

ANALYSIS OF FEES FOR CONNECTING THE INFRASTRUCTURE OF GENERALLY ACCESSIBLE CHARGING STATIONS TO NETWORKS WITH RATED VOLTAGE NOT HIGHER THAN 1 KV

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Abstract

On 22 February 2018, the Act on electromobility and alternative fuels came into force (Journal of Laws of 2018, item 317). This legal Act sets out the rules for the development and operation of infrastructure for the use of alternative fuels, which is closely related to the development of electromobility. The Act (2011/C81E/17) regulates and defines, among others obligations in the scope of technical requirements for the construction of a charging station and their minimum number in municipalities. This Act was introduced in order to develop electromobility, which in turn is to contribute to the reduction of CO₂ emissions [1].

The aim of the paper is to show the relationship between the geographical location of the connection of road charging infrastructure in our country, and the costs of its connection to the low voltage network, understood as the costs of the connection fee, which are paid to the Distribution System Operators. The costs of the connection fee in the case of power supply from low voltage lines cover the actual connection costs of generally available charging stations, i.e. the connection costs, i.e. the network section used to connect the devices or installations or the network of the entity with the connection capacity required by it, with the remaining part of the Distribution System Operators network. The Distribution System Operator also covers the costs of the measurement and settlement system. In addition, the paper indicates the preferential treatment of connecting charging stations, which are defined as reduced costs of connecting them in relation to other objects.

Keywords: Charging station; Reduction of CO₂ emissions; The Distribution System Operator; Costs of connecting charging stations.

1. INTRODUCTION

Act on electromobility and alternative fuels (Journal of Laws of 2018, item 317), introduced last year, aims to determine the rules of the development of infrastructure used for replacing fuels currently used in car transport, such as diesel and petrol, with electricity and alternative fuels. According to the provisions of this Act, hydrogen, compressed natural gas (CNG) and liquefied natural gas (LNG) are considered to be alternative fuels. The Act sets out also the rules for building a national network of charging stations for these car factors. Under the new regulations, public buildings and multi-family residential buildings, as well as related internal and external parking spaces,

shall be designed and done in the way that provides connection power, enabling them to be equipped with charging points with a power of not less than 3.7 kW. At the same time the Act obligates the local governments and state institutions to replace the stock that they possess with the stock which uses the alternative fuels. In accordance with the Act the “public charging station” shall be understood as the charging station equally available for every user of electric, hybrid or motor vehicle not being an electric vehicle within the meaning of the Act of 20 June 1997 Traffic Law, whereas the “charging infrastructure for public road transport” is defined as “charging or refueling points for electricity (or alternative fuels) together with the accompanying infrastructure necessary for their oper-

ation, intended for charging or refueling, in particular zero-emission buses used in public transport” [2, 3, 4, 5, 8]. The Energy Regulatory Office approved the applications of distribution system operators regarding the connection of electric car charging stations to their network. This office informs also that the amended tariffs include rates for connecting the road charging infrastructure of public transport and public charging stations [6].

In accordance with Electricity Law (Journal of Laws of 1997, item 348) for connecting the road charging infrastructure and publicly available charging stations to the network:

- 1) with a rated voltage higher than 1kV and not higher than 110 kV, the connection fee is determined on the basis of one-sixteenth of actual expenditure on the construction of the connection;
- 2) to the power grid with a rated voltage of no more than 1 kV, the connection fee is determined based on the rates included in the tariff, calculated on the basis of one-sixteenth average annual investment expenditure on the construction of sections of the network used to connect these entities, specified in the development plan; these rates can be calculated in relation to the size of the connection capacity, unit of length of the network section to be connected or the type of this section. Development plans are made by the distribution system operators and they relate to the electricity demand for a period of not less than 5 years [6, 7, 10, 16, 18, 19].

2. DISTRIBUTION COMPANIES OPERATING IN OUR COUNTRY

In our country the five biggest Distribution System Operators represented by Distribution Companies in the field of electricity distribution are operating. These are: Energa Operator joint-stock company, Enea Operator limited liability partnership, PGE Dystrybucja joint-stock company, Tauron Dystrybucja joint-stock company and innogy Stoen Operator limited liability partnership. The basic duty of Distribution Companies is to allow connecting new entities as well as planning the development of distribution network, providing its expansion and maintenance of the proper level of safety at work. The Operators of the distribution system in the matters of the distribution systems are held responsible for:

- having the power of generating units connected to the distribution network, without generating units

with a maximum capacity of 50 MW or higher, connected to the coordinated 110 kV network;

- managing system restrictions and conducting settlements with users of this system resulting from unbalanced electricity supplied to a distribution system and downloaded from it;
- purchase of electricity to cover losses arising in the distribution network during distribution of electricity by this network and the use of transparent ones and non-discriminatory market procedures when purchasing this energy [9].



3. DEFINING THE CONNECTION CAPACITY FOR ELECTRICAL DISTRIBUTION SERVICES

Connection capacity according to the analyzed tariffs for electricity distribution services is defined as an active power planned to be downloaded or introduced into the network, specified in the connection agreement (network connection agreement) as the maximum value determined during each hour of the billing period from the average values of this power in 15-minute periods used to design the connection.

Entities applying for connection to the network are divided into groups, so-called “Connection groups”, according to the criteria indicated in the Regulation of the Minister of Economy from May 4th, 2007 concerning the detailed conditions for the operation of the power system (Journal of Laws 2007.93.623). In accordance with the Regulation indicated above, the following division applies:

- 1) group I – entities whose equipment, installations and networks are connected directly to the network with rated voltage higher than 110 kV;

- 2) group II – entities whose equipment, installations and networks are connected directly to the network with rated voltage 110 kV;
- 3) group III – entities whose equipment, installations and networks are connected directly to the network with rated voltage higher than 1 kV, but not higher than 110 kV;
- 4) group IV – entities whose equipment, installations and networks are connected directly to the network with rated voltage not higher than 1 kV and connection power bigger than 40 kW or rated current of pre-meter protection in a current path greater than 63 A;
- 5) group V – entities whose equipment, installations and networks are connected directly to the network with a rated voltage not higher than 1 kV and a connection power not higher than 40 kW or rated current of pre-meter protection in a current circuit not higher than 63 A;
- 6) group VI – entities whose power devices are connected to the network through a temporary connection, which will be on the terms specified in the connection agreement replaced by the target connection, or entities whose equipment, installations and networks are connected to the network for a specified period, but not more than one year [12, 13, 15].

The connection fee is the quotient of the connection fee rate and the amount of connection capacity that has been granted to the connected entity as a result of a successful examined application for connection to the network and conclusion of the connection agreement (connection agreement). The value of the connection fee is specified in the connection agreement. Entity which is being connected pays the connection fee to the Distribution Company, which is the party of the connection agreement.

The Distribution System Operator (represented by a distribution company) covers the costs of the metering and billing system (meter).

Conclusion of a connection agreement for a power value of 25 kW generates a connection fee for the entity accounted at PGE Dystrybution S.A. in the amount of:

A. General formula for calculating the connection fee:

P (value of ordered connection capacity) x **OS** (connection fee from the distribution system operator's tariff)

B. Case study:

- I. connected power 25 kW;
- II. type of connection – cable connection;
- III. premises location – PGE Dystrybution S.A.;
- IV. value of the connection fee –
 $25 \text{ kW} \times 62.24 \text{ PLN/kW} = 1556 \text{ PLN (net)}$ – connection of an object other than public charging stations;
- V. value of the connection fee –
 $25 \text{ kW} \times 15.56 \text{ PLN/kW} = 389 \text{ PLN (net)}$ – connection of publicly available charging station.

Connection fees, which are detailed below (in point IV), apply to both new (original) connections to the network and cases of increasing the connection capacity as part of already existing connections. In practice, the realisation of the above is as follows:

A. Case study:

- I. type of existing power supply – cable connection;
- II. location – premises powered by PGE Dystrybution joint-stock company;
- III. existing power 20 kW;
- IV. the power increase refers to the occurrence of the connected entity by 25 kW, therefore the power increase by 5 kW;
- V. the connected entity will pay the fee for increasing connection capacity $5 \times 15.56 \text{ PLN} = 77.80 \text{ PLN}$ when connecting a generally accessible charging station; or $5 \times 62.24 \text{ PLN} = 311.20 \text{ PLN}$ when connecting other entity than the publicly available connection station.

4. DETAILED LIST OF CONNECTION FEES FOR CONNECTION GROUPS IV-VI AND GENERALLY ACCESSIBLE CHARGING STATIONS

The Distribution Companies specify in the tariffs for electricity distribution services approved by the President of the Energy Regulatory Office the rates of fees for connecting to the consumers network classified in connection groups: IV, V and VI and for connecting to the road charging infrastructure network of public transport.

Enea Operator limited liability partnership

Table 1.
Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	11.35	16.45
V	11.35	16.45
VI (for the newly built connection)	11.35	16.45
VI (when connected to an existing network)	1.97	1.97

There is a charge for connecting the charging station, which is the product of the charge rate for connection included in the table as above and the amount of connection power specified in the connection agreement with the following reservation:

- A. if the length of the connection exceeds 200 meters for the constructed connection infrastructure of the road charging station of public transport and generally available charging stations, an additional fee is charged in the amount of:
- I. 8.36 PLN in the case of a cable connection;
 - II. 6.18 PLN in the case of an outdoor connection.

Table 2.
Connection fees for networks with a rated voltage of less than 1 kV from entities other than charging stations that have been classified as connection groups: IV, V, VI

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	45.41	65.79
V	45.41	65.79
VI (for the newly built connection)	45.41	65.79
VI (when connected to an existing network)	7.87	7.87

For connecting entities included in connection groups IV–VI, a fee is charged which is the product of the connection fee rate included in the table as above and the amount of connection capacity specified in the connection agreement with the following reservation:

B. when the connection length of the connection infrastructure being built for entities included in the connection groups indicated in the table as above exceeds 200 meters, additional fees are charged in the amount of:

- I. 33.45 PLN in the case of a cable connection;
- II. 24.70 PLN for an outdoor connection [4].

Energa Operator joint-stock company

Table 3.
Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	10.95	11.77
V	10.95	11.77
VI (for the newly built connection)	10.95	11.77
VI (when connected to an existing network)	1.97	1.97

There is a charge for connecting the charging station, which is the product of the charge rate for connection included in the table as above and the amount of connection power specified in the connection agreement with the following reservation:

- A. if the length of the connection exceeds 200 meters for the constructed connection stations, an additional fee is charged in the amount of:
- I. 8.36 PLN in the case of a cable connection;
 - II. 6.18 PLN in the case of an overdoor connection.

Table 4.
Connection fees for networks with a rated voltage of less than 1 kV from entities other than charging stations that have been classified as connection groups: IV, V, VI

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	43.78	47.09
V	43.78	47.09
VI (for the newly built connection)	43.78	47.09
VI (when connected to an existing network)	7.88	7.88

For connecting entities included in connection groups IV–VI, a fee is charged which is the product of the connection fee rate included in the table as above and the amount of connection capacity specified in the connection agreement with the following reservation:

B. when the connection length of the connection infrastructure being built for entities included in the connection groups indicated in the table as above exceeds 200 meters, additional fees are charged in the amount of:

- I. 33.45 PLN in the case of a cable connection;
- II. 24.70 PLN for an overhead connection [6].

Tauron Dystrybution joint-stock company

Table 5.

Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with a rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	11.22	15.40
V	11.22	15.40
VI (for the newly built connection)	11.22	15.40
VI (when connected to an existing network)	1.97	1.97

There is a charge for connecting the charging station, which is the product of the charge rate for connection included in the table as above and the amount of connection power specified in the connection agreement with the following reservation:

A. if the length of the connection exceeds 200 meters for the constructed connection infrastructure of the road charging station of public transport and generally available charging stations, an additional fee is charged in the amount of:

- I. 8.36 PLN for cable connection;
- II. 6.18 PLN in the case of an overhead connection.

Table 6.

Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with a rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	44.91	61.60
V	44.91	61.60
VI (for the newly built connection)	44.91	61.60
VI (when connected to an existing network)	7.87	7.87

A fee is charged for connecting a charging station, which is the product of the rate of connection fee included in the table as above and the amount of connection power specified in the connection agreement with the following reservation:

B. if the length of the connection exceeds 200 meters for the constructed connection infrastructure of the road public transport charging station and public charging stations, an additional fee is charged in the amount of:

- I. 8.36 PLN for cable connection;
- II. 6.18 PLN in the case of an overhead connection [5].

innogy Stoen Operator limited liability partnership

Table 7.

Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with a rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	9.84	12.80
V	9.84	12.80
VI (for the newly built connection)	9.84	12.80
VI (when connected to an existing network)	1.97	1.97

A fee is charged for connecting a charging station, which is the product of the rate of connection fee included in the table as above and the amount of connection power specified in the connection agreement with the following reservation:

A. if the length of the connection exceeds 200 meters

for the constructed connection infrastructure of the road public transport charging station and public charging stations, no additional fees are charged.

Table 8.
Connection fees for networks with a rated voltage of less than 1 kV from entities other than charging stations that have been classified as connection groups: IV, V, VI, VI

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	39.37	51.19
V	39.37	51.19
VI (for the newly built connection)	39.37	51.19
VI (when connected to an existing network)	7.86	7.86

For connecting entities included in connection groups IV–VI, a fee is charged which is the product of the connection fee rate included in the table as above and the amount of connection capacity specified in the connection agreement with the following reservation:

B. if the connection length of the connection infrastructure being built for entities included in the connection groups indicated in the table as above exceeds 200 meters, no additional fees are charged [2].

PGE Dystrybucja joint-stock company

Table 9.
Fees for connecting to the road charging infrastructure network of public transport and generally available charging stations to the network with a rated voltage not higher than 1 kV

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	7.09	15.56
V	7.09	15.56
VI (for the newly built connection)	7.09	15.56
VI (when connected to an existing network)	1.97	1.97

A fee is charged for connecting a charging station, which is the product of the rate of connection fee included in the table as above and the amount of connection power specified in the connection agreement

with the following reservation:

A. if the length of the connection exceeds 200 meters for the constructed connection infrastructure of the road public transport charging station and public charging stations, an additional fee shall be charged:

- I. 8.36 PLN in the case of a cable connection;
- II. 6.18 PLN in the case of an overhead connection.

Table 10.
Connection fees for networks with a rated voltage of less than 1 kV from entities other than charging stations that have been classified as connection groups: IV, V, VI, VI

connection group	connection fee PLN / kW outdoor connection	connection fee PLN / kW cable connection
IV	28.36	62.24
V	28.36	62.24
VI (for the newly built connection)	28.36	62.24
VI (when connected to an existing network)	7.87	7.87

For connecting entities included in connection groups IV–VI, a fee is charged which is the product of the connection fee rate included in the table as above and the amount of connection capacity specified in the connection agreement with the following reservation:

B. if the connection length of the connection infrastructure being built for entities included in the connection groups indicated in the table as above exceeds 200 meters, additional fees are charged in the amount of:

- I. 33.45 PLN in the case of a cable connection;
- II. 24.70 PLN for an overhead connection [3].

5. CONCLUSIONS

Based on the presented analyzes, the following conclusions were drawn:

1. The lowest costs for connecting publicly available charging stations in 2019 for electric and hybrid vehicles in connection fees, which result from the tariffs for distribution services of the 5 largest Distribution Companies in Poland [14, 15], occur on the distribution network of innogy Stoen Operator Limited Liability Partnership, located in the capital city of Warsaw. The area of Poland with the most expensive connection fee related to the charging station is the

area located within the distribution network belonging to Enea Operator Limited Liability Partnership. The difference between the most expensive and the cheapest connection fee is 22%. In practice, the above translates into the following values:

Standard connection capacities of car chargers are: 50 kW, 150 kW or 350 kW;

a. connection fee of the charging station installed in the capital city of Warsaw is:

- 50 kW $\times$ 12.80 PLN = 640 PLN
- 150 kW $\times$ 12.80 PLN = 1920 PLN
- 350 kW $\times$ 12.80 PLN = 4480 PLN

b. connection fee for the charging station located in the city of Zielona Góra is :

- 50 kW $\times$ 16.45 PLN = 822.50 PLN
- 150 kW $\times$ 16.45 PLN = 2467.5 PLN
- 350 kW $\times$ 16.45 PLN = 5,757.5 PLN

2. Material (and also financial) outlays for the construction of low-voltage energy connection for vehicle charging stations are the same as for the construction of low-voltage connections for other facilities. In 2019, charges for connecting a charging station are treated preferentially and are lower in relation to connecting other facilities by an average of 75 percent – examples:

a. connection of the charging station in the city of Krakow is:

- 50 kW $\times$ 15.40 PLN = 770 PLN
- 150 kW $\times$ 15.40 PLN = 2310 PLN
- 350 kW $\times$ 15.40 PLN = 5390 PLN

b. connecting a facility other than a charging station in the city of Kraków is:

- 50 kW $\times$ 61.60 PLN = 3080 PLN
- 150 kW $\times$ 61.60 PLN = 9240 PLN
- 350 kW $\times$ 61.60 PLN = 21,560 PLN

The Act on electromobility and alternative fuels (Journal of Laws of 2018, item 317) creates conditions for the popularization of electric transport in Poland. However, special attention should be paid to the fact that the Act prefers only connecting generally available charging stations directly to the distribution network of a Distribution System Operator. This means that an example of additional connection of the charging station to the existing traditional refuelling station in post-payment mode (i.e. by existing power installations) it is not treated by the legislator in a preferential manner, i.e. connection in this way is more expensive by an average of 75 percent.

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