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Efficient planning and implementation of public chargers: Lessons learned from European cities

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Introduction

In order to reach their emissions reduction and air quality goals, many cities are working to greatly increase the uptake of electric vehicles (EVs) by their citizens and businesses. One key barrier to achieving widespread electric vehicle adoption is a lack of available charging infrastructure. While most charging for light-duty electric vehicles is done at home and at work in the early stages of the market, the development of a robust public charging network is required as the market matures, particularly in dense urban environments where many drivers lack access to private charging. Local governments have an important role to play in developing public and private electric vehicle charging infrastructure due to their authority over zoning, parking, building codes, and permitting and inspection processes.

This paper investigates best practices for streamlining cities' public charging infrastructure planning and implementation processes to reduce costs, accelerate deployment, and facilitate investment. Based on insights from Amsterdam, London, Oslo, Paris, and Stockholm, this study identifies three approaches cities can take to efficiently building out publicly accessible charging infrastructure and provides recommendations on how to streamline the process.

Background

Planning, installation delays, and easing soft costs are some of the challenges cities face in building charging infrastructure. A 2019 Rocky Mountain Institute study has shown that soft costs, which include the cost of finding the right site, meeting local building codes, and obtaining utility connections, easements, and construction permits, add

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considerable cost to charger deployment projects.[1] Unlike hardware costs, soft costs are unpredictable and more difficult to reduce. According to the aforementioned study, charging installation costs in the United States are three to five times the cost of the charger itself. Even in cities further along in transport electrification such as Oslo, soft costs are still a burden. According to one expert, in Norway's capital, the average price of a public alternating current (AC) regular charger has increased from 60,000 NOK to 110,000 NOK ($6,600 to $12,000 or €5,500 to €10,000) on average in the last three years mainly due to permits, regulation, and public tender processes.[2]

Soft costs also have a time impact, as communication between stakeholders, regulations, and permitting processes often create delays. Figure 1 below displays the time needed to approve and install an AC regular charging station in select cities. The cities cannot be compared directly because London and Paris provided averages (in blue), Oslo and Stockholm provided minimum process length (in green), and Amsterdam provided a range. As shown, in Amsterdam, the whole process takes between 10 weeks and 40 weeks.[3] In cities which are earlier in the process of ramping up their public charging infrastructure and are still figuring out the best way to do so, the process can be much longer.

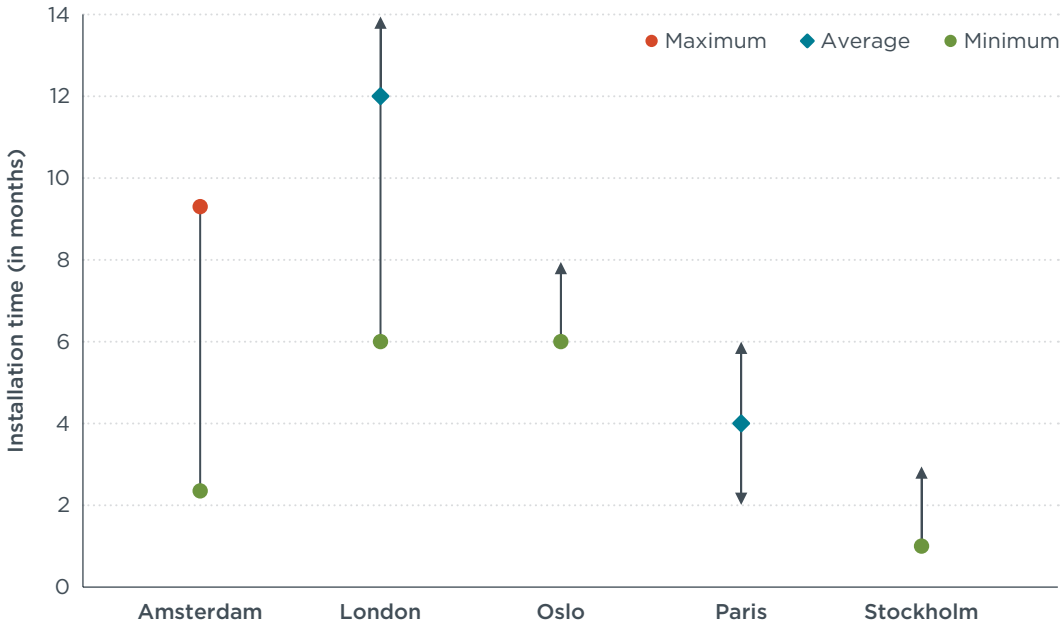

Figure 1. Time needed to install an AC regular charging station in selected cities.

The communication between the many stakeholders involved adds considerable time to the installation process. A non-exhaustive list of stakeholders includes local politicians and residents, local authority departments ranging from city planning to underground utilities to the department of transportation, grid operators, charging station operators, electric vehicle driver and advocacy organizations, and land and business owners. This process is further complicated by differences in the administration of road, land, and electricity systems in each city, so there is no universal blueprint of how to distribute responsibilities.

1 Chris Nedler, Emily Rogers, "Reducing EV Charging Infrastructure Costs," (Rocky Mountain Institute, Basalt CO, 2019), https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/

2 S. Portvik, Personal communication, September 2, 2020.

3 "Een openbare laadpaal in Amsterdam," Vattenfall InCharge, accessed September 4, 2020, https://incharge.vattenfall.nl/openbare-laadpalen/laadpaal-amsterdam/.

Beyond this, many stakeholders possess useful data but do not necessarily make it available, which makes it hard for municipalities, utilities, and operators to plan efficiently. Access to data on grid power availability, land available, and current location and usage of charging infrastructure is often an obstacle for municipality decision-making on charging locations.

These problems are further complicated by the lack of charging infrastructure interoperability, which might deter drivers from switching to an electric vehicle. Beyond different electric vehicles using different charging plugs, particularly for DC fast charging, drivers may need memberships and different payment options for different charging networks.

Insights from selected European cities

This section provides an overview of key charging infrastructure development steps and the lessons learned from five European cities leading the transition to electric vehicles (EVs): Amsterdam, London, Oslo, Paris, and Stockholm. Table 1 below summarizes the approaches chosen by those cities. The three different approaches mentioned in the table—demand-driven, planning-oriented, and business-oriented—are described in subsequent sections. The demand-driven approach crowdsources the task of locating new charging stations based on requests from electric vehicle drivers or other data inputs. For the planning-oriented approach, the government identifies a list of suitable charger locations for which operators can apply. In the business-oriented approach, the deployment of charging stations is mainly left to the private sector, with the governments' main role being to regulate and ease the process.

Table 1. Publicly accessible charging infrastructure development approaches in selected cities.

City	AC regular approach	DC fast approach	Time and cost to install an AC regular charger
Amsterdam	Demand-driven with one operator. The driver requests a charger, the application is reviewed and processed by the operator, and the city gives the formal approval.	Mix of planning- and business-oriented with multiple operators. The city has installed rapid chargers for taxis which are publicly accessible. The development is otherwise left to the market.	Between 10 and 40 weeks.
London	Mix of demand-driven and planning-oriented with multiple operators. Local authorities primarily follow drivers' demand, while TfL supplements using planning-oriented approach.	Mix of planning- and business-oriented with multiple operators. At city-owned locations, TfL conducts upstream work, and private companies operate the stations. Private businesses like parking and fueling station host additional stations.	Between 6 and 12 months and €3,300 for a lamppost charger (3 kW-7 kW). 12 months on average and €8,900 for a free-standing charger (7 kW).
Oslo	Mix of demand-driven and planning-oriented with one operator. The chargers are owned and operated by the city.	Business-oriented. All the stations are operated by private charging station operators.	6 months on average and at least €4,200 per 7 kW charger.
Paris	Planning-oriented with multiple operators. The city selects the charging station operator for given locations.	Mix of planning- and business-oriented with multiple operators. The city requires fueling stations under concession contract to install a DC fast or a natural gas station at the time of contract renewal.	4 months on average and between €8,000 and €10,000.
Stockholm	Planning-oriented with multiple operators. The charging station operator selects the location.	Planning-oriented with multiple operators. The charging station operator selects the location.	At least 1 month (and usually longer) and €4,800 on average without the grid connection cost.

Amsterdam

Demand-driven approach

With about five electric vehicles per charger as of early 2020, the largest city in the Netherlands has already developed a dense public charging infrastructure network focused on slow to fast residential chargers.[4] Amsterdam first provided a basic charging infrastructure network in 2009 to spur electric vehicle uptake and is now relying on a demand-driven approach, triggered by an electric vehicle driver's request for a charging station.[5] This approach is summarized in Figure 4 in the following section. The city pays private operators to install the stations, which are public and owned by the municipality. In addition, the city, in partnership with Amsterdam University, monitors charging station usage and if a particularly high demand for one point is noted, three points will be installed.

In 2016, Amsterdam signed a seven-year contract with the energy utility Nuon and its installation partner Heijmans for the roll-out of the charging infrastructure, with EVBox as the main supplier of charging stations.[6] Since the main bottleneck is usually the communication with public utilities, partnering with Nuon has been highly valuable to reduce installation time. In Amsterdam's model, Nuon and Heijmans review the application made by an electric vehicle driver and develop the installation plan in consultation with the road authority. However, the Amsterdam council road authority decides whether a new location will be installed and gives the formal permission. From the day the driver requests a charger near their home or workplace to the day the charging point is ready to be used, the process takes between 10 and 40 weeks. The two steps (outlined in Figure 4) which can vary significantly in length are the city approval of the installation plan and the site preparation. Amsterdam also leaves six weeks in the process during which residents in the neighborhood can object.

London

Mix of planning-oriented and demand-driven approaches

London's charging infrastructure strategy is shaped by the Electric Vehicle Infrastructure Taskforce, established by the Mayor of London in May 2018. The Taskforce, comprised of representatives from business, energy, infrastructure, and multiple levels of government, published an electric vehicle infrastructure delivery plan which quantified the charging needed by 2025 and advised on how to fill this gap.[7] The many stakeholders are taking additional steps to ease the charging station installation process. For example, Transport for London (TfL) has published electric vehicle charge point installation guidance which includes streetscape design principles, site selection criteria, and an installation checklist.[8] Additionally, the local distribution network operator, UK Power Networks, has published a heat map to identify energy grid constraints and display where charger installations will be cheaper and easier.[9]

In London, the implementation of AC regular chargers is led by 33 local authorities who own the majority of the public highways. The authorities choose the location for

4 Dale Hall and Nic Lutsey, *Charging infrastructure in cities: Metrics for evaluating future needs*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/EV_charging_metrics_aug2020

5 "Een openbare laadpaal in Amsterdam," Vattenfall InCharge;" Neupert, Hannes Neupert, "Mathieu Wijnen on Strictly City-Driven Charging Infrastructure," *electrive.com*, April 3, 2019. https://www.electrive.com/2019/04/03/amsterdam-a-city-driven-ev-charging-infrastructure/.

6 "Charging Electric Cars in Amsterdam," EVBox, accessed September 28, 2020, https://evbox.com/en/success-stories/amsterdam-city.

7 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan" (June 2019), http://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf.

8 Transport for London, "London's electric vehicle charge point installation guidance" (December 2019), http://lruc.content.tfl.gov.uk/london-electric-vehicle-charge-point-installation-guidance-december-2019.pdf

9 "DG Mapping Tool," UK Power Networks, accessed September 29, 2020. https://dgmap.ukpowernetworks.co.uk/site/?q=ev_ext.

a charger in collaboration with UK Power Networks and other underground utilities, taking into account suggestions made by electric vehicle drivers. Local authorities then award the implementation of the chargers to a charging station operator either directly or through a competitive process to obtain the best value. Compared to Amsterdam, where there is only one AC regular charging station provider and operator, there are multiple public and private entities that have delivered, or committed to deliver, chargers in London.[10]

In 2018, TfL established a procurement framework for local authorities to procure charge point operators to supply, install, operate, and maintain shared or dedicated supply charge points up to 22 kWh. Each local authority can choose which service they want the charging station operator to provide and what kind of contract they enter into (service provider or concessionaire). The framework determines the length of the contract, ownership of the infrastructure, and financial arrangement between the local authority and the charge point operator, which may include a revenue share. As an example, one of the major operators works with the local authorities to identify locations for the delivery of charge points and covers all costs of installation, paying a fixed annual fee to the local authority for the land. The local authority provides dedicated parking bays for each charge point as part of the agreement.

A 3 kW–7 kW lamppost charger usually takes 6 to 12 months to install and costs £3,000 ($3,900 or €3,300) on average. A free-standing 7 kW charger takes 9 to 12 months to install and costs £8,000 ($10,500 or €8,900). Charge points delivered through the framework are required to share usage data with TfL, London Councils, and the GLA, who conduct analysis and share the results with the local authorities to understand trends and inform future delivery.

The development of London's rapid (DC fast) charging network is led in part by TfL, which is in charge of finding suitable locations, doing civil works, and managing the grid connection. These works cost an average of £50,000 ($65,600 or €55,600) per site and are funded by the central government. TfL enters a concessionaire contract with rapid charge point operators who operate and maintain it for a period of eight years, paying TfL or the relevant local authority a fixed annual site fee and percentage of revenue share. Approximately half of all rapid charge points in London have been delivered in this way, with the remaining half delivered by the private sector, mainly on private land. TfL is in discussion with operators and other stakeholders to create new ownership models and shift more responsibilities to the private sector.

Oslo

Mix of planning-oriented and demand-driven approaches

With 64% of new vehicle sales being electric in Oslo in 2019, Norway's capital is a global leader in electric vehicle adoption.[11] While the Norwegian government made battery electric vehicles affordable to buy through extensive tax benefits, Oslo has focused on making them both affordable and convenient to use. Norway's capital was one of the first cities in the world to develop on-street chargers in 2008, which helped to spur electric vehicle uptake as visibility contributes to public attitudes on electric vehicles.

The "Lad i Oslo" (Charge in Oslo) EV charging deployment program, part of the Agency for Urban Environment of Oslo City Council, identifies possible locations based on EV drivers' suggestions and where gaps in charging infrastructure are apparent. The agency's civil works and electrical contractors are responsible for installing the chargers,

10 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan."

11 Dale Hall, Hongyang Cui, Marie Rajon Bernard, Shuyang Li, and Nic Lutsey, *Electric vehicle capitals: Cities aim for all-electric mobility,* (ICCT: Washington, DC, 2020), https://theicct.org/publications/electric-vehicle-capitals-update-sept2020

which are also operated by the agency. To make the installation review process more efficient, the "Lad i Oslo" program developed a checklist to ensure the agency has the information needed to be able to approve or reject the construction. A paraphrased version of the checklist is provided in Figure 2. Although typical cost information was not available, a charging station installed in 2020 composed of 12 AC 7kW chargers is expected to cost approximately 560,000 NOK ($60,000 or €51,100), or about $5,000 (€4,200) per charger, with soft costs accounting for about half of the total cost.[12]

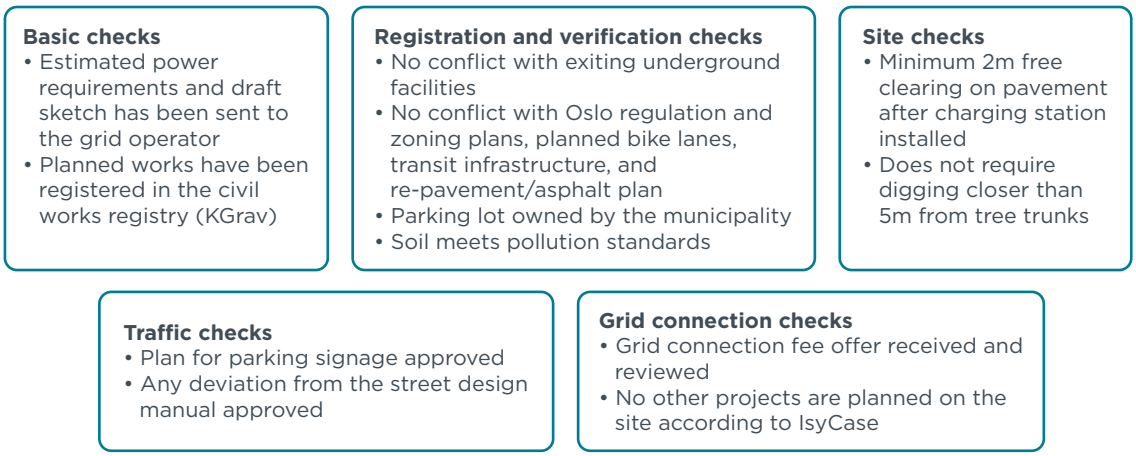

Figure 2. Overview of the checklist of information needed for a project to be assessed in Oslo.

Paris

Planning-oriented approach

Paris has adopted a city-led planning-oriented business model for the development of their public AC regular charging network. The city is responsible for finding the right location for the charging station and then outsourcing the implementation of the charging point to an operator. In order to spur electric vehicle uptake in the entire city, Paris has opted to select charging station locations based on providing even coverage across the city as opposed to driver demand. The city leads the initial discussions with the grid operator (Enedis), the underground utilities, and the historic preservation architects to find a suitable location. Once the location is found, the chosen charging station operator is responsible for all communications with the different stakeholders. This includes asking the urban planning and the mobility teams for a civil work authorization, requesting a grid connection and commissioning, and coordinating with the Controls office for the final inspection. The city holds weekly meetings with the operator during the whole process to discuss issues that may emerge.

As utility companies' response time tends to lengthen the process, Paris requires the electric connection to be independent from the charger to allow for easy maintenance or change of the charger without modifying the grid connection. The whole process takes approximately 4 months, and the total cost of installing an AC regular charger ranges between €8,000 and €10,000 ($9,300 – $11,700), two-thirds being installation costs. Concerning the implementation of a DC fast charging network, like many other cities, Paris has decided to concentrate on off-street locations such as fueling stations. For fueling stations under a concession contract, Paris mandates that stations install either a DC fast charging station or a natural gas station at the time of renewal.

12 M. Mølmen, Personal communication, September 21, 2020.

Stockholm

Planning-oriented approach

Stockholm has adopted a novel business model for charger installation. Private companies apply for one or more pre-selected locations displayed on a publicly available map,[13] install charging points at their own expense, and cover service and maintenance costs. In exchange, the operators are granted free access right agreements for the charging point. This solution provides benefits for both parties and avoids imposing a financial burden on local authorities.[14] The City of Stockholm is responsible for signage, sweeping, snow removal, and parking monitoring. Stockholm provides a detailed guide on how to establish a new charging point for electric cars, which is summarized in Figure 3 below.[15]

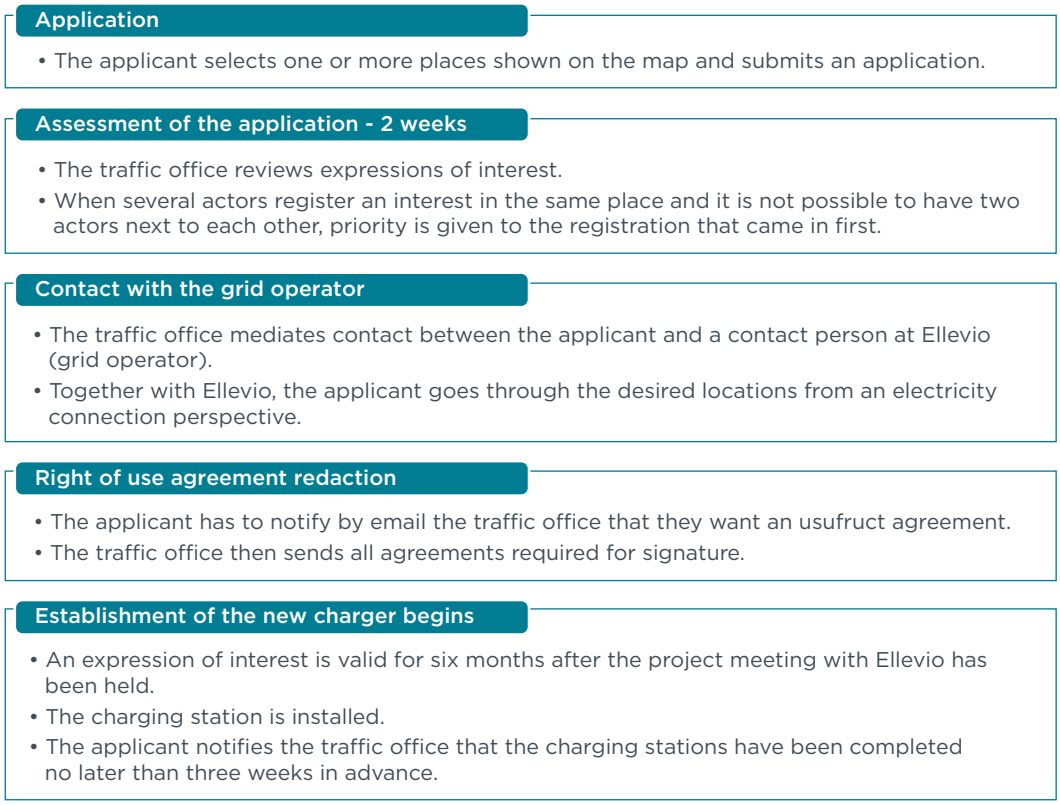

Figure 3. Stockholm public charging (AC regular and DC fast) station implementation process.

Once the charger is installed, the charging station operator is required to provide data on how the charging stations are used quarterly or semi-annually to the environmental administration. The total cost of installation of an AC regular charging station including design and project management is about 50,000 SEK ($5,600 or €4,800), not including the grid connection, which can vary substantially depending on the available capacity at the location. Timewise, the whole process takes at least one month and usually longer.

13 "Ansök Om Att Etablera Nya Laddplatser För Elbil," Stockholms Stad, accessed September 4, 2020, https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/.

14 Zachary Shahan, "Electric Vehicle Charging Infrastructure Guidelines for Cities", *CleanTechnica*, December 31, 2018, https://cleantechnica.com/2018/12/31/electric-vehicle-charging-infrastructure-guidelines-for-cities-cleantechnica-report/

15 "Anmäl Intresse För Att Sätta Upp Nya Laddare," Stockholms Stad, accessed September 4, 2020, https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/anmal-intresse-for-att-satta-upp-nya-laddare/#step-1.

Lessons learned

Selecting a charging station deployment process

The processes put in place by cities with relatively early vehicle adoption can be categorized into two public charging infrastructure development approaches: demand-driven and planning-oriented. Both approaches have pros and cons, and cities may choose some elements of both to suit the local context and the municipality's objectives. Cities could, for instance, adopt a demand-driven approach, but also use a planning-oriented approach to implement chargers in specific areas where uptake of electric vehicles is lagging or to plan for future demand. An additional approach primarily for fast charging is to encourage private companies to install the stations off-street on private land or publicly-owned but privately-operated land under concession contracts such as publicly accessible car parks and fueling stations. These approaches are discussed in detail below.

Demand-driven approach. A demand-driven approach, exemplified by Amsterdam, utilizes requests made by electric vehicle drivers to determine where charging should be installed. This approach is particularly suited for the first phases of infrastructure roll-out and immature EV markets as it ensures a minimum utilization by local EV users and helps in assessing demand location. Indeed, one main benefit of this approach is the guarantee of a minimum usage for the charger which can reassure private investors. However, a major pitfall of solely adopting this approach is that the network does not ensure coverage in areas where electric vehicle uptake is low.

In order to facilitate this approach, a heatmap of electricity grid constraints and a map developed by city planning or transportation departments displaying the suitable areas for charging stations are valuable. Those two maps can save considerable time in identifying the closest suitable location in response to a request for charging installation.

Figure 4 outlines the key charging station implementation steps for this approach. In the case of Amsterdam, from the day the driver requests a charger near their home or workplace to the day the charging point is ready to be used, it takes between 10 and 40 weeks. This timeframe could be reduced depending on the objection period length chosen or required by law.

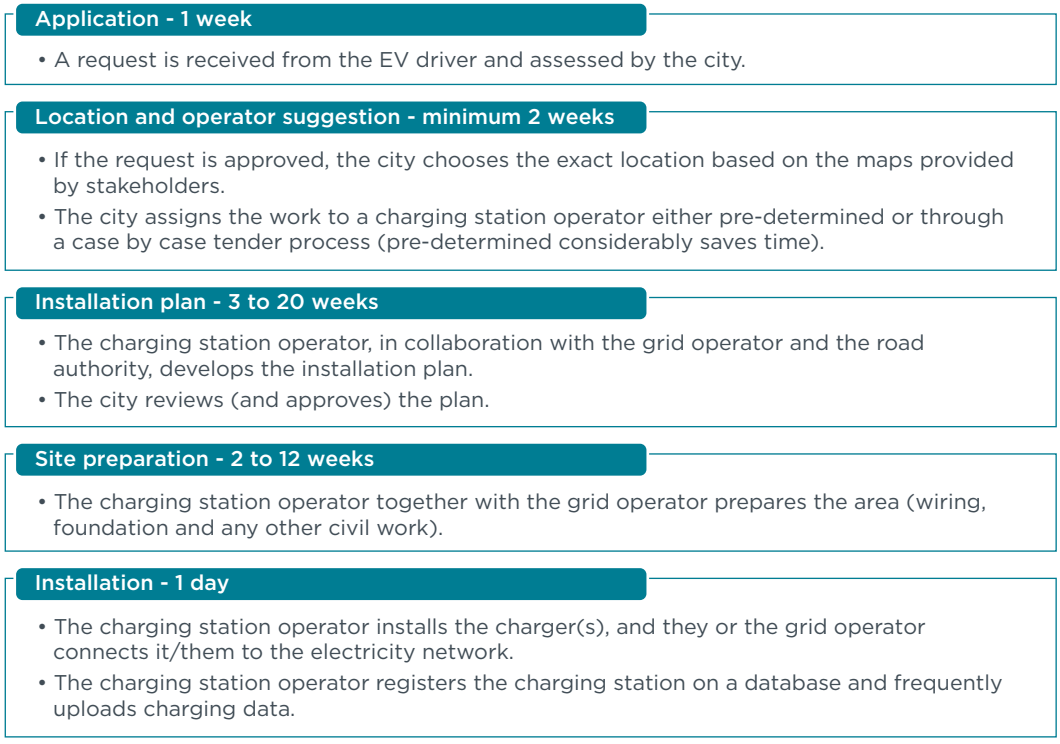

Figure 4. Key charging station implementation steps for the demand-driven approach.

In addition to soliciting requests from private electric passenger car owners for charging stations, cities should also engage with taxis, ride hailing, and car sharing companies. This could include encouraging the drivers to submit applications for residential chargers as well as incorporating trip data into analysis of the optimal charging locations. It is also important for cities to engage with the community during the process and not solely focus on EV drivers' demands. Community engagement serves multiple goals: to address a community's concerns about public space allocation, equitable access, changing traffic patterns, and potential property value or gentrification impacts, as well as to generally increase understanding and enthusiasm about electric vehicles across different communities.

Planning-oriented approach. In the planning-oriented approach, as exemplified by Stockholm, installation of a charging station is initiated by a charging station operator or local authority applying for a location offered by the city. This approach saves time and money by eliminating the back and forth between different stakeholders to make sure that the location is well suited for a charging station. It can also potentially encourage new uptake and planning instead of responding to existing demand. However, it requires a close upstream collaboration between city planning agencies, transportation agencies, and the grid operator, as well as modelling to forecast future demand. This collaboration is crucial to allow the city to identify suitable locations for new chargers and/or contact charging station operators with pre-selected locations.

Although this approach may save time for the implementation itself, it can require more time and resources upfront and may lead to underutilized assets. Indeed, the city needs to perform a thorough analysis of future vehicle uptake, housing type, and grid capacity to identify the most appropriate sites and avoid guiding charging to less-than-ideal locations where they may be underutilized or face greater upfront cost.[16] Recommendations on upstream collaboration are provided in the following section.

This approach works for publicly owned land but could also be applied to privately owned land if private landowners request to be considered for charging location sites. For example, retail stores, publicly accessible car parks, and fueling stations could be interested in installing either AC regular or DC fast publicly accessible chargers on their parking lots. Cities wishing to pursue this approach should engage with private landowners to determine if they would like to be listed as a suggested charging location. Figure 5 outlines the steps that a private business or a local authority should follow to implement a charging station. An estimated timeline is provided based on experiences from Stockholm and Amsterdam.

16 Dale Hall and Nic Lutsey, *Electric vehicle charging guide for cities*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/city-EV-charging-guide

Upstream collaboration and location identification

- The city identifies all the potential charging station locations by collaborating with all public agencies, grid operator(s), city planners, EV drivers groups, shared mobility companies, private landowners, and residents.
- The city publishes a map displaying all the potential locations and their estimated cost of connecting to the grid.

Location and operator selection - 2 weeks

- The charging station operator chooses a location and sends an application to the city.

OR

- The city contacts a charging station operator to install a chaging station at a given location or starts a tender process.

Site preparation - 2 to 12 weeks

- The charging station operator contacts the grid operator (the point of contact is given once the application has been accepted) and together they prepare the area (wiring, foundation, and any other civil work). The charging station operator is reponsible for all the civil works.

Installation - 1 day

- The charging station operator installs the charger(s), and they or the grid operator connects it to the electricity network.
- The charging station operator registers the charging station on a database and frequently uploads charging data.

Figure 5. Key charging station implementation steps for the planning-oriented approach.

This approach works for both AC regular and DC fast chargers and especially makes sense when EV adoption rates are high and for installing chargers at common public destinations such as retail stores. For DC fast chargers, an off-street location is recommended due to competing demands for public street and sidewalk space in cities, such as bus and cycle lanes, loading zones, and dining facilities. In addition, the large DC fast chargers can engender concerns from residents and accessibility groups about sidewalk obstruction. Additionally, DC fast chargers allow more flexibility in terms of location since they are used for shorter periods of time compared to AC regular chargers. It is thus often better for cities to locate them in off-street, highly visited settings like fueling stations, retail stores, or publicly accessible car parks. In order to incentivize the private sector to install charging stations on public land, cities could provide free off-street land access in exchange for charging station deployment—similar to Stockholm's approach.

Off-street business-oriented approach. In this case, the placement of chargers is mainly left to the market and responsibility for installation is shifted to the private sector. This option is usually chosen for the installation of DC fast hubs since those chargers offer a better business case due to more electricity sold and higher turnover, and eases pressure on the public space. In this approach, the main role of the municipality is to grant an installation permit if needed. In order to aid the process, the city can provide guidance on how to navigate the permit process. While cities have less leverage with this approach, they can incentivize the deployment of charging stations on private or privately-operated land through different mechanisms. For example, Paris grants concession contracts to fueling stations on public land and in order to renew the contract, those fueling station operators are required to install either a DC fast charging station or a natural gas station. Municipalities could also finance part of the installation of charging stations on private land. Some national funding—such as the €200 million provided by the German government for rapid charging infrastructure development—may also be available; cities have a role in communicating and helping residents and

businesses to participate in those national schemes. Local governments can also petition national governments to create such schemes.

The demand-driven and planning-oriented approaches are the two main strategies adopted by the leading European electric vehicle cities profiled above. Both have advantages (in green) and limitations (in red) presented in Table 2 below. One approach is not always favorable compared to the other due to the local context, the development of the electric vehicle market, and the local authority's goals. An ideal strategy would be to utilize a combination of both approaches to take advantage of their respective benefits. Cities could, for instance adopt a city-wide, demand-driven model and implement a planning-oriented approach at points of interest and in areas with lower electric vehicle uptake to ensure equitable infrastructure access.

Table 2. Demand-driven and planning-oriented approaches pros, cons, and key attributes.

Topic	Demand-driven approach	Planning-oriented approach
General	Well suited for the first phases of infrastructure roll-out to guarantee a minimum utilization in early markets.	Well suited for mature markets, chargers at points of interest, and to ensure equitable infrastructure access.
Location	Well suited for public residential and public workplace chargers.	Well suited for public destination chargers and works with any type of charger and location.
Type of charger	More suited for public on-street AC regular chargers.	Works for DC fast and AC regular chargers, on- and off-street, at public and private locations.
Time	Less time dedicated to an upfront analysis to forecast the location of future demand. Finding the right location close to the EV driver's request can be time consuming.	Takes more time and resources upfront for the city to do a thorough analysis to efficiently place charging stations. The installation process itself is time efficient.
Utilization	Guarantees minimum charging station usage which could reassure private investors. Usually serves fewer users for more time (more long residential charging sessions).[a]	Minimum charging usage is not guaranteed which could drive away private investments. Usually serves more users for less time (higher turnover rate).[a]
Operators' partnerships	Works best when a city partners upfront with a single charging station operator, or clearly identifies who is responsible for installing a charger for a given location and application.[b]	Works well with a variety of charging station operators.

[a] Robert van den Hoed, et al., "E-mobility: getting smart with data," (Amsterdam: Hogeschool van Amsterdam, 2019), https://www.hbo-kennisbank.nl/details/amsterdam_pure:oai:pure.hva.nl:publications%2F716c8c58-8cb2-41ed-bea6-abb0ff9001fb.

[b] There can be multiple charging station operators operating in the city, with each one being responsible for a given area and/or charger type.

Best practices for creating a streamlined charging strategy

In addition to implementing one or a combination of the approaches previously outlined, cities' charging infrastructure deployment process can be improved by incorporating best practices from the leading capitals profiled above.

Develop partnerships with stakeholders. One of the first things cities can do when creating a new charging strategy is set up a coalition of stakeholders to align electrification efforts, solidify commitments, and avoid miscommunication. A non-exhaustive list of stakeholders includes relevant public agencies, local politicians and residents, and private sector stakeholders such as grid operators, charging station operators, electric vehicle driver groups, landowners and business owners, and shared mobility operators. The Mayor of London took this approach in 2018 when it created the EV Infrastructure Taskforce. This coalition aimed to establish long-term business models, a charging station installation roadmap,[17] a permitting and inspection checklist, and an installation guideline for applicants. The taskforce also published an EV Infrastructure Delivery Plan which provides recommendations at the Greater London level regarding charging infrastructure deployment and partnerships.[18]

17 Dale Hall and Nic Lutsey, *Electric vehicle charging guide for cities*.

18 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan."

Specific guidance for working with key individual stakeholders is presented in Table 3 below.

Table 3. Guidance for working with key stakeholders.

Stakeholder	Primary contribution(s)	Best practices for city engagement
Grid operator	• Provide a heatmap to identify energy grid constraints and locations with suitable charging capacity and easy grid connection. This map should be dynamic, searchable, and regularly updated. This map can also show where upgrading will be done due to other projects in the area.[a] • Provide a guide on how to fill out a request for grid connection.	• Contact grid operator(s) early in the process to ask for the heatmap mentioned on the left. • Identify one point of contact or an "EV-expert" team to deal with stakeholders' questions and requests for grid upgrade and connection.
City agencies (city planning, transportation, engineering, public works)	• Provide a map of pre-selected areas where charging station deployment would be immediately approved. These include locations with no or limited accessibility issues, other projects underway, conflicts with underground utilities, or conflicts with city goals such as historic district preservation.[b]	• Engage with all public agencies that own land on which publicly accessible charging stations could be implemented (e.g., housing, parks, schools, transit, healthcare).
Private landowners and businesses (retail stores, publicly accessible car parks, fueling stations)	• Request to display their land on the map showing suitable charging station locations if they are interested in installing either AC regular or DC fast publicly-accessible chargers on their property.	• Match private landowners with operators if the planning-oriented approach is chosen. • Establish a list of information required for a private landowner to be matched with a charging station operator. This list would include the number, type, and exact location of chargers, and business model desired.
Charging station operators	• Provide information on charging stations type, location, and utilization data. • Ensure interoperability of their charging stations and ability to pay with any means of payment.	• Require that charging station operators provide access to data in order to inform their decision-making process. This could be done in exchange for the right to operate, especially if the station is located on public land. • Require interoperability of the charging stations and the ability to pay with any means of payment.
Taxi, ride-hailing, and car sharing companies	• Provide information on fleet electrification rate, pick up and drop offs locations, drivers' residence location and home charging accessibility. • Potentially provide funding to ensure drivers' access to charging infrastructure.	• Engage with companies to discuss charging stations locations and fleet electrification goals.
Public	• Join EV driver associations to voice your opinion, needs, and concerns. • Engage with city regarding proposed charging station installations. • Suggest a charging station location.	• Engage with the community to hear their concerns and answer their questions. • Adopt a demand-driven approach or allow electric vehicle drivers to suggest a charging station location to know where to install charging stations. • Clearly communicate on EV-related programs and raise public awareness.
Other levels of government (national, regional, metropolitan)	• Coordinate to ensure a cohesive regional network. • Provide funding.	• Engage with them to discuss policies and financial incentives, and ensure interoperability of the network.

[a] An example can be found at "DG Map | DG Mapping Tool." Accessed September 29, 2020. https://dgmap.ukpowernetworks.co.uk/site/?q=ev_ext.

[b] An example can be found at "Ansök Om Att Etablera Nya Laddplatser För Elbil - Stockholms Stad." Accessed September 4, 2020. https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/.

Develop a clear guide displaying all the steps and costs to install a charger and identify a few key persons in charge of communication. Another obstacle commonly faced by charging station installers and operators which can deter them from applying is the lengthy and often unclear permit application process and requirements specific to each city. One of the main complaints from charging point operators is the lack of guidance in the requirements for obtaining a construction permit and the slow process of approval.[19] A clear guide outlining the permit application process and requirements for each charging station type and business model will help both the applicant and the review team save time and money and lead to fewer rejected permits. This guide could take the form of a workflow outlining all the different steps, their associated requirements, the stakeholders involved, and an estimated timeline for installation. This guide could also inform applicants of potential costs and funding options. This information was included in London's electric vehicle charging station installation guide, which lists the capital costs and public funding available for different type of public chargers.[20]

Finally, clearly identifying one or a few key persons who can be reached when stakeholders have questions about the application and installation process is useful to reduce delays and increase clarity. Cities could also develop an informational platform, such as the Netherlands Knowledge Platform for Charging Infrastructure, in order to inform and motivate stakeholders.[21]

Consider different strategies or offer different locations for public AC regular and DC fast charging networks. Because the cost, impact on the grid, optimal locations, and other aspects differ between those two types of charging stations, many cities have different strategies for the deployment of the two charging types. While Amsterdam adopted a demand-driven approach for the development of its AC regular public charging network, Amsterdam council mainly leaves the extension of the DC fast network to the market and advises on installation on private premises or at locations such as fuel stations to ease the pressure on the public space. Many cities, such as London and Paris, are transitioning to this off-street, private-led approach for the development of a DC fast chargers' network. London's Electric Vehicle Infrastructure Taskforce suggests that the best way to deploy rapid chargers is to focus on the development of hubs in easily accessible off-street locations and to engage as much as possible with the private sector. For the deployment of AC regular chargers, cities could rely primarily on a demand-driven model or allow EV drivers to suggest a charger's location in order to improve usage and enable private sector delivery.[22] This demand-driven approach would be undertaken along with targeted other programs for overlooked applications in order to ensure equal infrastructure access.

Implement regulations on building codes and charging standards. To reduce future charging infrastructure costs, cities can implement regulations which require that all new parking and buildings are able to accommodate charging stations.[23] This addresses the main bottleneck and one of the largest cost drivers: the connection to the grid. For example, European regulations mandate that new and renovated

19 Chris Nedler, Emily Rogers, *Reducing EV Charging Infrastructure Costs*, (Rocky Mountain Institute, Basalt CO, 2019), https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/

20 Transport for London, "London's electric vehicle charge point installation guidance."

21 The Netherland Knowledge Platform for Charging Infrastructure, Accessed October 23, 2020. https://www.nklnederland.com/.

22 The Mayor's Electric Vehicle Infrastructure Taskforce, "London Electric Vehicle Infrastructure Delivery Plan;" Robert van den Hoed, Simone Maase, Jurjen Helmus, Rick Wolbertus, Youssef el Bouhassani, Jan Dam, Milan Tamis, and Bronia Jablonska, "E-mobility: getting smart with data," (Hogeschool van Amsterdam, 2019), https://www.hbo-kennisbank.nl/details/amsterdam_pure:oai:pure.hva.nl:publications%2F716c8c58-8cb2-41ed-bea6-abb0ff9001fb

23 Dale Hall and Nic Lutsey, *Electric vehicle charging guide for cities*.

residential buildings be equipped with the appropriate pre-wiring to facilitate the installation of charging points.[24]

Cities could also require station operators to install interoperable standardized charging stations to allow all electric vehicle drivers to charge at any public charging station with any means of payment. Interoperability also makes the transition to the next operator at the end of the tender more convenient, if required.

Conclusions

This working paper gathered insights from selected European cities on how to streamline the charging infrastructure planning and implementation process. It is aimed at helping cities overcome the challenges faced in order to accelerate charging station deployment, reduce costs, and facilitate investment. The ideal approach depends on the state of the market, the local context, and the municipalities goals.

A demand-driven approach, exemplified by Amsterdam, is aimed at matching the demand for charging stations from EV drivers with the supply of public on-street residential and workplace chargers. It is well-suited for the development of on-street residential AC regular chargers in immature markets as it guarantees a minimum charger utilization rate and helps to assess demand. In a planning-oriented approach, as seen in Stockholm's case, installation is usually initiated by a charging station operator or local authority expressing interest in installing a charging station. This approach works well for both on-street and off-street locations and for DC fast and AC regular chargers' implementation. It requires close upstream collaboration with city planners, grid operators, EV driver associations, residents, and private landowners to identify optimal charger locations.

A combination of these approaches could be used. For examples, a demand-driven approach for on-street residential and public workplace charging in early infrastructure roll out phases, accompanied by a planning approach for destination charging and in areas with lower electric vehicle uptake, could guarantee a baseline utilization and equitable infrastructure access.

Figure 6 below summarizes the key actions that cities can take to facilitate the public charger implementation process. This Figure also suggests new actions such as the implementation of regulations which could be addressed in future work.

24 Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance), Pub. L. No. 32018L0844, OJ L 156 (2018). http://data.europa.eu/eli/dir/2018/844/oj/eng.

Bring together all the different stakeholders

- Convene an EV infrastructure stakeholder coalition including all public agencies owning land, city officials, city planners, grid operators, charging station operators, local residents, EV drivers groups, land/business-owners, department of transportation/road authority, and shared mobility operators.
- Engage with the community (and not focus only on EV drivers' demands) to hear their concerns and answer their questions.

Define specific roles for stakeholders

- Develop partnerships with grid operator(s), city planners, and charging station operators. Those partnerships could result in an energy heatmap, a map of pre-selected charger friendly areas, and access to charging data.

Select a charging implementation strategy

- Based on a city's needs and resources, the city can choose and adapt the strategies that are best suited for its goals and ways of functionning. Two main strategies are a demand-driven approach and a planning-oriented approach.

Make clear guidelines readily available

- In collaboration with all the stakeholders, develop a clear guide/checklist displaying all the steps and costs to install both an AC regular and a DC Fast charger or hub and giving an overview of the different business models possible. This guide should especially outline the permit application process and requirements. Include the contact information of an 'EV-expert' able to quickly answer or redirect questions.
- Refine this guide at pre-defined intervals based on learnings and evolving market conditions.

Implement regulations

- Implement regulations to make sure new constructions are EV ready and ensure interoperability of charging stations.

Figure 6. Key upstream actions to facilitate the public charger implementation process.