsourcing, as well as the participation of works councils in innovation and investment committees (as at Daimler), can, however, also be applied in certain forms in smaller companies.

In discussions with works councils, it becomes clear that the decisive initiatives for the early theming of new products and qualifications tend to come from the employee side. In particular, the issue of training in plant change is also taken up from there. However, the interventions of employee representatives can also support the future viability of a company from a product perspective, for example by using producers' knowledge to draw up proposals for new products or processes in open participation programmes and then digitalising them, evaluating them and transforming them into new processes. Even if, ultimately, the company or plant management decides on the implementation of the proposals (it is also conceivable that committees with equal representation will be set up to take such decisions), employees gain from having exerted influence on the orientation of product development right up to the strategic positioning of the company, in addition to any codetermination committees and rights that may also be established. IG Metall sees this instrument as an opportunity to use the transformation of industry to expand co-determination.

5.4 Plant level

Primarily, the plant is the level at which the regulations agreed in collective agreements are implemented. The works council is an independent actor in interest representation and is obliged by the Works Constitution Act (Betriebsverfassungsgesetz – BetrVG) to strike a balance between company-related (economic) rationalities and employment-related rationalities (the reproduction of the workforce). The inter-company hierarchy deals with the issues of wage levels and wage composition, but elements are negotiated here that affect daily operations (shift divisions, occupational health and safety, holidays, overtime, skills and training, among others).

In transformation programmes, the plant level is important because it is here that change processes have a direct impact on employees. Strategic and conceptual considerations have the potential to be experienced in everyday working life and either generate legitimacy for a process – or otherwise de-legitimise it. For a membership-based democratic organisation such as IG Metall, this level is therefore decisive when it comes to success or failure. At the same time, the central power resource of the individual employee also lies at this level in the decision for or against union membership. Where the union exists, that structure of trust and the works council carry the positions, awareness and moods of the members into decision-making within the plant. It is here at which it is determined whether the union is acting with the members or not. A confident plant policy in transformation is therefore called a participation-oriented plant policy and refers both to the plant and to the union's organisational structures.

In addition to the political possibility of co-determination beyond the BetrVG (participation in decision-making bodies, agreements implementing overall company agreements), the focus is on motivating the workforce around new issues. For example, the initiative 'Work and Innovation' (*Arbeit und Innovation*) is a project in this area in which various employees, engineers, personnel managers, works councils and shop stewards have been trained in questions about the new world of work. Together with the trade union training centres, a work-oriented network of experts and Ruhr University

Bochum, a training programme has been developed (the so-called 'Learning Factory'). Here, the education and skills approach can be applied at plant level, since problems arising there lie at the heart of this initiative which, with the expertise of scientists, seeks to develop and test solutions for technological or process-related problems. This makes it possible for workers to experience that the decision-making and problem-solving structures in a plant or company are not given by natural law, but have arisen as a result of deliberate interventions and can be changed through concerted action. This course has already been held thirteen times with a total of 80 companies and 250 participants.

In addition, IG Metall is trying – on a pilot basis – to obtain a comprehensive overview of the specific situation in particular locations by means of plant surveys. Full-time representatives at a plant, together with employees, collect information on the product and on the skills status of employees in order to find out whether and how the plant is likely to be affected by the transformation process. This should make it possible to influence strategic decision-making processes at an early stage and to develop future-proof development perspectives. In this way, and in cooperation with the local and regional representatives of IG Metall, a transparent, participatory and bottom-up plant map is thus being created which facilitates a broad and detailed view of the extent and content of the involvement of individual regions, plants or companies. An exchange of experiences and the co-ordination of development strategies is intended to follow, with the aim of outlining a plant-specific development perspective in each company and for each plant. This will broaden the scope of action and strengthen the strategic position of employees in the transformation process.

Some of the union's districts are already well advanced on this work, with the project due to be implemented nationwide in 2020.

6. Conclusions – conditions for a successful transformation

In accordance with the transformation triangle of economic, environmental and political dimensions, a successful transformation for IG Metall means the striking of a balance between the development of sustainable and thus employment-securing products, their environmental sustainability and democratic access to their use. For the automotive industry, this means taking on a pioneering role in the competition for new drive technologies and mobility concepts in line with the enormous volume of employment and the innovative capacity of the sector.

These aspects are inter-connected. Of course, the problem of the qualitative and quantitative development of jobs is the starting point of any strategy for trade unions as this is the basis of their power to act. Without tighter climate regulation, the problems of air and space pollution in inner cities will soon have an impact on the industry and on the product. However, the development model of expansive automobile production has worked very successfully over the past decades according to the criterion of capital utilisation. With the precondition of the externalisation of the environmentally-consequential costs, which has always been a basic condition for capitalist development, the automobile industry is prospering in the centre and in emerging countries, albeit at different levels. Alternative development models that focus on the strengthening of environmental sustainability in line with the sector's goals in the Climate Protection Plan must therefore be developed on the basis of the current model of production if structural breaches are to be avoided. Above all, the development of resource- and energy-efficient technologies must be at the centre of the strategies of reconciliation between the environmental and employment policy dimensions of transformation. At the same time, it is clear that development here has, so far, contributed insufficiently to the reduction of greenhouse gas emissions.

Just as economic prosperity, based on successful value-added production, was a necessary condition in the past for the expansion of trade union power and thus workers' participation and co-determination, so could an interruption in this growth endanger this democratic process. The jobs vs. environment dilemma (Räthzel and Uzzell 2011) thus has a direct effect under current production conditions. The arguments of environmentally-motivated actors, who fear an even greater loss of jobs if industry is not committed to making products and production more natural and resource-conserving, only confirm this connection.[23] Resolving this dilemma implies the creation of other production conditions in which democratic control over the means of production is ensured. This possibility is certainly relevant as a strategic goal, but the effective power to act is anchored in the current conditions of production and ownership. As a result, this question cannot be resolved immediately, but compromises may be found with a view to addressing these conflicting goals. Striking such compromises that strengthen the power of employees and their representatives are, in turn, basic conditions for extending democratic control over production.

However, the necessary compromises in the regulation lead to numerous conflicts of objectives. For example:

> *Economic-environmental:* The current discussion about nitrogen oxide emissions in diesel technology is leading to a collapse in the number of registrations of this type of engine. Since there are no alternative drives on the market in the relevant price classes, consumers are switching to the petrol engine, which is leading to an increase in the CO_2 balances on manufacturers' fleets. It is true that diesel technology has made certain vehicle classes possible in the first place (for example, the SUV), but it is also true that a one-for-one switch makes it more difficult to achieve fleet-based reduction limits.
>
> *Environmental-global:* Even if the infrastructure, the procurement and recycling issues and the product portfolio of automobile manufacturers are designed in such

23. Nevertheless, these comparisons express some fairly speculative assertions. Popular comparisons, such as those with the lighting industry, the telecommunications industry or television screens are not possible because of several factors (the depth of value added and employment, the relevance of investment for households, innovation cycles, locations and supply chains). In this way, people may argue over the compensatory effects of higher household incomes when spending on fuel is invested in other consumer goods (ECF 2017 - Reference Study for Environmental Associations).

a way that electric cars become attractive for broad groups of buyers, apart from the aforementioned effects on jobs, the question of the environmental follow-on costs through battery cell production nevertheless remains. The electric car even offers the possibility of externalising these costs further than the traditional car, since the focus is often only on local CO_2 neutrality. There is, therefore, a conflict between locally-clean mobility and global responsibility for resource exploitation.

Environmental distribution policy: If one thinks ahead from the transformation of drives to the transformation of mobility, market-based regulation concepts to reduce emissions are likely to be particularly popular within a neoliberal paradigm. Although social differences are manifested and symbolically represented by the car, the right to individual mobility is democratically distributed over the presence of equal access to public infrastructure (road use, traffic rules, parking spaces). Whether this will be the same for private mobility service providers remains to be seen. On the consumer side, there is therefore a democratic problem with the reduction of individual means of transport by new mobility service providers.

Regional policy: This problem becomes all the more serious if one considers further social developments in the mobility of mass society. The result of progressive urbanisation and real estate speculation/rental price developments is that more and more people are being forced into the suburban belts of large cities and must travel ever-greater commuter routes.[24] In addition, the proportion of dual-earner households is increasing. These developments are challenging for a public transport system that is today already overloaded in urban centres and cannot increase in the short timeframe necessary to achieve the desired reduction in cars. At the same time, urban residents have an interest in clean air. There is, therefore, a conflict between interest in mobility for gainful employment and interest in the health of citizens.

Business management: Organisational theory is clear that successful processes and products from historically-evolved development strategies lead to path dependency. This means that, especially in large, hierarchically-structured organisations, various transformation processes are subject to numerous obstacles. The German automotive industry and combustion technology are good examples of this. Turning away from the combustion engine and individual mobility here means a devaluing of the networks of research and education institutions, development centres and production sites that have grown over the decades. Particularly successful actors in classical production see themselves in a conflict between having the highest amount of resources to achieve transformation on the one hand and having to generate these resources from classical technologies on the other. The transition to new drives and mobility is complicated by the asynchronicity of market ramp-ups of individual technologies

24. The average distance between home and work has increased from 8.7 km in 2000-2014 to 10.5 km in 2014 (statista.com 2014). In addition, the purposes of travel continue to diversify, i.e. there is a general trend in society to travel more and further.

in different segments. Thus, the uncoordinated transformation of social mobility, as a chaotic process, is affecting individual positions in the value chain and preventing path changes, the necessity for which has long been acknowledged individually. This conflict makes it particularly clear how important it is to have a consistent and transparent regulatory framework that takes into account the operational planning horizons of such far-reaching changes.

The democratic course of a just transition, on which the legitimacy of the actors and their strategies depends, is a two-sided one: on the one hand, it is a question of securing the perspective of tens of thousands of people on the future viability of their jobs; on the other, new exclusion mechanisms must be prevented. On this basis, political regulation measures to reduce CO_2 emissions from transport must be drawn up. This corresponds to the relationships between the dimensions of the crisis: the natural conditions created by transport are regulated by society. Nature reflects this regulation back into society along the lines of its own laws. The criteria of environmental sustainability are therefore reflected in the criteria of social sustainability. A climate policy regulation which orients itself along abstract reduction targets, makes these absolute values the central orientation of politics and then seeks that social conditions be adjusted to it isolates these two dimensions of sustainability. IG Metall sees the socio-political dimensions of its task in shaping change in industrial production, transport and mobility as occurring naturally in alignment with those who have to live with the results of these conditions – and with a decidedly international perspective.

References

ACEA (2017) Post 2021 CO2 regime for passenger cars, Position Paper, 13 September 2017. https://www.acea.be/publications/article/position-paper-post-2021-co2-regime-for-passenger-cars

Bauer W., Riedel O., Herrmann F., Borrmann D. and Sachs C. (2018) ELAB 2.0 Wirkung der Fahrzeugelektrifizierung auf die Beschäftigung am Standort Deutschland, Stuttgart, Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO. https://www.iao.fraunhofer.de/lang-de/images/iao-news/elab20.pdf

Blöcker A. (2015) Industrielle Wertschöpfungsketten: Herausforderungen für das deutsche Industriemodell am Beispiel der Automobilindustrie, WSI Mitteilungen, 7, 534-541.

BMVI (2016) Bundesverkehrswegeplan (BVWP) 2030, Berlin, Bundesministerium für Verkehr und digitale Infrastruktur. https://www.bmvi.de/DE/Themen/Mobilitaet/Infrastrukturplanung-Investitionen/Bundesverkehrswegeplan-2030/bundesverkehrswegeplan-2030.html

BMVI (2017) Verkehr in Zahlen 2017/2018, Berlin, Bundesministerium für Verkehr und digitale Infrastruktur. https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehr-in-zahlen-pdf-2017-2018.html

BUND, DUH, NABU and VCD (2018) Klimaschutz braucht ambitionierte Verbrauchsgrenzwerte für PKW. https://www.vcd.org/fileadmin/user_upload/Redaktion/Themen/Auto_Umwelt/CO2-Grenzwert/2018-04-13_CO2-Grenzwerte_Positionspapier_final.pdf

Cacilo A. and Haag M. (2018) Beschäftigungswirkungen der Fahrzeugdigitalisierung, Study 406, Düsseldorf, Hans-Böckler-Stiftung. http://www.boeckler.de/pdf/p_study_hbs_406.pdf

Diez W. (2017) Der Einfluss der Digitalisierung und Elektrifizierung auf die Beschäftigungsentwicklung in der deutschen Automobilindustrie, Arbeitspapier des Instituts für Automobilwirtschaft, Nürtingen-Geislingen, Hochschule für Wirtschaft und Umwelt.

DLR (2018) Development of the car fleet in EU28+2 to achieve the Paris Agreement target to limit global warming to 1.5°C, Report for Greenpeace, Stuttgart, Deutsches Zentrum für Luft- und Raumfahrt. https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/20180907_gp_eucarfleet_1.5.pdf

Dörre K. (2011) Funktionswandel der Gewerkschaften: von der intermediären zur fraktalen Organisation, in Dörre K. and Haipeter T. (eds.) Gewerkschaftliche Modernisierung, Wiesbaden, VS Verlag, 267-301.

ECF (2017) Low-carbon cars in Germany: a summary of socio-economic impacts, Brussels, European Climate Foundation. http://www.camecon.com/wp-content/uploads/2017/10/ECF_EN_CARS_SCREEN_V3.4_Singles.pdf

European Council (2018) CO2 emission standards for cars and vans: Council agrees its position, Press release, 10 October 2018. https://www.consilium.europa.eu/en/press/press-releases/2018/10/10/co2-emission-standards-for-cars-and-vans-council-agrees-its-position/

Falck O., Ebnet M., Koenen J., Dieler J. and Wackerbauer J. (2017) Auswirkungen eines Zulassungsverbots für Personenkraftwagen und leichte Nutzfahrzeuge mit Verbrennungsmotor, ifo Forschungsberichte 87, München, ifo Institut. https://www.cesifo-group.de/DocDL/ifo_Forschungsberichte_87_2017_Falck_etal_Verbrennungsmotoren.pdf

IPCC (2018) Global warming of 1.5°C: special report. https://www.ipcc.ch/sr15/

KBA (2018) Bestand in den Jahren 1960 bis 2018 nach Fahrzeugklassen, Flensburg, Kraftfahrt-Bundesamt. https://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/FahrzeugklassenAufbauarten/b_fzkl_zeitreihe.html

Kuhm K. (1997) Moderne und Asphalt: die Automobilisierung als Prozeß technologischer Integration und sozialer Vernetzung, Pfaffenweiler, Centarus-Verlag.

McKinsey (2016) Monetizing car data: new service business opportunities to create new costumer benefits.

Oliver Wyman (2018) FAST 2030: deutsche Automobilindustrie im perfekten Sturm von simultaner Technik-, Produktions- und Nachfrageveränderung bis 2030, Berlin, Verband der Automobilindustrie.

PA Consulting (2018a) Driving into a low emissions future. https://www.paconsulting.com/insights/2017/the-co2-emissions-challenge/

PA Consulting (2018b) CO2 Zielerreichung: Herausforderungen und Auswirkungen für die Automobilindustrie. https://ecomento.de/2018/06/04/e-mobilitaet-bedroht-267-000-jobs-in-der-autoindustrie/

PWC (2017) eascy: Die fünf Dimensionen der Transformation der Automobilindustrie, Frankfurt am Main, PricewaterhouseCoopers GmbH Wirtschaftsprüfungsgesellschaft.

Räthzel N. and Uzzell D. (2011) Trade unions and climate change: the jobs versus environment dilemma, Global Environment Change, 21 (4), 1215-1223.

Statista (2018) Weltweite Preisentwicklung für Lithium-Ionen-Batterien von 2013 bis 2020 (in Euro/kWh). https://de.statista.com/statistik/daten/studie/534429/umfrage/weltweite-preise-fuer-lithium-ionen-akkus/

Sommer B. and Welzer H. (2016) Transformationsdesign: Wege in eine zukunftsfähige Moderne, München, oekom verlag.

T&E (2017) Car CO2 Regulation: the case and content of an effective proposal. https://www.transportenvironment.org/sites/te/files/publications/Car%20CO2%20regulation%20311017.pdf

VDA (2018) Neuzulassungen: detailliert aufgeschlüsselte Zahlen zu den Neuzulassungen nach Kraftwagen und Marken, Berlin, Verband der Automobilindustrie. https://www.vda.de/de/services/zahlen-und-daten/jahreszahlen/neuzulassungen.html

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Towards a just transition: coal, cars and the world of work

Edited by Béla Galgóczi

This book investigates the challenge of achieving a just transition towards a net-zero carbon economy by drawing lessons from two carbon-intensive sectors: coal-based energy generation and the automobile industry. We regard just transition not as an abstract concept but as a real practice in real workplaces. While decarbonisation is a common objective, concrete transitions take place in work environments that are determined by the capital-labour relationship and its conflicts of interest. This is where the role of trade unions and social dialogue is key. The cases in this book demonstrate major differences between the two sectors as regards the nature and the magnitude of the challenge, but also in the practices applied and the roles played by actors; together, they represent the 'two faces' of a just transition.

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