



ELECTROMOBILITY IN POLAND

INVESTMENTS, TRENDS, EMPLOYMENT
2021 REPORT



Polish Investment
& Trade Agency
PFR Group

BERGMAN | ENGINEERING™
An engineering contracting company

TABLE OF CONTENTS

1. Foreword,
2. General information on the e-mobility market in Poland,
3. Existing e-mobility infrastructure in Poland,
4. Map of e-mobility investments in Poland,
5. Trends in planned e-mobility investments in Poland,
6. Support for investment projects in Poland,
7. Numerical summary of 2021,
8. Employment, earnings, and employee competencies forecasts,
9. Expert's statement - Green Cell,
10. Value chain in the e-mobility projects industry.

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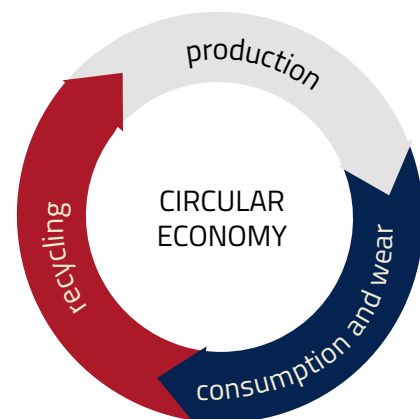
Foreword

Dear Reader,

Electrically powered vehicles have become an essential part of the global automotive industry in recent years. This is a great opportunity for Poland. It is in our country that the number of companies developing production in the electromobility sector is rapidly growing. **Poland is famous for innovation and high-quality production in this field, which makes it an attractive country for investors and business partners. This is a great time for the development of the Polish electromobility sector.**

The technology of powering vehicles with electricity dates back to the times of Thomas Edison. Back in the 19th century, it was the electric car that was the first to break the speed barrier of 100 km/h. Nevertheless, for a long time this idea was considered merely a curiosity. Only in recent decades has it become a reality on a global scale and has been dynamically developing since then. **This is mainly due to the increased environmental awareness of consumers, striving for the most sustainable development and, of course, technological progress.** After all, nowadays we have access to much more advanced tools and solutions in the automotive industry than twenty or thirty years ago.

Electromobility is a huge and still growing branch of the economy, which includes much more than the manufacturing of electric vehicles. It also includes the extraction of raw materials, as well as the modernization and development of the energy infrastructure. **When thinking about this sector, one should also consider the advanced recycling of vehicles and power cells, which allows for the actual implementation of the principles of the circular economy.** All these industries constitute integral elements of what we should understand nowadays under the broad concept of electromobility



It is also worth mentioning that electromobility is not only a segment of passenger cars, but also vehicles such as:



passenger cars



buses



off-road cars



planes



rail transport



scooters



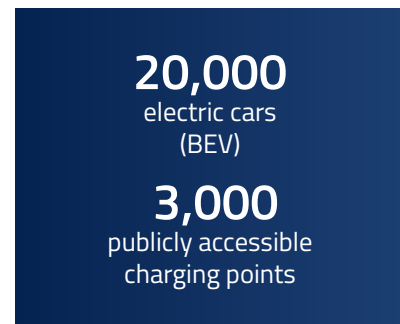
mopeds



bicycles

These are the areas in which our country has been dynamically developing in recent years, and in the future, it has a chance to be among the world's leaders.

Last year, almost **20,000 electric cars (BEV)** were registered in Poland, and there were over **3,000 publicly accessible fast and slow charging points**. Although the number of electric vehicles in our country is growing slower than in other European countries, other significant investments are located in Poland. One example is the largest car battery factory in Europe, located near Wrocław.



Our country is home to the production of 30% of all vehicle batteries manufactured in Europe. The attractive investment position of Poland means that an increasing number of companies choose our country as a place for the development of their production. It is a reason to be proud, and we, as PAIH, make every effort to maintain the inflow of such investments at a high level.

Since 2016, we have supported dozens of investment projects in the electromobility sector, worth over six billion EUR. Thanks to them, there have been created over 13,000 jobs for highly qualified workers and engineers.

We have to say that the electric vehicle sector is still at the beginning of its journey. This sector is constantly changing, implementing more and more effective solutions, and entering new areas of innovation. The energy inherent in electromobility is also changing. The share of clean and renewable energy sources is growing, and the infrastructure necessary for efficient vehicle charging is being developed. Forecasts indicate that as early as next year 20% of consumers will choose electric cars. There are seven factories producing e-buses in our country, and their number in urban transport systems has increased tenfold since 2016. There is also a noticeable trend to change the production of combustion vehicles to hybrid and electric vehicles in other factories located in Poland.

To sum up only the year 2021, we can note an increase in electric vehicle sales by 120%, and the implementation of five investment projects with a total value of over two billion EUR. **Meanwhile, investments planned by the end of 2022 are expected to create nearly 7,000 new jobs.**



We cordially invite you to read the report, in which we present in detail the current state of the electromobility sector, show possible development directions, and define the most promising opportunities. We wish you an enjoyable reading!

Foreword by the President of the Management Board of the Polish Chamber of Electromobility Development - Krzysztof Burda

The automotive market begins to change very dynamically, along with the development and increasing availability of electric vehicles. These changes are undoubtedly an opportunity for the market and domestic companies. Poland is also an attractive market for investors, as shown in this publication.

The climate policy adopted by 187 countries, including Poland, based on the Paris Agreement of 2015, assumes the pursuit of climate neutrality by 2050. **Electromobility has been recognized as an effective tool to decarbonize the transport sector and achieve climate goals.** This means a number of changes for the automotive market, ranging from component production processes, new sectors such as one for batteries, to final products, and changes in consumer habits. **It is undoubtedly a time of changes also in the economy. This is an opportunity for new companies and start-ups to provide advanced technologies while integrating them into global supply chains.** Additionally, it is about transforming and changing the production profile to electromobility for the current automotive sector companies.

Electromobility also creates opportunities for companies from outside the automotive sector that currently operate in other industries. Many entrepreneurs are not aware that after a light changeover, their lines could already provide components, products, or hall equipment for the electromobility industry, because this industry is not only for highly advanced components such as electrodes, separator, or electrolyte, but also copper electrical terminals, module covers, rubber elements, and measuring equipment – the specialty of many Polish companies.

The industry report presents the current state of the industry in Poland, key investments, trends, directions of development, as well as the market demand for highly specialized specialists and engineers. It is a comprehensive collection of information about the industry that can inspire recipients to further activities and search for opportunities. The Polish Chamber of Electromobility Development with partners such as PAIH and Special Economic Zones undertakes a number of activities that also support the development of the industry and are addressed to Polish entrepreneurs – including workshops presenting the business opportunities created by electromobility in the area of batteries.



Krzysztof Burda

President of the Management Board of the
Polish Chamber of Electromobility Development



Foreword from the President of Bergman Engineering - Tomasz Szpikowski

Electromobility - a topic that has been a hot topic for several years. We closely observe the market and we follow trends and investments because we know that each project is going to need people. Qualified staff of engineers and specialists, production workers and technicians – without them the electromobility revolution will not be possible.

Companies operating in e-mobility are a sector that generates a lot of jobs within one enterprise. Thanks to the knowledge of the market, experience, and a database of verified employees, we can respond to these needs almost immediately.

We joined forces with the Polish Investment and Trade Agency, the Polish Chamber of Electromobility Development, and the Green Cell company, and we prepared a comprehensive report on the state of the electromobility sector in our country.

We are pleased to present the results of our joint work.

Enjoy the read!



Tomasz Szpikowski
CEO Bergman Engineering



General information on the e-mobility market in Poland

The development of the electromobility sector is one of the priorities of the current economic policy, as evidenced by the support that the Polish authorities have so far provided to producers in the electromobility sector.

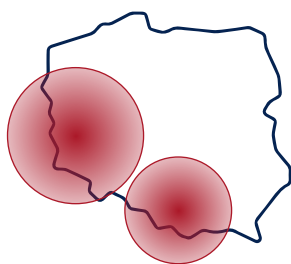
However, the support must cover the entire value chain. It is necessary to develop the infrastructure for the production of components and parts for the manufacturing of electric cars, i.e. lithium-ion batteries (including organic material made of silicon and electrolyte as well as fluorophosphate compounds or nickel-rich advanced cathode materials in the new eLNO technology, as well as other basic organic chemicals), engines for hybrid cars, cathode materials, production of electronic components (chips) for hybrid engines, production of connectors, sensors, modules and other innovative products, as well as machines for manufacturing batteries.

It is also important to adapt the road infrastructure to the growing number of electric vehicles. The broadly understood e-mobility sector also includes the production of electric bicycles (in Poland, these are companies such as: **Myatu Europe Intelligent Technology, Winfield or JOBO Europe**).

Since 2016, the Polish Investment and Trade Agency has supported nearly 30 investment projects in the electromobility sector, with a total value of over six billion EUR, which contributed to the creation of over 13,000 jobs for highly qualified workers and engineers. The investment projects came mainly from Asia (South Korea - nine investments worth nearly 2/3 of all projects, China - six, Japan - four), but also from Europe: Sweden, Belgium, and Great Britain.

Countries that gladly invest in Poland

South Korea (9 investments)
China (6 investments)
Japan (4 investments)
Sweden
Belgium
Great Britain



Investments in the electromobility sector are located mainly in the southern and western part of Poland, in the following voivodships: Lower Silesian (twelve projects), Śilesian (five investments in the following locations: Dąbrowa Górnicza, Jaworzno, Tuczna, Zabrze, Dąbrowa Górnicza), Opolskie (three investments). Investors also choose regions such as Greater Poland (Śrem), as well as the northern part of the country (two investments in the Pomeranian Voivodeship) and in central Poland (Sokołów).

The leader among the cities is the Wrocław agglomeration, containing as many as eleven factories producing components for the electromobility sector in the following cities: Wrocław, Biskupice Podgórne, Kobierzyce (LG), Jelcz-Laskowice (Toyota), Prusice, Wałbrzych.

The largest increase in investments in the electromobility sector could be observed in 2019, i.e. preceding the outbreak of the COVID-19 pandemic (six investments with a total value of over EUR 2 billion), which exceeded the value and amount of investments made in the two years of the pandemic: 2020 – 2021: six projects with a total value of EUR 2,3 billion.

2019
6 investments
2 bln €

Poland is the leader in battery production in Europe; it is estimated that our country manufactures approximately 30% of all battery production capacities in Europe.

Number of registered electric cars and charging stations at the end of 2021:



Nearly 20,000 electric cars



Over 3,000 publicly accessible charging points for electric cars

According to the data of the Polish Chamber of Electromobility Development (PIRE), at the end of February 2022, nearly 20,000 (19,758) fully electric vehicles (BEV - Battery Electric Vehicles) were registered in Poland in total. An interesting fact is that in the period from January to the end of February 2022 alone, almost half a thousand (483) electric cars were registered. **The vast majority is registered in the Masovian voivodship (154 BEV in Jan-Feb 2022)**, which is influenced, among others, by leasing companies and vehicle rental companies based in Warsaw. The second region with high purchase dynamics in the first quarter of 2022 is Greater Poland (51 BEV in Jan-Feb 2022). In third place is Silesian Voivodeship (48 BEV in Jan-Feb 2022). **Electric car users have the opportunity to take advantage of numerous incentives that additionally motivate them to purchase this type of vehicle.**

Incentives motivating the purchase of electric cars include:

- ✓ possibility of using bus lanes (until 2025)
- ✓ possibility of free parking in cities (based on local regulations)
- ✓ excise duty exemption
- ✓ higher depreciation limit
- ✓ possibility of using subsidies for the purchase of a new electric car (up to PLN 27,000 for natural persons and up to PLN 70,000 for entrepreneurs)

It is expected that from 2023, 20% of consumers will prefer electric cars, which will achieve a 20% share in the new car market.

Although the number of private electric car users is growing slowly, **Poland is one of the European leaders in introducing e-buses to public transport fleets in cities.**

Currently, there are seven factories in Poland producing such a fleet and exporting buses to all of Europe.



Existing e-mobility infrastructure in Poland

Pursuant to the Act on electromobility and alternative fuels (Article 60) in Polish cities with more than 100,000 inhabitants, there must be created an infrastructure for charging electric cars. The number of charging stations depends on the population and the density of the car fleet per 1,000 inhabitants and ranges between 60 (in 12 smaller cities with more than 100,000 inhabitants) and 1,000 charging points (in Warsaw). Figure 1 shows the number of electric vehicle charging stations as of 2019.¹

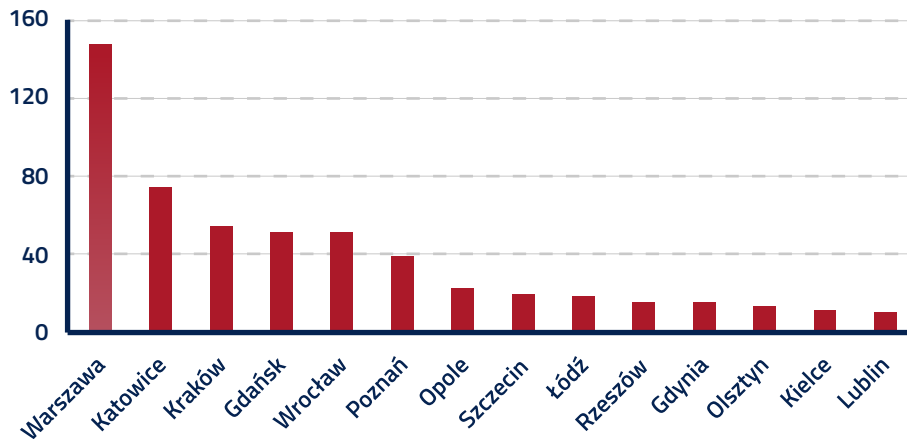
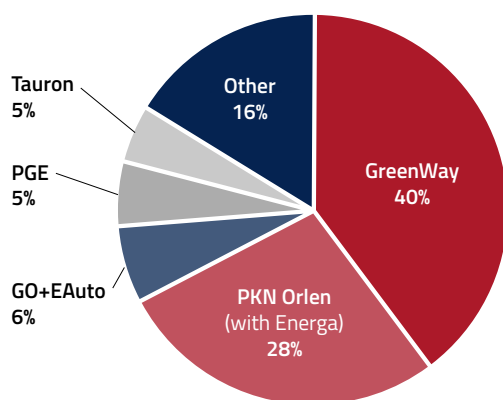


Figure 1. Number of electric vehicle charging stations in Poland

Similarly to the investments in the electric car component manufacturing sector, investments in car charging infrastructure require intensive support at the national level. Projects of this type may benefit from the following facilitations: **no need to obtain a building permit**, and distribution system operators who would like to provide their charging station **are exempt from the obligation to obtain a license to trade in electricity**. Financing investments in the charging infrastructure for electric cars is possible through the Low-Emission Transport Fund managed by the National Fund for Environmental Protection and Water Management (NFOŚiGW).



The largest charging station operators in Poland

The Polish Chamber of Electromobility Development noted that, based on data collected by the Office of Technical Inspection, at the end of February 2022, 1,017 publicly accessible fast charging points (DC) and 2,364 slow charging points (AC) were launched in Poland. The largest charging station operators in Poland are GreenWay and PKN Orlen. GO+EAuto and energy companies such as PGE and Tauron also have a significant market share.

¹„Analysis of the Development of the Electromobility Market in Poland in the Context of the Implemented Subsidies”, p. 11., E. Sendek-Matysiak, Z. Łosiewicz, MDPI, energies.

According to the electric bus meter operated by the Polish Chamber of Electricity Development (PIRE) and the Transinfo.pl portal, **at the end of February 2022, a total of 651 fully electric buses were registered in Poland.** In the first quarter of 2022 alone, 13 electric buses were registered. Similarly, the charging infrastructure for buses has also been intensively developed in recent years. The largest investments were carried out in Warsaw and in voivodship cities such as Kraków, Poznań, Zielona Góra and Lublin.

In the ranking of the most popular brands of electric buses, number one is undoubtedly Solaris. In 2021, the company from Greater Poland delivered to the market as many as 186 battery vehicles. The second place belongs to Autosan (15 units) with a contract for MPK Częstochowa, and the third to Busnex (12 units) with the Chinese brand Yutong, which in May completed its largest one-off contract - nine electric buses for Polkowice.

The leader in the production of electric vehicle charging infrastructure is the company Ekoenergetyka-Polska from Zielona Góra. It is already present in 26 countries around the world, and by the end of 2021, it had produced 2,500 stations. It employs over 500 people, of which the core are engineers and constructors. Ekoenergetyka-Polska has a significant share in the market of fast bus charging stations. The devices designed and manufactured by the Polish company operate in most European capitals, e.g. in Berlin, Paris or Warsaw. The market of fast charging stations for passenger cars and trucks is also developing intensively, an example of which may be the receipt of an order for several hundred ultra-fast charging stations for the Ionity network

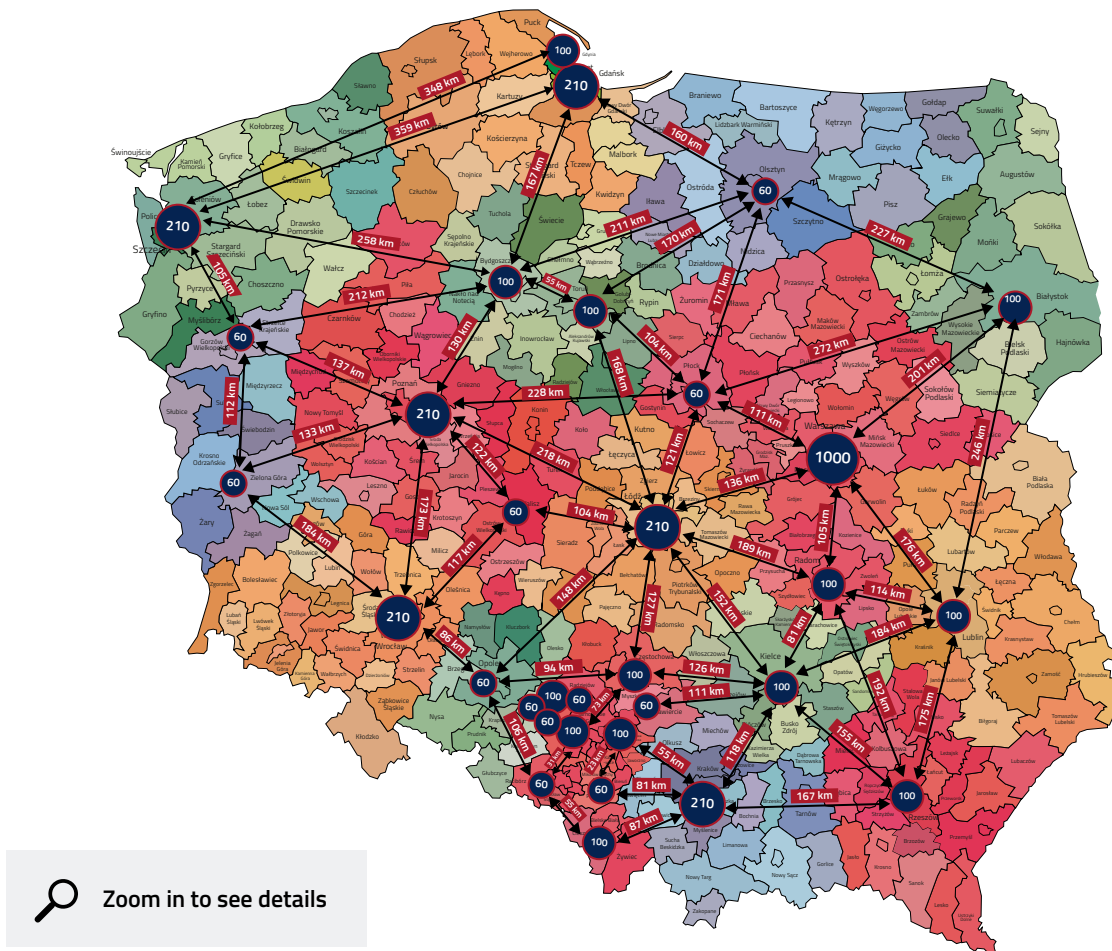


Figure 2. Distance between cities subject to the Act on Electromobility

Figure 2 shows the distances between the cities where the Act on Electromobility requires the launch of an appropriate number of electric car charging stations.⁴

Thanks to the implementation of the provisions of the Act on Electromobility in the field of the development of infrastructure for charging electric cars in large cities, it will be possible to drive between these cities with electric cars with a limited range (the longest distance: 359 km to be covered between the capitals of voivodeships in northern Poland: Szczecin and Gdańsk).

Unfortunately, such a distance between charging stations will not allow all cars available on the market to cover this distance. **The charging infrastructure for electric cars in certain places in the country (e.g. Central Pomerania) should be broadened to enable travel the distance between voivodeship cities for electric cars with a shorter range, which are also offered on the market (approx. 200 km).**

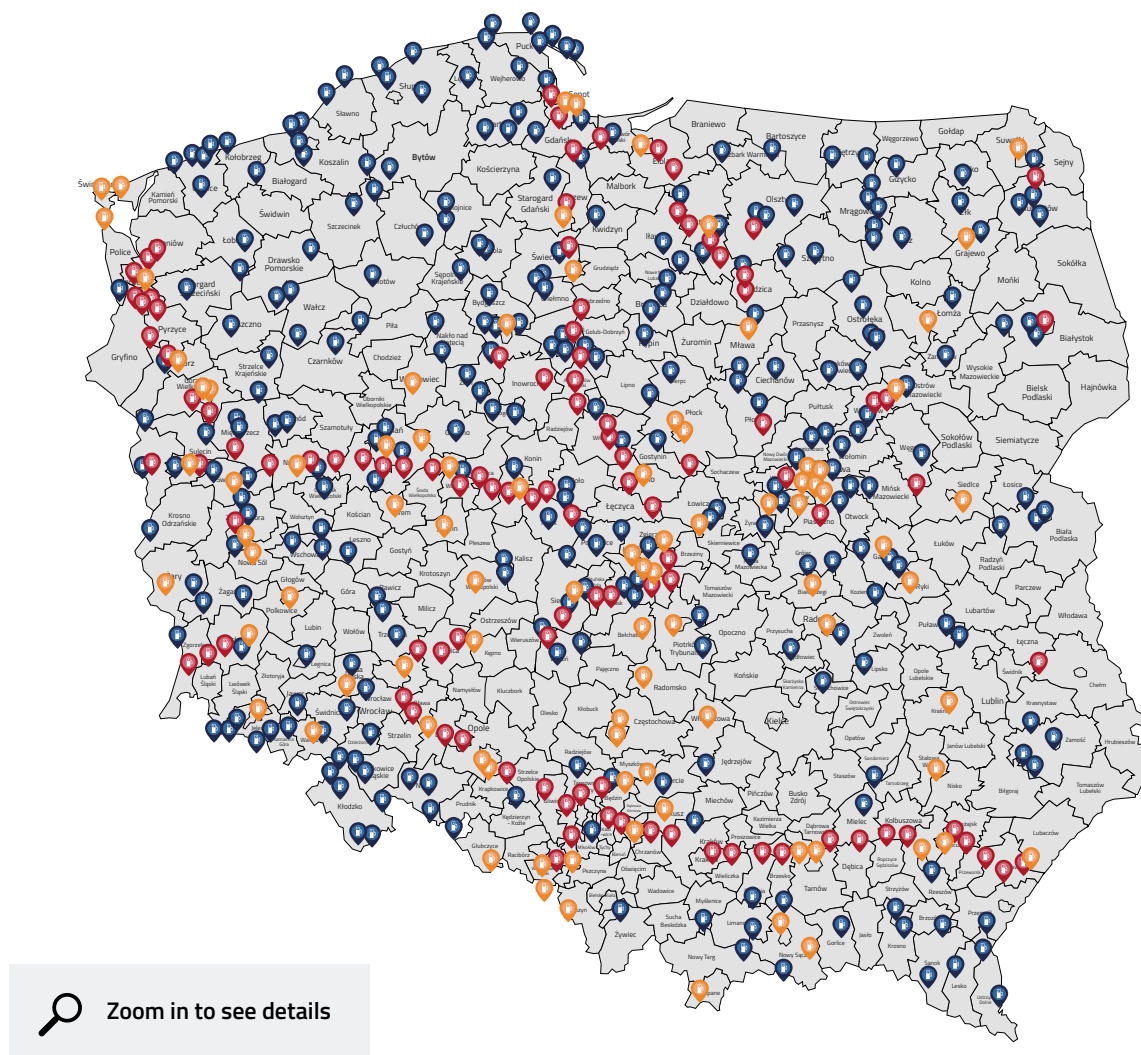


Figure 3. Map of electric car charging stations as of March 31, 2021, in accordance with the Act on Electromobility and Alternative Fuels

Map of electric car charging stations as at: March 31, 2021 in accordance with the Act on Electromobility and Alternative Fuels.⁵

⁴„Analysis of the Development of the Electromobility Market in Poland in the Context of the Implemented Subsidies“; p. 8., E. Sendek-Matysiak, Z. Łosiewicz, MDPI, energies.

⁵Idem, „Analysis of the Development of the Electromobility Market in Poland (...)“ p. 12.



Map of e-mobility investments in Poland

Figure 4 shows the location of projects in the electromobility sector in Poland broken down into individual segments – production of batteries and their components, production of electric vehicles, production of e-buses, and EV technology development centres.



Figure 4. Map of investments in the electromobility sector

The largest of the investments completed so far in Poland is the **LG Energy Solution factory in Kobierzyce near Wrocław** - with the possibility to produce batteries with a total capacity of up to 70 GWh per year. It is the largest battery factory in Europe and the largest production plant of the LG concern in the world. Batteries from this LG factory are delivered to cars such as:



Audi, Ford, Jaguar, Mercedes Benz, Smart, Porsche, Renault, Seat, Skoda, Volkswagen, Volvo.

The leaders of other segments include the Korean concern **SK Innovation** – a manufacturer of separators for lithium-ion (Li-Ion) batteries located in Dąbrowa Górnicza; **Volkswagen Motor Polska**, a manufacturer of an electric delivery vehicle VW Crafter; **Polaris Polska** – a manufacturer of electric off-road vehicles. On the other hand, among companies dealing with the development of technology, there can be mentioned the **Aptiv** company, which is a market leader in the creation of advanced ADAS driver assistance systems and is located in Kraków.

Leaders of other e-mobility segments:

- ✓ **SK Innovation**
- ✓ **Volkswagen Motor Polska**
- ✓ **Polaris Polska**
- ✓ **Aptiv**

Among the companies involved in the production of e-buses, there can be distinguished **Solaris**, a company with Polish roots, which currently belongs to the Spanish CAF capital group. Solaris is a leader in the production of electric buses, and for many years has been producing electric buses in Bolechowo near Poznań. Other producers of the e-fleet are **Volvo Polska**, which produces electric buses in Wrocław, and **MAN**, which started the production of e-buses in Starachowice.



Leaders in the production of e-buses:

- ✓ **Solaris**
- ✓ **Volvo Polska**
- ✓ **MAN**



Trends in planned e-mobility investments in Poland

An increasing number of companies is considering locating their production in Poland, which is caused by the attractive investment position of our country. Such a choice is supported by the developed road and energy infrastructure, highly qualified workforce, the growing number of companies from the electromobility sector, but also the presence of many academic and vocational training resources. Among the companies representing the electromobility sector, there are enterprises constituting various links in the value chain; after the investment made by LG, more and more companies from Korea, China and Japan are considering locating their investment projects in Poland. **Currently, the portfolio of PAIH includes 21 projects in the electromobility sector.**

Reasons why more and more companies are investing in Poland:



improving road infrastructure



improving energy infrastructure



highly qualified employees



presence of academic and vocational training centres



cooperation of companies from the e-mobility sector

One of the visible trends is the change from the current production of conventional vehicles to hybrid or fully electric vehicles. **Stellantis is currently designing a fully electric Jeep crossover, which will be produced at the Tychy factory, along with similar cars from the Alfa Romeo and Fiat brands. The investment in the production plant in Tychy will amount to over PLN 755 million, and the currently implemented production will be adjusted for this purpose.** Similar plans concern the Opel plant in Gliwice, where the Opel Astra model is produced – the best-selling model in the company.⁶

Meanwhile, Daimler plans to invest over EUR 200 million in the production of electric batteries in Jawor in south-west Poland. Initially, the investment involves the production of batteries for gasoline-electric hybrid cars. This is not an isolated trend. Since 2019, Toyota has invested almost EUR 100 million in Poland to implement the production of combustion engines for hybrid vehicles. Volkswagen, which produces the MAN eTGE electric truck in Września, started production of the new e-Crafter delivery van there in July 2020. LG Energy Solution (South Korea) plans to process lithium hydroxide mined in Upper Rhineland, in Graben, Germany, for its electric car battery factory in Poland.

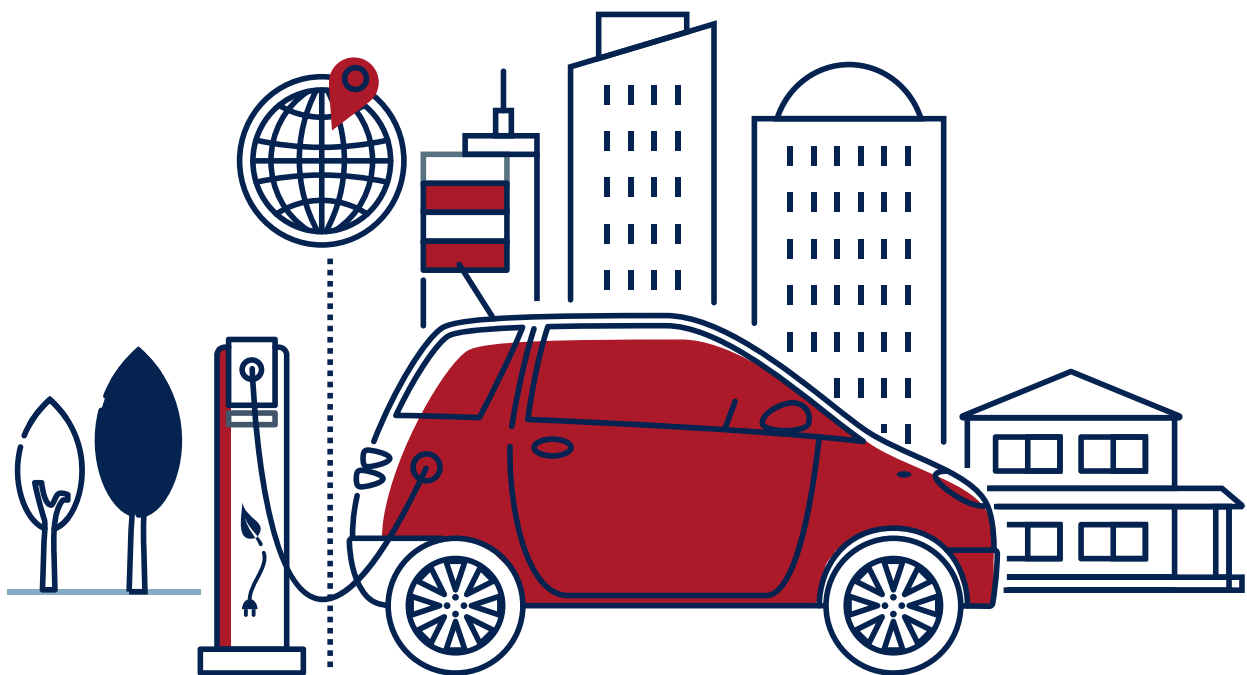
⁶Industry Report: Automotive Poland 3rd Quarter 2021, The Economist Intelligence Unit Limited 2021, p. 7.

In February 2018, the Sejm adopted the Act on Electromobility and Alternative Fuels, introducing incentives to increase sales of electric vehicles. It aims to expand the fleet of electric cars by 2025. The aforementioned incentives include tax breaks and subsidies for the purchase of new electric vehicles (NFOŚiGW), as well as reduced excise duty.



So far, several foreign car manufacturers have announced plans to produce electric vehicles in Poland, and ElectroMobility Poland, a company belonging to a consortium of state-owned energy companies, has unveiled a prototype of its first Polish EV, Izera, in July 2020.

The vehicles are to be produced at the factory in Jaworzno in Silesia, and production is to start in a few years.




Support for investment projects in Poland (incentives, tools)

Support for new investment projects is a form of regional public aid, the maximum amount of which depends on the level of development in a given voivodship.

✓ Polish Investment Zone (PSI) - CIT exemption

Od Since 2018, support for investors is available under the Polish Investment Zone (PSI). This tool offers the possibility of taking advantage of the income tax exemption for companies that meet the required quantitative (project value and employment) and qualitative criteria. **Depending on the voivodship, the available support levels range from 25% (Greater Poland and Lower Silesian) through 30% (Pomeranian and Silesian voivodships) to even 50% (five voivodships in the eastern part of the country, i.e. Warmian-Masurian, Podlaskie, Lublin, Świętokrzyskie and Subcarpathian).** In over half of the voivodships, the maximum level of public aid available under the regional map of support and CIT exemption is 40% (West Pomeranian, Lubuskie, Kuyavian-Pomeranian, Opolskie, Łódzkie, Lesser Poland, and part of the Masovian Voivodeship, except for its eastern part, where 50% is available, and the Warsaw agglomeration (public aid is no longer available). This is presented on the map below:

Regional aid map 2022-2027

 Zoom in to see details

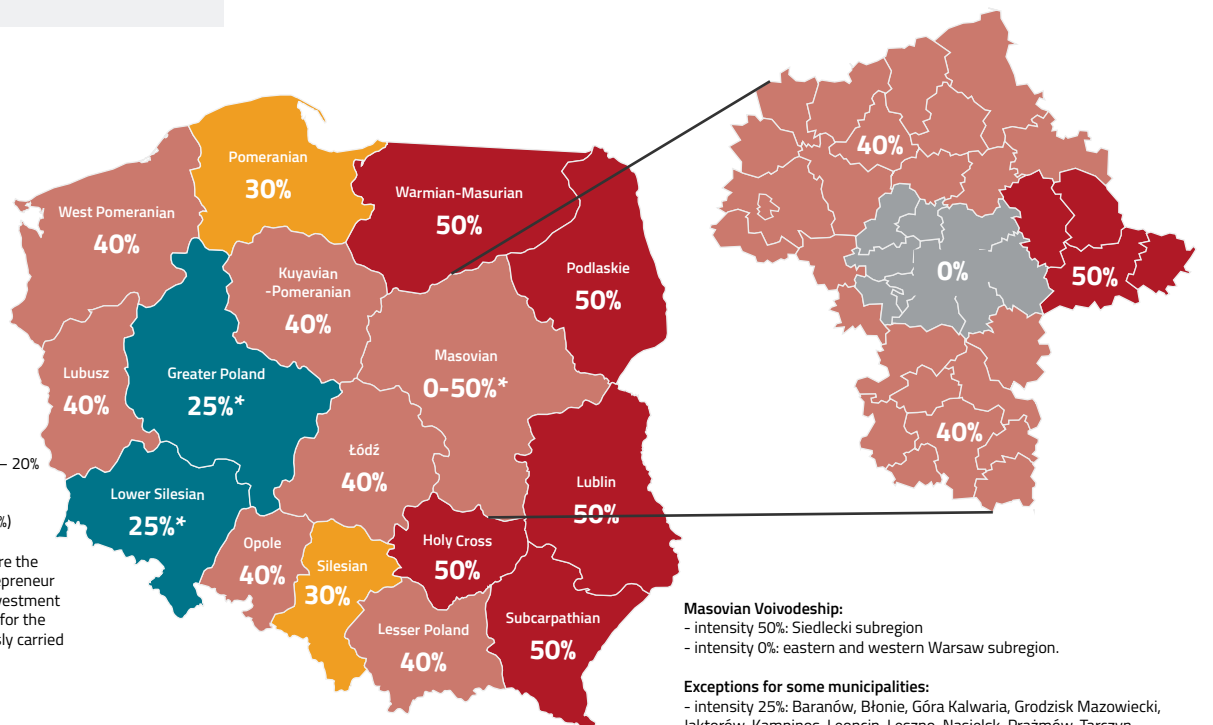
Maximum intensity:

- 50%
- 40%
- 30%
- 25%
- 0% (for some municipalities:
25% – 35%)*

Greater Poland Voivodeship:
Poznań and the Poznań subregion – 20%
(since 2025 r. – 15%)
Lower Silesian Voivodeship:
Wrocław – 20% (since 2025 r. – 15%)

Greater Poland and Lower Silesia are the so-called "c" regions - a large entrepreneur may obtain aid only for an initial investment for a new business activity (i.e. not for the same or similar to the one previously carried out in the establishment).

For micro and small: +20% points
For medium: +10% points
For regions under the Just Transition Fund: +10% points



Masovian Voivodeship:
- intensity 50%: Siedlecki subregion
- intensity 0%: eastern and western Warsaw subregion.

Exceptions for some municipalities:
- intensity 25%: Baranów, Błonie, Góra Kalwaria, Grodzisk Mazowiecki, Jaktorów, Kampinos, Leocin, Leszno, Nasielsk, Prażmów, Tarczyn, Zakroczym and Żabia Wola;
- intensity 35%: Dąbrówka, Dobrze, Jadów, Kałuszyn, Kołbiel, Latowicz, Mrozy, Osieck, Serock, Siennica, Sobienie-Jeziory, Strachówka i Tłuszcz.

www.paih.gov.pl

✔ Government grant

Another tool to support entrepreneurs is the so-called government grant. Obtaining support, as in the case of PSI, is conditional on meeting quantitative and qualitative criteria. Currently, the minimum quantitative criteria for receiving a grant is the creation of one hundred jobs and the value of the project in the amount of PLN 160 million. **It is also possible to obtain support with lower parameters (PLN 7 million and twenty new jobs) for innovative projects.** The maximum allowable support in the form of a cash grant may be up to 20% of eligible costs.

In order to obtain a grant, investment projects should meet qualitative criteria, including:

- ✔ create jobs for specialists
- ✔ collaborate with science
- ✔ influence the sustainable development of the region
- ✔ declare social responsibility

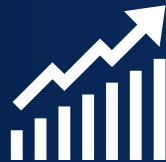
Furthermore, companies applying for a government grant may receive additional support for employee training. **The current Program will change, and the quantitative and qualitative criteria will be lowered. Information on the Program and planned changes is provided by the Investment Centre at PAIH.**

✔ Real estate tax exemption (RET)

The third form of regional public aid available to investors is the exemption from real estate tax (RET). The object of taxation is land, buildings and structures, and the entities are property owners. Establishing the possibility of obtaining an exemption from real estate tax takes place pursuant to a resolution of the Commune Council.

Numerical Summary for 2021

Sales of electric vehicles in 2021 were at a very high level compared to previous years, despite the decline in the overall market for new passenger cars, but this growth was mainly due to a very low base in the comparable pandemic year before, i.e. in 2020.



According to the Polish Automotive Industry Association, sales of electric vehicles increased in the first half of 2021 and were higher by 120% year on year.

In 2021, there were implemented five projects in the e-mobility sector for a total amount of EUR 2,081.6 million. Employment in these five investments amounted to 2,412 employees.

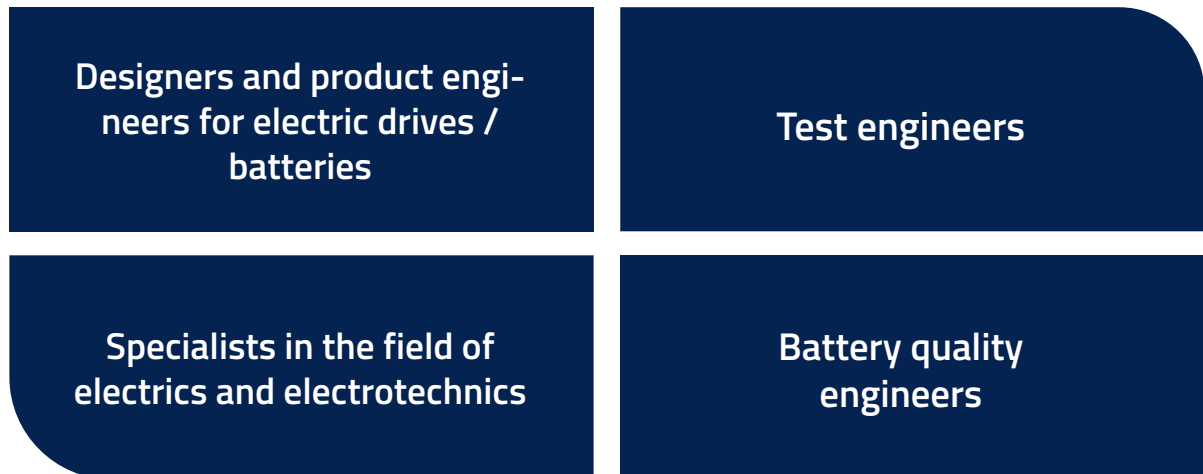
Among the key projects in 2021, there were investments by companies such as:

Company	Investment region	Investment value	Employment
SK Hi-Tech Battery Materials Poland (South Korea)	Dąbrowa Górnicza Silesian voiv.	EUR 840 mln	852 employees
SK Nexilis (South Korea)	Stalowa Wola Subcarpathian voiv.	EUR 646,6 mln	500 employees
LG Energy Solutions (South Korea)	Biskupice Podgórne Lower Silesian voiv.	EUR 380 mln	500 employees
Northvolt (Sweden)	Gdańsk Pomeranian voiv.	EUR 165 mln	500 employees
Capchem Poland Sp. z o. o. (China)	Śrem Greater Poland voiv.	EUR 50 mln	60 employees

Employment, earnings, and employee competency forecasts

Employment forecasts

The e-mobility sector in Poland has been developing intensively for several years, which of course translates into an increase in demand for specialists in the field of electromobility. In 2021, there was increased demand mainly for the following:



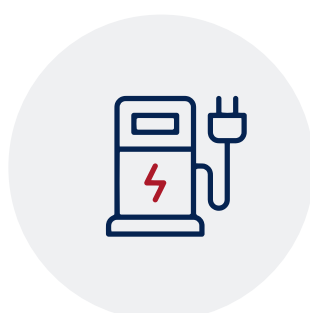
Apart from positions related to the production of electric batteries or its modules, there are many positions related to **battery storage, recycling - giving the battery a second life**. Here, a significant role is played by positions related to **product management - Product Managers or Market Analysis Experts** in the use and disposal of electric batteries. In addition, the third group of positions in this sector concerns charging stations for electric batteries. In this industry, the demand for **service technicians / electrical technicians** has increased.

Whom else does the e-mobility market need?

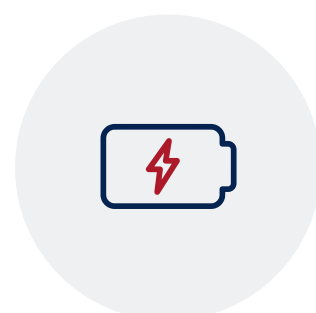
The electromobility sector is not only factory workers. The market needs people who create the entire infrastructure necessary for the proper functioning of the industry. In 2022, there will be an increased demand for:



Analysts in the field of data handling and systems monitoring the condition of infrastructure for the e-mobility sector

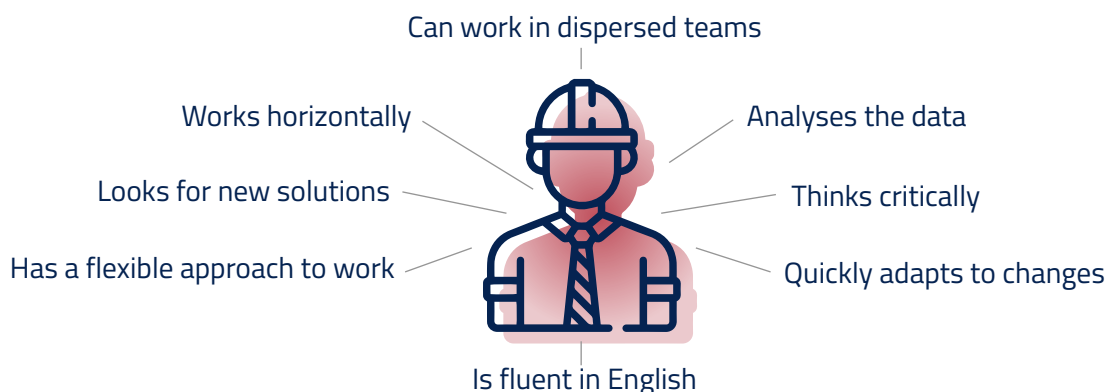


Specialists for servicing the charging infrastructure of electric cars



Electric battery service technicians and electric battery post-warranty service specialists

Candidate's competency profile in electromobility



Earnings in electromobility in 2021



Constructor: PLN 8.000 – PLN 10.000 gross
Test engineer: PLN 8.000 – PLN 11.000 gross
Product engineer: PLN 9.000 – PLN 11.000 gross
Electronics specialist: PLN 9.000 – PLN 11.000 gross
Battery quality engineer: PLN 8.000 – PLN 10.000 gross

Labour costs in the e-mobility sector

The share of labour costs in the production of electric cars is at a low level due to the high level of production automation and the relatively low demand for labour.



By the end of 2022, LG Energy Solution battery investments in Kobierzyce will generate approx. 6,000 jobs.



Umicore: employment of 400 people (Nysa, SOP: Feb 25, 2020).



Mercedes-Benz Cars - production of batteries for the EQ model (Jawor, Lower Silesia): 300 FTE.

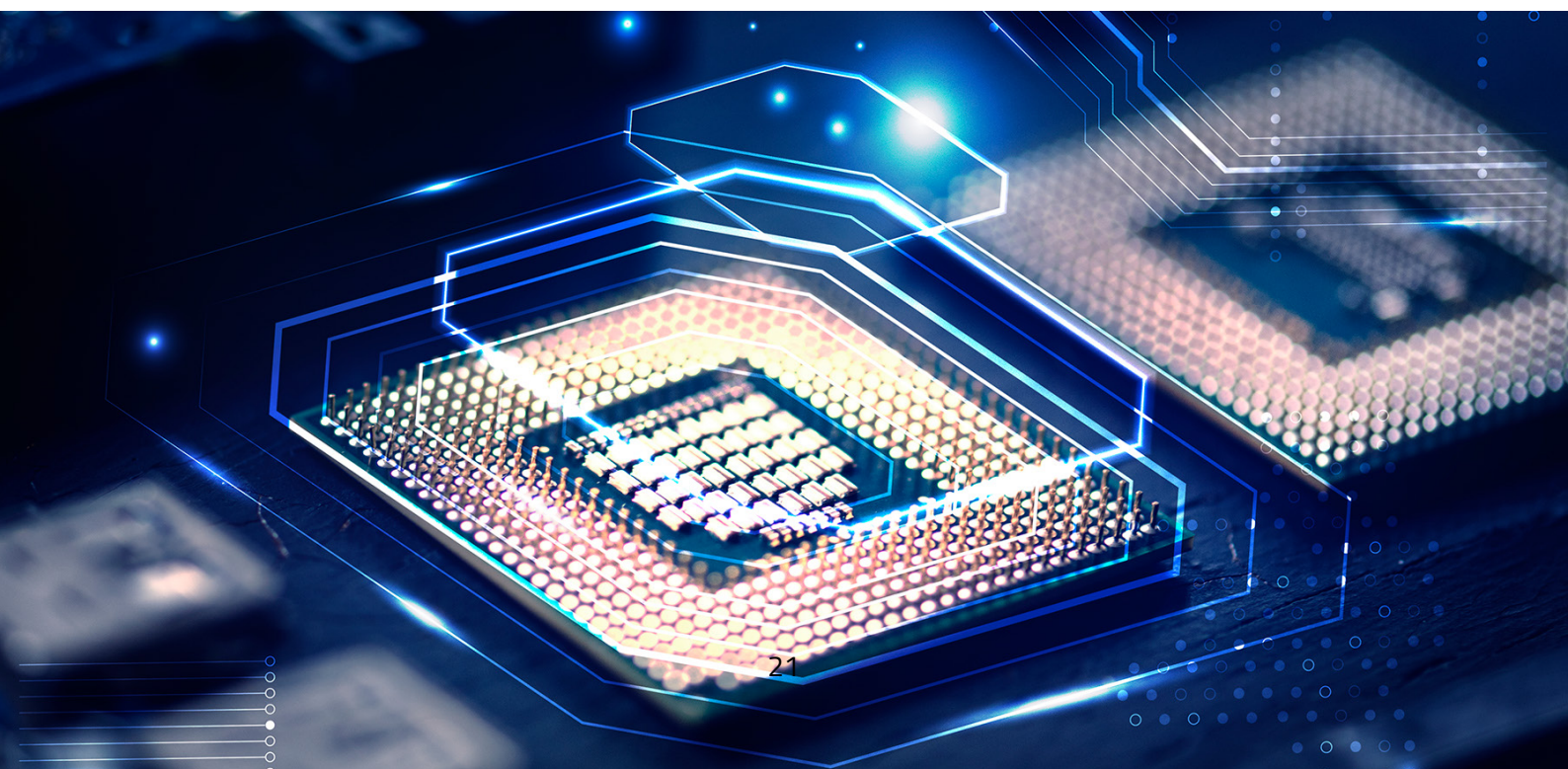
For a long time, almost the entire electromobility supply chain was outside the European continent, which, combined with a shift in the centre of gravity of the vehicle value - from the drive unit to the battery, threatened European companies to marginalise their supply chains. Therefore, around 2017, a decision was made to build European competences in the field of battery production. **It quickly turned out, however, that the biggest barrier to the development of domestic capabilities is not the lack of capital, but the deficit of qualified employees in the field of electromobility.**

Today, the rates of electromobility engineers and technicians have diverged from the rates of their counterparts in traditional automotive – interestingly, currently the most valued specialists in the field of servicing lithium-ion battery factories are Poles. It is Polish engineers who are building the Northvolt factory in Sweden or the Gigafactory Tesla near Berlin.

Electromobility is an interdisciplinary industry that requires employees with knowledge: mechanical, electronic, power electronics, electrochemical, programming in the field of big data, and embedded systems. In particular, the lack of qualified electronic programmers is a serious challenge, as so far, the electronic market has been dominated by Asian countries. In the past, the needs of industry led to the appearance of technicians and engineers in the education system, combining mechanics with programming and basic knowledge of electronics – this is how the profession of mechatronics, highly valued today, was created.

The electromobility industry in the field of battery production needs a combination of mechanics with electrical engineering, electrochemistry, and embedded programming (at the level of C and C++ languages). Electromobility is also largely about programming – communication protocols: BMS and chargers, network service of charging stations, diagnostics of battery packets, or advanced algorithms controlling the operation of drive units (e.g. reluctance motors). It is clear, however, that this is programming that requires strict electrical knowledge.

Electromobility also requires high-class specialists for big data analysis, as one of the key features of modern cells is the traceability of products at the level of a single cell. Combined with warranty periods of up to ten years, this leads to the creation of gigantic databases.



Also, the control of the production process in the automotive regime, with examination of the process capability and statistical analysis of parameters, poses the challenge of processing huge amounts of data in real time (for example, one of the machines producing prismatic cells works at a speed of about 30 pieces per minute, collecting over 4,000 parameters each cycle).

The Polish economy is in a privileged position here, as the LG ES factory near Wrocław attracted investments from other areas of the electromobility supply chain. Thanks to this, it was Polish engineers and technicians who, as the first ones in Europe, acquired many unique skills in the field of production of batteries and components used in this field..

Poland is also a programming power, and electronics is a popular hobby, with a myriad of training materials available on the Internet in Polish. These comparative advantages must be used wisely, promoting programming professions and introducing more classes in the field of electrical engineering and electrochemistry in schools.



Rafal Biszcza

Director of PIRE Knowledge HUB





Piotr Hojda (Head of Design, Green Cell): Home charging stations drive electromobility

Electric cars, although present on the market for over a dozen years, are still considered an exotic means of transport. It's time to change this perspective and bring users closer to electromobility through solutions that will support energy independence and help to charge cars at home.

On the straight path to electromobility

Changes in world markets are driving us towards sustainable energy. It happens consistently and dynamically. The rapid increase in crude oil prices, the diversification of energy sources in most European countries, the increasing risk of a blackout, and even the reduction of carbon dioxide emissions through legal regulations make us look more and more hopefully at electromobility based on renewable energy sources. **However, we need products that will prompt the revolution in energy and transport to bring about a higher quality of life.**

The origins of Green Cell are related to batteries for mobile accessories, but we quickly understood that **the future belongs to electromobility**. This is perfectly illustrated by market data. At the end of last year, there were 38,000 electric cars and plug-in hybrids on Polish roads, as well as over 10,000 electric two-wheelers. In Germany, these numbers are even more impressive. In 2021, our western neighbours registered over 355,000. electric cars, i.e. as much as 83% more than a year earlier.

Our team has great hopes for electromobility. Many electric car enthusiasts work with us, and our customers are also involved in the process of creating new products. We can always count on their valuable insights as well as commitment to testing prototype chargers. **By observing the market and collecting comments from electric car users, we decided to focus on solutions for charging cars at home.**



The development of public networks of chargers, and advances in technology around cells used in cars are important, but even more crucial is to ensure a positive user experience when charging the car, to facilitate the entire process, and to provide an alternative to energy derived from coal.

New solutions support independence

Electromobility requires a holistic approach and a broader perspective on EV accessories. It is worth analysing not only where the energy for charging electric cars will come from, but also the motivations and emotions that accompany users when buying a car and using various types of products.

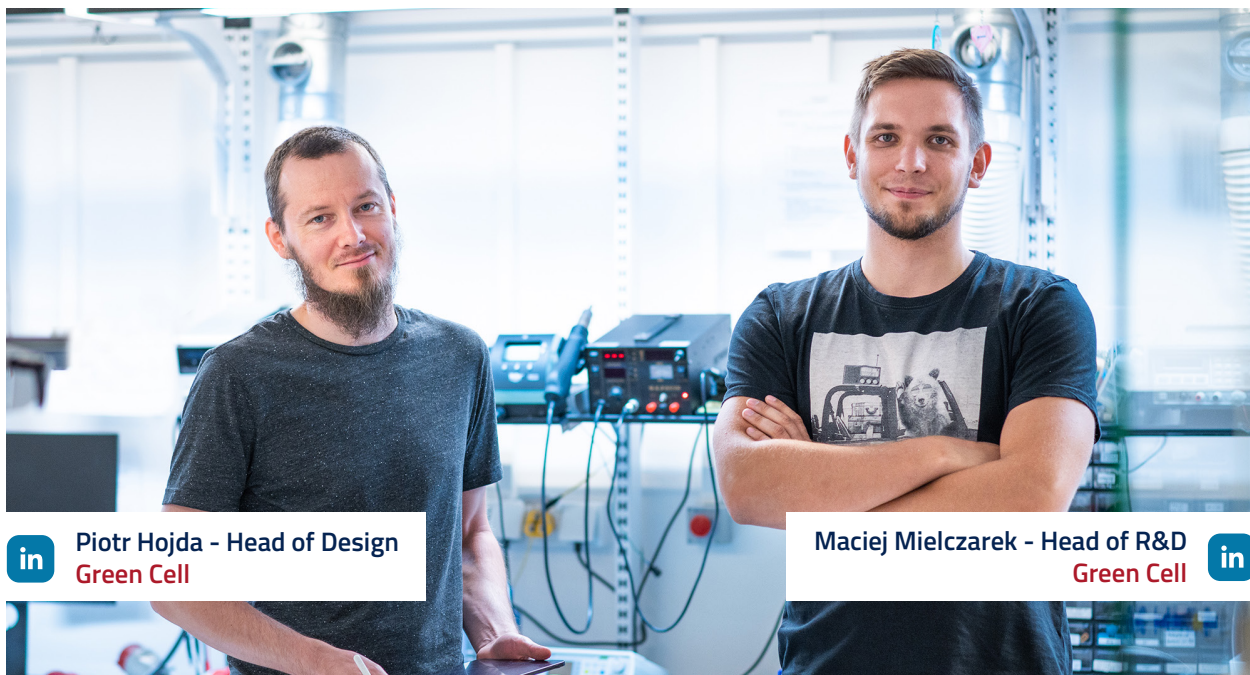
Many people would like to supply their car with green energy, therefore the development of the sector will largely determine the finding of solutions combining electromobility with renewable energy.

One such solution is an ecosystem composed of several types of EV chargers, but also an energy storage, a photovoltaic inverter, and a home power management system. In the case of Green Cell, its first element is the electric car charger – GC Mamba, the prototype of which was presented last year. By placing all the electronics in the plugs, the module usually located in the middle of the cable has been eliminated. In addition, an LCD screen has been placed in the Type 2 plug, and the product is accompanied by a dedicated application, thanks to which the user can change the charging parameters and track its course. This way, the device provides the user with full control over the charging process and remains versatile as it is connected to a three-phase socket. This is a good example of the direction in which the electromobility market can develop. The new electric car charging devices are sure to be even more compact and user-focused.

We are aware that new technologies are the key to accelerating the development of electromobility. That is why, like many other companies, we focus primarily on research and development. Our 30-person R&D team consists of designers, engineers, IT technicians, and programmers. Own projects allow to build know-how, improve the quality of products and, consequently, transfer more and more processes to Poland. Since we do not want to confine ourselves to designing, we have opened an e-bike battery factory in Balice near Krakow, where there will be assembled up to 50,000 batteries per year.

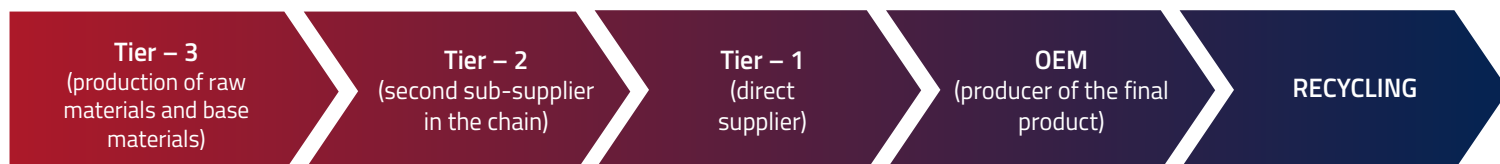
I believe that the key to a more dynamic development of the entire electromobility sector requires closeness to users, understanding their needs, and creating solutions that will support modern, distributed energy. It is worth basing these activities on the independence that EV provides to both, users and designers.

Green Cell



Value chain in the e-mobility project industry

The e-mobility value chain consists of five production stages: OEM (producer of the final product), Tier - 1 (direct supplier), Tier - 2 (the second sub-supplier in the chain), Tier - 3 (production of raw materials and basic processes), and recycling. These stages are presented below, with an indication of selected manufacturers representing a given element of the value chain.⁹



(A) Tier – 3 (e.g. producer of raw materials and basic processes):

- Processes related to the processing of raw materials, enrichment of the basic material,
- Semiconductors and rare materials (companies absent in Poland),
- Manufacturers (e.g. CAPCHEM),

(B) Tier – 2 semi-finished products:

- UMICORE: production of cathode materials,

(C) Tier – 1 Components and production of subassemblies:

- BOSCH, DELPHI, APTIV, ZF, CATL (companies absent in Poland),

(D) Final assembly of electric cars -> Original Equipment Manufacturers (OEM)

Manufacturers: Volkswagen Poznań. There are no processes in the field of final assembly of electric passenger cars in Poland. There is production of electric buses (e.g. Solaris)

(E) Recycling: Waste services, Elemental Strategic Minerals, Royal Bees Recycling, etc.

Priority of components in the value chain due to the share of the added value of a given component in the value of the final product (percentage share), the time and logistic link with the final assembly, and the current supply in Europe.

(A) A Batteries constitute up to ~25% of the total added value of the car, but their time and place of production do not have to be related to the final assembly. Batteries require a lot of employment of people with high qualifications (know-how). Currently, there is no high battery supply in Europe.

- ✓ **Manufacturers of batteries or parts for batteries (including battery separators) present in Poland include: SK Innovation, LG Energy Solution.**

⁹Please note that only some of the companies listed below are present in Poland. In the case of some producers, it is not possible to unambiguously qualify only one value chain, because a given concern may integrate several activities and production processes vertically within the same capital group.

ⓑ Structural and external body accounts for up to 19% of the added value, and its availability is rigidly linked to the place and time of final assembly. **There are a large number of body manufacturers in Europe today, due to the large internal market and the final assembly.**

ⓒ Electric motor: estimated value is 13% of the car's total value. Electric motors could be successfully produced in Poland.

✓ **There are currently no producers of electric motors in Poland. In the world, these are, among others, the following companies: ZF (present in Poland, but not in the field of engine production), BorgWarner, Valeo, BOSCH, DRAXLMAIER, Thyssenkrupp, Hyundai Mobis, Magna.**

ⓓ Other components, for which locating production in Poland would have great potential, are high and low voltage architecture (the added value is approx. 9%), as well as Advanced Driver Assistance Systems (ADAS).

✓ **Manufacturers in this segment include: APTIV, Nidec, Veoneer.**

From the above value chain, the production of electric motors (Toyota) and batteries is developing the best in Poland (production capacity in 2022 will amount to approx. 65-70 GWh; mainly LG in the area of Wrocław). There is an insufficient supply of batteries for electric cars in the EU.

The value chain in the electric car battery production sub-sector consists of six stages, represented by the following manufacturers (only some companies are present in Poland):

1 Primary raw materials for the production of batteries:
Morita, SQM, Dow Chemical Company, BASF, FMC Lithium

2 Chemical cells and cell components:
Umicore, Mitsubishi, Celgard, Targray, Asahi Kasei, NEI

3 Battery cells – integration of chemical cells and components into cells:
GS Yuasa, CATL

4 Battery modules – assembly of cells into modules, ensuring compliance with safety and temperature management requirements: SK, Lishen, Voltabox, Romeo Power

5 Battery pack – assembling modules into battery components for installation in the car:
Continental, Bosch, Samsung, LG, Panasonic, BYD, Tesla, BMW, VW, Daimler, Renault, GM

6 Integration of the battery with the car, charging management:
Hyundai, Ford, Nissan, GM, BYD, Tesla, BMW, VW, Daimler, Renault, GM

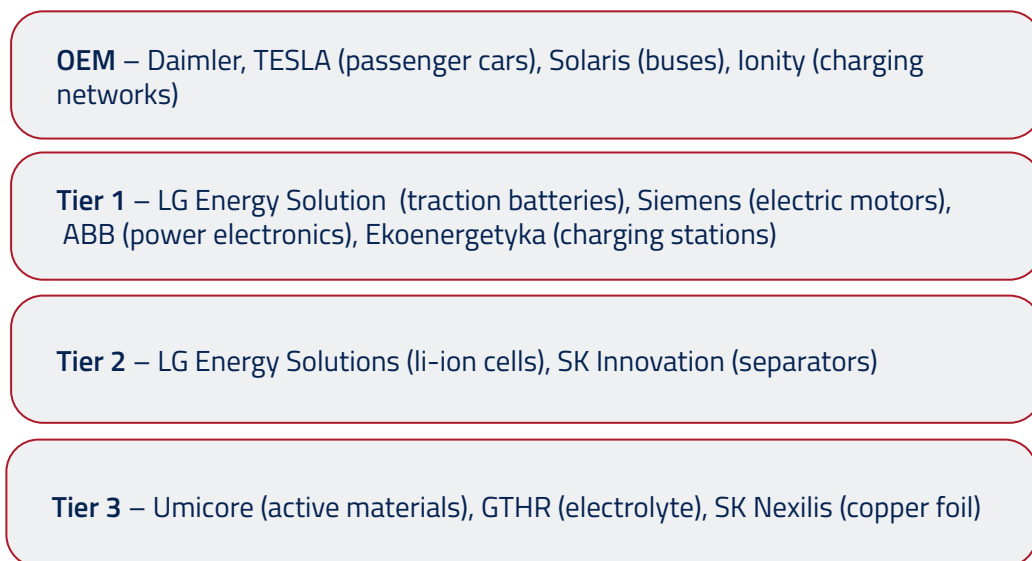
Investments implemented within the value chain of the electromobility sector generate further investments. **An example of this is the fact that Guotai-Huarong and Capchem, sub-suppliers for LG Energy Solution, locate their investments close to their recipient. Similarly, Foesung does so in Kędzierzyn-Koźle, which will produce inorganic fluorine compounds as the electrolyte of lithium-ion cells. It is similar with the investment of the Belgian concern Umic.**



To understand the intricacies of the value chain in the electromobility industry, first it is important to explain the so-called Tier system in the automotive industry. Today's cars consist of over 30,000 parts which, as a result of the phenomenon of globalisation, are produced in many independent factories. At the same time, the highest standards of reliability and safety are expected from a passenger car, which in a way contradicts the complexity of the supply chain. **That is why the automotive industry is highly standardized and each link in the production chain has a strictly defined place assigned to it, subject to restrictive standards: ISO, VDA or IATF.**

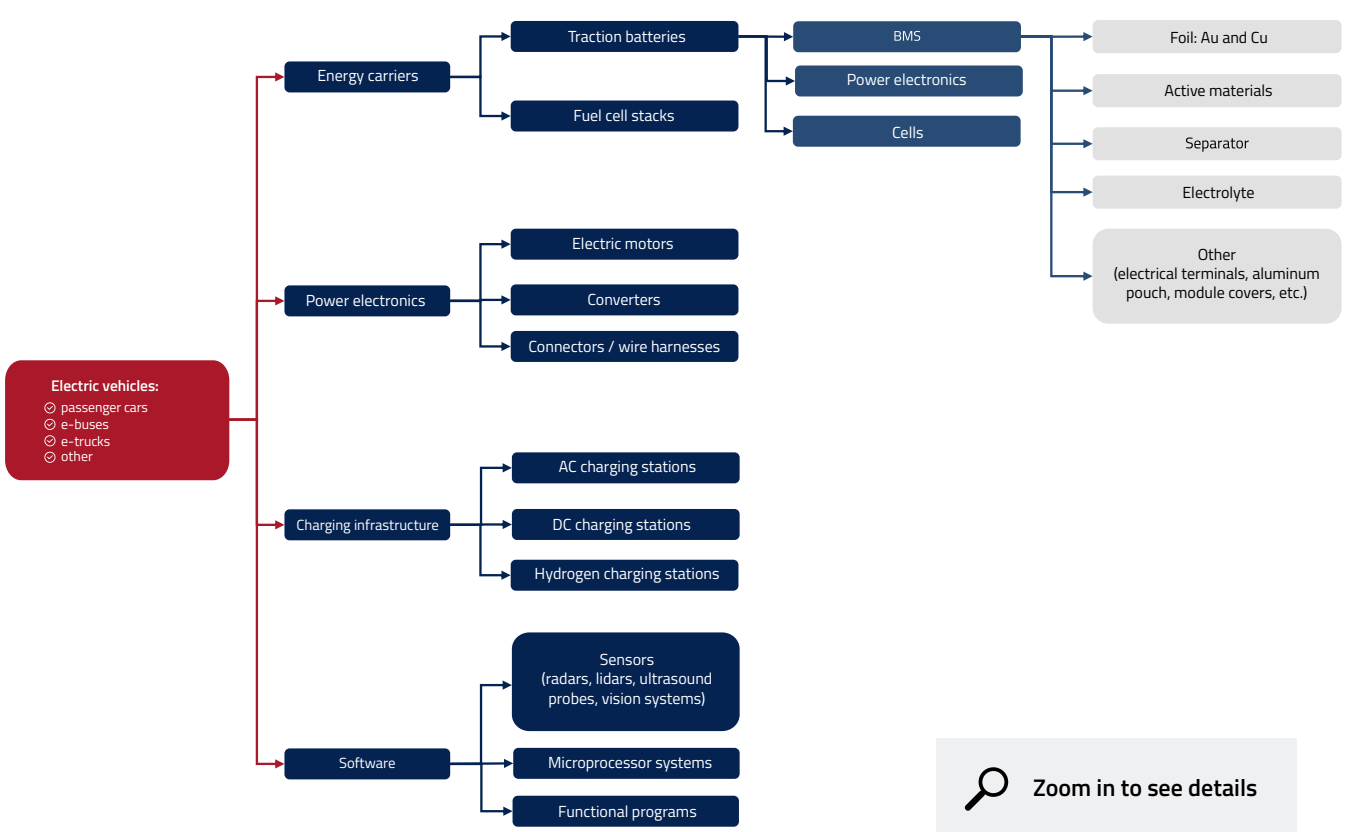
At the very top of the production pyramid there is an OEM (Original Equipment Manufacturer), i.e. the manufacturer of the car, for example VW, PSA or Tesla. Component suppliers, i.e. TIER 1, such as Bosch, Delphi, Aptiv, ZF, cooperate directly with the OEM. TIER 2 are suppliers of semi-finished products who do not cooperate directly with OEMs – they are often SME (Small and Medium Enterprises), which are not known outside the industry, e.g. Spinko Motors. At the base, there are TIER 3 companies, i.e. raw materials suppliers – BASF, Umicore etc.


In the traditional value chain, there applies a principle according to which the highest margins are achieved by OEM, and subsequent links in the chain must be content with a correspondingly lower share in the final value of the car. There is also a rule that companies in the lower Tiers are more easily replaceable. In the electromobility industry, the division is as follows:



What distinguishes the electromobility industry is the fact that the largest product margins currently fall to Tier 2 suppliers, i.e. producers of lithium-ion cells (Panasonic, LG ES, CATL, etc.). The deficit of batteries on the market leads to an unprecedented situation in which OEMs have to seek to secure contracts with battery manufacturers, which in practice significantly reduces their margin. This is the reason why the leading players, one by one, declare the development of their own production of cells, which in turn pushes them into a foreign role of a seekers of raw material contracts with Tier 3 entities.

If we add to this that cell producers in the European Union will be responsible for their recycling, the whole concept of division of labour within the supply chain becomes questionable, and it looks as if OEMs have just integrated vast production areas.



 Zoom in to see details

Thank you for reading our report!

It was created in cooperation with the Polish Investment and Trade Agency, the Polish Chamber of Electromobility Development, and the company Bergman Engineering, which deals with the recruitment and contracting of engineers and specialists.

The Krakow-based company Green Cell is also the content partner of the report.

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