Lessons learnt from the Norwegian policy on electro mobility (e-mobility) and recommendations for the EU policy

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Glossary and definitions

AEV – all-electric vehicles
AFI – Alternative fuels infrastructure Directive
BEV – battery electric vehicle
CMP – Clean Mobility Package
CNG – Compressed Natural Gas
CO$_2$ – carbon dioxide (consists of carbon atom covalently double bonded to two oxygen atoms); occurs naturally as a trace gas
COP21 – 21st Conference of the parties to the United Nations framework convention on climate change, known as Paris Climate Conference 2015
EV – electric vehicle
FCEV – fuel cell vehicle
GHG – greenhouse gas emission
HDV Heavy duty vehicle
HEV – hybrid electric vehicle
ICEV – internal combustion energy vehicle
IEA – international energy agency
LCA – life cycle assessment
LDV – light-duty vehicle
LEV – low emission vehicle
LNG – Liquefied Natural Gas
NEDC – New European Driving Cycle
NGO – non-governmental organisation
NOx – nitrogen oxides, most relevant for air pollution nitric oxide (NO) and nitrogen dioxide (NO$_2$)
TFEU – Treaty on the functioning of the European Union
TCO – Total Cost of Ownership
TTW – emissions Tank-to-wheel
VW – Volkswagen
WLTP – Worldwide Harmonised Light Vehicle Test Procedure
WTT – emissions well-to-tank
WTW – emissions well-to-wheel
ZEV – zero emission vehicle
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1. Introduction

Today’s society cannot imagine life without energy. Affordable or cheap electricity is an indispensable driver and component of everyday activity across the globe. A minor interruption in electricity supply causes problems and disruption in the functioning of the entire system (internet, TV, heating and cooling systems, heavy industry, etc.). An uninterrupted flow of the electricity is the basis for the economy of every country. For decades, cheap electricity has been delivered based on the supply of natural gas and coal, being the primary source of the GDP growth and policy decisions. However, the last decade has drawn attention to the scarcity of fossil fuels (OECD, 1999, p. 64) and, additionally, broader negative impact on climate (World Energy Outlook, 2017).

The awareness of the catastrophic effects of Greenhouse Gas (GHG) emissions caused the forming of a global movement in search of clean alternative energy resources and provided the opportunity for disruptive innovators, business and policymakers to shift their activities and high dependence from fossil fuels. Winter 2015 was marked as a turning point for millions of people, who went demonstrating during the Paris climate summit, demanding a clean energy revolution (Sutter, 2015).

A common agreement of the 178 governments during the 21st United Nations Conference of parties (COP21) led to the process of uniting all the countries (except Syria, Nicaragua and later via its withdrawal, the USA1) to limit emissions and to keep the overall increase in the global temperatures below 2 °C, with an aspiration of limiting them to 1.5 °C (Climate Analytics, 2015).

The EU’s roadmap towards a low-carbon economy in 2050 includes electricity as an alternative power source and a potential replacement for fossil fuels in transport and heating (2050 low-carbon economy, 2017). The emphasis on transport is especially crucial since it “represents almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities (...) In this sector, road transport is by far the

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biggest emitter accounting for more than 70% of all GHG emissions from transport in 2014”. (A European Strategy for low-emission mobility, 2017).

In 2015, EU citizens travelled on average 12,962 km per person within the EU, and they did most (72%) of it by passenger cars. To cover such a distance, one would need to drive from Madrid to Helsinki via Budapest and back. The use of buses, railways, trams, and metros was all well below 10% and aviation close to 10% (Statistical pocketbook 2017 - EU transport in figures, 2017, p. 19). The EU through its 28 Member States has the most extensive network of 5 million km of paved roads in the world, which in size surpasses both that of the United States (4.4 million km) and China (4 million km). The Union’s fleet of 254.2 million passenger cars is slightly larger than that of the United States\(^2\), and it easily outweighs the aggregated figure of China, Japan and Russia altogether (Statistical pocketbook 2017 - EU transport in figures, 2017, p. 16).

These figures illustrate well, the possible magnitude of the impact of policy changes related to road transport and the role of passenger cars. It is not a question that the current technology and the current way of life using cars are not sustainable. The “diesel gate” (Hotten, 2015) scandal, which erupted involving several major car manufacturers focused the attention on the significant differences between the policy targets enshrined in optimal laboratory conditions and the real-life use of vehicles, and in the end it substantially damaged the reputation of internal combustion engines in Europe. Motivated by the concerns of the population, the impacts of – mostly urban – air pollution, the EU has a chance to set a new policy agenda. According to the European Environmental Agency, more than 428,000 premature deaths were attributable to fine particulate matter (PM2.5), ozone (O\(_3\)) and nitrogen dioxide (NO\(_2\)) exposure in the European Union (Air quality in Europe - 2017 report, 2017, p. 9). Even though not all this pollution can be directly attributed to the transport sector, the urban areas of Western Europe for several years have been struggling with the pollution emitted by internal combustion engines. Apart from the environmental concerns, the way we use transport needs to change as well. The inefficiencies caused by congestion from road transport are estimated at one percent of EU Gross Domestic Product or EUR 100 billion (Study

\(^2\) Due to the difference in their sizes of the population though, while in the EU there is statistically one car for two persons, in the US, the figure is close to one car for one person.
on Urban Mobility, 2017). With the increasing demand for mobility (including both passenger and freight transport) this figure is expected to rise.

Electro mobility has a potential to deliver to the policy goals on the side of clean vehicles, and the current distrust with the internal combustion engine represents a good opportunity for the electric vehicle industry to gain momentum. From the policy perspective, the relative openness from the side of the population implies that now is the time to launch those policy changes, which may significantly affect citizens’ everyday life.

Electric cars (further also referred to as “EVs”) may also prove one of the most effective tools in security of energy supply and a broad use of renewable and carbon-free energy sources in the transport sector which could help the European Union to achieve its targets on CO₂ emissions reduction and could significantly lower the health hazard posed by traditional combustion engines in particular in urban areas (Clean transport, Urban transport: Electric Vehicles, 2017). The proliferation of electric vehicles, the development of the required infrastructure (e.g. charging stations) and the need for new solutions coming from research and development can also contribute to the creation of new jobs and help Europe to preserve its top position on a global level in developing and putting in place cutting-edge technologies.

2017 has marked a new milestone in the EU policy ambitions towards the reduction of carbon dioxide emissions. Following the State of the European Union address of the president of the European Commission Jean-Claude Juncker on 14 September 2017 which included fight against climate change (European Commission. Press Release, 2017), two months later (8 November 2017), the European Commission published its Clean Mobility Package which proposes that carmakers reduce the average CO₂-emissions of the produced cars by 30% by 2030 (Climate Action: 2050 low-carbon economy). The legislative process which is concluded by the co-decision of the European Council and the European Parliament is expected to last until 2019. Since the impacts of a substantive policy change – i.e. a reinforced push towards electric vehicles – reach far beyond only the automotive industry, it is expected that a very wide scope of stakeholders are going to be engaged in the legislative process, including inter alia environmentalists, the car production-lobby (Blanckaert, 2017), representatives of
linked industries (e.g. battery producers, developers of charging infrastructure but also representatives of the traditional industry e.g. the oil upstream and refinery lobby), local decision makers involved in urban planning and developers of IT solutions.

Norway, a non-EU Member State, has become a leading country in the world by taking serious measures towards fighting climate change with the introduction of innovative tools. So far Norway has been a “pioneer-country” in the use of the electric vehicles and thus can provide an appropriate base for comparison. Today’s fleet of electric vehicles is the largest in Norway per capita in the world (Aasness & Odeck, 2015). With the ambitious plans to tackle climate change, the EU could use the best experience of the electric vehicles’ implementation and provide tailored-made policy goals, to best suit the needs and competitive advantages of each Member State.

This paper concentrates on the research of relevant policies, related stakeholders and the governments’ incentives to introduce, or increase the number of, EVs.
2. Theoretical framework

2.1 Electric vehicles technical background

Generally defined, an electric vehicle is a “vehicle which uses one or more electric motors for propulsion” (Electric Vehicles Definition, 2010). The technological advancement has brought about various types of vehicles that may be considered as electric in the broader sense, despite that, their technical characteristics and modes of operation differ. Regulations and public policy measures often differentiate among these categories and if such differentiation exists, it is indicated in the thesis assessment.

The general typology of the automotive powertrain can be divided into the two primary types of electric cars: first, all-electric vehicles (AEVs), which run entirely on electricity, including often referred BEV – battery electric vehicles; and the second type – plug-in hybrid electric vehicles (PHEVs) which use a combination of plug-in charging and gasoline to run.

Three\(^3\) major types of electric vehicles with the key features and examples can be observed in Table 1:

- **Battery Electric Vehicle (BEV);**
- **Plug-in Hybrid Electric Vehicle (PHEV);**
- **Traditional/Standard Hybrid Vehicles (HEV).**

<table>
<thead>
<tr>
<th>Types of fuel</th>
<th>BEV</th>
<th>PHEV</th>
<th>HEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity only.</td>
<td>Electricity; Petrol.</td>
<td>Petrol; Electricity.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanism of operation</th>
<th>BEV</th>
<th>PHEV</th>
<th>HEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>The vehicle is operated via an electric motor, which receives its power from the car’s battery pack.</td>
<td>The main source of power is the electric motor, which is supplemented by the internal combustion</td>
<td>The vehicle’s main propulsion comes from its internal combustion engine. The electric motor is complementary.</td>
<td></td>
</tr>
<tr>
<td>The battery can be</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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\(^3\) Sources also mention the Fuel Cell Electric Vehicles, where a chemical reaction of the stored hydrogen and oxygen charges the electric engine. Since this technology is not yet widely spread and regulation does not specifically cover it, this vehicle type is omitted from the analysis.
charged from an external source. 

engine in order to extend the vehicle’s range.  
• The battery for the electric motor can be charged from an external source.  
• Electric motor cannot be charged from an external source, it receives energy from the movement of the vehicle.  

| Examples of models | BMW i3; Renault Zoe; Tesla Model S/X. | Volkswagen Golf GTE; KIA Optima; | Toyota Prius; Honda Civic Hybrid; Lexus RX400 h |

Electric motors have several advantages over conventional combustion engines. This includes their higher efficiency (an electric vehicle converts around 80% of the energy it uses to usable power, compared with around 20% for a conventional vehicle), high durability, lower maintenance costs and quieter noise levels at low speeds. (...) The battery in an electric vehicle stores electrical energy that the electric motor uses to power the vehicle. Most electric vehicles use lithium-ion batteries. These have certain advantages over most other battery types, including higher energy storage capacity and longer life-spans. However, current battery systems tend to be both heavy and costly.” (Electric Vehicles in Europe, 2016, p. 11).

Battery electric vehicles (BEVs) usually receive higher purchase subsidy due to perceived zero emissions while being in use. (P. Plötz, S. Funke et al, 2017, p. 3). PHEVs’ fuel consumption depends on the distance driven between recharging and the all-electric range (P. Plötz, S. Funke et al, 2017, p. 4). Analytically, it is difficult to measure the PHEV fuel consumption due to the lack of the official measurements of the share of electricity and conventional fuel for propulsion. In addition it largely depends on the individual driving and charging patterns.
2.2 Literature review

The thesis’s backbone consists of a critical review of the available literature on the topic. The Norwegian national plans and municipal regulations (primarily in the capital city Oslo) and other reports served as the primary source for mapping the main elements of the public policy, and I rely on mostly academic reports and analyses for the assessment of the success of the policy. The sources related to the European Union dimension of the policy elements are primarily those of the European Commission and the European Environment Agency (communications, reports legislative proposals and impact assessments). Where possible, I attempted to incorporate also Member State regulations in the assessment. Given the high level of the lobby and media interest, I occasionally used documents prepared by the various stakeholders, mostly to demonstrate the diverging views and to formulate a critical position.

2.2.1 Description of the EU policy

General information

The European transport policy is a key instrument for realizing the free movement of goods, persons and services, and as such, it is one of the cornerstones for the functioning of the internal market. Even though it was marked as one of the first common policy areas of the European Economic Community with its base enshrined in the Treaty of Rome⁴, the actual transport policy was born in a revolutionary way. The European Parliament took its fellow institution the Council of the European Union to the European Court of Justice because of the latter’s failure to develop common transport policy. The Court’s ruling in 1985 proved to be a decisive trigger followed by numerous legislative and strategic proposals by the European Commission laying the foundations of a common transport policy in 1992 (The EU explained: Transport, 2014, p. 4).

Partly because of its high dependence on fossil fuels, the environmental and the energy-related aspects have been an integral element of the European transport policy since its

inception in 1992, and have been gradually gaining more and more emphasis within. There are numerous policy areas – such as the development of physical infrastructure and missing links, removing the administrative barriers to foster cross-border transport and to integrate national markets, harmonizing national policies and standards – which are essential for achieving the goals of sustainable and efficient mobility, even so, due to the limited scope of this paper, they are not researched. The related EU policy areas are taken into account only to the extent they have a bearing on electro mobility. The links between the EU transport and other policy areas are presented in Figure 1.

**Figure 1 - The links of the EU transport policy to other EU policies. Source: (COM(2017) 283 final, 2017, p. 4)**

![Image of Figure 1](image)

**Review of the Clean Mobility Package**

“The Clean Mobility Package\(^5\)” (CMP) (EC: Mobility and transport, 2017) was adopted by the European Commission on 8 November 2017, and it is the second out of three batches of policy and legislative proposals, which all together form part of the Commission’s strategy “Europe on the Move” (for more details, see: (Resilient Energy Union with a Climate Change Policy, 2017)). The principles and tasks of the “Europe on the Move” strategy were set out in the Commission’s preceding European Strategy for Low-Emission Mobility (COM 501, final, 2017).

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\(^5\) The name “Clean Mobility Package” is the short working form of the Commission’s second mobility package issues under the umbrella communication “A European Union that protects the planet, empowers its consumers and defends its industry and workers”.

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The proposals are linked to the climate policy objectives of the Union summarized in the Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy (COM 80 final, 2015). It is expected that in the second quarter of 2018 a third and final Mobility package will be adopted (Management Plan 2018, 2017, p. 14). Figure 2 provides a general overview of Europe on the move strategy.

Figure 2 - The packages under the “Europe on the Move strategy”

![Image](image-url)

The Clean Mobility Package includes both direct measures to move away from internal combustion engines such as the new CO₂ standard (EC: Mobility and transport, 2017) and also indirect measures to incentivize low-carbon solutions for instance via taking stock of the trans-European deployment of alternative fuels infrastructure (Directive 2014/94/EU, 2014), the promotion of clean and energy-efficient road transport vehicles

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6 The first package “An agenda for a socially fair transition towards clean, competitive and connected mobility for all” (An agenda for a socially fair transition towards clean, competitive and connected, 2017) is not analysed in detail in this thesis.
(COM 0653 final, 2017), the battery initiative\(^7\) and a proposed revision of the Energy Performance of Buildings Directive 2010/31/EU (Amending Directive 2010/31/EU 2008/0223(COD), 2017). Only in three out of these five areas did the European Commission table a new legislative proposal in the package\(^8\) and even those are only amendments of already existing pieces of the acquis. The lack of legislative proposals in new areas demonstrates that the Commission considers the refinement of the existing legislative framework appropriate. Furthermore, it shows that there is still not enough policy maturity and/or political will – or just simply no visible need\(^9\) – to put in place new legal proposals for a more detailed regulation focusing on electro mobility. The main elements of the Clean Mobility Package are explained in brief later on in this Chapter.

The CMP was sent to the co-legislators and relevant stakeholders for consultation and it is currently undergoing the ordinary legislative procedure (formerly called as “co-decision” or “COD”) of the European Union, notably, following the proposal by the European Commission, it is being discussed in the European Parliament (lead committee ENVI), and in the Council Working Groups (Briefing: EU Legislation in Progress, 2018, pp. 1-14). Since the ordinary legislative procedure usually takes longer than a year and the mandate of the current European Parliament and the incumbent college of commissioners of the European Commission lasts until 2019, there is no certainty that a political agreement and thus an approval of the legislative elements of the Clean Mobility Package can be achieved before the next European Parliamentary elections.

\(^7\) The package also includes two additional proposals, which will not be part of the assessment of this thesis. These include a proposal for a directive on the establishment of common rules for certain types of combined transport goods between Member states and a proposal for a regulation on common rules for access to the international market for coach and bus services.

\(^8\) The other two legislative proposals in the package i.e. stimulating combined use of trucks and trains, barges and ships for transport and promoting the development of bus connections over long distances do not fall under the scope of this thesis and therefore are excluded.

\(^9\) As several policy measures in the area of fostering electro mobility focus on local and national level, the principle of subsidiarity may be a reason why no European-level regulation is considered either by the Commission or by the Member States.
*Regulation for setting emission performance standards for new passenger cars and light commercial vehicles (CO₂ Regulation) (COM 676 final, 2017)*

The core of the proposal is setting cost-effective CO₂ emission reduction targets for new vehicles up to 2030 and the introduction of an incentive mechanism to increase the share of zero/low-emission vehicles. The EU action is justified by the cross-border impact of climate change and the need to safeguard the European single market in vehicles. In addition, the political argument also refers to China’s introduction of mandatory quotas for vehicles and derives from this development that the EU’s automotive industry must become a global leader in clean vehicles if it wants to preserve its position on the global market.

The new regulation is also supposed to remedy the shortcomings experienced so far during the implementation of other existing pieces of the acquis:

- for consumers the savings on lifetime fuel costs have been lower than expected because of the increasing divergence between the test cycle and the real world emissions performance;
- the implementation of the current policies will not help to sufficiently decrease the GHG emissions to reach the EU target of 40% reduction, compared to the emissions in 1990 by 2030 and the target of 60% reduction by 2050. Out of these general targets, the road transport sector will need to deliver at least 30% emission reduction by 2030 compared to the 2005 levels\(^{10}\);
- air quality problems in urban areas pose an increasing problem in particular related to NOₓ emissions.

The new regulation recasts and merges two old regulations related to passenger cars and light commercial vehicles and is planned to enter into force in 2020. The proposed target for the new EU-fleet is a 30% reduction in 2030 compared to the 2021 targets both for passenger cars and vans\(^{11}\). This would be achieved via setting an interim target for 2025. The first target until 2020 is 95 g/km for passenger cars and 147 g/km for

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\(^{10}\) The current proposal is just one of the several elements of policy proposals to cut the road transport emissions. The revised Renewable Energy Directive and the revision of the Eurovignette Directive both aim at reducing road transport related emissions.

\(^{11}\) The proposal maintains the Tank-to-Wheel (TTW) approach describing the target for the whole sales-weighted average of a manufacturer’s fleet in gCO₂/km.
vans, both measured via the New European Driving Cycle (NEDC)\textsuperscript{12} which represents the currently being phased-out methodology. As of 2021, the emissions targets will be based on a new test procedure, the Worldwide Harmonised Light Vehicle test Procedure (WLTP)\textsuperscript{13}.

A new crediting system for low/zero-emission vehicles is to be introduced, which is expected incentivise manufacturers to increase the share of such vehicles in their overall portfolio.

The Commission proposal steps up the enforcement and penalty regime by proposing closer monitoring of the deviations in real \(\text{CO}_2\) emissions compared to the type approval values, the real world representativeness of the WLTP test procedure and imposing financial penalties in case a car manufacturer exceeds its target.

\textsuperscript{12} The NEDC was designed in the 1980s and became outdated today due to several evolutions in technology and driving conditions. It includes a lighter test procedure (\textit{inter alia} shorter cycle distance, lower average speed) than the WLTP, which entered into force in 2017.

\textsuperscript{13} The WLTP procedure is defined in Commission Regulation (EU) 2017/1151 and it aims to provide \(\text{CO}_2\) emission and fuel consumption values that are more representative of real world conditions i.e. stricter than the previous NEDC test cycle.
As regards the budgetary implications, according to the Commission, the proposal does not require additional financial resources, which means that on EU level, taxpayers will not have to pay more because of this regulation, however, it may be assumed that some financial burden on national level will appear. Regarding monitoring and reporting and concerning the penalties to the manufacturers for non-compliance with their targets, Article 7 part 6 states: “Member States shall designate a competent authority for the collection and communication of the monitoring data in accordance with this regulation and shall inform the Commission of the competent authority designated”. (COM 676 final, 2017, p. 46). It is worth to note the outcomes of consultations with stakeholders on the other directive on clean road transport vehicles. The policy proposal PO5, which had the highest costs and introduction of the high level of intervention, was rejected by most of stakeholders (SWD 367 final, 2017).

The CO₂ regulation provides a prediction on the level of national administrations and budgets: it is expected to have a revenue loss in fuel tax income in 2030 at approximately 0.04% of the EU-28 GDP, which is “assumed to be compensated by an increase in indirect taxation” (COM 676 final, 2017, p. 3).


This proposal represents the core and most direct policy instrument that affects the market share of electric vehicles. The Commission decided to propose the amendment of an existing directive due to the fact that stakeholders during the public consultation opposed converting it into a directly applicable regulation. An EU directive – by its nature – allows for certain flexibility on national and lower levels because it must be transposed by the national legislators, and its provisions are not directly applicable by the letter. This makes the directive less effective in delivering a desired particular policy goal, but it also provides an appropriate tool to accommodate national, regional and local differences and specificities.

The leitmotif of the proposal is that the engagement of the public sector via public procurements can provide demand-side stimulus for an increased market uptake of clean and energy-efficient vehicles. This in turn can contribute to the economies of scale in the production of such vehicles and could lead to reduced costs and thus prices. The
Commission assumes that the greater visibility of these vehicles could establish consumer trust and could incentivise citizens to consider switching to such vehicles. The reason for EU-level action is justified by importance of public procurements in achieving the EU’s environmental, climate, energy and competitiveness objectives.

The ex-post evaluation of Directive 2009/33/EU in 2015 showed that public procurement is not used to the desired extent in order to provide the necessary positive impact and in fact it had limited impact on the spreading of clean and energy-efficient vehicles. The old directive had also other weak points that were connected to the limited provisions on its scope – i.e. it covered only direct purchase by public bodies but no other options such as renting, leasing or hire-purchase and it covered only public passenger transport but no other forms of transport services. In addition, now a more clear definition of the “clean vehicle” is provided.

The newly proposed amendments aim to tackle all the previous weaknesses. A crystallised definition from the “clean and energy-efficient” to “clean vehicles in support of low-emission mobility” (i.e. not zero-emission but “low”), aims to widen the directive’s scope; the definition of what is a clean vehicle is based on the emissions-based approach (tank-to-wheel CO\textsubscript{2} and air pollutants\textsuperscript{14} for light-duty vehicles and alternative fuels for heavy-duty vehicles). The newly amended directive includes lease, hire-purchase and other services (i.e. to public road transport, special purpose road transport passenger services, non-scheduled passenger transport and hire of buses and coaches with a driver).

The follow-up approach is something that most of the stakeholders agreed on. The planned reporting and monitoring framework (Member States will need to report on the implementation every three years starting in 2023), will become a crucial instrument in monitoring the success and failures of all the Member States.

The estimated cost savings for the new policy are approximately EUR 4.2 billion relative to the baseline 2020-2035 indicating wider socio-economic and environmental benefits. The new legislation will be evaluated in 2027. Certain weaknesses of the current proposal, nevertheless, can be observed (Bellona Foundation, 2018):

\textsuperscript{14} particulate matter, nitrogen oxides and non-methane hydrocarbons
• getting rid of the monetisation methodology for life-cycle costing adds flexibility but it opens the door for favourable policies to specific models;
• focusing on tank-to-wheel and not on well-to-wheels (see Figure 4) does not realistically take into account the carbon footprint for producing ZEVs;
• an objective Cost-Benefit Analysis (CBA) should take into account the full life cycle of the vehicles including decommissioning.

Figure 4 - WLTP Policy recommendations. Source: (WLTP, Worldwide Harmonised Light Vehicle Test Procedure, 2017)

Alternative fuel infrastructure (COM 652 final, 2017)

The European Commission’s Communication on Alternative Fuels Infrastructure is not a legislative proposal but rather a review of the implementation of Directive 2014/94/EU in particular of the national policy frameworks aiming to foster the deployment of fuelling/charging stations for:
• electric vehicles;
• (CNG) Compressed Natural Gas vehicles;
• (LNG) Liquefied Natural Gas vehicles and
• Hydrogen fuel cell cars.

The aim of this Directive is to support the market uptake of such vehicles via providing the charging/fuelling infrastructure that is necessary for the day-to-day operation of
these cars. The Commission’s ambitions are remarkable in a sense that they plan to create an interoperable EU backbone infrastructure by 2025 at least for the TEN-T Core Network corridors (DIRECTIVE 2014/94/EU, 2014). The estimated required budget for this network is 1.5 billion EUR. (Wainwright, S. Peters, J., 2016).

Figure 5 - TEN-T core network corridors. Source: (Infrastructure - TEN-T - Connecting Europe, 2017)

It is worth mentioning, that the current and foreseen research and development projects, related to the infrastructure concentrate on the mapped corridors. In the course of my interviews, I raised this question to Eurelectric and Verbund (Austria’s largest electricity provider). Verbund indicated that also remote areas in Austria are being considered and a number of charging stations for electric cars has been and are being planned to be installed. As Eurelectric points out, “If car manufacturers reach this goal, they would – ceteris paribus – automatically also reach the emission performance standards. The European electricity industry is heavily investing into electric vehicle charging infrastructure, as well as charging services development and the development of grids to smart grids. And we are not the only ones – also car manufacturers are investing into high-power chargers along motorways, and some sell EV charging boxes
to their customers who buy an electric car. The charging infrastructure will not be a problem – also because a charging point installation is very quick: when we see that more cars are coming, we can adapt the infrastructure accordingly” (EURELECTRIC aisbl, 2017).

According to the European Alternative Fuels Observatory there were 118,000 publicly accessible electric charging points available at the end of September 2017. In case the 7% share of electric vehicles is achieved by 2025 (as assumed by the European Commission’s Impact Assessment for the proposal of the CO₂ Regulation) the investment needs would mean: 440,000 publicly accessible charging points by 2020 via an investment of EUR 3.9 billion and 2 million publicly accessible charging points by 2025, which would trigger an investment of EUR 2.7 – 3.8 billion per year as of 2021, depending on the share of fast chargers.

The Member States’ National Policy Frameworks (NPFs) are the primary tools for setting clear long-term targets and for fostering relevant support measures thus providing the necessary regulatory and policy certainty. It is this reason why the lack of ambition and the persisting uncertainty in some NPFs represent a considerable barrier to the development of the required alternative fuels infrastructure. The support measures in NPFs vary significantly among Member States in terms of maturity and priority setting but also about the targeted transport modes (e.g. trains, buses, taxis, bikes, shared cars etc.). While acknowledging the national and regional differences in the use of transport, such a diverse national policy environment hinders the development of a pan-European network of alternative fuels infrastructure and more importantly it keeps the uncertainty whether the vehicles of the future should run on electricity, gas or another form of energy. The technological neutrality of the European Commission also contributes to this uncertainty.

The Commission plans further actions and dialogue with the Member States to update their NPFs to be in line with the other policy targets related to clean mobility. The other instruments such as the CO₂ Regulation and the Clean Vehicles Directive could also provide additional push for more ambitions related to alternative fuels infrastructure on national level.
EU public funding is also expected to contribute to the development of the alternative fuels infrastructure. The first Connecting Europe Facility (CEF) call in 2017 provided EUR 150 million for projects of alternative fuels infrastructure and by spring 2018 the Commission topped up the programme’s budget by an additional EUR 350 million. Apart from CEF, funds from the Cohesion Fund and the European Regional Development Fund are also available.

Since the majority of electric charging points are expected to be in urban areas, it is important that actions on all levels contribute to this:

- The joint design by including stakeholders and the implementation of Sustainable Urban Mobility Plans (SUMPs) proved to be successful in bringing together various actors in mobility;
- Local governments in the Covenant of Mayors for Climate and Energy should include measures for the reduction GHG emissions in their Sustainable Energy and Climate Plans;
- Information on urban access schemes must be more transparent for citizens.

It is vital that consumers are fully on board in embracing and using the alternative fuels infrastructure for charging their electric vehicles. To this end, more user-friendly, seamless and interoperable services and payment solutions which can be used on a pan-European level must be introduced and the service providers identified.

**Battery Initiative**

“..To ensure that new vehicles and their components are produced in the EU. EUR 200 million will be allocated to batteries research and innovation (in addition to the 150 million EUR already allocated”. (COM(2017) 0675 final, 2017)

The strategically important battery initiative of the CMP does not include yet the necessary regulation proposals. The current negotiations on the EU level are happening “behind the closed doors” (Bellona Foundation, 2018). Among the key events and documents that are publicly available, the only official information is related to the launch of the European Battery Alliance (October 2017), by Maroš Šefčovič, Vice-President of the European Commission (The European Battery Alliance, 2018). This is an industry-led initiative that “will act as a catalyst for establishing a competitive
battery value chain in Europe. Clearly, it is observed from the speech and from the lack of relevant policy documents that, indeed, in the area of the e-mobility initiatives, manufacturers are: “not sitting and waiting for us to push them. Many of them have made announcements in recent months and years about the targets they are setting for themselves. BMW committed itself to produce 25 electrified vehicles of which 12 will be fully electric – by 2025. The PSA Group announced that it would launch 11 electric Citroën, Peugeot and DS vehicles in Europe within the next five years. Four of these will be pure-electric models. And by 2025 each model would have an electric variation” (Šefčovič, 2018).

The most recent report, Fuelling Europe’s future: how the transition from oil strengthens the economy (Low-carbon cars in Europe: A socio-economic assessment, 2018) suggests that “transition towards clean mobility cannot be successful without profound changes to the technologies used to power vehicles. Cleaner fuels such as electricity and hydrogen will need to become the norm.” The key findings of the report draw the important conclusion that policymakers should adopt ambitious measures on the EU and national level to provide a quick and successful transition towards e-mobility.


A direct link between the uptake of EVs and the EPBD was often was underestimated by members of the European Parliament (Bellona Foundation, 2018). As a researcher of this topic, I believe this is an important and valuable lesson that should be taken on board by many policymakers across EU. As representatives of Bellona foundation stated: “It is important to educate not only consumers, but also policymakers” (Bellona Foundation, 2018). Clearly, in Norway both sides quickly realised that energy saving is possible with the use of EVs and with efficient building performance.

According to the data provided by the European Commission, “Buildings are responsible for 40% of energy consumption and 36% of CO₂ emissions in the EU. Currently, about 35% of EU buildings are over 50 years old. By improving the energy efficiency of buildings, total EU energy consumption could be reduced by 5-6%, whilst CO₂ emissions could decrease by about 5%”. (Buildings: key laws, 2018).

This Directive puts an emphasis on the lack of charging infrastructure, which can be a potential barrier to the consumers who are willing to purchase an EV. This policy instrument can reinforce and bring in place the desired deployment of the charging infrastructure. “The revised Directive includes ambitious provisions to ensure that the buildings’ car parks will be progressively equipped with charging points, allowing electric vehicle owners charge their vehicles when and where needed” (Buildings: key laws, 2018).

According to the Amendment 54, Article 1 – paragraph 1 – point 5 – point b: “The requirement will apply to (new and major renovation of) non-residential buildings with more than 10 parking spaces, but only for 20 % of parking spaces. For such buildings, at least one recharging point will also have to be installed and made available for users (e.g. to charge their vehicle while at work)”. ((COM(2016)0765 – C8-0499/2016 – 2016/0381(COD)), 2018).

The directive will also require Member States to lay down requirements for the installation of a minimum number of charging points, for all non-residential buildings with more than 20 parking spaces, by 1 January 2025, and to simplify the deployment of charging points in buildings, e.g. in relation to permitting and approval procedures.
The Council of Ministers is expected to finalise its formal agreement in an upcoming Council meeting. This endorsement will be followed shortly by the publication of the text in the Official Journal of the Union, which will enter into force 20 days after publication. Member States will then have to transpose the new elements of the Directive into national law within 20 months (Buildings: key laws, 2018).
2.2.2 Description of the Norwegian policy

Norway is often referred to as a success story in fostering the introduction of electric vehicles with consistent policy measures, which arch over a considerable period of time. In 2017, there were 176,000 electric cars in Norway altogether, and 39% of all newly sold personal light-duty cars in that year were electric. These figures make Norway arguably one of the pioneer countries in electro mobility (the global comparison is provided in Figure 6. However, even these impressive figures mean that only 1 in 16 cars in Norway (Global EV outlook 2017: two million and counting, 2017, p. 12) is, in fact, electric, which cannot be considered as significant market share within the total personal LDV stock.

![Electric car sales, market share in selected countries, 2010-16. Source: (Global EV outlook 2017: two million and counting, 2017, p. 12)](image)

So far it is the battery electric vehicles (BEVs) which dominate the sales of EVs in Norway; however, the share of hybrids especially plug-in hybrid vehicles (PHEVs) is also catching up. During 2017 the share of BEVs among the newly registered LDVs was 20.8% and PHEVs constituted 18.4% (Ayre, Clean technica, 2018). Since the regulations for these different electric vehicle types are not identical, whenever possible the relevant policy framework will be explained separately for both.

Electric cars in Norway are mostly used for everyday commuting; popular day trips and rarely for longer-distance travels such as holidays. For those, the ICE models still appear to be the best choice even if the trend is changing and EVs are used for longer trips and for a wider range of activities than just within-day commuting and travel (Figenbaum, 2015, p. 26).
The first elements of the Norwegian electric vehicle policy were put in place at the end of the 1990s with the intention to boost the Norwegian automotive sector and to take steps to preserve the environment, however, a visible increase in the number of EVs can be observed only since 2009-2010. Since the 1990s, the scope of policy elements has been broadened, even though they still remain a collection of various actions and are not merged into a single dedicated electric vehicle strategy or program (see Figure 7). Today the Norwegian policy on electro mobility is shaped by national and global environmental and sustainability targets and may be heavily influenced by EU legislation due to the relevance and applicability of EU directives and regulations to the European Economic Area (EEA) (Hanley, 2017).

*Figure 7 - Comparison of long-term policies in Norway and other countries. Source: (Figenbaum, 2015, p. 13)*

**Long term policies and incentives in Norway**

<table>
<thead>
<tr>
<th>Norway</th>
<th>Typical other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchored in broad political agreements</td>
<td>Current government or local authority policy</td>
</tr>
<tr>
<td>Open ended, until law/regulation changed</td>
<td>Linked to date or target, renewal needed</td>
</tr>
<tr>
<td>Tax exemptions, large taxes on ICEs</td>
<td>Grant/bonus from budget allocations, no taxes on ICEs</td>
</tr>
<tr>
<td>National</td>
<td>Often regional partial markets, fleets, vans</td>
</tr>
<tr>
<td>Stable over long time</td>
<td>Frequent change and short time horizon</td>
</tr>
<tr>
<td>Never empty</td>
<td>Funds run empty, lead time for new budget</td>
</tr>
<tr>
<td>Consumer oriented</td>
<td>Fleet oriented</td>
</tr>
<tr>
<td>Many valuable user privileges</td>
<td>Some offer preferential parking</td>
</tr>
</tbody>
</table>

**Conclusion:**

| Stable long term framework for businesses and consumers, risk compensated for all. | Unstable short term framework, risk for actors/consumers related to changes |

*Exeptions: France, UK*

The energy system decarbonisation goal of the Norwegian Ministry of Climate and Environment from 2017 sets 80-95% GHG emissions reduction by 2050 from the 1990 level (“Prop.77 L (2016–2017): Lov om klimamål”, 2017)\(^15\). The EV deployment target in the National Transport Plan (NTP) 2018-29 states that “after 2025, all new light-duty vehicles, city buses and light commercial vans should be zero-emission vehicles” (National Transport Plan 2018–2029, 2017)\(^16\).

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\(^{15}\) Lov om klimamål from Norwegian “love for climate”  
\(^{16}\) Avinor AS, Norwegian National Rail Administration (Jernbaneverket), Norwegian Coastal Administration (Kystverket) and the Norwegian Public Roads Administration (Statens Vegvesen), (2016).
Financial incentives

The scope of the financial incentives includes and can be summarised in Table 2:

- No purchase/import taxes (1990)
- Exemption from 25% VAT on purchase (2001)
- Low annual road tax (1996)
- No charges on toll roads or ferries (1997 and 2009)
- Free municipal parking (1999)
- 50% reduced company car tax (2000)
- Exemption from 25% VAT on leasing (2015)

It is expected that in 2018 there will be a revision of the tax incentives. Free toll roads will probably be replaced with a new system with differentiated prices depending on CO₂ and NOₓ emissions (European Alternative Fuels Observatory, 2017).

<table>
<thead>
<tr>
<th>National financial incentives to reduce the purchase price</th>
<th>Measures for the installation of charging infrastructure</th>
<th>National operational incentives</th>
<th>Local rules and measures (regionals, municipalities)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exemption on registration tax (only for BEVs)³⁷</td>
<td>Financial support to charging stations</td>
<td>Free use of toll roads¹⁸</td>
<td>Free parking in urban areas¹⁹</td>
</tr>
<tr>
<td>VAT exemption (only for BEVs)</td>
<td>Financial support to fast charging</td>
<td>Limited and later full bus lane access in urban areas²⁰</td>
<td></td>
</tr>
<tr>
<td>Lower company car tax</td>
<td></td>
<td>Reduced ferry rates (from 2009 free access on ferries connecting parts of the national road network. For other ferries, local governments can decide).</td>
<td></td>
</tr>
</tbody>
</table>

"National Transport Plan 2018-2029" -
https://www.ntp.dep.no/English/_attachment/1525049/binary/1132766?_ts=1571e02a3c0
¹⁸ The measure is in place only until 2019 after that a low fee will be applicable.
¹⁹ This measure was applicable on a national level but since 2016 the authority to decide was transferred to local government level.
²⁰ The regulations on the national level include the rules related to traffic signs but local municipalities may diverge (typically in a more restrictive way) from that.
Charging infrastructure

In Norway the development of the charging infrastructure started in 2010 with public funding provided to the promoters. Recently fast charging has been encouraged, and on the main highways charging points have been installed every 50 km (Nordic EV outlook 2018: Insights from leaders in electromobility, 2017) and until the end of 2017 they covered almost the full highway network.

There were 9000 public charging stations in 2017 available in Norway which corresponds roughly to 1 public charging point for 18 EVs. The growth rate of public charging points compared to the number of EVs is decreasing which may give the impression that the infrastructure can hardly keep up with the increase in the number of the EVs. However, this is a distorted picture, because most of the charging actually takes place at home. (Also on the global level it appears that the share of private chargers has consistently been much higher than public chargers, as seen in Figure 8. The Norwegian examples show that charging an EV does not really replicate the fuelling habits for an ICE car. No commercial or public chargers are used in most of the time and charging takes place at night with a slow charger. This also fits the picture of using the EV mostly for short day-trips (Figenbaum E. and M. Kolbenstvedt, 2016).

Figure 8 - Frequency of charging by category in Norway 2014-2017. Source: (Nordic EV outlook 2018: Insights from leaders in electromobility, 2017, p. 31)

It may have contributed to the success of the widespread instalment of private chargers that in Norway it is possible to install a charging point in existing buildings without the approval of the housing unit board. This is not the case in all countries. There used to be
no specific regulation to prescribe the installation of charging points in new buildings, though in most cases they were installed because it increases the value of the parking place. However, since January 2018 EVs are supported via a new regulation on the requirements for electric vehicle supply equipment in new buildings and parking lots. For parking lots and areas of new buildings, a minimum amount of 6% has to be allocated to electric cars. As an incentive, the 2018 budget allocated to housing associations for installing chargers doubles the 2017 budget to NOK 20 million (USD 2.4 million) (Norwegian Ministry of Transport, 2016).

Local rules and measures

Since 2016 Norwegian municipalities have the authority to decide on the range and level of local incentives towards using EVs (Figenbaum E. and M. Kolbenstvedt, 2016). This can address the anomalies and provide responses on the local level but it also leads to a fragmented regulatory framework and more difficulty in tracking what rights and perks the owners of EVs have. On the other hand, local incentives can have a strong impact on the overall population of EVs in the area (e.g. a tunnel with a high toll except for EVs connecting isolated areas can be a good motivation to purchase an EV so that the toll can be saved).

Criticism

In spite of the overall positive and encouraging image of the Norwegian electro mobility policy, the figures warrant a more critical examination of its overall effectiveness. Even though the share of electric vehicles among new cars sales is significant – a bit more than 1 in 3 new cars are electric, the overall share of EVs within the total national fleet remains hardly below 3% (Zeniewski, 2017). This shows that with all the incentives in place, no massive conversion of the traditional petrol/diesel vehicles to electric cars has taken place. It may also signal that the impacts of the policy may be expected to kick in at a much longer timespan than originally expected. Vivid debates are taking place in Norway as to whether and if yes, then to what extent, the favourable treatment and incentives for electro vehicles should be continued. On the one hand, the tax exemptions represent lost income for the state budget additionally, and local communities are beginning to experience the adverse effects of the high concentration of electric vehicles.
in their areas in the form of congested bus lanes and thus public transport and the lack of parking places. Furthermore, some argue that because the average price of EVs is higher than a traditional car, the benefits and incentives are in fact providing support for the already wealthy part of the society, and because the incentives are financed from the general budget, this represents a de facto welfare transfer from the poorer segments of the Norwegian population to the rich ones. The voices to revoke the positive discrimination of EVs are counter-balanced by arguments that the policy has not yet delivered a critical amount of electric vehicles within the total fleet. The essences of these discussions present a showcase of the potential traps and negative externalities, which should be avoided in the design of the European policies on electro mobility.
2.3 Methodology, concept and research question/hypotheses

2.3.1 Research method

Transport – similarly to other sector-specific policies – has a multi-layered dimension in the European Union including local, national and European levels. In an attempt to provide a comprehensive picture, I will focus my research mostly on the European and partly on the national level and will bring examples of local initiatives only for illustration.

The thesis employs a qualitative method in examining whether the current and the suggested European policy framework on electro mobility is fit and robust enough to generate an increase in the share of electric vehicles within the total fleet of the European Union. Through the case study of the Norwegian policy implementation, I examine the Norwegian experience gained in the last 10 years, starting from 2007-2008, and I compare it with the recently proposed approach in incentivizing electro mobility in the EU\textsuperscript{21}. A comparative analysis between the future EU policy goals and the Norwegian results (as seen in Figure 9), can provide a basis to identify those potential policy actions where the Norwegian best practices can be used as an example for the EU, and which are those adverse effects that should be avoided.

\textsuperscript{21} Within the scope and EU’s related policies to the “Clean Mobility package”, issued on 8 November 2017.
As a result of the qualitative assessment of both the Norwegian and European policies, I map the main elements on both sides, including the lessons learnt from Norway (if applicable). The list of policy elements is helpful to conduct a peer-review, two-case comparative study.

The results of such a comparison would only be fully relevant in the case of two comparable entities. The European Union and Norway are however substantially different in several dimensions. One is a supranational organization with limited powers (due to the principle of subsidiarity (Resilient Energy Union with a Climate Change Policy, 2017) to directly impose regulations, while the other one is a single state. The EU’s Member States have significantly diverse levels of economic development and different economic and political objectives. Norway has relatively cheap electricity available from its massive hydropower plants, whereas in the EU the structure of the energy mix belongs to national authorities, and Member States do have heterogeneous sources of energy with – occasionally – diverging national energy policies. These differences are taken into account and are considered during the comparative analysis in Chapter 3.

22 The lack of coordination especially in power generation led to anomalies on the internal EU electricity market. The European Commission’s proposed Clean Energy Package and the new electricity market design within aims at establishing certain levels of coordination among national energy policies.
In order to add a practical component to my research, I have also collected citizens’ input via an online survey and conducted a series of interviews with the prominent EU and Norwegian stakeholders.

2.3.2 Survey methodology and findings

As part of the research for this thesis, an online survey was carried out to map consumer choices and expectations for electric vehicles. The questionnaire was designed and published using the European Commission’s EU survey tool (https://ec.europa.eu/eusurvey/home/welcome). The detailed list of questions can be found in Figure 17. Between 1 March and 25 April 2018 a total of 240 replies were submitted covering 20 countries. The geographical distribution of the respondents’ countries is illustrated in Figure 10.

Figure 10 - The number and share of replies submitted for the survey per country. Source: own compilation.

The replies were dominated by males (66% vs. 28% of females). In a few instances, the respondents chose not to reveal their gender. The open call for contributions was

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23 For the sake of simplicity, non-EU countries are counted as a single group/country.
24 The labels of the countries with one or two replies are not indicated on the graph for better visibility. From Austria, Denmark, Estonia, Luxembourg and Portugal 2-2 replies were submitted. From Bulgaria, Lithuania, Poland, Romania and the United Kingdom only one submission was received from each.
advertised via social media and did not target a specific group of people (based on, for instance, age, location, gender or social status).

Since the survey did not have a special target group and was not designed to reach-out to a pre-defined part of the society comprehensively, its results cannot be considered representative. However, its results provide valuable insight into the attitudes and perceptions towards electric vehicles in a random sample of the population.

A great number of the survey’s respondents currently own a car, which is fuelled by petrol (34%) or diesel (30%) and to a much lesser extent by electricity (8%)

When asked about the reasons for purchasing an electric car, the overwhelming majority of the responses (159) indicated contributing to the reduction of the carbon footprint and saving the environment. In a few (5) cases a reference to the role of EVs in better urban air quality and the anticipated future regulations and prohibition of entry into cities for cars with internal combustion engines (mostly diesel) was made. This shows a strong link – in the perception of many respondents – between EVs and clean environment.

The second most often chosen reason (70) was that buying an EV is a sound economic choice and a good investment. This reason is complemented with low running and maintenance costs and the expected reduction of prices. Those respondents who considered an EV a sound economic investment were asked an extra question about which (existing or planned) public policy incentives would convince them to buy an EV. Half of the replies were either empty or indicated that the person does not have any specific incentives in mind. This might either show that considering an electric vehicle a good investment is only an assumption without hard evidence and/or that respondents are not aware of any specific policy instruments which could motivate a purchase.

25 These include fully electric vehicles, battery-powered hybrids and plug-in hybrids.
26 All respondents could indicate multiple choices for this question, hence the figures indicating the number of replies sum to a higher amount than the overall number of respondents.
Those who did provide an answer to this question indicated two groups of measures: the reduction of initial costs via tax breaks and subsidies and the availability of easy and cheap charging (both infrastructure and electricity).

Purchase reasons, related to the new technology of EVs and trying a new technology were indicated in a lower number of instances (43). A similarly low number (32) of respondents indicated that they would buy an electric vehicle because it would better suit their mobility needs than a car with an internal combustion engine. Only a handful of respondents (4) felt that buying an electric car would be trendy and would make them look as a trendsetter.

Those respondents who indicated that they do not plan to purchase an electric car in the coming 10 years (91 persons) were invited to provide the reasons for their choice. The most often quoted reason (48) was that electric cars have limited range. The second most frequently appearing reasons were the following: no opportunity to charge an electric car e.g. living in a block of flats without a private parking place (32) and insufficient funds for purchase (31). The third group of reasons why one would not want to buy an EV in the coming 10 years involves: lack of trust how the electricity will be priced for charging cars (23) and preference to use other services e.g. car sharing (22).

The following three groups of reasons for not purchasing EV, were indicated by 15 persons each: a) electric vehicles are not as clean as anticipated (battery production and disposal, production of electricity, child labour, pollution transferred from the place of use to the place of battery production); b) preference to stay with the traditional internal combustion engine technology; c) concerns about the amortisation and value-loss of the electric car in the longer term.

Regarding what minimum range (km with a single charge) would make an electric car similar in comfort and reliability to a traditional car, respondents indicated a distance equal or somewhat less than an average internal combustion engine car. Around one

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27 These expectations fit into the general picture of measures which could be used in order to promote the spread of electric vehicles. (The survey included another question on this. See below the results and findings of that question.)

28 All respondents could indicate multiple choices for this question, hence the figures indicating the number of replies sum to a higher amount than the overall number of respondents.
third (81) selected 200 – 350 km and another third (84) selected 350 – 500 km as an ideal minimum range. A fifth of the respondents would consider an electric vehicle range of more than 500 km as a minimum. This shows that respondents would expect electric vehicles to have longer ranges than today\textsuperscript{29} but at the same time they have realistic expectations and would not consider the range of a diesel vehicle (>700 km) as a minimum for an EV.

Figure 11 - What minimum range (km with a single charge) would make an electric car similar in comfort and reliability to traditional cars for your use? Source: own compilation.

![Graph showing the distribution of responses regarding the minimum range for electric cars.](image)

As regards to the charging time (see Figure 12), the most frequently selected option was 20 – 30 minutes. The rest of the replies are somewhat balanced both downwards (shorter charging time) and upwards (longer charging time). The ideal shortest charging time can significantly be influenced by the use of the vehicle (i.e. short-term city travels vs. long-distance hauls) but the numbers show that the majority of respondents would expect to spend only slightly more time for charging than the time they currently spend fuelling their car with petrol or diesel.

\textsuperscript{29} By taking the range of a Volkswagen e-Golf (190 km) or a Renault Zoe (210 km with a 22 kWh battery), Kia Soul EV (130-190 km), Smart (145 km) or a BMW i3 (130-183 km) as an example. (Source: https://en.wikipedia.org/wiki/List_of_electric_cars_currently_available)
Concerning the perceived best measures to promote the spread of electric vehicles, two choices were significantly more popular than others (see Figure 13). The installation of more publicly available charging stations and financial incentives (purchase price reduction, vehicle tax exemption) were indicated 169 and 154 times respectively. Other measures such as free parking in urban areas (113), electric car rentals (including car sharing service) (90) and reduced tolls on highways (81) were selected in fewer instances. The use of bus lanes (42) and better media coverage (36) appear as less important elements in promoting electric vehicles. The category “Other” contains heterogeneous replies; but some recurring drivers are visible. These include the desire to have electric vehicles really environmentally friendly (better recycling of batteries, cleaner production of batteries and clean electricity to charge the EVs), shorter charging time and easier/cheaper access to home charging and penalising regulation for petrol and diesel cars (higher taxes, fees, limitation of circulation etc.). Interestingly only one reply considered the leadership role of the public sector as an important measure to increase the spreading of electric vehicles.
From the overall replies and additional non-standardised answers, it seems that the high costs and the charging constraints (availability of infrastructure and limited range) are the key concerns for the respondents related to electric vehicles. The issue of pollution which takes place in the overall life-cycle of an electric car (from production to scrapping) and the effects of a massive roll-out of EVs on electricity demand (with its production) including the environmental impacts of large-scale battery replacement, highlight worries about the sustainability of replacing internal combustion engine cars with electric ones. Some argue that the proliferation of electric cars should go hand in hand with the reformation as mobility as such and the spreading of community transport and shared vehicle use.

2.3.3 Interviews with the major relevant stakeholders

In addition to the literature review, a series of interviews have been conducted with experts and policy officers, who are involved in the area of electro mobility. Officers of the European Commission’s Directorate-General for Mobility provided valuable insight into the background and motivations behind the specific proposals of the Commission, and personal views of the directions of the political negotiations with the European Council and the European Parliament. Insight views on the level of Member States interests and negotiations in the European Parliament were presented by the office of
the Member of the European Parliament Bendt Bendtsen, who is currently the ITRE\textsuperscript{30} rapporteur. Representatives of stakeholder organizations (Bellona, Eurelectric, Regional Environmental Centre for Central and Eastern Europe) provided information how the industry and other organizations (environmental NGOs, local communities etc.) perceive the European policy proposals and what impacts they anticipate. Potential weaknesses and controversies are reflected in Chapter 3. The scope of the questions can be found in the list of Table 6 in the Annexes.

2.3.4 Research question and hypotheses

The research question of the thesis looks at the expected efficiency of the public policy to reach an objective – i.e. a higher share of electric vehicles, which is assumed to be fixed and unchallenged.

The research question is: Can EU & Member State policies deliver an increase in the share of electric vehicles in the EU?

It is therefore not within the scope of this paper to explore and argue whether electric cars indeed represent the unique solution to the environmental and health problems of Europe, or whether they represent the appropriate means to tackle climate change.

To provide an answer to the research question, mentioned above, a key hypothesis has been identified and is being tested in the course of this paper.

On the basis of the Norwegian example, national policymakers can successfully incorporate the suggested EU policies to increase the share of electric vehicles.

3. Results and discussion – comparison of the EU and Norwegian policies

3.1 Assessment of the policy in the European Union

The chapeau Communication from the European Commission (COM 675 final, 2017, pp. 2-4) puts the Commission’s legislative and policy proposals into context and summarizes the main drivers of the Clean Mobility Package. The structure of the document suggests that three main issues provide the justification for the Commission’s proposals:

2. Focusing on consumers and the citizens of Europe (including the aftermath of the diesel scandal) – EU proposal: Alternative Fuels Infrastructure;
4. Other “strategic work streams” also incorporate the EU’s plans towards lowered emissions and include charging infrastructure in public buildings, homes and public areas (COM 675 final, 2017, p. 11).

“This second "Europe on the Move" package thus addresses three key political priorities: Europe that protects the planet; Europe that empowers its citizens; Europe that defends its industry and workers”. (COM 675 final, 2017, p. 4).

The regulation in the EU’s transport sector – due to its dimensions and essential economic role31 – has direct implications on citizens’ life, and the policymakers need to juggle between and bridge among widely differing interests. For the sake of certain targets that will be put in the course of policy delivery, certain sacrifice might occur on the way to a given goal. The changes triggered by regulations and policies in infrastructure, research and development may not have the same impacts and

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31 The transportation and storage sector in the EU employs more than 11 million people in the EU, which represents more than 5% of the total employment. The sector generates approximately 5% of the EU’s total GDP and it has a share of 20% in the EU’s exports (European Semester Thematic Factsheet: transport, 2017).
consequences across all EU countries. No assessment is included in this paper concerning a quantified level of economic, financial (global and EU scale) or technological changes or the level of CO₂ reduction which are catalysed by the introduction of EVs. The researched scope of recommendations and measures of the CMP shows that the impact on existing jobs and growth of the EU Member States may not be sufficiently enough to meet the targets across all of the EU Member States. With the European Parliament elections coming in 2020, the CMP might have a longer timeframe to be fully voted and revised closer to 2023 (Directorate-General for Mobility and Transport, 2018). However, this period might provide a good opportunity for EU Member States to test the waters and to collect feedback on the scope of possible EV policies reflected through consumers’ perception, effects on the economies of scale, innovative solutions, etc.

The climate challenge and the tasks under the Paris Framework necessitate immediate actions to move to low-carbon transport. Road transport alone is responsible for 20% of the EU’s total emissions and it is the prime source (73%) of emissions in the transport sector. The EU policy here is twofold – on the one hand the imposition of stricter emission standards on car manufacturers represents a prescriptive policy measure. On the other hand, the Clean Vehicles Directive represents incentive regulation, with its aim to encourage the market uptake of clean vehicles through public procurements. The measures related to consumers and citizens stem from the collapse of consumer trust in the automotive industry following the diesel scandal (Hotten, 2015) and the fact that any cardinal shift to a new technology (i.e. low-carbon transport) would require consumer trust and buy-in. Actions in this batch i.e. the development of alternative fuel infrastructure aim at creating the possibility to use the new transport modes in a seamless and interoperable way throughout Europe. The Commission’s political priority is to create such transport modes for the citizens, which are clean, accessible and affordable for all. This is closely linked to the basic European idea of the freedom of the movement of persons.

A sufficient penetration of EVs across all EU markets can be possible only with simultaneous and coherent policies to incentivise industries and consumers. The overarching idea behind the CMP stands in building policies on EU and national level that target the decrease of carbon emissions and will promote innovative economic
growth (including, but not limiting to: research and development of alternative sources of energy, etc).

Electric vehicles should not be perceived as a “medicine” to fight the extensive carbon emissions. However, introduction of extensive incentives for broader e-mobility can contribute to reaching the ambitious EU’s goals by 2030, and, what is even more important, affect and change the consumers’ behaviour related to climate change. Most recent trends in the use of the electric cars and extensive market penetration in Norway, demonstrate a level of disruptive innovation, which is most certainly perceived as a forward-looking inclusion of the: “four disruptive technology driven trends in the automotive sector: diverse mobility, autonomous driving, electrification, and connectivity” (McKinsey & Company, 2016, p. 3). The problematic point here might be the low percentage of consumers who are willing and capable of paying a relatively higher price for the EV rather than for the ICEV (fuel prices in the past 20 years remained at acceptable range for the average consumer) (Transport fuel prices and taxes — European Environment Agency, 2017).

A number of proposals that EU has already put forward, have the potential to be a game changer in the market of EVs. Yet, on the path to meet the decarbonisation targets, there are numerous cases which show that the results of this process are not clear-cut and not homogenous, especially if the calculations of CO₂ reductions involve 28 Member States. The level of progress in reducing pollution and pursuing the introduction of EVs in the market dramatically differs between the North-West European and South-Eastern countries. It is expected that the increase in the share of electric vehicles will take place in 3 waves (Directorate-General for Mobility and Transport, 2018): 1.) leading position of the North-West EU member-states with citizens willing and ready to invest in EVs, 2.) then moving towards the Mediterranean EU Member States with high potential of countries like Slovenia to become zero-emission country (The Slovenia Times, 2017) and, 3.) finally, Eastern European countries. As it can be observed in Table 3 and in Table 4, many Western European countries have already taken serious steps in cutting the sale of ICE vehicles.
Table 3 - Plans to ban the sale of ICE cars (selected countries, as an example and with the available recent information). Source: own compilation.

<table>
<thead>
<tr>
<th>Country</th>
<th>Action</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK (Saarinen, UK plans petrol and diesel car sales ban from 2040, 2017)</td>
<td>Britain has said it would ban the sale of all new diesel and petrol cars from 2040, replicating plans by France. The sales ban does not include hybrids (Riley, 2017).</td>
<td>2040</td>
</tr>
<tr>
<td>France (Stothard, 2017)</td>
<td>France is set to end all petrol and diesel vehicle sales by 2040, its new environment minister, Nicolas Hulot announced. The plans form a part of the new French president Emmanuel Macron’s ambitions to make France carbon neutral by 2050.</td>
<td>2040</td>
</tr>
<tr>
<td>Norway</td>
<td>The government’s transportation plan outlines a clear target: All new passenger cars and vans sold in 2025 should be zero-emission vehicles (Petroff, 2017).</td>
<td>2025</td>
</tr>
<tr>
<td>Netherlands</td>
<td>All new vehicles sold in the Netherlands must be zero-emission by 2030. (earlier plan was 2025) – Used ICE cars can still be sold after this. The government will adapt its taxation system to facilitate the uptake of zero-emission cars (Beckman, 2017). The country has the highest number of charging points per capita in the world, and the second largest concentration of electric vehicles in Europe. It aims to have 200,000 electric vehicles on the road by 2020 and for 10% of new sold vehicles to be electric (Gray, 2017).</td>
<td>2030</td>
</tr>
<tr>
<td>Germany</td>
<td>The Bundesrat passed a non-binding resolution in 2016 inviting the EU Commission to ensure the realisation of emission-free mobility until 2030 (Gray, 2017).</td>
<td>2030</td>
</tr>
</tbody>
</table>
### Table 4 - Cities' actions to ban diesel cars (selected cities, as an example and with the available recent information). Source: own compilation.

<table>
<thead>
<tr>
<th>City / country</th>
<th>Action planned</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leipzig, Germany (Matussek, 2018)</td>
<td>Germany’s highest administrative court in Leipzig ruled in favour of upholding bans that were introduced by lower courts in the cities of Stuttgart and Düsseldorf. The court said it would be up to the city and municipal authorities to apply the bans, but advised them to “exercise proportionality” in enforcing them, and to impose them gradually, granting exemptions for certain vehicles, such as ambulances, rubbish collection lorries and police cars. Presiding Judge Andreas Korbmacher said: “Bans are generally permissible and can be implemented in a way to avoid disproportionate effects, European Union rules require that cities must implement them if there are no other effective measures to reduce pollution (...). The environment minister, Barbara Hendricks as a respond stated: “Driving bans can be avoided, and my goal is and will remain that they do not come into force.”</td>
<td>The court stated that: “Euro 5 cars must be exempt from bans until Sept. 2019, while older Euro 4 vehicles and earlier models can be removed from the streets immediately”.</td>
</tr>
<tr>
<td>Stuttgart, Germany32</td>
<td>16 February 2017: the state cabinet moved to forbid diesel cars from many streets, whenever high levels of soot particles are measured and the city has to proclaim a “pollution alarm” (Tost, 2017). – Baden-Württemberg had appealed the rulings, saying such curbs should be decided at the federal level, meaning the planned proposals will be delayed in 2018.</td>
<td>From 2018</td>
</tr>
<tr>
<td>Munich</td>
<td>Plans to ban diesel cars which don’t meet the Euro-6 standard. – Statements by mayor (Munich mayor says diesel deal might not avert car ban, 2017)</td>
<td>N/A</td>
</tr>
<tr>
<td>Hamburg</td>
<td>Limited diesel driving ban on two busy roads in the Altona district from late April 2018 – with exceptions for Altona residents, ambulances, city services and delivery vehicles. The driving ban in the city state is expected to immediately apply to all vehicles that do not comply with the Euro 6 standard (AFP/DPA/The Local, 2018).</td>
<td>April 2018 (plan)</td>
</tr>
</tbody>
</table>

32 Since 1st March 2008, Stuttgart has been a Low Emission Zone. This means that only vehicles in certain emission categories may drive in the urban area of Stuttgart. These regulations are designed to lower the high levels of particulate emission and nitrogen dioxide pollution in the air, and they have been implemented throughout Germany in so-called Low Emission Zones. The traffic restrictions in these Low Emission Zones apply all the time, i.e. irrespective of whether the levels of air pollution are higher or lower at any one time. Low Emission Zones are marked with special road signs. An additional sign specifies that only vehicles displaying an emissions sticker, and therefore in compliance with certain emissions gas standards, are allowed to drive within this area. [https://www.stuttgart.de/en/item/show/573353](https://www.stuttgart.de/en/item/show/573353)
<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>Berlin Senate also plans to review whether driving bans should be introduced in the nation’s capital from 2019 (AFP/DPA/The Local, 2018).</td>
<td>2019 (?)</td>
</tr>
<tr>
<td>London</td>
<td>£10 “Toxicity Charge”(^{33}) for pre-Euro 4 cars in October 2017 and an UltraLow Emission Zone in 2020, which will charge pre-Euro 6 cars 12.50 pounds per day in central London. It covers the same area as the existing congestion zone and will be in addition to the congestion charge and will apply 24 hours a day, 365 days a year. Replaces the £10 T-Charge which will apply for older cars entering the capital from October 2017 (Mayor of London: press release, 2017).</td>
<td>Started in 2017 and to be updated in 2020</td>
</tr>
<tr>
<td>Barcelona</td>
<td>“The decision to ban older cars in Barcelona is not specifically aimed at diesel but will clearly affect diesel. The measure — a joint initiative between the city, municipalities on the edge of Barcelona, and the state of Catalonia — will make it illegal on working days to drive cars bought before January 1997 and vans bought before October 1994.” (Ayre, 2017)</td>
<td>2019</td>
</tr>
<tr>
<td>Oxford</td>
<td>In the first stage of its plans from 2020, taxis, cars, light commercial vehicles and buses which are not zero-emission, will be banned from six streets in the city center, including near the world-famous Oxford Union debating society. The zone will be gradually widened to include more streets and further vehicle types until 2035 when all emitting vehicles, including trucks, will be banned from the centre. (Pitas, 2017).</td>
<td>2020 and updated in 2035</td>
</tr>
<tr>
<td>Rome</td>
<td>Rome has become the latest capital to propose a ban on all diesel cars by 2024 from its historic centre (Saarinen, 2018).</td>
<td>2024</td>
</tr>
<tr>
<td>Paris</td>
<td>In test version back in 2014, Paris banned cars with even-numbered plates for one day. The effect showed positive reduction of pollution by 30%. As of 2016 all drivers with cars made before 1997 are not permitted to drive in the city center on weekdays. Paris also plans to double its bike lanes and limit select streets to electric cars by 2020. Instated rule of car-free Sundays as of 2016 (Anzilotti, 2016).</td>
<td>Started from 2016</td>
</tr>
</tbody>
</table>

Countries with higher GDP are more responsive to policy incentives for purchasing EVs (2017 Global EV Outlook, 2017). It is also important to take into account the responsiveness of EU Member states towards the Clean Mobility Package through the perception of the consumers (EU citizens and tourists), manufacturers, environmental NGOs, regional infrastructure developments and municipalities and, national

\(^{33}\) Will operate on top of, and during the same operating times, as the Congestion Charge (Monday to Friday 7am-6pm), so it will cost £21.50 to drive a pre-Euro 4 vehicle in the zone.
governments (political leaders, representatives in EU institutions). These are the key stakeholders who also have different priorities and level of responsiveness to the policy incentives. In terms of level of influence and seeing the picture from the broader international prospective of growth and jobs, car manufacturers play a key role in the process of incentivising e-mobility. The fact that the “strictness” of the EU’s rules were unexpectedly watered down in the last minute (this includes the exclusion of the EV quotas in the car production, no set limits on life-cycle emissions and no specification on rules to decarbonize electricity) (Forbes, 2017) was regarded as a reverence move in favour of the German car lobbying association. A number of the environmental lobby groups were disappointed by the final outcome. According to Forbes, the Transport & Environment (T&E) lobby group stated that: “T&E welcomed the 30% zero emission sales target but said without sanctions, it would be ineffective.” (Forbes, 2017).

The EU’s softened tone towards car manufacturers also creates a potential loophole in delivering the sufficient amount of EVs to the consumers. The Norway-based Bellona Foundation drew the attention that the current shortage of EVs in Norway might happen in the EU as well if the EVs’ demand and supply are not balanced. During the Commission’s policy development process there was a potential to prevent manufacturers from “mere window dressing, but it was watered down” (Bellona Foundation, 2018).

The other side of the coin is the responsiveness of the car manufacturers, who put forward profitability (immediate or short-term, stable and based on traditional rather cheap car production), counterbalancing the long-term investment and climate issues commitment. With no strict rules for the game from the EU’s side, no strict rules would be applicable on national levels. Such a situation would deviate from the example of the Norwegian policy package, which is clear, coherent and with a certain consequences.

Wrap-up of the assessment of the policy in the European Union

When looking at the broad array of EU policy and legal measures the question of effectiveness of the financial incentives comes up. Even though they are not directly mentioned in the EU’s legislative proposal, still they appear to be the most effective
when they reduce the gap between the purchase price of EVs and ICE and in addition they provide a total cost of ownership (TCO) advantage compared to traditional cars (Hoy, K. and H. Weken, 2017). Clearly for such policy measures, the choice lies exclusively with national authorities. The improved cost efficiency (e.g. lower battery costs) of EVs and keeping the EV-related TCO on a low level will probably not be enough, and ICE will need to be “killed” and heavily taxed. Increasing the costs of ICE will help to reduce the gap between the purchase price (and thus the TCO) between ICE and EVs.

A supportive policy environment will also enable market growth by making electric vehicles appealing for consumers, which will in turn reduce the risks for investors and car manufacturers and operators of ancillary services. Fundamental support mechanisms target both the deployment of cars and the charging infrastructure. All the elements of driving policies (financial incentives, regulations, standards, mandates, fuel economy regulations and other regulatory instruments e.g. urban limitations, public procurement policies, R&D in innovative technologies, support of SMEs, infrastructure), have to be carefully balanced, in order not to hinder the proliferation of EVs.

The success of EVs also greatly depends on how well the countries and local governments regulators use their current income (fuel taxes) to create favourable (and economically sustainable) conditions for EVs. And here it is essential to mention the need for the better quality and not quantity of road infrastructure. This means that there is not necessarily a need for more roads but for a revolutionary change in the way we move around. The concepts of interconnected self-driving cars, robot taxis and intelligent traffic systems no longer belong to the category of science fiction. Just like after the shocks of the oil crises, people will (need to) adapt to the new conditions in their everyday life.

The European policymakers and national governments obviously have the delicate job of keeping the balance between pushing the European automotive industry to participate in (or even to drive) the transformation into a low-carbon economy while at the same time avoid the collapse of this essential sector. Research and development and new technologies such as next-generation batteries can create a new globally competitive industry in the EU. Inclusion of all of the boundary conditions (indicated in Figure 14)
clearly has a potential to become an important lesson to be taken by the policy makers across EU.

Figure 14 - Incentives for cleaner vehicles in urban Europe. Source: (I-CVUE, 2017)

3.2 Lessons learnt from the Norwegian policy

As the elements of the Norwegian EV incentives have been put in place in the last 20 years, it must be taken into account that they had time to mature and be refined. The Norwegian example is so much important because the European Union’s political targets until 2030 do not give such an extensive timespan for the policy elements to be introduced and matured.

According to the research carried out by the IEA in its Nordic EV Outlook and the number of individual research projects, which the Outlook refers to, the price reductions of electric vehicles are the most important incentives for the first-movers, i.e. those people who adopt the technological shift before the massive roll-out. The other policy elements, which work on a longer term such as circulation tax reductions, seem to have a smaller impact in consumer decisions, which focus usually on the near-term expenditures (see Figure 15). Additional measures, such as charging infrastructure appear to be of secondary importance.
In order to achieve such a price reduction of electric vehicles it seems straightforward to increase the prices via taxes and other financial burden on ICE to the level so that the price gap disappears. The question is, whether a price-equality together with the other incentives will be strong enough to convince people to buy an electric car instead of petrol or diesel one, or the price-matching is not enough and the ICE models must be considerably more expensive to dissuade people from purchasing them on a large scale.

It is visible from the Norwegian policy developments that they flexibly reacted to the changes in the market share of electric vehicles, to the demand from consumers and to the technological changes. The gradual reduction of certain incentives such as the toll-free use of roads or the free use of bus lanes shows the evolution of public policy i.e. that once the demand proves solid enough; the policy maker starts to reduce the perks received from purchasing an electric vehicle. The gradual inclusion of hybrids in the incentive schemes (e.g. reduction in the weight calculation for defining the level of weight tax) shows the policy consideration that for longer journeys the current battery operated vehicles (BEVs) are not yet fully adequate, yet, with hybrids, also this consumer demand can be fulfilled in a cleaner way than using ICE models. The phase-out of the use of bus lanes by electric vehicles is a result of congestions caused by EVs in peak hours. The decision of the Norwegian government to delegate the authority to

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34 According to the IEA Nordic EV Outlook 2018, respondents were asked to pick the three most important policy measures related to their choice to purchase an electric car. The y axis reflects the proportion of which each policy measure was selected by the respondents.
regulate this incentive to municipalities shows that more flexibility on a local level can maximize the benefits of EVs without leading to negative externalities such as congested bus lanes because of the free use by EVs.

A much more direct impact on public policy and state governance is the changes in the income from vehicle and fuel taxes due to the lower share of ICE and more EVs (Figure 16). Norway’s Ministry of Finance predicts that the income from these two forms of tax could fall from USD 6 billion in 2017 to less than USD 2.5 billion by 2030 (Finansdepartementet Norge Ministry of Finance, 2017). This also highlights that a massive incentive campaign for EVs can work only as long there is someone to pay for it, i.e. the consumers of ICE models via increased purchase, operation and fuel taxes or other local levies. If the market uptake of electric vehicles increases, a tipping point will inevitably arrive at a possibly accelerating speed (as the number of EVs increases\(^{35}\)), where making the traditional cars more expensive will not provide enough income to maintain the incentives for EVs.

![Figure 16 - Total purchase price for mid-size ICE, BEV and PHEV cars in the Nordic countries, 2017](image)

Considerations about the “post-fuel-tax” period might seem running ahead but alternatives such as road pricing should be explored. Charging the use of infrastructure via the distance travelled corrected with the environmental performance of the vehicle

\(^{35}\) With the proliferation of EVs and increase of consumer trust plus the incentives in place, it can be expected that an increasing number of consumer decide to purchase an electric vehicle. Thus the decreasing income from ICE taxes and levies will need to support an increasing number of electric vehicles.

\(^{36}\) This comparison is based on Volkswagen Golf models: Golf 1.0 110 horsepower (hp) Turbo Stratified Injection (TSI) petrol for ICE, e-Golf for BEV and Golf GTE for PHEV.
and/or using different pricing for peak hours such as a congestion surcharge could all provide income to the state budget.

The success of the Norwegian policy also stems from its stability, consistency and predictability\(^\text{37}\). Quick, unexpected and/or radical changes can affect both market and consumer trust such as the example of Denmark shows. Policymakers and regulators should take the Danish lessons learnt into account when planning their own measures.

In Denmark the level of incentives was significant in absolute numbers due to the high amount of tax on ICE cars. The registration, VAT and purchase tax together can represent 150% of the import price of a larger ICE car, which made such a car more expensive than an electric vehicle. In 2016, the Danish government decided to gradually phase-out during a 4-year period the exemption of BEVs from the registration tax with a gradual increase to 20% of the full tax in 2016, 40% in 2017, 65% in 2018, 90% in 2019 and 100% in 2020 (PHEVs did not have such incentive). At the same time, the vehicle registration tax applicable to all cars including ICE decreased which brought down the price of ICE models close to the EVs and thus diminished the price competitiveness of the latter. PHEVs even became even more expensive than ICE models and BEVs were not much cheaper any more. After the collapse of the EV market (radical drop in new registrations) the Danish government decided to maintain the registration tax for BEVs at 20% for 2 additional years until reaching the level of 5,000 new registered BEVs (Nordic EV outlook 2018: Insights from leaders in electromobility, 2017).

Even though, the changes restored the cost competitiveness of EVs vs. ICE models, the market still has not recovered. The measures had the strongest impact on the most rapidly developing segment of the EV market in Denmark namely the upper market segment, which contributed to almost 66% of all new car sales in 2015 in Denmark.

The increase of EVs can change consumption patterns in other ways as well and this can have indirect impact on other areas. According to a survey by Norsk Elbilforening the purchase of an electric car reduces the reliance on walking, cycling and public transport, which, in turn can potentially bring back urban congestion and the raw material (and

\(^{37}\text{This point was a united answer from all the interviewed stakeholders – TD.}\)
energy) needs of the transport sector to the previous levels. Practically, the increased use of EVs could just replace the resources needed but may not change the way people use mobility as a service. An interesting analogy is the introduction of energy-saving light bulbs in Europe. According to a study published in Science Advances (Christopher C. et al, 2017) the lower consumption of bulbs did not bring about an overall decrease in lamp use and thus in energy consumption. People rather used the energy efficiency gains to install even more bulbs and maintain the same level of energy consumption as before.

A massive conversion of privately owned EVs instead of ICE models will not likely to solve the problem of resource intensity of the transport sector and the congestion in urban areas. The proliferation of EVs will need to be accompanied by a complete change in the mind-set and the model how transport is organised today. The EU should probably not go down the same road as Norway and start penetrating with privately owned EVs the market, but it should skip this step and move directly towards an electrified, shared (preferably somewhat automated and connected) EV fleet if the aim is to create sustainable urban and cross-country transport. A successful policy boosting of privately owned EVs can effectively scrap other policies trying to motivate the use of public transport and/or reduce the congestion in urban areas.

Note: Finland applies CO₂ based registration taxes. Sweden has a direct purchase subsidy (super green car rebate) equivalent to USD 4,700 or BEVs and USD 2,300 for PHEVs. In Iceland there is a combination of CO₂ based registration taxes and a VAT exemption for electric cars. Norway applies VAT and weight tax exemptions for electric cars (partial weight tax exemption for PHEVs). Denmark applies a registration tax deduction for BEVs and PHEVs equivalent to USD 1,500, and an additional registration tax reduction for BEVs. The tax scheme considered for Denmark is the one in place before October 2017 (Nordic EV outlook 2018: Insights from leaders in electromobility, 2017).
### 3.3 Comparison

The main elements of the EU’s policy related to electro mobility have been described in Section 2.2.1 and elements of the Norwegian policy described in Section 2.2.2. Based on that information, this chapter attempts to give a broad overview and comparison of what incentive systems those policy measures create in their proposed form\(^{38}\). The summary of the key policy elements can be observed in Table 5.

<table>
<thead>
<tr>
<th>Driver</th>
<th>EU</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Climate goals;</td>
<td>• Climate goals and clean transportation.</td>
</tr>
<tr>
<td></td>
<td>• Safeguarding global position in trade and competition;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Growth and jobs linked to R&amp;D.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>EU</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Technological neutrality.</td>
<td>• Aim at electric vehicles explicitly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>EU</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Most regulatory measures on the production and supply of vehicles;</td>
<td>• Measures to directly reduce the total cost of ownership via immediate actions (e.g. VAT exemption) and longer term measures (vehicle tax breaks);</td>
</tr>
<tr>
<td></td>
<td>• Indirect measures to support demand for EVs (creating market uptake by the public sector and alternative fuel infrastructure).</td>
<td>• Some complementary measures related to charging infrastructure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focus</th>
<th>EU</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Pan-European level observing the principle of subsidiarity;</td>
<td>• On national level from the start, but regulation of an increasing number of measures is delegated to local level.</td>
</tr>
<tr>
<td></td>
<td>• Must be complemented by national, regional and local measures.</td>
<td></td>
</tr>
</tbody>
</table>

The Clean Mobility Package shows that the **main driver** is the ambition to achieve the climate goals, however, trade and global competition (especially vis-a-vis China) via research and development is also a major element of justification. The consumer dimension is more linked to the social implications of the industry policy (growth and jobs), even though it is also a dedicated element in the policy to ensure that consumers

\(^{38}\) Since the Clean Mobility Package is currently a proposal from the European Commission, this chapter covers a theoretical exercise considering that the proposed changes enter into force as they are proposed.
can make an informed choice when purchasing a vehicle. Unlike in Norway, the automotive sector is a vital player in the bloc’s economy in many ways – employment, contribution to the GDP, role in research and development, global trade etc.

Furthermore, the countries which host the biggest players of the automotive industry such as Germany and France are also the EU’s most influential Member States. Any regulation in the sector thus is expected to be highly political and highly sensitive, which makes negotiations in the EU’s ordinary legislative procedure even more difficult. As a result, the adopted legal text is usually a compromise, which may include non-consistent measures or a lack of clarity in order to provide the necessary flexibility for implementation in all Member States and to accommodate all negotiating parties’ interests and concerns.

The subject of the EU policy is technological neutrality. This means that no technology or solution is singled out as a preferred one and it is left to the market to decide which option will spread. The positive fairness of such an approach might be offset by the regulatory uncertainty which it causes by not providing clear signals to the market and to investors which technology direction should be pursued. It can be safely said that the current EU mobility policy is not a “sales policy” for electric vehicles.

The mechanism of the EU policy focuses on the supply side (i.e. cars manufacturers) via common rules and standards for emissions putting a pressure on them to convert a higher share of their portfolio into clean vehicles. Other EU rules, such as the Directive on ambient air quality and cleaner air for Europe (DIRECTIVE 2008/50/EC, 2008) have an indirect impact on the car industry via the increasing awareness (and legal obligation) to tackle air pollution caused to a large extent by road transport. Apart from the “sticks”, the policy also entails the “carrots” via attempting to provide a favourable environment for increasing the market uptake of clean vehicles via extra demand generated from public procurements, and from the encouraged development of alternative fuels infrastructure (including building standards which also contribute to the easier usability of clean vehicles). There are numerous “soft policy” measures as well, which focus mostly on stimulating the debate, foster the transparency of automotive manufacturers and provides fora for exchanging best practices. General public support programmes contribute to the successful implementation of the policy.
Lastly, the focus of the EU policy and legislation is on pan-European level, with certain tasks prescribed on national level (via directly applicable regulations) or tasks to be designed on national level (via non-directly-applicable directives). Because of the principle of subsidiarity, the EU does not regulate the sub-national level, this should/could be done by national or regional/local governments. It must be noted that the EU policy is one element in a multi-layered dimension of policies and it is complemented by numerous actions and laws determined on national level.

The Norwegian policy is mostly driven by achieving the climate targets and clean transportation; although, it does not appear to have such strong links to other policy areas as the EU policy. Even though it was launched to boost the Norwegian automotive sector, today it is visible that it clearly did not prove successful in that purpose\(^39\). At the same time, the Norwegian policy – being national – is a result of a much lighter compromise and negotiation process than the one in the EU and thus might yield more consistent and clear regulations in the end.

The subject of Norway’s policy is specifically aimed at electric vehicles, with further distinction among BEVs and PHEVs. The policy has been stable and consistent throughout the last 10 years which proved to be important for the market success of EVs.

The mechanism of the Norwegian policy focuses on reducing the total cost of ownership through purchase price reductions by tax exemptions. Some elements of incentivising the development of charging infrastructure and building regulations exist but they do not appear as the considerable element. It must be noted that via the European Economic Area, Norway will most probably need to adopt some of the EU’s acquis related to clean transport.

A number of policy measures have been though delegated to the local level, which shows the evolution and the changes in the focus of the policy.

\(^39\) The only Norwegian electric car company, which managed to survive for 20 years was TH!NK Global. The firm, which was founded in 1991 produced a total of 2,500 small city electric cars and went bankrupt in 2011. Source: [https://en.wikipedia.org/wiki/Think_Global](https://en.wikipedia.org/wiki/Think_Global)
4. Conclusions and recommendations

According to the Norwegian experience (and the Danish lessons learnt), the main driver in the EV success is to **bridge the cost gap between ICE and EVs**. The other measures (charging infrastructure, practical every day perks) are secondary. But no matter what is the level of seniority in the related policies, **all of them should be taken on board by the EU Member States and introduced in a coherent way.**

After the detailed two-case comparative study, the result brings this paper to the hypothesis, raised in the 2.3.4 subchapter. Following the test through the qualitative assessment of both the Norwegian and European practices, **the research hypothesis:** “On the basis of the Norwegian example, national policymakers can successfully incorporate the suggested EU policies to increase the share of electric vehicles”, **has been confirmed.**

At the same time, it is important to keep in mind, that the EU’s Clean Transport Package does not contain measures that would directly reduce the price/cost gap between ICE and EVs. (Even though, it includes many useful and important measures). **The EU policy alone will not be able to deliver and replicate the success of Norway.** **The key lies with Member States** who could either give the EU the mandate to introduce measures that would bridge the gap, or they could do it on their own national policies. The problem is that such a scenario could lead to 28 different regimes and approaches. The complexity will be further increased by the various measures on local level. **A coordinated roll-out and update of policies is therefore of key importance.**

It is vital to mention that the anticipated increase in the EVs’ market uptake in line with the objectives of the above mentioned legislative proposals, will have to be carefully balanced, in order to preserve the EU’s competitiveness, jobs, growth and investments. The automotive sector in Europe provides jobs for 12 million people and generates 4% of the EU’s GDP (EU: the economy, 2017). In the Commission’s view, **the EU automotive industry needs to re-invent itself and focus on innovation, digitisation and decarbonisation** (e.g. electrified power trains, autonomous driving and connected vehicles) in order to remain globally competitive in the technological transformation...
towards electric and fuel cell vehicles. This probably poses a formidable challenge to the traditional European car manufacturers, who will have to invest heavily in new technologies and get rid of those which they have been investing massively until now (clean diesel technology). Also, regaining consumer trust and, in parallel, managing the transition via the training and recruitment of workers with the needed new skills will require additional resources from manufacturers. Everything must be delivered in a cost-effective way to be able compete with other regions such as China.

The potential effects of a regulatory capture by massively pursuing EVs should be taken into account (to avoid a similar situation as with diesel cars, which were heavily subsidised earlier). Whatever the policy decision is on EVs, there must be frank and detailed CBA what sorts of impacts a large proliferation of EVs will have. This will lead to better way of rethinking mobility and it will help to focus on how we use a vehicle instead of what energy source the vehicle is using to move around.
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Annexes

Figure 17 - Survey questions on consumer choices and expectations for electric vehicles. Source: by (Tamara Demydenko, 2018)

Questionnaire on consumer choices and expectations for electric vehicles

The aim of this survey is to collect and to map consumer preferences and expectations towards electric vehicles.
Please provide the answers to the following questions. If you have questions, please contact me at: elemobility2018@gmail.com

PLEASE DO NOT INSERT ANY PERSONAL DATA IN THE QUESTIONNAIRE!

Context

1. Please indicate the country of your current residence:
   - Austria
   - Belgium
   - Bulgaria
   - Croatia
   - Cyprus
   - Czech Republic
   - Denmark
   - Estonia
   - Finland
   - France
   - Germany
   - Greece
   - Hungary
   - Ireland
   - Italy
   - Latvia
   - Lithuania
   - Luxembourg
   - Malta
   - Netherlands
   - Poland
   - Portugal
   - Romania
   - Slovak Republic
   - Slovenia
   - Spain
   - Sweden
   - United Kingdom
   - Non-EU country
2. Please indicate the county of your current residence:

3. Please indicate your gender:
   - Female
   - Male
   - Rather not say

4. Do you currently own a car?
   - Yes - with a petrol engine
   - Yes - with a diesel engine
   - Yes - a plug-in hybrid
   - Yes - a battery powered hybrid
   - Yes - a fully electric vehicle
   - No

5. Which year was your current car produced?

6. Can you name some electric car models from the top of your head? (no googling :)

Purchasing an electric car

7. Are you planning to purchase an electric car within the next 10 years?
   - Yes
   - No

8. When do you plan to purchase an electric car?
   - Within 1 year
   - In the coming 1-5 years
   - In the coming 5-10 years

9. What type/category of electric car would you purchase?
   - Small city-car (2-door)
   - Compact (5 seats with limited boot space)
   - Mid-class (5 seats capable of transporting 4 pers. with baggage on longer distances)
   - Sportscar
   - SUV
   - Other

10. What category of electric car would you purchase?
11. What price would you realistically pay for your electric car?
At today's prices EUR

12. What are the main reasons why you would consider purchasing an electric car?
Multiple answers can be selected:
☐ It is trendy - I would feel like a trendsetter
☐ I like to try new technological initiatives
☐ I could contribute to reducing carbon footprint / save the environment by driving an electric car
☐ It is sound economic choice - good investment
☐ An electric car better suits my mobility needs than a traditional one
☐ Other

13. Please indicate what existing (or planned) public policy incentives convince you to purchase an electric car:

14. Please provide some more details about the reason(s) why you would consider purchasing an electric car:

15. Could you mark the main reason(s) why you would not consider purchasing an electric car?
Multiple answers can be selected:
☐ I do not have sufficient funds for the purchase
☐ I have sufficient funds but I am concerned about the amortization and value-loss of the car on the longer term
☐ I would prefer to stay with traditional technologies (internal combustion engine)
☐ I will wait until self-driving cars are introduced
☐ I would use other services (e.g. car-sharing)
☐ I do not know much about electric cars
☐ Electric cars have limited range
☐ I would not have the opportunity to charge my electric car (e.g. I live in a block of flats without a private parking place)
☐ I do not trust how the price of electricity will be priced for charging cars
☐ Other

16. Please describe for what other reasons you would not consider purchasing an electric car:

Other consumer expectations
17. What minimum range (kms with a single charge) would make an electric car similar in comfort and reliability to traditional cars for your use?

- 100 - 200 km
- 200 - 350 km
- 350 - 500 km
- More than 500 km

18. What is the shortest timeframe of charging (from flat to full battery) that would make an electric car similar in comfort to traditional cars for you?

- Max 10 mins
- 10 - 20 mins
- 20 - 30 mins
- Max 1 hour
- 1 - 2 hours

19. What do you think would be the best way to promote the spread of electric vehicles?

- More publicly available charging stations
- Better media coverage
- Electric rental cars (including car sharing services)
- Financial incentives (purchase price reduction, vehicle tax exemption)
- Free parking in urban areas
- Use of bus lanes
- Reduced tolls on highways
- Other

20. Please indicate here if you have other suggestions:

21. If you have any other comments or questions related to the topic or the research you can provide them here:
| 1. | Is it possible/realistic to achieve the 2030 targets? (Reduce average CO₂ emissions of produced cars by 30% by 2030)? |
| 2. | Can the current EU and national policies deliver the desired increase in the share of electric vehicles (EVs) in the EU until 2030? |
| 3. | What the EU’s role should be in fostering the increased share of EVs?  
   - The wider scope of regulations (i.e. new legal acts in more areas); or  
   - More detailed regulation (i.e. regulate what is currently regulated on a national level); or  
   - Only to provide funds and leave the policies to the national/regional level;  
   (Please, elaborate more and add other answers). |
| 4. | What are the potential weaknesses in the EU strategies/policies that could jeopardize reaching an increased share of EVs in the EU by 2030? |
| 5. | What lessons (both best practice and adverse effects) could the EU (&MSs) learn from the Norwegian policy on EVs? |
| 6. | In your opinion would giving up technological neutrality improve the chances to reach the 2030 targets? (I.e. pledging the policy to a dedicated technology e.g. electro mobility). |
| 7. | Is there enough policy certainty for the car manufacturers to keep up with the planned demand in EVs in the EU to reach the 2030 targets? (Please elaborate why or why not). |