BEACON Bridging European & Local Climate Action

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INCENTIVES FOR ELECTRIC VEHICLES IN NORWAY

Study

On behalf of:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

European Climate Initiative EUKI

of the Federal Republic of Germany

Incentives for Electric Vehicles in Norway

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Abbreviations

BEV	Battery Electric Vehicle
CO_2e	Carbon dioxide equivalent
EmoG	E-Mobility Law
ETS	Emissions Trading System
EU	European Union
EUR	Euro
EV	Electric vehicle
GDP	Gross domestic product
GHG	Greenhouse gas
ICE	Internal combustion engine
IEA	International Energy Agency
LULUCF	Land use, land-use change and forestry
NDC	Nationally determined contribution
NGO	Non-governmental organisation
NOK	Norwegian krone
NOx	Nitrogen oxides
PEV	Plug-In Electric Vehicle
PHEV	Plug-In Hybrid Electric Vehicle
TCO	Total cost of ownership
TFC	Total final consumption
VAT	Value added tax
ZEV	Zero-emission vehicle

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1 Summary

Norway's global leadership role in the promotion of electric vehicles (EVs) is due to early and comprehensive policy interventions targeting both the monetary aspects of vehicle purchases as well as aspects related to the ease of use of low and zero-emission vehicles (ZEVs). By 2025, all new passenger road vehicles sold in Norway should be ZEVs according to a recent (non-binding) decision by the Norwegian government. Already today, close to 40% of new vehicles purchased in Norway are EVs, either Plug-In Hybrid Electric Vehicles (PHEVs) or Battery Electric Vehicles (BEVs), and more than 50% of other hybrids are included in this estimate (Ayre, 2018). Although Germany has recently seen a rapid increase in new registrations for EVs, their absolute amount and share remain very low: in 2017, out of a total of 45.8 million passenger cars on the road in Germany, only 53,861 were BEVs and 44,419 were PHEVs (Kraftfahrt-Bundesamt, 2018). The lack of success of Germany's most important policy instrument for the promotion of e-mobility, namely purchase premiums, raises the question of what other instruments have made Norway a frontrunner in e-mobility and how its experience can, if at all, be transferred to Germany[1].

Given Norway's electricity system's low-emission factor in electricity production, the electrification of transport bears tremendous potential for emissions reduction for the achievement of the country's 80 to 95% GHG reduction goal by 2050 compared to 1990. The focus of this study is on passenger road traffic, an area in which Norway has introduced a comprehensive mix of policy instruments. From the broad variety of instruments in place, this study focuses on those of highest relevance for EV buyers in Norway, namely tax exemptions or reductions and non-monetary measures that improve the user experience for drivers of EVs, especially in large urban areas.

While Norway's policy mix has led to a drastic increase of EVs of all types and the over-achievement of targets (over half of all registrations of new vehicles in Norway were EVs in December 2017), some lessons for implementation can be drawn. For example, the opening of bus lanes to EVs in Norwegian municipalities has led to local congestion and criticism from public transport operators. The latter type of measure has practically not been employed in Germany, even though it has been available to municipalities since 2016. Another challenge encountered by the Norwegian EV boom is the lack of charging infrastructure compared to the high numbers of EVs on Norwegian roads.

While the transfer of specific policy options such as a reduction or exemption from VAT for EVs requires close legal scrutiny in Germany, the Norwegian approach of setting out policy priorities, general guidelines and principles in an integrated National Transport Plan for the longer term (twelve years, 2018–2029) can serve as inspiration.

[1] We thank Dr. Roman Ringwald from Becker Büttner Held (bbh) for insights shared during an expert interview on 03 May 2018.

2 National context in Norway

2.1 Norway's national climate policy

Norway is a frontrunner in climate protection efforts and has set ambitious targets for the reduction of national greenhouse gas (GHG) emissions. For 2050, Norway has set the target to be carbon neutral, defined as reducing GHG emissions 80 to 95% below 1990 levels (Climate Action Tracker, 2018a). The overall goals are defined by the Climate Law (Norwegian Government, 2017) that was passed in June 2017 and came into effect in January 2018. The law establishes legally binding emissions reduction targets for 2030 and 2050 (Climate Action Tracker, 2018a).

According to Norway's nationally determined contribution (NDC), the country aims to reduce GHG emissions by a minimum of 40% by 2030 compared to the levels of 1990 and defines the transport sector and environmentally friendly shipping as priority areas for enhanced action (Norwegian Government, 2015). The Climate Action Tracker nevertheless rates Norway's NDC as 'insufficient', i.e. being at the least stringent end of the range of a fair share of the global effort to mitigate climate change and reach the Paris Agreement targets in a fair manner, as the current level of commitment is found to be consistent with an increase an global average temperature between 2–3 °C (Climate Action Tracker, 2018b).

As can be seen in Figure 1, GDP grew considerably faster than CO_2 emissions and population, pointing to a certain degree of decoupling. Over the same period, the CO_2 intensity of energy consumption has remained relatively stable. In 2014, Norway's energy-related CO_2 emissions per capita amounted to 7.0 tonnes (t), which was close to the IEA median and around one-third less than the IEA average of 10.1 t.

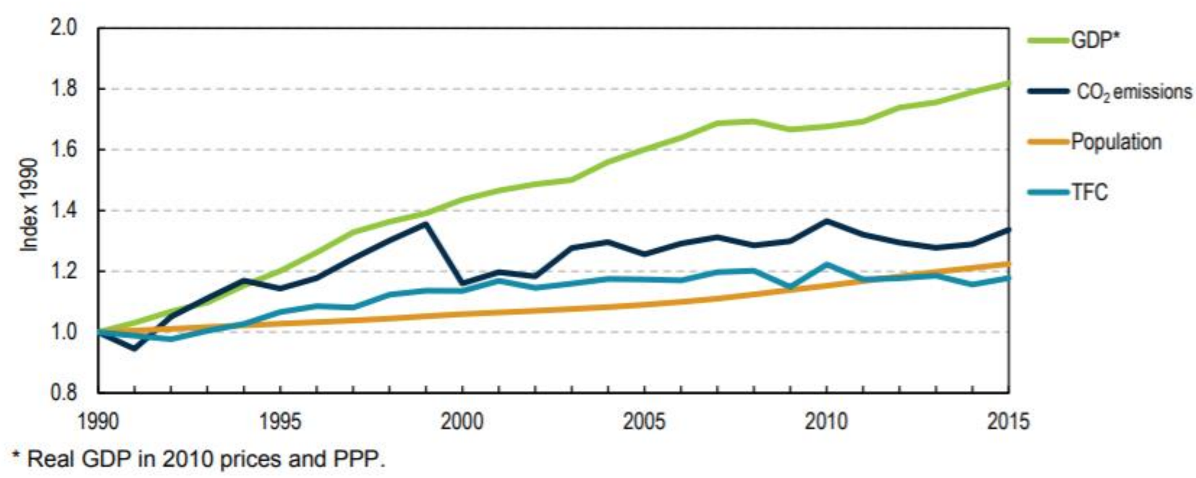

Figure 1: CO_2 emissions, population and GDP in Norway, 1990–2015 (International Energy Agency, 2017a), TCF stands for Total Final Consumption

As shown in Figure 2, the power system in Norway is dominated by hydropower, which accounts for roughly 95% of the total installed capacity; renewables are responsible for 98% of power generation (Norwegian water resources and energy directorate, 2018). As a result, the power sector's emission factor is very low at

16 gCO_2e/kWh (Norwegian water resources and energy directorate, 2018) while Germany's exceeds 500 gCO_2e/kWh. To further reduce emissions, the Norwegian government will facilitate the transition from fossil fuels to renewable energy in transport, industry, oil and gas extraction, and heating. In 2015, only 1% of power generation was accounted to the transport sector.

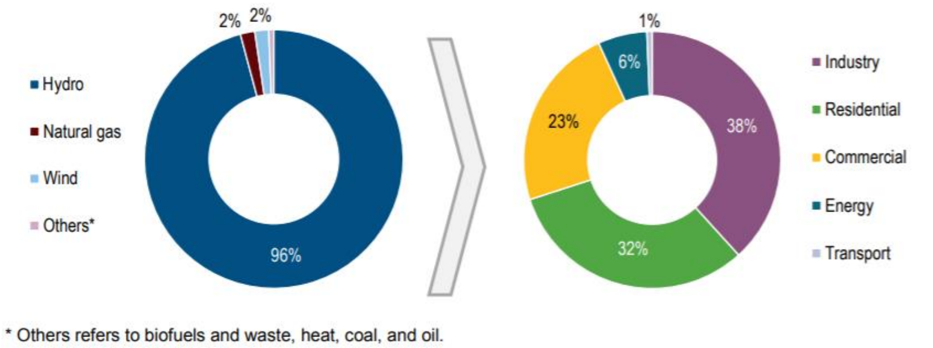

Figure 2: Electricity generation in Norway by source and consumption by sector, 2015 (International Energy Agency, 2017a)

Norway's emissions in the transport sector have stagnated since the early 2000s, as can be seen in Figure 3, while overall emissions show a slight upward trend. Reductions are significant in the industrial sector. The policy priorities, general principles and instruments to be used to ensure a strong contribution from the transport sector to national climate efforts are set out in the 2018–2029 National Transport Plan. The overall aim of national transport policy is described as a "transport system that is safe, promotes economic growth and contributes to the transition into a low-emission society" (National Transport Plan, 2016). The first of the 'paramount priorities' set out by the plan is the "the use of incentives for zero- or low-emission transport modes, alternative fuels and better capacity utilisation in order to achieve climate objectives without reducing mobility".

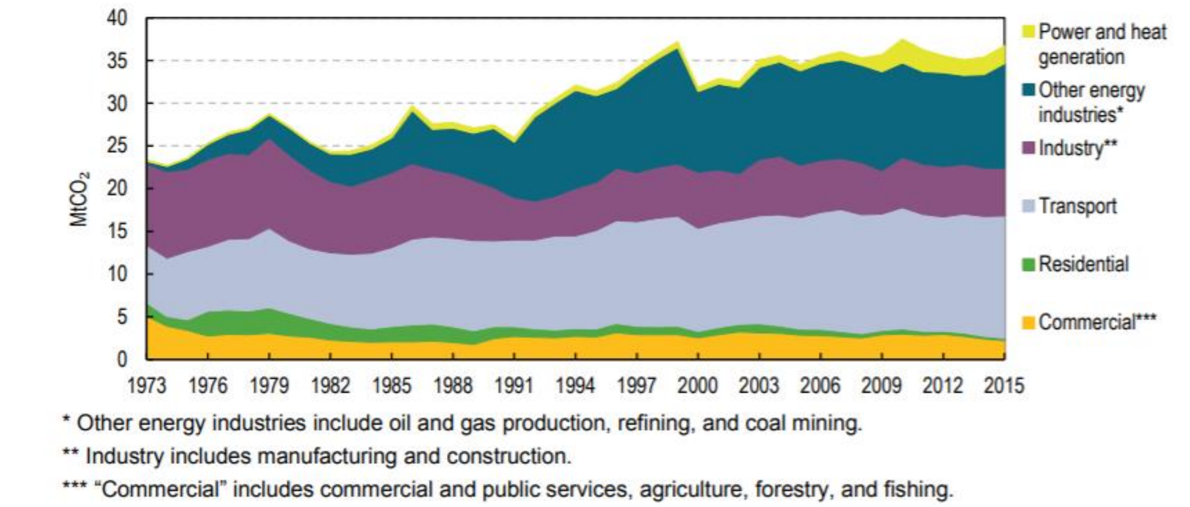

Figure 3: Development of emissions of all GHG (million tCO_2e) per sector in Norway from 1973-2015, excluding LULUCF (International Energy Agency, 2017a)

Five priority areas for action are identified in the plan (National Transport Plan, 2016), including investment in low- and zero-emissions technologies; increase in the use of sustainable biofuels; public transport, cycling and walking in cities; modal shift from road to sea and rail in freight transport; and lower emissions from transport infrastructure.

These priorities translate into concrete recommendations for further policy action. The plan foresees that from 2025 all new light vehicles, new city buses and new light commercial vehicles should be zero-emission vehicle (ZEVs) and that by 2030 the same should apply to all new heavy commercial vans, 75% of new long-distance buses, and 50% of new lorries (National Transport Plan, 2016). Along the lines of the European Union (EU) White Paper on transport, deliveries and distribution of goods within the largest city areas should be “almost without emissions”.

To ensure the implementation of the priorities, the Norwegian government intends to continue its policies for tax differentiation and subsidies for the purchase of ZEVs and low-emission vehicles (see below). The aim to make sustainable vehicles not only competitive with but significantly less expensive than conventional ones is also reflected in differences in terms of taxes and tolls. Among the non-monetary measures to be promoted, priority for parking space for ZEVs and availability of sufficient charging infrastructure, even at long distances, are prioritised.

2.2 Sector context

Norway’s transport sector is highly influenced by its low population density and high urbanisation rate. Norway has 5.3 million inhabitants and one of the lowest population densities within Europe, with a high urbanisation rate of 80% (World Bank, 2018a). Population growth is moderate, with 0.8% in 2016.
Norway is one of the wealthiest countries in the world and has one of the highest GDP per capita in Europe at around USD 90,000 (~ EUR 75,513) (Trading Economics, 2018). The petroleum sector is a core industry for the Norwegian economy. In 2015, this sector generated 15% of GDP and 40% of exports. Financed through the revenue from fossil fuels, Norway’s sovereign wealth fund is the largest in the world, currently valued at over EUR 650 billion (Central Intelligence Agency, 2015). Despite Norway’s high fossil fuel reserves, renewables play an important role in the country’s energy system. As 98% (2016) of Norway’s electricity is produced from hydropower, the GHG emission reductions associated with the electrification of transport are significant (Norwegian Government, 2016).

GHG emissions in Norway amount to 53.2 million tonnes CO_2e ($MtCO_2e$) (i.e. 9.3 tCO_2 per capita). Transport is the largest contributor to CO_2 emissions, at around 14 $MtCO_2e$ of total emissions, equivalent to a share of roughly 26.3% in 2015. Transport emissions have grown by 43% since 1990, as the number of vehicles and volume of transport increased (International Energy Agency, 2017a). In comparison, total GHG emissions in Germany amounted to 906 $MtCO_2e$ in 2016 (about 8.9 tonnes CO_2e per capita (World Bank, 2018b)). The German transport sector contributes 160 $MtCO_2e$, which is about 18% of total CO_2e emissions.

Air quality in Norway is generally good, but in some urban areas, the limits for particulate matter and nitrogen oxides (NOx) are exceeded, especially in the winter (International Energy Agency, 2017a). The main source for air pollution is road transport, which makes up 74% of all freight and 88% of passenger traffic in the country. Figure 4 offers an overview of the modal split between road, rail, air and water transport in the freight and passenger segments in Norway.

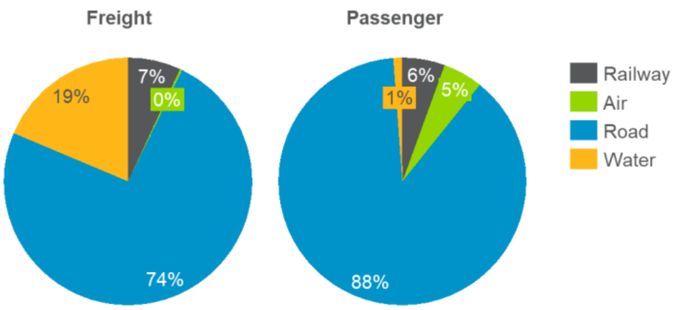

Figure 4: Modal split of transport in Norway (Wethal, 2017)

Norway has positioned itself as one of the leading EV markets in the world. A market share of 20.8% BEVs and 18.4% PHEV was attained in 2017 and roughly 142,000 BEVs and more than 67,000 PHEVs are registered in Norway. In total, the fleet consists of 2.5 million passenger vehicles that drive on average approximately 13,000 km/year. Norway has set itself ambitious CO_2 emission targets for new vehicles, aiming for 85 g/km by 2020 compared to the EU-wide target of 95 g/km by 2020. This target was already overachieved in 2017, with an average of 82 g/km (Climate Action, 2018).

Norway has favourable conditions for home charging as most households park their vehicles on their own land. In addition, most households also have sufficient grid capacity to charge EVs, as this capacity is needed for electric space heating for 74% of households (Figenbaum E. , 2017). To put things in perspective, in Norway, average household electricity consumption is at 16,000 kWh per year (Norwegian Ministry of Petroleum and Energy, 2018) while in Germany, the average consumption is substantially less with 3,500 kWh/household (International Energy Agency, 2016). In Norway, fossil fuel prices are also among the highest in Europe, whereas electricity is relatively cheap with 15.15 EUR cents/kWh in 2016. In comparison, electricity prices in Germany were with 29.77 EUR cents/kWh in 2016 about double the price in Norway (Statista, 2018).

The Norwegian transportation sector is heavily taxed, which includes registration taxes on new vehicles, annual taxes, taxes on fuels and numerous toll roads. This regime makes it possible to create incentives by selectively foregoing taxes, thus influencing the types of vehicles sold.

3 General description of incentives for EVS

3.1 History and overview

The history of advertisement and promotion of EVs in Norway dates back to the late 1980s when an exemption from the registration tax was granted that allowed testing of BEVs (Norsk Elbilforening, 2017). Based on these incentives, the first market niches were carved, which were municipal and utility fleets testing. Inspired by the 1990 California ZEV mandate that included an obligation to sell 2% of BEVs from 1998, 5% in 2001 and 10% in 2003, Norwegian stakeholders, such as its EV association, started to set targets for the reduction of local pollutants and the introduction of clean electricity into the transportation sector.

An NGO started a campaign in 1993 to seek media attention by driving a BEV on toll roads in Oslo and parking in municipal parking spaces without paying. As a result, free parking and an exemption for toll road fees were established as national BEV incentives from 1997 and 1999 by national laws (Fearnley, Pfaffenbichler, Figenbaum, & Jellinek, 2015). As BEVs were still very expensive, relative to fossil fuelled cars, an exemption from the value added tax (VAT) (then 24%) was proposed to increase BEV competitiveness. It was introduced in 2001 following a political agreement in the parliament on a revision of the VAT law, with one sentence in the agreement stating that BEVs shall be exempted from VAT (Assum, Kolbenstvedt, & Figenbaum, 2014). A municipality close to Oslo introduced an extra NOK 25,000 (~EUR 2,623) purchase support for its inhabitants. However, after 2003 there were multiple BEV setbacks as car manufacturers stopped producing BEVs due to poor sales, changing priorities, and a planned ban on Cadmium in batteries in the EU.

Still, the BEV lobby continued to promote electrification of transport and in 2003, bus lanes were opened for BEV owners in Oslo and surrounding municipalities (Figenbaum, Eskeland, Leonardsen, & Hagman, 2013). Due to increasing toll roads around cities and main roads, the existing incentive that excluded BEVs from paying toll had a higher impact. To achieve a more favourable position for BEVs in rural and coastal areas, the government reduced rates for BEVs on national ferries from 2009 (Ministry of Transport and Communications, 2008). Just after the financial crisis of 2008, Norway introduced an economic stimulus package that included EUR 6 million for the installation of charging stations. Simultaneously, the EU proposed a target of 95 g/km average CO_2e emission for new vehicles in 2020, which increased interest in BEVs.

In 2012, a White Paper on Climate Policy was published introducing a BEV-specific policy, which was followed by a broad Climate Policy Settlement in the Norwegian Parliament (Norwegian Government, 2012). Instead of the EU target of 95 g/km, Norway set a more ambitious target for new passenger vehicles to emit on the average 85 gCO_2e/km by 2020. In addition, consensus was reached to uphold the financial incentives until at least 2018, or until a total EV car stock of 50,000 vehicles is reached. This target was reached early in 2015 (Norsk Elbilforening, 2017), but the Norwegian parliament decided to continue the incentives until 2020.

Because BEVs became more popular, and the incentive to access bus lanes was frequently used, concerns about congestion on bus lanes were raised. As a result, since 2015, BEV access to bus lanes in Oslo during rush hours is only granted if at least one passenger is travelling in addition to the driver. In addition, the free ferry incentive was downscaled in some places after a national reform in road ownership in 2010 (Norsk Elbilforening, 2017). For an overview of incentives, see Table 1.

Table 1: Overview of introduction of relevant policy instruments for EVs in Norway (International Energy Agency, 2017b) (European Alternative Fuels Observatory, 2018) (Norsk Elbilforening, 2017)

Year of introduction	Instrument	Functioning	Status
1990 (as an exemption) 1996 (permanent)	Exemption from registration tax ('Forskrift om engangsavgift pa motorvogner')	Norway levies a registration or import tax on cars, which can reach EUR 10,000 or more depending on the car model's CO_2 emissions. BEVs are exempted from the tax. The calculation of the registration tax has a large progressive component, as mass, engine power, CO_2 and NO_x emissions are included in the calculation. The exemption is expected to run out at the end of 2020, but due to the low-emissions, BEVs will still pay a lower amount. For plug-in hybrid electric cars, the vehicle mass is reduced by 26% (since January 2015) which approximates excluding the electric powertrain from the calculation. The reduction used to be 10%, was increased to 15% in 2013 and in 2015 to 26%. As a result, PHEVs also pay a lower tax. The tax curves are adjusted on a yearly basis.	Currently still in place. At the end of 2017, Norway retracted a plan to tax electric cars that weigh more than 2 metric tonnes. The proposed tax immediately became known as the 'Tesla tax' because it was likely to increase the cost of the new Tesla Model X, an SUV. Legislative source: Vehicle import duty resolution, Section 5, §1 (i); Road Traffic Act.
1996	Low annual road tax ('Forskrift om årsavgift for motorvogn')	BEV pay a lower annual road tax. Instead of NOK 3,060 or (~EUR 367), owners of BEVs pay NOK 435 (~ EUR 52).	The annual tax will increase to half the rate of fossil fuelled cars in 2018 and to the full rate in 2020. Legislative source: Regulation of annual fee for motor vehicle (Norwegian Tax Administration, 2018).
1999	Introduction of special registration plates	EVs get a special license plate with the prefix 'EL' or 'EK' (since 2015). In the future, the prefix 'EV' will be introduced, once the other two are exhausted. This was implemented to make	In place.

Year of introduction	Instrument	Functioning	Status
		administration of incentives easier for example with allowing access to bus lanes and EVs more visual on the road.	
1999	Free municipal parking	From 2010, local governments can decide on incentives such as access to bus lanes and free municipal parking.	Still most parking spots in the street or on public are free for EVs. This incentive can save drivers up to thousands of Kroners per year but might be revised with growing numbers or EVs.
2000	Reduced company car tax	BEVs used as company cars also pay a reduced tax: For BEVs, the list price was reduced by 50% to calculate the company car tax. (International Energy Agency, 2017b).	Since 2018 Norway still provides a 40% reduction on the company car tax.
2001	Exemption from 25% VAT on purchase	BEVs are exempted from paying the value added tax of 25% on the purchase or leasing rate.	The VAT exemption for electric cars is prolonged until 2020, but will be replaced by a new scheme, which may be subject to a ceiling that could be reduced as technology develops (Johnsen, 2017).
2005	Access to bus lanes*	BEVs have access to bus lanes in most Norwegian towns and cities. Since 2015, access for BEVs in bus lanes in Oslo has required carpooling with at least one passenger during rush hour.	As of 2017 local governments can decide on incentives such as access to bus lanes and free municipal parking.
2009	No charges on toll roads**	BEVs enjoy exemptions from road tolls in Norway as a general rule (AutoPASS, 2016). Road tolls can be substantial in Norway, amounting to several thousand Euros a year on certain roads and tulles.	Complete exemption for toll roads will likely be phased out over the coming years; however, tolls should not exceed half of similar payments made by fossil fuel-powered vehicles.

Year of introduction	Instrument	Functioning	Status
2009	No charges on ferries**	BEVs are exempted from ferry charges.	Reduced rates instead of exemptions are currently being implemented. From 2018, only a 50% reduction will be applicable.
2015	Exemption from 25% VAT on leasing	Implemented in line with the VAT tax exemption at purchase.	In place.

* Introduced in Oslo region in 2003, ** Introduced regionally in 1997.

The most important incentives for Norway are financial. Norway's approach is outstanding insofar as the total cost of ownership (TCO) is lower for Plug-In Electric Vehicles (PEVs) in comparison to internal combustion engine (ICEs) vehicles. A TCO consists of a car's purchase price, its maintenance and fuel costs, and the infrastructure costs over the lifespan of the vehicle. Sometimes, insurance and financing costs are also included in this calculation.

A study in Norway found that for 41% of EV buyers, the primary reason to buy an EV was 'to save money' (Haugneland, Lorentzen, Bu, & Hauge, 2017). This share of price-conscious EV buyers is likely to be even higher in the general population compared to early EV adopters. As Figure 5 shows, VAT and exemptions from tolls on roads are perceived as the most important drivers for the purchase of an electric car, followed by the purchase tax exemptions.

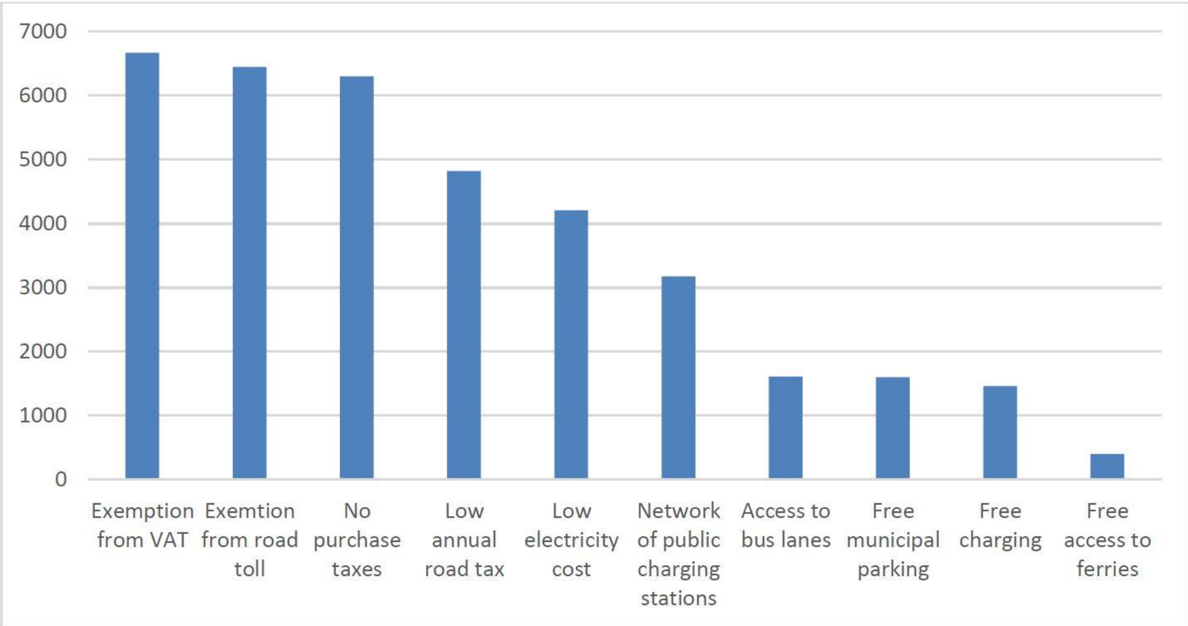

Figure 5: Perceived importance of Norway's electric car support policies based on survey results (Haugneland, Lorentzen, Bu, & Hauge, 2017)

To explain the effectiveness of EV incentives in Norway, it is useful to take a look at the extent to which the abovementioned exemptions and reductions bring down the cost of purchase of EVs compared to ICE cars for buyers in Norway. Table 2 compares purchase prices of certain types of ICEs and their BEV equivalents in Norway. The advantages are also very significant regarding the operational cost incurred every year. Depending on the location and type of use, these can be up to 75% lower for BEVs than for conventional vehicles (Kallbekken, Sælen, Hermansen, & Lannoo, 2018).

Table 2: Comparison of retail prices and price components of conventional and BEVs in Norway (Haugneland, Lorentzen, Bu, & Hauge, 2017)

Category	Conventional ICE vehicle	BEV	Conventional ICE vehicle	BEV
Model Name	Audi A7	Tesla Model S	Volkswagen Golf	VW e-Golf
Specification	2.0 TFSI 252hk quattro aut	75D 4WD	1.0 TSI 110hk Businessline	Exclusive
Import price	NOK 319,464	636,000 NOK	NOK 180,624	NOK 259,900
CO_2tax	NOK 125,253 (157 g/km)	0	NOK 31,827 (109 g/km)	0
VolkNOx tax	1,525 (21.5 mg/km)	0	NOK 2,263 (31.9 mg/km)	0
Weight tax	NOK 109,198 (1720 kg)	0	NOKK 21,526 (1162 kg)	0
Scrapping fee	NOK 2,400	NOK 2,400	NOK 2,400	NOK 2,400
25% VAT	NOK 139,460	0	59,660	0
Retail price	**NOK 697,300 (~EUR 73,000)**	**NOK 638,4000 (~EUR 67,000)**	**NOK 289,300 (~EUR 31,000)**	**NOK 262,300 (~EUR 27,000)**

3.2 Interlinkages with other policy instruments

The regulatory framework for EVs in Norway goes beyond targeting consumers at the point of the purchasing decision. It includes political incentives for the rollout of charging infrastructure, research activities, information and marketing. Norway has an extensive network of public charging infrastructure. The installation of large parts of this network is financed by Enova (formerly known as Transnova), an agency funded through the sale of natural gas and petroleum. In 2009, Enova commenced the rollout of charging infrastructure with EUR 6 million. Additionally, the national level municipalities have invested extensively in charging infrastructure. For instance, Oslo spent EUR 2 million on the construction of charging stations. Today, 2,000 charging points are available across the city (Kvisle, 2012) (The City of Oslo, 2018). The Norwegian government has also initiated a program aiming to finance the installation of a minimum of two fast charging points on every 50 km of all main roads. The availability of charging infrastructure plays an important role for the consumer decision. Studies have found that charging infrastructure (per inhabitant) has a strong correlation with PHEV adoption (Sierzchula, Bakker, Maat, & Wee, 2014). In the broader policy framework, it is important to note Norway's early adoption in 1991 of a CO_2 tax on petroleum production in addition to the later adoption of a CO_2 tax component on vehicle purchases in 2007 (Zeniewski, 2017).

4 Impacts of the policy instruments

4.1 Effectiveness

Assessing the effectiveness of policy instruments, i.e. their ability to enable the achievement of defined policy goals, requires a reflection on the indicators to be used to evaluate them. For the sake of this short study, the effect of policy instruments in terms of increasing the sales of EVs, measured as the absolute number of registered BEVs and their share in the overall fleet and the emissions reduction, is the focus.

A first look at the market share of newly registered EVs in Norway and Germany is shown in Figure 6 where the large difference between the two countries becomes visible. In 2017, the combined share of BEVs and PHEVs reached almost 40% in Norway but well below 5% in Germany. It should be noted that the policy measures taken in Norway also took several years to show a significant effect. The acceleration of market uptake is very probable not only due to policies but likely also the availability of more attractive/affordable types of EVs and 'neighbour effects' that predict a faster uptake of technologies once they become more visible, e.g. because neighbours use them.

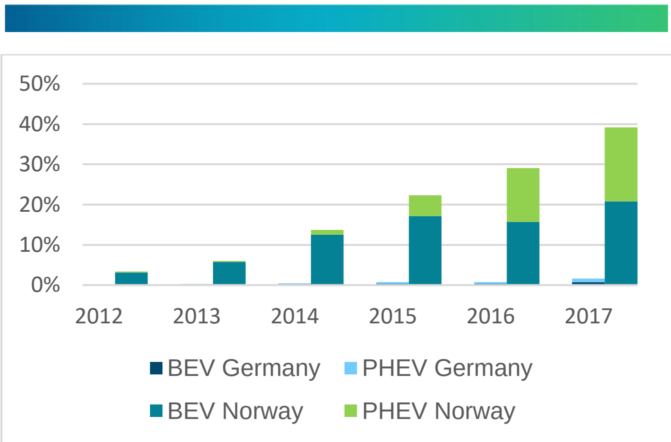

Figure 6: Market share of EVs in new registrations in Germany compared to Norway (European Alternative Fuels Observatory, 2018)

The share of PEV in the total mix of passenger vehicles was 0.16% in Germany and 5% in Norway in 2016 (PHEV and BEV combined). It is important to note that the fiscal incentives that are at the heart of the Norwegian policy mix for EVs only apply to BEVs in their full version (PHEVs also benefit from discounted rates on registration taxes due to their low CO_2 emissions), hence only about half of the registrations of EVs.

Isolating the contribution of particular policy instruments to the uptake of EVs is a methodological challenge but has been attempted by researchers. Figure 7 shows a simulation of expected changes that would occur to the current forecast of BEV adoption if individual incentives were removed. The graph shows that bus lane access and VAT as well as purchase tax exemptions have the most important effect on BEV adoption, while annual benefits such as road tax rebates have a smaller impact on the adoption of BEVs in Norway.

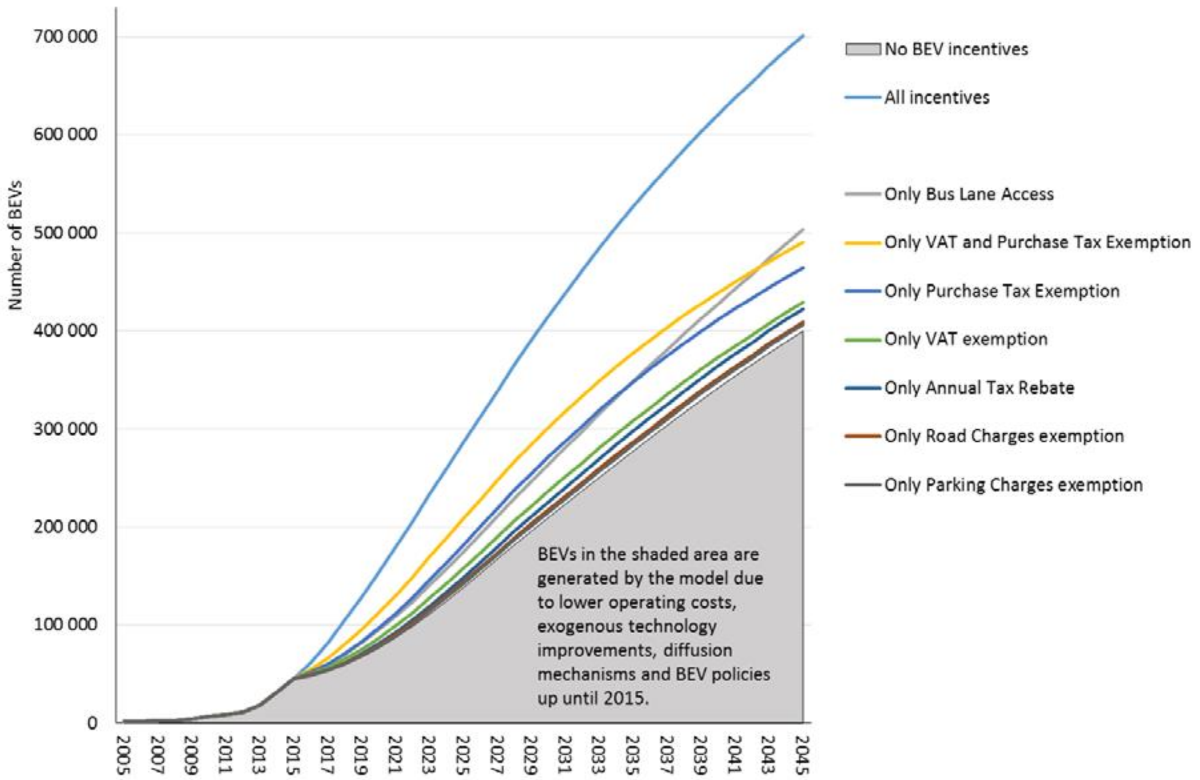

Figure 7: Partial effects on BEV stock if individual incentives were removed (Norway) (Fearnley, Pfaffenbichler, Figenbaum, & Jellinek, 2015)

Other studies based on consumer surveys have shown different results as to whether the reduction in operational cost (road tolls, annual taxes) or the upfront investment (VAT and registration tax) are more important to consumers (Højklint & Hofvander Hansen, 2017). The incentives in place provide for reductions of up to 75% of the operating cost of an electric car compared to conventional cars and make EVs cheaper than conventional vehicles in many cases (Kallbekken, Sælen, Hermansen, & Lannoo, 2018).

The second metric to consider when assessing Norway's policy mix for EV promotion is emissions reduction in the transport sector. Here, the differences in electricity emissions factors are important. Norway's electricity mix has a high share of renewables, hence the GHG reduction potential of EVs is high. GHG emissions from road traffic have nevertheless only recently started to decline after several years of stability. They increased by 27.8% between 1990 and 2016 but declined by 3.6% between 2015 and 2016 (Statistics Norway, 2017). Norway had set itself a target of 85 g CO_2e per passenger km in new cars by 2020 and achieved this target early in 2017. These values are significantly lower than EU limits and are a promising sign that emissions from road traffic will decrease further in the future (Climate Action, 2018).

For the overall assessment of the effectiveness of Norway's EV policies, potential adverse effects also need to be considered (described in more detail below). More drivers of EVs on bus lanes may hinder public transport and cause congestions. The argument that individual motorised transport, as opposed to biking, walking or public transport, is incentivised through EV policies should therefore also be taken into account.

4.2 Cost efficiency

In addition to the ability of an instrument to achieve the targets it is designed to enable; the related investment is an important criterion for assessment. Given governments' budget constraints, the aim of successful policies should promote the largest number of BEVs per EUR spent (Fearnley, Pfaffenbichler, Figenbaum, & Jellinek, 2015). In the case of EVs, direct costs of instruments (e.g. subsidies), implementation costs and foregone revenues, (e.g. from reduced taxes) need to be considered. Since the climate protection potential of transport electrification is in focus here, the cost per unit of CO_2 saved is an essential metric. Researchers have found that, in the case of Norway, exceptional access to bus lanes achieves the lowest budget cost per tonne of CO_2 saved whereas exemptions from parking charges come with a comparatively high cost to the public budget. As shown in Figure 8, most policy measures in the mix lead to a budget cost of NOK 30,000 to 40,000 (~ EUR 3,133–4,177) per tonne in 2020, which appears to be as a prohibitively high price and requires close scrutiny as a research result.

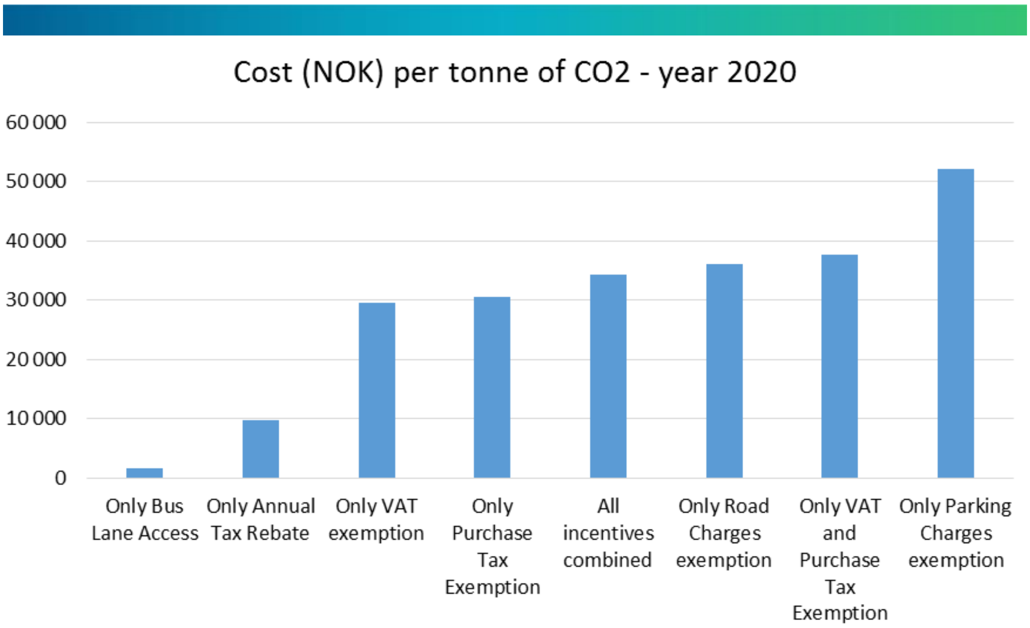

Figure 8: Cost per tCO_2 in 2020 linked to particular BEV promotion measures (Fearnley, Pfaffenbichler, Figenbaum, & Jellinek, 2015)

Despite discussions around the cost of policy measures, Norway has taken the decision that fiscal incentives for zero-emissions vehicles would be extended even beyond the achievement of the target mark of 50,000 ZEVs on Norwegian roads by December 2017 (initial goal: 2020). The Revised National Budget (Fearnley, Pfaffenbichler, Figenbaum, & Jellinek, 2015) extends the exemption from VAT until 2020. It should be noted that the discussion in Norway on the cost of its EV policies, in particular the VAT exemption is growing. As discussed below in the section on transferability, Norway's budget surplus and sovereign wealth fund should be taken into account when assessing the budgetary burden of EV policies in Norway.

4.3 Co-benefits and side-effects

Given the rapid uptake of EVs in Norway with more than half of new vehicles now electric, the country is a test case for the co-benefits and side-effects of larger shares of EVs. In terms of co-benefits, cities like Oslo have

supported the introduction of EVs even beyond the national policies for reasons of reducing local air pollution and reducing noise linked to the use of internal combustion engines. Given the lack of a Norwegian automobile industry, the co-benefits of the policies in terms of direct manufacturing jobs are negligible.
Regarding negative side-effects, it is worth noting the loss of revenue from certain categories of taxes that have put a burden on some municipalities. The National Transportation Plan 2018–2029 therefore contains proposals to reinstate some fees again due to some municipalities complaining about revenue shortfalls from exempted EVs (Avinor; Jernbaneverket; Kystverket; Staten Vegves, 2016). A less straightforward side effect of Norway's policies is congestion in areas where bus lanes can be used by EVs (Højklint & Hofvander Hansen, 2017). This may have negative effects on the ease of using public transport and hence hamper the overall aim of a sustainable transport system. Since January 2017, Norwegian local authorities have the freedom to decide on local incentives such as free or reduced parking fees, access to bus lanes and exemptions from toll charges and ferry charges. In a number of municipalities, parking fees were introduced as a consequence, but these are capped at 50% of the fees for conventional cars (Højklint & Hofvander Hansen, 2017).

4.4 Success factors and challenges

Norway's example is not only arguably a highly successful case in global comparison for the promotion of EVs, but also a widely discussed one. Among the success factors for Norway's promotion of EVs is the very high degree of public and political acceptance of the importance of promoting low-emission transport (Zeniewski, 2017). The country's emissions targets as well as the Climate Policy Settlement of 2012 were met with overwhelming support in parliament. Support for EV promotion also extends to industry. The Norwegian utilities Fortum and Statkraft have both invested heavily in charging infrastructure and operation.

Norway does not have a strong conventional automotive lobby, and support for EVs from industry grew early on. An Electric Vehicles Association was set up as early as 1995 and has since been an important lobbyist for generous EV incentives. The support to EVs and charging infrastructure is partly channelled through the state agency Enova that supports public charging infrastructure in municipalities in addition to other measures such as sustainable shipping and freight transport.

Given the generous incentives provided to buyers of EVs in Norway, in particular the exemptions from registration tax, VAT and road tolls, one of the challenges for the ongoing promotion of EVs is growing resistance to the high cost of the program. In fact, the fiscal incentives were intended to be upheld until 2017 or until the benchmark of 50,000 was reached (Zeniewski, 2017) but have been prolonged. Some argue that the EV market in Norway is now mature enough to gradually phase-out incentives, but the Norwegian EV association and environmental organisations argue that the level of support will need to increase to ensure a breakthrough of e-mobility beyond early adopters and second or third cars. Some also argue that the incentives are pushing private vehicle ownership and are therefore at odds with larger climate goals. The 2012 Climate Policy Settlement also stated that future growth in travel demand should primarily be met with public transport, bicycling or walking.

The ongoing discussion on the cost of EV promotion is also reflected in (now abandoned) plans of introducing a so-called 'Tesla tax' on heavier EVs. However, the plans were rapidly abandoned following protests from the Electric Vehicles Association (The Local Norway, 2017). The success of Norway's program is making it increasingly difficult for buyers to obtain their preferred EV models within a reasonable time frame. Waiting times of up to two years for certain models are becoming more frequent (Kallbekken, Sælen, Hermansen, & Lannoo, 2018). This issue is also increasingly visible in Germany, where long wait times for EVs have been reported (Transport & Environment, 2018).

5 Transferability

5.1 General comparability of the context

Norway's mix of policy instruments for the promotion of EVs has played a central role in making the country a European and global frontrunner in the uptake of BEVs and PHEVs. Norway has the lowest emissions in g/km of new passenger cars in Europe, leading to strong interest in the country's policy experience. Norway's starting situation for the promotion of EVs as an effective contribution to climate action is undeniably exceptional. The high political acceptance of generous tax exemptions for EVs
and Norwegians' favourable view on EVs are key conditions for success of its policy mix. Several aspects need to be considered when assessing overall transferability of Norway's policy mix to Germany. These aspects will be discussed in more detail regarding different policy instruments in this section.

The German government's plan of bringing one million EVs on the road by 2020 and 6 million by 2030 appears very ambitious compared to the status quo and current evolution of the sector.
The German E-Mobility Law (EmoG) entered into force on 12 June 2015. It lays the foundation for regions, cities and towns to grant advantages to EVs (such as access to bus lanes) but does not mandate such measures. Germany's primary policy tool for the promotion of EVs, purchase premiums of EUR 3,000 (PHEVs) and EUR 4,000 (BEVs), have not been met with sufficient uptake from consumers. The success of the purchase subsidy is limited to only about 60,000 cars. The instrument has been budgeted for 300,000 cars and runs until June 2019 (Handelsblatt, 2018). The following points merit attention in considering the transferability of Norway's experience:

- **National budget and per capita income**: Norway's wealth stemming from the export of oil and gas have given the country budget surpluses and provides the government with greater room for manoeuvre to sponsor expensive incentives and accept lost revenue due to tax cuts. Norway's per capita income is 17% higher than Germany's, possibly making it easier for its citizens to invest in environmentally friendly technology or, as in the case of Norway, in addition to conventional technology (Countryeconomy.com, 2018). Many of the EVs purchased in Norway are second or third cars in a household. This has led to a public debate on whether the generous incentives provided to buyers of EVs are socially fair and whether investment in public transport, walking or biking should be promoted as a more equitable form or sustainable transport.

- **Higher taxation of vehicles and additional charges**: Norway's success in promoting EVs is in large part due to the possibility of providing exemptions from the high fees/taxes car owners and users face in the country. Most of these costs do not exist at all or at a comparably high level in Germany. For example, Norway's purchase taxes often add up to a third of the price of a new conventional car for buyers in Norway, but EVs are exempted from this tax. Hence, for Germany to create similarly strong incentives for EVs by eliminating the price difference between electric and conventional engines, very large subsidies/purchase premiums to EV buyers would be needed while framework conditions would not change for buyers of conventional cars. For instance, in Germany, the purchasing price for similar vehicle categories is currently higher for BEVs by EUR 6,650 – 8,350 (BMW), EUR 5,490 (Citroen), EUR 2,814-5,260 (Mercedes) in Germany (ADAC, 2016). According to the ADAC, due to the high purchasing price, the costs per km are higher for BEVs than for conventionally fuelled vehicles by EUR cents 7.5 to 32.8 despite increasing prices for conventional fuels.

- **Role of national automotive industry:** The political context for the promotion of EVs differs fundamentally between Germany and Norway. The German automotive industry's importance as a provider of jobs, exports and regional as well as national wealth mean its competitiveness has to be considered in policy decisions, while this is not the case in Norway.

- **Public acceptance for e-mobility:** In Norway, already more than half of new cars are BEVs and PHEVs while Germans still appear more hesitant. Two-thirds of Germans plan to buy an ICE car as their next vehicle (7% all-electric, 23% hybrid) (Deloitte, 2018). Low visibility of EVs in the public space may be one factor for the lower acceptance in addition to the compared lack of incentives.
- **Integration in a national strategy:** Norway's long-term transport sector strategy 2018–2029 offers guidance to policy makers on how to prioritise different policy measures. It sets out the overarching priorities for the sector and aims to achieve the integration of different policy instruments to avoid conflicts in the targets. There is no such strategy in Germany yet.
- **Differences in the electricity mix:** The emissions reduction potential of electrifying the road transport sector is particularly high in Norway given the country's predominantly renewables-based electricity mix. The difference between both countries is rather large with 16 gCO_2/kWh (Norwegian water resources and energy directorate, 2018) in Norway and over 500 gCO_2/kWh in Germany. Even though Germany's electricity mix still has a significantly higher emissions factor, the increasing share of renewables in the German electricity mix, framed by a clear target to cover 65% of electricity consumption from renewable energy by 2030, also make electrification of transport a central emissions reduction requirement. The effects of emission reductions through BEVs are disputed. A study by T&E finds that even with the most carbon intensive electricity mix found in Europe, BEVs emit fewer GHG than a conventional diesel vehicle over their lifespan (Messagie, 2017). The German automotive association ADAC disagrees: a study conducted with the ifeu institute suggested that upper-midrange cars only become less emission intense after an exceedingly high distance of km travelled (580,000). For smaller cars, the study agrees that BEVs are less emission intense than conventionally fuelled vehicles when the whole lifespan is observed (Stegmaier, 2018).

5.2 Properties of the instrument

In addition to the contextual factors outlined above, the following table provides an overview of aspects to consider regarding the transferability of Norwegian policy instruments for the promotion of EVs. The most important difference to keep in mind when assessing transferability is the lower taxes for vehicles in Germany compared to Norway, offering fewer opportunities for tax exemptions. The German car registration tax is very low compared to Norway and when implemented in 2019, road tolls will be negligible compared to Norway. Hence, a revision of

- Opportunities for grant reductions from the VAT at purchase,
- A company car tax exemption overhaul, and
- Easier implementation of access to bus lanes

appear as the interesting instruments implemented in Norway to consider for transfer to Germany.

Table 3: Overview of instruments for EVs in Norway and considerations for transfer to Germany

Instrument	Considerations for transfer to Germany
Exemption from 25% VAT on purchase and on leasing for BEVs	Several studies present VAT exemptions as the most effective argument for car buyers to choose an EV in Norway (Norsk Elbilforening, 2018). However, the transferability of the instrument to Germany is not straightforward as the introduction of reduced VAT is linked to EU provisions. Reduced rates for VAT already exist in Germany under the current rule that EU countries are currently allowed to set two rates under 15%, but not under 5%. The European Commission proposed changes to this rule in January 2018 that would allow countries to set a complete exemption from the VAT for particular products. The experience from Norway shows that while the effectiveness of the instrument is high, the cost efficiency of a complete VAT exemption could be less favourable. Considerations of social equity also play a role.
Exemption from registration tax	In Germany, the registration levy ('Zulassungsgebühr') must be paid at the point of registering a vehicle and costs EUR 26 (STVA, 2018). This would not be a significant incentive compared to Norway's very high registration taxes up to EUR 10,000.
Low annual road/ motor vehicle tax	Germany already offers reductions on the vehicle tax ('KFZ-Steuer'). Further reductions would likely have a smaller effect than VAT exemptions. BEVs registered before 2016 are exempted from ownership taxes for the first ten years and for five years for vehicles registered between 2016 and 2020 (Tietge, Mock, Lutsey, & Campestrini, 2016). PHEVs benefit from lower ownership taxes because CO_2 emissions are part of the calculation of the tax. With a complete vehicle tax exemption, the annual savings are in the range of EUR 55–165 (Autokostencheck.de, 2017).
Exemption from road toll	There will be an exemption from the road toll for EVs in Germany, whose implementation is expected from 2019 ('Infrastrukturabgabe') (BMVI, Infrastrukturabgabe, 2018). Given the changes in vehicle calculation taxes, the exemption will generate annual savings in the range of EUR 2-10 (BMVI, 2018). Compared to Norway's very high road tolls, this exemption is unlikely to constitute an incentive for the purchase of EVs.
No charges on ferries	Germany has only very few ferries that transport cars, so that this instrument is not relevant in the German context.
50% reduced company car tax	Germany has already introduced a reduced company car tax (Tietge, Mock, Lutsey, & Campestrini, 2016). Germany adds 1% of the car's vehicle list price to the employee's monthly income for tax reasons. For EVs, this amount is reduced (in 2018) by EUR 250 per kWh of the installed battery and is capped at EUR 7,500. The deduction will be further reduced until 2023. Again, the amount of the incentive in relative terms compared to conventional cars and in absolute terms is much lower than in Norway, where the list price of BEVs is reduced by 50%.
Access to bus lanes	Municipalities in Germany are already allowed to grant access to bus lanes for EVs but are hesitant to implement this measure, for instance due to the expected impact on public transport. Municipalities are also hesitant to test this as removing privileges after implementation (e.g. when EV numbers go up) might be met with resistance.
Free municipal parking	Municipalities are already allowed to let BEVs park for free and some (e.g. Hamburg) have implemented it.
Special license plates	Germany already has license plates for EVs labelled with 'E'.

5.3 Potential impacts

Norway's electricity mix is, with 98%, dominated by renewables, making any electrification efforts in the transport sector very effective emissions reduction measures. Germany's 2030 climate targets of reducing emissions by 40% compared to 1990 level require reinforced action in the transport sector, where emissions have stagnated or even slightly increased. It is important to note that to achieve effective emission reductions in this sector, the increase of the share of renewables in the power sector will have to be accelerated to ensure electrification leads to emissions reduction (Dietrich, Leßmann, & Steinkraus, 2016). Indeed, some studies have criticised the promotion of EVs in Germany given Germany's coal-heavy electricity mix. This argument should be nuanced, though, given the clear expansion path for renewables in Germany, co-benefits such as local air pollution reduction and the added flexibility that EVs may provide to the power system.

When considering the expected impacts of Norwegian policy instruments in Germany, it is important to note that measures took several years in Norway before the considerable effect became apparent. Given the broader variety of available car models today and the growing trust in EVs among consumers, Germany might be able to 'leap frog' compared to early adopters like Norway.

5.4 Conclusion

Norway's policy mix for EVs is outstanding regarding its degree of ambition. The Norwegian approach does not focus on making EVs slightly more affordable than their normal price, but on making them considerably *cheaper* than conventional cars, both at the point of purchase and during operation. This principle differentiates the Norwegian approach from other countries' policies.

An important insight from the Norwegian experience that can effectively be considered in the German context is a national, integrated transport strategy that also addresses potential conflicts between public transport and the promotion of individual EVs. Norway's investment in a world-class network of charging infrastructure and the effective implementation of non-monetary benefits such as access to bus lanes for EVs are important framework conditions for the success of its e-mobility promotion, even without considering the important fiscal incentives. Norway's example shows that hesitance regarding new technologies can be overcome if appropriate measures are taken. A main challenge for Germany and many other countries will be the adoption of a tax system that reflects CO_2 emissions, either through the implementation of carbon components in existing taxes or the introduction of a carbon tax in non-ETS sectors such as transport.

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