POWERING A NEW VALUE CHAIN IN THE AUTOMOTIVE SECTOR

The job potential of transport electrification

EuropeOn

ELECTRICAL CONTRACTORS ASSOCIATION

ACKNOWLEDEMENTS

Report Team

Alyssa Pek, Communications Advisor, EuropeOn

Giorgia Concas, Secretary General, EuropeOn

Janne Skogberg, EuropeOn Expert, Electric Vehicles, STUL

Lucien Mathieu, Transport & Emobility Analyst, Transport & Environment

Oddvin Breiteig, EuropeOn Expert, Electric Vehicles, NELFO

Disclaimer

The stakeholders who contributed to this study shared the aim of establsihing a constructive and transparent exchange of views on the economic and social implications of transport electrification in Europe. The objective was to complement existing studies on this topic and bring a different perspective to ongoing debates. Each stakeholder contributed their knowledge and vision on these issues. The information and conclusions in this report represent these contributions, but should not be treated as binding on the organisations involved. This study was undertaken with the technical assistance of Transport & Environment.

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EXECUTIVE SUMMARY

Transport is the single biggest source of CO2 emissions in Europe and a major cause of urban air pollution and its health effects.
Electromobility is seen as a key solution to tackling both concerns and also a generator of considerable positive economic impacts, both at the macro-level and for individual citizens in lower fuel costs.

However, there are concerns the shift to electromobility will result in a reduction in jobs in the automotive industry. This study has therefore sought to assess whether jobs created in the new electromobility value chain offset those lost in automotive manufacturing.

The study has assessed job creation in a number of electromobility value chain segments and concludes that by 2030 a total of nearly 200,000 permanent jobs would be created. This is based upon a moderate uptake of plug-in vehicles amounting to around 35% of new car sales by 2030.

Jobs created in the electricity value chain are several times higher than those lost (even in worst case assumptions) in automotive manufacturing.

Most of the new jobs will be downstream and are associated with the installation, operation and maintenance of charging points.

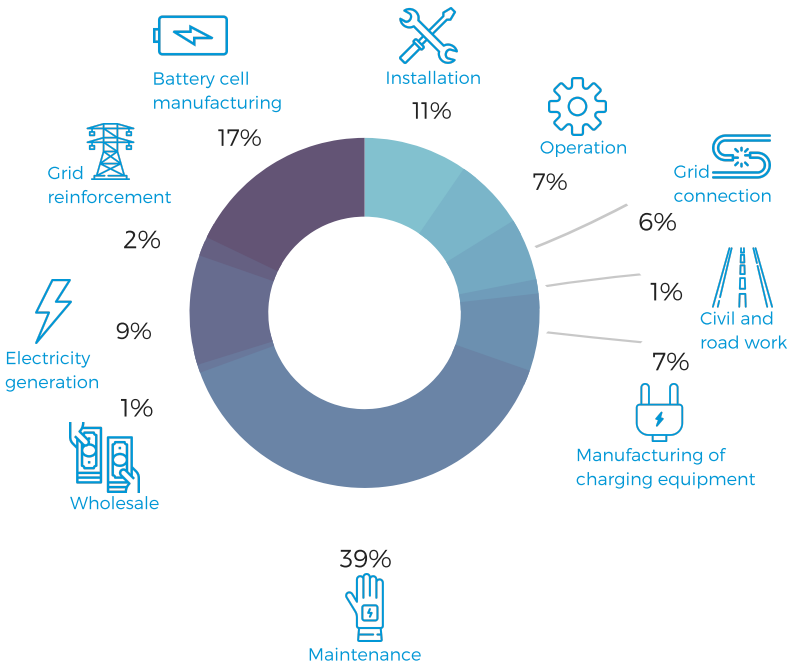
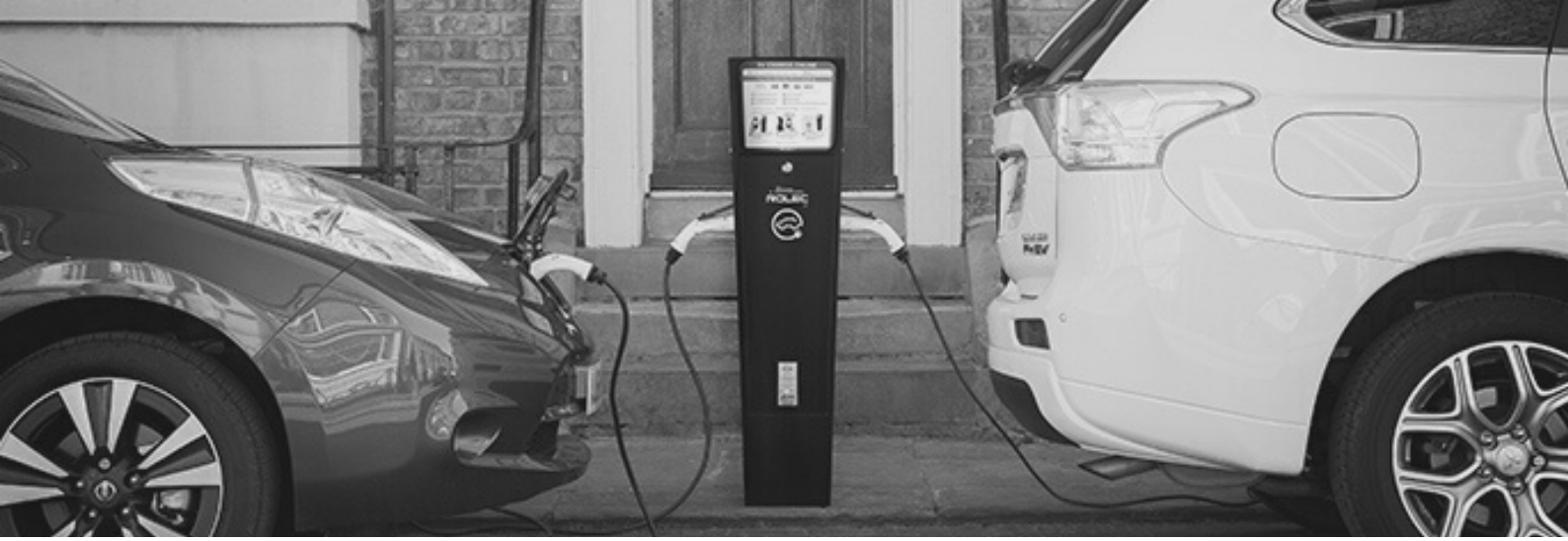


Figure 3: A breakdown of the total 199,470 jobs created in the baseline scenario based on sector.

Altogether, these segments will create around 112,500 new jobs, accounting for 57% of job creation.
The message is clear: electromobility is good for the environment, good for drivers - who achieve lower vehicle running costs - and good for jobs and the economy.

This study only has a 2030 time horizon and only covers electric passenger cars. Additional jobs will be created after 2030 and through electrification of vans, trucks and buses, as well as of shipping and aviation.



INTRODUCTION & BACKGROUND

Transport is the single biggest source of CO2 emissions in Europe, responsible for around 27% of total EU CO2 emissions.[1] Combustion engine vehicles also pose a problem in terms of air quality, especially in cities, with negative consequences on the health of European citizens. There is general agreement among policy makers and stakeholders that a transition to clean mobility is necessary in Europe.

Several analyses have established that transport decarbonisation would not only yield climate and health benefits, but it would also create positive economic impacts, both at the macro-level and for individual citizens. These result from lowered oil imports, a positive EU trade balance and savings for consumers to fuel their cars.

Despite these clear benefits, questions have been raised about the potential impact of electromobility on jobs in Europe.

A study from the Fraunhofer Institute has looked at the employment impact of electromobility on the German car manufacturing industry.[2] A report from Cambridge Econometrics has examined the macro-economic impact of electromobility on jobs in Europe.[3] Our assessment specifically considers the effect of a shift to electric passenger cars on jobs along the new electromobility value chain.

Electrical Contractors in the driver's seat for Europe's electromobility journey

For over more than 100 years, electrical contractors have built both power infrastructure and installations to bring electricity, from the countryside to cities, to all consumers, from businesses to households. EuropeOn, the European Association of Electrical Contractors, is the voice of these hard-working employees.

The electrical contractors' role has always been crucial, as electricians are there wherever power is needed and where equipment and infrastructure needs to be designed, installed, maintained, refurbished and dismantled.

The electrical contracting sector creates a high number of local jobs and powers an extensive network of small businesses across Europe - EuropeOn alone represents more than 1 million electricians and over 100,000 small and medium electro-technical service companies.

In the last one or two decades, the role of electrical contractors has evolved from the physical connection of single pieces of equipment to the physical and digital

integration of systems and solutions, spanning from smart cities, to smart power grids and buildings.

Today, electrical contractors are at the forefront of Europe's electrification, decarbonisation and digitalisation trends, and are key to reaching Europe's objectives for energy efficiency, renewable energy and clean transport.

The installation and operation and maintenance of electric vehicle (EV) chargers has already started impacting electricians across Europe, who are ramping up their skills and are taking advantage of this new business opportunity, diversifying their portfolio of services to include electromobility. In the next years, electromobility will accelerate the current trend towards more wide-ranging, skilled electricians' jobs across Europe.

This study asks the question how many jobs will electromobility create? It is intended to inform policy makers and stakeholders as they engage in the current legislative debates including on future car and van CO2 regulations.

THE ELECTRICAL CONTRACTING SECTOR CREATES A HIGH NUMBER OF LOCAL JOBS AND POWERS AN EXTENSIVE NETWORK OF SMALL BUSINESSES ACROSS EUROPE - EUROPEON ALONE REPRESENTS OVER 1 MILLION ELECTRICIANS AND OVER 100,000 SMALL AND MEDIUM ELECTRO-TECHNICAL SERVICE COMPANIES.

Current status of electromobility in Europe

Today, electric vehicles represent less than 1% of the car stock in the EU. However, sales of EVs are growing exponentially (from 70,000 new EV sales in 2014 to 217,000 new sales in 2017) - and so are the installations of EV chargers, with 26,000 public chargers in 2014 to 132,000 installed public chargers today.[4]

Increasing EV competitiveness and consumer awareness will generate continued growth in the EV market; however, EU legislation under negotiation may have a very important impact on determining the likely minimum growth in the next decade.

In particular, as part of the new EU regulation on emission performance standards for new passenger cars and for new light commercial vehicles, the EU Parliament and Council are currently debating decreasing allowed CO2 emissions from cars and minimum sale shares of zero-emission vehicles by 2025 and 2030. Depending on how ambitious and strict these objectives are set, the EV market may have a small or big boost in the EU. As negotiations stand today, it seems that EU objectives will translate into around 35% new EV sales by 2030; this means that in the same year EVs will represent about 10% of the fleet.

Existing analyses estimate that the number of jobs in car manufacturing in Europe may decrease in the future with an uptake in electromobility. The manufacturing processes are much simpler in battery electric cars than those with internal combustion engine (ICE) vehicles. However, the manufacturing for plug-in hybrid vehicles is more employment intensive. The impact upon net car manufacturing jobs will therefore depend upon the ratio of battery electric to plug-in hybrid models. Employment in the sector will also be impacted by productivity gains from robotisation occurring throughout the

manufacturing industry. However, this effect will occur irrespective of electrification.

The report "Mapping out the future for the automotive industry"[5], published by the Fraunhofer Institute and commissioned by the major car manufacturers in Germany, claims that 75,000 jobs of the current 210,000 jobs would be lost in the German automotive industry from 2017 to 2030. However, only 27% of these job losses can be attributed to the rise of electromobility, with the remaining losses being a consequence of productivity gains.

It is also important to note that the Fraunhofer study assumes that battery electric models will take up 40% of the passenger vehicle market share in Europe, more than what foreseen by the EU regulation on CO2 standards for cars that is currently under negotiation. The Fraunhofer study also assumes that battery manufacturing, a key segment of the EV value chain, will take place outside of Europe despite many important initiatives by the EU and evidence carmakers are likely to source cells close to manufacturing sites for electric cars.

Ultimately, it is undeniable that electromobility is on the rise in Europe and we are only just beginning to see its impacts on the EU's economic and social situation. The more we understand its impact, the better we can prepare and take advantage of the EV revolution for the benefit of all Europeans.

About this study

Whilst employment in car manufacturing may decline in coming years, the shift towards electrification will ultimately create a high number of new jobs along the transport value chain. This study quantifies the jobs that will be created due to electromobility along the full electrical value chain, including: the production of batteries and chargers, the sales of electrical equipment, the installation, connection to the

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grid, operation and maintenance of the chargers, associated grid reinforcements and civil and road work, as well as production of necessary additional electricity. These jobs are high skill and entirely new to the automotive sector.

It is important to stress that the scenario we take in this study is of 35% new EV sales, translating into around 10% EVs in the total car fleet by 2030. Looking at how rapidly new technologies are adopted today, we think that the deployment of electric passenger cars may go well beyond our assumptions by 2030. After 2030, we are convinced that the electrification of the whole passenger car fleet and of broader road transport, i.e. buses, vans and trucks, as well as of shipping and aviation, will lead to the need for a much larger charging infrastructure and for a market for the replacement of old charging equipment after 2030. Hence, we do not see 2030 as the peak year for transport electrification employment. On the contrary, 2030 will only be the first step on the path to the transport electrification revolution.

METHODOLOGY

Scope

Time: This study has a 2030 time horizon, as targets at EU level are being set for this year.

Geographical scope: This study covers EU28. Of course, if we had expanded the scope to geographical Europe, numbers would have been higher, driven primarily by Norway - one of the world leaders in electromobility.

Vehicles: This study only covers passenger cars. Electrification of buses and freight transport can also have a significant impact on job creation; in particular, urban buses and urban delivery are bound to electrify at an important rate. However, this analysis focuses only on passenger cars. This analysis excludes also rail transport, which is already extensively electrified, and shipping and aviation, as currently there are no plans in EU28 to sensibly electrify these two sectors by 2030.

Chargers: We have considered all types of chargers, from home to ultra-fast charging points.

Sectors: Jobs created are classified in 10 sectors: battery manufacturing, charger manufacturing, wholesales, installation of the chargers, grid connection, grid reinforcement, civil and road work, charge point operation, charge point maintenance and electricity generation. Job creation from manufacturing of electrical equipment and power electronics for vehicles is excluded from this analysis. We have also excluded job creation from the replacement of chargers. Finally, we have not included in this report the jobs derived from the installation, operation and maintenance of complementary technologies, such as solar PV and battery systems.

Calculation

The general approach to this analysis is illustrated in the flowchart Figure 1 below. In blue are the main assumptions (see Annex for details on the assumptions used). The assessment described in the figure is made for every year between 2015 and 2030.

The assessment of the 5 other categories follows a different approach:

- Charge point operation: the number of jobs is simply calculated from the number of public chargers that can be operated by a single employee on average.
- Charge point maintenance: the number of jobs is estimated based on the average number of hours required for the maintenance of each type of charger.
- Electricity generation: the amount of additional electric energy required to power the vehicles is converted into a number of jobs based on today's figure of the total

number of employees required to generate EU's total electricity production.

- Battery manufacturing: Based on the number of er
- Grid reinforcement: Based on low voltage and medium voltage grid reinforcement cost estimates per r

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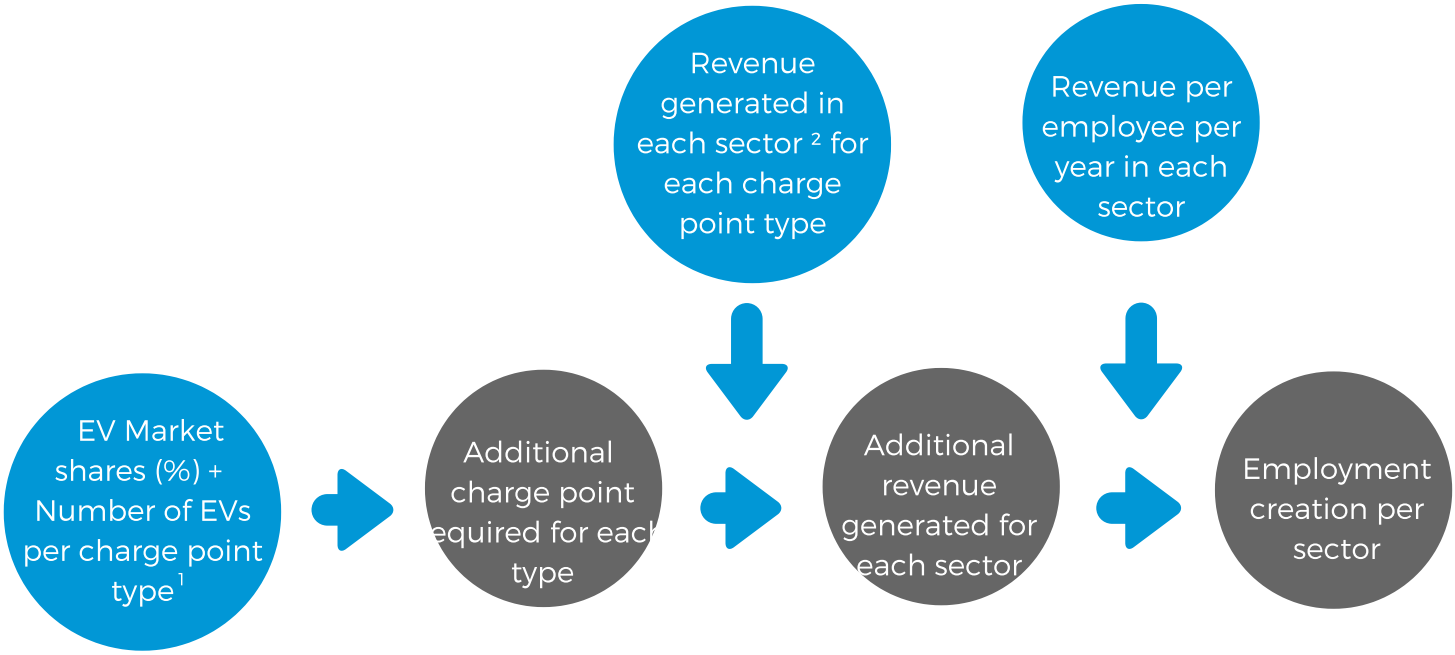
FIGURE 1: METHODOLOGY FLOW CHART



[1] The charging infrastructure considered are classified in 5 categories here: Home chargers (typically 3.7-7kW), work chargers (typically 3.7-7kW, with some 11-22kW), public charging in parking (typically 11-22kW on-street-parking), public fast charging (50kW) and ultra-fast charging (150-350kW).

[2] This approach only applies to the installation of the chargers, the manufacturing of the charging equipment, the grid connection, the civil and road work and the wholesales.

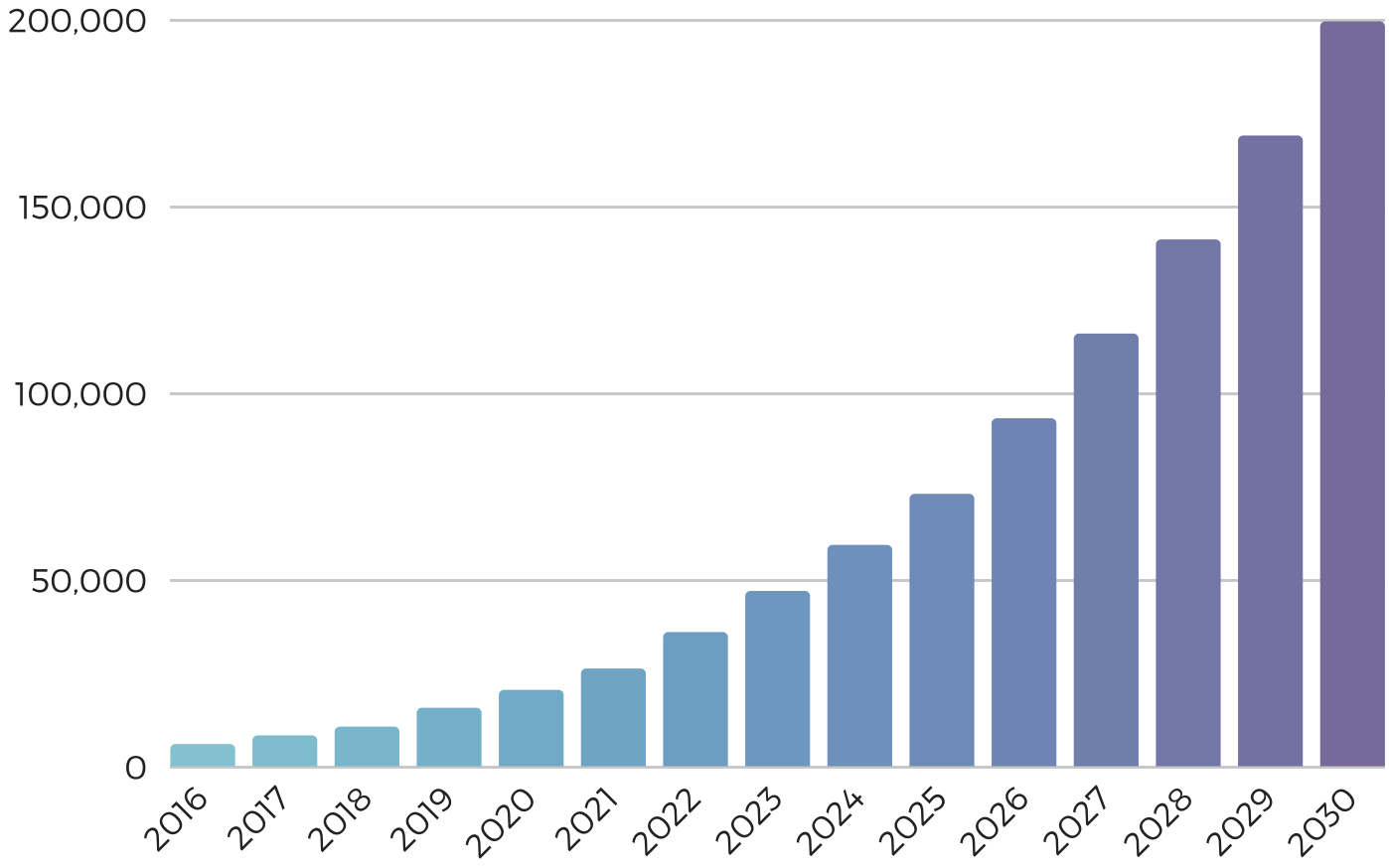
RESULTS

Overall Job Creation

As the uptake of EVs increases every year in Europe to meet the proposed 35% target, nearly 200,000 permanent jobs would be created due to electromobility by 2030. As you can see in Figure 2, we would see an exponential growth in job creation overall.

It is worth noting that our estimations for the year 2030 are in the same range as projections from the report "Fuelling Europe's Future: How the transition from oil strengthens the economy" from Cambridge Econometrics.[7] The Fuelling Europe's Future study took however a broader macro-economic approach, and did not consider some of the value chain

FIGURE 2: TOTAL NEW JOBS CREATED FROM EV 2016 - 2030



AS THE UPTAKE OF EVS INCREASES EVERY YEAR IN EUROPE TO MEET THE PROPOSED 35% TARGET, 199,470 PERMANENT JOBS WOULD BE CREATED DUE TO ELECTROMOBILITY BY 2030.

segments which we have now analysed. Combining these two approaches together, we can see that EVs will create a positive economic impact from all perspectives.

While our analysis stops at the year 2030, we can take our findings and realistically apply them to a more long-term scenario where 100% of Europe's car fleet are EVs, as many EU countries are planning to ban the sale of ICE cars by 2050 or before. If we assume that all of EU's fleet is 100% electric, the number of permanent jobs in the electromobility sector would stabilise at 1.1 million in this year for the maintenance and operation of the chargers and the battery manufacturing and electricity generation.

This is not taking into account the jobs that would inevitably also be created for the replacement of chargers, which currently have a lifespan of about 15 years. An additional 116,000 more permanent jobs would be created if we were to consider the installation and equipment manufacturing associated with charger replacement.

Altogether, our analysis shows that approximately 1.2 million permanent jobs would be created in the electromobility sector once the car fleet is 100% electric in Europe.

Moreover, it is important to note that the jobs created in the sectors under analysis are jobs that are local and cannot necessarily be automatised, with the exception of battery and charger manufacturing. This means that these jobs will be for the benefit of European SMEs and drive local economic dynamism.

Job Creation per sector*

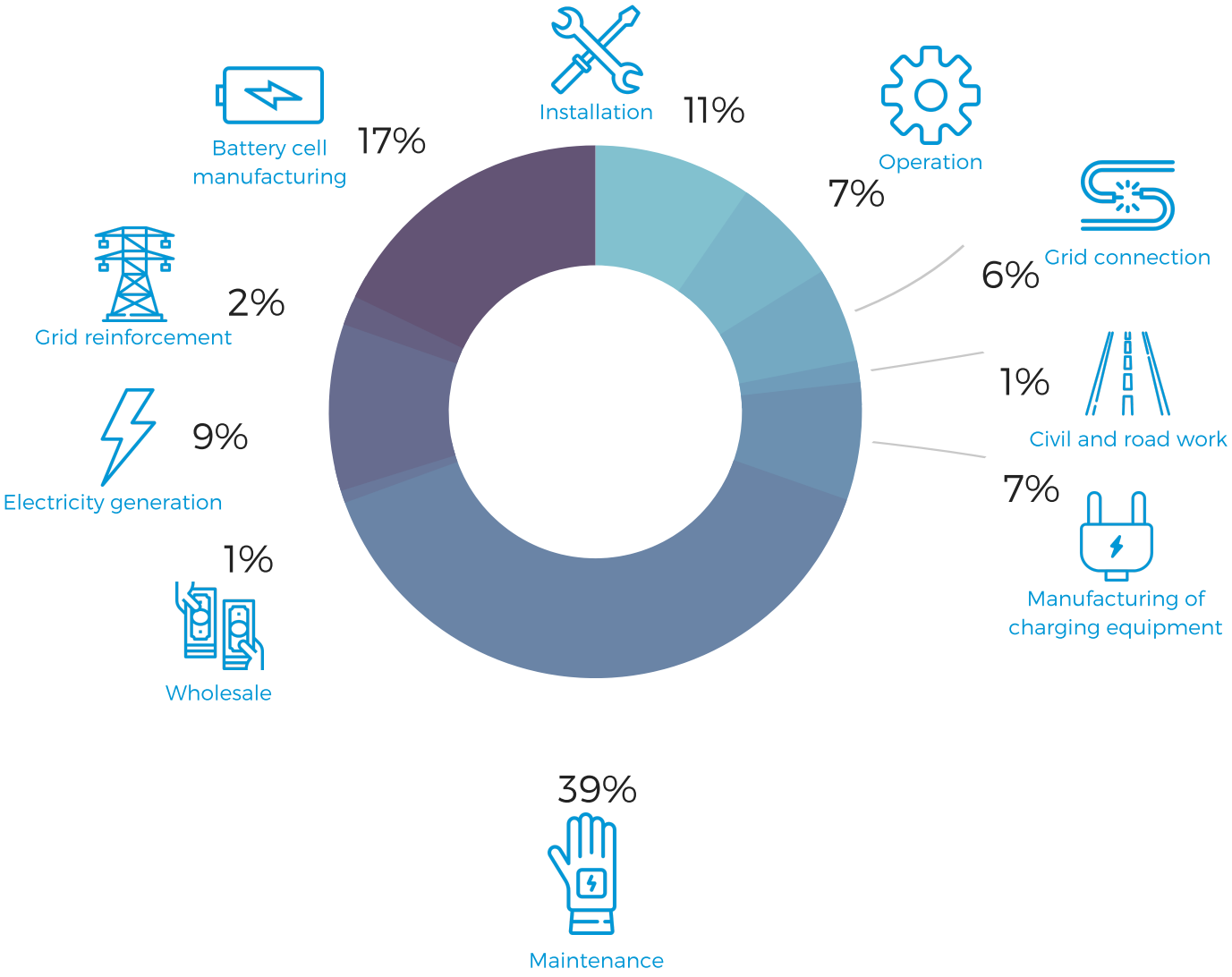
The maintenance of the chargers is the most job intensive segment on the electromobility value chain, creating 77,000 new jobs and accounting for 39% of total new jobs by 2030. Maintenance includes the repair, but does not include the replacement of the charging infrastructure.

Battery cell manufacturing is second and perhaps shows the greatest potential for job growth. We estimated that it could account for 34,800 new jobs and for 17% of total new jobs by 2030. Although there are no battery gigafactories in Europe today, there is strong political will to develop this business in Europe: the German government minister Peter Altmeier and the EU energy commissioner Maroš Šefčovič want to have about 30% of global battery production in 2030 take place in Europe.[8]

The installation of the electric vehicle chargers is the third sector in terms of job creation potential. It could account for 21,400 new jobs and 11% of all new jobs by 2030. The installation covers the contacts between the customer and the electrical contractor to identify the customer's, as well as the technical and regulatory, needs and requirements. It also includes the planning, the offer, administrative paperwork and the actual installation. Electric vehicle chargers will probably increasingly be sold in a package with complementary technologies,

*See Figure 3 on page 11

FIGURE 3: SHARE OF JOBS CREATED PER SECTOR



such as solar PV and battery systems. This will contribute to making the electrician's job an increasingly skilled, wide-ranging and green profession. This will also make the profession more attractive for young workers, bridging the workforce gap which today exists in several EU countries.

Electricity generation could yield 18,700 new jobs, accounting for 9% of total new jobs by 2030. This segment covers the production of additional electricity demand triggered by the consumption of an increased amount of electric passenger cars.

Operation of the charging points may generate 14,000 new jobs, representing 7% of all new jobs by 2030. Operation includes metering, billing and smart charging, covering the interactions of the chargers with the users and the grid. Smart charging of course has a great growth potential, as there is a need to electrify transport in a way that matches the increasing production from variable sources of energy, such as wind and solar, and in a way that supports electrical grids.

Manufacturing of the charging equipment may also represent 7% of all new jobs, leading to the creation of 14,100 jobs.

RESULTS

Grid connection may generate 11,500 new jobs, accounting for 6% of total new jobs by 2030. Grid connection is the process of linking an EV charger to the existing grid so that it can efficiently power electric vehicles. This can vary in complexity and job intensity depending on if it is a home charger or an ultra-fast charger and if it is in a building or a public space.

Grid reinforcement could lead to the creation of 4,000 new jobs, meaning 2% of total new jobs. Grid reinforcement means grid upgrades and extensions that will be necessary as more and more EVs are consuming electricity from the grid.

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Civil and road work represents just 1% of total new jobs, yielding 2,400 new jobs. This segment covers the ground works that are are a prerequisite for the subsequent installation and connection of the actual EV chargers.

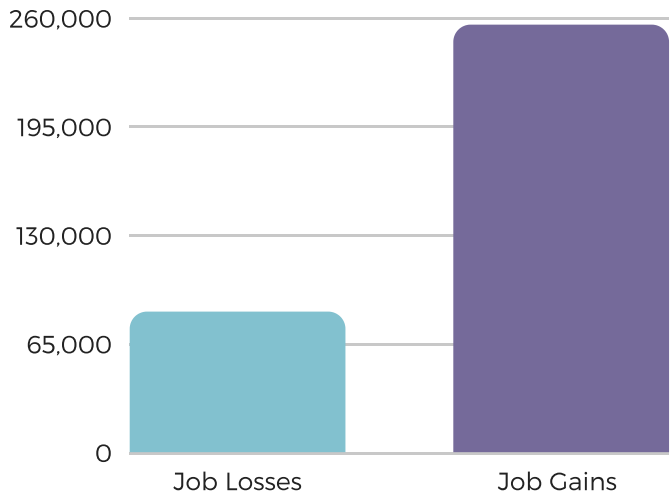
Wholesales also accounts for 1% of total jobs, generating 1,600 jobs by 2030. This segment includes the steps needed to bring the electrical material from manufacturers to final customers

CONCLUSIONS

It is clear from these results that an electrified transport system offers considerable job creation potential.

If we consider the Fraunhofer Institute study on the negative impacts of electric vehicles on employment in automotive manufacturing and translate to the EU scale, an estimated 306,000 jobs will be lost in total in the automotive manufacturing sector by 2030. Of these, only 84,000 are specifically due to an increase in electromobility and the remainder caused by productivity improvements.[9] This study however assumed a aggressive penetration of battery electric vehicles.

FIGURE 4: JOB LOSSES VERSUS JOB GAINS*



*Calculated when comparing the total permanent job losses in manufacturing from a 40% EV market share in Europe versus total permanent job gains in the same scenario.

ELECTROMOBILITY CAN NOT ONLY FILL IN THE GAPS INCURRED IN AUTOMOTIVE MANUFACTURING, BUT IT OFFERS THOUSANDS MORE JOB OPPORTUNITIES FOR SME'S AND LOCAL COMMUNITIES ACROSS EUROPE.

Our study has taken a much more realistic baseline scenario of 35% EV market share by 2030, and shows that more than 2 times the jobs are created in the the electricity value chain than are lost in automotive manufacturing. If our study modelled more ambitious assumptions as used in the Fraunhofer Institute study (25% BEVs and 15% PHEVs market share), 255,000 permanent jobs would be created by 2030. This means that a net balance of 171,000 jobs would be created in 2030 due to an uptake in electromobility as a whole. These are high quality, local, green jobs.

The study demonstrates that the EV revolution creates an important opportunity for jobs in an entirely new value chain in the automotive and electrical sectors. Electromobility can not only fill in the gaps incurred in automotive manufacturing, but it offers thousands more job opportunities for SMEs and local communities across Europe.

POLICY IMPLICATIONS

If the EU wants to take advantage of the opportunity created by electromobility to drive local economic growth, the regulatory framework, both at EU and national level, must accompany the transition towards electromobility, encouraging both the introduction of EVs on the market and the installation of EV chargers.

Besides the above-mentioned obligation on car manufacturers to decrease CO2 emissions from their cars and to sell a minimum share of zero-emission cars, the following measures are key:

- Obligation on public authorities to lead by example, procuring a minimum share of zero-emission vehicles, thus creating a market for clean cars, buses, trucks, etc.

- Support to innovation and pilot projects in electrification of shipping and aviation, following the example set by Norway.

- Reforms of fiscal regimes, to increase the competitiveness of electric vehicles vs combustion engine vehicles, and to ensure that the income from fuel taxation is not replaced by income from electricity taxation - electricity prices should become cost-based and dynamic, to encourage smart EV charging.

- Forward-looking building regulations, limiting the civil work costs associated with the installation of EV chargers at home, at work and in public parking.

- Cutting red-tape, especially via the introduction of the right-to-plug, particularly in multi-occupancy buildings.

SOURCES

1 European Environment Agency, November 2017, "Approximated Greenhouse Gas Emissions in 2016": https://www.eea.europa.eu/publications/ approximated-eu-greenhouse-gas-inventory-2016

2 Fraunhofer IAO, 2018, "ELAB 2.0 Wirkungen der Frahrzeugelektrifizierung auf die Beschäftigung am Standort Deutschland": https://www.euractiv.com/wp-content/uploads/sites/2/2018/08/ELAB2.0.pdf

3 Harrison P, 2018, "Fuelling Europe's Future: How the transition from oil strengthens the economy": http://www.camecon.com/wp-content/uploads/2018/02/ECF-Fuelling-Europe_EN_web.pdf

4 "European Alternative Fuels Observatory", European Commission: https://www.eafo.eu/

5 This is the title of the English executive summary of the study mentioned in footnote 3.

6 Eurelectric, September 2017, "Smart Charging – Key to unlocking Electro-mobility's potential": https://www.eurelectric.org/media/2162/smart_charging_statement-2017-030-0589-01-e.pdf

7 Cfr. footnote 3.

8 See for instance article from Electrictrive, 13 November 2018, Europe to carry 30% of global battery cell production: https://www.electrive.com/2018/11/13/europe-to-carry-30-of-global-battery-cell-production/

9 According to ACEA there are 2.5 million employees in direct automotive manufacturing and 0.9 million indirect automotive manufacturing in Europe, which together equal 3.4 million jobs. Taking the same percentage of job loss of 8.9% in the German context to the EU level equals 306,000 jobs that are lost. As the study maintains that electromobility is only responsible for 27% of these total job losses, this would mean 84,000 jobs at the EU level.

Category	Name	Value	Source	Justification (if needed)
EV roll-out	Share PHEV:BEV	1:1		
	Share in 2021	6%	T&E, CO2 emissions from cars, the facts, April 2018	5-7% estimated
	Share in 2025	15%	Council proposal	
	Share in 2030	35%	Council proposal	
	EU28 passenger car market	15.1 million	2017 value, assumed constant	Conservative assumption
#EVs per charge point	Home (all EVs)	1.25	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018 (FEF)	
	Work (all EVs)	5	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Public parking (all EVs)	10	European Commission's recommended ratio for # EVs per public charger, see Directive 2014/94/EU on the deployment of alternative fuels infrastructure	Conservative assumption because this excludes public fast chargers and FEF assumes 5
	Fast (50kW) (BEVs only)	50 (today) - 300 (2030)	Partly from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	50 is aligned with today's figure and 300 is long term value from FEF
	Ultra-fast (150-350kW) (BEVs only)	2,000 (today) - 1,000 (2030)	Partly from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	Conservative assumption, FEF assumes around 600 in 2030 and 1,000 in 2040
Charger installation costs (€)	Home	400	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	

	Work	700	Expert consultation	Optimistic assumption: FEF uses €400 but this assumes they are all 7kW. Some workplaces chargers will deliver 11-22kW
	Public parking	3,000	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	€5,000 of installation has been split with 3,000 for installation and 2,000 for grid connection
	Fast (50kW)	5,000	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Ultra-fast (150-350kW)	5,000	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
Charger equipment costs (€)	Home	600 (2015) - 350 (2030)	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Work	800 (2015) - 450 (2030)	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Public parking	2,500 (2015) - 1,400 (2030)	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Fast (50kW)	30,000 (2015) - 22,000 (2030)	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Ultra-fast (150-350kW)	120,000 (2015) - 100,000 (2030)	Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
Grid connection costs (€)	Public parking	2,000	Derived from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Fast (50kW)	4,643	Derived from Cambridge Econometrics, Technical report,	

			Fuelling Europe's Future, February 2018	
	Ultra-fast (150-350kW)	200,833	Derived from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
Civil and site work costs (€)	Fast (50kW)	45,071	Derived from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
	Ultra-fast (150-350kW)	63,083	Derived from Cambridge Econometrics, Technical report, Fuelling Europe's Future, February 2018	
Maintenance (hours per charger per year)	Home	2	Expert consultation	
	Work	5	Expert consultation	
	Public parking	20	Expert consultation	
	Fast (50kW)	30	Expert consultation	
	Ultra-fast (150-350kW)	40	Expert consultation	
Share of revenue dedicated to wholesales (distribution, planning, expertise, etc..)	Home	10%	Expert consultation	
	Work	10%	Expert consultation	
	Public parking	10%	Expert consultation	

	Fast (50kW)	10%	Expert consultation	
	Ultra-fast (150-350kW)	10%	Expert consultation	
Employment intensity	Installation (€ revenue per employee per year)	171,429	Eurostat, Industry by employment size class (NACE Rev. 2, B-E)	Category: "Installation of industrial machinery and equipment"
	CAPEX (charging equipment) (€ revenue per employee per year)	204,169	Eurostat, Industry by employment size class (NACE Rev. 2, B-E)	Category: "Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus"
	Grid connection (€ revenue per employee per year)	143,812	Eurostat, Industry by employment size class (NACE Rev. 2, B-E)	Category: "Construction of utility projects"
	Civil and road work (€ revenue per employee per year)	187,181	Eurostat, Construction by employment size class (NACE Rev. 2, F)	Category: "Civil engineering"
	Operations (jobs per public charger)	0.0044	Expert consultation	One employee for 226 public chargers
	Services (€ revenue per employee per year)	600,000	Eurostat, Distributive trades by employment size class (NACE Rev. 2, G)	Category: "Wholesale of electronic and telecommunications equipment and parts"
	Electricity generation (employees per GWh generated)	0.31	Eurostat, Industry by employment size class (NACE Rev. 2, B-E)	Category: "Electric power generation, transmission and distribution"
	Grid reinforcement	143;812	Eurostat, Industry by employment size class (NACE Rev. 2, B-E)	Category: "Construction of utility projects"
	Battery manufacturing (employees per GWh	350	Tesla Gigafactory employs about 7,000 workers for a current	Conservative assumption as Tesla's Gigafactory is very automated. Alternatively Eurostat

	charging)			
	Low voltage grid - Multiple EV charging in multi-dwelling or business buildings (without smart charging)	650	Eurelectric, smart charging: steering the charge, driving the change, March 2015	
	Low voltage grid - Public charging spots in the streets and parking lots (without smart charging)	240	Eurelectric, smart charging: steering the charge, driving the change, March 2015	
	Medium voltage grid - Multiple EV charging in multi-dwelling or business buildings (with smart charging)	80	Eurelectric, smart charging: steering the charge, driving the change, March 2015	
	Medium voltage grid - Public charging spots in the streets and parking lots (without smart charging)	20	Assumed	"Smart charging could reduce most of this cost [from €80 million" Eurelectric, smart charging: steering the charge, driving the change, March 2015
	High voltage grid reinforcement	0	Expert consultation	Conservative assumption: current underutilization of the grid and increase use of smart charging allows the network current capacity to cope with future electricity demand (+2% in 2030)
	Share of smart charging	0% in 2015 up to 95% in 2030	Expert consultation	
	Share of EV charging - single dwelling house (home)	60%	Derived from FEF with additional assumptions	Conservative assumption, charging in single dwelling house was considered 3 times higher than in multi-dwelling homes
	Share of EV charging - multi-dwelling house (home)	20%	Derived from FEF with additional assumptions	
	Share of EV charging - multi-dwelling (work)	10%	Derived from FEF	Assumed all work charging is multi-dwelling

	Share of EV charging - public parking	10%	Derived from FEF	
Others	Share of batteries manufactured in the EU	0% in 2015 - 50% in 2030	Expert consultation	Conservative assumption as the EU aims to have 10 gigafactories (EU Battery Alliance)
	Replacement of chargers and life-cycle of equipment	Not considered		Conservative assumption
	PV and batteries on site	Not considered		Conservative assumption
	E-mobility service providers	Not considered		Conservative assumption

CONTACT

THE EUROPEAN ASSOCIATION OF ELECTRICAL CONTRACTORS

+32 (0)2 253 42 22
info@europe-on.org
Rue d'Arlon 69-71, 1040 Brussels
www.europe-on.org
@EuropeOn_EU