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Debunking the myth of the grid as a barrier to e-mobility

Eurelectric position paper

April 2021

Eurelectric represents the interests of the electricity industry in Europe. Our work covers all major issues affecting our sector. Our members represent the electricity industry in over 30 European countries.

We cover the entire industry from electricity generation and markets to distribution networks and customer issues. We also have affiliates active on several other continents and business associates from a wide variety of sectors with a direct interest in the electricity industry.

We stand for

The vision of the European power sector is to enable and sustain:

- A vibrant competitive European economy, reliably powered by clean, carbon-neutral energy
- A smart, energy efficient and truly sustainable society for all citizens of Europe

We are committed to lead a cost-effective energy transition by:

investing in clean power generation and transition-enabling solutions, to reduce emissions and actively pursue efforts to become carbon-neutral well before mid-century, taking into account different starting points and commercial availability of key transition technologies;

transforming the energy system to make it more responsive, resilient and efficient. This includes increased use of renewable energy, digitalisation, demand side response and reinforcement of grids so they can function as platforms and enablers for customers, cities and communities;

accelerating the energy transition in other economic sectors by offering competitive electricity as a transformation tool for transport, heating and industry;

embedding sustainability in all parts of our value chain and take measures to support the transformation of existing assets towards a zero carbon society;

innovating to discover the cutting-edge business models and develop the breakthrough technologies that are indispensable to allow our industry to lead this transition.

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KEY MESSAGES

- Network capacity upgrade is often identified as one of the main barriers to the roll-out of electric vehicle (EV) charging infrastructure in a timely manner. Eurelectric has therefore conducted a survey amongst its membership with the aim of providing detailed insights into network planning. This planning is key to support the deployment and integration of EV charging infrastructure in the distribution network and identify potential underlying grid capacity reinforcement.

- A recent study conducted by Eurelectric and E.DSO reveals that, even with up to 70 million EVs on Europe's roads by 2030, triggered grid build out is marginal compared to that of other investment drivers. European distribution grids will need €25-35 billion of investments until 2030 to support the development of e-mobility and integrate EV charging infrastructure. However, this only represents 8% of total investment needs by 2030, – far behind the modernisation of the distribution grid and the electrification of buildings & industry. More investment is expected in the years to come.

- From the perspective of distribution system operators (DSOs), there are similarities across Europe towards the approach of the roll-out and integration of chargers. However, distinctions should be made between the network connection of specific EV chargers (on specific streets, for specific projects), and overall network planning. The latter considers the upstream capacity requirements to support local projects, the expected future load requirements in the area from buildings, and the growth of existing loads. Network planning is required for a specific set of new EV connections in a local area with local reinforcement requirements assessed, and this impact is then consolidated with other load increases up stream to assess the overall impact on network reinforcement needs.

- Grid reinforcement remains a local exercise based on specific parameters. These parameters relate to the characteristics of the distribution network in areas under consideration, and the expected future load requirements (accounting for both the location and power capacity requirements of the chargers). DSOs are evaluating all these factors to analyse the network situation and develop various EV charging scenarios, thus allowing them to identify the available capacity and connection cost at different grid connection points.

- Our findings show that the costs of network capacity reinforcement and the deployment of new charging points can be optimised by using smart and flexible (e.g. load management) solutions which change depending on the demand pattern of the electric vehicles. By taking advantage of DSOs' in-depth knowledge of the distribution network and planned network development, it is possible to make a more optimal use of the network while maintaining the required levels of quality and security of supply.

- Solutions exist and can be implemented to most efficiently integrate EV charging infrastructure in the distribution grid while achieving the desired goals. To this end, we have identified a list of the most frequent costs and time drivers for grid reinforcement across Europe.

- DSOs should be included in the planning and development process for the deployment of EV charging infrastructure as early as possible, to facilitate grid network connections. A close and early cooperation between DSOs and all involved parties has been shown to ease the process and bring valuable cost and time efficiency. This is particularly true in case of deployment of public chargers and the wider roll-out of home chargers.

- To conclude, this paper shares lessons learned by network operators and their key involvement in integrating thousands of charging points to the power system across Europe. It also provides concrete examples of grid reinforcement projects, showcasing the value of DSO involvement.

Debunking the myth of the grid as a barrier to e-mobility

Introduction

Electrification of transport within an increasingly clean electricity mix is the most effective, efficient and sustainable way to decarbonise this sector, reduce its dependence on fossil fuels imports from outside Europe and eliminate air pollution. This requires the deployment of a solid and dense charging infrastructure for electric vehicles (EVs) in a timely manner to support the development of e-mobility. While the number of electric vehicles on European roads keep increasing, it is necessary to ensure the effective integration of EVs in the power system in order to align the network and maintain the required levels of quality and security of supply. To that end, distribution system operators (DSOs) may need to reinforce the distribution grid before connecting chargers to the electricity network.

Network capacity upgrade is often identified as one of the main barriers to the roll-out of EV charging infrastructure in a timely manner. For this reason, Eurelectric has conducted a survey among its membership with the aim of providing detailed insights into network planning. Network planning is a key exercise to support the deployment and integration of EV charging infrastructure in the distribution network and identify potential underlying grid reinforcement. This report also sheds light on the circumstances which oblige DSOs to reinforce the grid and the various time and cost drivers for grid reinforcement from across Europe.

DSOs play a key role in the deployment and integration of EV charging infrastructure in the electricity network and much experience has been gained by connecting thousands of charging points to the power system across Europe. This paper shares lessons learned by DSOs in this regard and highlights concrete examples of grid reinforcement projects, showcasing the value of DSO involvement.

Grid reinforcement for EV charging infrastructure

A recent study conducted by Eurelectric and E.DSO[1], and carried out by Monitor Deloitte, reveals that, even with up to 70 million EVs on Europe's road by 2030, triggered grid builds out is marginal compared to other investment drivers. Indeed, European distribution grids will need investments of €25-35 billion until 2030 to support the development of e-mobility and integrate EV charging infrastructure. These only represent 8% of grid total investment needs by 2030, far behind the modernisation of the distribution grid (25% of total investment needs) and electrification of buildings & industry (19%). This clearly indicates that the European distribution grid has the capacity to integrate the majority of the charging needs by 2030.

Network planning is key to support the deployment and integration of EV charging infrastructure in the distribution network. This is a regular exercise conducted by DSOs as part of network development and is not specific to integrating EV charging infrastructure. The DSOs' main challenge with regard to planning for EV charging infrastructure is related to the uncertainty (e.g general mobility concept in cities, locations for charging points, future load capacity) and the lack of coordinated overall strategy for electrification. Adopting a more coordinated approach would allow DSOs to perform grid planning, including for EV charging, in a more optimal way.

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[1] "Connecting the Dods: Distribution grid investment to power the energy transition" conducted by Eurelectric, in cooperation with E.DSO, and with the analytical support and facilitation of Monitor Deloitte.

Network requirements for connecting charging stations to the grid

The approach to network planning for the roll-out of charging stations from the perspective of DSOs is similar across geographies in Europe and comparable with other new network accesses. However, network planning remains a local exercise that depends on a wide set of parameters.

Furthermore, a distinction should be made between network planning performed for a specific connection requirement (e.g. integration of a known number of EV chargers in a specific area) and overall network planning, which should be based on a network development plan to be published by the DSO at least every two years according to Article 32.3 of the Electricity Directive (EU) 2019/944. Overall network planning aims at estimating the impact of additional future loads, including EV charging infrastructure, on the distribution grid and thus plan network development in the mid- to long-term accordingly. This is a forward-looking exercise where access to reliable and accurate forecasts of future electrification trends is key.

In both cases, the ultimate goal is to identify parts of the network where congestions could happen, thus threatening security and quality of electricity supply. When performing network planning, DSOs assess a wide set of parameters related to the characteristics of the distribution network in the considered area, to the future load in this area but also to the location as well as power and capacity requirements of the chargers.

More specifically, in the case of a specific project, these factors generally include:

- The exact location of the charging station, and number of charging points;
- The technical features of the chargers such as the type of connection (1 phase vs 3 phases), the charging speed (e.g. slow or fast charger), power quality use (mainly harmonics from rectifiers or the existence of power input into the grid (V2G technology);
- The requested power capacity for the charger or set of chargers; the simultaneity factor
- The use of smart charging solutions, e.g. controllability of the EV charging point(s) via load shifting, energy management of the charging station;
- The capacity of power lines and power transformers in the considered area and at the connection point.

These parameters are evaluated by the DSO to analyse impacts of such charging infrastructure on the peak power demand and the distribution system. DSO thus evaluate the network situation and can identify the best suited grid connection point with the chargers. Finally, they can assess if grid reinforcement is necessary in that particular case or if a flexible solution (e.g. load management customer site) or a grid-serving control could be deployed in order to avoid or to postpone grid reinforcement. Alternative solutions can be proposed by the framework of economic network planning where the DSO ensures cost-effectiveness (other location for instance) or other flexible solutions. When network planning is well coordinated, DSOs can also assess how the project might benefit from planned network evolutions such as the electrification of heat in buildings.

As far as overall network planning is concerned, the parameters to be considered by DSOs include:

- A forecast of the total number of EVs on the road and the type of EVs (e.g. number of heavy-duty vehicles);

- The probable density of charging points and their power requirements (ultra-fast/fast/slow charging) in the considered area;
- A forecast of the EV charging simultaneity factor and the utilisation rates of charging stations, taking into account behavioural patterns of the drivers such as charging location (e.g. home charging or public charging) and use of smart charging solutions and dynamic electricity prices;
- The timing and magnitude of EV charging power;
- Additional electrification trends and their evolution (e.g. electrification of the heating sector and integration of heat pumps).

DSOs use these parameters to develop various EV charging scenarios and predict future load profiles. Such profiles are then used to analyse the voltage and current load on network components to ensure that the network can satisfy all future loads.

Grid reinforcement: what is it exactly?

As a preliminary remark, there is not always need for network capacity reinforcement for integrating EV charging. The low and medium voltage networks, where most of EV charging infrastructure will be connected, are not uniformly dimensioned across Europe as their size and capacity highly depend on population density and electrification level (e.g. in the heating, industry and transport sectors). For instance, the capacity of the distribution grid is less of an issue regarding to integrating EV charging infrastructure in countries where the use of electric heating is widespread.

The general principle for grid reinforcement consists in anticipating the impact of increased load on the network and ensuring that the network will continue within standard operation (power quality, reliability).

Network reinforcement would be considered when the network is in consideration of simultaneity factor overloaded, i.e. the requested capacity is higher than the current installed network capacity allows for (see Box 1 for concrete example) or when the impact of voltage or power quality would breach standards. When new demand entails a significant increase in the power flow in one or several elements of the network, the DSO conducts a study or calculations to evaluate the necessary reinforcements. The analysis considers the network situation in normal conditions (i.e. all elements are in service) and takes into account the new load forecast. This can be the case when large new consumers, such as fast charging stations, connect to the network.

The low voltage network can also be overloaded or the capacity of the electrical equipment is nearly reached because of an accumulation of small increases in demand ~~of~~ from customers connected to the network. But where home charging stations are installed gradually, in small increments, the DSO monitors the load development, and reinforces network components as they become overburdened.

The DSO will not immediately consider grid reinforcement but also look for smart and flexible solutions which could solve the issue if this is more economical. In each situation, DSOs will have to analyse the cost-effectiveness of any flexible solution. We further investigate these various solutions later in the paper.

As previously emphasized, it is important to adopt a coordinated approach for network planning. Indeed, if other customers request additional capacity at the same point of the distribution grid, it is important that these requests are coordinated in order to optimise network investments and adequately dimension grid reinforcement.

Example

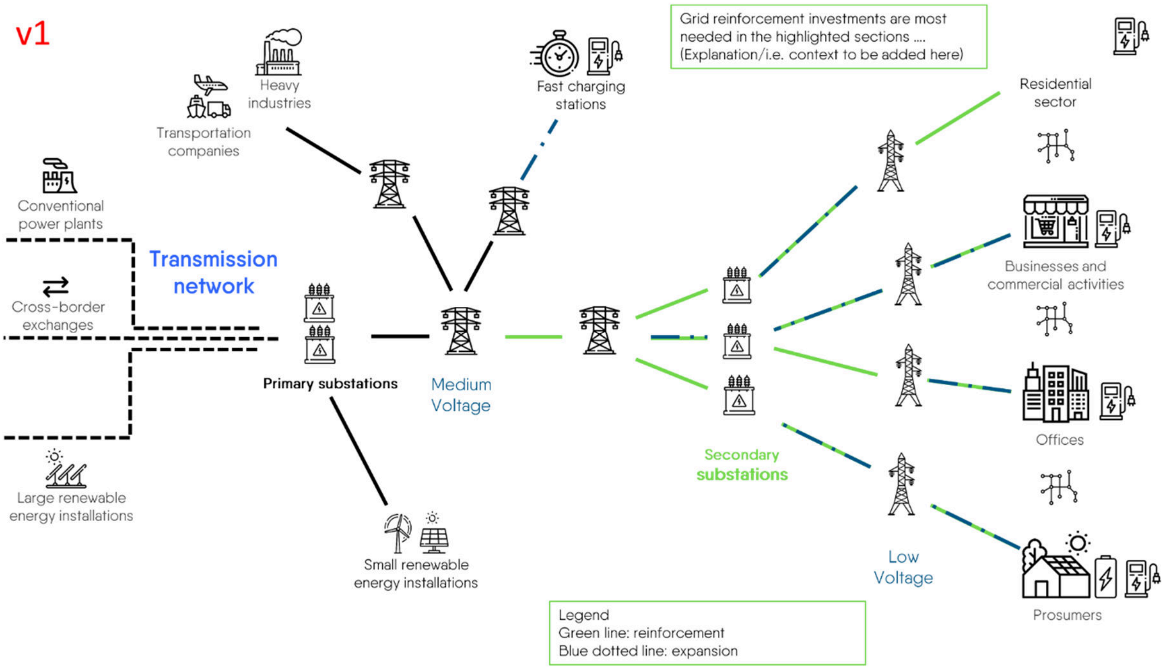
A new charging point requires a 100 kW power demand connection at low voltage level. At the point of the grid where the connection is required, there is a low-voltage line with a cable section sufficient to meet the existing loads but not enough to deal with the new total load (following the addition of the demand of the new charging point). The network analysis shows that the total load exceeds the recommended cable capacity limit, and consequently, that a reinforcement of the low voltage network will be necessary. In this particular case, an option is to either install a cable with a larger section or place a new substation. Since not all reinforcements can be made simultaneously load shifting of home charging stations is an option to postpone. Another to inject power into the necessary reinforcement. Ideally, letting ones load be controlled should be voluntary and the customer should be allowed to specify how high the proportion that may be controlled should be. However, this requires an existing network of financial incentives for the customer such as lower grid fees.

In Italy, the experience gained so far shows that more in-depth analysis is needed in the case of requests for high-power charging stations in some urban areas, while in all other cases network capacity reinforcement is generally not needed. In the near future, it is expected that much attention will be required in urban contexts with high population density due to the likely impact of the increased electrification of the heating and transport sectors.

Of course, the situation regarding the investment needs for grid reinforcement vary greatly. In Finland the distribution network is very robust due to, for example, the use of electric space heating, saunas and water heaters. It is very common for detached houses to have 3x25 A or 3x35 A main fuses – providing 17 or 24 kW of capacity.

- This means that in most detached homes (meaning roughly 50 % of Finnish people) it is usually relatively easy to charge an EV or two
- Finnish EV drivers often schedule the charging to use night time tariff. This is common practice, since water heaters have been used this way for decades.

Types of works carried out as part of network capacity reinforcement



Box 1. Types of works carried out as part of network capacity reinforcement

Grid reinforcement works are intended to increase the capacity of the affected elements of the existing network to maintain the full availability of the grid. In general, the works consist of reinforcing the network segment to which the charging point is connected and possibly also some upstream network, e.g. a low voltage line or a secondary substation.

The main considerations include:

- Upgrading existing lines (cable, overhead lines) and transformers by increasing nominal power by adding switchgears/switchboards;
- Building new lines (cables), new transformers and substations (for MV or HV depending if this is a primary or secondary substation) or replacing old ones. In the case of connecting to a secondary substation, the solution usually involves upgrading one or more elements of the secondary substation (for example, the transformer) or even building a new one;
- Extending the meshing of the grid, especially for the low voltage network;
- Adding new connection points;
- Very exceptionally (e.g. when there is a large concentration of recharging points), Medium Voltage reinforcements could be required too, such as upgrades on MV cables and/or substations. It is more likely that the addition of EV loads will bring forward the reinforcement of existing network rather than be solely responsible for instigating the reinforcement, particularly where the electrification of heat is also considered,

For certain urban environments or important traffic routes, the DSO may, in order to anticipate conditions in the connection process (duration of connection and connection costs) provide zones/locations that are more or less likely to build/upgrade the network, thus enabling network users and local government information.

What are the cost and time drivers of grid reinforcement?

Costs drivers are non-linear and may vary depending on the case. Indeed, grid reinforcement is determined by the capacity required. Costs are typically low for the initial increase of capacity and then when installations ramp up, costs become more important as network investment typically requires step changes in investment once certain limits are exceeded e.g. when the maximum substation capacity is exceeded then a new substation is required.

Upgrading and installations of power cables usually have a significant cost due to the civil works requirements in digging streets/roads, with upstream capacity costs driven mainly by primary cost drivers being assets such as breakers, transformers and overhead lines. Putting in place new assets involves works such as excavations and backfilling which are also costly. In the case of secondary substation upgrading, the costs for the grid are usually lower since, in general, they simply involve replacing existing electrical assets with ones of larger capacity, but not the duplication of the whole infrastructure which would also involve civil works and site acquisition.

The results of our survey pinpoint the following cost~~s~~ drivers for grid reinforcement, by order of magnitude:

- Location;
- Restrictions due to the condition or configuration of the existing network;
- Excavation costs or cable trench (more so in urban areas) and related civil work / labour costs;
- Material and installation costs;
- Cost of non-delivered energy;
- Fault repair and maintenance;

Early planning offers cost reduction opportunities by coordinating in advance interventions on the same sections of the network. If the network planning is not well coordinated with current and future requests for capacity, this could result in stranded assets. Solutions such as e.g. load shifting or synchronization of consumption with renewable generation may also contribute to minimize costs. Additionally, smart meters and grids increase monitoring, and therefore help to understand more accurately where investments to modernize the grid are needed or can be avoided.

Costs are also reduced by increasing utilisation of existing assets, as the majority of charging points are currently largely underutilised. Utilisation can be increased by flattening load peaks using financial incentives such as tariffs and connection fees. A clear national and local strategy for planning and development of charging infrastructure would provide more investor certainty.

With regards to time drivers, the main issue comes from permissions for long trenching works and permits. Moreover, installing networks cannot be done quickly. There is a need to develop solutions that can be developed quickly (for example, larger transformer size that fits into existing substations or new substation design, which can be installed on the pavement of urban streets).

- It depends on the range of the needed reinforcement. Also, the higher the complexity level of reinforcement interventions to be carried out, the more time it will take. For instance, it is particularly time consuming to look for sites for installing new secondary substations.
- An important time driver is the potential need to get planning approval by local authorities providing authorisations for work. Local permits from local administration, authorisation procedures.
- If the regional distribution grid or transmission grid is to be reinforced, both the licensing process timeline and building timeline can be very long (between 2 and 10 years) and this becomes the main time driver for network capacity reinforcement.
- Performing network studies to evaluate the optimal network reinforcement also takes time
- Reducing administrative burden will speed up the project, as time for other elements (network study, construction works) cannot be decreased.

A solution would be to simplify and accelerate authorisation and permit granting processes and, at the same time, facilitating a proper involvement of administration at all levels.

Examples

- Across EU countries, there is a big issue with the civil law and its administration (getting construction permit), which might take years in some cases and cannot be changed by DSOs' actions.
- In the Czech Republic, DSOs are obliged to connect customers to the grid within a reasonable time frame. Therefore, the reinforcement is not so much driven by costs as by customers' needs. The main costs with respect to cable (reinforcement or new ones) are by far excavation works and pavements/surface works.
- According to the Spanish regulation, the necessary reinforcements in the element to which the charging point is connected must be paid by the customer. The cost of reinforcements in higher voltage levels, if necessary, are paid by the DSO.
- France: DSOs provide free online tools for self-running network simulations (such as traffic light results) so the requester can then have an idea of the impact on the network of the requested capacity on each location (green means no reinforcement would be needed). This will reduce iterations between the user and the DSO for adjustments.
- Norway: In the local distribution grid, projects can be completed within months, provided that the necessary equipment is available or can be made available shortly.
- Experience in Lithuania shows that standard terms for projects up to 50,000 EUR is 85 days. This can be minimised by performing network reconstruction in advance with long-term e-mobility roll-out in mind.
- Germany: It is mandatory for the DSO to comply with the customer's requests to become connected. This must occur in a reasonable timeframe as soon as possible.

The role of smart charging solutions

Grid reinforcement can be avoided or optimized thanks to smart charging solutions.

First, grid reinforcement can be avoided by upgrading the network at low levels of penetration. At high levels it may be possible to deploy other solutions such as dynamic load management of charging, introducing charging power limitation or control for example (e.g. peak shifting system which allows to avoid multiple charging scenarios at the same time). It may also be possible to improve load shifting capabilities such as consuming at off peak time (time-varying tariffs can be a solution as well, incentivising energy consumption at off-peak hours).

Germany for example has planned to have 10 million EVs and 1 million charging points by 2030. Partial reinforcement of the grid will be necessary. Since capacities are limited and therefore not all reinforcements can be done simultaneously, peak shaving for private charging stations is in discussion to optimize the necessary reinforcements and accelerate the connection of charging stations. The customer can determine the level of the capacity to be controlled himself. As an incentive, the customer receives lower network charges for the controllable portion. Customers also have the option of opting out.

If possible, avoidance of grid reinforcement might be possible in certain cases by developing EV charging points which can be operated flexibly, and which may also incorporate battery storage to reduce peak demand requirements. Demand management of charging stations (in case of multiple charging stations at one charging site) as another approach, as the optimal saturation with HV/MV and MV/LV stations, so shortening circuits and lines. EV charging points can also be distributed in a larger geographical area and a coordinated strategy for EV charging points may optimize grid planning and optimize investments.

In case of multiple charging points connected by one single inlet to the distribution grid, promotion of local power management of the charging points would help DSOs to reduce or at least postpone investments in grids.

If possible, grid reinforcement can be minimised by lowering the maximum power requests required and through the availability and capability of smart meters: much more information on the loads connected at each point would become available. It would allow a more realistic estimation of the need to reinforce the network thanks to a more detailed analysis of the utilisation factors of the network at a particular location. As an example, in France, some 'smart connection' that includes flexibility contracts prior to connection, mainly at MV level, are currently being suggested on a case-by-case approach.

Careful planning of the routine renewal of the grid considering project developments each year and planned conversion and reconstruction of the grid (changing topology and cross-sections) is another approach. Renewable generation could also be synchronised with consumption at a substation level (i.e. peak load during midday in a business area).

Finally, in the medium term it could be deferred or possibly even avoided by means of flexible connection contracts, including options such as smart charging, V2G, power modulation, storage system, or time shifting.
However avoiding or optimising grid reinforcement is a limited solution. For example, in countries where the network is older, reinforcement cannot be avoided for higher loads. In addition, there is a critical point to note when considering alternatives to grid reinforcement such as batteries, such solutions are only economic if deferring grid investment for a significant period.

Facilitating projects

Different facilitators can be developed.

To help, DSO should be included as soon as possible, regarding site selection, allowing optimisation of sites in light of the existing distribution network. This is the best way to provide information about costumer's connection. It is interesting as well to cooperate with charging point owners and local authorities, making it easier to obtain the necessary permissions. A close and early partnership between the DSO and all the involved parties will ease the process and bring efficiency, especially if there is a preparation of long-term e-mobility plan.

A discussion about the power requirement and its localisation could significantly optimise the whole operation performance in terms of costs, time and nuisance reduction in urban spaces.
In addition, looking in the electrification of heat as it uses the same network, may be useful.

Early sharing of charging equipment installation plans (information sharing at the concept, etc.) can speed up the process of deployment of infrastructure, as DSOs can provide technical support to Public Administrations and Municipalities in the search for the most suitable locations. This is especially important in the case of public tendering of charging points. Therefore, providing DSOs with more data concerning charging stations and utilisation factors should help.

Finally, it would be very impactful to simplify authorisation procedures.

Lessons learned by DSOs

As illustrated above, DSOs play a key role in the deployment and integration of EV charging infrastructure in the electricity network. Significant experience in energy management has been gained by connecting thousands of charging points to the power system across Europe. As a conclusion to this report, we would like to share lessons learned by DSOs in this regard.

A very good and coordinated network planning is key to smoothly and cost-efficiently integrate EV charging infrastructure in the electricity network. It is important that the current and future needs of all consumers in the considered areas are well coordinated as this can considerably reduce the overall costs of investment. Additionally, access to reliable forecasts for future electrification of e.g. heavy-duty vehicles and other sectors would allow grid operators to perform their network planning exercise more accurately.

The deployment of smart grids allows DSOs to obtain very granular information about the network they operate. A thorough analysis of this data can help to conduct forecast studies on the future impacts of EV charging infrastructure on the distribution network. The outcomes of these studies are crucial to identify parts of the network where congestions could happen. Once potential congestions are identified, DSOs can start assessing what would be the best solution to solve them either through the implementation of flexibility solutions or via grid reinforcement. DSOs will have to analyse the cost-effectiveness of any flexible solutions. Thus, DSOs can perform forward-looking investments so that the capacity of the distribution network does not become a bottleneck in the deployment of EV charging infrastructure.

Experience shows that it is important to involve DSOs at an early stage of the project so that they can contribute with their expertise and in-depth knowledge on the distribution network. Where possible, customers should introduce their connection request well in advance. DSOs can provide advice on site selection and on solutions to be deployed for connecting the chargers in a cost-effective and timely manner. Therefore, the various stakeholders involved in the project should trust the DSO's expertise. As far as public charging stations are concerned, cooperation with charging point owners and local authorities is key to a successful connection procedure.

Annex: concrete project examples from European DSOs

Approaches developed in ESB Networks:

- Existing infrastructure such as MV/LV Substations have the capability of being uprated substantially, increasing their capacity from 400kVA to 1000kVA by changing the transformer
- Specifically, ESBN have one solution built and Type Tested with three others are at an advanced stage with completion expected by Q2 2021:
- Ester Transformer of 630kVA Capacity but capable of coping with peak loading of up to 900kVA. The small size means it can be retrofitted in many existing packaged substations
- Tap Changing 1MVA Transformers: In this case a solution was required either for very heavy loads or situations where voltage drop due to high loads was expected to be a problem. Use of a Copper/Copper transformer minimised size and heat loss so that the 1000kVA transformer could replace the existing 400kVA unit already incorporated in existing or new Packaged Substations.
- Pole Mounted 300kVA Transformers: ESBN currently have a 200kVA Pole Mounted Transformer which is hung on a single pole, and the goal was to develop a 300kVA transformer which could directly replace the 200kVA on the same pole. This has now been designed and a prototype is being assembled for Type Tests in Q2 2021.
- Sidewalk Transformer: Nearing completion of the design stages is a slim but tall 200kVA transformer which can be placed on the back of the public footpath against a wall and be used to inject power into adjacent cables which may be limited in capacity due to their size. This averts the need to source a new Substation site which can be difficult in an already built-up area.
- In Office and Apartment blocks, provision of a single connection to an EV Aggregator can allow the EV Aggregator to directly manage the charging of the EV's connected within the building so that the EV Charging remains within the capacity level agreed yet allows all EV's to charge to a satisfactory level.

- Project results expected: Upgrading existing capacity in existing infrastructure is very fast (1-2 days) and much less expensive than any alternative as civil and electrical work is avoided – simply replace the existing transformer. This is also feasible because the cable capacity at LV from the Substations is normally greater than the transformer capacity.
- In the case of the Pole Mounted 300~~K~~kVA, the alternative at present would be to use a Ground Mounted Substation wherever a site could be found and then dig back with cabling to where the reinforcement power is required. At less than €10,000 for such a transformer replacement job this compares well with the alternative option, where every 100m of trenching would cost €10,000 euros, the Ground Mounted installation would be over €20,000 and the purchase of a suitable site in a built up area could well be a multiple of these costs.
- For SideWalk Transformers the attraction is the ability to place the transformer on the public path at a spot chosen because it is conveniently located to MV and LV cables. The alternative would again be to find a site elsewhere which could be quite distant and carry out trenching for additional cabling back to where the reinforcement is required.

Example from i-DE:

- Project info: Connecting an EV charging station (capacity of 100 kW) to the low voltage network. In this case, a low voltage line was needed from the nearest network point, which was the most efficient solution considering that no reinforcement of the existing grid was needed.
- Project results: The charging station operator required 2 points for its purpose and the study tried to converge with this requirement. The grid analysis showed that the supply in these conditions was possible. No smart charging solutions were used. It took 16 months to complete the whole project (including the preparation works of the charging point electric receiver). Total cost close to 3.700€

Example from CEZ:

- Project info: Ongoing project in Prague to include EV chargers into the public lighting poles. This is a joint project of the city of Prague with the local DSO. The project targets parts of the grid where the DSO performs routine renewal of the grid regardless of the charging infrastructure. However, the coordinated approach can decrease the investment costs. It also helps the DSO to manage the impact of EV charging infrastructure on the grid and the city of Prague to promote e-mobility in different parts of the city.
- Project results: The project is expected to create AC charging points on up to 3000 poles throughout the city within several years, each will have the possibility to charge at least 2x11 kW (3 phase). Depending on the parking possibilities next to these charging points (but a least one parking spot is available), it can be up to 5,000-6,000 charging points. The project started in 2019 and will last for 6 years. Since costs will be included in the standard renewal of the grid, it is not expensive for DSOs to create new connection points within the lighting pole next to existing distribution grid.

Example from Enedis:

- Project info: Bus depot in Lagny (in Paris area). Project was driven by Parisian Transport Company, RATP, in close cooperation with Enedis for e-mobility guidelines & connection request. Capacity of 15 MW is provided over 2 HV substations, allowing available capacity of 7.5 MW in case of failure/outage of the substation. The bus depot is equipped with 200 charging points, allowing 200 electric buses to be charged the next morning ready for their routes. By optimising the shared capacity within the fleet, the needed connection capacity has been reduced, the works duration was shortened, and it allowed for a decrease of the related costs.

- Project results: Typically, it takes approximately 18 months from planning to the actual grid connection. There was a close partnership from the early stages of the design phase to the commissioning of the installation. An important source of optimisation was the collaboration on the exploitation convention between the DSO and bus operator. The smart charging solutions also allowed for cost reduction.

Example from Enel X:

- Project Info: The first Enel High Power Charging project in Italy is part of the e-Via Flex-e initiative, under EU Connecting Europe Facility program, with the aim to deploy 14 High Power Chargers (HPC) sites in Europe, 8 of which in Italy. The overall objective of the project is to foster Electric Vehicle use across Europe, through High Power Charging infrastructures. The project is focused on the Core Network Corridors (CNC) in Spain, France and Italy, thus facilitating cross-border trips with electric vehicles.

- A typical HPC site is composed of four charging stations with a power of 350 kW and 2 Charging Points, allowing the possibility to charge one vehicle per charging stations at a time. The technical specifications of the connectors which are used in the sites are Combined Charging System for DC and CHAdeMO for DC Charging. In order to reduce the impact to the grid and facilitate the time to market of the charging sites, the grid connection is designed in a scalable way, e.g. starting from 800kW serving customers with a simultaneity factor of 0.6, instead of the nominal 1.4MW (350kWx4). This is particularly useful in the first years of operations, where limited traffic at 350kW peak power is expected. Over time, thanks to the real time monitoring of the infrastructure, as soon as the customers usage density rises, the connection can be further enhanced, up to the nominal full value of 1.4MW. This solution has also a positive impact on the financial performance of the asset, postponing part of the operating cost linked to the full nominal power. The average time from first request to activation can be reduced, also through early involvement of the DSO for the Medium Voltage request aimed to optimize the connection works and, if necessary, grid reinforcement.

- In order to further reduce impact on the grid and speed up time to market of HPC installations, Enel will start deploying in selected locations Battery Energy Storage System (BESS), where an initial simultaneity factor of 0.6 will be met through a blending of grid connection at 600kW and buffering storage at 200kW.

- Project results: To date 3 HPC sites within EVIA FLEX-E project are already active and located in: Peschiera del Garda (VR), Zanica (BG), Biandrate (NO). Other 4 sites are under construction and planned by end of 2021 within this project, with many more to be deployed in the 2021-2025 timeframe. The continuous monitoring of the utilization rate of the stations allows Enel, to align over time the performance of the charging infrastructures to the customers usage and therefore adapting according to the demand, the connection needs, facilitating the time to market of the HPC sites, thus boosting the adoption of EVs into the mass market phase.

Picture of HPC site located in Peschiera del Garda, Italy

Eurelectric pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability

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