Center Automotive Research

CAR STUDY:

Tightening of EU - CO2 Requirements and the effects on Jobs in the European Auto Industry

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Contents

[1] We would like to thank the European Climate Foundation for financial support, which allowed us to implement the study in the present design, in two language versions (German/English) and by purchasing data for the countries France. Italy, Spain, Slovakia.

Planned EU tightening of CO2 requirements endangers jobs in the European auto industry less than feared – in contrary: across all sectors positive effects on employment can be expected.

Ferdinand Dudenhöffer [1,2]

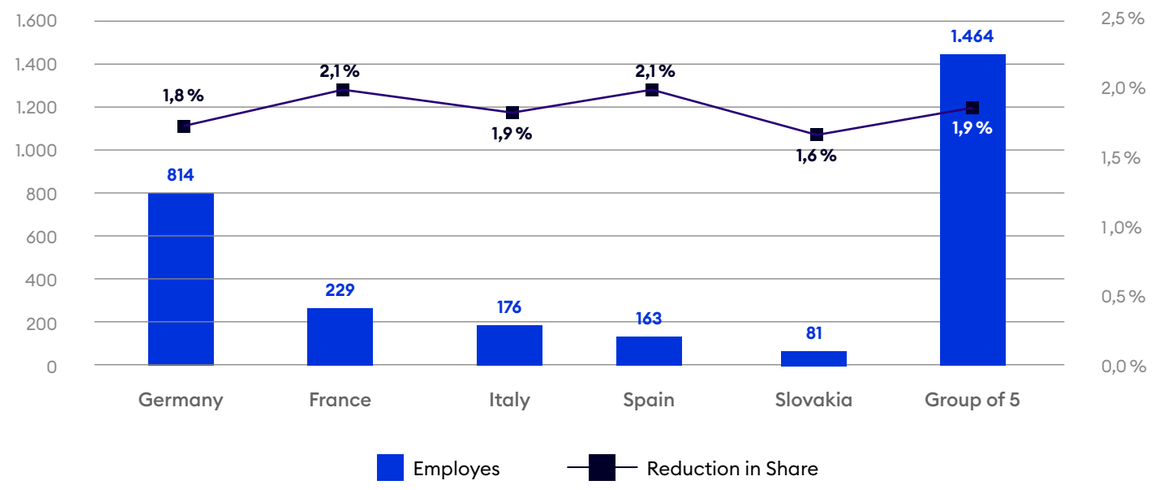
SUMMARY

The EU Commission is planning to further reduce the level of CO2 emissions from new passenger cars. Under the planned requirements, only 47.5 grams CO2/km would be allowed per new car from 2030. If this number is exceeded, high penalties are foreseen for carmakers.

Within a static microeconomic model, we analyse the effects of this stronger regulation on employees in the automotive industry in five EU automotive countries (hereinafter referred to as the Group of 5): Germany, France, Italy, Spain, Slovakia as well as the Group of 5. The Group of 5 stands for 70% of total manufactured passenger cars in EU 27 in 2019. The model is based on an analysis of two vehicle types and applies industry data from 2019 and 2020.

The results show that the strengthening of CO2 emissions targets will have only negligible negative employment effects for the automotive industry. The calculated effects of the model are summarised in Fig. 1 below.

Fig. 1: How stronger CO2 standards will effect employment (in 1.000 employees)



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@ Marek Piwnicki

The blue bars in Fig. 1 indicate the number of employees within the motor industry in important EU-car-manufacturing countries in the years 2019 and 2020. The total impact varies between 1.8% (Germany) and 2.1% (Spain). According to our model, 1.9% of today's jobs would be no longer be needed within the Group of 5. To put it in a broader perspective, even in the simple model of an isolated industry, it is hard to show negative effects on employment. As our analysis applies a microeconomic static single sector model, effects from other sectors, as well dynamic competitive advantages have to be added.

Economies of scale create important competitive advantages in the automotive industry, which includes countries and regions. If the transformation to zero-emission passenger cars arrives late, Europe will be in a situation of competitive disadvantage relative to Asia and North America. This jeopardises jobs of the future. Therefore, we have taken into account job losses due to an old technology like combustion burning vehicles and also the loss in creating new jobs for the industry of tomorrow, like battery cell manufacturing. Considering this opportunity costs, there is a positive job creation effect due to the stronger EU-emission-rules. Moreover, studies, such as Cambridge Economics, point to considerable positive employment effects in other sectors, following a transition of the car industry. This includes sectors, such as construction, power, services and several manufacturing sectors.

The accelerating shift towards battery electric vehicles has risen up the agenda of the manufacturers. In early 2021, GM announced that they will produce only electric vehicles from 2035. Volvo has announced to stop the production of internal combustion engines by 2030 and Jaguar Land Rover from 2025. Importantly, VW has promised that 70% of all new passenger cars sold in Europe by 2030 will be battery electric cars.

It is clear that the race towards zero emission mobility is accelerating. For these reasons, also a stronger Euro 7 emission regulation, which currently is under discussion, would not be a disadvantage. Automotive manufacturers will define the pace, the supplier industry need to speed up to avoid job and turnover losses.

In conclusion, the strengthening of CO2 emission performance targets and the subsequent transformation will improve the competitive position of the European automotive industry. From a broader industrial perspective, the overall positive effect on employment is substantial and an improvement of CO2 standards will create jobs, as has been historically demonstrated.

1. Introduction

Following the implementation of the EU Regulation 2019/631, CO2 emission performance standards for new passenger cars and light commercial vehicles became effective in the EU on 17 April 2019. From 1 January 2025, the following EU-wide CO2 emission performance standards will be implemented:

a.) for the average emissions of the fleet of new passenger cars, an EU-wide fleet CO2 emission target standard will be applied, which corresponds to a reduction of the target for the year 2021 by 15% ...

b) for the average emissions of the fleet of new light commercial vehicles, an EU-wide fleet target standard will be applied corresponding to a 15% reduction in the 2021 target....

From 1 January 2030, the following EU-wide fleet targets will be effective:

a.) for the average emissions of the fleet of new passenger cars, an EU-wide fleet standard will be applied, which corresponds to a reduction of the target for the year 2021 by 37.5%...

b) for the average emissions of the fleet of new light commercial vehicles, an EU-wide fleet target standard will be applied, which corresponds to a reduction of the target for the year 2021 by 31% compared to the year 2021 ...

However, in mid-September 2020 the European Commission announced:

„To achieve a climate-neutral EU by 2050 the intermediate target of an at least 55% net reduction in greenhouse gas emissions by 2030, the Commission is proposing to revise the regulation“.

www.ec.europa.eu

According to a communication from the Commission, the corresponding change to Regulation EU 2019/631 is planned for Q2, 2021.

@ Sara Kurfeß

2. Outline of the Study - Expected Employment Effects

What is the effect on employment that can be expected in the European automotive industry from above mentioned strengthening of the CO2 emission performance targets?

To answer this question, we will concentrate on major European countries with a strong automotive sector: Germany, France, Italy, Spain and Slovakia. To study the effect on employment, we apply an idealised model that assumes two different passenger car types. The effect on employment in the automotive industry in United Kingdom was excluded, due to the withdrawal from the European Union and associated upheavals.

Our analysis focused on the passenger car market and excludes light commercial vehicles, for the year 2030.

3. Regulatory Environment

Fig. 2 shows the former CO2 targets and EU car fleet results. For example, for the year 2008, a CO2 target of 140 g CO2/km was formulated as a voluntary commitment by car manufacturers. The target was missed, and the CO2 emissions achieved were 160 g CO2/km on average. In reaction, the EU Commission formulated the CO2 target of 130 g CO2/km to be effective from 2015, i.e., if carmakers would not meet the regulation standard strong penalties would be imposed.

The result of the 130 gCO2/km target was an innovation boost, with fuel-saving technology flowing into large-scale production. Fig. 3 shows examples of innovations that were taken into mass production between 2010 and 2015. Lightweight construction became more important, start-stop systems went into series production, 3-cylinder engines and the downsizing of internal combustion engines became the trend, shift point displays and much more. Fig. 2 shows the effects of the fuel-saving innovations that have made a significant contribution to reducing fleet consumption through the EU CO2 requirements. During a seven-year period, from 2008 to 2015, the fleet consumption and the corresponding CO2 emissions were reduced from 160g CO2/km to 120g CO2/km. The goal was clearly exceeded.

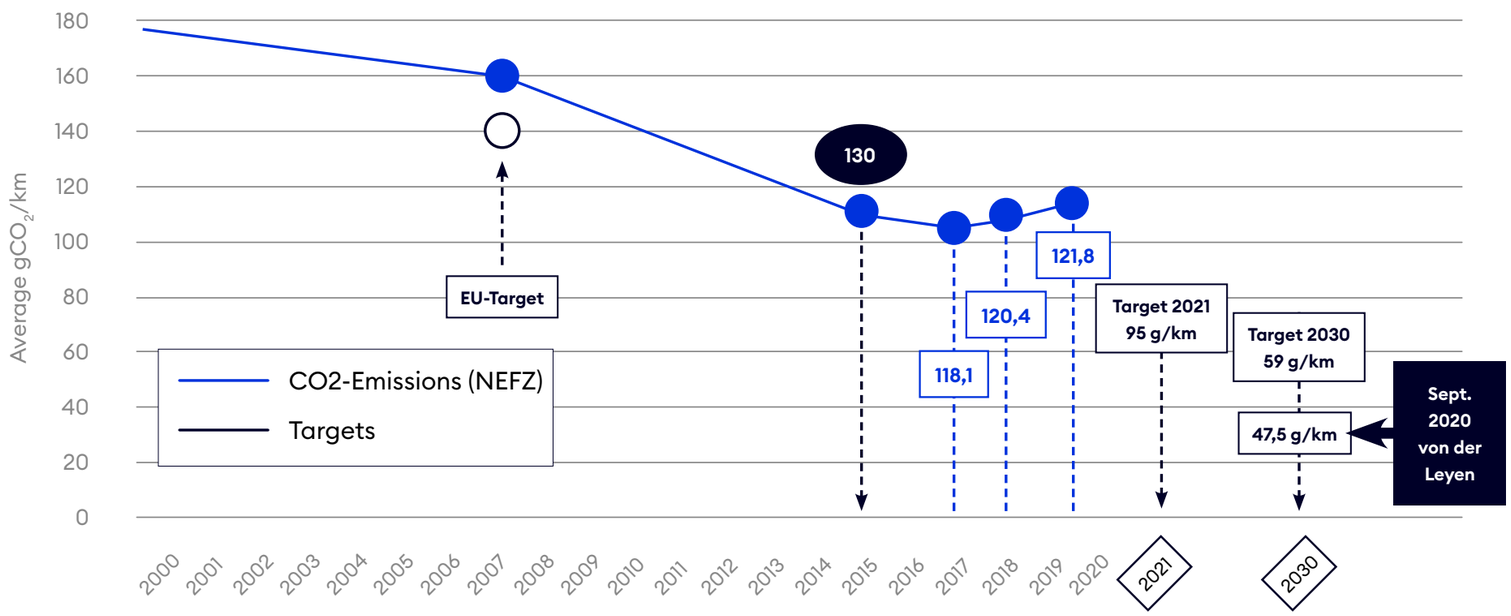
@ Volkswagen AG

Remarks:

The method of measuring CO2-emission had been until 2019 the so called NEFZ-test-procedure. (NEFZ: Neuer Europäischer Fahrzyklus). Meanwhile, so called WLTP test is defined and binding for measuring CO2-emissions. WLPT cannot translated with a fixed coefficient into NEFZ and vice versa. Due to agreements with the industry the NEFZ test will be decisive for meeting the emission standards. Therefore, we apply to our model NEFZ-metrics.

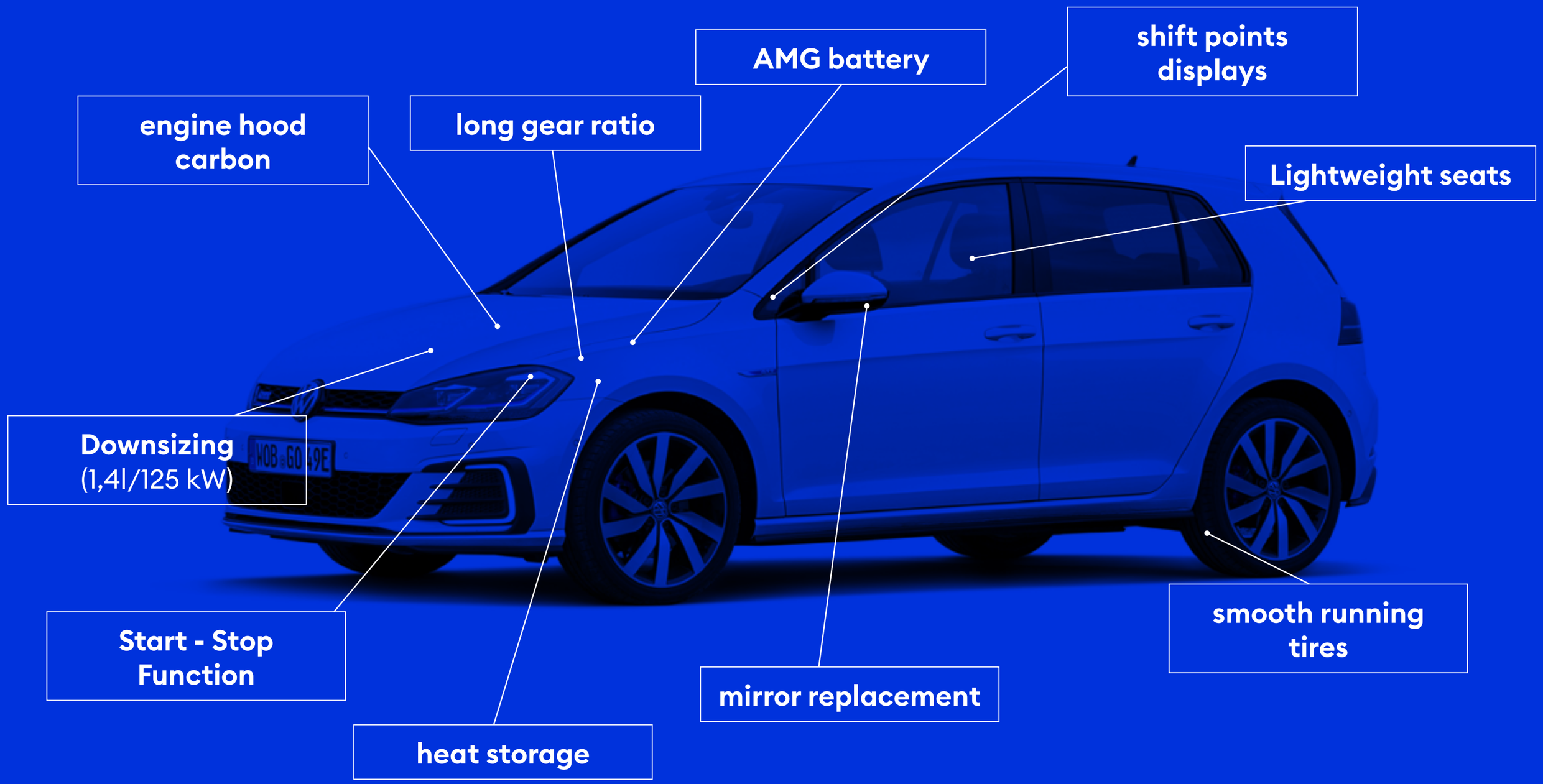
@ Volvo

Fig. 2: CO2-Emissions passenger cars EU 28
(in Gramm CO2 pro km) (NEFZ-Cycle)



SOURCE: EU-COMMISSION, CAR

Fig. 3: Fuel Saving Technologies driven by CO_2-Regulation



@ Michiel Annaert

3.1. Positive Job-Effects of Stronger Regulation

Despite a series of claims and reports from automotive sector, neither passenger car prices nor employment was negatively affected by the CO2 emission performance standards regulation. Passenger cars remained affordable, and the employment increased, such as in the German automotive sector.

Fig. 4 shows that in the period 2007 to 2015, the number of employees in the German auto industry increased from 726,000 to 839,000 – a growth of 15%. Strengthened CO2 targets have led to the opposite of what the industry has suggested, with further innovation, and a corresponding increase in the number of employees.

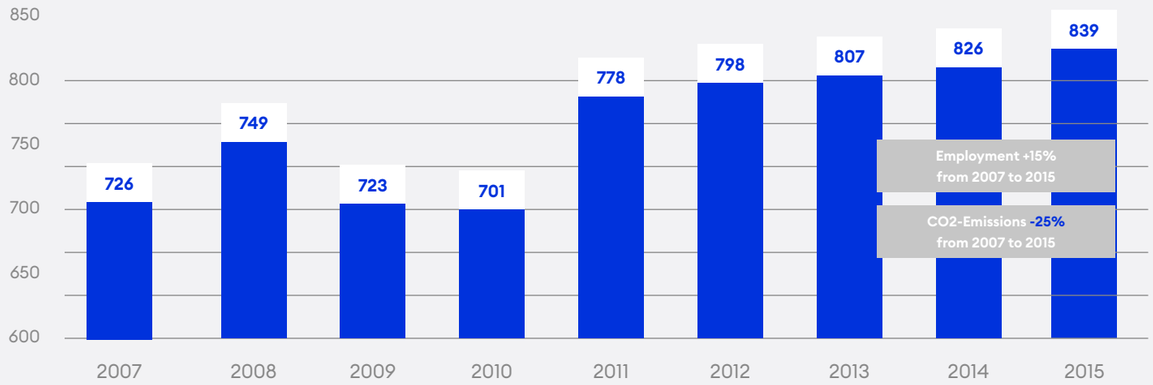
These are striking examples, which demonstrate that stricter regulation has fostered innovation and gave a competitive advantage to the industry. What has been seen in the past should also be visible in the future.

Positive Job-Effects of Stronger Regulation

3.2. Ban of Combustion Engines in Important Markets

3.2. Ban of Combustion Engines in Important Markets As with environmental standards implemented so far, announcements to phase out the internal combustion engine have had a similar effect. There are clear regulatory frameworks that create predictability, stimulate investment and make the transformation calculable.

Fig 4: Employment German Car Industry (in 1000 jobs)



SOURCE: VDA, CAR

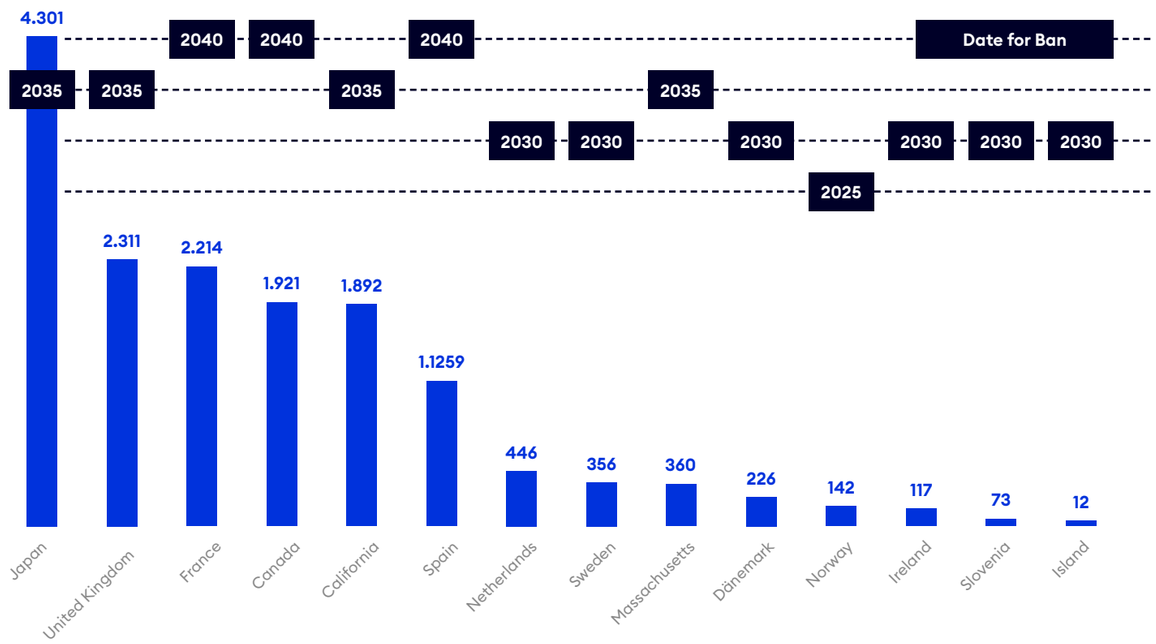
The announcement of an exit from the internal combustion engine is a clear investment signal for the power sector. The demand for electricity for battery-electric cars from the phase-out date will be predictable, which will initiate competition. Some kind of race between the power service providers for best location for charging stations will start with an agenda to ban combustion engines. Investments promise long-term profits selling charging power.

At the end of 2019, Japan had announced that it would be phasing out combustion engines for new vehicles from 2035 as shown in Fig.5. Japan is a significantly more important car nation than Germany. With car production of 8.33 million new cars, Japan was the third largest car manufacturing country in the world in 2019, behind China and the US.

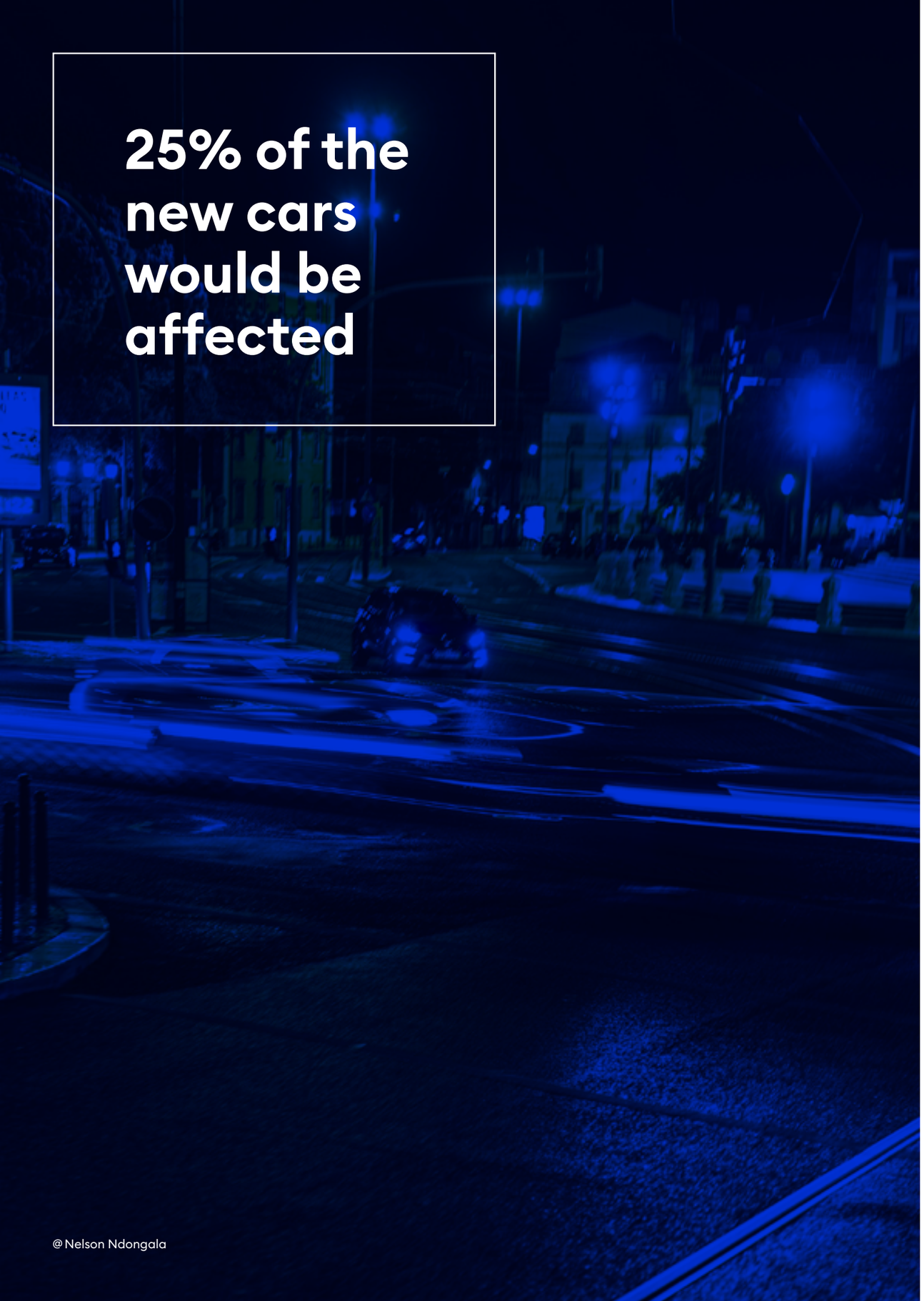
In automotive producing countries, such as Japan, Spain, Canada, France, UK or the Netherlands, exit data are defined. In these countries it is clear how high the demand for electric cars will be from the year of the phase-out. Car manufacturers can estimate the demand for electric passenger cars precisely, with significantly less risk and thus higher investment security. The same applies to battery manufacturers and suppliers. Worldwide, automotive countries with an annual production of 16 million cars - based on the year 2019 - and 1.7 million employees in the automotive industry have decided to phase out the internal combustion engine.

There is international pressure that drives electric vehicles. The faster Europe steps in, the better for industry. This is equivalent with establishing economies of scale fast and for faster progress we'll need stronger regulation.

Fig. 5: Car Markets with 15.6 Mio. Sales will Ban Combustion Engines
Passenger Car sales (in 1000 vehicles in 2019)



SOURCE: CAR



@ Nelson Ndongala

3.3. Ban of Combustion Engines Germany

One argument that is put forward repeatedly is that jobs would be endangered in the German auto industry with a fixed exit date for internal combustion engines. Is this argument viable? The fear of the switch marks the mood among German politicians and trade unions. They want the electric car, but in such a way that the jobs for combustion engines are preserved: squaring the circle. In 2019, 1.699 million people were employed in the five major car nations with an exit date and 832,000 people were employed in the auto industry in Germany. The job argument would - if it actually existed in its hard form - affect 1.7 million people.

How much could an exit from combustion engines in Germany affect employment in the auto industry? Domestic car production is decisive for this. According to the VDA, 3.99 million cars or 75% of the new cars produced in Germany were exported in 2019. With a fixed exit date for cars in Germany, “only” 25% of the new cars produced in Germany would be affected. For Germany, the arguments in Fig.6

Fig. 6: Automotive Nations with Exit-Strategy in Comparison

	Exit date combusion engines	**Passenger car production 2019** (in Mio. Units)	**Car-sales 2019** (in Mio. Units)	**Employees Car Industry 2019** (in 1000)
Japan	2035	8,33	4,30	910
Spain	2040	2,25	1,26	156
Canada	2040	1,96	1,92	130
France	2040	1,68	2,21	221
United Kingdom	2035	1,30	2,31	166
Schweden	2030	0,27	0,36	90
Netherlands	2030	0,18	0,45	26
Total		**16,0**	**12,8**	**1.699**
Germany		4,66	3,61	832

SOURCE: CAR, NATIONAL ASSOCIATIONS

Fig. 6 include production volumes of Opel and Ford as well for exports. At the same time, a fixed exit date would ensure that the German carmakers align themselves to domestic demand and therefore ensure their production facilities are geared towards battery electric vehicles.

3.4. Carmaker by itself announce Exit Strategies

During the last months carmakers started to define and announce exit strategies for internal combustion engines, as shown in Fig. 7.

Fig. 7: Carmaker with Exit-Strategy for Combustion Engine

	Exit announced by carmakers	Remarks
Bentley	2030	
Daimler	k.A	2039 only CO2-neutral new cars
Ford	2030 for Europe	
General Motors	2035	In 2025 GM to sell 1 Mio. BEV
Hyundai-Kia	k.A	1 Mio. BEV sales for 2025
Jaguar Land Rover	2025	
Porsche	k.A	In 2030 Porsche to sell 80 % EV
Renault	k.A	In 2025 Renault to 30 % BEV
Toyota	2050 CO2-neutral	
Volkswagen	k.A	In 2030 VW to sell 70 % BEV in Europa
Volvo	2030	In 2025 Volvo to sell 50 % BEV
VW-Konzern	k.A	In 2030 VW-group to sell 30 % BEV

SOURCE: PRESS ANNOUNCEMENTS BY CARMAKERS

The automotive industry itself seems not believe in the future of combustion engines in passenger cars. Announced planned regulations, such as the Euro 7 vehicle emission standards, will speed up this transition further. To establish the structures for electric vehicles fast will be decisive for the future of the European car sector.

3.5. Battery Cell Manufacturing Sites in Germany and Tesla add more than 30,000 Employees

Ahead of the transformation process starts in the engine and transmission manufacturing centres, another phenomenon can be observed in Germany: foreign direct investments in cell factories and cell assembly. The following plans have been announced or in development:

1. **CATL 16 GWh cell factory in Erfurt with expansion plans up to 100 GWh**
2. **sVolt - 24 GWh cell factory and module assembly in Saarland**
3. **Northvolt Zwei and VW- 40 GWh cell factory in Salzgitter**
4. **Farasis - 6 GWh with expansion plan to 10 GWh in Bitterfeld**
5. **Automotive Cells Company (ACC) PSA-Total -24 GWh in Kaiserslautern**
6. **Tesla Gigafactory - car factory and cell production with 12,000 employees by July 2021 in first construction phase**

Even with conservative calculations, the plants that will be fully operational by 2025 at the latest will employ more than 35,000 people in total, excluding wider employment effects in mechanical engineering and electrochemistry in Germany. The feared job loss as a result of the transformation starts in Germany with a major positive employment impulse that was not taken into account in many assessments in the past.

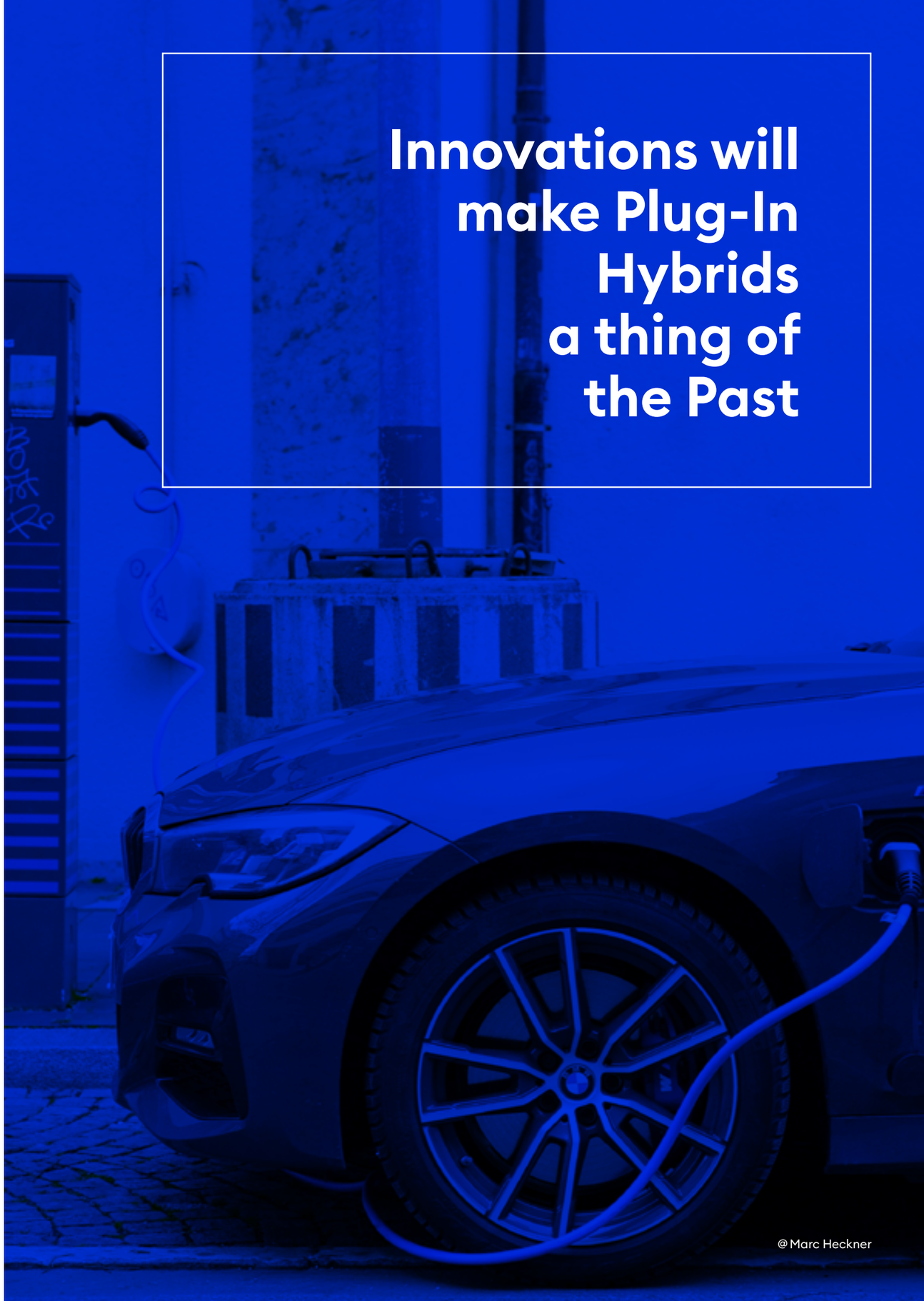
This is the status of 2020. It can be assumed with a high degree of certainty that this is by no means the final result, but rather an interim result. Therefore, it cannot be ruled out that the transition to electromobility could have a similar effect as the strengthening of the CO2 regulation in the year 2000, with the stipulation that the fleet consumption of 130 g CO2 / km had been achieved by 2015. These positive employment effects are shown in Fig. 4.

To conclude, we should not just concentrate on a small model-calculation focusing on substitution combustion engines with electric drivetrains. We have to take into account the whole process and therefore expect that fast transformation triggered by stronger regulation will show the same effects as described in sections 3.0 and 3.1. Innovations, substitution and disruption will create new jobs.

3.6. Innovations in Lithium-Ion-Batteries will make Plug-In Hybrids a thing of the Past

Considerable advances in electrochemical power storage systems can be expected in the next decade. Solid-state battery cells offer the biggest technological advancement, with improvements anticipated for charging time, energy content per kg, number of cycles, safety and costs. These may allow solid-state batteries to support a driving range of 1000 kilometres, with a battery pack weight that is in the order of magnitude of today's 400 km range for mid-range vehicles. The US start-up QuantumScape, in which the VW Group has an equity stake, as well as Toyota (Toyota's game-changing solid-state battery en route for 2021 debut - Nikkei Asia) and Samsung (High-energy long-cycling all-solid-state lithium metal batteries enabled by silver – carbon composite anodes | Nature Energy) went public with the first information on solid-state batteries. When these innovations are implemented, the charging and range comfort of fully electric vehicles will be equivalent to those of today's diesel passenger cars.

Continuous improvements in LFP and Cobalt-Nickel-Manganese cathodes, as well as silicon-based anode material already result in significant performance improvements. Near future battery technology introductions, such as the 4680 cell from Tesla, or blade batteries, will further improve battery costs and energy density. We are convinced that, as a result of the high level of technical progress, plug-in hybrids will no longer be marketable before 2030 due to high costs, expensive exhaust gas cleaning and rising CO2 taxes and we therefore do not include plug-in hybrids in our model.



4. The Model

In a model analysis, which is based on the framework conditions of the EU 27, we simulated the effects of a tightening of the CO2 requirements. The starting position is the 2019 EU CO2 guidelines with 130 gCO2/km per average car.

Fig. 8 illustrates the structure of the model and the key assumptions it makes. The framework is the EU 27 car market, which fluctuates at around 12.7 million car sales per year on a long-term average.

In the model we assume that there are two types of vehicles. The first type of vehicle is a 104g CO2/km car. In 2020, 94.6% of all new cars in EU 27 had been of this typ. Thus x = 0,946 for Fig. 8. The second type of vehicle is a BEV with 0 g CO2/km. In 2020, 5.4% of new cars in the EU 27 were BEV. This means that 1-x = 0.054 applies for 2020. The CO2 requirements in EU 27 had been fulfilled.

The CO2-emissions of the two car-types are measured according to the NEFZ-test procedure. Despite the fact that CO2-measurement will be based on the new WLTP-test-procedure, penalties still rely on NEFZ-test results. Therefore, we applied the NEFZ- procedure for our analysis.

The reference point in time for the model is the year 2030, considering two potential versions of the new CO2 fleet targets being in place:

1. **the original regulation target of 59.4 gCO2 / km**
2. **a revised regulation target of 47.5 gCO2 / km that is proposed to become effective after EU 9/2020 (see chapter 1. Introduction)**

Two questions arise:

1. **How many additional BEVs must be sold to meet the proposed stronger standard of 47.5 g CO2/km (change in the mix)?**
2. **What employment effects will result according to our model for the countries??**

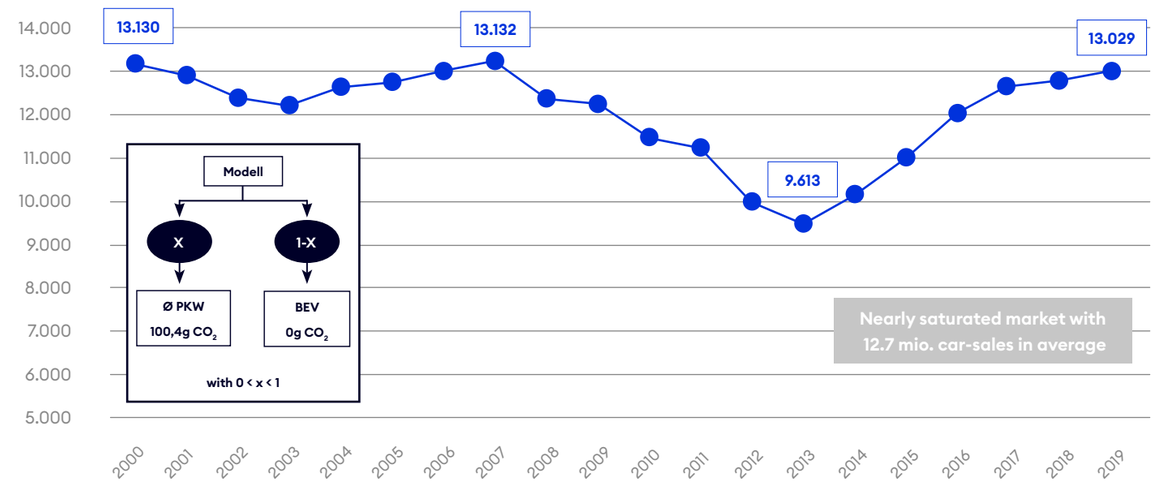
a.) Germanyb.) France c.) Italy d.) Spain e.) Slovakia

The model assumes that plug-in hybrids will hardly play a role by 2030. This is also because great advances in battery storage technology are to be expected. (see also sections 3.5 and 3.6)

4.1. The Model Mix in 2030

Fig. 8 summarises the results. In our model, in 2020 with the 95 g CO2 target, 5,4% of new cars in EU 27 must be fully electric vehicles (BEV). According to the previous requirements of EU Regulation 2019/631, only 59.4 gCO2 / km are permitted in the fleet average for 2030.

Fig. 8: Car Market EU 27 (in 1.000 units)



SOURCE: ACEA, CAR

Fig. 9: Modell-Mix 2030

	BEV Share	EU market (cars)	BEV (cars)
BEV in 2020 with 95 gCO2/km	5,4 %	12.700.000	685.800
BEV in 2030 with 59,4 gCO2/km	40,9 %	12.700.000	5.187.963
BEV in 2030 with 47,5 gCO2/km	52,7 %	12.700.000	6.692.900
Additional BEV due to tightening	11,8 %	12.700.000	1.504.937
Additional cells at 60 KWh per vehicle			**90 GWh**

With the 9/2020 proposal of the EU Commission of 47.5 gCO2 / km, our model shows that a BEV share of 52.7% or 6.692.900 fully electric new vehicles, are necessary to meet the more stringent fleet target. The model also shows that due to the stricter fleet targets, 1.504.937 BEVs must be sold in addition. This answers question 1 in section 4.

1. How many BEVs will have to be sold as a result of the proposed tightening (change in the mix)??

- Answer: 1.504.937 BEV

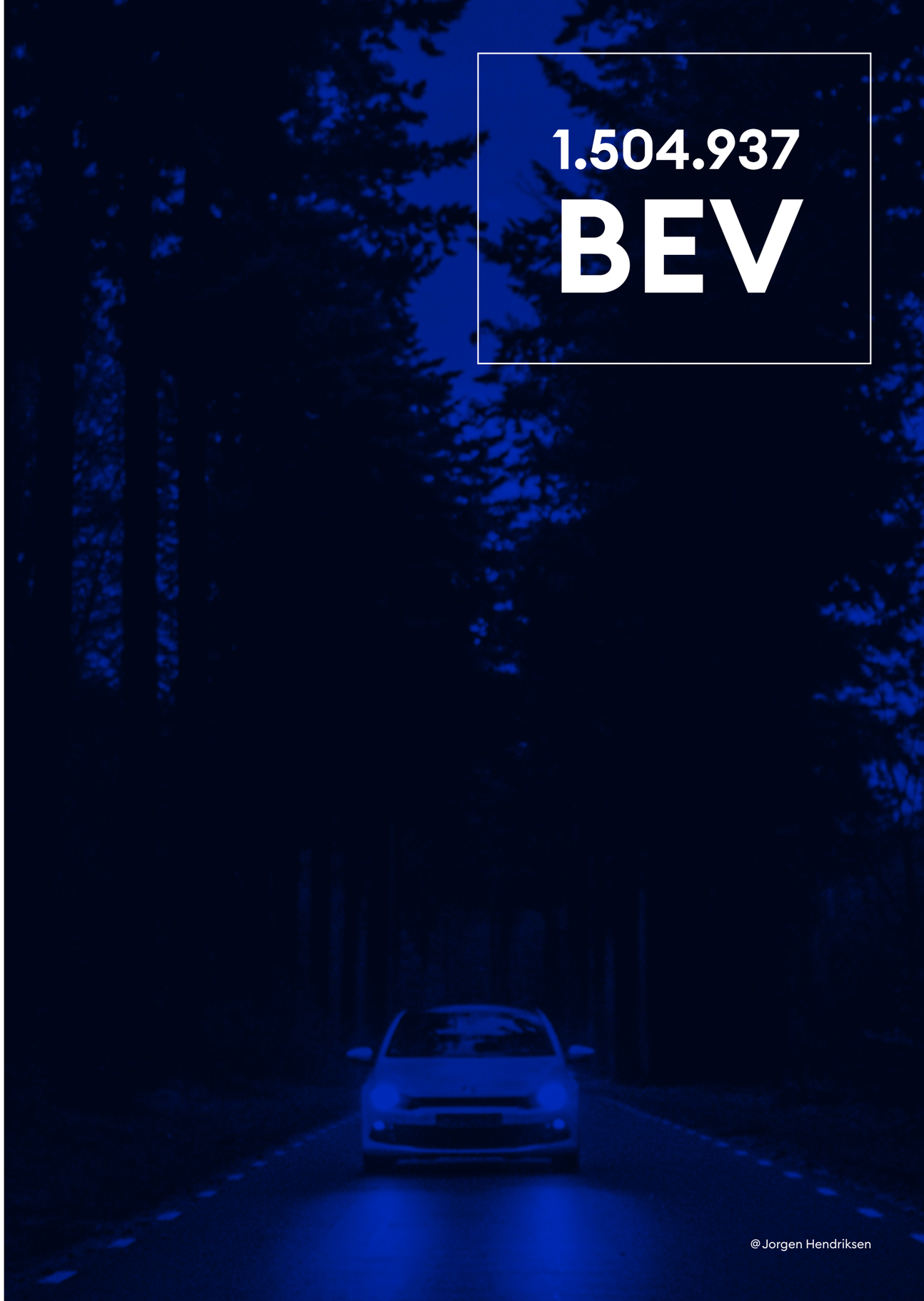
At the same time, the need for battery cells is increasing. With an assumed battery capacity of 60 kWh per new car, the tightening of regulation would mean an additional lithium-ion cell capacity of 90 GWh. In other words: More than one Giga factory from Tesla in Fremont in their final stage of 55 GWh. The total investment should then be 9 billion euros for the additional cell capacities, based on the Panasonic-Tesla figures. If we take into account the related jobs in battery cell manufacturing and assembly, the reported 90 GWh would correspond to an additional 25,000 jobs.

4.2. Employment-Effects in Germany

In the next step, let‘s take a look at how the more ambitious of CO2 requirements in 2030 will affect car production in Germany. We take the car production figures for 2019 as a reference date, as shown in Fig. 10 below

Fig. 10: Production-Effects for Germany

	2019	2019 Share
Car-production Germany (in units)	4.663.749	100,0 %
Car-production Germany allocated to EU (in units)	3.108.539	66,7 %
Germany: Additional BEV due to EU tightening in %	11,8 %	11,8 %
Additional BEV due to tightening allocated to EU (in units)	368.359	11,8 %
Share additional BEV in car-production Germany	**7,9 %**	**7,9 %**



@ Jorgen Hendriksen

A total of 3.1 million cars were produced in Germany in 2019, which were sold in the internal market (EU 27). In our model calculation for the tightening of CO2 emissions (Fig. 9), an additional 11.8% of electric cars are required due to stricter emission requirements. This results in the 368,359 additional electric cars mentioned in Fig. 10. Measured against car production in Germany, that is 7.9% of total car production, a manageable number.

At the end of April 2020, the automotive industry in Germany had 814,000 employees. Let us now make a first, very simple estimate of how an additional 7.9% electric cars or fewer combustion engines in production can affect jobs. It is an upper limit that we are now defining because not all jobs are affected by electromobility.

Fig. 11: Employment-Effects Germany

	Apr 20
Employment Car Industry Germany	814.000
Share added value powertrain	35 %
35% of employees allocated to powertrain	284.900
6,1% less employees due to fewer ICE 2030 by stronger CO2	22.502
Share of replaced manpower from total employment	2,8 %
Net-Reduction Jobs 66% (without battery-cell-production)	**14.852**
Net-Reduction Jobs 66% share on total	**1,8 %**

An upper limit for jobs that could arise as a result of the tightening would be 2.8% of the total number of employees in the auto industry or 22,502 jobs. At the same time, the additional electric cars also need electric motors, power electronics, battery modules, cells and so on. If one assumes that two thirds of the jobs in the powertrain production are eliminated - which is more of an upper limit if the jobs necessary for the electric drive train are offset – 14,852 jobs are still at risk from the tightening.

However, this does not take into account that further battery cell production has to be organised and that green electricity is necessary for cell production. Furthermore, additional charging stations and wall boxes will be required, and electric cars will generate additional sales, with a positive impact on jobs in wind and solar power generation. In summary, we do not predict a negative workplace effect in the German auto industry.

Additional positive effects from the transition to e-mobility, such as increased exports of electric cars from Germany, have not been included in the analysis. The longer the German auto industry concentrates on „combustion engine drives and plug-in hybrids“, the weaker its international competitive position will be. Much like the Tesla Gigafactory in Grünheide, the German auto industry is gaining potential and strength.

Conclusion: We do not expect a negative effect on the employment in the German car industry due to stricter EU requirements. The opposite is, in fact, the case, as Section 3.1 has shown; an increase in employment in Germany can be expected.

Effects in Germany

@ KIA

4.3. Employment-Effects in France

Similar to the analysis for Germany, we analysed the job effects for France within our model. Based on the 2019 car production figures in France, the car production effects shown in Fig. 11 result.

Fig. 12: Production-Effects for France

	2019	2019 Share
Car-production France (in units)	1.675.198	100,0 %
Car-production France allocated to EU (in units)	1.327.805	79,3 %
France: Additional BEV due to EU tightening in %	11,8 %	11,8 %
Additional BEV due to tightening allocated to EU (in units)	157.343	9,4 %
Share additional BEV in car-production France	**9,4 %**	**9,4 %**

A total of 1.33 million cars were produced in France in 2019 and sold in the internal market (EU 27). In our model calculation for the tightening of CO2 emissions (Fig. 8), an additional 11.8% of electric cars are required due to the tightening of the CO2 fleet standards. This results in the 157,343 additional electric cars mentioned in Fig. 12. This corresponds to 9.4% of the total car production in France.

Fig. 13 shows how the additional 157,343 fully electric cars affect employment in the present model. The present model results in a loss of 4,978 jobs for France.

This calculation does not take into account that further cell production is necessary, that green electricity is necessary for cell production, that additional charging stations and wall boxes are needed, nor that electric cars will generate additional sales, with a positive impact on jobs in wind and solar power generation. In summary, we do not predict a negative impact on jobs in the French auto industry - even with a strict analysis. A previous Cambridge Econometrics analysis and other studies indicate considerable positive employment effects in the construction, electricity, hydrogen, services and many manufacturing sectors due to the transformation of the car industry.

Fig. 13: Employment-Effects France

	2019
Employment Car Industry France	229.422
Share added value powertrain	35 %
35 % of employees allocated to powertrain	80.298
6,1 % less employees due to fewer ICE 2030 by stronger CO2	7.542
Share of replaced manpower from total employment	3,3 %
Net-Reduction Jobs 66 % (without battery-cell-production)	**4.978**
Net-Reduction Jobs 66 % share on Total	**2,2 %**

Conclusion: We do not expect a negative effect on employment in the French car industry due to stricter EU requirements. The opposite is the case, as section 3.1 has shown for the preceding analyses, an increase in employment can be expected.

4.4. Employment-Effects in Italy

Analogous to Germany and France, Fig. 14 and Fig. 15 show the effects to be expected for Italy according to the model.

Fig. 14: Production-Effects for Italy

	2019	2019 Share
Car-production Italy (in units)	542.007	100,0 %
Car-production Italy allocated to EU (in units)	375.890	69,4 %
Italy: Additional BEV due to EU tightening in %	11,8 %	11,8 %
Additional BEV due to tightening allocated to EU (in units)	44.543	11,8 %
Share additional BEV in car-production Italy	**8,2 %**	**8,2 %**

Fig. 15: Employment-Effects Italy

	2019
Employment Car Industry Italy	176.303
Share added value powertrain	35 %
35 % of employees allocated to powertrain	61.706
6,1 % less employees due to fewer ICE 2030 by stronger CO2	5.071
Share of replaced manpower from total employment	2,9 %
Net-Reduction Jobs 66% (without battery-cell-production)	**3.347**
Net-Reduction Jobs 66% share on total	**1,9 %**

Effects in Italy

According to the present model, the planned stricter CO2 requirements will result in a substitution of 44,543 internal combustion engine cars with fully electric ones. This corresponds to the net loss of 3,347 jobs in Italy.

As in section 4.2 (Germany) and 4.3. (France) the calculation in Fig. 15 does not take into account that further cell production activities are required. Further green electricity is requisite for cell production, additional charging stations and wall boxes have to be built and maintained. We expect electric cars will generate additional sales, with a positive impact on jobs in wind and solar power generation. In summary, we do not predict a negative workplace effect in the Italian auto industry. Drawing from a previous Cambridge Econometrics analysis and other studies, we expect positive employment effects in the construction, electricity, hydrogen, services and many manufacturing sectors due to the transformation of the car industry.

Conclusion: A negative effect on the employment in Italian car industry due to stricter EU requirements is not predicted. The opposite is the case, as section 3.1 has shown for the preceding analyses, an increase in employment can be expected.

Effects in Spain

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4.5. Employment-Effects in Spain

Following the same pattern as the three above countries, Fig. 15 and Fig. 16 show the model results for Spain. A production switch of 206,705 cars is calculated for Spain, which corresponds to a net loss of 3,454 jobs.

Fig. 16: Production-Effects for Spain

	2019	2019 Share
Car-production Spain (in units)	2.248.019	100,0 %
Car-production Spain allocated to EU (in units)	1.744.362	77,6 %
Spain: Additional BEV due to EU tightening in %	11,8 %	11,8 %
Additional BEV due to tightening allocated to EU (in units)	206.705	11,8 %
Share additional BEV in car-production Spain	**9,2 %**	**9,2 %**

Fig. 17: Employment-Effects Spain

	2019
Employment Car Industry Spain	162.634
Share added value powertrain	35 %
35% of employees allocated to powertrain	56.922
6,1% less employees due to fewer ICE 2030 by stronger CO2	5.234
Share of replaced manpower from total employment	3,2 %
Net-Reduction Jobs 66 % (without battery-cell-production)	**3.454**
Net-Reduction Jobs 66 % share on total	**2,1 %**

This calculation (Fig. 17) does not take into account that further cell production is required, that green electricity is necessary for cell production, that additional charging stations and wall boxes are also needed. We expect electric cars will generate additional sales, with a positive impact on jobs in wind and solar power generation. In summary, we do not predict a negative workplace effect in the Spanish auto industry. Within that context, a previous Cambridge Econometrics study showed considerable positive employment effects in the construction, electricity, hydrogen, services and many manufacturing sectors due to the transformation of the car industry.

Conclusion: A negative effect on the employment in Spanish car industry due to stricter EU requirements is not predicted. Rather the opposite is the case, as section 3.1 has shown in the preceding analyses, an increase in employment can be expected.

4.6. Employment-Effects in Slovakia

With a car production of 1,069,442 vehicles in 2019, Slovakia was the fifth largest car production country in EU 27. In our model, the effects shown in Fig. 18 and Fig. 19 result for Slovakia.

The model shows that 76,063 of the 1,069,442 manufactured passenger cars must be produced on a fully electric basis due to the planned stricter CO2 regulation. This would mean that 1,335 jobs would be lost in the present model.

Fig. 18: Production-Effects for Slovakia

	2019	2019 Share
Car-production Slovakia (in units)	1.069.442	100,0 %
Car-production Slovakia allocated to EU (in units)	641.886	60,0 %
Slovakia: Additional BEV due to EU tightening in %	11,8 %	11,8 %
Additional BEV due to tightening allocated to EU (in units)	76.063	11,8 %
Share additional BEV in car-production Slovakia	**7,1 %**	**7,1 %**

Fig. 19: Employment-Effects Slovakia

	2019
Employment Car Industry Slovakia	81.273
Share added value powertrain	35 %
35 % of employees allocated to powertrain	28.446
6,1 % less employees due to fewer ICE 2030 by stronger CO2	2.023
Share of replaced manpower from total employment	2,5 %
Net-Reduction Jobs 66 % (without battery-cell-production)	**1.335**
Net-Reduction Jobs 66 % share on total	**1,6 %**

As in the case of Germany, France, Italy and Spain, the calculation in Fig. 19 does not take into account that further cell production is necessary, that green electricity is necessary for cell production or that additional charging stations and wall boxes are needed. We also expect that electric cars will generate additional sales, with a positive impact on jobs in wind and solar power generation. In summary, a negative workplace effect in the Slovakian auto industry is almost impossible to measure. Drawing from a previous Cambridge Econometrics analysis and other studies, we expect positive employment effects in the construction, electricity, hydrogen, services and many manufacturing sectors due to the transformation of the car industry.

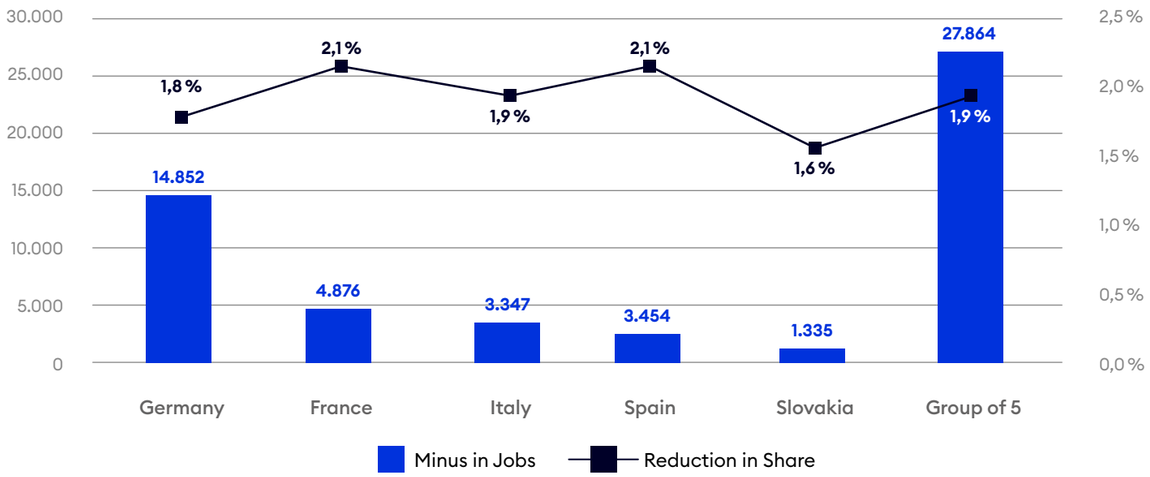
Conclusion: A negative effect on the employment in Slovakian car industry due to stricter EU requirements is not predicted. Rather, the opposite is the case, as section 3.1 has shown for earlier specifications, an increase in employment can be expected.

5. Conclusion

This model-based analysis shows that even in a static one-sector model, insignificant net effects on employment in five important vehicle production countries in the EU can be expected as a result of a stronger CO2-regulation as intended by the EU commission.

According to our model less than 28,000 direct jobs in the automotive sector of the five countries Germany, France, Italy, Spain and Slovakia are at risk as Fig. 20 shows. This corresponds to a risk to 1.9% of the employees in the automotive sector. The need for additional

Fig. 20: Employment-Effects without other Sectors



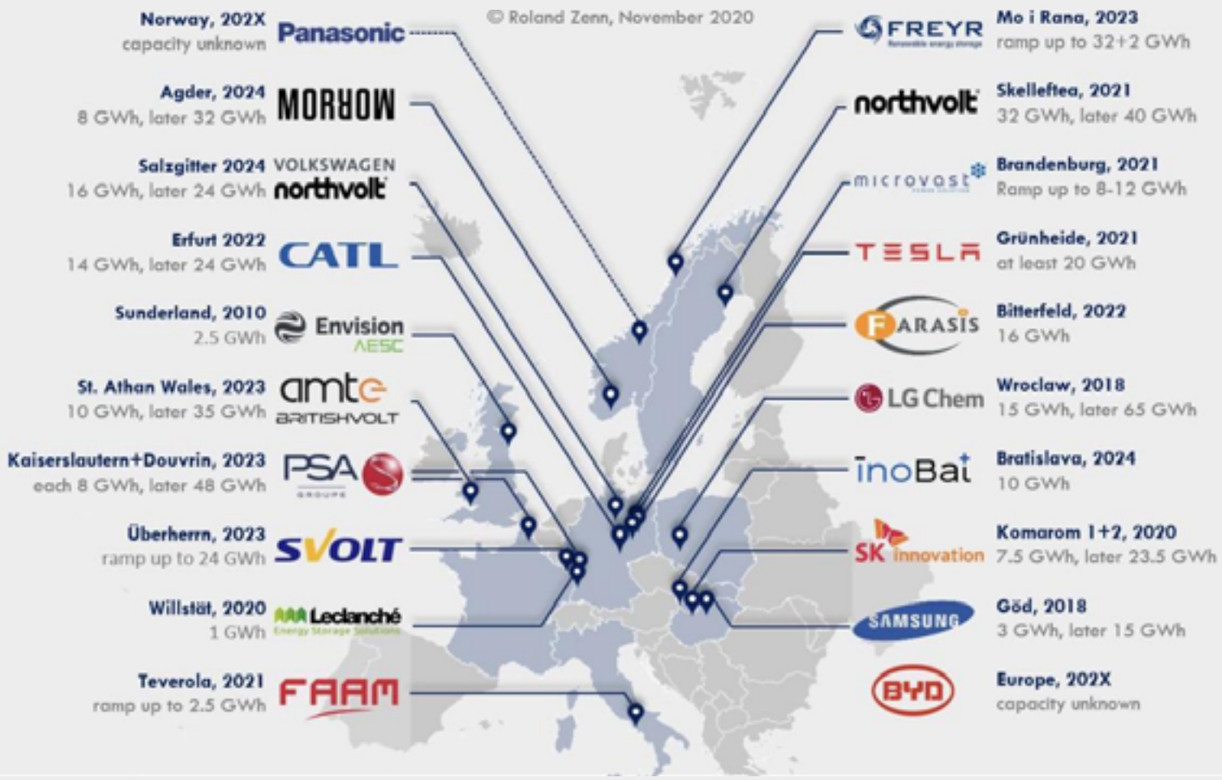
battery cell factories for 90 GWh (see Fig. 9) lithium-ion production capacity due to stricter CO2 requirements (as noted in Section 4.1.) is associated with an additional requirement of 25,000 jobs.

It must be noted that this is the worst-case scenario, assuming that we will not have positive effects in other sectors as well as neglecting competitive advantages, the automotive industry can be expected by a fast transition into green technology.

Other studies, like the study completed by Cambridge Economics, point to considerable positive employment effects in the construction, electricity, hydrogen, services and most other manufacturing sectors if the car industry gets behind electric vehicles. Thus, overall, we will have strong positive employment effects by transitioning car production to electric vehicles.

Furthermore, we have strong evidence from the strengthening of the EU-CO2-regulation in the period 2008 to 2015. During this time, important innovations became marketable. Fuel saving innovations helped the industry to become more competitive and to increase employment. Figure 3 provides an insight into the green innovations which went into the mass-production, including lightweight construction, 3-cylinder engines, Start-Stop-Systems, Mild Hybrids, downsizing of internal combustion engines and shift point displays. At that time, without

Dawn of European Gigafactories: Announced Lithium Ion Battery Cell Production Sites



regulation all these innovations couldn't be sold in the market. What occurred in 2008 to 2015 can be repeated by fast transformation of the European car industry.

Of great importance is the new battery-cell industry in Europe. Fig. 21 provides a map which shows the currently know plans for battery production in Europe. Further, in March 2021 Seat announced at a ceremony with Spain's King to support plan for a battery cell production site in Martorell. Stimulated by the strengthened EU CO2 requirements, international chemical and cell production groups have invested or are planning to invest in the EU on a large scale. According to Fig. 21 there are plans for 350 GWh cell production capacity.

The tightening of the CO2 standards leads to the faster and larger construction of the battery production in Europe with the chance that additional vehicle production will come back to Europe, as economies of scale come into effect. According to current estimates, there will around 50,000 new jobs in 2030 that will be created by switching to electromobility.

Today carmakers including General Motors, Ford, VW, Audi, Porsche, and Mercedes have already announced that they will focus on electric vehicles as fast as possible. Mary Barry, CEO of GM, announced early this year that GM will stop producing combustion engine cars by 2035, Volvo by 2030 and Jaguar-Landrover from as early as 2025. Strong regulation will support these bold decisions and will help us to establish a competitive future car industry in Europe.

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