strategy&
Part of the PwC network

CLEPA
European Association of Automotive Suppliers

Electric Vehicle Transition Impact Assessment Report 2020 - 2040

A quantitative forecast of employment trends at automotive suppliers in Europe

Contents

List of abbreviations

AF	Alternative Fuels
BEV	Battery Electric Vehicle
BoM	Bill of Material
CLEPA	European Association of Automotive Suppliers
CO_2	Carbon Dioxide
EFTA	European Free Trade Association (Iceland, Liechtenstein, Norway, and Switzerland)
EU	European Union
EURO 7	European Emission Standard
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
FHEV	Full Hybrid Electric Vehicles
FTE	Full-Time Employees
H_2	Hydrogen
HC	Headcount
HEV	Hybrid Electric Vehicle
HV	High Voltage
ICE	Internal Combustion Engine
IEA	International Energy Agency
LCV	Light Commercial Vehicle
LPG	Liquified Petroleum Gas
MHEV	Mild Hybrid Electric Vehicle
NEDC	New European Driving Cycle
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
PwC	PricewaterhouseCoopers
TA	Technology Area
TtW	Tank-to-Wheel
WtW	Well-to-Wheel
WLTP	Worldwide Harmonized Light Vehicles Test Procedure

1 Executive summary

Reaching climate neutrality in the EU by 2050 requires ambitious emissions reductions. This means an unprecedented transformation for the automotive industry and its supply chain — one that will have a major impact not only on employment, but also on consumer choice, the affordability of individual mobility, and EU competitiveness. The face of the industry will change as a result of the transition to electric powertrains, the use of renewable fuels and energy sources to power vehicles, and the restructuring of production sites and the workforce. The products that have been used for more than 100 years to move people and goods, and which have successfully powered the EU economy, will be replaced by emerging technologies. Traditional business models will have to evolve, and competencies developed over decades will have to be transformed into something different, something new. One imperative, however, will remain the same: The industry's resilience and ingenuity will be needed to drive innovation forward.

Existing studies of the electric vehicle (EV) transition are mostly qualitative, or they focus on individual European countries. Few, if any, have assessed the impact of this transition across the region, or on the automotive suppliers as an industry segment. But we believe that to help automotive leaders steer their efforts in the right direction, a better understanding of the impact of the EV transition on Europe's automotive supplier industry as a whole and its employment forecasts, particularly from a regional perspective, is of utmost importance to maximise the associated opportunities and minimize the threats.

Therefore, the goal of this study is to paint a quantitative picture of the EV transition in Europe in order to answer three questions:

1. *What is the impact of different powertrain technologies and component requirements on value-add[1] for automotive suppliers in Europe?*
2. *What is the corresponding effect on employment[2] for automotive suppliers in Europe?*
3. *What would a mixed technology, EV-only, or a radical EV-implementation scenario mean for climate targets, value-add, and employment in Europe?*

The study´s methodology is complementary to previous studies as it models figures from a value chain perspective.

1 "Value-add" in this study is defined as revenue minus material costs and describes the part of the company's individual value creation that directly contributes to the country's economy.

2 "Employment" is defined as all direct and indirect labour contributing to the value creation, and Full-Time-Equivalent (FTE) is interchangeable with headcount (HC) throughout the report. All value-add and employment figures refer only to the automotive powertrain industry sector.

Data was gathered – supported by the European Association of Automotive Suppliers (CLEPA), national associations, and companies – in an explorative survey based on numerous questionnaires and validated with multiple expert interviews. To realistically model commercial decisions, production capacities at shift level (typically three eight-hour blocks) as well as country attractiveness, criteria have been assessed to develop wind-down scenarios for internal combustion engine (ICE) vehicle technologies and ramp-up scenarios for EV technologies.

The scope of the study covers the EU27 member states, the EFTA, countries and the UK. Additionally, seven countries were analysed in detail: Germany, Italy, France, the Czech Republic, Spain, Poland, and Romania.

The pace and the likely impact of the EV transition on suppliers were grouped into three market scenarios: a mixed-technology scenario, an EV-only scenario, and an accelerated radical scenario. The scenarios differ in carbon dioxide (CO_2) target setting and allowance of alternative fuels, EURO 7 emission legislation, and governmental subsidies (COVID recovery plans).

Mixed-technology scenario

The mixed-technology scenario projects a 50% tailpipe CO_2 reduction by 2030, compared to the 2020 95g NEDC passenger car target. This scenario assumes a role for sustainable renewable fuels to achieve net CO_2 reductions with hybrid and other ICE-based technologies, hence meeting the Paris climate goals. The allowance for alternative fuels amounts to 20g by 2030 and 30g by 2035. EURO 7 norms will in this scenario facilitate a significant role for mild hybrid electric vehicles (MHEV) in reaching CO_2 emission reductions. The scenario assumes that governmental subsidies are granted for battery electric vehicle (BEV) purchase incentives only, but not for infrastructure. The 50% CO_2 reduction is 5% percentage points less than currently foreseen in the European Commission’s (EC) Fit for 55 proposal, at tailpipe level.

EV-only scenario

The EV-only scenario follows the STEP scenario, as proposed by the International Energy Agency (IEA) in 2020 and is on par with the approach taken by the European Commission’s Fit for 55 proposal. It projects a 60% tailpipe CO_2 reduction by 2030 and a 100% reduction by 2035. This scenario assumes, with a 7g alternative fuel allowance in 2030, a marginal role for sustainable renewable fuels. The EURO 7 norm is expected to be more restrictive and favour full-hybrid electric vehicles (FHEV). Governments are assumed to be supporting BEVs with both incentives and charging infrastructure funding that will help to create a network of around 1 million public charging stations in Europe by 2024.

Radical EV-implementation scenario

The radical scenario projects a 100% tailpipe CO_2 reduction by 2030, significantly more stringent than the European Commission’s Fit for 55 proposal. This scenario assumes highly restrictive EURO 7 emissions norms, which can only be met with significant additional cost to meet with mild hybrid electric vehicles (MHEVs). Governments are assumed to be supporting BEVs with incentives and charging infrastructure funding that will help to create a network of more than 1 million public charging stations in Europe by 2024. City-wide bans for ICE vehicles will reinforce the impact of national policy decisions.

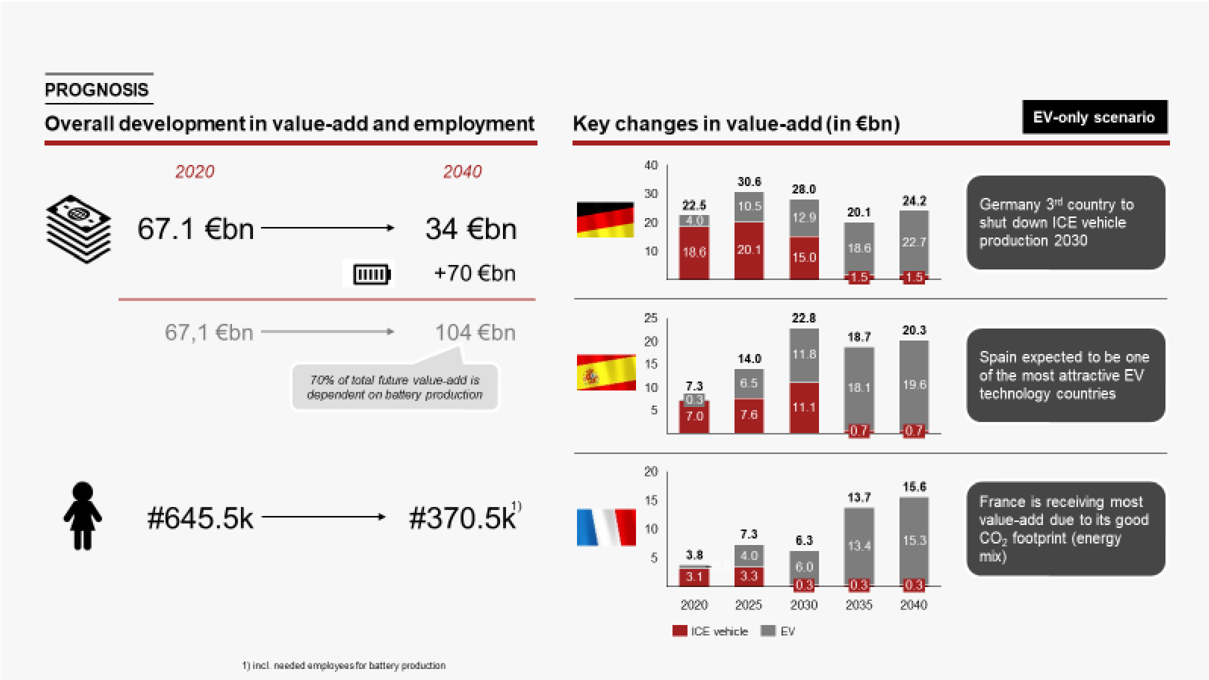
Within the three market scenarios mentioned, various powertrain-related components have been analysed each specifically for EV and ICE vehicles.

Of course, there are alternative CO_2 reducing technologies that also have an impact on Tank-to-Wheel (TtW) metrics. These technologies are predominantly powertrain-related but also involve other vehicle components. Non-powertrain examples include aerodynamic improvements such as grille shutters or air curtains and low-rolling resistance tires or LED headlights. Powertrain options range from more efficient alternators to stop-start systems. The other option when considering emissions reduction is to look at Well-to-Wheel (WtW) metrics and focus on the fuel side, with either synthetic or biofuels as part of the decarbonisation process.

So far, the European Commission's CO_2 legislation has only revolved around TtW, but that does not give the full picture as CO_2 is only measured at the tailpipe. Fully electric vehicles are therefore favoured with zero tailpipe emissions, although the vehicle is rarely charged with fully renewable electricity. WtW is more comprehensive but more complicated to measure since the amount of renewable energy varies.

The greatest potential TtW CO_2 savings come from further drivetrain electrification (in order of CO_2 impact): mild hybrid, full hybrid, plug-in electric hybrid/range extender electric vehicle, and full electric vehicle/fuel cell electric vehicle. As a result, drivetrain electrification is the focus of our analysis in this study. There are also other technologies on the market or technologies currently being researched for decarbonization of the transportation sector (e.g., renewable fuels, green hydrogen, and e-fuels), but these are not the primary focus here. Furthermore, there have been discussions and research made in regard to volunteer WtW crediting for alternative fuels. The credit system works as follows: alternative fuels are produced by a fuel supplier, sustainability fuel credits are issued and entered into a database, original equipment manufacturers (OEMs) buy the credits from a fuel supplier, and finally the credits are then calculated towards an OEMs CO_2 target [1]. In the EC's Fit for 55 package, full battery electric vehicles and fuel cell electric vehicles are the preferred solutions.

The key results for the EV-only scenario are:



1. Electrification puts **powertrain employment**[3] **at risk** (potential **net** loss of up to -275k employees until 2040).
   – In all, 501k jobs at stake in the ICE domain, without counting employment opportunities created by electrification.

2. **Majority of future value-add** in EV powertrain technologies depends on **EU battery production** (70% of value-add).
   – Subsequently, European employment depends significantly on local battery production.

3. A **net reduction** of 291k jobs is expected **between the 2030 and 2035** timeframe alone.
   – A total of 359k jobs impacted in the ICE domain only, making the transformation towards future needs necessary (e.g. software, electronics, infrastructure).

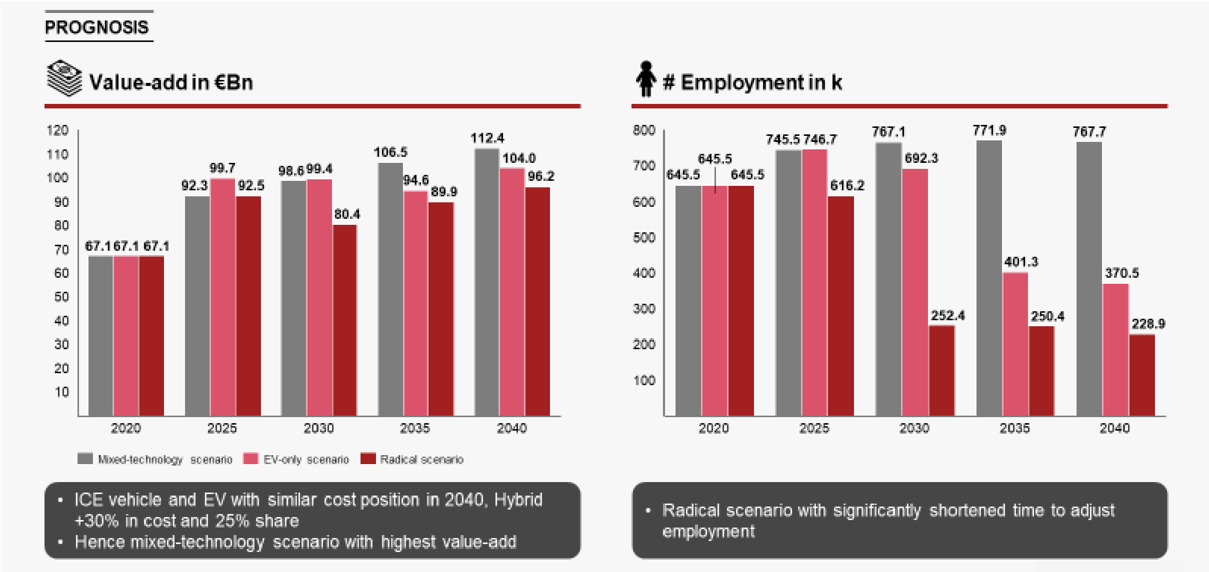
4. A **mixed-technology scenario mitigates** the impact on employment and creates value-add until 2040.
   – This would be driven by hybrid vehicles market share.

5. **Western European countries** will likely be best placed as strongholds in **EV production** (+56.2 €bn value-add until 2040).
   – By contrast, Central Eastern European countries will shape the run-down of ICE vehicle production.

3 Powertrain employment only, no further social impacts considered

Comparison of the three scenarios — mixed-technology, EV-only, and radical — in value-add and employment of the time period between 2020 and 2040:

Value-add and employment change by scenario



One prerequisite of the study's results must also be made very clear. All scenarios and calculations have been made on the assumption that there will be a full battery value chain based in Europe, from the processing of raw materials to the final battery assembly. The battery accounting for 70% of the electric powertrain value share is indispensable for employment in Europe. Based on the current public debate and company announcements, this assumption appears fair: Chemical industry players are positioning themselves in this huge market, and automotive suppliers as well as OEMs deem the battery to be vital to driving performance. However, major obstacles remain, such as local sourcing of critical minerals needed for battery cell production and certainly timing remains a factor of uncertainty.

The auto industry is in a deep period of transition: 125 years of ICE development and perfection must evolve into a very different business model for the sector in Europe to remain successful for another 125 years. This study gives quantitative information on the expected value-add and employment in European countries. The information gathered in this study is suitable to support economic and entrepreneurial decision making for Europe`s future, particularly given the corresponding context: Eastern European countries are more likely to shape ICE vehicle run-down, while Western European countries will play a key role in EV technologies. Net employment will decrease significantly, mainly due to higher automation of EVs and less manual work required. Additionally, depending on the Fit for 55 program and corresponding regulation, the industry will have very limited time for shaping the transition. The radical scenario will give the industry only five years to settle a completely new value architecture changing the heritage of 125 years. There is hope for the auto industry to stay relevant in European countries, but it will likely necessitate investments in new capabilities and new employment scenarios that require significant reskilling, particularly in the areas of IT/software, electrical engineering, and chemical engineering. At the same time, technology openness toward green hydrogen and e-fuels, among other sustainable options, will help ease transformation.

2 Introduction: Current situation and challenges

There is strong evidence that CO_2 and other greenhouse gas emissions (GHG) from human activity are causing observable global climate change. Under the 2015 Paris Agreement, GHG emissions must be cut by 95% by 2050 [6] in order to limit global warming to 2°C. Currently, CO_2 regulations for passenger cars account for (*see Figure 1*). about 51% of these transportation-related emissions,[4] which represents around 12% of total global emissions. According to the IEA [7], GHG emissions from Europe's passenger car sector have increased by 20% during the last 30 years. Despite substantial gains in fuel efficiency, the number of vehicles in operation, the trend toward larger vehicles, the average age of vehicles, and the number of driven kilometres by vehicle and year are all expected to increase.

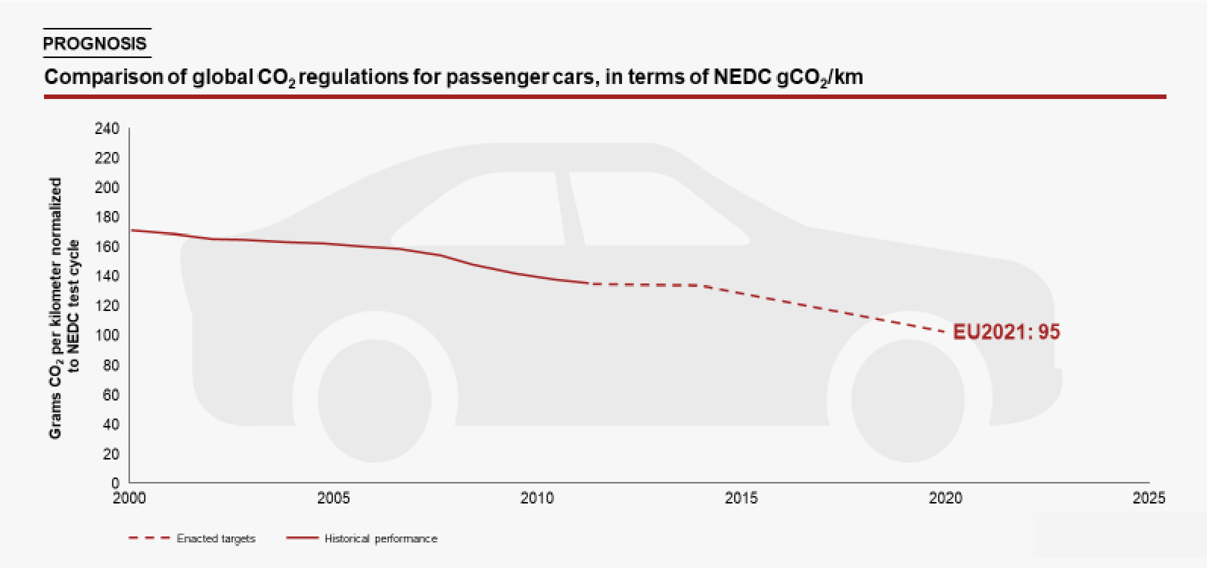


Figure 1: EU CO_2 regulations for passenger cars in terms of NEDC [gCO2/km] [3]

Therefore, Europe will have to take measures to steadily decarbonise the mobility sector. Consequently, Europe's passenger car sector faces one of its greatest challenges over the coming decades. Europe is one of three regions, along with China and the United States, with the highest GHG emissions from passenger cars, and significant reductions in GHG emissions are needed to achieve both global and European climate goals.

More than a decade ago, the EU introduced its first regulations on the GHG tailpipe emissions of passenger cars, which have subsequently been tightened. These regulations aim to cut GHG tailpipe emissions from newly registered cars to 95g/km in 2020 and to 80g/km in 2025 (*see Figure 1*) [8]. They are expected to be tightened further to support efforts to reduce the EU's emissions by 55% by 2030 (as noted in the Fit for 55 package), and for the EU to be carbon-neutral by 2050 [9]. As well as aiming to reduce road transportation–related GHG emissions, the EU is likely to tighten regulations for pollutant emissions, e.g., nitrogen oxides, under the proposed

4 In this report, the term "passenger cars" includes light-duty vehicles up to 3.5t gross vehicle weight.

EURO 7 emissions standards policy. Currently, alternative fuels are also in discussion to replace today's fossil fuels for ICE vehicles, but these alternative fuels do not address tailpipe emissions though they do certainly help to reduce GHG emissions. Moreover, alternative fuels are also considered for commercial, heavy-duty vehicles. Alternative fuels also have the advantage of being able to directly refuel a new ICE vehicle on the market today. Alternative fuels have so far not been included in the EC's latest Fit for 55 proposal for CO_2 standards, but they offer a potential solution for the existing ICE vehicle fleet now and in the future. Alternative fuels have been discussed in the Renewable Energy Directive (RED), the Energy Taxation Directive (ETD), and previous Fit for 55 drafts. But the current EC proposal has so far only considered TtW and therefore alternative fuels are less relevant than when WtW and existing vehicles are considered. Major investments will be required to produce enough alternative fuels in the future and reduce the cost of production.

These regulatory efforts have resulted in increasing complexity in technology and insecurity regarding consumer behaviour for car manufacturers — also known as OEMs — and their portfolio of conventional and alternative vehicles and powertrains. OEMs have reacted to these policies with even more sophisticated exhaust systems for conventional vehicles with ICEs, while simultaneously ramping up production of EVs, either hybrids that combine electric and combustion powertrains, or standalone batteries or fuel cell EVs (e.g., BEVs and FCEVs).

This transition from an almost entirely ICE vehicle portfolio toward a more electrified portfolio significantly impacts the current value-add structures of both OEMs and their suppliers. The automotive supplier sector is a major employer across the EU, which makes a substantial contribution to the competitiveness of the EU's industrial base, as measured by percentage of total employment, value-add, and other KPI metrics. Understanding the impact of the EV transition on Europe's automotive supplier industry and its employment, also from a regional perspective, is therefore of utmost importance to maximize the associated opportunities and minimize the threats for competitiveness and employment.

In summary, the EV transition brings a series of uncertainties for automotive suppliers in different areas (*see Figure 2*).

Figure 2: Areas of uncertainty for automotive suppliers

3 Purpose and scope of this study

3.1 Purpose

Existing studies of the EV transition are mostly qualitative or focus on individual European countries. They have not yet assessed the impact of the EV transition across the region, nor on the automotive supplier industry.

This study aims to show the expected impact on employment in the supplier industry caused by an accelerating EV transition and is based on a quantitative approach to answering the most relevant key questions, focusing on the following three areas:

- *What is the impact of different powertrain technologies and component requirements on value-add for automotive suppliers in Europe?*

  The focus of the study is the value-add that can be generated by the European automotive powertrain industry. The study assesses whether the industry will see a change in value-add or experience no change from the EV transition.

- *What is the corresponding effect on employment for automotive suppliers in Europe?*

  The study quantifies the expected effect of value-add changes to the employment in European countries based on their competitiveness.

- *What would a mixed-technology, EV-only, or a radical EV-implementation scenario mean for climate targets, value-add, and employment in Europe?*

  Lastly, the study considers the potential impact on value-add and employment of an accelerated EV transition impacted by policy and regulatory specifications due to increased concerns about global warming and air quality.

3.2 Scope of this study

The study focuses on the automotive powertrain technologies of passenger cars and light-duty commercial vehicles below 3.5 tons, exclusively. Europe as a whole is covered, including the 27 EU countries, the four European Free Trade Association (EFTA) member states, and the UK. In addition, the study focuses in more detail on seven EU member countries, which together account for around 74% of Europe’s automotive supplier revenue: the Czech Republic, France, Romania, Spain, Italy, Poland, and Germany *(see Figure 3).*

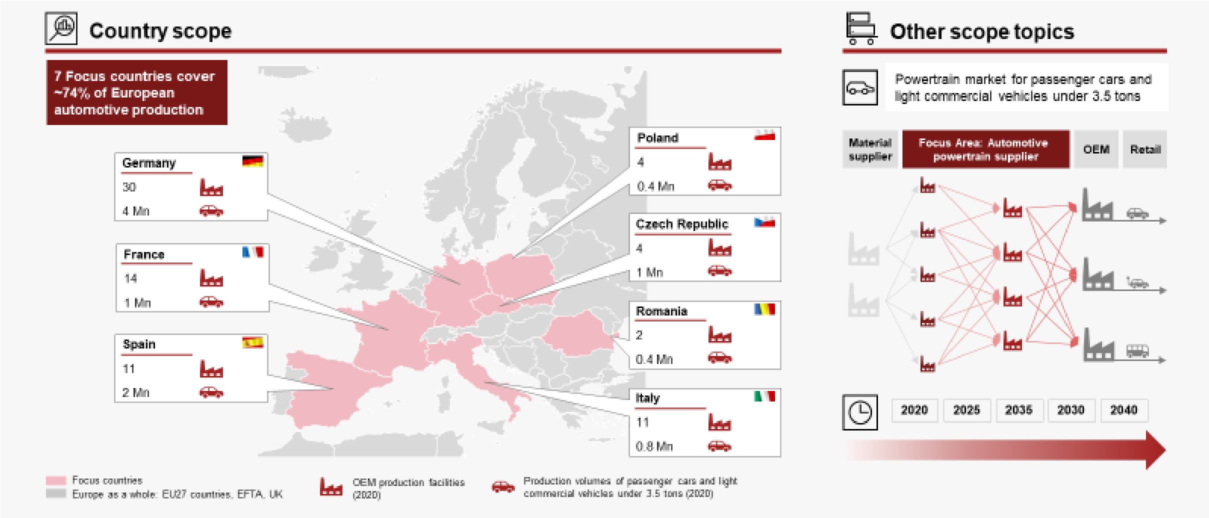


Figure 3: Scope of the study

The automotive powertrain industry is an extremely important sector in Europe. Based on the latest ACEA fact book (2021), automotive manufacturing (vehicle and components) represents 8.6% of EU employment in manufacturing. The automotive industry also accounts for a significant share of the demand in adjacent industries such as the manufacturing of bearings, electric motors, cooling and ventilation equipment, and tyres. If those activities are included, the automotive industry's contribution to employment reaches 11.6%. In total, more than 60% of automotive manufacturing jobs are within the automotive supplier industry.

Taking a look across countries, direct employment in automotive manufacturing accounts for more than 10% of manufacturing employment in six EU member states. In Romania and Slovakia, the automotive industry represents the highest share with 15.7% of manufacturing employment. Automotive suppliers alone employ tens of thousands of people in individual EU member states as indicated by Eurostat data on employment in manufacturing of parts and components, as shown below *(see Figure 4)*. To ensure a consistent measurement across countries, this study relies on the narrower defined category of employment in manufacturing of parts and accessories for motor vehicles (NACE code C29.3). But this leaves out of scope employment in adjacent industries. CLEPA's inclusion of these activities estimates employment by automotive suppliers in the EU at 1.7 million FTE. Assessments by the Spanish, Italian, and Portuguese automotive supplier associations also suggest that Eurostat data could understate the direct employment by automotive suppliers, with national estimates for direct supplier employment at 212,500 FTE, 158,000 FTE, and 61,000 FTE, respectively [2] [3] [4] [5].

PROGNOSIS

		Vehicle		...whereof Powertrain	
	Country	Value-add €Mn 2018	Employ. in k 2018	PT Value-add €Mn 2020; (2040)[1)]	PT employ. in k 2020; (2040)[1)]
Focus countries	Germany	24,686	289,876	**22,500 (24,200)**	**150,600 (67,900)**
Focus countries	France	7,434	95,820	**3,800 (15,600)**	**27,800 (31,400)**
Focus countries	Italy	6,828	95,999	8,700 (4,700)	74,000 (14,800)
Focus countries	Poland	5,161	166,981	2,900 (3,500)	55,100 (43,900)
Focus countries	Spain	4,778	78,593	**7,300 (20,300)**	**72,000 (45,900)**
Focus countries	Romania	3,472	169,662	1,900 (3,600)	56,200 (28,700)
Focus countries	Czech Republic	4,412	134,969	2,300 (4,900)	40,700 (40,800)
	Hungary	2,224	76,418		
	Slovakia	1,648	53,218		
	Sweden	1,409	22,814		
	Portugal	1,112	32,573		

1) Derived from forecast model

Figure 4: EU7 focus countries value-add and employment

The EV transformation forces powertrain suppliers to make conscious decisions that will highly impact the future industry development, employment changes, and the resulting GDP within the respective country.

At an overall European level, the study forecasts the expected effects of the EV transition on value-add and employment at a powertrain component level (referred to as “technology areas”). Prognoses for the seven focus countries are made at an aggregated ICE vehicle and EV technology level.

A large proportion of automotive value-add is typically generated by suppliers, as part of the industry’s highly complex value chain. These provide systems and modules, components, semi-finished goods, or raw material. This study, however, focuses on automotive powertrain suppliers and excludes raw material suppliers.

Finally, the study provides a comprehensive, long-term, and quantitative view of the expected effects of changing market structures and regional distribution of value-add and employment in the automotive powertrain supplier industry, covering the period from 2020 to 2040.

4 Methodology

This chapter explains the study’s methodology, covering four models: market scenarios, technology segmentation, value-add forecast, and employment impact forecast.

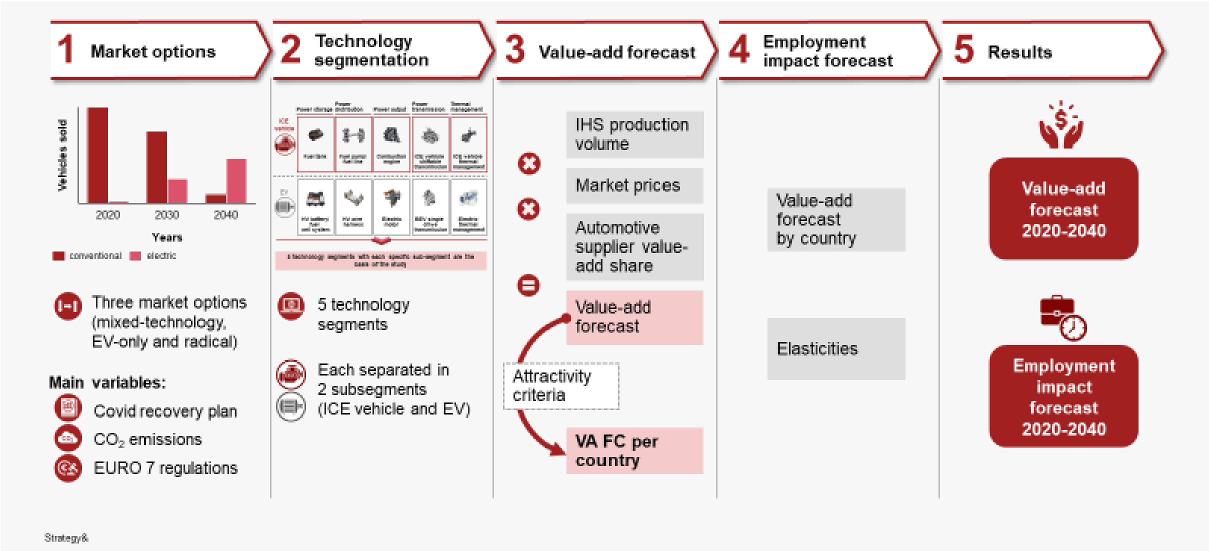


Figure 5: Key steps of the study's methodology

4.1 Market scenarios

The pace and the likely impact of the EV transition on suppliers were grouped into three market scenarios: a mixed-technology scenario, an EV-only scenario, and an accelerated radical scenario.

Discussions about possible market scenarios intensified in July 2021, when EC President Ursula von der Leyen announced the commission’s detailed proposals for implementing the Green Deal targets for the mobility sector. Most notably, these included proposing an end to the new registration of vehicles without zero emissions at the tailpipe in 2035, while not even mentioning the previously much-discussed new fleet emission limits for 2030.

For the purposes of the study, the regulatory scenarios were translated into consistent market volume scenarios for annual new registrations of light vehicles (comprising vehicle categories M1 and N1 by EU classification) across all the European countries in scope. For this geographical area, both historical new vehicle registrations as well as final vehicle assembly numbers were assessed at a powertrain technology level and used as a common starting point to derive future market volume scenarios.

All three-market volume scenarios share some overall prerequisites. Yearly new vehicle registrations are assumed to remain governed by the same impact factors they have been governed by historically, in particular, economic growth cycles. Structural changes such as wide-ranging changes of mobility patterns or shifts in purchasing behaviour have not been considered. Therefore, the total market volumes between the three scenarios remains relatively constant. It should be noted, however, that sales volumes increased significantly over the 2020 base year due to catch-up and recovery of the car market after short-term COVID-19 impacts.

Across all scenarios, there is no assumption of a significant push against removing the existing older vehicle parc or an increased overall replacement pressure. This is because a new car can be expensive, and some use cases will require an ICE vehicle for a longer period of time. Furthermore, there is no assumption of any increase in fossil fuel prices beyond the current CO_2 pricing plans or any change in future electricity prices. Purchasing behaviour is also assumed to stay constant, as well as general vehicle prices.

In the seven focus countries, the consideration of import and export volumes concentrates on complete engines and transmissions, which are regularly shipped between factories across different countries and regions, both within and between corporate groups. Europe as a current net exporter of internal combustion engines is assumed to remain so in the future with electric motors. With transmissions, Europe is also a net importer today, and is expected to remain so in the future in the absence of visible indications to the contrary.

The role of the aftermarket for ICE vehicle technologies is considered for all vehicle systems in the study's market scenarios model. But it is expected to shrink from 2020 to 2040, as more and more vehicles in the global fleet become fully electric. In 2040, we expect many older ICE vehicle cars still to be in operation in the region, and globally. Overall, we estimate aftermarket revenue will grow throughout the studied period, when HEV and BEV parts are included. Spare parts have been assumed to account for 10% of supplier production in 2020. Employment impact in the aftermarket workshops are not included.

The overall current and future state of charging infrastructure in Europe has not been included as a structural variable in the model. However, the number of publicly available chargers is taken as an indicator of assumed overall support for electric vehicles. The amount of assumed regulatory support for charging infrastructure also has been indicated for each of the three scenarios. The mixed-technology scenario has the lowest assumed external support whereas the radical scenario has the highest assumed level (*see Figure 6,* which shows the EV-only and the radical scenario assumptions in detail).

PROGNOSIS

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
All scenarios	95g NEDC target	120g WL TP target	COVID Recovery Plans			Public access chargers	80/101g CO_2 target	Euro 7 (new TA)	Euro 7 (old TA)					
Mixed-technology scenarios			Only BEV support			<< 1m public access chargers		Feasible, also MHEV	Feasible, also MHEV			**-50% CO_2** = 48/60g target; a-fuels -20g	a-fuels -30g	Ca. 30% ICE vehicle/ HEV (exp.)
EV-only scenario			+ BEV charging			1m public chargers target met		Harsh (FHEV favored)	Harsh (FHEV favored)			-60% CO_2 = 38/48g target; a-fuels -7g	0 gram CO_2 target for new fleet, w/a-fuels -10g	
Radical scenario			+ ICE vehicle city bans			> 1m public access chargers		Almost unfeasible, incl. MHEV	Almost unfeasible, incl. MHEV			**0 gram** CO_2 target for new fleet	Explicit end of ICE vehicle sales	

Strategy&

Figure 6: Mixed technology, EV-only, and radical scenarios for market assumptions 2019 – 2040

Charging infrastructure and other state support: impact on the mixed technology, EV-only, and radical scenarios.

For all three scenarios, a 15% CO_2 reduction is expected by 2025, as this target has already been set. All the cases also assume that the EURO 7 emissions norm will come into force on 1 January 2026 for new type approvals, and one year later for all remaining old type approvals.

Mixed-technology scenario

In this scenario, COVID-19 government recovery plans are only expected to include some additional BEV support, with no forecasted government support for charging infrastructure or city-wide bans on ICE vehicles. As a result, the mixed-technology scenario projects publicly available vehicle charging stations in Europe by 2024.

The mixed-technology scenario is also based on the upcoming EURO 7 emissions norm being more accepting toward ICE vehicles and mild hybrids than in the other two scenarios (base and radical). It is assumed that meeting EURO 7 standards will be possible with just MHEVs, and as a result, the scenario of BEVs is rather slower. The mixed-technology scenario also assumes that ICE vehicle powertrains, specifically MHEV, will still have a significant share by 2040.

The scenario projects a 50% CO_2 reduction by 2030, based on the 2020 95g NEDC stricter passenger car target, rather than the EC's previous 37.5% reduction target by 2030, from the 2020 level. This 50% CO_2 reduction is 5%-point less than the EC's Fit for 55 proposal. With a 20g offset, it's possible to meet the CO_2 target with a 28% CO_2 reduction from electrified powertrains and the other 22% from the alternative fuels. After 2030 there is no specific CO_2 target assumed for this scenario. The focus is instead on the entire vehicle fleet and using alternative fuels to reduce CO_2.

The mixed-technology scenario is, therefore, still stricter regarding CO_2 reduction than the previous EC target, with an allowance for alternative fuels making it possible to reach the more ambitious target while remaining less aggressive on electrified powertrains than the other two cases. The allowance is a credit to avoid penalties and the impact is considered at the tailpipe for the fuel burned.

EV-only scenario

The EV-only scenario follows the STEP scenario,[5] as proposed by the IEA in 2020 and is in line with the EC's Fit for 55. The EV-only scenario assumes that as part of their COVID-19 recovery programs, governments will support BEVs with incentives and charging infrastructure funding that will help to create a network of around 1 million public charging stations in Europe by 2024, compared to the current number of around 285,000. With a generally stricter view on ICEs, the EURO 7 emissions norm is expected to be harsher and favour FHEVs.

For the EV-only scenario, the 2030 CO_2 reduction target is only 10% stricter than the mixed-technology scenario, but the alternative fuels allowance is drastically reduced to just 7g. This 60% CO_2 reduction is 5%-point stricter than the EC's Fit for 55 proposal. The 7g alternative fuels offset is, however, equivalent to 7.5% of the total 60% CO_2 reduction. By 2035, the CO_2 target is 0g with the alternative fuels allowance increasing to 10g. By comparison, the Fit for 55 proposal contains a 55% CO_2 reduction target by 2030, without an allowance for alternative fuels.

Radical scenario

The radical scenario could also be called a "net zero by 2030" scenario and, thus, it's the most aggressive. A100% CO_2 reduction, which it assumes, is 45%-point more than the EC Fit for 55 proposal. It also assumes government COVID-19 recovery programs that would incorporate BEV incentives, charging infrastructure support, and city-wide bans for ICE vehicles. For these reasons, in this scenario, more than 1 million publicly accessible chargers will be available by 2024. The radical scenario also has the most aggressive assumptions about the EURO 7 emissions norm, which is projected to be almost impossible to meet with "just" MHEVs. The 2030 CO_2 target of 0g is five years earlier than in the EV-only scenario, and there is no alternative fuels allowance. All ICE vehicle sales are assumed to have ended by 2035.

For production volumes in all three-market scenarios, EV technologies include BEV and FCEV; ICE vehicle comprises of the rest. For value-add considerations, the electric part of hybrids was considered within EV technologies.

Market scenario evolution 2020-2040

In all three scenarios, the base year for modelling was 2020. The 15% CO_2 reduction target for 2025 is also consistent across all three scenarios with various outlooks thereafter

In the **mixed-technology scenario**, there is a slow uptake of BEVs through 2025 because government incentives are limited to purchase incentives and do not cover charging infrastructure. In this scenario, PHEVs remain an important powertrain for

5 The Stated Policies Scenario, or STEPS. It was proposed by the International Energy Agency (IEA) in 2020.

efforts to reduce CO_2. FHEVs peak in 2025 as they become more affordable. It is only in 2030 that the volume of BEVs begins to slightly exceed PHEVs. Only the mixed-technology scenario assumes that petrol and diesel vehicles will still be sold in 2030 without at least being MHEVs, due to the more relaxed assumption for EURO 7 regulations.

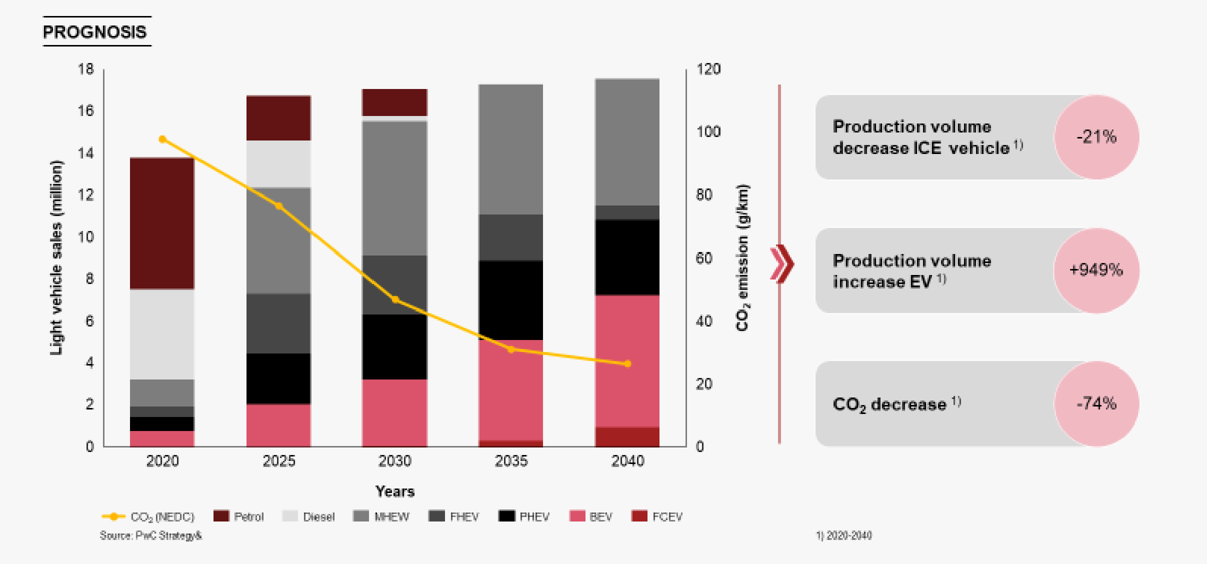


Figure 7: Mixed-technology scenario market scenario

As a result, the forecast NEDC CO_2 level in 2030 is 46g. WLTP is calculated at a factor of 21% above this level. The alternative fuel allowance is increased to 30g in 2035, limiting the need for the retirement of ICE vehicle with MHEV technology. By 2040, the market is equally split between MHEV ICE vehicle and BEV/ PHEV. The CO_2 value falls continuously from 2020 but is still more than 25g in 2040, as seen in Figure 7.

The **EV-only scenario** includes government incentives for BEVs and funding for charging infrastructure, helping to increase the market share of BEVs by 2025. The harsher EURO 7 regulation only allows for limited ICE vehicle offerings in higher vehicle segments[6] and results in a quicker phaseout compared with the mixed-technology scenario. PHEVs and FHEVs are also both needed to fulfil EURO 7 requirements.

6 E segment and above

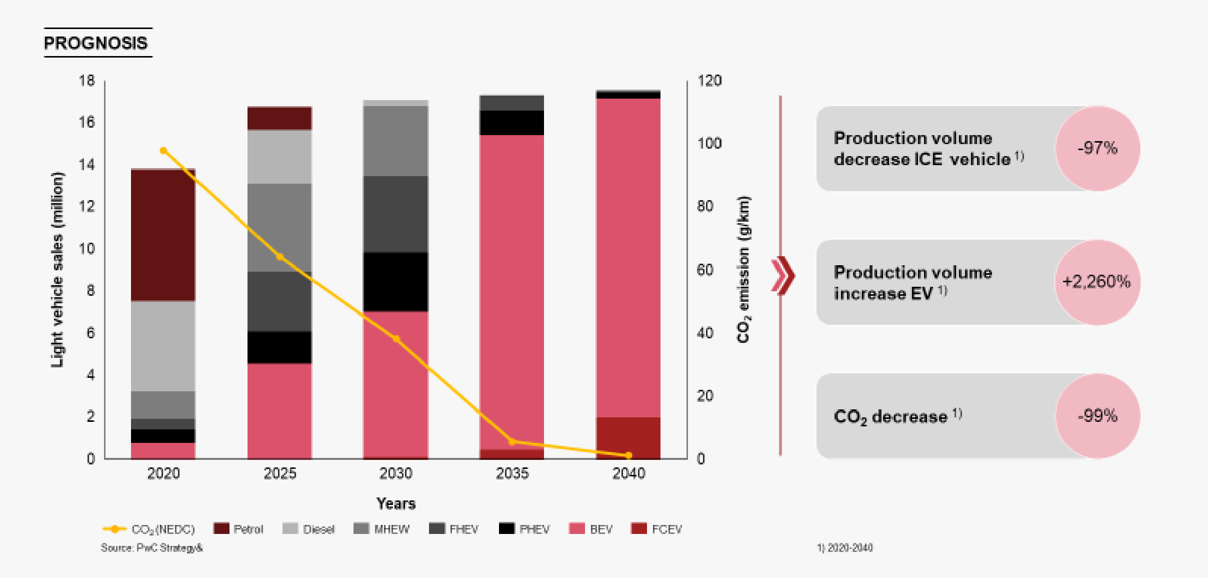


Figure 8: EV-only market scenario

By 2030, the CO_2 target of 38g at NEDC (or 48g at WLTP) is met, with an alternative fuels allowance of 7g. The phase-out of ICE vehicle from 2035 onwards requires a steep increase in BEVs and FCEVs from 2030. The retraction of ICE vehicle offerings is almost complete by 2040, with a visible share of FCEV due to support for hydrogen filling infrastructure and ample supply of green hydrogen.

The **radical scenario** envisages that support for BEV purchases and charging infrastructure will be complemented by ICE vehicle city-wide traffic bans, accelerating BEV sales through 2025. The CO_2 target of 48g is significantly exceeded by 2030 due to ZEVs gaining more than 90% market share, almost entirely through BEVs. Substitution of BEVs by FCEVs begins to occur from 2035, as the relative cost becomes more competitive and battery capacity gets substituted by hydrogen-powered fuel cells. The retraction of ICE vehicle offerings is therefore completed by 2040, with FCEVs claiming a growing market share due to widely available hydrogen filling infrastructure and affordable green hydrogen.

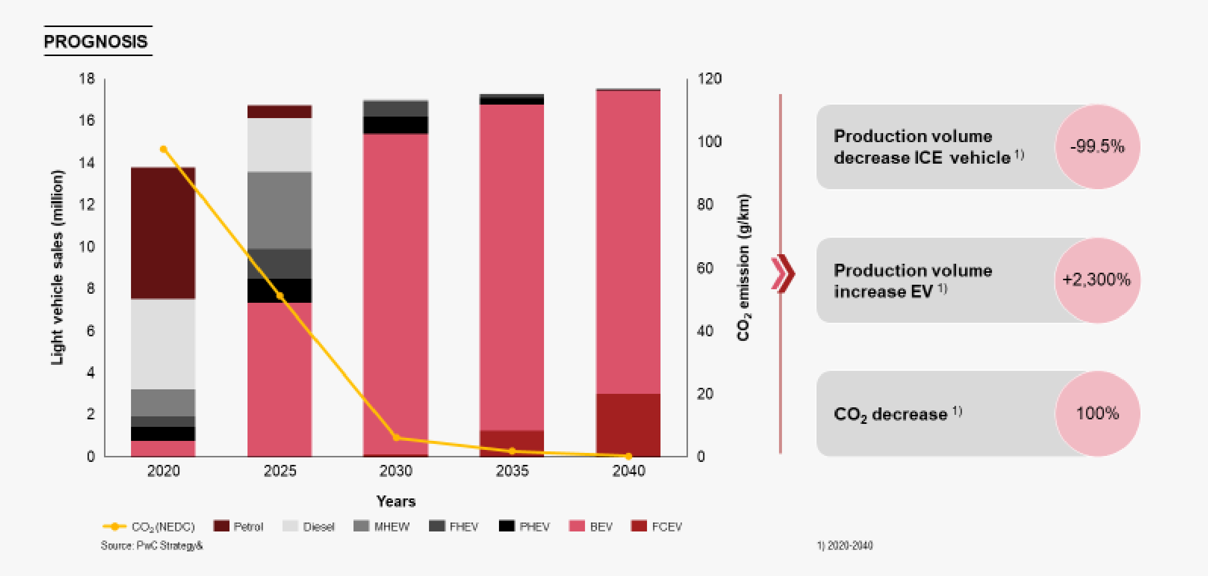


Figure 9: Radical scenario

4.2 Technology segmentation

To analyse the impact of electrification on a technical level, the study separates the powertrain into five technology areas (TAs) at the level of technical functions. The powertrain functions are:

I. Energy storage
II. Energy distribution
III. Energy transformation
IV. Energy transmission
V. Thermal management

Figure 10 shows the five TAs for both ICE and EV powertrain scenarios. Hybrid vehicles are classified as ICE vehicles which also use technology areas from EVs.

Figure 10: Technology areas for ICE and EV

Energy storage covers powertrain components that are relevant for storing the energy required to move the vehicle forward. ICE vehicle powertrains carry either gasoline or diesel, or in some cases gaseous fuels, such as LPG, that are stored in the fuel tank. In EVs, the energy is stored in on-board high-voltage (HV) traction batteries, while in FCEVs it is stored in hydrogen fuel tanks.

Energy distribution includes components relevant for distributing the energy from power storage through the vehicle into power transformation. Within an ICE vehicle powertrain, power distribution typically covers fuel lines and fuel pumps carrying the liquid or gaseous fuel. In EVs, it covers the high-voltage wiring harness and in FCEVs the hydrogen pipes.

Energy transformation transforms the stored energy into mechanical energy. Within an ICE vehicle, a combustion engine converts the liquid or gaseous fuel into mechanical energy (torque and speed), while in EVs and FCEVs, an electric traction motor converts electrical energy into mechanical energy.

Energy transmission adjusts the mechanical energy into the right doses to move the vehicle according to the driver's preferences. Both ICE vehicles and EVs commonly use a transmission. ICE vehicles have a multi-gear shiftable transmission, while EVs typically apply a single- or double-gear drive.

Thermal management ensures an optimized temperature level for the other powertrain TAs and covers cooling liquids, pipes, and heat exchangers for both ICE vehicles and EVs with different levels of complexity.

4.3 Value-add forecast model

This section introduces the main rationale and methodology for creating the value-add on a European and technology level perspective per market scenario, which serves as the starting point and basis for the distribution of value-add in both the ICE vehicle and EV forecast modules (*see Chapter 4.4, employment impact forecast model*).

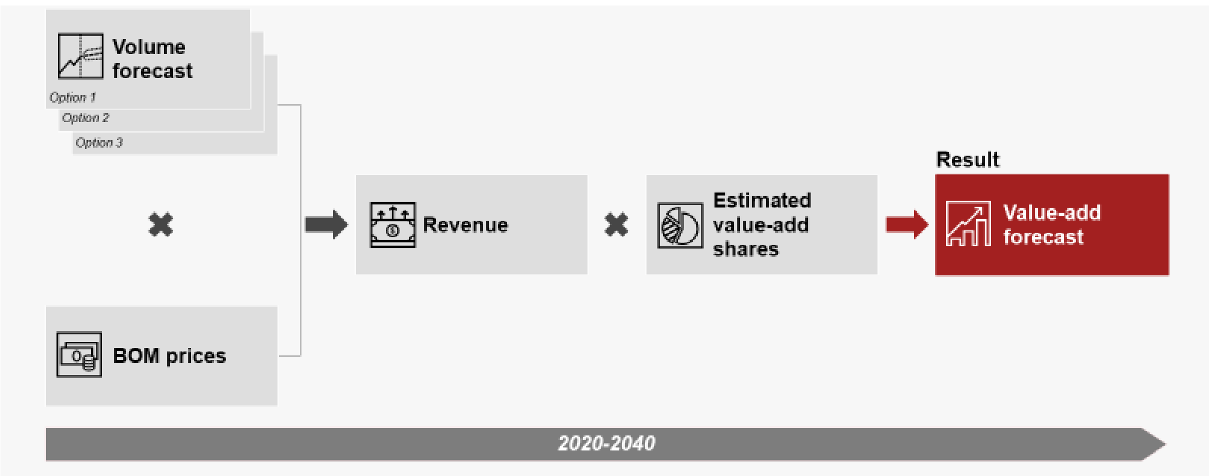


Figure 11: Value-add forecast model

“Value-add” in this study is defined as revenue minus material costs and describes the part of the company’s individual value creation that directly contributes to the country’s economy. Value-add includes the cost of production equipment, workers' pay, sales and administrative costs, and profit.

Revenue is derived by multiplying relevant production volumes for the defined technology areas based on the underlying market volume scenarios with the respective bill of materials (BOM) prices over time (2020-2040). In addition, we’ve applied the experience and expertise at PwC Strategy& to our analysis. Based on our extensive market and R&D insights, the evolution of technology BOM price development over time for powertrain-related systems, ranging from energy storage (tank or battery) through power conversion (engine or motor) to traction distribution (transmission, differentials, and shafts), is derived. Overall, a steady state is assumed without significant changes for established vehicle systems. However, high-voltage, lithium-ion-based battery systems will benefit from significant scale effects leading to relatively lower value shares going forward.

PwC Strategy& analysis was further used to forecast the value-add shares per technology area to 2040. The underlying value-add is calculated by multiplying revenue with estimated value-add shares.

Looking first at costs, the cost of BEV-related components continues to gradually fall as production and competition increases and economies of scale are generated. On the other hand, ICE vehicle costs increase for exactly the opposite reasons, and with stricter environmental regulations (e.g., EURO 7) to comply with. The main cost driver for this development is the additional exhaust treatment technology.

The value-add was distributed and allocated to the seven EU focus countries (EU 7) via an adjusted powertrain value-add per employee [10] and the corresponding ICE vehicle and EV employee amount per country reported by the associations. The yearly distribution of the value-add on a country level is also influenced by the “attractiveness” of the respective country (*see Chapter 4.4, point (i)*).

4.4 Employment impact forecast model

The chosen approach covers: 4.4.1 country-specific criteria for modelling a country`s attractiveness for the replacement of ICE vehicle technology-related capacity and EV technology-related investment and capacity expansion (attractiveness indices); 4.4.2 elasticity of value-add changes on employment figures; and 4.4.3. divestment and investment forecast of employment for ICE vehicle and EV technologies.

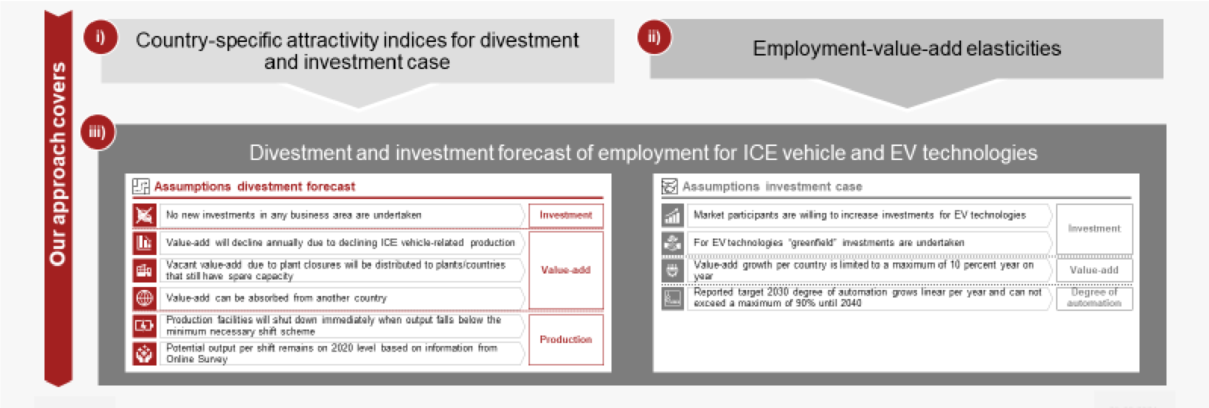
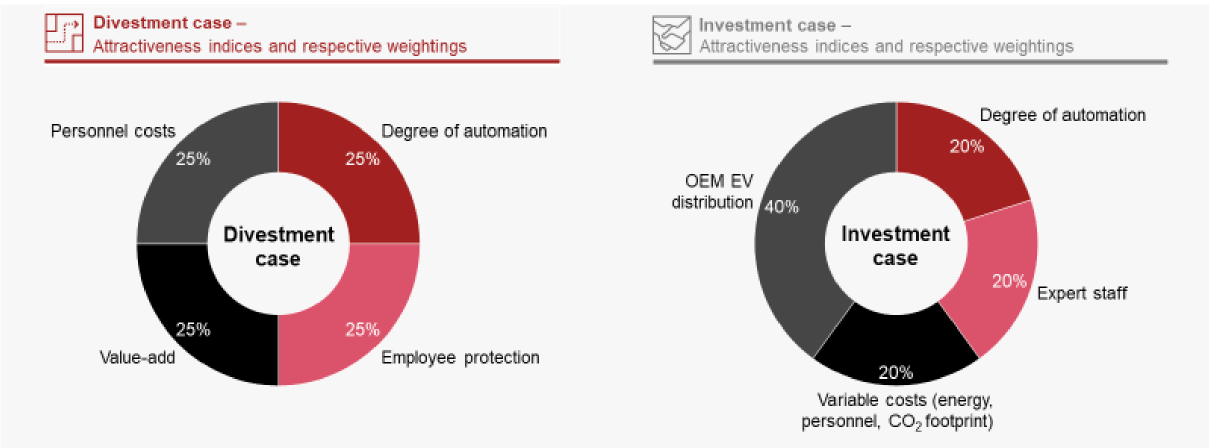


Figure 12: Employment impact forecast model approach

4.4.1 Country-specific attractiveness indices

Several criteria define a country's attractiveness for integrating additional value-add into production facilities as some ICE vehicle technologies facilities close down, or for investing in additional EV technologies facilities to ramp up EV manufacturing. Each criterion is weighted based on the conducted interviews and expert sessions according to its importance to the overall attractiveness score. The selected criteria and their respective weightings are as follows:



Divestment case

- Employee protection (weighted 25%): This reflects the influence of labour protection legislation. The higher the labour protection in a country, the less attractive it is for OEMs to continue ICE vehicle production in the future and absorb additional value-add that becomes available from other countries. This is because ICE vehicle production is a decreasing business. Therefore, capacity should be made available for new technologies that secure future employment instead [6].
- Value-add (25%): This reflects the 2020 value-add baseline for ICE vehicle technologies. The higher the 2020 value-add, the more attractive a country becomes, because it suggests that future generations of value-add will be easier to come by, due to existing business, customers, and partnerships [15].
- Degree of automation (25%): This reflects the 2020 baseline for reported degree of automation. The higher the degree of automation, the more likely it becomes that a country receives additional ICE vehicle value-add to minimize poor utilization of machinery.
- Personnel costs (€/hour) (25%): This reflects average personnel costs. Countries with less expensive employees are correspondingly considered more attractive. [12]

Investment case

- Degree of automation (20%): This reflects expected investments in assets with a higher degree of automation for EV technologies. This index will change over time to reflect ongoing investments in automation technology and efficiency increases.
- Variable personnel (€/hour) and energy cost (€/kWh) as well as CO2 footprint within a country's production (in g/kWh) (20%): This reflects a country's average variable costs and carbon footprint. The lower the costs and carbon footprint, the more attractive a country becomes [13].
- Skilled labour force, (20%): Reflects the availability of employees with automotive powertrain production expertise being released due to the decrease ICE vehicle production volumes. This index changes over time in line with annual releases of employees in the divestment case.
- OEM EV production 2020 (40%): This reflects the current level of country-specific EV vehicle production rates by OEMs. The higher the production, the more attractive a country becomes for future supplier investments. This index changes over time to reflect changing OEM production rates [14].

The overall country score is created by multiplying each country's ranking per criterion with its specific weighting (see above). The country's annual attractiveness score has a significant influence on the order in which it absorbs value-add. The most attractive country is the first to absorb value-add, and so on.

4.4.2 Elasticity of value-add changes on employment figures

The study assumes that employment figures are directly influenced by the plant's generated value-add and volume changes. It is assumed that the changes in value-add have x-to-y relationship to changes in employment figures — so-called elasticity. The elasticity effect is multiplied with the value-add change year-by-year to forecast the annual employment change per country. Elasticities were calculated based on company interviews conducted for this study and are the same across countries at EV and ICE vehicle level.

4.4.3 Divestment (ICE) and investment (EV) forecast of employment for ICE vehicle and EV technologies

For the **divestment case,** the study is based on the following assumptions:

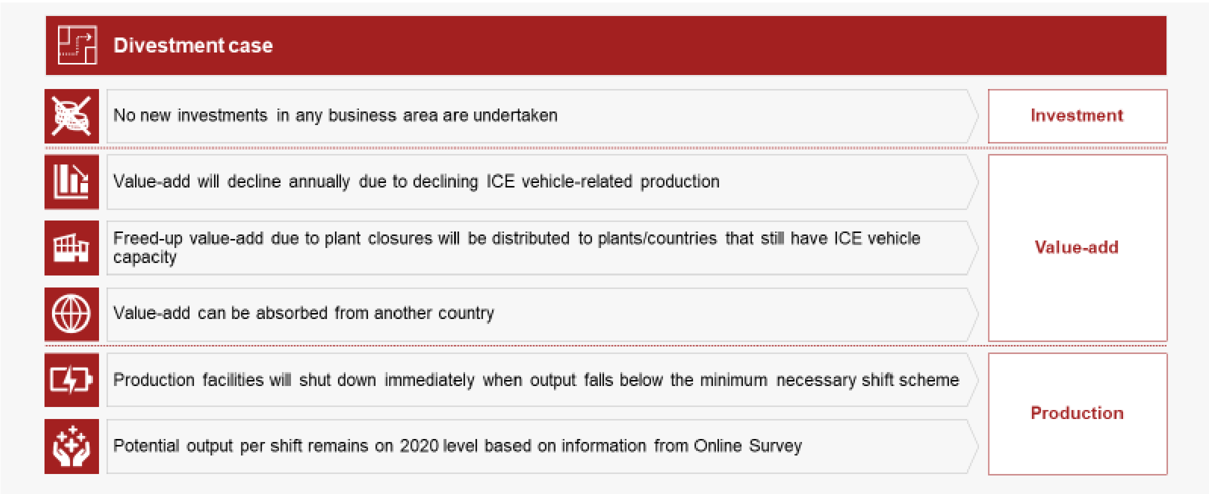


Figure 13: Assumptions divestment case

The distribution of ICE vehicle volume and value-add is mainly influenced by the countries' average minimum and maximum plant operation shift schemes (which were collected via the PwC Strategy& company survey) and the attractivity score of the individual countries (*see ii*). ICE vehicle production is being shut down in a country its ICE vehicle production if its available volume is insufficient to utilize the minimum production shift scheme.

If a country's ICE vehicle production was shut down, its remaining value-add and volume is distributed to the other countries. The countries are each ranked via an attractivity index (*see ii*) and can only absorb a maximum value-add in accordance with its maximum shift scheme include a 30% uplift.

For the investment case, the study is based on the following assumptions:

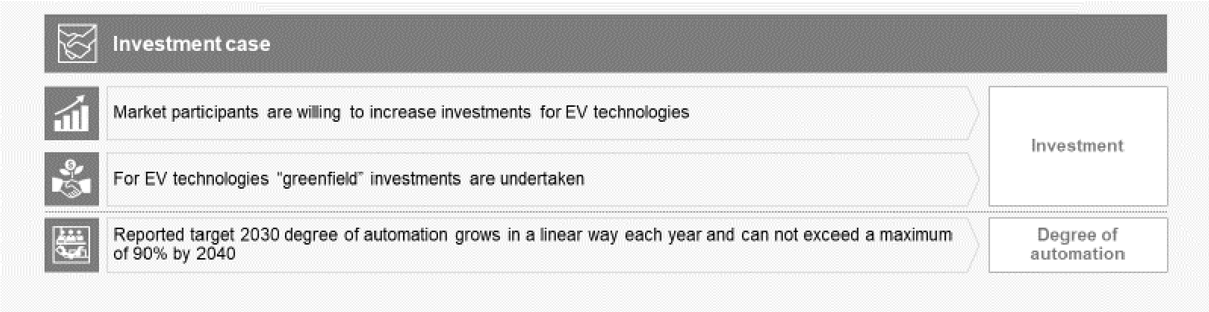


Figure 14: Investment case assumptions

The distribution of increasing EV production volume and value-add is mainly influenced by the countries' individual yearly attractivity score (*see ii*). Based on this score, newly generated value-add is distributed between the countries via a pre-defined percentage rate (value-add distribution of 2020). The most attractive country matches get the highest percentage of value-add.

The employment development within the divestment and investment case is forecasted in accordance with the countries value-add development and an individual elasticity factor (*see iii*) for ICE vehicle and EV technologies.

In addition to the individual focus country forecasts, the employment forecast was expanded to cover Europe. (For this study's definition of Europe, see section 3.2.) That was done by scaling the forecast employment development between 2020 and 2040 at the focus country level up to the European level, on the basis that the focus countries are generating 74% of the European-wide created value-add.

5 Data

The following section gives an overview on the underlying data input for the value-add and employment forecasts.

5.1 Value-add model

Production figures (2020 to 2028) are based on IHS Markit and PwC Autofacts data. For the years 2029 to 2040, a CAGR model with accelerators was used for modelling and extrapolation. Input to derive a value-add prognosis for the defined technology areas for both ICE vehicles and EVs was provided by senior automotive experts from PwC Strategy&. This input can be divided into two categories.

The first category covers product costs for each of the technology areas for both ICE vehicles and EVs. For each area, product costs of an average-specified vehicle-powertrain (i.e., regarding power and range) are used, giving a bottom-up product cost for a complete vehicle powertrain. As a result, the cost of an EV powertrain is about three times as high as an ICE vehicle powertrain in the base year 2020, with the EV high-voltage battery being the main cost driver. Approaching 2040, the overall powertrain cost of ICE vehicles will increase by about 30% on average, mainly due to more complex exhaust treatments to comply with new (pollution) emissions regulations and lack in economies of scale. In contrast, the cost of an average EV powertrain will decrease between 2020 and 2040 by 40%. The decrease applies across all EV technology areas but is mainly down to the battery and can be attributed to growing knowledge about new EV technologies helping to make the production processes more efficient and use fewer inputs.

The second category covers the relative automotive supplier value-add per technology area. For each of the two powertrain technologies, the overall product costs were split into a share of material cost and a value-add share of automotive suppliers. The material cost shares range in the ICE vehicle technology areas from 25% to 41% (e.g., the fuel pump and line having the highest share of 41%), with a cost-weighted average of 26%, indicating an average automotive supplier value-add of 74% throughout the value chain. In contrast, the material cost range within the EV technology areas range from 25% to 50% (e. g. electric traction motors having the highest share of 50%), with a cost-weighted average of 31% and a respective value-add of 69%. This indicates a higher share of material cost in an EV compared with an ICE vehicle (e.g., more copper and less steel). Between 2020 and 2040, an average EV powertrain has an overall higher product cost compared with an ICE vehicle (about 45% higher in 2040). As a result, both the absolute material cost as well as the absolute value-add of an EV always exceeds that of an ICE vehicle powertrain (*see Figure 17*). For HEVs, a mixed set of prices from FHEV, MHEV, and PHEV was taken to reflect the expected BOM price development, which is likely to represent the powertrain type with the highest BOM prices by 2030 onwards compared to pure ICE vehicle and EVs.

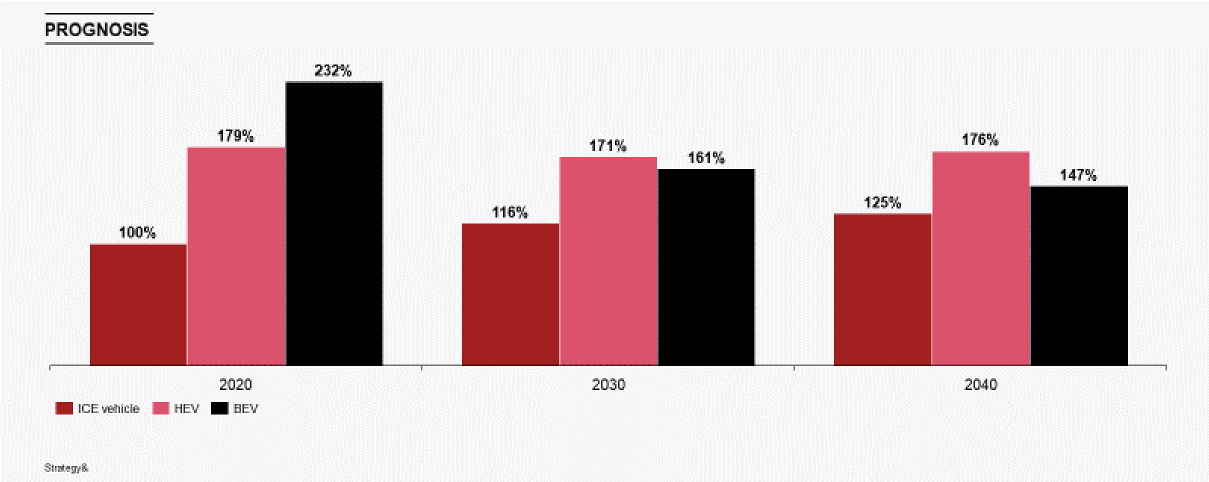


Figure 15: Overview BOM prices ICE vehicle comparison ICE vehicle, HEV and BEV

Note: The relative material cost (e.g., the cost of copper) and wage costs (i.e., the cost per hours) are kept constant until 2040 for simplification purposes.

5.2 Employment impact model

Underlying input data was collected via three different channels: 5.2.1 CLEPA and other associations country data; 5.2.2 CLEPA PwC Strategy& online surveys; and 5.2.3 workshops and interviews with C-level European automotive suppliers as well as automotive associations across the countries covered. The organisation, stakeholder management, and contacting of participants as well as participation in workshops and interviews were the responsibility of CLEPA.

5.2.1 CLEPA and other associations country data

The number of full-time employees (FTEs) per country on ICE vehicle and EV level for 2020 and turnover per country on ICE vehicle and EV level are the starting point in the ICE vehicle and EV calculations for 2020-2040 (please refer to section 4d). In short, approximately 440,000 employees are currently employed in the automotive supplier powertrain business in countries within the scope of the study. The table below sets out the results on a per country basis.

Input data association surveys – Powertrain

	ICE vehicle	EV	Total Market
Countries/Regions	**Total employees**	**Total employees**	
Germany	132.6	17.9	150.6
Italy	72.9	1.1	74.0
Spain	70.0	2.0	72.0
Romania	54.0	2.2	56.2
Poland	51.7	3.5	55.1
Czech Republic	37.0	3.7	40.7
France	24.0	3.8	27.8
Total	**~442.3 k**	**~34.1 k**	**~473.4 k**

Figure 16: Input data received from CLEPA & other associations enhanced with EUROSTAT

5.2.2 PwC Strategy&'s company survey

In addition to the data provided from CLEPA and other associations, European automotive suppliers provided their input via the PwC Strategy& Company Survey. Questions about the following key data were included:

- Current, minimum, and maximum shift schemes
- Turnover
- Material costs

Manufacturing costs

- Asset value
- Direct and indirect FTE
- Estimated degree of automation

There were 199 operating plants that part in the survey, and 99 of the responses provided all necessary information. Thirty percent of the respondents are currently producing EV powertrain technologies and 70% are working on ICE vehicle powertrain technologies.

5.2.3 Workshops and interviews with C-level European automotive suppliers as well as automotive associations

In addition to the data previously mentioned, there were also interviews and workshops for all technology areas and several countries to gain more insight into individual plants, companies, and business models. These interviews and workshops included general discussions on current and future business models as well as how companies may adapt to ever-changing markets and to electric car production.

As a part of the interviews and workshops, company representatives got introduced to the three market scenarios (please refer to Section 4b). Based on these market scenarios, the effect of changes in value-add on employee numbers was elaborated.

The outcome of the summary of all interviews and workshops is the basis for the elasticity input explained in section 4d. The FTE-elasticity for ICE vehicles increases with an accelerating EV transition while the FTE-elasticity for EVs rather decelerates, indicating expected increasing over-proportional freeing up of FTEs at decreasing ICE vehicle production as well as growing efficiencies in future EV production at higher volumes.

Today (in million Euro, in number FTE)	Elasticity FTE/Value-add	
	ICE vehicle	EV
Mixed-technology scenario (Delta) %	69%	68%
EV-only scenario (Delta) %	84%	65%
Radical scenario (Delta) %	93%	58%

Figure 17: Elasticities ICE vehicle and EV technologies

In total, 33 interviews and workshops were conducted, and ICE vehicle and EV were discussed separately depending on the technology area the company was in at that time. An overview of the technology areas in which interviews and workshops were conducted can be found below:

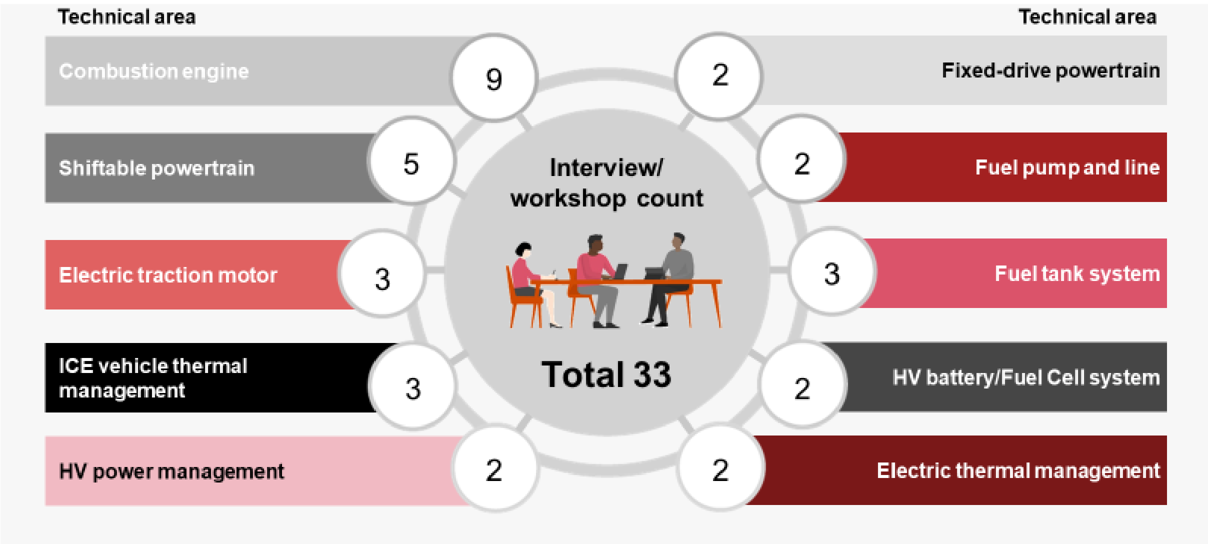


Figure 18: Number of conducted interviews and workshops by technical area

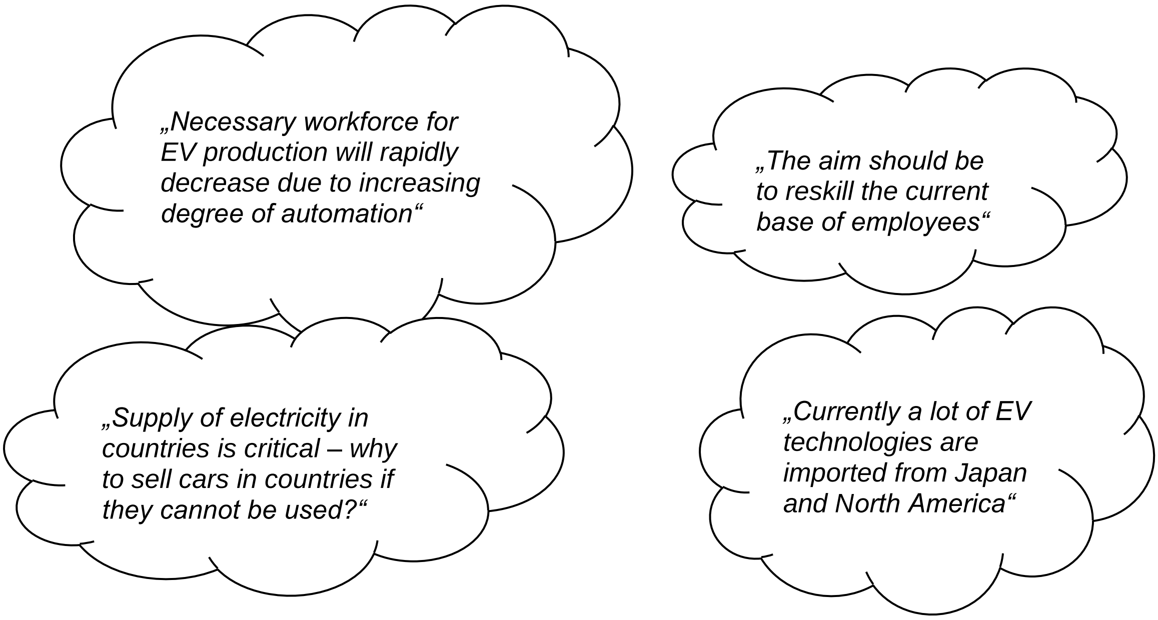


Figure 19: Selected quotes of conducted interviews & workshops

6 Results

The following chapter illustrates the study's results on the sensitivity scenarios for the mixed technology, EV-only, and radical scenarios for a) value-add forecast and b) employment forecast, both for Europe as well as the seven specified focus countries during the timeframe between 2020 and 2040. All scenarios have a value-add increase in 2025 in common – driven by costly Euro 7 technology - and a wind down until 2030 and beyond. Employment in Europe follows accordingly.

6.1 Focus countries and Europe view

6.1.1 Forecast value-add changes 2020-2040

EV-only scenario

The following graphs show the forecasted value-add for ICE vehicle and EV technologies for EU27 + EFTA + UK:

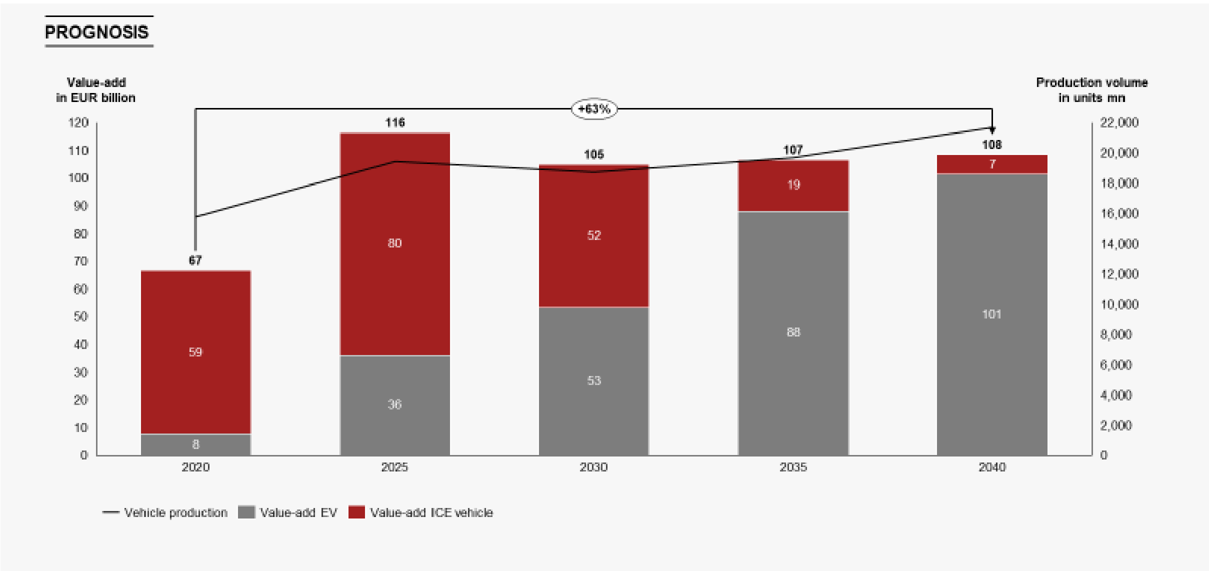


Figure 20: Value-add development EU+EFTA+UK 2020-2040

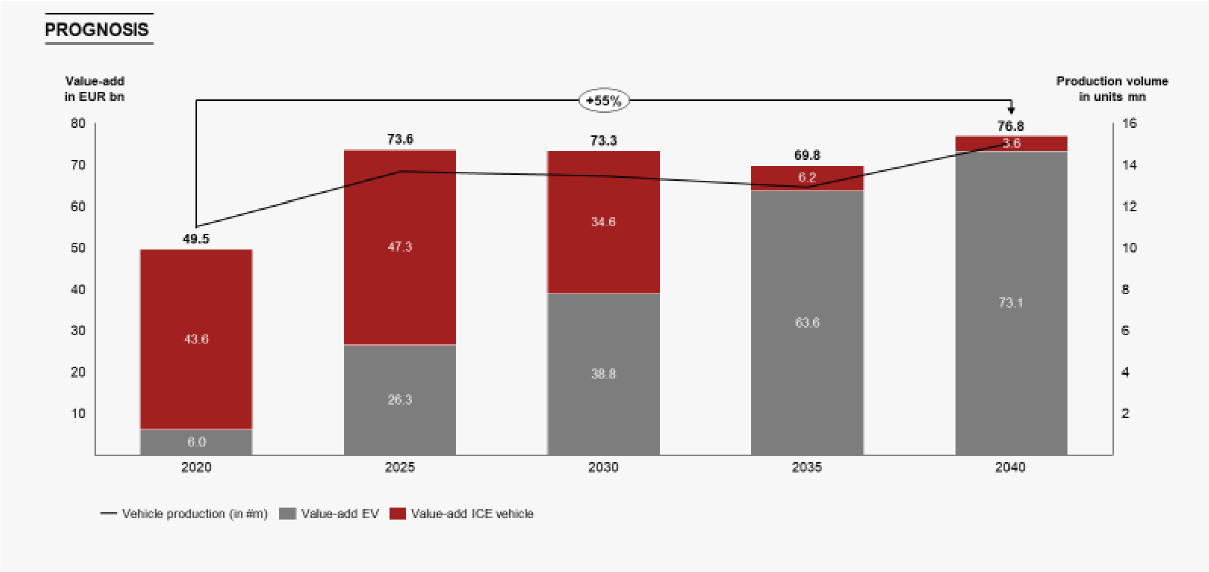


Figure 21: Value-add development EU 7 2020-2040

ICE vehicle technologies: The EV-only market scenario forecasts a slight increase in ICE vehicles and an increased sales of hybrid vehicles. Moreover, due to the technical content in exhaust treatment for the ICE vehicle technologies, value-add per vehicle will increase as well. This results in a value-add peak in 2025. However, as electrification heavily progresses, a strong increase of electric vehicles and, thus, a continuous downward trend in ICE vehicles is forecasted until 2040, showing a sharp decrease after 2030. In total, the value-add is expected to shrink by approximately 92% until 2040.

EV technologies: As described by the EV-only market scenario, the EV technologies show a strong increase in volume from 2020 onwards (e.g., +13.6Mn) pieces until 2040 for the EURO 7 focus countries). This results in an increased value-add prognosis from 2020-2040 of 1,100%. In addition to the volume increase it is expected that the value-add share is increasing over-proportionally to the volume until 2040 due to higher product costs in EV powertrain components. Increased value-add is driven by high-voltage lithium-ion battery systems. The forecast assumes a battery value chain industrialized locally in European countries. Moreover, the EURO 7 market regulation will impact the value-add creation and, thus, the employment development, as it accelerates the shift toward EV technologies.

Summing up, the increasing value-add per vehicle results in over-proportional growth compared with production volumes. On a European level thee overall forecasted change in value-add can be further broken down to the single technology areas, as follows:

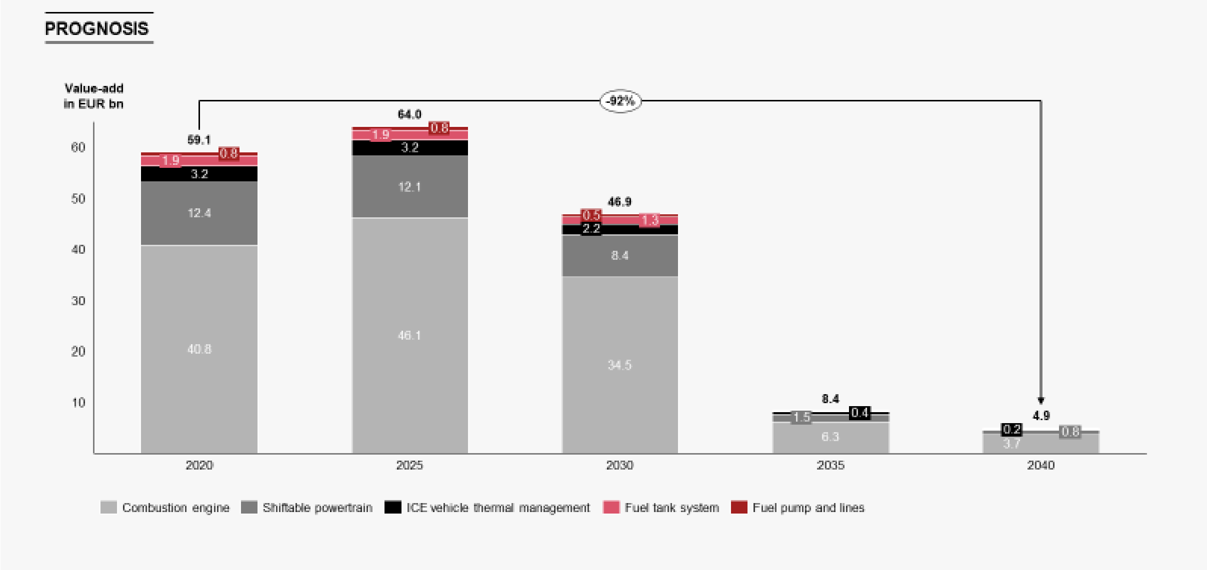


Figure 22: Value-add Europe ICE vehicle technologies from 2020-2040

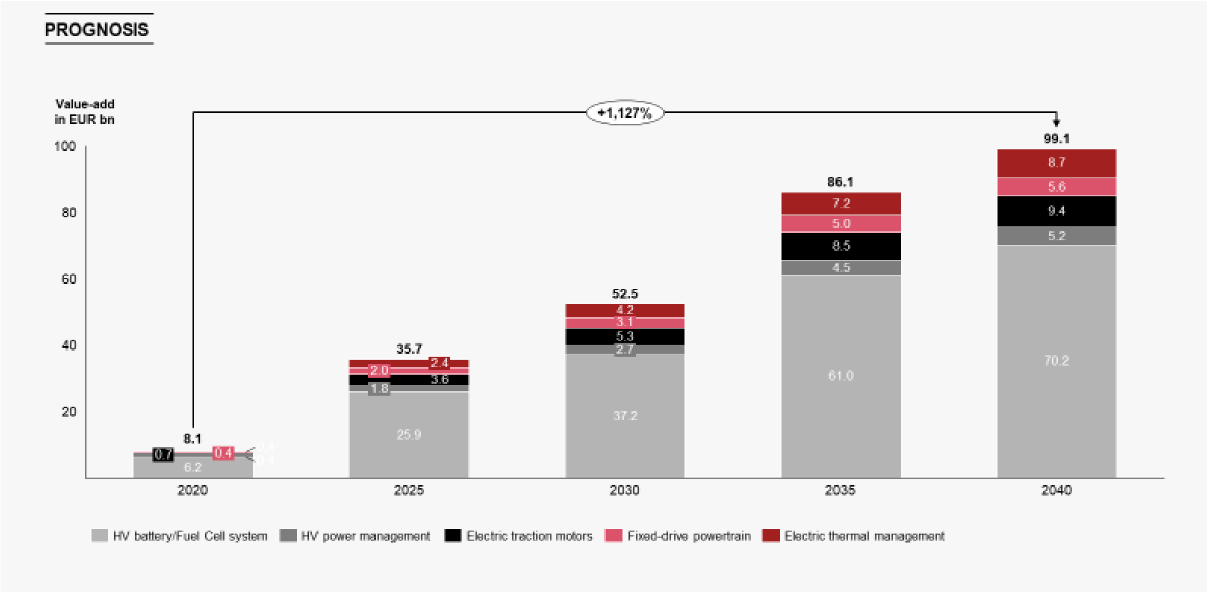


Figure 23: Value-add Europe EV technologies from 2020-2040

For ICE vehicle technologies, the percentage decline from 2020-2040 is similar for all technology areas. On top, the share of value-add contribution for the single technology areas in 2020 remains constant. The same principle accounts for the structure in employment for 2020 and 2040.

In comparison, for EV technologies, the structure of value-add changes until 2040 with HV batteries/fuel cells making approximately 70% of all created value-add in 2040 — respectively for the employment development.

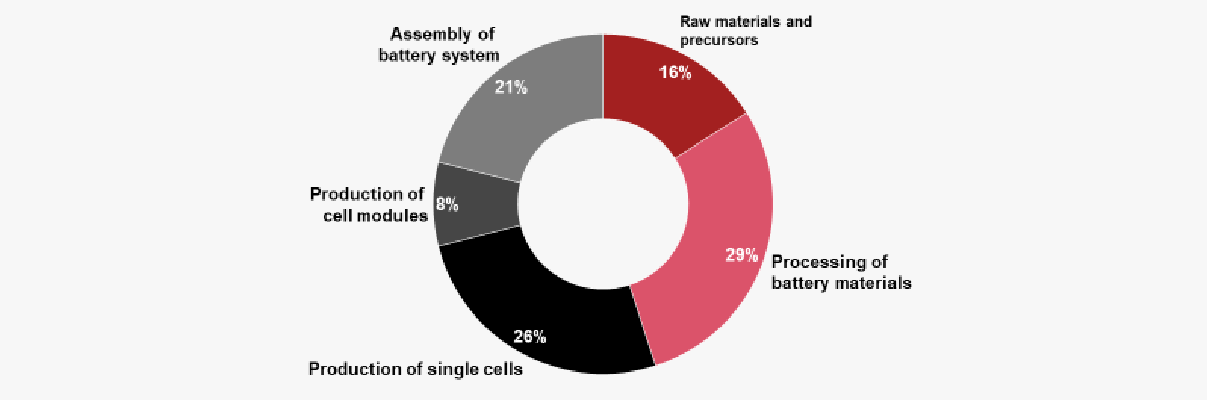


*Figure 24: SEQ Figure * ARABIC 25: Automotive battery value chain and value share*

The automotive battery value chain can be broken down into five steps: (1) raw materials and precursors, (2) processing of battery materials, (3) production of single cells, (4) production of cell modules, and (5) assembly of battery system. Its corresponding value shares can be split down by percentages according to Figure 25.

Sensitivity mixed technology and radical scenario vs. EV-only scenario

The following section compares the low and radical sensitivity scenarios with the EV-only scenario. Key drivers are the underlying volume mix and its development over time based on the specific assumptions of each of the market scenarios (*see section 4.1*).

The graphs below show the forecasted value-add for both ICE vehicle and EV technologies for Europe for the mixed-technology scenario.

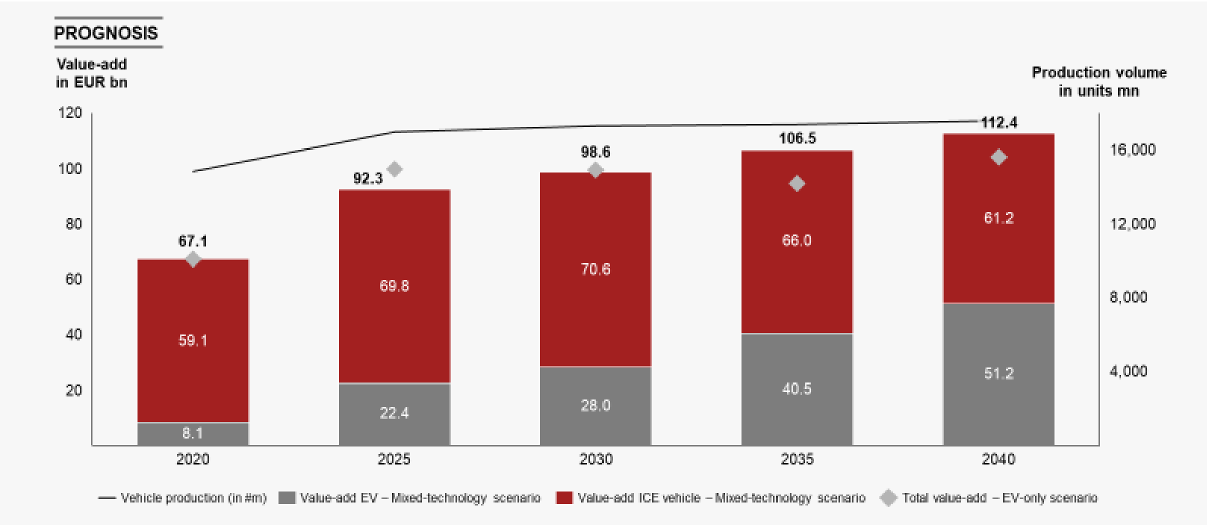


Figure 25: Mixed-technology scenario value-add change from 2020-2040 vs. EV-only

In comparison to the EV-only scenario, the mixed-technology scenario market scenario assumes a technology openness and, thus, a longer demand of ICE vehicle technologies, resulting in a higher share in 2040. This scenario also has the greatest share of PHEVs, which have a higher value-add due to the two powertrains. This correlation is directly reflected in the respective value-add development. The overall ICE vehicle value-add will result in about €60 billion with a peak of €70,6 billion in 2030.

The radical scenario indicates the other side of the spectrum, which assumes even stronger market regulations toward ICE vehicles and therefore an even faster EV transition. Here, the share of ICE vehicle technology value-add in 2040 is non-existing, meaning that the complete value-add is generated by EV technologies.

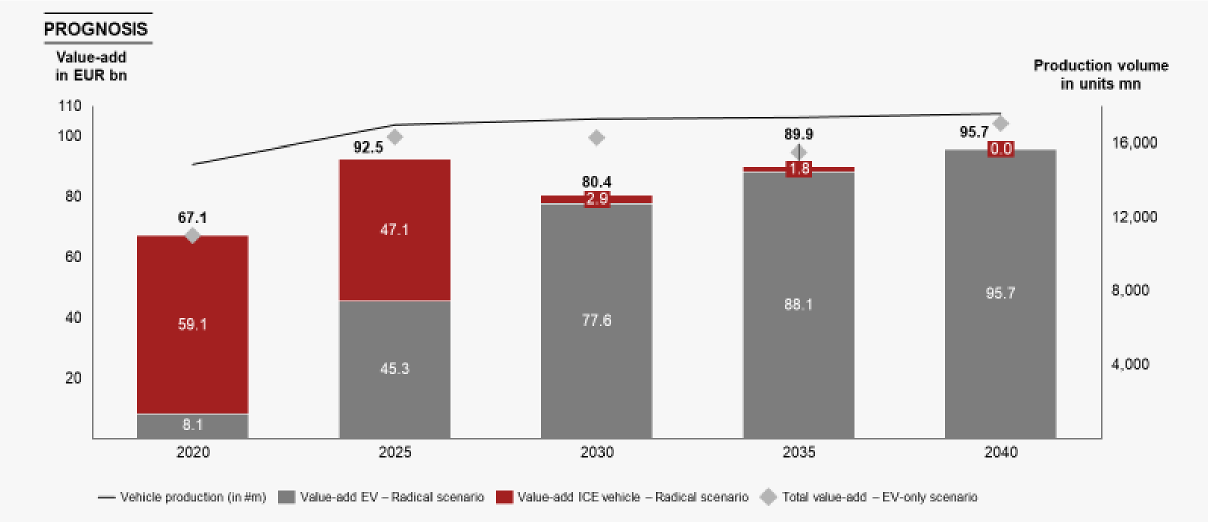


Figure 26: Radical scenario value-add change from 2020-2040 vs. EV-only

6.1.2 Forecast employment impact changes 2020-2040

EV-only scenario
Overall, the forecasted increasing value-add until 2040 does not result in an increase in headcount. In fact, the forecast shows a net loss of powertrain employment of ~43% until 2040. Other business segments such as software or infrastructure might offset the decrease in employment in the future. These segments are not part of this study.

ICE vehicle technologies: An upward trend is noticeable in the number of employees until 2025. After this, there is a strong decline until 2040 with approximately 84% less employees compared to 2020. The reason for that development is due to the slightly increasing forecast of ICE vehicle sales until 2025 and, in parallel, the increasing demand for hybrid vehicles and technical content until 2030.

EV technologies: Employment in EV technologies is expected to increase significantly (+490%) until 2040. However, the increase in employment is under-proportional to production volumes due to higher degrees of automation. Similar to the value-add, the employment prognosis is also highly influenced by the assumption that battery production is scaled up in European focus countries.

The graphics below show comparisons of the change in employment for ICE vehicle and EV technologies for the in-focus countries (EU7) as well as Europe from 2020-2040.

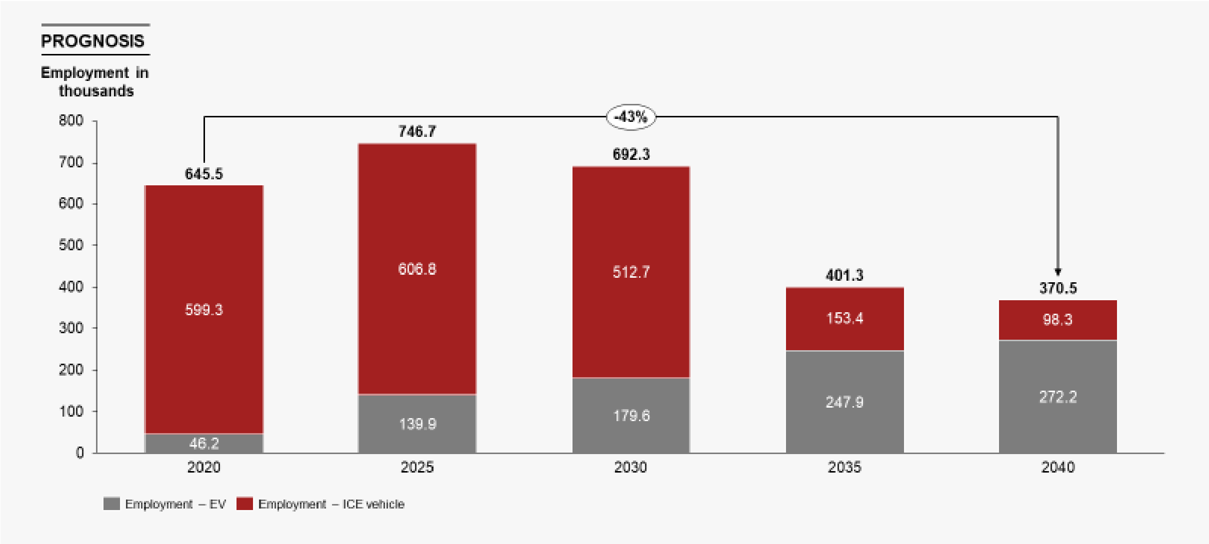


Figure 27: Employment change EU+EFTA+UK from 2020-2040

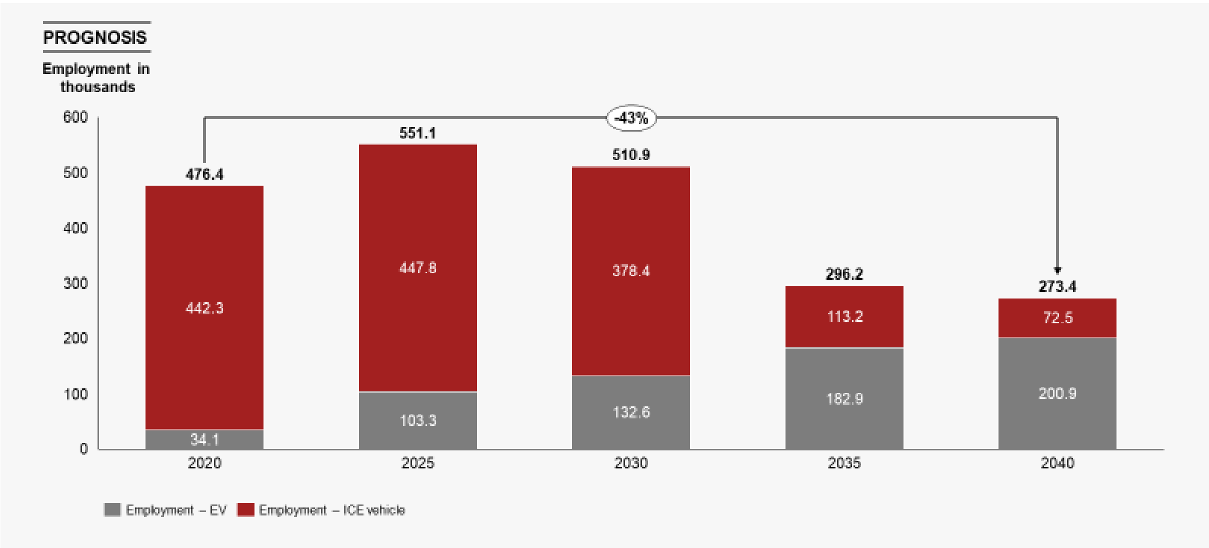


Figure 28: Employment change focus countries from 2020-2040

On a European level, the overall forecasted change in employment can be further broken down to the single technology areas resulting as follows:

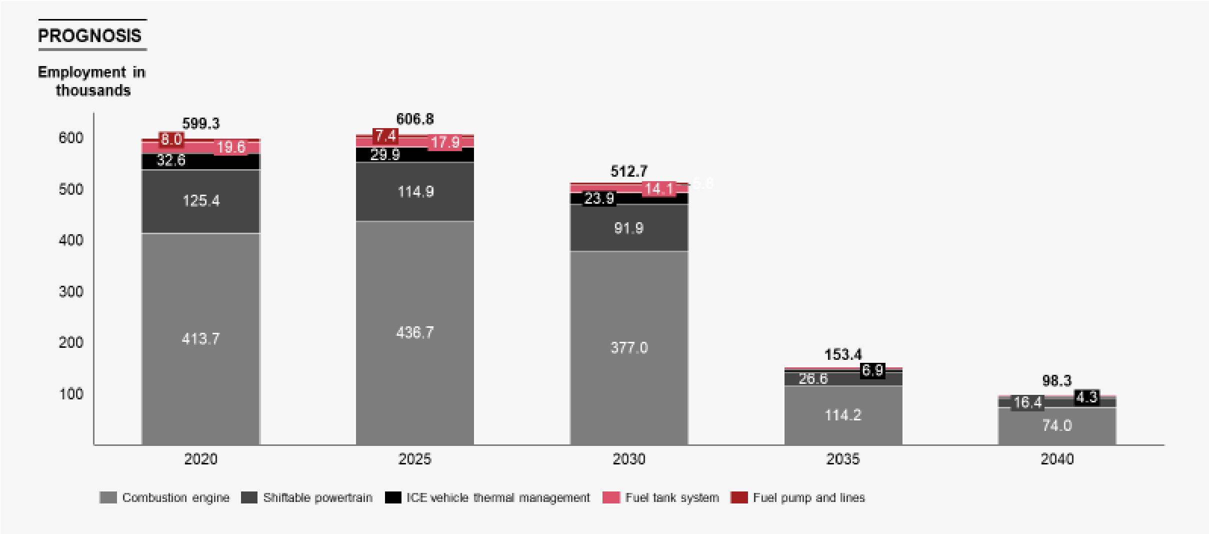


Figure 29: Employment change EU+EFTA+UK from 2020-2040 by ICE vehicle technology area

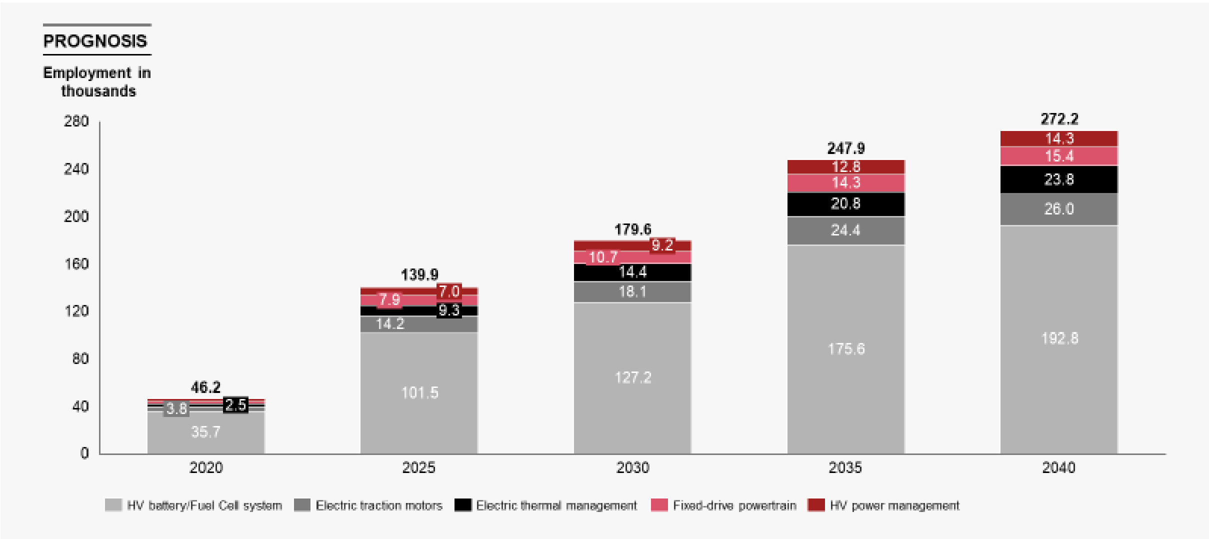


Figure 30: Employment change EU+EFTA+UK from 2020-2040 by EV technology area

The overall development as well as key implications for the change in employment are identical to developments in value-add, please see above for further illustration.

Sensitivity mixed technology and radical scenario vs. EV-only scenario

Subsequently, the impact of both the mixed technology and the radical scenarios on European employment will be compared with the EV-only scenario. Looking at the overall employment across Europe within the mixed-technology scenario, an increase in the required workforce of about 120,000 FTE between 2020 and 2040 can be observed, translating into an additional 20%. And compared with the EV-only scenario, the mixed-technology scenario expects about twice as much employment mainly due to an increase in electrified ICE vehicles (hybrids).

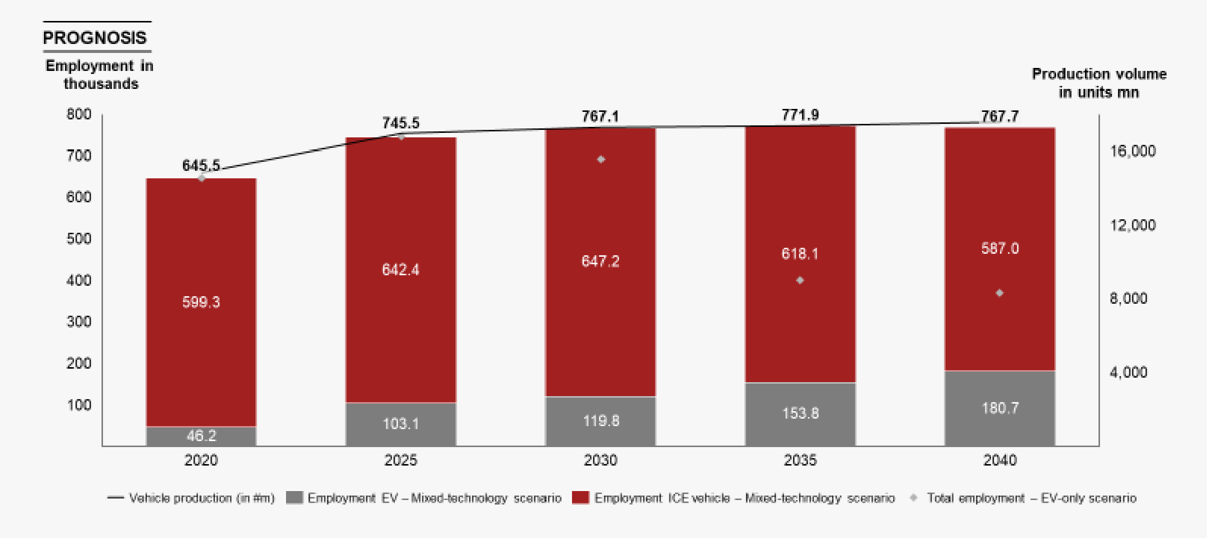


Figure 31: Mixed-technology scenario employment change from 2020-2040 vs. base scenario

Looking at the overall employment across Europe within the push scenario, a decrease of required workforce between 2020 and 2040 of about 400,000 can be observed, translating into a decrease of more than 60%. Compared with the EV-only scenario, the radical scenario expects about one-third less employment mainly due to a phase out of both ICE vehicles and hybrids. Due to an earlier strong shift toward EVs, the employment delta between EV-only and push scenario is largest in the period around 2030.

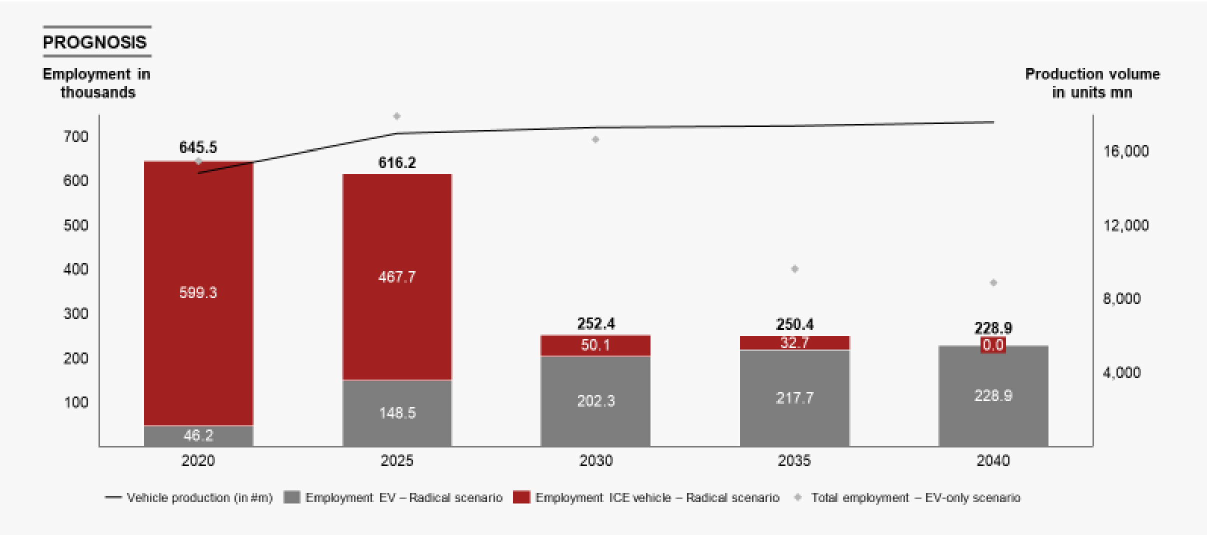


Figure 32: Radical scenario value-add change from 2020-2040 vs. EV-only

6.2 7 focus countries deep dive

In the following charts, a comparative overview of all countries is provided, followed by the value-add and the employment changes from 2020 to 2040 for each country specifically.

6.2.1 ICE vehicle technologies

PROGNOSIS

Value-add – ICE vehicle (in €bn)	2020	2025	2030	2035	2040
Germany	18.6	20.1	15.0	1.5	1,.5
Italy	8.5	9.2	0.8	0.8	0.8
France	3.1	3.3	0.3	0.3	0.3
Czechia	2.0	2.2	1.1	1.2	0.1
Spain	7.0	7.6	11.1	0.7	0.7
Poland	2.6	2.8	3.6	1.7	0.1
Romania	1.8	2.0	2.7	0.2	0.2
EU7	**43.6**	**47.3**	**34.6**	**6.2**	**3.6**
EU27	**59.1**	**64.0**	**46.9**	**8.4**	**4.9**

Figure 33: Value-add by country for ICE vehicle technologies from 2020 to 2040

PROGNOSIS

FTE – ICE vehicle (in #k)	2020	2025	2030	2035	2040
Germany	132.7	134.3	105.3	10.5	10.5
Italy	72.9	73.8	6.6	6.6	6.6
France	24.0	24.3	2.1	2.1	2.1
Czechia	37.0	37.5	25.4	33.3	16.9
Spain	70.0	70.9	99.0	6.5	6.5
Poland	51.7	52.3	68.8	49.7	25.3
Romania	54.0	54.7	71.2	4.6	4.6
EU7	**442.3**	**447.8**	**378.4**	**113.2**	**72.5**
EU27	**599.3**	**606.8**	**512.7**	**153.4**	**98.3**

Figure 34: Employment by country for ICE vehicle technologies from 2020 to 2040:

The forecast shows a concentration of ICE vehicles powertrain production in selected Eastern European countries with a focus on the Czech Republic and Poland in order to guarantee scaled production effects. Nevertheless, a significant amount (approximately 50%) of the remaining total ICE vehicle value-add is expected to be transferred to other global regions outside Europe (after 2030). But this survey did not analyse the potential regions that could benefit from that trend.

6.2.2 EV technologies

PROGNOSIS

Value-add-EV (in €bn)	2020	2025	2030	2035	2040
Germany	4.0	10.5	12.9	18.6	22.7
Italy	0.2	1.2	1.9	3.3	3.9
France	0.8	4.0	6.0	13.4	15.3
Czechia	0.3	1.6	2.4	4.2	4.8
Spain	0.3	6.5	11.8	18.1	19.6
Poland	0.3	1.2	1.8	2.9	3.4
Romania	0.1	1.4	2.0	3.0	3.4
EU7	**6.0**	**26.3**	**38.8**	**63.6**	**73.1**
EU27	**8.1**	**35.7**	**52.5**	**86.1**	**99.1**

Figure 35: Value-add by country for EV technologies from 2020 to 2040

PROGNOSIS

FTE – EV vehicle (in #k)	2020	2025	2030	2035	2040
Germany	17.9	34.6	39.6	50.4	57.3
Italy	1.1	3.7	5.0	7.4	8.2
France	3.8	12.0	15.7	27.0	29.4
Czechia	3.7	11.6	15.2	21.7	23.9
Spain	2.0	18.9	28.1	37.4	39.4
Poland	3.5	9.4	12.3	17.0	18.7
Romania	2.2	13.2	16.8	22.1	24.0
EU7	**34.1**	**103.3**	**132.6**	**182.9**	**200.9**
EU27	**46.2**	**139.9**	**179.6**	**247.9**	**272.2**

Figure 36: Employment by country for EV technologies from 2020 to 2040

Germany, Spain, and France are forecasted to ramp-up EV production faster than other focus countries. Overall, the significant increase in EV powertrain volume considers that European countries will build up battery production.

6.2.3 Country snippets

Germany

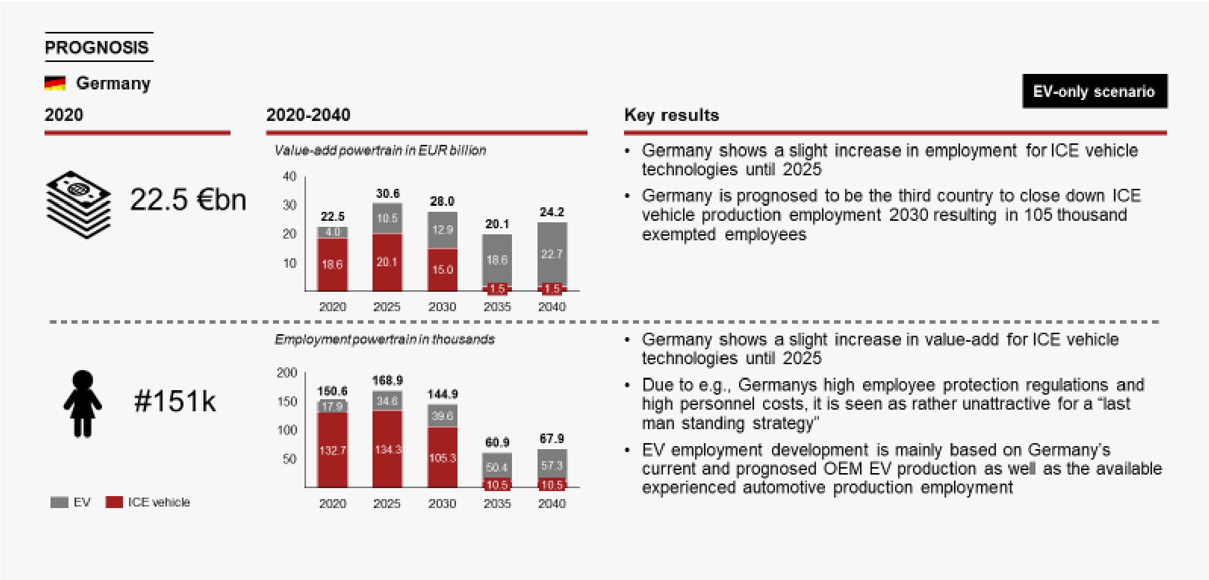


Figure 37: Key results in Germany

Italy

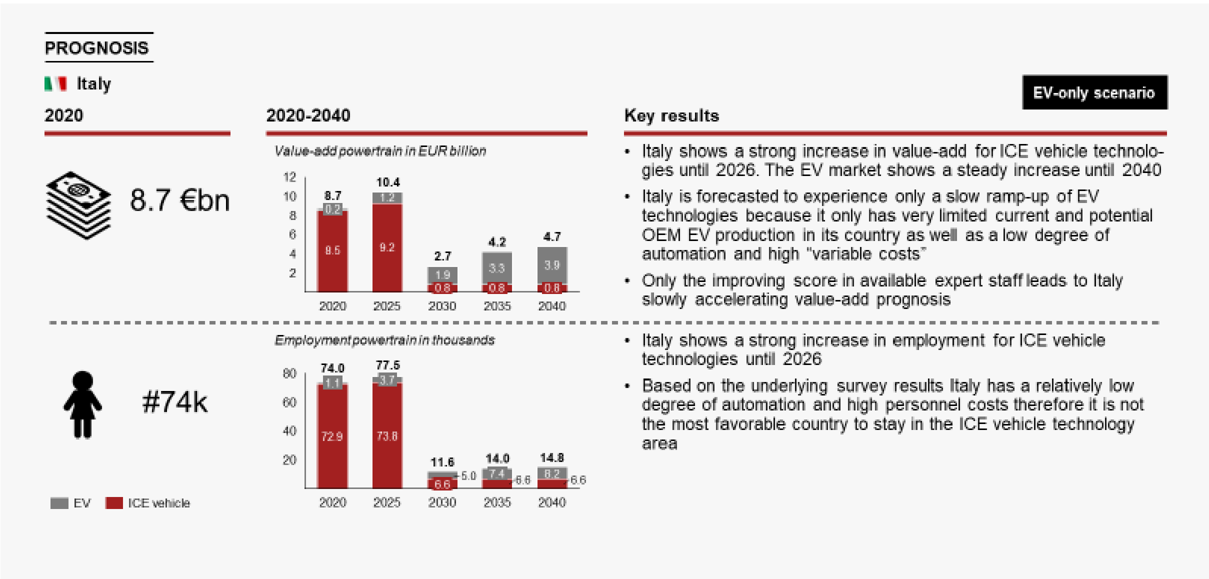


Figure 38: Key results in Italy

France

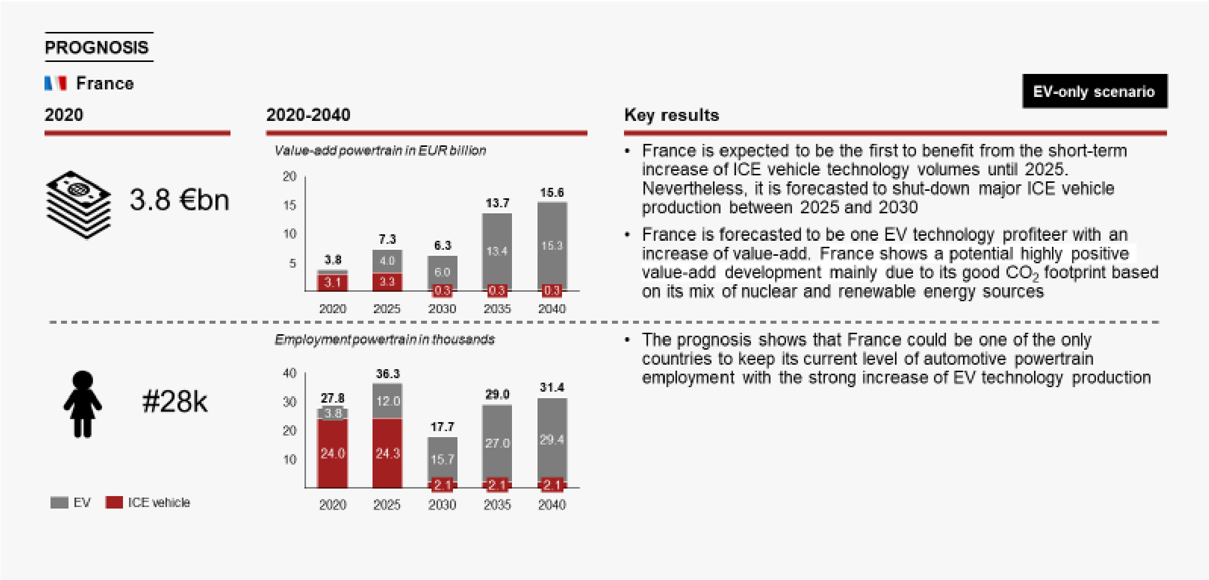


Figure 39: Key results in France

Czech Republic

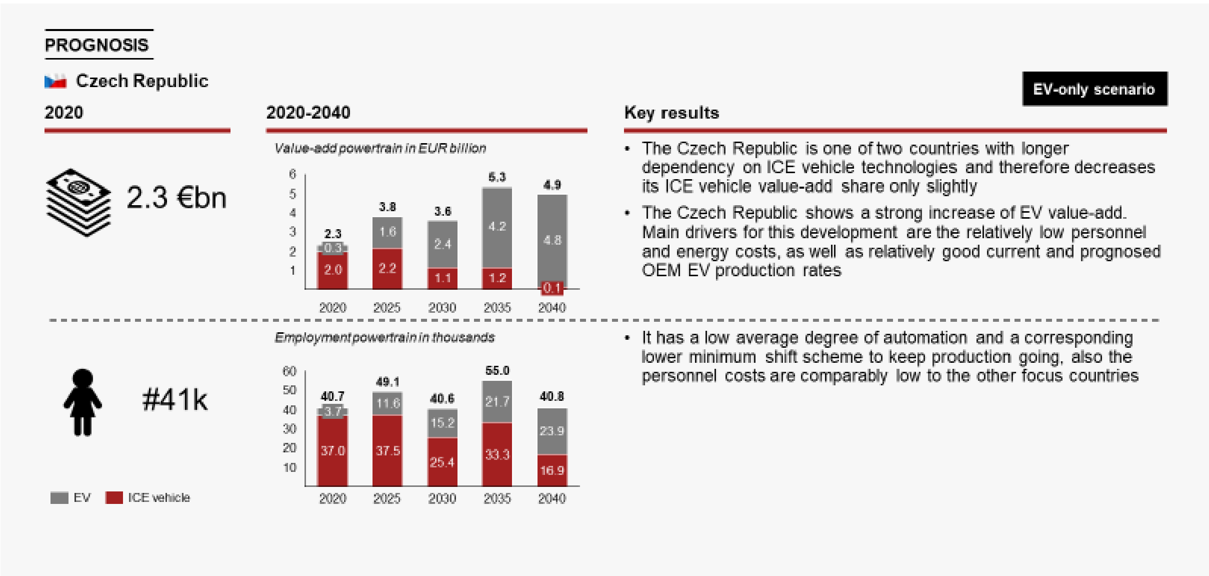


Figure 40: Key results in the Czech Republic

Spain

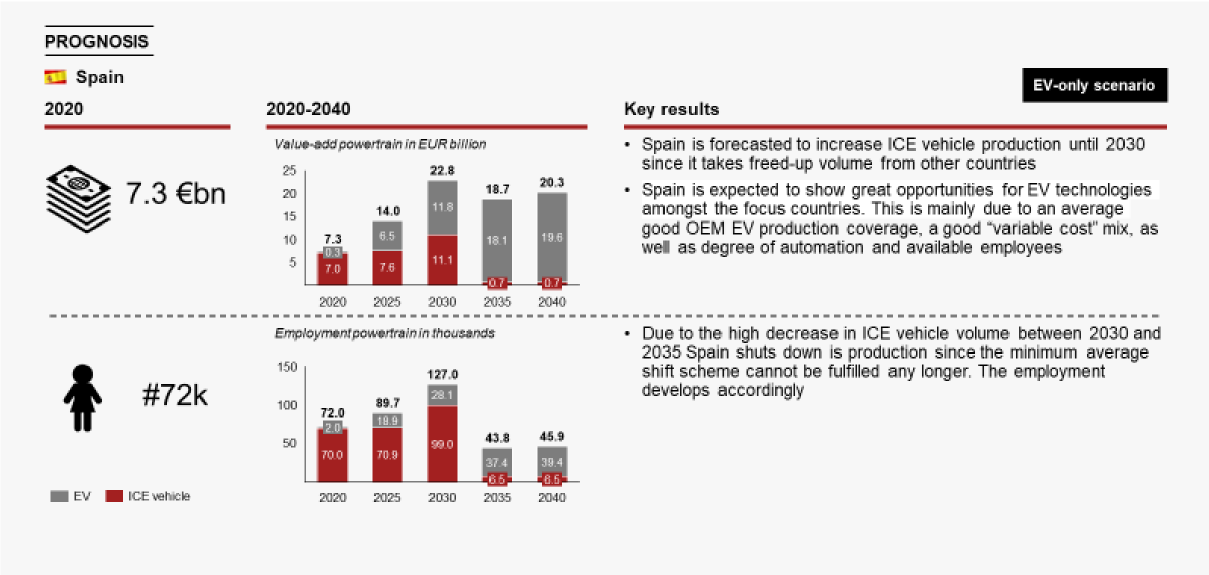


Figure 41: Key results in Spain

Poland

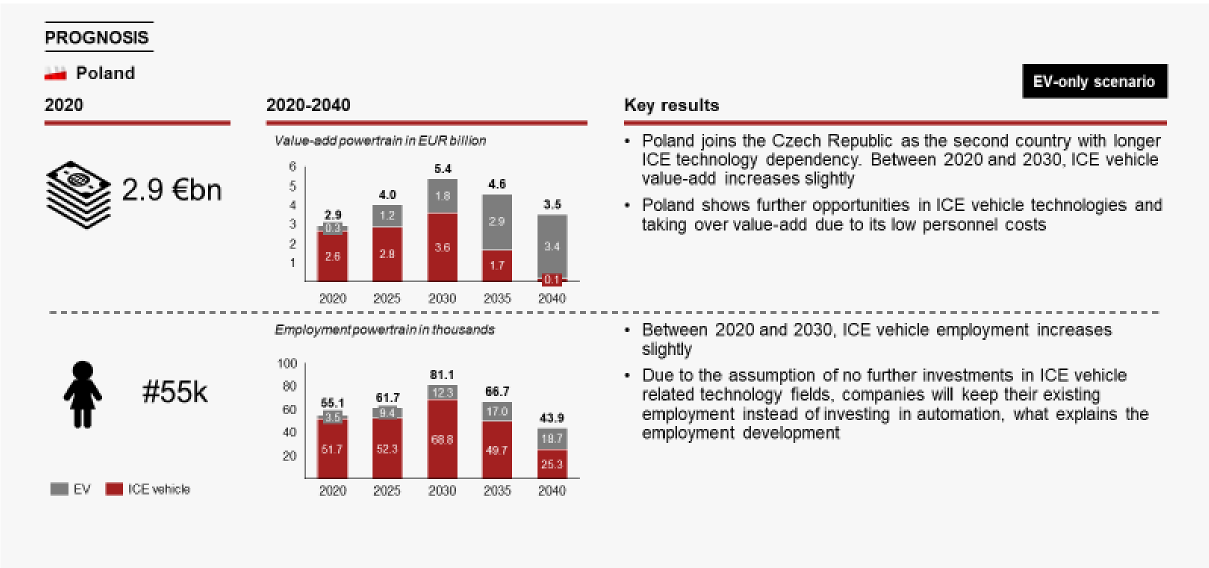


Figure 42: Key results in Poland

Romania

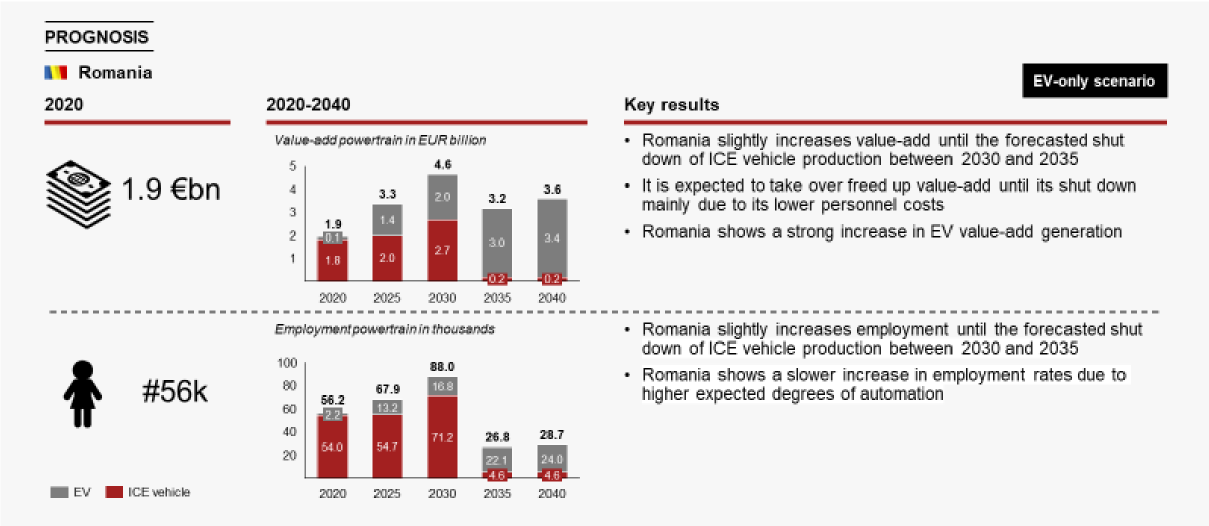


Figure 43: Key results in Romania

6.2.4 Sensitivity mixed technology and radical scenario vs. EV-only scenario

Compared to the EV-only scenario, the key driver shaping the mixed technology and radical scenario sensitivity scenarios are the different underlying market volumes defined within the market scenarios (*see section 4a*).

Germany

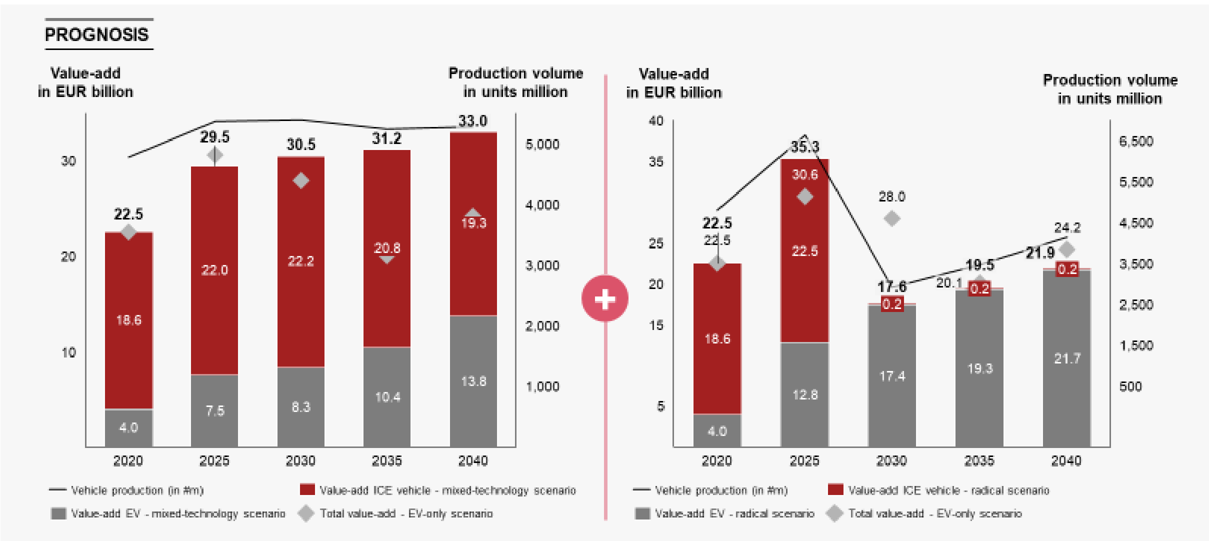


Figure 44: Mixed-technology scenario vs. radical scenario Germany

In comparison with the EV-only scenario for Germany, the value-add of the mixed-technology scenario indicates a relevant increase from 2030 onward, keeping the value-add at an almost constant level of about €30 billion. This stabilizing effect can be explained by Germany keeping the production of ICE vehicle components up until

2040 in the mixed-technology scenario versus shifting ICE vehicle production out in 2035 in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), Germany would potentially see a similar value-add from 2035 onward, compared with the mixed-technology scenario, however the delta of employment is massive in the “hot transition phase” between 2025 and 2030.

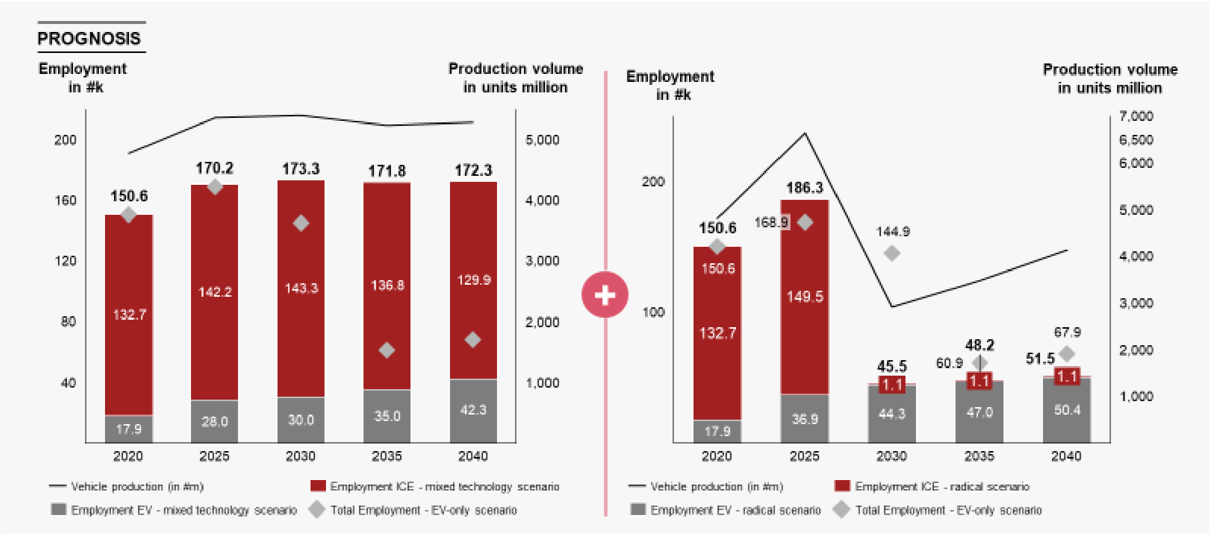


Figure 45: Employment mixed-technology scenario vs. radical scenario Germany

In comparison with the EV-only scenario for Germany, the employment of the mixed-technology scenario indicates a small decrease from 2030 onward, keeping the employment at an almost constant level of about 170k.

Italy

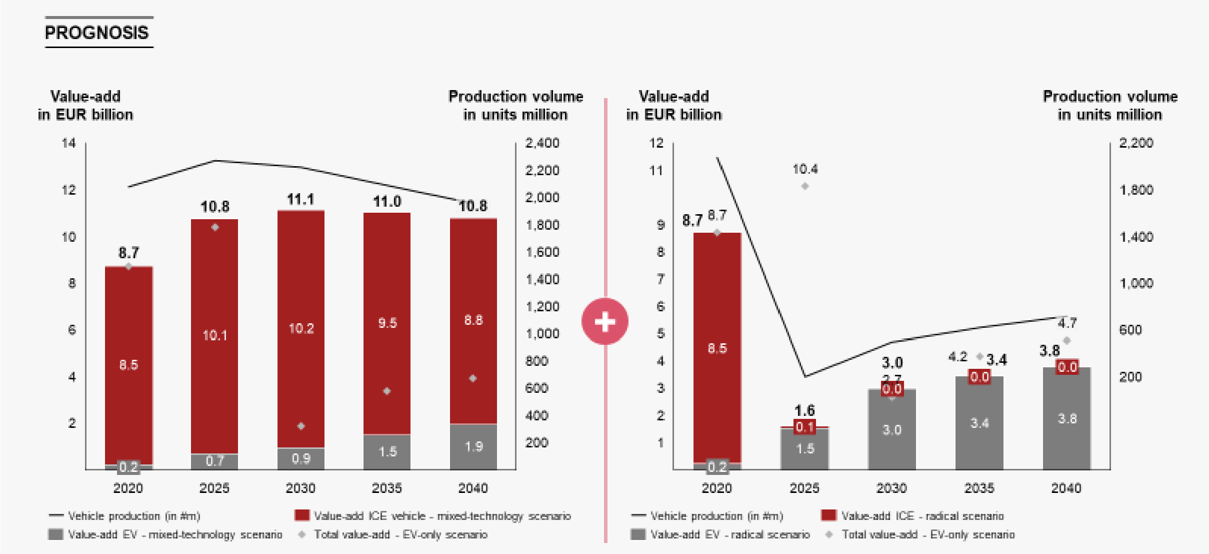


Figure 46: Mixed-technology scenario vs. radical scenario Italy

In comparison with the EV-only scenario for Italy, the value-add of the mixed-technology scenario indicates a relevant increase from 2025 onwards keeping the value-add at an almost constant level of about €11 billion. This stabilizing effect can be explained by Italy keeping the production of ICE vehicle components up until 2040 in the mixed-technology scenario versus shifting ICE vehicle production out in 2030 in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), Italy would potentially see a similar value-add from 2035 onward, compared with the mixed-technology scenario, however the delta of employment is significant in the “hot transition phase” around 2025.

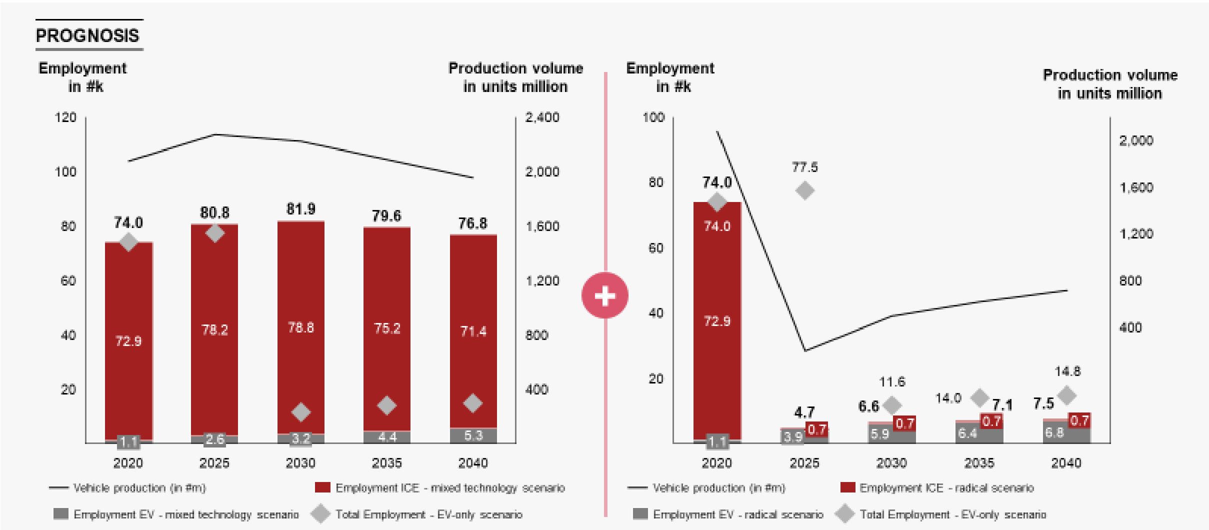


Figure 47: Employment mixed-technology scenario vs. radical scenario Italy

In comparison with the EV-only scenario for Italy, the employment of the mixed-technology scenario indicates a small decrease from 2030 onward, keeping the employment at around 77k in 2040.

France

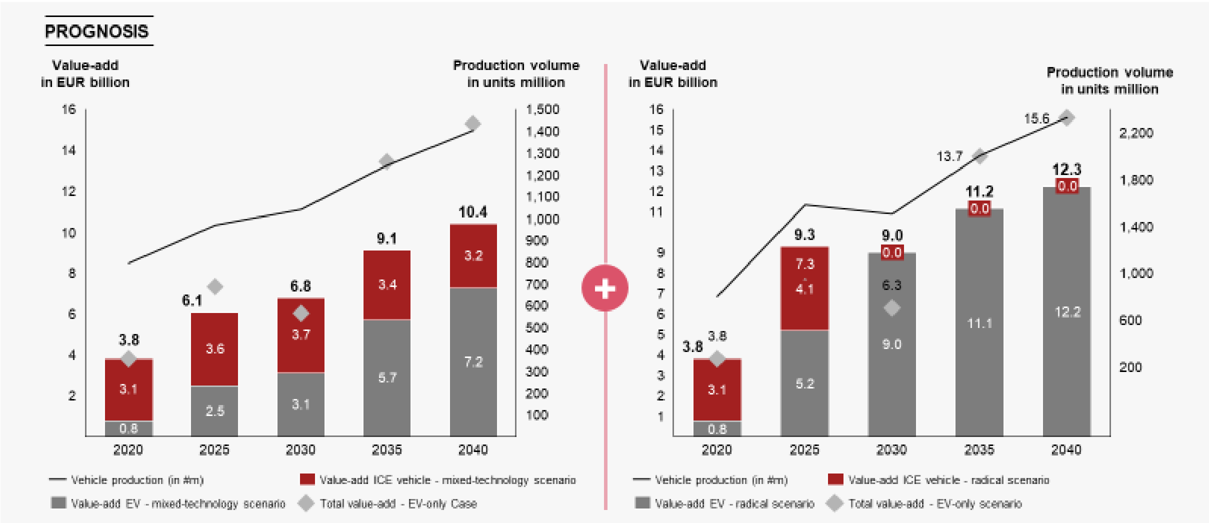


Figure 48: Mixed-technology scenario vs. radical scenario France

In comparison with the EV-only scenario for France, the value-add of the mixed-technology scenario indicates a relevant decrease from 2035 onwards keeping the value-add at a level of about 10bn. Euro. This effect can be explained by France keeping the production of ICE vehicle components up until 2040 in the mixed-technology scenario and not as intensively ramping up EVs as in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), France would potentially see a similar value-add from 2035 onward, compared with the mixed-technology scenario, however the delta of employment is relevant in the "hot transition phase" around 2030.

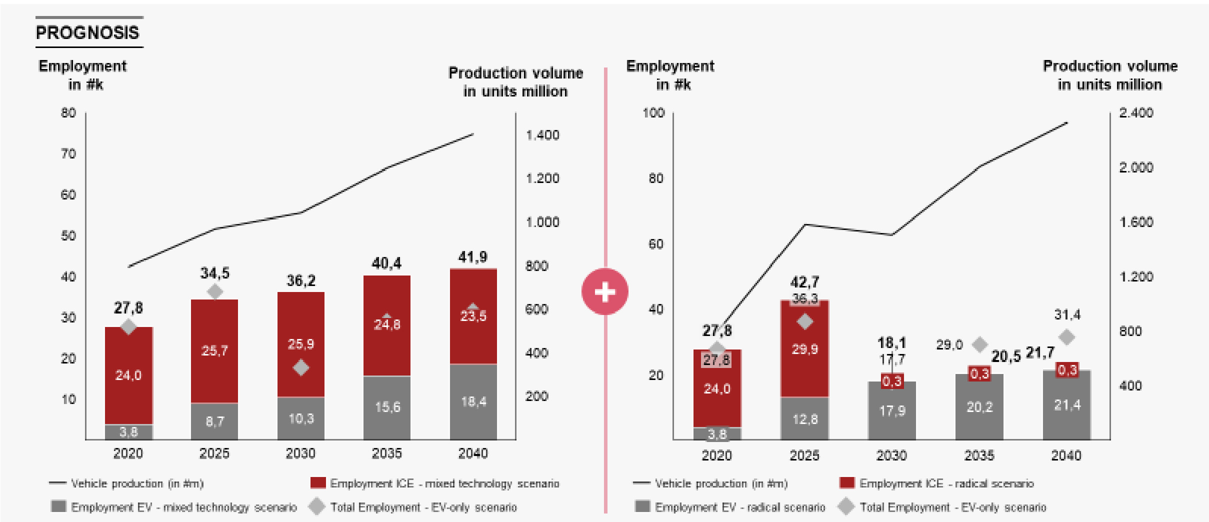


Figure 49: Employment mixed-technology scenario vs. radical scenario France

In comparison with the EV-only scenario for France, the employment of the mixed-technology scenario indicates a constant increase from 2020 onward, keeping the employment at above 40k in 2040.

Czech Republic

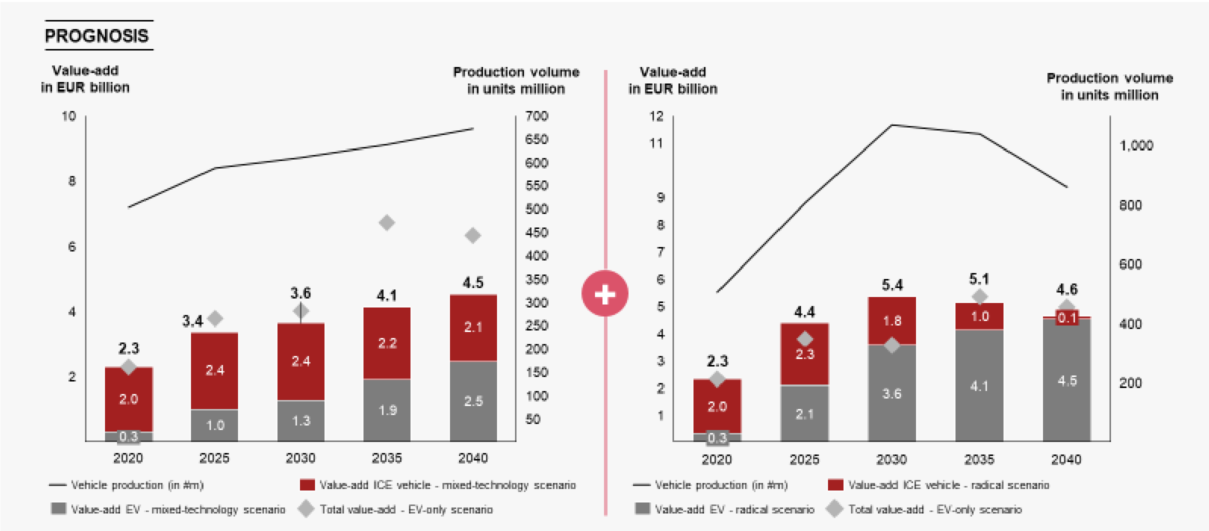


Figure 50: Mixed-technology scenario vs. radical scenario Czech Republic

In comparison with the EV-only scenario for the Czech Republic, the value-add of the mixed-technology scenario indicates a relevant decrease from 2035 onwards keeping the value-add at a level of about 4 billion euro. This effect can be explained by the Czech Republic keeping the production of ICE vehicle components up until 2040 in the mixed-technology scenario and is not as intensively ramping up EVs as in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), the Czech Republic would potentially see a lower value-add in 2040 compared with the mixed-technology scenario due to the phase out of ICE vehicle production by then.

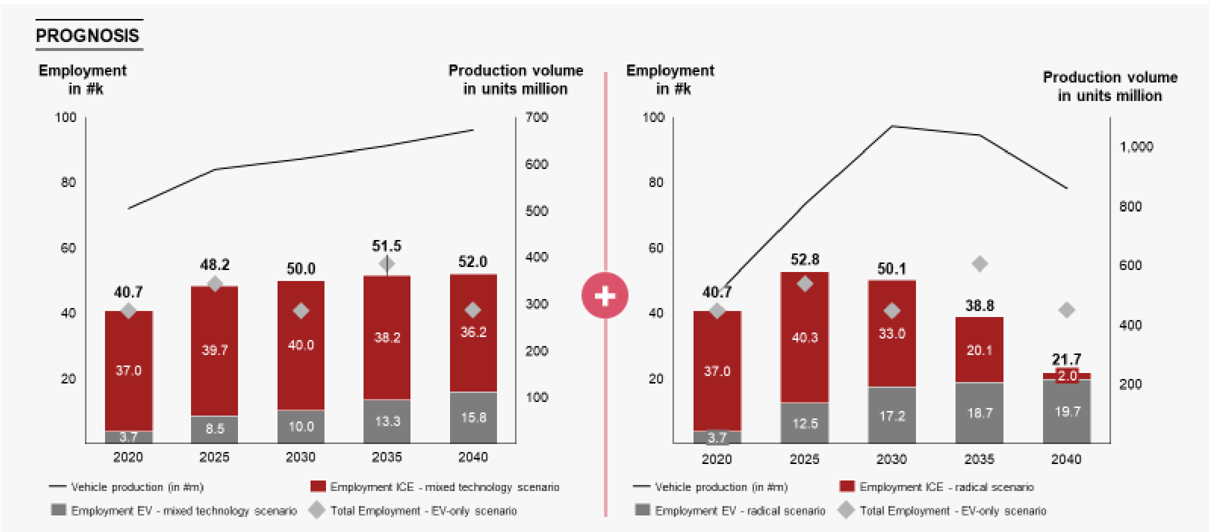


Figure 51: Employment mixed-technology scenario vs. radical scenario Czech Republic

In comparison with the EV-only scenario for Czech Republic, the employment of the mixed-technology scenario indicates a small increase from 2030 onward, keeping the employment at above 50k.

Spain

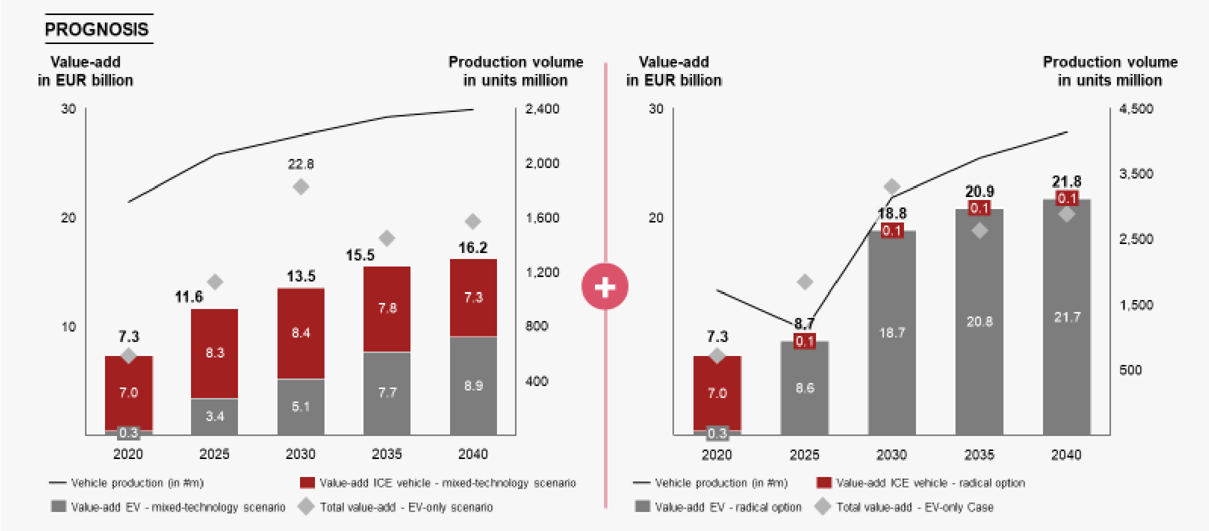


Figure 52: Mixed-technology scenario vs. radical scenario Spain

In comparison with the EV-only scenario for Spain, the value-add of the mixed-technology scenario indicates a relevant slower increase from 2035 onward with a value-add at a level of about €26 billion in 2040. This effect can be explained by Spain keeping the production of ICE vehicle components up until 2040 in the mixed-technology scenario and not as intensively ramping up EVs as in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), Spain would potentially see a similar value-add from 2035 onward, compared with the mixed-technology scenario with a significant increased value-add between 2025 and 2030 being a stronghold of the EV transition.

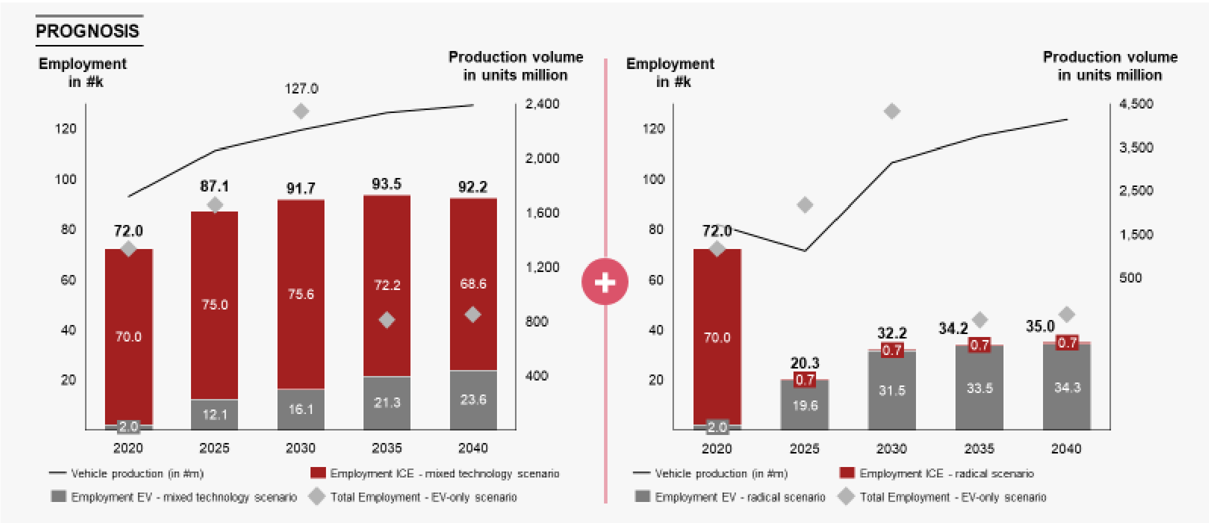


Figure 53: Employment mixed-technology scenario vs. radical scenario Spain

In comparison with the EV-only scenario for Spain, the employment of the mixed-technology scenario indicates a constant increase from 2030 onward, keeping the employment above 90k in 2040.

Poland

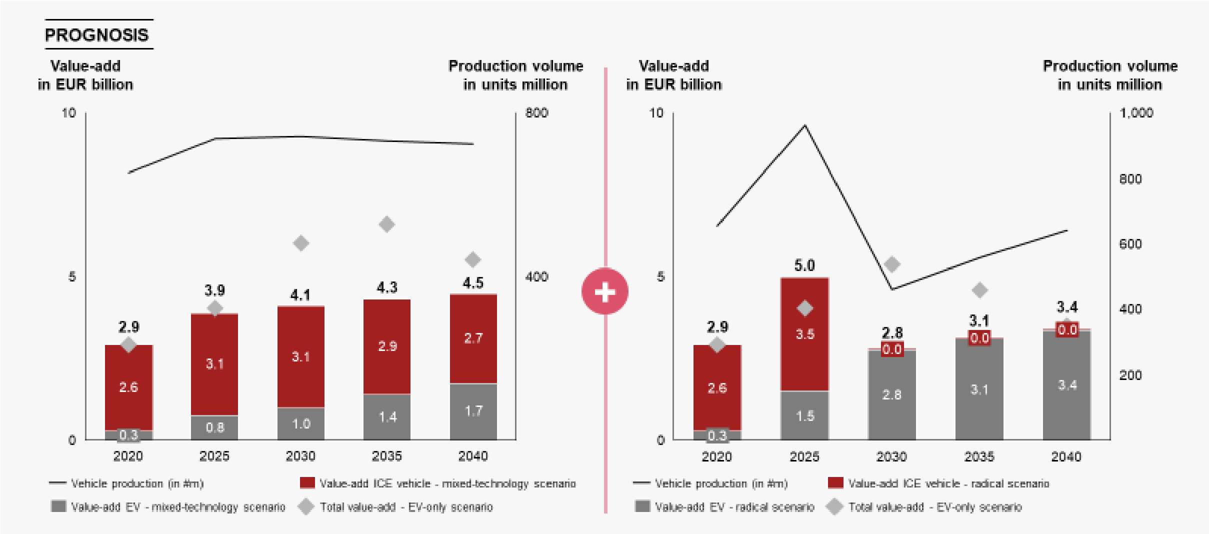


Figure 54: Mixed-technology scenario vs. radical scenario Poland

In comparison with the EV-only scenario for Poland, the value-add of the mixed-technology scenario indicates a relevant decrease from 2025 onwards keeping the value-add at a level of about €4 billion. This effect can be explained by other countries keeping the production of ICE vehicle components up and not shifting capacity as intense to Eastern Europe as in the EV-only scenario. Assuming an accelerated EV transition (radical scenario), Poland would potentially see a much lower value-add from 2030 onward, compared with the mixed-technology scenario due to the phase out of ICE vehicle production by then.

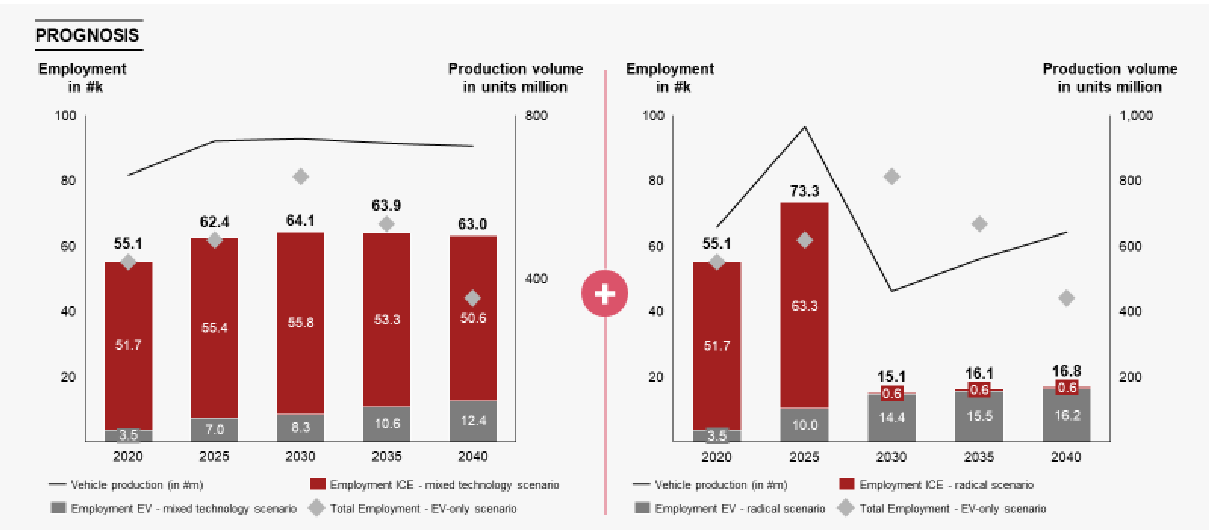


Figure 55: Employment mixed-technology scenario vs. radical scenario Poland

In comparison with the EV-only scenario for Poland, the employment of the mixed-technology scenario indicates a slight decrease from 2030 onward, keeping the employment above 60k in 2040.

Romania

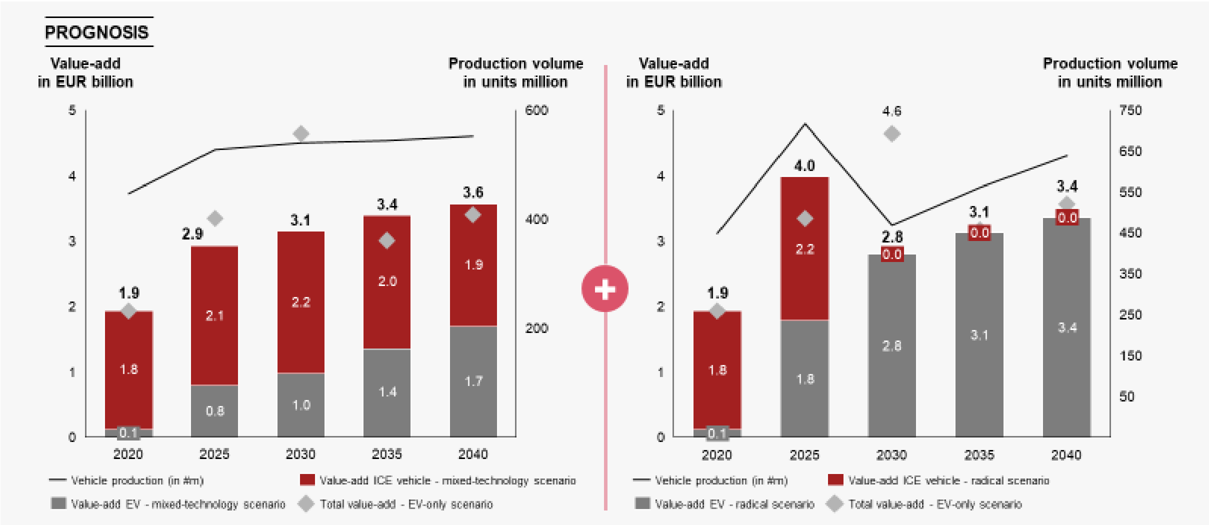


Figure 56: Mixed-technology scenario vs. radical scenario Romania

In comparison with the EV-only scenario for Romania, the value-add of the mixed-technology scenario indicates no relevant increase from 2035 onward, keeping the value-add at a level of about €3 billion to €4 billion. This effect can be explained by Romania keeping the production of ICE vehicle components up until 2040 in the mixed-technology scenario. Assuming an accelerated EV transition (radical scenario), Romania would potentially see a similar value-add from 2035 onward, compared with the mixed-technology scenario, however the delta of employment is relevant in the “hot transition phase” around 2030 due to an earlier phase out of ICE vehicle component production.

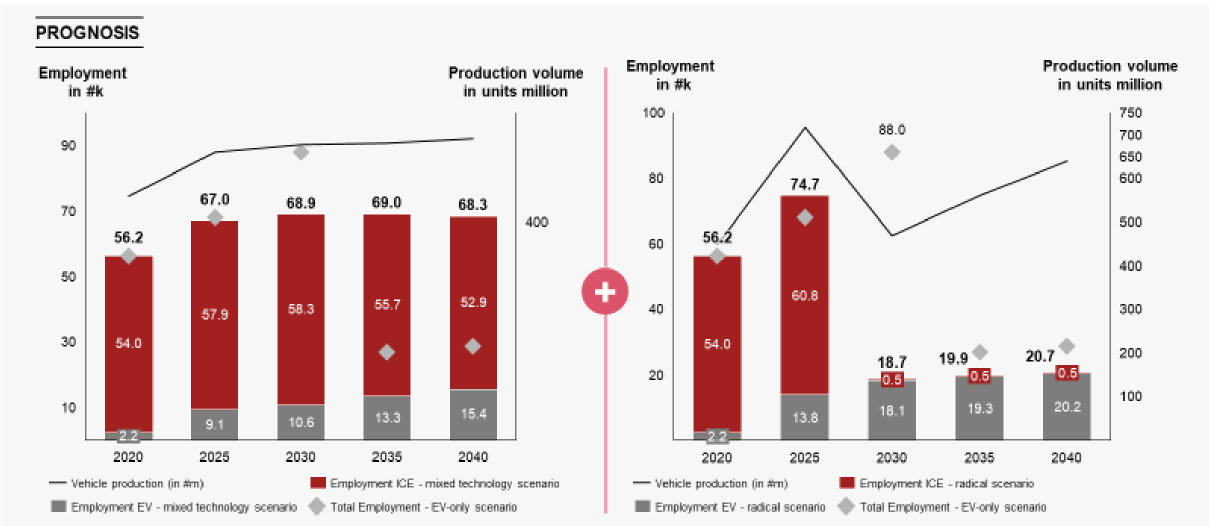


Figure 57:Employment mixed-technology scenario vs. radical scenario Romania

In comparison with the EV-only scenario for Romania, the employment of the mixed-technology scenario indicates a constant level from 2030 onward, keeping the employment around 68k to 69k.

6.3 Technology area deep dive

This section looks at the results on a European level for 2020, 2030, and 2040 for each technology area.

6.3.1 Shiftable powertrain (ICE vehicle) <-> Fixed-drive powertrain (EV)

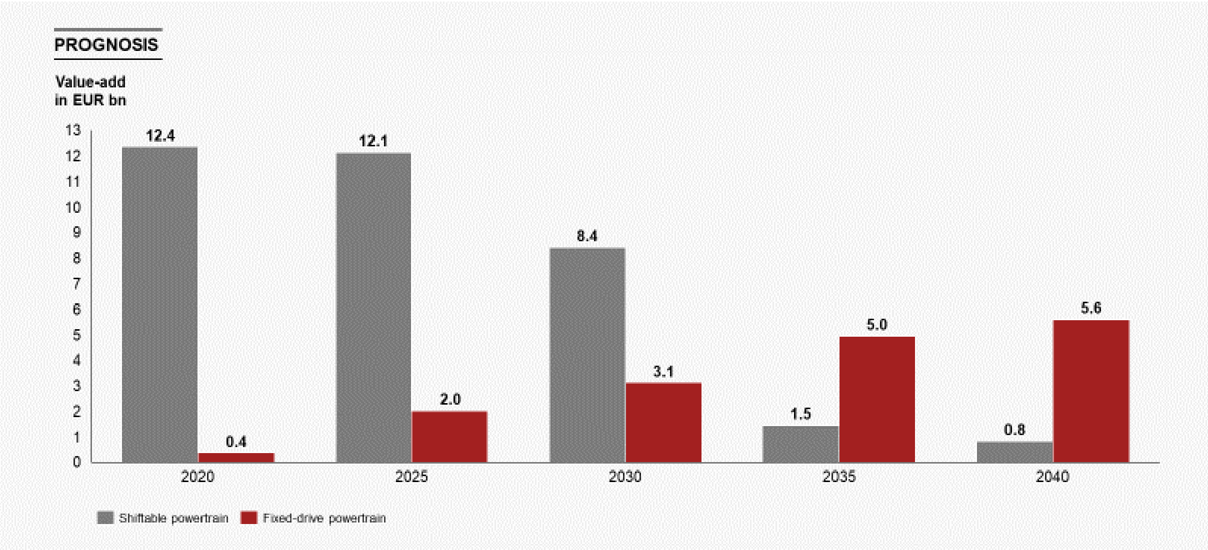


Figure 58: Value-add change EU+EFTA+UK 2020-2040 Powertrain

The graph above compares the value-add for EU+EFTA+UK in 2020, 2030, and 2040 for shiftable powertrains (ICE) and fixed-drive powertrains (EV). The value-add for the former falls by 90% between 2020 and 2040, whereas for the comparable EV technology area — fixed-drive powertrain — it increases by the factor of 15. Overall, the value-add for gear components falls by €12.8 billion (2020) to €6.4 billion (2040) — a decrease of about 50%.

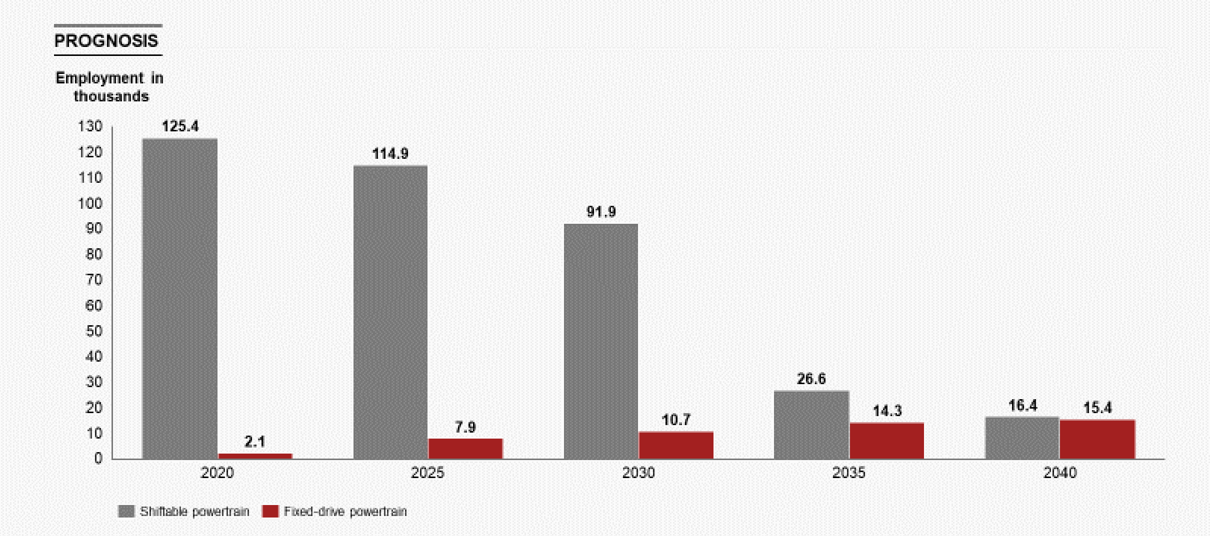


Figure 59: Employment change EU+EFTA+UK 2020-2040 Powertrain

The above graph compares the expected employment change for the EU, EFTA, and the UK in 2020, 2030, and 2040 for shiftable powertrains (ICE) and fixed-drive powertrains (EV). The employment for the former falls by approximately 83% whereas the employment for the latter rises by approximately 820%. Taking both technology areas together to illustrate the transition from ICE vehicle to BEV, the employment falls from the approximately 127,000 FTE to approx. 32,000 FTE in both technology areas — notably, a 75% decrease.

This trend was confirmed by some participants during the workshops and interview sessions. Certainly, one contributing factor is the decreasing complexity in BEV powertrain technology compared with the traditional ICE vehicle powertrain, resulting in the need for fewer employees.

6.3.2 HV battery

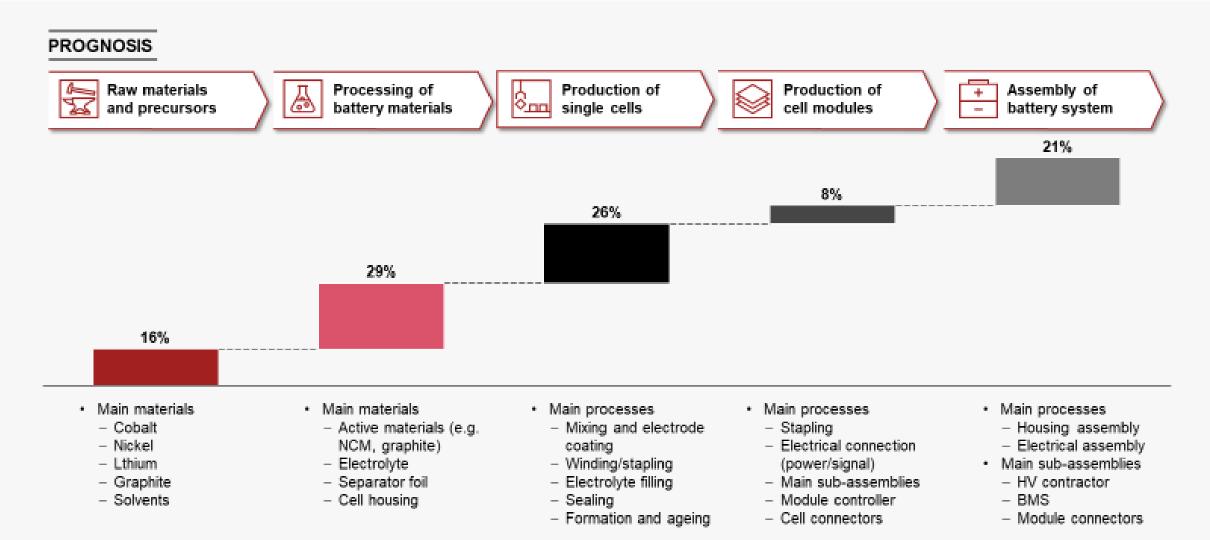


Figure 60: Automotive battery value chain and value share [11]

Figure 54 shows the automotive battery value chain— from raw materials and precursors, to processing battery materials, to the production of single cells, to the production of cell modules, to the assembly of battery systems. The report assumes industrialization of the battery value chain locally in European countries. Local content is driven by optimized supply chain, carbon footprint, technical and physical prerequisites, and limitations. European chemical industry players are currently investing in the ramp-up of production facilities in processing of battery materials and precursors.

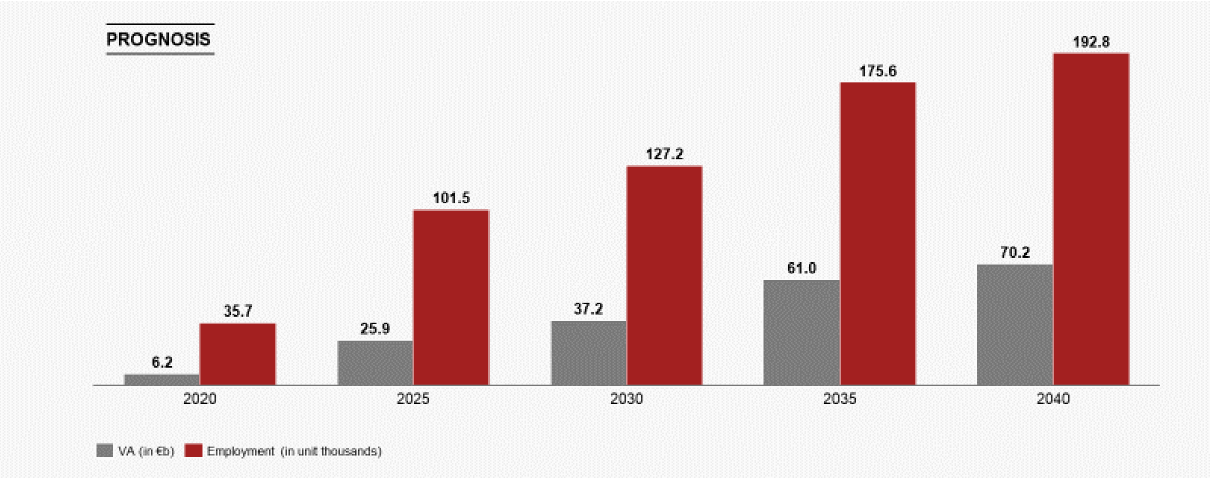


Figure 61: Value-add/ Employment change HV battery/ Fuel Cell system

The above graph shows the forecast value-add as well as employment change for HV battery/fuel cell systems for the EU, EFTA, and the UK for 2020, 2030, and 2040. Between 2020 and 2040, the value-add is projected to increase by 11 times, whereas employment will increase by 5 times. This can be explained by an increasing degree of automation and efficiency gains.

Each of the four relevant stages of the automotive battery value chain accounts for a significant value share. Hence, that of the approximately €70 billion value-add in 2040, processing of battery materials, production of single cells, production of cell modules, and assembly of battery system will each account for multibillion-euro businesses and consequently large-scale employment opportunities. In order to safeguard a relevant value-add and employment in European countries, it is essential to secure industrial settlement along an integrated battery value chain.

7 Conclusion

Five major conclusions about both the impact on value-add and on employment can be drawn:

First, the overall value-add of the European automotive powertrain industry will increase from an estimated €67 billion in 2020 to €104 billion in 2040, +55%. This upward trend is partially due to the higher number of sold units and the replacement of ICE vehicle with BEV (~+35%) but also thanks to a higher average value-add per vehicle (~+25%). BEVs are more expensive than comparable ICE vehicles and therefore currently often come with government sponsored incentives. The difference in acquisition costs between BEVs and ICE vehicles will decrease over time. BEVs also have the advantage of a lower total cost of ownership and the ability to recycle or repurpose the battery.

Second, the value-add in mechatronic components will decrease significantly (e.g., power transformation and power transmission from ICE vehicle from an estimated ~€50 billion in 2020 to ~€15 billion in EVs in 2040).

Third, the value-add for ICE vehicle technologies will most likely migrate to Eastern European countries with only two countries left (known as the "last man standing") producing mainly aftermarket products. While the ICE vehicle value-add by European automotive suppliers will increase in the short term (2025) in some regions (e.g., Germany and Spain), some European automotive suppliers will potentially phase out ICE vehicle production over the mid-term (e.g., Italy in 2030) while others ramp it down over the long term (e.g., France and Germany in 2035).

Fourth, the majority of EV value-add is expected to happen within batteries (~€70 billion in 2040), followed by electric motors (~€10 billion in 2040), which together make up about 80% of EV value-add by 2040. Finally, the majority of value-add for EV technologies should accumulate in the EU, EFTA, and the UK (namely in Germany, Spain, and France) because those areas have a head-start in EV production, and they have available talent to employ.

We now turn to which countries and technology areas we think will benefit the most from the EV transition, which ones will be hit the hardest, and which will be left largely untouched.

The biggest winner in terms of technology areas for value-add and full-time employees will be EV batteries, which generate more than €70 billion and more than 200.000 FTE respectively. In addition, electric motors are expected to contribute significantly, at about €10 billion and roughly 30.000 FTE. Looking at this on a country level, most of the EU7 focus countries will increase their absolute value-add — most significantly France and Spain. France benefits the most with more EV FTE in 2040 compared with ICE-related FTE in 2020. Interestingly, the Czech Republic and Poland will be able to increase their overall employment until 2040 in the industry thanks to their stronghold position in ICE-technologies.

The shift to EVs is expected to have a strong effect on ICE-related mechatronic components, with combustion engines and transmissions showing the most significant absolute decrease in value-add (-€ 45 billion) and -450.000 FTEs across Europe. Further, the relative decrease in value-add and thus employment is expected to be significant in fuel pumps and tank systems, ending the period in 2040 at about €200 million. and 3.500 FTEs. Countries with currently almost no EV production, limited employment, and limited green energy will see an overall decrease in technology areas between 2020 and 2040. Italy, for example, is expected to lose about 45% of its value-add and 90% of its FTEs between 2020 and 2040 under the chosen modelling assumptions. Most of the focus countries in the study (e.g., Germany, Italy, Spain, and Romania) potentially needed fewer employees in 2040 than they did in 2020. However, a short-term increase towards 2025 before the overall employment decline starts in 2030 puts companies under significant pressure.

In conclusion, there are major opportunities and threats for the European automotive supplier industry during the shift to electric vehicles. The biggest opportunity lies with a significantly increased absolute value-add in EV components. This is estimated to achieve a higher absolute value-add than ICE vehicle components produced today (nearly +70%). In addition, the market for electronics and electrochemical suppliers will become significantly larger due, for example, to a higher demand for semiconductors and battery cells. However, the challenge for the future is the timely industrialization of production capacities locally in European countries.

The major threat is the forecasted fall of nearly 40% of net total powertrain employment. In particular, the market for mechanic and mechatronic suppliers will become significantly smaller and consolidation can be expected. However, the impact on certain areas might be less drastic as companies may refocus their portfolios towards an EV world. On the other hand, effects on employment through OEM insourcing has not been regarded. The study also does not take into account the demographic development of individual countries and the resulting implications. Furthermore, production exports to the global market are only considered as a result of capacity constraints.

8 Outlook

While this report provides a detailed assessment on the expected impact of the EV transition on European automotive suppliers regarding value-add and employment, four further fields of interest would be worthwhile analysing with regard to this period or even beyond.

First, it seems worthwhile to build upon the demonstrated employment outcomes to look at specific reskilling and upskilling requirements to manage the transition from a qualification perspective.

Second, the predicted shift in value-add throughout the EV transition could serve as a basis to subsequently examine the impact on production machinery and equipment until 2040. While some of the current machinery and equipment may be repurposed toward EV components, the overall change will potentially face a huge transition similarly to the change of value-add structure and employment.

Third, the suppliers' required investments to manage the transition toward electromobility could be used to generate an overall picture of the financial effort required by the European automotive suppliers over this period.

Finally, further insights that will help shape the transition can be gained by assessing the impact of other automotive mega trends such as connectivity and digitization on the European automotive supplier industry.

9 References

[1] Frontier Economics, 2020. [Online]. Available: https://www.bmwi.de/Redaktion/DE/Downloads/C-D/crediting-system-for-renewable-fuels.pdf?__blob=publicationFile&v=4.

[2] CLEPA, 2021. [Online]. Available: https://clepa.eu/who-and-what-we-represent/suppliers-eu-employment-footprint/portal/.

[3] ANFIA, 2021. [Online]. Available: https://www.anfia.it/en/lobby/r-d/itemlist/category/8-associati?7.

[4] AFIA, 2021. [Online]. Available: https://afia.pt/en/statistics/.

[5] Sernauto, 2021. [Online]. Available: https://www.just-auto.com/news/spanish-suppliers-2020-turnover-down-15-to-eur30bn/.

[6] Intergovernmental Panel on Climate Change (2013). Climate Change 2013 – The Physical Science Basis. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/03/WG1AR5_SummaryVolume_FINAL.pdf:

[7] Destatis (2019). Straßenverkehr: EU-weite CO2--Kohlendioxid--Emissionen seit 1990 um 24 % gestiegen. Retrieved from https://www.destatis.de/Europa/DE/Thema/Umwelt-Energie/CO2_Strassenverkehr.html.

[8] International Council on Clean Transportation (2014). EU CO_2 Emissions Standards for Passenger Cars and Light-commercial Vehicles. Retrieved from https://theicct.org/sites/default/files/publications/ICCTupdate_EU-95gram_jan2014.pdf.

[9] Council of the European Union (2021, July 14). Fit for 55: Delivering the EU's 2030 Climate Target on the way to climate neutrality. Retrieved from https://eur-lex.europa.eu: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0550.

[10] Eurostat (2021). National accounts aggregate by industry - Power train value-add. Retrieved from https://ec.europa.eu/eurostat/de/web/products-datasets/product?code=sbs_sc_sca_r2

[11]] Eurostat (2021). National accounts aggregate by industry - Power train value-add. Retrieved from https://ec.europa.eu/eurostat/de/web/products-datasets/product?code=sbs_sc_sca_r2.

[12]8 Eurostat (2020). Personnel costs. Retrieved from https://ec.europa.eu/eurostat/de/web/products-datasets/product?code=sbs_sc_sca_r2

[13] International Energy Agency (2021). CO2 emissions. Retrieved from https://iea.org/: https://www.iea.org/data-and-statistics/data-browser/?country=WORLD&fuel=CO2%20emissions&indicator=CO2BySource

[14] Information Handling Service (2021). Light vehicle power train – Engine production forecast. Retrieved from https://connect.ihsmarkit.com/autoinsight-data-rowser/editQuery/LightVehiclePowertrain/EngineProductionForecast

[15] PwC Strategy&. (2020). Powertrain Study 2020 – Staying profitable in the new powertrain age. Retrieved from https://www.strategyand.pwc.com/de/powertrain-study.html

10 Appendix

The following illustrates deep-dive analysis for EV-only scenario on the seven focus countries, Germany, Italy, France, Czech Republic, Spain, Poland, and Romania:

10.1 Germany

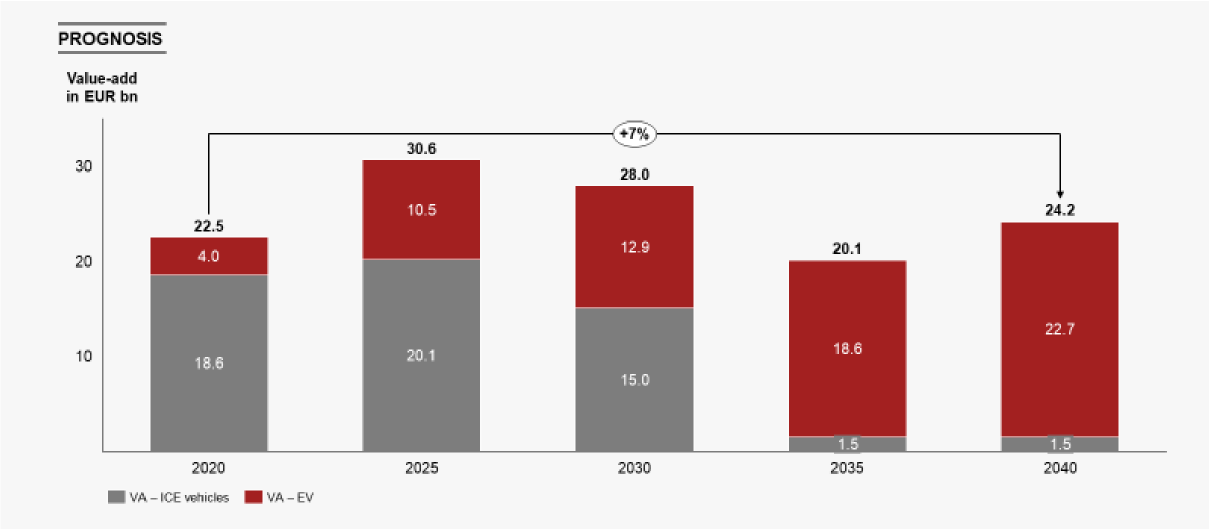


Figure 62: Value-add change Germany from 2020-2040

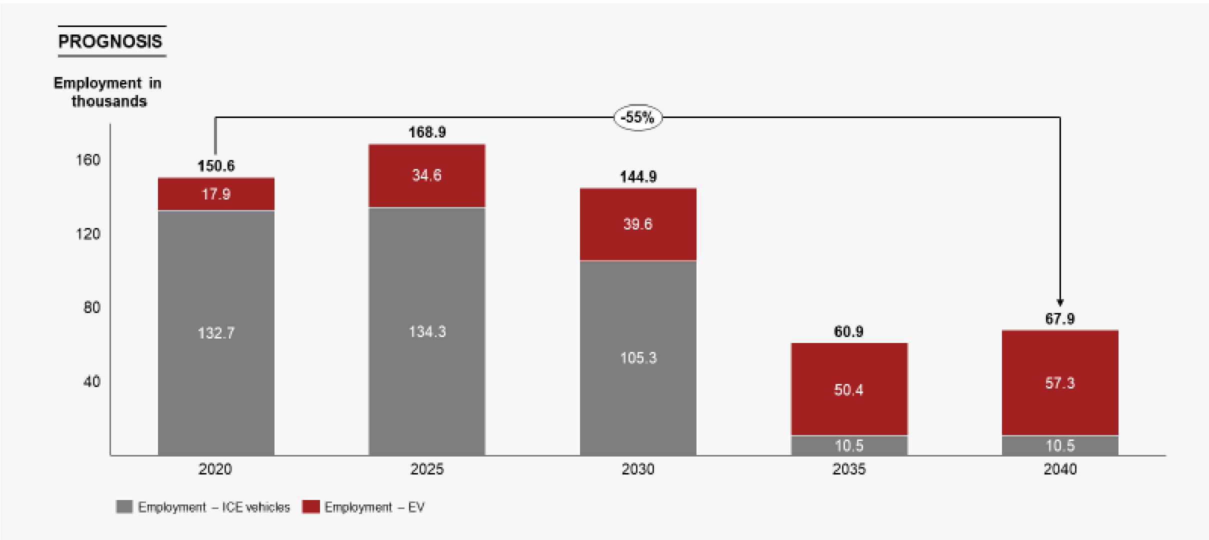


Figure 63: Employment change Germany from 2020-2040

ICE vehicle technologies: Germany shows a slight increase in value-add and employment for ICE vehicle technologies until 2025, when we see a decline until the end of ICE vehicle production in 2031. After Italy and France, Germany is expected to be the third country to close down ICE vehicle production after 2030, resulting in 105,000 exempted employees. Due to Germany's high employee protection regulations and high personnel costs, for example, it is seen as rather unattractive for an ICE vehicle technologies run down in comparison to other focus countries. Companies may try to quickly shift toward forward-looking EV technologies soon to secure future jobs. The forecasted production volume between 2030 and 2035 is not sufficient to utilize the minimum average shift scheme of Germany's automotive powertrain suppliers. Therefore, Germany is expected to shut down ICE vehicle production until then.

EV technologies: Germany shows a strong increase in value-add (+470%) from 2020 to 2040 within EV technologies. This forecasted development is mainly based on Germany's current and prognosed OEM EV production as well as the available experienced automotive production employment. Due to the country's forecasted early shutdown in ICE vehicle technologies, these employees become available for the EV transition. The employment forecast shows a disproportionately mixed technology increase of 220% until 2040. This is mainly driven by a higher degree of automation. In summary, Germany is prognosed to be one of the EV technology profiteers since it is able to regain a 2020 production volume size.

10.2 Italy

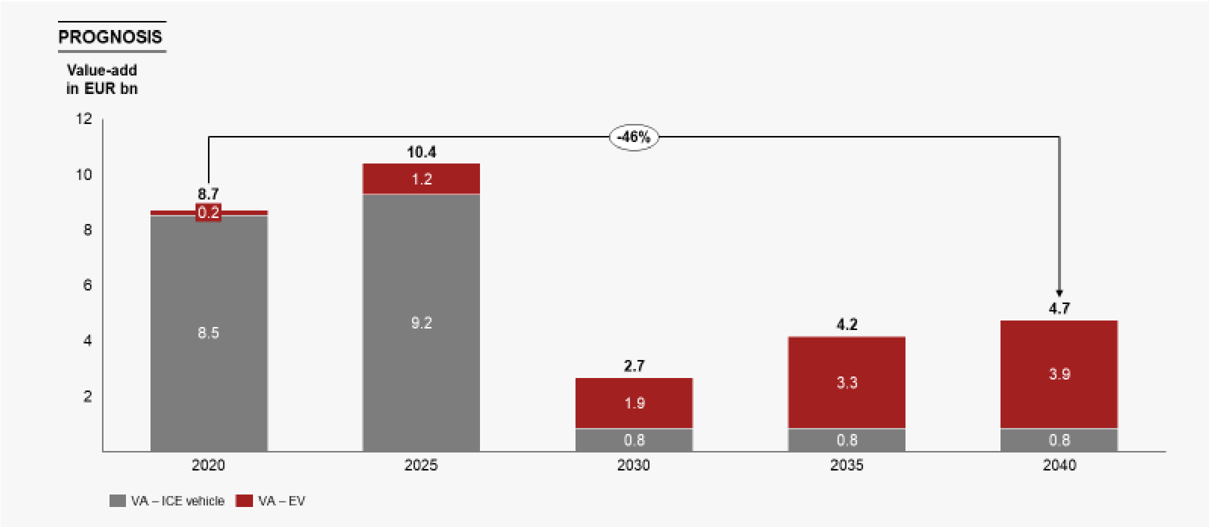


Figure 64: Value-add change Italy from 2020-2040

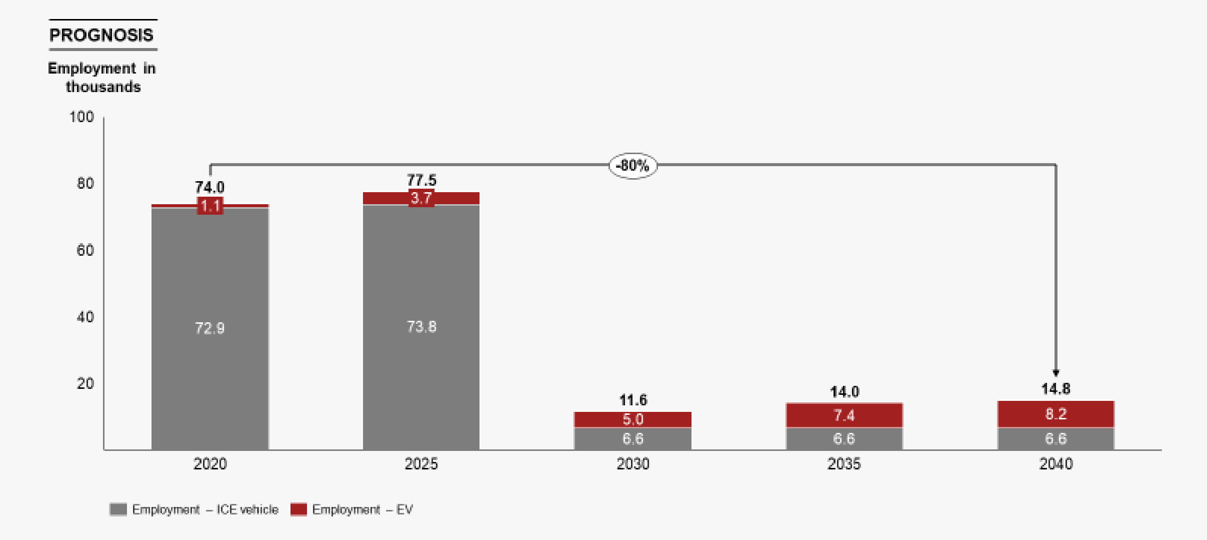


Figure 65: Employment change Italy from 2020-2040

ICE vehicle technologies: Italy shows a strong increase in value-add and employment for ICE vehicle technologies until 2026, when a slow decline begins until the end of ICE vehicle production between 2025 and 2030. Italy has, based on the underlying survey results, a relatively low degree of automation and high personnel costs. Therefore, it is not the most favourable country to stay in the ICE vehicle technology area.

EV technologies: The EV market shows a steady increase, although it only recovers about 45% of its 2020 value-add by 2040. Italy is forecasted to experience only a slow ramp-up of EV technologies because it has very limited current and potential OEM EV production in its country as well as a low degree of automation and high "variable costs." It depends very much on the decision of Stellantis on where to produce EV components. Only the improving score in available expert staff leads to Italy slowly accelerating value-add prognosis. Moreover, Italy competes with France, which have better CO_2 footprint due to its energy mix of nuclear and renewable energy sources.

10.3 France

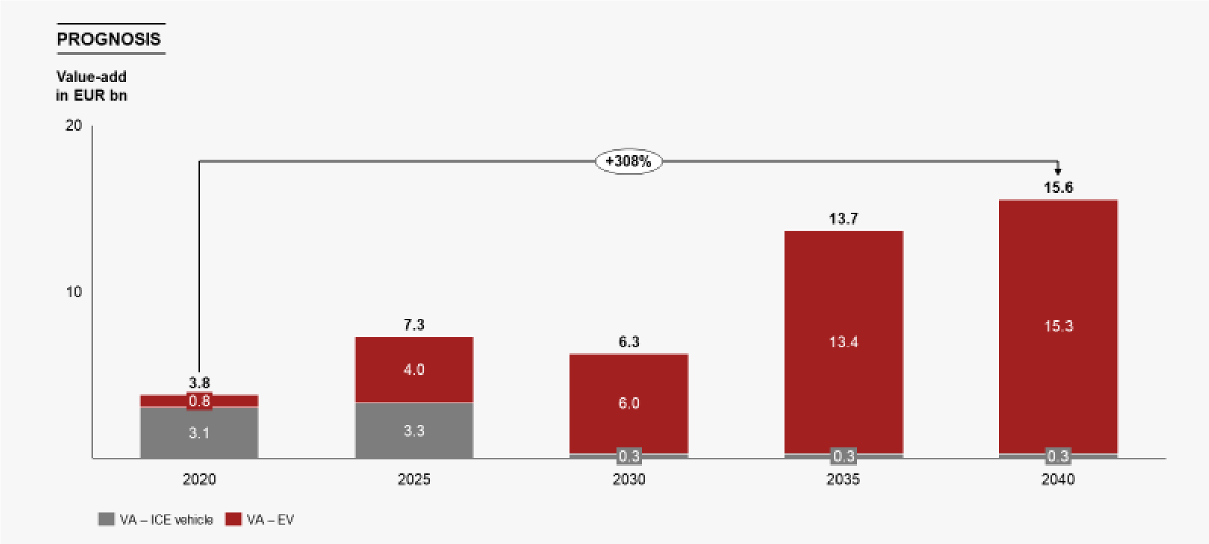


Figure 66: Value-add development France from 2020-2040

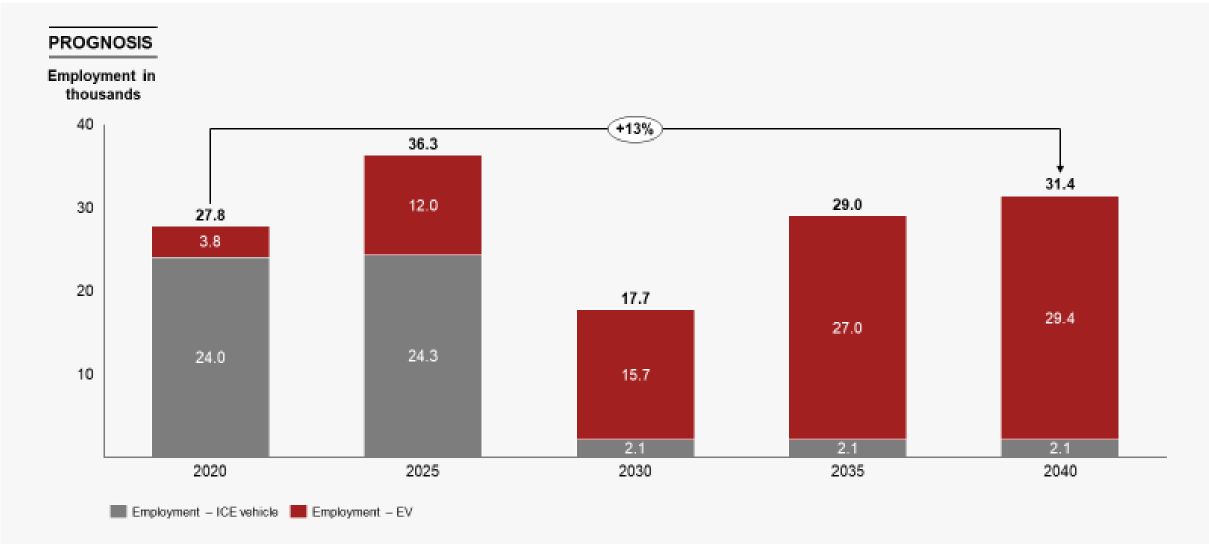


Figure 67: Employment development France from 2020-2040

ICE vehicle technologies: France is expected to profit from the short-term increase of ICE vehicle technology volumes until 2025. Nevertheless, it is forecasted to shutdown major ICE vehicle production between 2025 and 2030.

EV technologies: France is forecasted to be an EV technology profiteer with an increase of value-add of +1900% and is getting the most value-add, mainly due to its good CO_2 footprint based on its mix of nuclear and renewable energy sources. The prognosis shows that France could be one of the only countries to keep its current level of automotive powertrain employment with the strong increase of EV technology production. Key drivers leading to this development are France's current and forecasted OEM EV production numbers, its low energy costs, its CO_2 footprint, and its degree of automation.

10.4 Czech Republic

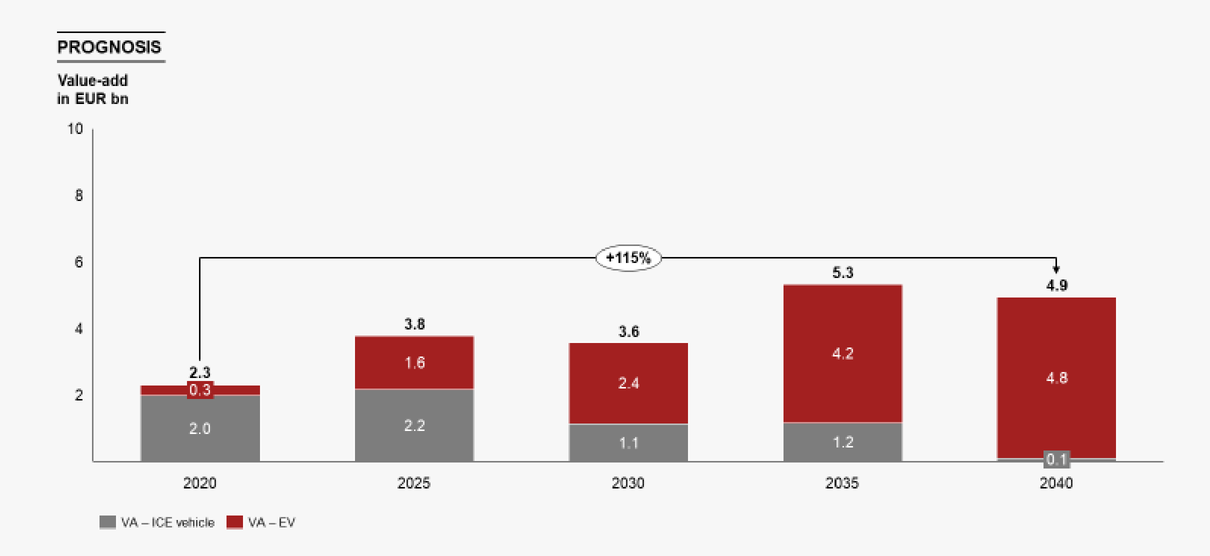


Figure 68: Value-add development Czech Republic from 2020-2040

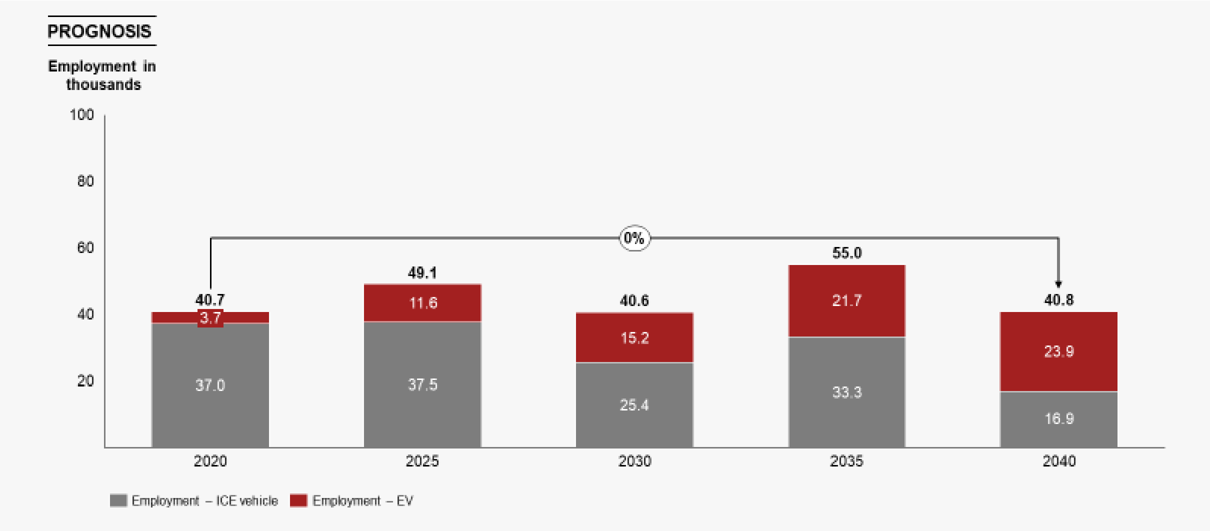


Figure 69: Employment development Czech Republic from 2020-2040

ICE vehicle technologies: The Czech Republic is one of two stronghold in ICE vehicle technologies and therefore decreases its ICE vehicle value-add share only slightly. The employment development follows that trend resulting in small decrease in employees until 2040. The Czech Republic has a low average degree of automation and a corresponding lower minimum shift scheme to keep production going. Also, its personnel costs are comparably low to the other focus countries. These are the main reasons that the Czech Republic is prognosed to produce ICE technologies longer than other countries.

EV technologies: The Czech Republic shows a strong increase of EV value-add (15 times higher until 2040). The main drivers for this development are the country's relatively low personnel and energy costs, as well as its relatively good current and prognosed OEM EV production rates. Similar to the other countries, the employment increases in the Czech Republic are under-disproportional to the value-add (6 times higher until 2040).

10.5 Spain

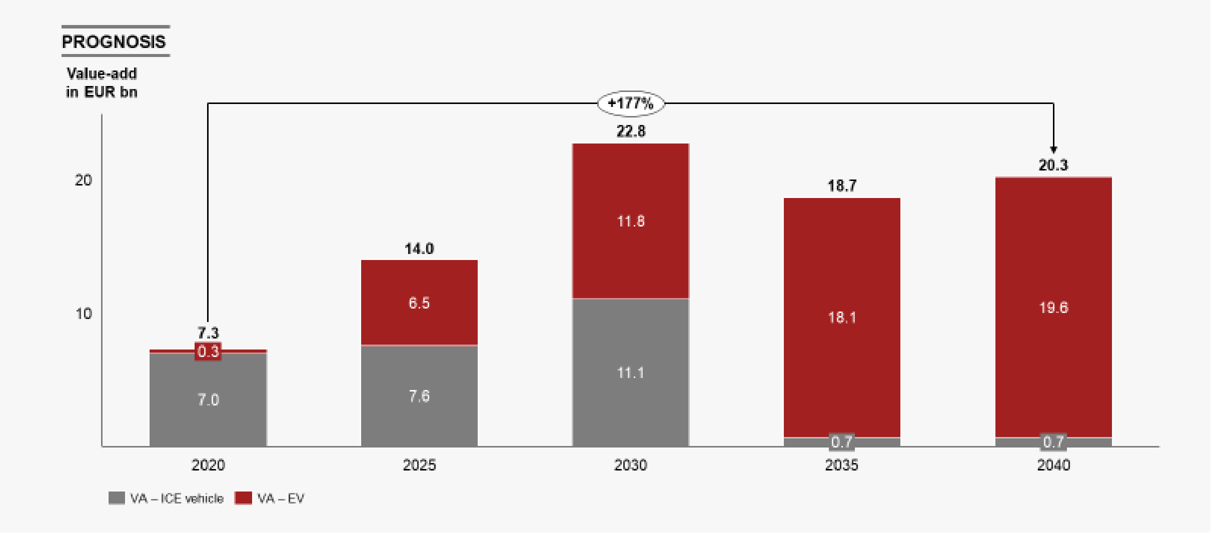


Figure 70: Value-add development Spain from 2020-2040

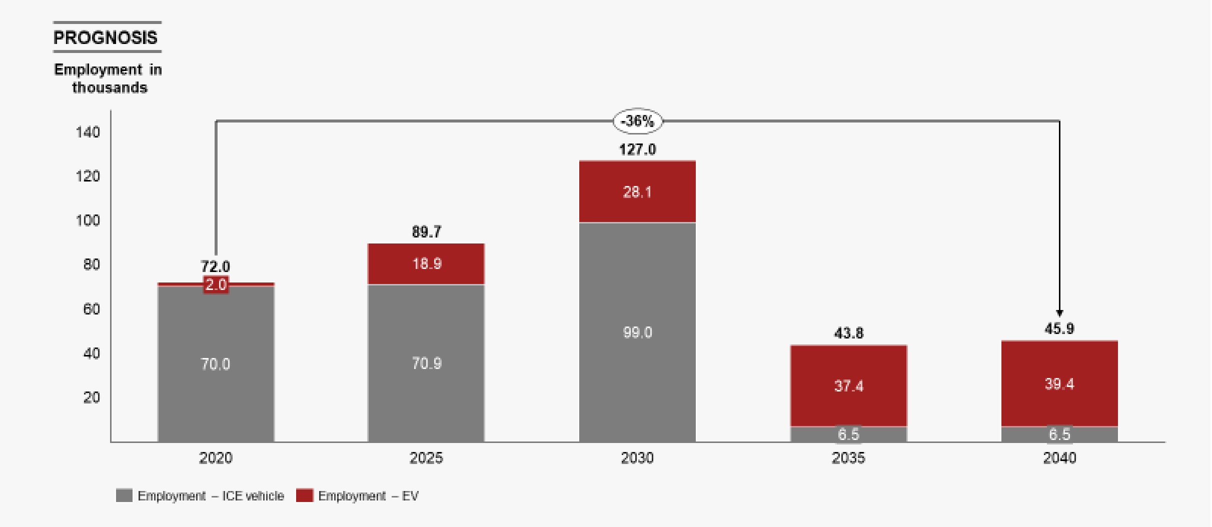


Figure 71: Employment development Spain from 2020-2040

ICE vehicle technologies: Spain is forecasted to increase ICE vehicle production until 2030 since it takes freed-up volume from other countries. Nevertheless, due to the high decrease in ICE vehicle volume between 2030 and 2035, Spain shuts down is production since the minimum average shift scheme cannot be fulfilled any longer. The employment develops accordingly.

EV technologies: Spain is expected to be one of the most attractive EV technology countries within the focus countries. This is mainly due to an average good OEM EV production coverage, a good variable cost mix, as well as the degree of automation and available employees. The value-add is prognosed to increase 62 times until 2040. The employees should simultaneously increase 20 times. Moreover, Spain has a good energy mix with 22% nuclear-, 43% renewable-, and only 2% coal-based energy.

10.6 Poland

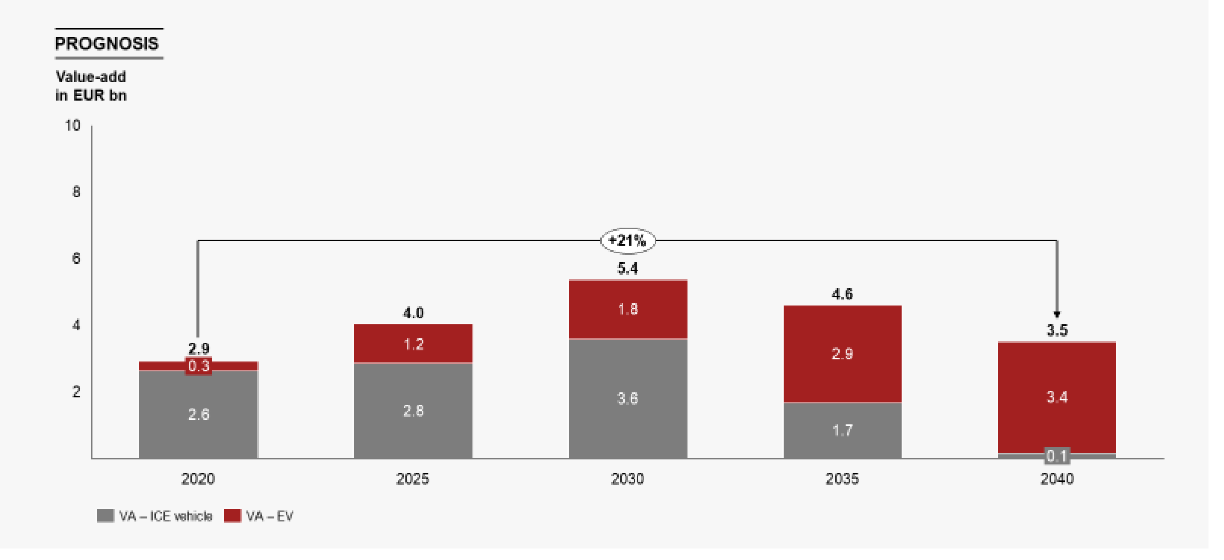


Figure 72: Value-add development Poland from 2020-2040 vs. EV-only

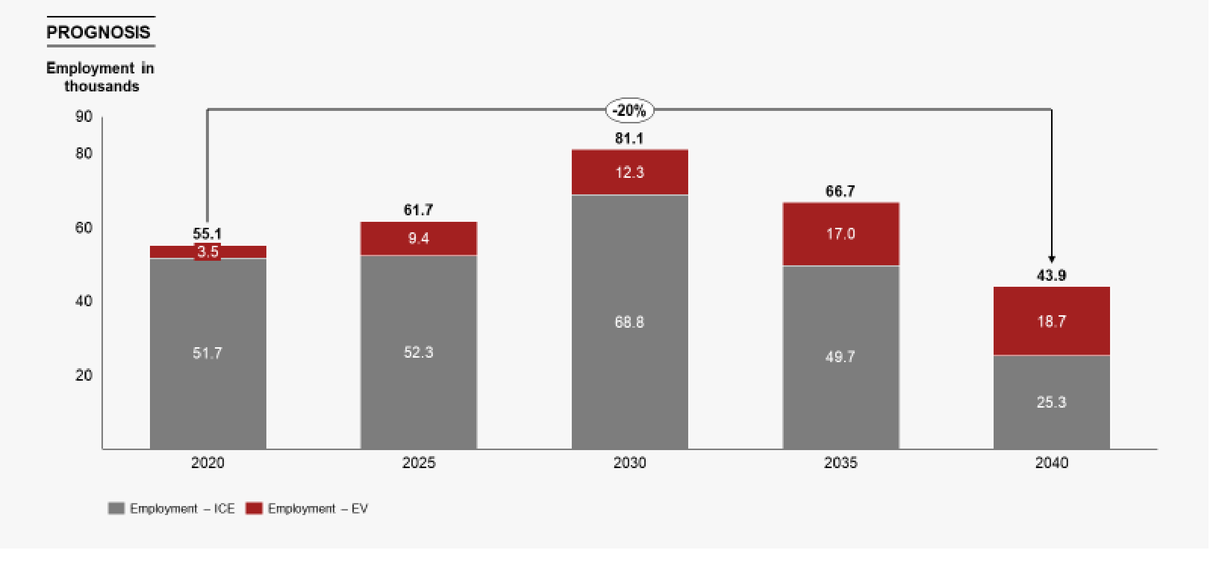


Figure 73: Employment development Poland from 2020-2040

ICE vehicle technologies: Poland joins the Czech Republic as a stronghold for ICE-technologies. Between 2020 and 2030, ICE vehicle value-add and employment increase slightly. Due to the assumption of no further investments in ICE vehicle-related technology fields, companies will keep their existing employment instead of investing in automation, which explains the employment development. Poland is attractive for surviving in ICE vehicle technologies and taking over value-add due to its low personnel costs.

EV technologies: Poland shows a strong increase in EV value-add (12 times) with a lower growth rate in employment (5 times). The sum in value-add for 2040 is forecasted to outperform the ICE vehicle value-add of 2020. Poland is attractive for EV investments due to its low personnel costs and improving degrees of automation.

10.7 Romania

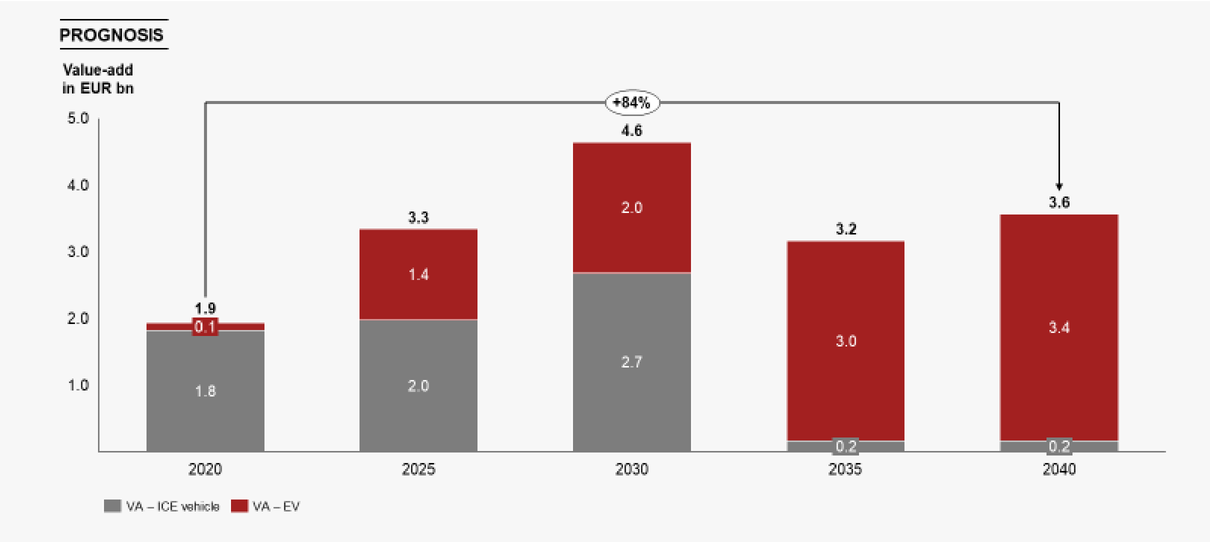


Figure 74: Value-add development Romania from 2020-2040

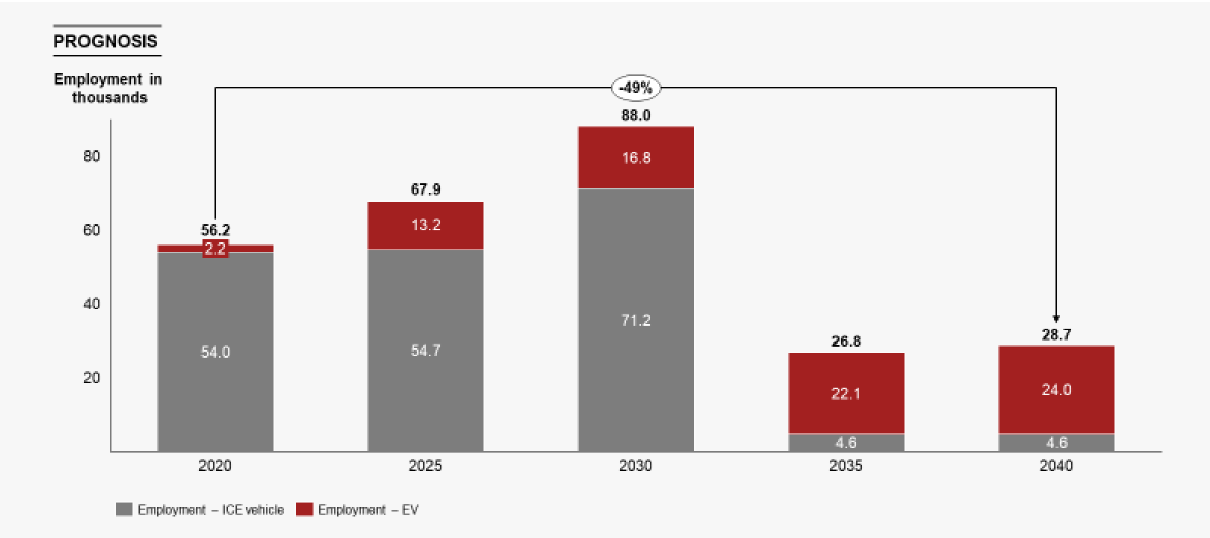


Figure 75: Employment development Romania from 2020-2040

ICE vehicle technologies: Romania slightly increases value-add as well as employment until the forecasted shut down of ICE vehicle production between 2030 and 2035. Romania is expected to take over freed up value-add until its shutdown mainly due to its lower personnel costs.

EV technologies: Romania shows a strong increase in EV value-add generation (29 times), however, similar to other countries, it is expected to experience a slower increase in employment rates due to higher expected degrees of automation. Romania is attractive for investments in EV technologies due to its good CO_2 footprint, low personnel cost, and good degree of automation.

Project team

Henning Rennert
Partner,
Automotive Suppliers

henning.rennert@strategyand.de.pwc.com

Katherina Gasser
Senior Manager,
Automotive Restructuring

katherina.gasser@pwc.com

Dr. Philipp Rose
Manager,
Automotive Electrification

philipp.rose@strategyand.de.pwc.com

Steven James van Arsdale
Manager,
PwC Autofacts

steven.james.van.arsdale@pwc.com

Luis Hertle
Senior Associate,
Restructuring

luis.hertle@pwc.com

Patrick Frauenknecht
Associate,
Deals

patrick.frauenknecht@pwc.com

Project sponsors

Felix Kuhnert
Partner,
Global Automotive Leader

felix.kuhnert@pwc.com

Jörg Krings
Partner,
Automotive Leader

joerg.krings@strategyand.de.pwc.com

Thomas Steinberger
Partner,
Automotive Restructuring Leader

thomas.steinberger@pwc.com

This publication contains general information only. Neither PwC Strategy& (Germany) GmbH (“Strategy&”) nor any other member company of the international corporate network of PricewaterhouseCoopers (“PwC Network) nor the European Association of Automotive Suppliers (“CLEPA”) are providing a professional service by publishing this study. This publication is not intended to support or be used for any business or financial decisions or for performing any related actions. To do this, you should seek advice from a qualified advisor.

No (express or tacit) statements, guarantees or representations are made with regard to the correctness or completeness of the information in this publication, and neither Strategy& nor any other member company of the PwC Network nor CLEPA, nor their employees or agents, shall be liable or responsible for any loss or damage of any kind arising directly or indirectly and incurred by any person or company who rely on this publication.

Strategy&, other member companies of the PwC network and CLEPA are legally autonomous and independent companies.