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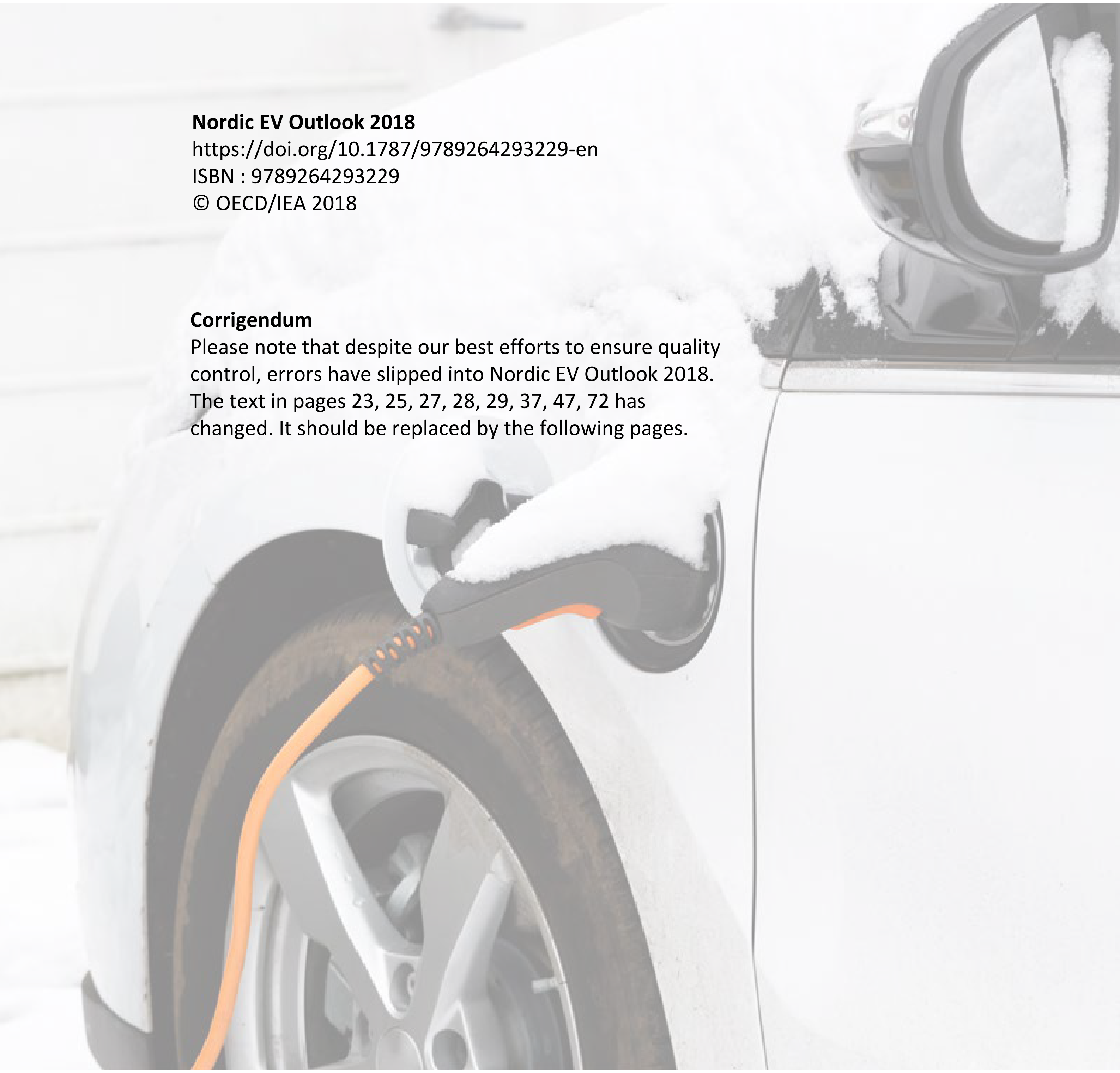

Nordic EV Outlook 2018
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Corrigendum

Please note that despite our best efforts to ensure quality control, errors have slipped into Nordic EV Outlook 2018. The text in pages 23, 25, 27, 28, 29, 37, 47, 72 has changed. It should be replaced by the following pages.

Nordic EV Outlook 2018

Insights from leaders in electric mobility

market structure summarised in Figure 2.2 highlights the influence of policy measures: BEVs tend to have a bigger market share where their purchase price is lower than that of PHEVs (Denmark and Norway) and vice-versa (Finland, Iceland and Sweden). Table 2.3 provides more detail of the determinants of electric vehicle powertrain choices.

Table 2.3 • Influence of vehicle purchase taxes on the electric vehicle market structure

Country	Relationship between vehicle purchase taxes and electric car market structure
Denmark	The partial derogation of the registration tax is only granted to BEVs. Moreover, the differentiation of the registration tax deduction based on fuel consumption rating leads to greater incentives for BEVs than for PHEVs. High registration taxes on large vehicles (registration tax above a certain purchase price are much higher, and small vehicles are typically priced well below large models) also focus the Danish BEV market on the small model segment, which includes the top sold BEV model.
Finland	Despite registration tax rebates that depend on the gCO_2/km rating, the difference between the registration tax of BEVs and PHEVs is lower than the import value gap. In addition, zero emission vehicles are also subject to limited incremental rebates compared with low-emission cars (under 50 gCO_2/km). This makes the VW Golf PHEV model purchase price lower than for the BEV version.
Iceland	Registration taxes are flat regardless of CO_2 emission levels up to the threshold of 80 gCO_2/km. This does not provide an advantage for BEVs over PHEVs. Consumer preference is also oriented towards large vehicles with off-road capacity, more frequently available as PHEVs.
Norway	The exemption from VAT and registration taxes is only granted to BEVs. This is a key determinant for the lower purchase price of BEV models versus PHEVs. Yet, PHEVs are fairly popular in households with one car or taking frequent trips exceeding 100 km. In January 2017, the incentives for PHEVs were increased. In particular, the deduction on the total weight to be used for the determination of the taxation rate increased from 15% in 2015 to 26% in 2017. For large PHEVs this change leads to registration tax cuts of NOK 16 000-80 000 (USD 1 900-9 500) compared with similar ICE cars.
Sweden	In 2016 the “super green” car rebate was modified to favour BEVs compared with PHEVs, bringing the purchase price of BEV and PHEV cars with similar attributes to about the same values. The relative BEV or PHEV share in Sweden’s electric car market was not affected by the measure. A factor that explains the resilience of this distribution is the tax relief for company cars (Box 2.1), coupled with popular consumer preferences towards large PHEVs. With the new bonus-malus system coming into play in 2018, the further difference between incentives for BEVs and PHEVs might change the mix, leading to higher BEV shares.

Sources: ACEA (2015); ACEA (2017c, 2017d); Insero (2017); Government of Norway (2017a); and Danish Ecological Council (2015).

Key point: **Consumer choice in vehicle purchases is influenced by policy measures that impact the upfront price including taxes and registration fees.**

Figure 2.6 shows the relationship between the total purchase price incentive and the purchase price gap for mid-size ICE, BEV and PHEV cars (using Volkswagen Golf models as a benchmark) and the market share of BEVs and PHEVs in each Nordic country. For all the Nordic countries

implies that the TCO of a BMW i3 (BEV) is 5-11% lower than a Volvo V40 (diesel and gasoline version) and a Toyota Prius (HEV), even though the upfront costs are 24-41% higher for the BEV. Norway is involved in an EU project, I-CVUE, to provide a transparent tool on TCO calculations for policy makers and fleet operators (Hoy and Weken, 2017).

lowest in the region. This is largely attributable to Denmark's changes in vehicle registration taxes for both ICE and electric cars (see Table 2.2 for details). In particular, the partial removal of the exemption from the vehicle registration tax for electric cars and the contextual reduction in the vehicle registration tax (applicable to all cars, including ICEs) in 2016, led to a reversal of the cost competiveness of electric vehicles in the upper market segment (Figure 2.7). Since this segment accounted for nearly two-thirds of the 2015 electric car sales, Danish electric car sales fell very significantly in 2016 (Danish EV Alliance, 2017). The corrective measure freezing the increase in registration taxes for electric cars adopted in April 2017 and the new registration tax scheme enforced in October 2017 continued to provide mixed signals, undermining consumer confidence and limiting opportunities for a rebound.

Box 2.1 • Taxation on company cars: Focus on Sweden

In most countries, the benefit represented by the private use of company cars is subject to income taxes. The amount is typically calculated as a percentage of the purchase value of the car, including vehicle registration taxes and operational costs (personal travel only), also accounting for depreciation.

In Sweden, where cars are not subject to registration taxes, the application of this approach would favour ICE over electric cars, given their comparatively lower purchase price. The Swedish legislation allows reducing the value of the benefit represented by the private use of company cars if they are electric*, and therefore reduces the amount of income taxes that needs to be paid on it. Thanks to this, the monthly cost of leasing an electric car is lower than that of an equivalent ICE for the employee, even if the car is still more expensive for the company (Wikström, 2018).

In Sweden, this measure, combined with complementary activities to stimulate response from corporate social responsibility programmes, proved to be effective in stimulating the adoption ofelectric cars. In November 2017, company cars accounted for approximately 70% of the new electric car sales (Wikström, 2018).

*The reduction of the value of the benefits was capped at EUR 1 700 (USD 1 900) in 2012-16 and at EUR 950 (USD 1 070) in 2017 (Wikström, 2018).

Taxes on circulation and use

This section broadens the perspective on policies supporting electric mobility in the Nordic region. It focuses on circulation taxes.

Circulation taxes in most Nordic countries tend to promote vehicles with good environmental performance and vehicles in the smaller car market segments thanks to differentiated rates based on key environmental indicators (Table 2.4). Their influence on consumer decisions is mitigated by the tendency for consumers to give greater relevance to near-term expenditures, and by the fact that the absolute amounts of circulation taxes tend to be low if compared to registration taxes. These factors make purchase incentives a more important driver of consumer choice.

- Electric cars can be parked for free for up to two hours in the city centre of Reykjavik and Akureyri in Iceland (Bilastaedasjodur, 2017).
- The Danish government issued a rule exempting electric cars from parking fees for up to DKK 5 000 (USD 760) per year (Flader, 2017). In practice, this means that other than in Copenhagen, electric car owners rarely pay for public parking.[11]

Waivers on access to bus lanes

In Norway, electric cars are granted free access to bus lanes, but several bus corridors are experiencing regular congestion during rush hour.[12] The municipality of Oslo tackled this issue in 2017 by granting access to the bus lane on two specific corridors during rush hours only to electric cars with two or more persons on board.[13]

Reduced charges on the use of transport infrastructure

Road use charges are in place both in Norway and Sweden (where both Gothenburg and Stockholm apply congestion charges). In Norway, electric cars enjoy exemptions.

In Norway, electric cars are exempt from paying for the use of regional toll roads. This measure added up to NOK 7 500 (USD 900) in 2016 (Figenbaum and Kolbenstvedt 2016).[14] From 2019, electric cars will have to pay the tolls, but at a lower fee. Since 2009, electric cars have been granted free access on most ferries that connect parts of the national road network. On ferry crossings that are not part of the national road network, local governments decide the fees.

Box 2.2 • Strong electric car uptake induced by local measures: Examples from Norway

Local incentives are in force simultaneously with national measures. As a result, it is not easy to separate to what extent each incentive influences the uptake of electric cars. However, the variation in the shares of electric car adoption in specific areas is indicative of the impact of local incentives. Given the wider extent of local incentives and the robust electric car market uptake, Norway provides the best examples in this respect.

The geographic variation in electric car uptake appears to be strongly linked to two particularly important aspects of the local road network: whether there are ferry crossings, toll roads or cordon toll rings in operation along main commuting routes, and whether there is pronounced congestion that BEVs may avoid by using a bus lane.

The highest share of BEV cars in the stock of any Norwegian municipality, with more than 21% of the fleet as of December 2017, is found in the sparsely populated archipelago of Finnøy, northeast of

[11] The exemption is payed for by municipalities and is optional. Not all municipalities use the rule.

[12] Regulations fall under the national regulation on traffic signs, which since 2005 allows electric cars in bus lanes, unless indicated by the municipality (local roads) or Norway's Public Roads Administration (national roads) (Figenbaum, 2018).

[13] While implementing this type of local policy, it is important to avoid a modal shift from public buses to cars. In the case of Norway, the access to bus lanes for electric cars has not reduced the modal share of buses, but instead bus utilisation is at its highest ever level. The main reason is that public transport is less expensive than cars.

[14] In the third quarter of 2017, the price of toll roads in Norway was differentiated for ICE gasoline and ICE diesel cars: during peak hours, the price for diesel ICE cars doubled, while price for gasoline ICEs was slightly decreased.

Stavanger. The costs savings from the NOK 150 (USD 18) toll levied in each direction on the undersea tunnel connecting the archipelago to the mainland are likely a strong driver. Thanks to a 40% discount available to users paying a NOK 4 800 (USD 580) advance deposit, commuters using electric cars may avoid an annual toll expenditure on the order of NOK 37 000 (USD 4 500) (Fridstrøm, 2017a). The electric car stock share is also above the national average in the city of Oslo and in the surrounding municipalities: at end-2017, the BEV car share in this area was 9-12%, compared with a national average around 4% (Fridstrøm, 2018). This suggests that the combination of the cordon toll exemption, free parking and free charging in Oslo, and facilitated access to bus lanes have boosted demand for electric cars. Among vehicles crossing the Oslo cordon toll ring during January-June 2017, BEVs represented around 10% of all light vehicles (passenger cars and small cargo vans) (Fridstrøm, 2017a).

Public procurement

Public procurement programmes can encourage the uptake of electric vehicles. Adopting electric vehicles in public fleets provides a number of advantages in kick-starting a wider electric vehicle market: having leverage on prices via bulk purchasing; central charging outlets; showcasing the technology to the public and making it common in the urban landscape. Increasing demand in public fleets also helps stimulate the availability of models and attracts new market player for charging services. This, in turn, will benefit individual customers when they choose to drive electric vehicles.

Eight EVI member countries committed to electrify their public fleets in the Government Fleet Declaration (EVI, 2016).[15] Among the Nordic countries, the Swedish government mandates the adoption of environment-friendly and electric cars in government fleets, with the exception of some classes of cars (e.g. emergency vehicles, cars with more than five seats, vehicles used by security and protection institutions) (Sveriges Riksdag, 2009). The Swedish public fleet comprises approximately 32 000 vehicles (passenger cars and vans) (Wikström, 2018). The public EV fleets represent a significant purchasing group and contribute to national climate change goals. Since 2013, the Danish Energy Agency has funded programmes to support municipalities and companies in the purchase of electric cars for fleets (Sørensen, 2017). Public procurement is moving quickly in Copenhagen, which aims to convert its entire bus fleet to electric vehicles by 2031 (Niss, 2017).

Box 2.3 • Electric buses in Nordic cities

The use of electric buses in the Nordic countries is currently transitioning from the testing and demonstration phase to the commercial phase. According to the data we were able to collect from each Nordic country there are approximately 104 electric buses and minibuses on the road in the Nordic region: 6 in Denmark, 16 in Finland, 1 in Iceland, 28 in Norway and 53 in Sweden. At least 18 cities in the Nordic countries are testing electric buses or operating entire lines of electric buses (EAFO, 2018), while another five cities have announced that they will begin to make use of electric buses in the coming years. Capital cities have the most ambitious plans for the electrification of public buses: Copenhagen would like to have its fleet fully composed of electric buses by 2031 (Niss, 2017); Oslo plans to have 60% of its bus fleet electrified by 2025 (Ruter, 2018); Helsinki plans to have one-third of its fleet electrified by 2025 (HSL, 2015). If these cities achieve their public transport electrification pledges by 2025, about 2 000 electric buses will be on the roads, representing a substantial increase in the uptake of electric buses in the coming years.

[15] Canada, China, France, Japan, Norway, Sweden, United Kingdom and United States.

In addition to their low GHG emissions, if fuelled by low-carbon electricity, electric buses have three additional benefits that make them attractive compared with biofuel and conventional buses: they emit no tailpipe emissions; they produce less noise in urban environments; and they provide a more comfortable journey experience due to lower vibration and noise. Electric buses have a purchase price premium, for which policy measures can help in the deployment of electric buses. For example in Sweden, electric buses are granted a rebate, which in February 2018 was increased to cover 20% of the bus cost thus reducing the price premium for local authorities (Miljö- och energidepartementet, 2016).

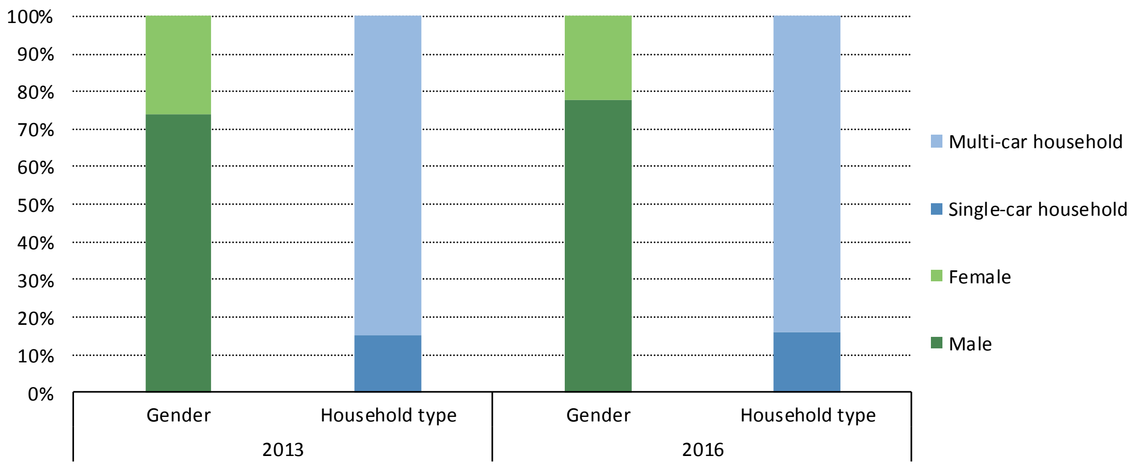
Consumer response: Focus on Norway

Norway clearly stands out as the most developed electric car market in terms of sales share and stock. “Elbilisten” survey of electric car owners in Norway, carried out by the Norwegian Electric Car Association, provides a number of insights (Norsk Elbilforening, 2017). Key indicators are briefly discussed in the following sections.

Electric car adopters

Early adopters of electric cars in Norway identified by the Elbilisten survey are primarily middle-aged men (average 47 years for BEV owners, 55 years for PHEV owners; the latter value is similar for ICE car owners) with a high level of education and income, and living in urban areas (Figenbaum and Kolbenstvetdt, 2016). The gender distribution of electric car owners has not change significantly in recent years (Norsk Elbilforening, 2013 and Norsk Elbilforening, 2016). As a wider range of non-luxury electric car models have reached the Norwegian market in recent years, consumers having a broader range of income levels had access to electric car models (Figenbaum, 2018). Most electric cars were sold in households with more than one car (Figure 2.8). The Elbilisten survey also noted that, on average, electric car owners have inspired 2.4 other people (e.g. colleagues or family members) to purchase an electric car (Norsk Elbilforening, 2017), suggesting that electric car adoption was rather strongly influenced by the consumer's network.

Figure 2.8 • Electric car owner profiles in Norway, 2013 and 2016



Sources: Norsk Elbilforening (2013); Norsk Elbilforening (2016).

Key point: Norway’s electric car market is dominated by male customers and multi-car households.

3. Electric vehicle supply equipment

This section provides an overview of the status of electric vehicles charging infrastructure in the Nordic countries, highlighting EVSE deployment and policy support to date. It also looks at actors that have been contributing to the development of charging infrastructure, recognising that a number of stakeholders are exploring business models for various EVSE types and new companies are regularly entering the market.

Standards and types of chargers

The *Global EV Outlook 2017* provided an overview of the various international standards and types of chargers (IEA, 2017a). This section presents further insights on the status of European standards and charger types, focusing on conductive charging (Table 3.1).[1]

Table 3.1 • Characteristics of EVSE in the Nordic region

	Current	Level	Power	Mode	Connector type
Devices installed in households, the primary purpose of which is not to recharge electric vehicles	AC	Level 1	≤ 3.7 kW	Mode 1-2	Type C and Type F
Slow EV chargers (private or public)	AC	Level 2	≥ 3.7 kW and ≤ 22 kW	Mode 2-3	IEC 62196 Type 2 (7-22 kW); Commando (7-22 kW) Tesla connector
Fast EV chargers (publicly available)	AC, tri-phase	Level 2	> 22 Kw and ≤ 43.5 kW	Mode 3	IEC 62196-2 Type 2
	DC	Level 3	> 22 kW and ≤ 150 kW	Mode 4	CCS Combo 2 Connector (IEC 62196-3 Type 2) (50 kW) CHAdeMO (IEC 62196-3 Type 4) (50 kW) Tesla (120 kW)
Ultra-fast/high-power EV chargers (intended for public use, but not yet deployed)	DC	Level 3	> 150 kW and ≤ 350 kW	Mode 4	CCS Combo 2 (IEC 62196-3) (150 – 350 kW) and CHAdeMO (150 - 350 kW)

Notes: kW = kilowatt; AC = alternating current; DC = direct current; CCS = Combined Charging System, CHAdeMO = Charge de Move. Type 2 IEC 62196-2 and 62196-3 (CCS Combo 2) connectors are mandated by the EU 2014/94 Directive.

Note that in Norway it is not legal to continuously charge at 3.7 kW from a Type C, normally limited at 2.9 – 3.4 kW (Figenbaum, 2018).

Sources: IEA (2017a); IEC (2014a); IEC (2014b); IEC (2016); ABB (2017b); and Ionity (2017).

Key point: Power output, sockets and connectors of EVSE used in the Nordic region are aligned with European standards and practices.

[1] Most of current EVSE in the Nordic region is based on conductive charging. There are some experiments with inductive charging (wireless) (Unplugged, 2015), though there has been no large-scale rollout.

Table 3.3 • Overview of investment cost for chargers in Sweden, USD 2017

Type	Year	Charging point (USD thousand)	Installation (USD thousand)	Grid upgrade (USD thousand)	Total (USD thousand)
Home (2.4 to 6.4 kW)	2017				0.6 - 1.4
Publicly accessible slow (3.7-11 kW)	2017	0.6			0.8 - 2.3
Publicly accessible slow (6.4 kW)	2014	1.1 - 1.2	0.6 - 1.2		1.8 - 2.1
Publicly accessible slow (22 kW)	2017				2.3 - 5.8
Publicly accessible fast (43-50 kW)	2017	18 - 29	2.3 - 18	3.5 - 18	23 - 64
High power (350 kW) (Europe-wide)	2017				225

Sources: Emobility Sweden (2017); City of Stockholm (2016); Autoblog (2017).

Key point: **Investment costs vary widely across charger types, with much higher investment required for publicly available chargers, especially fast chargers.**

Inter-operability

From a business perspective, increasing access through inter-operability leads to higher revenues for CPOs due to higher utilisation rates. Services from roaming platforms and EMSP allow for more visibility and reliability of the EVSE network. For example, Hubject provides its customers a map of all connected charging points and their status. Hubject charges the EMSP around USD 25 per activated EV user per year. Charging point operators (CPOs) pay a fixed one-time fee and a yearly variable fee depending on the charging points they want to connect to the platform (Daiber and Hofmann, 2017). The variety of hardware standards and the availability of various software protocols to enable charging also add a layer of complexity to electric vehicle charging.

Grid usage charges

Another challenge for CPOs is the current pricing structure used by distribution system operators (DSOs). Most DSOs charge a flat tariff, regardless of the time of the day. Fast charging often has peak effects during evenings (NVE, 2016a). These peaks are expensive and since the volume of kWh used in sparsely populated areas is relatively low, the actual grid cost per kWh can be over EUR 1/kWh (USD 1.13/kWh) (Ihle, 2017). Historically, grid customers (consumers or CPOs) that experience high peaks also have high energy use, leading to relatively low grid cost per kWh, e.g. EUR 0.05/kWh (USD 0.06/kWh). However, the costs of handling demand at peak times are 20-times lower than for some fast charging sessions in sparsely populated areas where similar peak demand will occur due to electric car charging. Depending on the regulatory framework, DSOs and/or CPOs determine who carries the burden of these additional costs.

Policy and regulations supporting EVSE deployment

Publicly accessible EVSE deployment is relevant as an instrument to ensure charging service availability, building trust and reducing “range anxiety”. This led to the development of a broad range of policy instruments aiming to stimulate its deployment. This section reviews existing policy support distinguishing between fiscal policies (such as public funding and investments) and regulatory measures. Policies are also clustered here according to their geographical scope of

Country/ region	Policy instrument and objective	Description	Current status
Denmark	Extension of commercial electricity tax rate for private and public charging.	Since 2016, Denmark offers a tax exemption for commercial charging, which in 2017 was extended to 2019, and favourable tariffs for electric buses were extended to 2024 (Government of Denmark, 2017).	Tax rates were maintained in 2017.
Finland	Subsidy scheme of EUR 4.8 million (USD 5.4 million) for public charging stations (Government of Finland, 2017b).	The subsidy is targeted only to public smart charging stations and intends to boost the implementation of fast chargers. The subsidy rate for normal chargers is 30% and 35% for fast chargers, and the budget is equally split between both types. Funding will only be made available if the charger has an open payment system.	
Iceland	EVSE infrastructure funding for publicly accessible charging stations 2016-18.	Publicly accessible charging infrastructure to allow Icelandic EV users to drive around the island.	Already 26 public chargers have been installed as of 31 December 2017.
	Policy support for workplace chargers.	Most workplaces in Iceland have private parking spots, which makes it a suitable target for policy support.	The workplace EVSE support policy is currently under development.
Norway	Regulation on the requirements for EVSE in new buildings and parking lots (Norwegian Ministry of Transport, 2016).	For parking lots and parking areas of new buildings, a minimum amount of 6% has to be allocated to electric cars.	Approved and came into force 1 January 2018.
	Oslo: expanded budget for EVSE deployment (Portvik, 2017).	The 2018 budget allocated to housing associations for installing chargers doubles the 2017 budget to NOK 20 million (USD 2.4 million).	
Sweden	Projects from Klimatklivet assigned to EVSE for 2018-20 (Wikström, 2018).	For 2018-20, additional SEK 700 million (USD 82 million) have been assigned and the budget proposal for 2018 includes provisions to increase this amount.	SEK 700 million (USD 82 million) have been assigned to the programme.
	Implementation of support scheme for private charging (Government of Sweden, 2017c).	Between 2018 and 2020, SEK 90 million (USD 11 million) will be annually allocated to support home chargers with up to 50 % or SEK 10 000 (USD 1200) for hardware and installation costs.	

Key point: **Nordic countries have policies and plans to advance EVSE deployment, including financial support measures.**

The European Commission is estimating a target of 440 000 publicly accessible charging points by 2020 by using a minimum ratio of one publicly accessible charger per ten electric cars. The target takes into account the number of electric cars estimated to be necessary by the end of 2020 to meet the political ambition for the European Union to become a world leader in decarbonisation (Box 5.1). An updated target of 2 million publicly accessible recharging points is also set for the end of 2025 (EC, 2014c and EC, 2017b).