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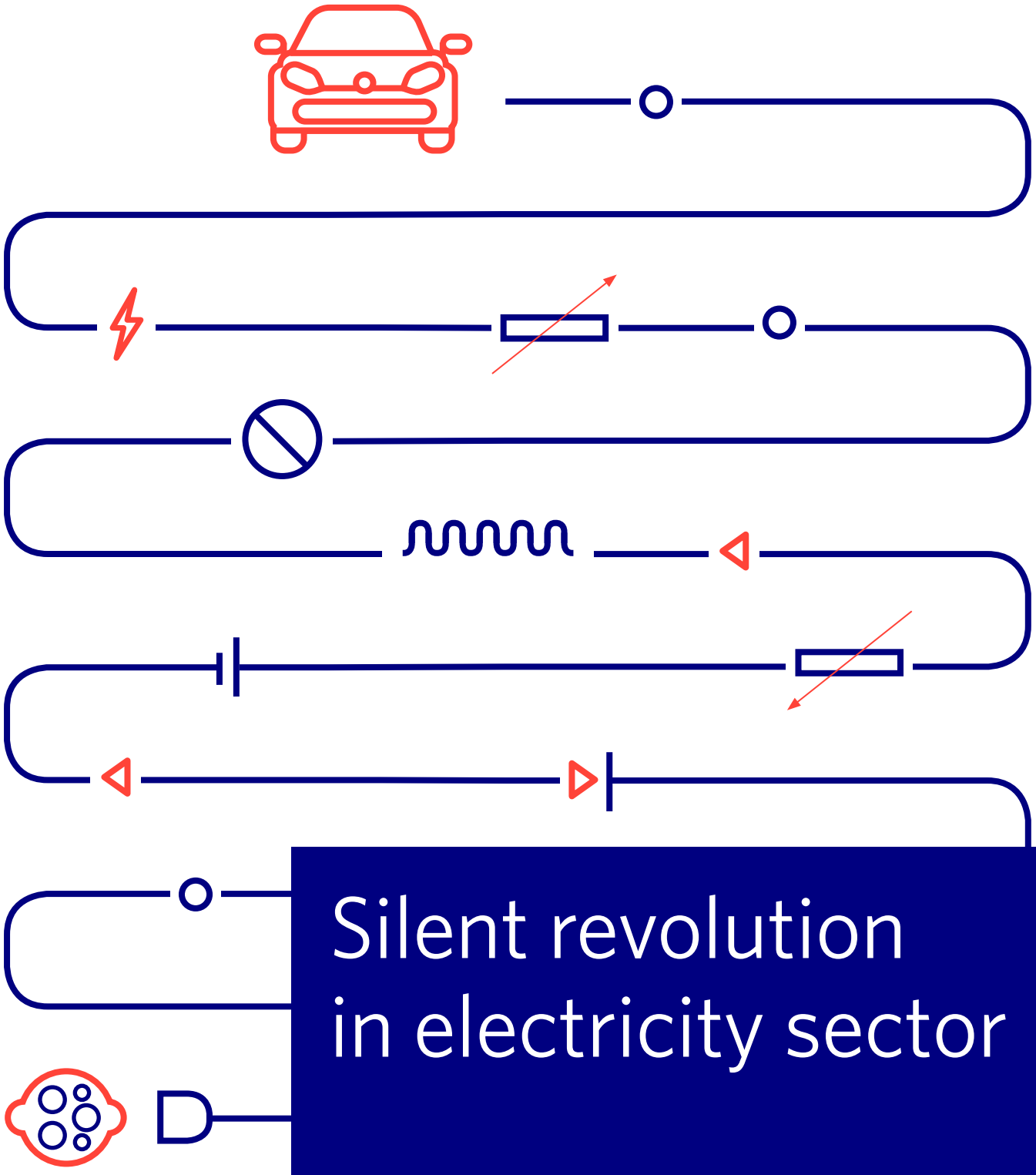

Silent revolution in electricity sector

Electromobility in Poland

Key findings and recommendations

1. Electromobility could help the electricity sector in Poland. In the initial stage the investment resulting from electric vehicles deployment will strengthen the transmission and distribution grids. One million electric cars will create an opportunity to balance the system better, fill the night valley and integrate variable renewable energy sources. In the longer run, electromobility will spur spreading of revolutionary, new technologies such as energy storage.

2. The current EU financial perspectives create a unique opportunity to use electromobility as an argument in order to invest in the Polish electricity sector and speed up its take up of new technologies. Other possible sources of funding include the Emissions Trading System and its modernization fund that can be used to finance the infrastructure for electric cars. The issue of "green bonds", popular among investors, should also be considered to secure public investment in the charging stations.

3. Persuading consumers to drive an electric car requires a lot of incentives. Norway, the Netherlands, and other pioneers of electromobility have examined ways of supporting this and developed sets of best practices, which should be used. In addition to soft incentives, there is a need to develop the charging infrastructure and subsidise the purchase of cars. The latter mechanism should link the value of incentive to the income of the consumer. Also, the cost of the car should be reduced as the size of the fleet increases.

4. The development of electromobility is a huge coordination effort. It is essential to maintain a close dialogue between central and local governments, business and the non-governmental sector. Only a joint effort will allow the identification and resolution of the problems which are obstructing the spread of electric cars in Poland. Such co-operation needs to be institutionalised as soon as possible.

5. Implementing electromobility meets a number of objectives of sustainable energy and environmental policies. It reduces dependence on imported oil, aids the modernisation of the energy sector, stabilises the energy system and improves air quality in cities. The promotion of electromobility in Brussels will allow Poland to improve its image from a country obstructing progress in climate and environment policies to a country with a positive agenda.

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The report was commissioned by Fortum. The supporting partner of the report is the Electric Vehicles Promotion Foundation.
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Introduction

A clever management of electromobility could become a ladder that will lead the Polish electricity sector and the whole economy to a higher level of industrial development

Electric cars are coming back into favour after a century of oblivion. In the early stages of the development of the automotive industry, at the end of the nineteenth century, it seemed that the simpler electric motor would win out over the internal combustion engine. Eventually, the mass -produced, internal-combustion Ford T won out, confining electric cars to history.

Growing environmental awareness, technological advances and the increase in oil prices have led to a resurgence of the electric car. One milestone was the launch of the Tesla Roadster in 2008 – the first mass-produced electric car, equipped with lithium-ion batteries. From that point, the number of electric vehicles has continued to grow. In 2015, it crossed the barrier of one million registered electric cars, including about 750,000 vehicles which run exclusively on batteries. According to estimates of the International Energy Agency (IEA), the number of new electric cars will grow at an accelerating pace. By 2020 there will be almost 20 million worldwide, by 2025 – 60 million and, by 2030 – 150 million[1].

Even so, only in seven countries the share of electric vehicles is more than 1 per cent (including in Norway, where almost every fourth car sold in 2015 was electric). Ninety per cent of electric cars sales globally takes place in eight countries, and the share of electric cars in new registrations is only 0.1 per cent.

The growth of the market has been limited so far mainly by the high price of electric vehicles, their short range, long charging times and poor infrastructure, which is, however, evolving. According to the IEA, the number of charging stations is increasing quickly – in 2010 there were only about 20,000 world-wide, but almost 1.5 million by 2015 (of which approx. 1.3 million are private charging stations; 162,000 are publically available and have a capacity of up to 22 kW, and 28,000 are public fast charging stations, usually with a capacity of approx. 50 kW). China is responsible for a large part of the increase – nearly half of all fast charging stations and a quarter of the remaining ones are located in the Middle Kingdom.

Maintaining the fast development of electromobility will become possible thanks to technological advances in the production of batteries. In 2008, when the first Tesla Roadsters were available for sale, the average cost of a battery was USD 1000/ kWh. The cost dropped to USD 268/ kWh by 2016. IEA estimates that after the opening of the new Tesla and General Motors factories (in 2020 and 2022 respectively) the cost of a battery will fall to below USD 100/kWh. At the same time, the battery capacity, which determines the e-car's range, is increasing[2]. The record models can already travel over 400 km on a single charge.

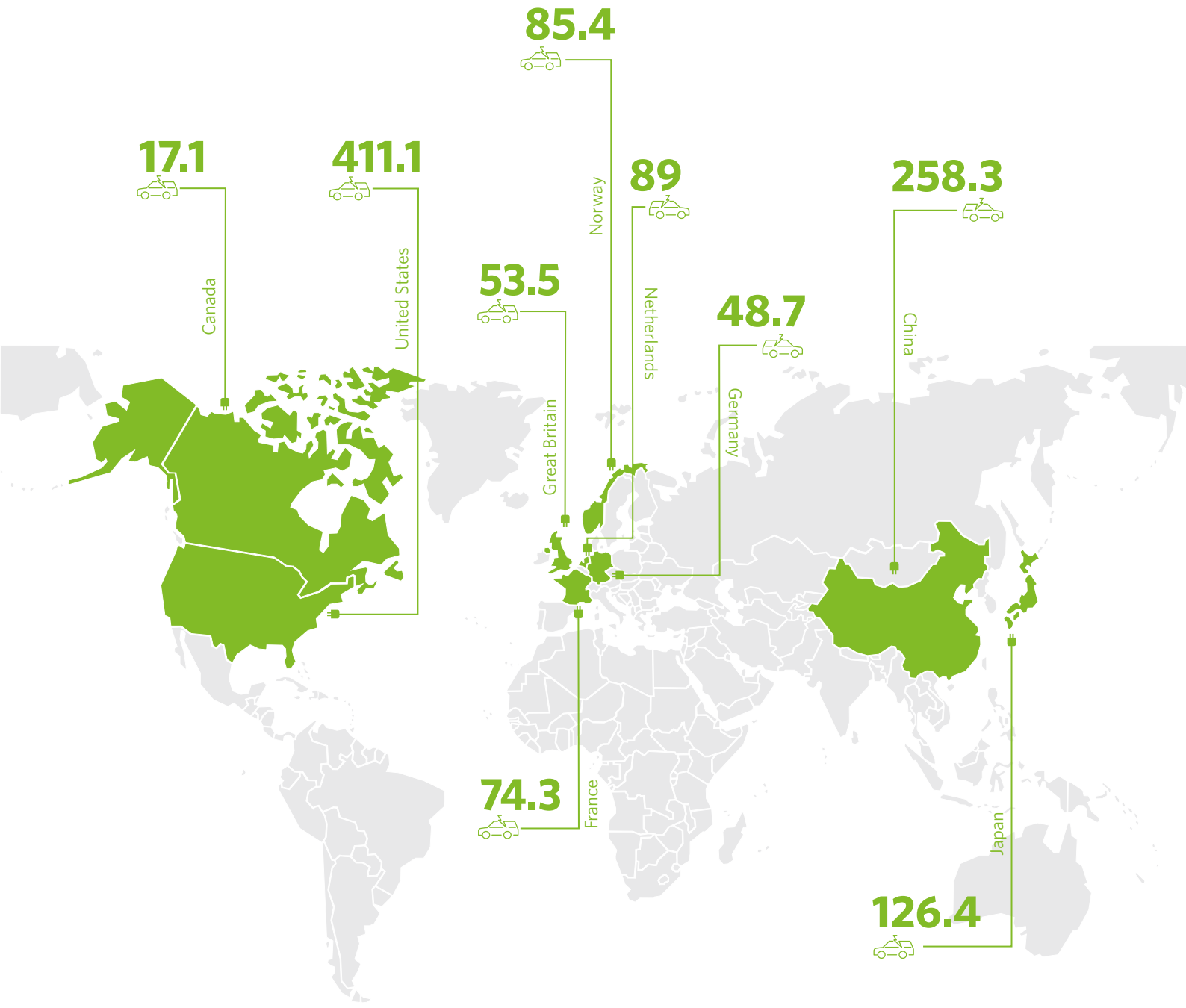
There are also more and more models at prices similar to cars with a combustion engine. Renault Zoe and Nissan Leaf are increasingly popular in Europe, where the market is also likely to be revolutionised by Tesla Model 3 and Chevrolet Bolt (known in Europe as Opel Ampera). IEA has stressed that the growth of electromobility requires a coordinated support for e-cars and simultaneous investments in the production and distribution of electricity. The benefits do not only accrue to the climate – the reduced level of pollution and noise will also have a positive impact on the health and quality of life of people in cities. Another important advantage is the reduced consumption of oil.

In the coming years, the electromobility revolution will spread to more countries, including Poland. The Government "Responsible Development Plan" and the detailed plans for the deployment of electric transport are an ambitious attempt to become one of the pacesetters.

1 Including scooters and electric buses.

2 In 2008 it amounted to 50 Wh/l on average and approximately 300 Wh/l in 2015.

MAP 1 | NUMBER OF REGISTERED ELECTRIC CARS IN CHOSEN COUNTRIES (IN THOUSANDS)



Source: Elbil.no, HybridCars.com

The global electric car market is so small that Poland could still go from a follower to a leader. It will, however, be a difficult task. What is needed is an extensive strategy which must be implemented by central and local governments, energy companies, the automotive industry and the ICT sector. The stakes are high and a clever management of electromobility could become a ladder that will lead the Polish electricity sector and the whole economy to a higher level of industrial development.

Polish ideas for electrification of transport

The Ministry of Energy in co-operation with the Ministry of Development has prepared a "Package for clean transport" – a set of three documents which determine the development strategy for electromobility in Poland. The main one is the „Plan for the development of electromobility", which defines the broad lines of measures to support electric transport until 2025. The technical issues, concerning mostly with building the network for charging electric, CNG and LNG cars, are described in a document entitled „The national framework for the alternative fuel development policy". It also contains a detailed list of planned legislative measures. By amending the law on bio-components and liquid bio-fuels, the Ministry of Energy plans to set up a Fund for low-emission transport which will finance projects to develop electromobility.

Public consultation on all three documents finished in September and October 2016. The "Plan for developing electromobility" and the "National framework for the policy of developing alternative fuels" are framework documents which have to be adopted by the Council of Ministers and will only then be enforced by adopting the appropriate new laws and amending the existing legislation.

TABLE 1 | NUMBER OF NEW REGISTRATIONS OF ELECTRIC CARS IN POLAND (THOUSANDS)

	2011	2012	2013	2014	2015	2016 (before Q3)
Electric vehicles	0.03	0.03	0.03	0.1	0.3	0.4
Hybrids	0.8	0.8	1.8	3.9	5.4	7

The draft amendment to the law on bio-components and liquid bio-fuels is currently moving through the government legislative path. At the beginning of November 2016, the draft was sent to the Council of Ministers, and after its adoption will be submitted to parliament as a government draft.

Plan for development of electromobility

The first goal is to promote electric vehicles in Poland. The Ministry of Energy assumes that one million will be registered in Poland by 2025. To achieve this goal, there will have to be an expansion of the infrastructure for charging so that users of electric cars will be provided with levels of convenience similar to users of internal-combustion vehicles, including on trunk routes. It is also necessary for financial support to be given for the purchase of electric cars as at the moment one of the barriers to the development of electromobility is the high price of the vehicles. The government indicates that support will diminish over time, because as technology advances (including cheaper and better batteries) electric cars will become more affordable and widespread.

The increase in the number of electric cars will bring about a series of consequences for the electricity sector. The Ministry of Energy estimates that one million vehicles will generate an annual demand of approximately 2.3-4.3 TWh of electricity, which is on the one hand a challenge for the national grid, but on the other – an opportunity for firms in the sector. The Ministry estimates that over the ten-year lifetime of the average vehicle, the revenues to energy companies from the sale of electricity for charging cars could reach as much as PLN 20 billion. These funds could be then used for, among other things, investments in the low and medium voltage grids necessary to integrate EV charging stations. Batteries for electric cars will be charged up mainly at night and as a result will coincide with the "night valley" which presently exists because of the drop in demand for electricity which happens at night. In order to manage the demand for electricity better, the Ministry wants 80 per cent of consumers to be equipped with remotely read meters (*"smart*

meters") and wants dynamic tariffs for electricity to be introduced which will encourage the charging cars when demand for electricity is falling. The Ministry proposes the construction of energy storage devices, and devices for recovering energy from the expansion process of natural gas. The owners of these stores, and car-owners, would be encouraged financially to return electricity back into the system.

The increase in the number of electric vehicles will also reduce oil consumption, which will in turn translate into greater energy independence for Poland. Although the country is self-sufficient in terms of electricity production, 97 per cent of its oil is imported from abroad at a cost of some 2-4 per cent of GDP annually. The Ministry also draws attention to the environmental aspect of the projected changes. Poland currently has the worst air quality in Europe and a reduction in the number of internal-combustion engines will lead to an improvement of the situation. According to estimates of the World Health Organization, air pollution is the most dangerous environmental factor to the health. In the world as a whole, more than 7 million people die each year from diseases caused by pollution (primarily respiratory disease, stroke and coronary heart disease), which accounts for one-eighth of all deaths[3].

TABLE 2 | PREMATURE DEATHS IN POLAND CAUSED BY EXPOSURE TO AIR POLLUTANTS (PM2.5, O_3, AND NO_2) (2013)

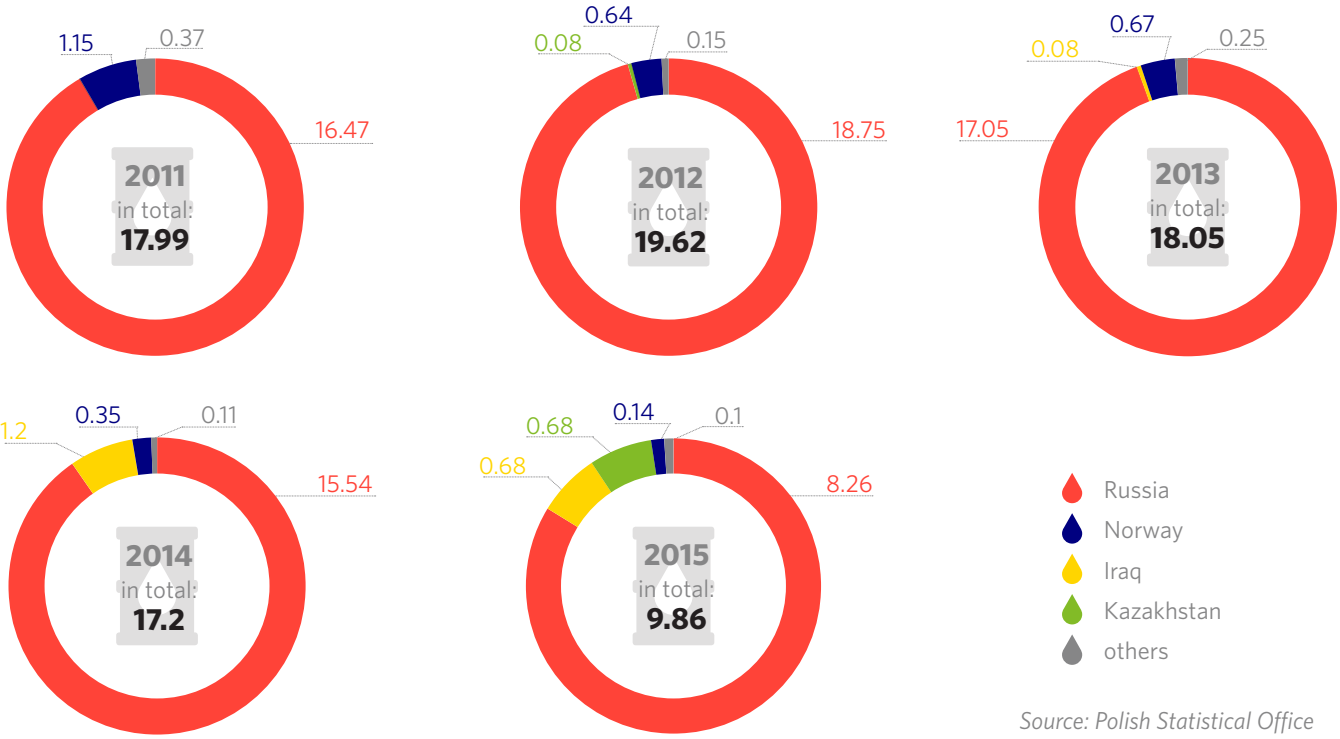
	PM2.5	O_3	NO_2
Poland	48 270	1 150	1 610
EU28	436 000	16 000	68 000

Source: European Environment Agency

The aim of the „Plan for the development of electromobility" is not only the spread of electric vehicles among Poles, but also an increase in the opportunities for Polish firms to participate in this market. The Ministry sees three challenges to which Polish companies and scientists can respond. The first of them is the new business models associated with the use of the cars and possible additional services. Ministry of Energy assumes that with the move away from internal-combustion vehicles the popularity of owning a car will decrease. More and more people will have shared vehicles or use public vehicles, which will create a market for innovative car-pooling systems and similar solutions that could be created by Polish companies. The second challenge is related to technology, and especially to batteries. Currently, the development of the market for electric cars is conditioned by price, size, capacity and speed of charging. For the forecast growth in the number of cars actually to happen new solutions are needed, including the use of batteries for electricity storage or for their recycling. If a market for electric cars

3 WHO: Burden of disease from Household Air Pollution for 2012.

GRAPHIC 1 | THE BILL FOR IMPORTED OIL (USD BN)



Source: Polish Statistical Office

is to be created in Poland, this would justify an increase in spending on research and development in this area. The third challenge is to create new brands that could emerge during the technological breakthrough. This is a chance for Polish companies which are not able to compete with traditional car-makers. They can use the „underdevelopment advantage" and enter the market. They, rather than existing suppliers could become the first-rank suppliers or even car manufacturers.

Measures are divided into three stages. The first, which runs until 2018, is the preparatory phase. During this period, the prototypes of Polish electric vehicles will be built along with a small market. At the same time preparations will be finalised to build a network of charging stations. The Ministry also wants to carry out promotional campaigns that will increase the interest in electromobility among Poles. The „national policy framework for the development of infrastructure for alternative fuels" is also to be adopted, as is the Law on the development of electromobility.

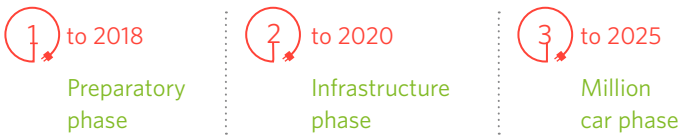
In the second stage – from 2019 to 2020 – the producers will start to assemble short series of electric cars and the first charging stations will also be built (shared between electric cars, LNG and CNG). There will be increased incentives for the purchase of electric vehicles.

In the third phase – to 2025 – electric cars will be mass-produced, and thanks to existing infrastructure and support systems, they will rapidly replace internal combustion engine cars. This process will be accelerated by, for example, introducing a ban on internal-combustion vehicles entering city centres.

In France, Renault and PSA (Peugeot and Citroen) received a total of EUR 3 billion in low-interest government loans for research and development related to electric cars.

In China, at central and local level, tax exemptions were introduced for factories for electric vehicles and components. The state offers subsidies to new businesses to enable the production of small, low-cost vehicles to low-specifications and in short production runs.

GRAPHIC 2 | PLAN FOR THE DEVELOPMENT OF ELECTROMOBILITY



In the „Plan for the development of electromobility" it is assumed that measures to support the industry, stimulate demand, increase awareness, and changes in law and in the energy sector will go ahead in parallel.

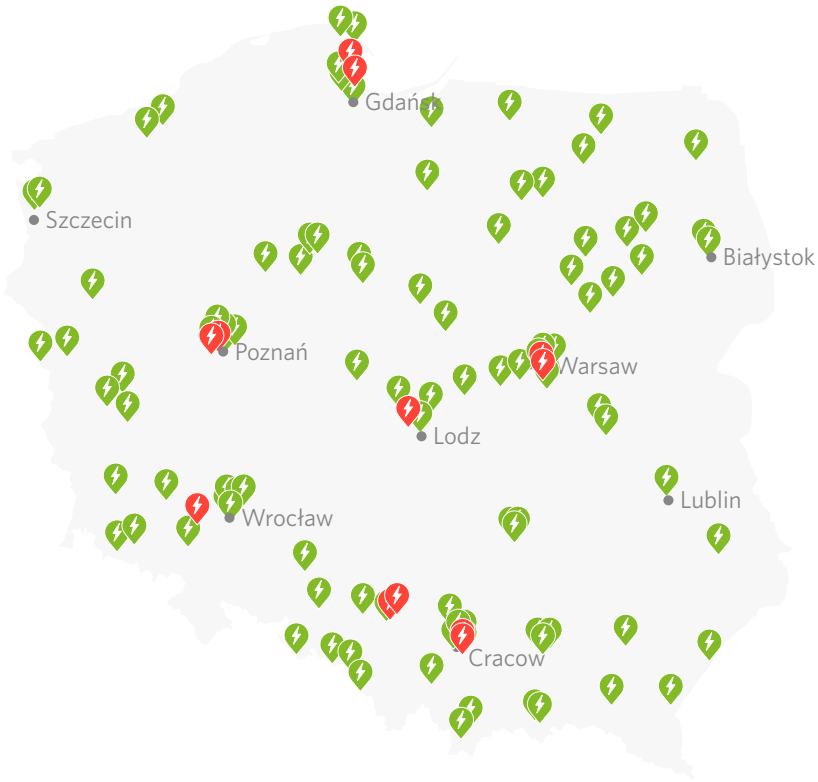
In terms of support for the industry, the Ministry of Energy is primarily focused on financing innovation. Funds for this purpose will come from, among other sources, the National Fund for Environmental Protection and Water Management (NFOŚiGW), National Centre for Research and Development (NCBiR), private equity funds, the Fund for low-emission transport and from energy companies through a specially established company,

TABLE 2 | COMPARISON OF PRICES OF ELECTRIC CARS AND COMBUSTION ENGINE CARS (PLN)

Cheapest variant price

electric car model	catalogue price	reference combustion engine car price	difference – amount	difference – %
Renault Zoe	89 900	**419 00 [Clio]**	48 000	114,56%
Nissan Leaf	128 000	**66 500 [Pulsar]**	61 500	92,48%
Volkswagen e-Golf	157 190	**63 090 [Golf]**	94 100	149,15%
Tesla Model S	291 400	**n.a.**	n.a.	n.a.
BMW i3	153 700	**94 600 [116i]**	59 100	62,47%
Kia Soul EV	150 000	**59 900 [Soul]**	90 100	150,42%

MAP 2 | EXISTING CHARGING STATIONS



According to the Ministry of Energy, there are just over 300 publicly accessible charging stations for electric cars in Poland today

Public stations (slow)

Public stations (fast)

Source: : http://www.autaelektryczne.pl/mapa-stacji-ladowania-pojazdow-elektrycznych.html

In Norway, electric cars are exempt from customs and excise duties since 1990. Their users are also exempt from a 25-per cent rate of VAT on car purchase, pay less road tax (445 crowns annually compared to 3,100-3,700 crowns for a conventional car; about PLN 220 as against PLN 1,500-1,700). In the case of company cars, tax is reduced by half.

In the US, from 1 November 2016 California has given a subsidy for the purchase of a new electric car for low income earners, starting at USD 4,500 and decreasing with the buyer's income, with incomes above USD 150,000 ineligible for to discounts. Those changing an old car and buying low-emission in exchange can count on getting up to USD 9,500. Grants depending on the value of the car and earnings of the client are also provided by federal administration.

ElectroMobility Poland. At the same time, energy companies, ministries and NCBiR will lead the analysis of new business models associated with electric cars. This will allow the selection of the most effective model of support for research and then production. The role of the administration and the energy companies' special purpose vehicle will primarily be financing and the analysis of the potential for production, while the firms themselves will be responsible for production itself and the marketing. The state financing system will be designed in such a way to allow support for risky projects at an early stage of their development.

In order to increase the demand for electric vehicles, excise duty charged on them will be abolished (and will be reduced for low-emission vehicles) Depreciation on this type of vehicle will be become more favourable as well. The changes are to come into force in 2018 at the latest. The Ministry also wants to impose a charge on the owner of new cars, which will depend, among other things, on the vehicle's emissions, and thereby promote ecological cars. Subsidies for the purchase of buses will also be introduced which will benefit mainly local authorities. Ultimately – by 2025 the Polish market for electric buses is to be worth at least PLN 2.5 billion annually, which can be translated into sales of about 1,000 buses. Over the years 2016-2018 pilot projects will be launched promoting electric cars in selected cities. These may include for instance exemption from parking charges, permission to drive in bus lanes or to be allowed entry to the city centres. Thus, for example, an amendment to the Environmental Protection Law envisages the creation of low emission zones in cities, which only electric vehicles might enter. Costs falling on local authorities will be reimbursed from the Fund for low-emission transport. By 2025 at least half of all the cars belonging to the public administration are to be electric – ministries hope to popularise electromobility leading by example. In parallel, an obligation will be imposed to build infrastructure for charging cars alongside public sector investments.

The national policy framework for the development of infrastructure for alternative fuels

The Ministry of Energy document is a technical plan for the development of a network of charging points for electric cars, and LNG and CNG filling stations. It is based on EU Directive 2014/94, according to which a network of refuelling CNG vehicles and charging points for electric cars should appear in population centres by 2020. In terms of infrastructure for electric cars, the Ministry's target is 6,400 charging stations in 32 agglomerations in Poland (including 400 fast chargers). By this point there should be 50,000 electric vehicles registered in Poland.

The network development plan does not provide specific targets for the number of charging points after 2020.

In order to realise the network development plan, the Ministry of Energy proposes a number of changes in terms of financial support for infrastructure and for the purchase of vehicles as well as for the manufacturers of electric vehicles. Many of them coincide with the assumptions of the „Plan for the development of electromobility." For this reason, the „national framework" can be regarded as an outline of the legislative action proposed, not only in the area of infrastructure development, but also to stimulate demand for electric cars and provide incentives for users.

The new law will determine the rules for the market for charging cars. It will also establish a system of access to data about the location of charging points for alternative fuels. This will allow the introduction of solutions that already exist and work well, as for instance in Scandinavia, where Fortum Charge & Drive charging stations (1134 of them) can be found through a smartphone application.

An amendment to the Energy Law will exempt suppliers of electricity for charging electric vehicles from the obligation to have a concession to trade. Another support measure will exempt the electric vehicles charging points from property tax.

An amendment to the Construction Law will introduce obligations such as ensuring proper power connection for car parks in any new public buildings and residential buildings for multiple households. It will also facilitate the construction of charging stations for electric vehicles as well as the construction and reconstruction of distribution networks and connections.

Fund for low-emission transport

According to the draft amendment to the Law on bio-components and liquid biofuels, the Fund will be established as a state earmarked fund at the disposal of the Minister of Energy. It will be operated by Bank Gospodarstwa Krajowego (state-run bank). The Fund is to be the main vehicle for the government's financial investments in electromobility.

The fund will be financed from the state budget calculated as 1.5 per cent of the previous year's planned revenues from excise duties on fuel for motor vehicles (these funds were previously used for the budget reserve) and by the transmission system operator, who will contribute 0.1 per cent of the „justified return on capital employed in the activities of electricity transmission".

The specific aims of the Fund include support for investments in the production of biofuels, infrastructure, including infrastructure for the sale of LNG and CNG, electricity for vehicles and hydrogen, as well as support for manufacturers of vehicles run on these fuels. Local authorities can also count on support from the Fund for public transport using low or zero emission vehicles, including finance for the purchase of vehicles. There will also be similar support for individual buyers of green cars. The Fund will also support research on new types of fuels as well as educational and promotional activities.

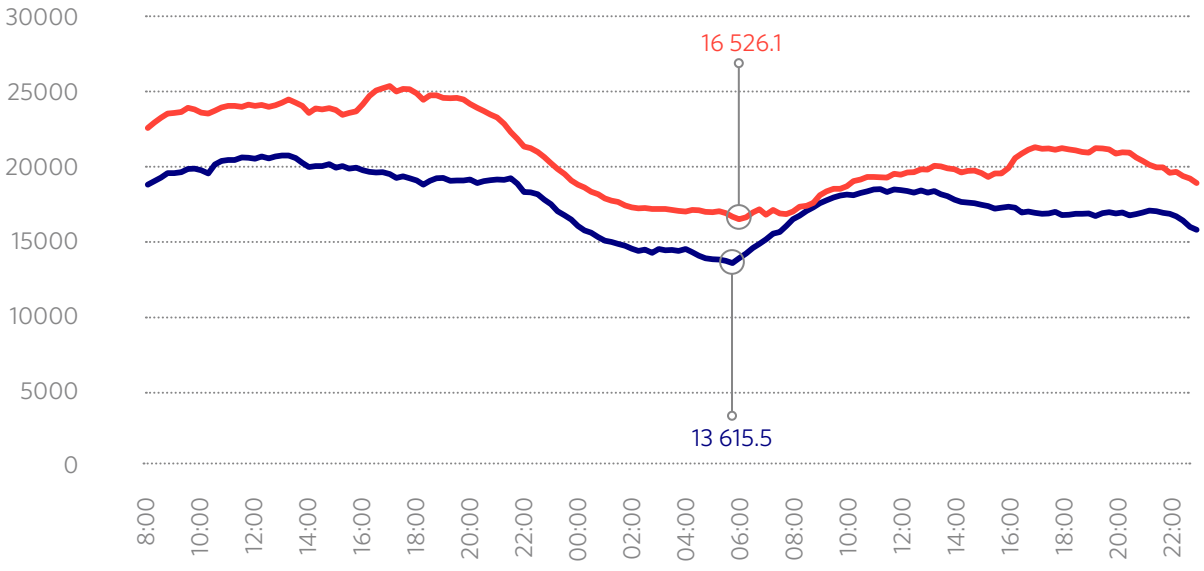
The Fund is expected to start operating from 2018. According to the Ministry of Energy, in the first year it should get PLN 465 million from the state budget. Over 10 years it will receive approximately PLN 5.3 billion.

In the UK the central budget subsidises local initiatives supporting electromobility as part of a special "Go Ultra Low City" programme – such as the construction of bus lanes which can be used by electric cars, public charging stations, the creation of car-sharing systems, the purchase of electric vehicles by public agencies or the exemption of such cars from parking charges.

In Germany, in order to support electromobility, the federal government has launched a fund worth EUR 1 billion euro. It was developed in collaboration with BMW, Daimler and Volkswagen and is funded equally by the state and the car-makers. People who buy an electric car worth up to EUR 60,000 will receive EUR 4,000 rebate. EUR 100 million of the fund will be spent on the purchase of electric vehicles by public institutions.

Changes needed in infrastructure

CHART 1 | DAILY POWER CONSUMPTION PATTERN (MW) – "NIGHT VALLEY"



Source: Based on data from PSE (transmission system operator)

According to PSE, during the period 08.00-20.00 demand for electricity in Poland amounts to 23-24 GW. However, during the night (especially between midnight and 06.00) demand falls by one-third, to about 15-16 GW.

At the moment Poland is not adapted to the widespread use of electric vehicles. They are much more expensive than internal-combustion vehicles and their owners find almost no benefit of having such cars. They also cannot count on state support. There is a lack of charging stations, especially to enable journeys between cities. The distribution network is not suited for the rapid development of charging stations. The relatively simple and proven methods used in other countries to support the development of the market are not allowed by Polish law. Therefore, in the coming years numerous changes are needed covering investments and legislation. The introduction of soft incentives will also be necessary. Only then will one million electric vehicles become a reality.

Modernisation of the network

According to calculations by the Ministry of Energy, one million electric cars in Poland would generate an annual demand of up to 4.3 TWh of electricity.

In August 2015, Poland introduced limitations of power supply at 20th degree[4], the most restrictive to industrial consumers. It happened for the first time since the 1980s.

4 Polish legislation establishes 10 degrees of limitations of power supplies to energy consumers, i.e. between 11 and 20, where 20th is the most restrictive.

Creating incentives for electricity storage will allow better distribution of generation and consumption within the day.

It means that the Polish electricity sector already faces difficulties in certain circumstances to cope with the demand. Its further increase associated with the popularisation of electric vehicles is a challenge for electricity producers, the transmission network operator and the distribution network operators.

In its comments on the „Plan for the development of electromobility" PSE (transmission system operator) has indicated that at this stage and without a detailed simulation it is difficult to estimate how much the development of electromobility will burden the transmission network. There is no doubt, however, that change will be large and require investment. Power output of chargers for electric cars vary depending on the model and ranges from a few kilowatts to 90 kW for domestic Tesla fast chargers or as much as 120 kW for superchargers. Even weaker chargers may therefore have a power output equal to all other electrical appliances in the household (which is usually much less than 10 kW) and stronger stations already constitute a heavy burden for the local network. The burden of installing chargers in public areas is even more challenging. According to the „National policy framework and infrastructure for alternative fuels" Warsaw alone is expected to create 1,367 publicly available chargers by 2020, including in 1,304 with a capacity of up to 22 kW and 63 fast chargers of greater power output. Assuming that the normal charger will work close to the limit of 22 kW (the power output of the small chargers installed in Warsaw by RWE and now Innogy), and the „fast" chargers will be comparable with Tesla superchargers, the system as a whole will reach in the capital a capacity of over 36 MW. On the national scale, the charger system will reach 182 MW.

Another problem for the power system is that demand for electricity is variable. According to PSE, during the period 08.00-20.00 demand for electricity in Poland amounts to 23-24 GW. However, during the night (especially between midnight and 06.00) demand falls by one-third, to about 15-16 GW (see Chart 1).

In the absence of proper management an increased popularity of electric cars, may lead to an increase in the variations in demand for electricity at different times of the day. There is a need to modernise the network, which will have to move in two directions – on the one hand to encourage owners of electric cars to charge their vehicles at night, and on the other, to use distributed renewable energy sources and electricity storage to balance the newly created demand.

Smart grid and meters could assist in achieving both goals. The installation of smart meters for electricity consumption and the introduction of dynamic tariffs (varying depending on the current demand in the system) encourage individual consumers and businesses to produce their own energy when the price is high, and consume it at the lowest price – usually at night. Incentives for small producers or prosumers will help to reduce the load on the transmission network, because the energy will be generated and consumed locally to a greater degree than today. An additional advantage is the ability to feed electricity to the grid generated by domestic RES installations. Creating incentives for electricity storage will allow better distribution of generation and consumption within the day, which is particularly advantageous in the case of variable energy sources such as photovoltaic and wind energy.

At the same time investments are needed in the existing transmission and distribution network. This is especially true for areas where it is planned to install many new charging stations, including fast chargers. In addition, the technical requirements associated with the possible installation of chargers has to be taken into account even where such stations are not installed at the moment. New buildings must be equipped with connections powerful enough to install them – this is particularly the case for office buildings and public institutions.

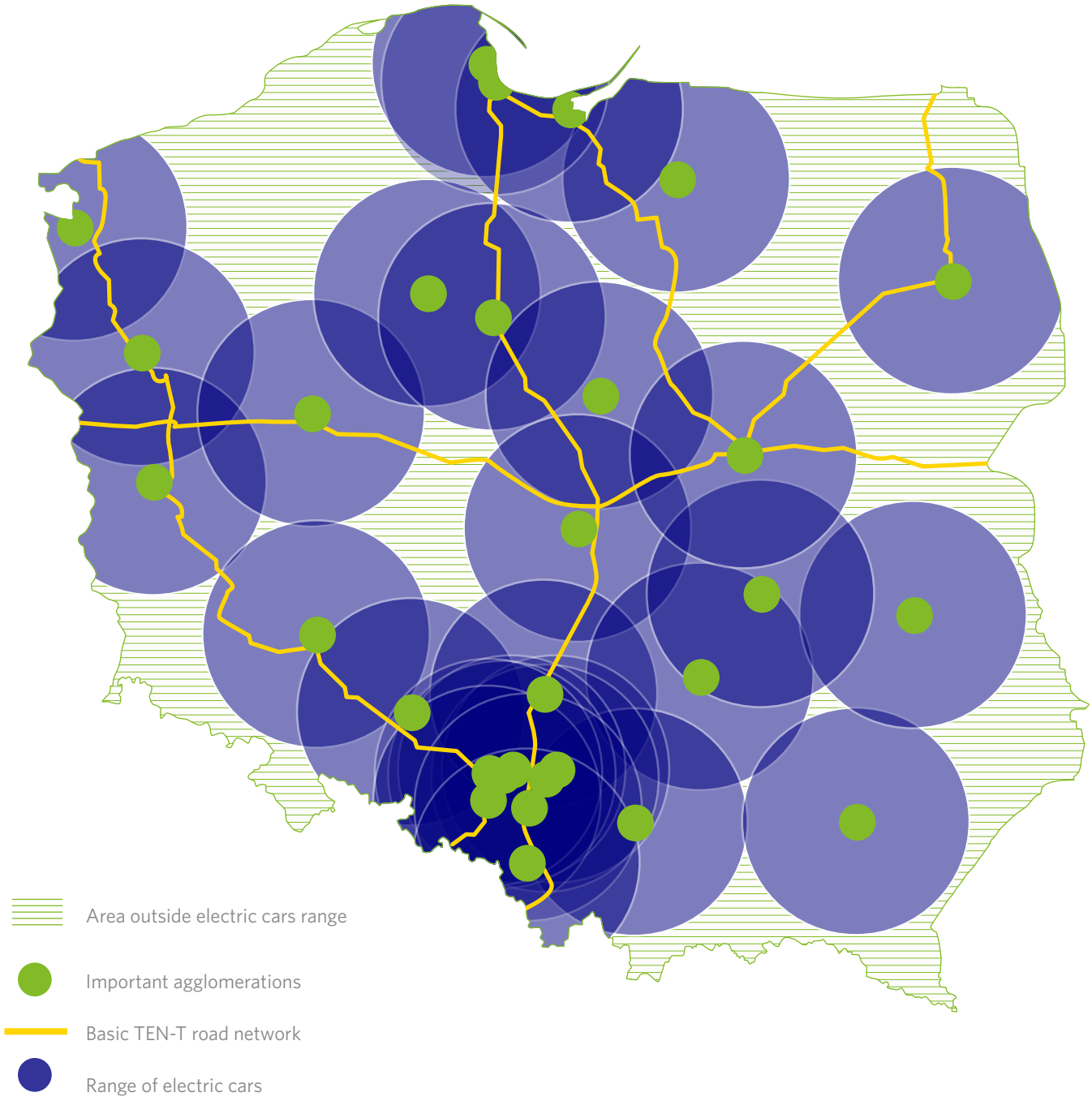
Charging stations

According to the Ministry of Energy, there are just over 300 publicly accessible charging stations for electric cars in Poland today. It is true that Poland has a very high ratio of the number of charging stations compared to the number of electric cars (one charger for approximately four vehicles), but this is the effect of a very low number of electric cars registered in the country. The stations are located mainly in the largest population centres. There is a lack of charging points on the through routes and even in smaller provincial cities. It is not known how many private charging points there are – it is difficult to estimate, because car batteries can be recharged up at home from a standard wall outlet without any additional hardware.

The installation of new charging stations is limited for financial, legal and regulatory reasons. According to estimates by the Ministry of Energy, building an ordinary charging station costs PLN 16,000-70,000 while the construction of fast charging station require an expenditure of PLN 100,000-250,000. As a rule investmentin charging stations for the time being are not commercial – no one in Poland sells this kind of service for money (in accordance with relevant law,

MAP 3 | PLANNED DEVELOPMENT OF CHARGING STATIONS

Source: The national framework for the alternative fuel development policy



city	planned number of charging stations
1. Warsaw	1 367
2. Cracow	523
3. Wrocław	474
4. Poznań	435
5. Lodz	431

city	planned number of charging stations
6. Gdańsk	320
7. Szczecin	244
8. Bydgoszcz	243
9. Lublin	213
10. Katowice	237

this would require a concession for electricity trading). Access to public charging stations is free and is usually treated as a way to promote both a particular company, as well as the general idea of electromobility. The Ministry of Energy estimates that to achieve profitability a charging point would need to have annual sales of 32.85 MWh, while for a fast charging stations – the figure is 452.6 MWh. These assumptions should be treated with caution, since they take a theoretical price of electricity and of a service which does not exist today.

It is unclear whether the construction of charging stations and connections require a building permit, or a notification about the works is enough – the decision depends on the interpretation of the local authorities. Another barrier is the need to install additional meters before the charging stations even if they are equipped with meters that measure electricity consumption for each load. Potential investors are struggling with problems related to construction work – time consuming formalities, uncertainties as to the ownership of land and the difficulties of using sites besides public roads.

To speed up the installation of charging stations the abolition of formal barriers is required. Charging stations should be considered as minor architectural features, which do not require a building permit. There is no need to change the law to do this. The application of a uniform interpretation of regulations across the country would be enough. Requiring installation of charging points during the modernisation of national roads and motorways as well as during the construction of new routes would help strengthen the network and enable long distance travel by electric cars. In practice, such a condition could be applied during the construction of filling stations on major routes. The General Directorate for National Roads and Motorways (GDDKiA) could stipulate that tenders should take into account the need to build proper power connections. This could greatly facilitate (financially and technically) the decision to launch a commercial charging station by entrepreneurs. The model could be the PKP PLK (Polish rail company) tenders on electrified railway lines. The requirement to build connections and charging stations should also apply to all new investments in urban centres, particularly office buildings, parking garages and communication hubs (stations, airports). It will be harder to induce property owners to install stations in existing buildings despite the fact that for them the cost of installing a station is usually relatively small compared to the investment of the independent entrepreneur.

The overall improvement of the investment process related to public roads would encourage construction of chargers. In addition, to projects relating to electromobility the authorities should apply similar simplifications as for the development of a fibre optic network. Charging stations must be exempt from property tax, a point on which European regulations may be helpful. On 30 November, 2016, the European Commission published a proposal for revision of the Energy Performance of Buildings Directive, which envisages the introduction of an obligation, from January 2025, to install charging points for a minimum of 10 per cent of the parking spaces in new office buildings and those that are subject to major renovations. The obligation will apply to buildings that have a minimum of 10 parking spaces. For residential buildings which have more than 10 parking spaces, the Commission has proposed a duty of providing wiring that allows connection of chargers for all the places in new buildings and those subject to major renovations. In the case of residential buildings, the new rules start to take effect with the coming into force of the amended directive – far sooner than in 2025.

6.4 k.

The Ministry of Energy plans that this number of charging points will operate in Poland in 2020.

The government should also establish a legal framework which will permit the sale of charging services. The main change should be the abolition of the requirement for the owners and operators of charging stations to obtain a concession for trading in electricity. The legal and formal regulatory requirements of running this kind of business ought not to be more complicated than for filling stations. They should be even easier, because the technical aspects and safety of electricity sales is less risky than the sale of normal fuel. They should also be exempted from the tariff approval by the President of URE, the energy regulator. As a result, entrepreneurs would be able to compete on price and to take extra fees for fast charging.

The sale of electricity for charging vehicles should be exempted from excise duty. At current rates, Ministry of Energy has estimated the annual cost of such a solution at PLN 86 million annually.

It is very important to create a system of information on charging stations. Studies show that psychological barrier associated with the limited range of electric cars and the lack

of charging stations is one of the strongest impediments for electromobility. Many Polish cities have already established systems for road information indicating for example the availability of parking – the same systems could be used to provide information about the location of charging points. A good example is a dedicated mobile app used by Fortum Charge & Drive in Scandinavia. The Fund for low-emission transport should support the development of similar mobile applications and other tools that help drivers locate charging stations.

Legal changes

In Norway, the National Energy Fund finances the programme for the installation of public chargers – at the request of citizens, chargers are installed also in areas remote from the cities. Installation is handled by Enova, a firm owned by the Ministry of Energy.

In Germany, EUR 300 million is reserved under a special government programme for the expansion of the network of chargers.

The implementation of the „Plan for the development of electromobility" requires legal changes for the development of infrastructure (both transmission networks and charging stations) and preferential treatment for owners of electric cars (fiscal and organizational).

The first step should be changes in the tax law – the laws on personal income tax, corporation tax, excise duties and the tax on goods and services (VAT). They should include, among other provisions, the exemption of electric cars from excise duty and VAT. The Ministry of Energy is proposing to limit the number of registrations (100,000 cars), which will be entitled to relief. After achieving this figure the exemption from VAT should not be eliminated completely, but rather gradually reduced. The risks associated with the introduction of generous tax breaks and then their abrupt reduction or elimination is shown by the examples of Denmark and the US state of Georgia. In Denmark from 1 January 2016 a 20-percent sales tax (for internal combustion cars it is 180 per cent) was imposed on electric cars which they were previously exempt from. As a result, in the first half of 2016, sales fell by 80 per cent compared to the same period in 2015. And in Georgia, after the elimination of one-off subsidies of USD 5,000 monthly sales of the most popular Nissan Leaf, fell from more than 1,000 to less than 100 units.

The high cost of electric vehicles means that a relatively large proportion of them – in many countries more than 50 per cent – is registered by companies. An amendment to the law to allow for a higher depreciation of such purchases could encourage companies to replace their fleets with electric vehicles.

At the same time as the introduction of incentives to buy electric cars, the government should discourage the registration of the least environmentally-friendly vehicles. The simplest method, proven by other countries, is the

TABLE 4 | PROPOSED CHANGES IN EXCISE DUTY ON CARS (VALUES IN PLN)

Engine	Euro 6 (from 2016)	Euro 5 (2010-2015)	Euro 4 (2005-2009)	Euro 3 or older (before 2004)
<1200 cm³	1 000	2 000	2 300	3 500
1200-1499 cm³	1 500	2 400	2 550	8 000
1500-1999 cm³	1 950	3 120	3 320	10 000
2000-2499 cm³	9 000	18 000	20 700	29 000
2500-2999 cm³	14 000	25 000	32 000	40 000
3000-3499 cm³	20 000	36 000	46 000	57 000
3500-3999 cm³	27 000	42 000	62 000	76 000
>3999 cm³	35 000	55 000	80 000	98 000

Proposed rates before the vote in the parliament

Source: The draft law amending the Excise Duty Act and the Traffic Law Act.

introduction of a registration fee dependent on the age and level of emissions of the vehicle. The fee could be a one-off at registration or in the form of an annual road tax (similar to that paid in the UK during the annual technical inspection): an indirect effect would be to discourage the import of old cars.

In December, 2016, the Sejm (lower house of the Polish parliament) received a Senate (upper house) draft amendment to the Excise Duty Act and the Traffic Law Act, which involved changing the rates of excise duty on passenger cars. The amendment excludes electric cars from excise tax (previously they were subject to a rate of 3.1 per cent as were internal combustion cars with an engine capacity of fewer than 2000 cm^3). Excise rates were to be dependent on the normal level of emissions and not, as at present, on the value of the car. The Sejm did not deal with this act in 2016. The new rates will, however, almost certainly come into force in 2017. (see: Table 4)

Legal changes are also necessary to make it easier for owners of electric cars to move around the city. The law in Poland does not at present allow for introducing charges for motorist to enter inner city areas and therefore there is no possibility to have preferential treatment for low emission vehicles. For this purpose, amendment to the Environmental Law Act and the Law on Public Roads is needed. The new law should also allow electric cars to drive in bus lanes (the same amendment should make it legal for cyclists to use these segregated lanes). The amendment to the Law on Public Roads should further ensure the possibility of free parking for electric cars.

Legal changes should also support the introduction of electric vehicles in public services, public transport and fleets of service vehicles in public administration. An amendment to the Public Procurement Law could specify a requirement to give preference to companies offering transport or municipal services using electric vehicles. The new rules could also provide for mandatory use of these cars by the administration, although the thresholds will have to be tailored to the financial possibilities of the authorities.

New provisions are also needed in the field of energy law. An amendment should allow the introduction of dynamic tariffs for electricity and make it easier for prosumers and those investing in energy storage.

Regulation

The liberalisation of the rules and the spread of commercial sales of battery charging services will probably lead to a slight increase in electricity prices – sellers will have to absorb the cost of installing the station and adding their margin. Therefore, at the initial stage of market development regulatory intervention may be required in order to keep electricity prices at a level attractive for drivers, while profitable for the station operators. In the transitional stage it may be appropriate to impose price caps or agree the profit margins of the seller. These solutions would be easier to implement in comparison with the complex responsibility for approving tariffs. They would also allow the energy regulator to maintain controls over the price of electricity.

In the initial stage of popularisation of electric cars in Poland energy should be free for car owners – as it now is. For this rule not to lead to blocking the development of private and public investment in the charging stations, the Fund for low-emission transport could have a separate pool of funds to support the building of charging stations. Other potential sources of financing are the Modernization Fund within the framework of the revised Directive on Emissions Trading Scheme (ETS Directive), NFOŚiGW and the European Fund for Strategic Investment. Such a support could be provided in several ways: through subsidy on investments based on the cost of building the station and the expected sales, by reimbursing the cost of electricity used for the free charging or by subsidising car owners. Support will be effective if it is not burdensome on the administrative front – it could therefore be determined on the basis of data from smart meters installed in the charging stations. Possible support mechanisms include funding for the owners of vehicles based on the cost of the electricity they use to charge a vehicle at home. Determining the amount of such support aid would, however, be technically complicated.

Each support mechanism for the popularization of electric vehicles should be reduced gradually and ultimately the electricity market for vehicles should operate on principles similar to those of the conventional fuels market.

In the Netherlands, owners of electric vehicles in Amsterdam can skip the queue to get a parking permit for the city centre. Owners of internal-combustion cars often have to wait several years to get the document. There are also separate parking spaces and free chargers in the city centre.

In Norway, electric cars can use the bus lanes throughout the country. There are free parkings in urban areas and free public chargers. Electric cars have special registration plates that increase public awareness.

The basic incentive, which is almost standard in Western Europe, should be the abolition of parking charges for electric cars

An interesting idea applied by Fortum in Norway is to price the time at the charger, not the electricity. It allows for covering electricity cost and at the same time incentivises drivers to vacate charging stations addressing the problem of their availability.

Soft measures at local level

Practical support for users of electric vehicles is an important complement to fiscal and legal support. There are examples from abroad, such as Norway and California, where owners of electric vehicles can drive in separate lanes (bus or carpooling lanes). Support may also be translated into financial benefits, including free parking and the entry to city centres. Similar incentives are usually introduced at the local level and charged to the local government budget. In many countries, however (including the UK) local authorities can apply for various kinds of subsidies from the central budget.

In Poland, given the absence of a coordinated policy of soft incentives for owners of zero- or low-emission vehicles, only a few local authorities have introduced support measures, most commonly involving free parking[5]. Owners of electric cars and hybrids do not have to pay for parking in Katowice, Gdańsk and Toruń, as well as areas outside the city centre in Wrocław. Some cities, including Kraków, Szczecin, Rzeszów and Tarnów give big discounts on parking, but only on the purchase of an annual ticket. In Warsaw and Kraków, electric cars may drive into streets closed to private cars with internal-combustion engines.

To achieve the goal of one million cars by 2025, such incentives would have to be introduced on a larger scale and in more towns and cities. They should also be harmonised across the country and given publicity. The lack of coordination and the local character of the benefits mean that drivers are seldom aware of the benefits available to them outside their home town.

The basic incentive, which is almost standard in Western Europe, should be the abolition of parking charges for electric cars. The difficulty in finding a parking space in the city is listed as one of things which annoy drivers the most, but also as one of the reasons for giving up on the use of a car. Giving exemption from fees, combined with the designation of sites for low or zero emission vehicles and the installation of public chargers, has contributed to a sharp increase in the number of electric vehicles in places such as Amsterdam. This method is more effective, the more crowded is the city, and Polish agglomerations are among the European leaders in this regard. Copying the model of Amsterdam and designating free parking spaces in, for example Warsaw and Cracow's old towns and the business centres would be a tangible benefit for drivers. This would have to be accompanied by the introduction of clear identification of electric vehicles, for example the special plates as used in Norway.

Facilitating entry to urban centres or – after making appropriate changes in the law – exemption from fees for such entry would have an equally positive impact on the market forelectric cars. Another action should be to allow drivers of electric cars to use bus lanes. Local authorities should consider ways to promote the use of electric vehicles by taxis. One instrument of support would be subsidising purchases, and the other fiscal and administrative incentives for fleet replacement, which could include for example lower licensing fees for drivers of electrical cars or preference in tenders for operating at airports, railway stations and for the public administration. In holding discussions with private developers, local authorities should also ask for a guarantee of constructing charging stations in new residential areas or at shopping malls (at present this mechanism is often used by investors to offer a partnership for or complete financing of the reconstruction of the local road system). It should be assumed that once the revised Building Directive comes into force the appropriate responsibilities will be imposed on developers. The minimum requirements of the amended directive may not, however, be sufficient to meet the ambitious objectives of the development of electromobility in Poland.

According to statements from local authorities, more and more of them are considering the creation of short-term city car rentals on a principle similar to that of bicycle rentals. Small systems of this type now exist in Kraków and Lublin, and there is a tender for a large system in Warsaw[6].

For the present, however, they use diesel cars, and their main goal is to reduce the number of private cars in urban centres, which often sit unused for hours on end. In the next stage of the development of these systems, city governments should think about using electric vehicles. Thanks to advanced applications and management systems in renting drivers should be encouraged (by for example

5 M. Lisiak, Masz hybrydę lub auto elektryczne? Dostaniesz ogromną zniżkę na parkowanie.

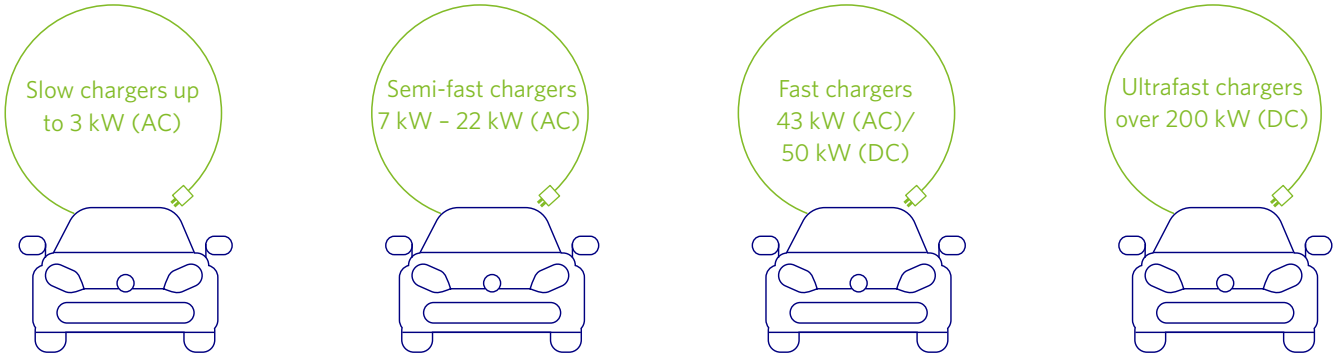
6 J. Dybalski, Dlaczego warszawski car-sharing nie będzie elektryczny?

differentiated rates for rental depending on the charging station) to park vehicles at stations that are less busy in terms of charging, and thus contribute to the sustainability of the demand for electricity.

Soft support instruments should also include the promotion of electric cars. The benefits of having such a car should be advertised. Parking spots for electric cars and benefits to enter otherwise restricted city zones should be clearly marked and local authorities should create a sense that the electric car is a choice which is profitable not only financially, but in terms of the practical aspects of daily life.

Since some local initiatives may prove to be a heavy burden for the local authority's budget, the plans of the Fund for low-emission transport should include a pool of money for financing local initiatives.

TYPE OF CHARGERS



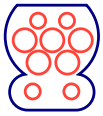
TYPE OF PLUGS

AC

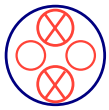
Type 1
3-7kW
1-phase

Type 2
3-43kW
1/3-phase

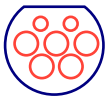
DC



CCS
50kW



CHAdeMO
50kW



Tesla
50-120kW

How the development of electromobility will help the electricity sector

The implementation of the objectives of the „Plan for the development of electromobility" will have a definite impact on the electricity market and entities which operate within it. While in the initial phase of development of electromobility, the impact on the sector will be low, the way of integrating a million electric cars will determine the stability of the National Power System. The government's strategy and the investment decisions taken will determine whether the undoubted revolution which is the development of electromobility will be properly utilised.

Increased demand for electricity

Advancing standards in the energy efficiency of equipment, buildings and lighting are causing a steady decline in demand for electricity. The integration of renewable energy sources further erodes the income of those producers who have conventional generation capacities. In a changing energy market, electric cars are one of the few features that contribute to an increase in the demand for electricity.
Estimates of the importance of electromobility to the power sector are provided by various

TABLE 5 | ELECTRICITY DEMAND FOR ESTIMATED NUMBER OF VEHICLES

Year	Number of vehicles	Power demand (MWh)
2016	2 397	5 303
2017	5 704	12 621
2018	13 576	30 039
2019	32 310	71 492
2020	76 898	170 150
2021	183 017	404 958
2022	366 034	809 915
2023	549 051	1 214 873
2024	823 576	1 822 309
2025	1 029 470	2 277 886

Source: Ministry of Energy

institutions. According to calculations by Eurelectric, a 10 per cent share of electric cars in the European car fleet will mean a 82 TWh level of additional demand for electricity. The European Commission estimates that achieving the 80 per cent target of electric cars in Europe's vehicle fleet would mean an increase in electricity demand of approximately 150GW of installed capacity. The Ministry of Energy estimates that achieving one million electric cars in Poland will entail the generation of an additional annual demand for electricity of 2.3-4.3 TWh. This is not a significant quantity if one considers that Poland generated 161 TWh of electricity in 2015. Nevertheless, it will be an additional source of revenue for Polish generators which will grow exponentially after 2025 with the further development of the electric car market. (see: Table 5)

Modernisation and expansion of the network

The additional demand for electricity can be met not only by new power plants, but also by making better use of existing capacity. To achieve this, there needs to be investment in the expansion of transmission and distribution grids. According to Trinomics' experts[7] the development of electromobility requires a well-developed distribution network. They estimate that the Polish network is insufficiently developed to take advantage of the first wave of electric cars. On the other hand, the lack of an adequate infrastructure is an opportunity for modernisation and expansion. Investment needs can be met through appropriate planning as well as improving regulations and providing the inflow of capital.

At the moment it is difficult to determine the size of the challenges that the electricity sector will face since there are no calculations of the investment in the grid that will be required by the development of electromobility. PTPiREE, The Polish Society for the Transmission and Distribution of Electrical Power, estimates that by 2019 companies will spend approximately PLN 42 billion on investments in distribution and transmission networks[8]. This estimate does not, however, include the appearance of one million electric vehicles on Poland's roads. One can imagine that some part of the cost of infrastructure development for electric cars will be integrated with the already planned network investments. The spread of electromobility will nevertheless, carry additional costs for the operators of transmission and distribution systems and there is an urgent need for them to be estimated.

The Ministry of Energy is planning that until 2020, the effort to install charging points will be concentrated in 32 designated urban agglomerations. It is in the latter, and along TEN-T roads that investment needs will be the greatest. Investment in distribution networks will be made necessary especially by fast chargers: according to the Ministry's plans, 400 of these are to be built by 2020. They require access to considerable power capacity, and the existing infrastructure will not be able to deal with them.

The distribution system operators as well as the transmission system operator can use electromobility as an excuse to invest in strengthening the low and medium voltage grids, which is necessary from the point of view of the stability of the system. Investments in the development of charging points can be easily integrated into plans to expand and strengthen the grid.

Ambitious targets for the development of electromobility will also force investment in smart grids and metering. Without these, charging cars may prove an additional burden on the network and a destabilising factor in the way it works. This is linked to the models of behaviour of car owners, who charge them at similar times. The connection of as many as a million electric cars in Poland to domestic chargers with an assumed capacity of even 4-5 kW, may cause a maximum power demand of 4-5GW, equivalent to approximately 10 per cent of the installed capacity in the Polish power system today.

Poland already invests in smart metering, but there is a lack of appropriate incentives on the horizon to achieve the ambitious EU objective, according to which at least 80 per cent of meters should be replaced by smart metering by 2020. The development of electromobility could become exactly the incentive to speed up the implementation of smart meters, and make it easier to obtain financing for this purpose.

In the future the falling cost of batteries will increase the profitability of small – and microgrids. In such systems, electricity from batteries will replace costly diesel generators which are a burden on the environment.

The stabilisation of the network

Car batteries will give network operators a tool to manage demand and enable a whole range of other system services (such as control of voltage and frequency).

The intelligent systems of car charging will allow to control and manage when and how they access the network. In this way, the car will be charged up during periods of low demand for electricity. On the other hand, at the peak periods of electricity consumption charging will be delayed

7 Assessing the status of electrification of the road transport passenger vehicles and potential future implications for the environment and European energy system, September 2016.

8 Polska. Z energią działa lepiej. Energetyka przesyłowa i dystrybucyjna – report of PTPiREE, 2015 r.

to relieve the system. The same principles should guide the rental of urban electric cars. Battery management for cars can smooth out the daily profile of electricity demand, filling the night valley and facilitating the system operator's work. The key to this type of service will be the introduction of dynamic tariffs, which can also be used for other segments of the market. At the moment it is unprofitable to introduce such tariffs for reasons such as a lack of economies of scale, something which the development of electromobility will help to achieve.

The growing number of electric cars means an increase in the quantity of distributed electricity storage, which can give power back to the system during periods of peak demand. System services associated with this are known as vehicle-to-grid (V2G).

In the course of its working life, a car spends approximately 90 per cent of its time in a car park[9], so the introduction of V2G requires co-operation between the owners of electric cars and the providers of system services. The key will be to persuade drivers to share their cars by connecting them to the network while they are parked. This could be achieved for example, by introducing a system of battery rental. By aggregating the power of multiple batteries, system services can be offered by network operators, electricity generators, as well as completely new players known as aggregators. V2G services are currently at the research and testing stage. Their implementation will require the use of smart grids and smart metering on a large scale.

In the future, used batteries could prove to be an important element in helping to stabilise the electricity system. Once a battery has been degraded by about 30 per cent, it can then be used as stationary storage. Such stores could consist of single or multiple battery units. According to Bloomberg New Energy Finance, the cost of such batteries can drop to USD 49 dollars per kWh of electricity by 2018 compared to the present cost of new stationary batteries, which is about USD 300.

9 P.Barter, „Cars are parked 95% of the time". Let's check!, (2013).

A further option to stabilise the network would be to equip fast charging stations with stationary batteries which could be charged during periods of low demand for electricity when no cars need filling up. They could then be used to charge cars at peak demand times in order to relieve the power system. Again, this method of stabilising the network would be possible only given considerable decrease in the cost of batteries.

Municipal electric cars could also be used as mobile energy storage – when there is reduced demand to rent them (such as in the holidays, weekends and at night), some of them could „share" their battery, for example, to power local street lighting.

The integration of renewable energy sources is also an important element of stabilising the network. Car batteries can be used as storage which is compatible with variable sources of generation. Regulations and dynamic tariffs can encourage car charging when the photovoltaic panels and windmills are producing electricity, which is at the moment often a burden for a system relying on large, conventional power stations. Similarly, at periods of peak demand, the use of V2G solutions will allow electric vehicles plugged into charging points to give electricity to the grid to cover shortages.

More innovative solutions

Changing the electrical power system to an intelligent one opens the field to entirely new services and will create new markets. Information from the meters will need to be collected, processed and made available in real time in order to adjust prices dynamically and control the flow of electricity. Innovative ICT companies will appear on the market and demand for smart metering equipment and smart network programming services will increase.

Along with lowering the cost of batteries, V2G services and the use of stationary batteries in conjunction with renewable energy sources and chargers will become widespread. The need for easy payment for car charging services will generate a demand for new services in the fintech field.

Fortum, in partnership with the owner of the property and the city authorities, is building 100 charging stations with a capacity of 22 kW each in garage parking in the centre of Oslo. Additionally two fast chargers with a power of 50 kW will be installed, which will in future be increased to 150 kW, translating into a total of 2.5 MW of installed capacity. To handle such a large capacity without building new power connections, Fortum decided to use stationary energy storage. The project provides for the possibility of an intelligent charge control, to help the electricity network, and even to allow a two-way exchange of electricity between vehicles and the network – V2G.

How to finance the development of infrastructure

The scale of investment in the electricity sector resulting from the implementation of the „Plan for the development of electromobility" has not yet been estimated. One can, however, already indicate the potential sources that can be used for this purpose.

Fund for low-emission transport

The Fund for low-emission transport, due to start operating in 2018, is considered the most important source of financing for the development of electromobility in Poland. According to the Ministry of Energy, over a ten year period the Fund would have approximately PLN 5.3 billion at its disposal. The financial needs of the first phase of the development of electromobility and the number of projects to be supported will, however, be huge and could exceed this budget. The establishment of new support mechanisms based on the state budget will, moreover, be extremely difficult. It can therefore be said with a high degree of certainty that the electricity sector will benefit from the Fund to a limited extent. However, there are other sources of funding, not mentioned in the plans of the Ministry of Energy, from which the development of electromobility can be financed.

The Juncker Plan

The European Fund for Strategic Investments (EFSI), established in order to reduce investment risk and encourage business to be more active, will mobilise investments worth EUR 315 billion by 2018. The Fund is managed by the European Investment Bank. There are no guaranteed national envelopes, and projects are selected on the basis of economic reasons. Poland has problems with obtaining support from the EFSI, because the Polish authorities are focused on the absorption of the structural and cohesion policy funds. Up to the end of November, 11 Polish projects were EFSI-funded. One of the projects is the investment related to connecting new customers to the medium and low-voltage grids where one of the Polish distribution companies is the beneficiary. This shows that the Juncker Plan is an appropriate tool to support the electricity sector in its transition towards electromobility. Work is already underway on the next EFSI budget and it is clear that its priorities will be compatible with electromobility. The Fund places great emphasis on co-operation between the administration and business and therefore projects implemented by companies within the context of the government's „Plan for the development of electromobility" have a good chance of support. This is also true for projects promoted by the government.

Norwegian and EEA funds

Poland is the largest recipient of Norwegian and EEA funds. The allocation given to Poland was EUR 809.3 million over the period from May 1, 2014 to April 30, 2021. The key thematic areas of the funds include energy security and climate change. When in 2008, an installation for the capture and storage of CO_2 was under development an agreement was reached with the Norwegian government to concentrate resources on this venture. Similar discussions can be undertaken in order to earmark funds for developing the infrastructure for electric cars. Given the experience of Norway with electric transport, the likelihood of agreement seems to be high.

The European Emissions Trading Scheme

The European Emissions Trading Scheme (EU ETS) is another potential source of support for investment in the electricity sector related to the development of electromobility. One of the elements in the reform of the EU ETS, currently under way, is the creation of the Modernisation Fund, from which Poland has a guaranteed income from the sale of 135 million CO_2 emission allowances. At today's prices, this amounts to about EUR 675 million. The disbursement of Poland's share will be managed in co-operation with the European Investment Bank. Investments in the electricity sector related to the promotion of electric cars may be a good way to make use of the Fund.

A further idea for financing electromobility is the pool of 280 million free allowances which Poland could assign for its power sector as part of the reform of the EU ETS. The requirement of the free permits system is that they are allocated for free provided that there is an equivalent investment in projects such as the development of the network. Expansion of charging points could be an appropriate way to meet the investment obligations.

Green bonds

In December, 2016 Poland became the first government in the world to issue "Green bonds" worth EUR 750 million. The funds raised from the issue as a whole must be invested in accordance with the pro-environment Green Bond Framework[10] prepared by the Ministry of Development and Finance. The guidelines do not include investments in electromobility, an omission which should be corrected in subsequent issues.

The National Fund for Environmental Protection and Water Management

NFOŚiGW is one of the institutions that distribute funds from the European Union budget for 2014-2020. More than PLN 5.6 billion is available for projects that reduce emissions in the economy. The promotion of electromobility is among the priorities of the National Fund for 2017. The Fund includes a special GAZELA BIS funding programme to support low-carbon public transport, which allows the financing of the construction of charging stations. Support programs aimed at the protection of air quality, which GAZELA is part of, have access to funds amounting to PLN 425 million.

Polish Development Fund

In December, 2016 the Polish Development Fund (PFR) presented its Development Strategies. PFR assets involved in development programmes comprise about 3.8 per cent of Polish GDP. This share will probably increase in the years following the launch of the EU funds for 2014-2020. Financing electromobility should be one of the priorities of the Fund. One of its components – PFR Investments – has PLN 4.5 billion for investments in infrastructure. In addition, the Polish Agency for Enterprise Development (PARP), which is part of the PFR group, has PLN 8.7 billion at its disposal to support innovation.

10 http://www.finanse.mf.gov.pl/documents/766655/c7ef4509-80ee-41e6-8dca-084250f63b6b

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