GEODE FACT SHEET
E-MOBILITY

GEODE Working Group Smart Grids

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GEODE
The Voice of local Energy Distributors across Europe

Table of contents

1. Scope and Drivers **4**

2. Role of DSOs in E-Mobility **5**

3. Market models for building charging stations **6**

4. Barriers and challenges **7**

5. Current legislation **9**

6. Activities of GEODE members in E-Mobility **9**

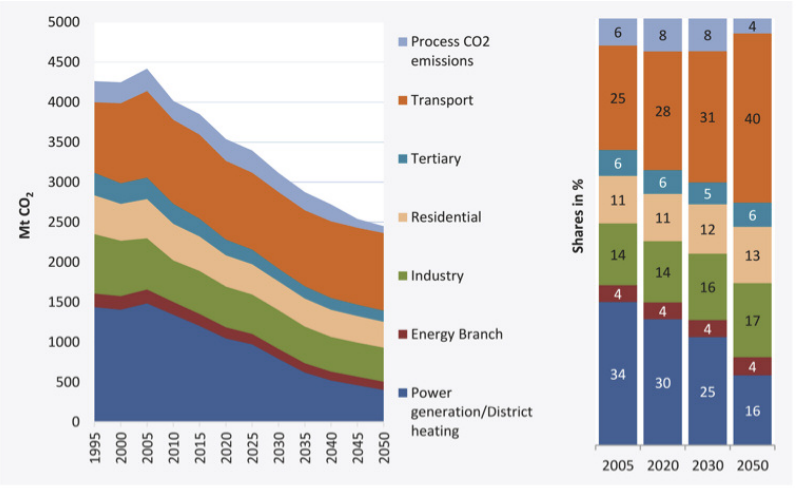
7. Key messages **10**

1. Scope and Drivers

The transport sector is responsible for around a quarter of EU greenhouse gas emissions, making it the second biggest greenhouse gas emitting sector after energy. Road transport alone contributes to about one fifth of the EU's total emissions of carbon dioxide (CO_2), the main greenhouse gas. While emissions from other sectors are generally falling, the share of emissions for the transport sector will increase significantly in the future (see the charts below)[1]. In the EU, there are since several years policies in place to reduce emissions from a range of modes of transport such as CO_2 emissions targets for cars but also ambitions to include aviation in the EU Emissions Trading System (EU ETS). One key technology to help reach the targets set by the European Commission is to replace fossil motor vehicles by electric vehicles (EVs), provided there is sufficient non fossil power capacity available in the grid.

To achieve this target – amongst others – Directive 2014/94/EU of 22 October 2014 on the deployment of alternative fuels infrastructure obliges Member States to set up a national strategic framework and thus to create a uniform technical standard for charging stations by 18 November 2016. This standard is to govern the requirements of charging stations made available to the public (i.e. smart meters, charging on an ad-hoc basis, non-discrimination). The objective of a uniform technical standard is to facilitate the charging of e-vehicles at public stations across all European Member States independent from the station operator. At European level, the focus is on reducing CO_2 emissions and thus on European climate policy objectives.

This paper focuses on e-vehicles and the technical and economic challenges seen from the perspective of DSOs.



EVOLUTION OF CO_2 EMISSIONS BY SECTOR

Data from 2013 – European Commission Report EU Energy, Transport, GHG Emissions, Trends to 2050

[1] http://ec.europa.eu/clima/policies/transport/index_en.htm

2. Role of DSOs in E-Mobility

The DSO's role is to provide a connection to the network on the request of the customer. The DSO enables charging stations to ensure reliable connections to the grid, and is providing the connection point, the quality of the supply and the metering of the consumption, exactly as for any other consumer.

In general, e-vehicle charging stations are installed in the following locations including:

- Domestic installations, such as installations in, or adjacent to, houses and their associated garages.
- On-street installation, e.g. at parking facilities.
- Commercial and industrial installations, such as installations in, or adjacent to, business premises, e.g. shops, offices, factories, etc., including public and private car parks.
- Workplace installations, both for business purposes (e.g. in the field of public transport) and for the private use of employees and customers.

Here are the commonly adopted charging installation types in terms of ownership and their respective impact on the distribution networks:

- **Private charging:** in this case, the customer connects the EV, behind the meter of the DSO, e.g. via a wall box, to the house installation. Typical private charging profile indicates that demand coincides with peak residential demand, as the consumer charges in the evening, e.g. when coming home from work.

  For the networks, given the nature of charging observed, this highlights an opportunity for load shifting with the consumers' energy requirement still being met (i.e. shift the charging of the EV overnight to have a full battery next morning and at the same reducing the evening peak of the residential customer).

- **Public charging:** points are located in public areas and usually owned and operated by e-mobility providers. Alternatively, a company or a service provider engaged by this company could operate such a charging station (instead of an e-mobility provider). Typical public charging profile indicates demand coincides with peak commercial demand, as the consumers charge during the operating hours of business facilities. Although there are times when energy demand can be shifted to favour network utilisation, consumer behavior suggests that load shifting in public charge points is more difficult to enforce, unless it is absolutely needed due to a grid emergency situation.

3. Market models for building charging stations

Several actors may have an interest in setting up charging stations and provide charging services such as energy companies, cities and local communities, new market actors (ESCOs and charging aggregators). In principle, a large pool of potential investors who would be prepared to fund the installation of electric charging stations exists.

From **GEODE**'s point of view it is possible and cost effective to set up a network of electric charging stations based on free market principles. The market will build the charging infrastructure in accordance with the growing needs of customers in a cost-effective manner.

On the other hand, the lack of charging stations and the scarcity of EVs on the streets illustrates the ingredients of a potential stranded investment: a "chicken-and-egg problem". The market needs new companies providing chargers and charging services to the market.

GEODE describes below possible market models to overcome the "chicken-and-egg problem" and to deploy an adequate and accessible charging infrastructure:

- The infrastructure investment is subsidized by the authorities until an economically viable number is achieved and the income from customers using EVs covers the costs of owning and operating the infrastructure. For example, in Norway it's expected to have approximately 100.000 EVs by 2017 (5 % of the national car park). Also, owners/operators compete for subsidies based on criteria for deploying the best and most relevant public infrastructure.
- In some countries the network operators are allowed to own charging stations. The infrastructure investment is integrated in the grid tariff, thus spreading the cost across all grid users. Operation of chargers should still be in a competitive market.
- Alternatively it´s possible that DSOs, as neutral actors, operate the charging stations if this is done in compliance with the condition of non-discriminatory access.
- A market-driven approach is also possible. In some EU countries, for example Finland and Sweden, independent charging station service providers are managing a number of publicly accessible charging stations on a market basis. Swedish and Finnish startup companies were founded and/or are owned by a number of local energy companies.

4. Barriers and challenges

TECHNICAL

When assessing the impact of EVs on the electricity grid, the expected load (capacity, kW) is a key parameter (it's not about energy, kWh). Concerning the costs of grid integration, this can be illustrated by the principle "slow charging is cheap".

A high degree of simultaneity of the charging processes – many EVs being charged at the same time – would bring the existing grid to the limit of feasible performance. This could happen even with a low penetration of e-vehicles in the event of a geographic accumulation of charging points. For example, 100 charging stations in a country will probably not cause problems if well distributed (geographically), but 100 charging stations in a small village is likely to cause problems if smart/coordinated charging is not used (see next section).

With an increasing number of charging spots for EVs on the road, it will become necessary to extend electricity distribution grids in a well-directed and timely way. There is the option of developing intelligent solutions for coordinated charging strategies which help to minimize the impact on the grid while, at the same time, fulfilling customer needs ("full" tank when starting the EV) – smart charging. A pre-condition for that is to increase the monitoring ability and controllability in the medium and low voltage distribution grid, as the impact on the existing grid depends strongly on the local conditions and has to be judged individually for each line.

As a general principle the charging processes can follow the traffic light concept. As long as the traffic light grid status is green (grid stability is not at risk) charging processes can be done without any restrictions. In all other situations the interests of DSOs must have highest priority in order to maintain grid stability. Smart charging would be a suitable mechanism to avoid bottlenecks in the grid.

In addition to that single-phase charging processes are creating asymmetrical phase loading. This fact reduces the hosting capacity of the grid significantly.

In that respect **GEODE** supports the possibility to have direct contracts between DSOs and customers respectively operators of charging stations to be able to influence charging processes (procure flexibility services) as an appropriate management tool, due to the local dimension of DSOs' requirements.

Moreover, there is the added possibility to influence the charging process by means of tariff-based incentives. In this regard a development towards more capacity oriented grid tariffs could be an effective measure to smoothen the load curve.

Other issues are:

- In the future there might be parts of the grid with a lack of capacity due to a significant number of chargers installed in a given area. DSOs would require investments to reinforce the grid. These increased costs will impact all customers.
- The development of smart/coordinated charging solutions – for meeting the mobility requirements of the customers on one hand and to minimise the impact on the grid (optimization of utilization of the available capacity) on the other hand, has to be facilitated. Additionally, there are technical **concerns around the power quality** issues these loads could create. However, by controlling the time for charging and the possible use of power from batteries on some occasions, investments can be avoided and the vehicles can be used to use the grid more effectively.
- It is fundamental that in accordance with European guidelines and standards for charging infrastructures, EVs manufacturers should guarantee that EVs comply with **power quality standards to ensure the impact on the network is minimal**. This applies equally to all EV owners.
- It is important to communicate that identifying the location (and potential clusters) of EV is critical for ensuring DSOs are made aware of new loads – with enough time ahead – to allow for proper planning and to address network issues if required.

ECONOMICAL

- The lack of investments, especially in infrastructure and charging stations due to high investments costs and expected low utilization rate, are current barriers.
- This shortage of investments is linked to the major obstacle – the lack of EVs on the market – which makes it difficult to set up any market based charging infrastructure. In some countries new tax laws and special rights when using EVs (e.g. allowance to use bus lanes) are promoting e-mobility.
- There will be a business case for charging operators once a critical mass is achieved. The income of charging operators is mainly based on the amount of chargers that are operating and the number of charges done per day. The charging operators are looking for alternative income streams, as for example the bundling of services, and products based on the digitalized business model seem to be the next step in the development. In the UK for instance, there are the following opportunities for expansion of the business: bundling car-charging with electricity; bundling car-charging with offering storage (flexibility) from parked vehicles.

5. Current legislation

Many Member States have set out ambitious targets to achieve a low carbon transition. In most countries there is still no national legislation which decides whether network operators are allowed to own or operate chargers.

It has to be ensured that European standards for installing charging infrastructure are implemented to facilitate the use of charging stations across Europe independently of the operator of the individual charging stations.

6. Activities of GEODE Members in E-Mobility

GEODE members are involved in e-mobility. These activities range from providing public and private charging stations to pilot projects for smart charging (time or capacity regulated control of the charge). Some network operators own and provide charging stations as a service provider (retail business), others only provide chargers. For these purpose, some network companies have established subsidiary companies.

Links to projects and activities of **GEODE** members:

- **http://myelectricavenue.info**
- **http://www.energynetworks.org/electricity/futures/electric-vehicle-infrastructure.html**
- **http://www.smartgridssalzburg.at**
- **http://www.electrodrive-salzburg.at**
- **http://www.fahre-emil.at**
- **http://gronnkontakt.no/**
- **http://clever.nu/get-access-to-clevers-network/**

7. Key messages

- E-Mobility is one important part of the solution to decarbonize transport, provided that there is enough fossil free production capacity available in the grid. Building a sufficient number of charging points is fundamental for the future development of the electrification of the transport sector.
- The European Member States have to put in place and comply with common technical standards.
- Best practices must be shared in how to identify the location of EVs and charging stations.
- Interaction between the e-mobility sector and the electricity sector should be enabled and emphasise the importance of power quality standard compliance.
- It is important to increase customer awareness when purchasing new EVs vehicles and the impact this will have on their domestic electricity demand and potential supply upgrade requirements. Visibility is of essential importance and only through strengthening communication with customers they will be able to help monitoring and enabling the uptake of e-vehicles.
- Further implementation of EU funded R&D on electrification of transport is needed.
- If the charging points are an asset of the DSO, the business case would be more easily made as retailers would only have to support variable costs (energy).
- To build a competitive market for EV charging, it might be necessary to facilitate a close cooperation between authorities and market players until a critical mass is reached. In this regard it might be an option that DSOs are allowed to invest, own and operate charging stations to overcome this obstacle.
- DSOs need to have the possibility to influence the charging processes in order to minimize the impact on the distribution grid and safeguard grid stability (smart/coordinated charging).
- DSOs should be allowed to have direct contracts with customers and operators of charging stations to be able to influence charging processes (procure flexibility services) as an appropriate management tool, due to the local dimension of the DSOs' requirements.

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Everhill, Per – Tekniska Verken i Linköping, Sweden

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Gimeno, Carmen – GEODE Secretary General

Hallinder, Jonathan – Kraftringen, Sweden

Lehto, Ina – Finnish Energy, Finland

McWilliam, Jamie – Energy Networks Association, United Kingdom

Pedersen, Jan – Agder Energi, Norway

Persson, Jonas – Mälarenergi Elnät, Sweden

Taus, Hans – Wiener Netze, Austria

The Voice of local Energy Distributors across Europe • Avenue Marnix 28 • 1000 Brussels
Tel. +32 2 204 44 60 • Fax +32 2 204 44 69 • info@geode-eu.org • www.geode-eu.org