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Making informed choice of delivery fleet in local logistics

Commercial viability of electric vehicles compared to diesel vehicles

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Abstract

The world is changing. The environmental options of vehicles are becoming more and more popular, but how does this affect to the world of logistics and local deliveries? As vehicles are a major asset to a logistics company it is vital to know if the new alternatives are a better investment than the traditional options.

The aim of this study is to find out if battery electric vehicles (BEV) would be commercially viable option in Finnish local delivery setting, when compared to diesel vehicles (DV). To achieve the study objectives, quantitative data was collected in form of reports on taxes and incentives as well as technical data of the mentioned vehicle groups from manufacturers' websites. Also, five interviews were conducted to gather qualitative primary data. The interviewees were selected to represent different expert profiles relevant to the study.

The research used method triangulation by combining quantitative and qualitative approaches. After analyzing these two different sets of data, conclusions and answers could be derived from it. The results showed that in their current state BEVs are not a commercially viable option in a Finnish local delivery environment. The main reasons include the poor capabilities of the vehicles, when compared to a traditional DV, and the weak or even lacking infrastructure needed to operate and charge the BEVs. Currently the BEV infrastructure is not competitive when compared to the existing infrastructure supporting DVs.

The research revealed some indications of reasons to opt for BEVs in local deliveries, mostly focusing on marketing and PR side of the company and not in the operational side.

This study can serve as a model for future studies on the subject even tough technical and commercial parameters change.

Keywords/tags

Battery electric vehicle, BEV, Local delivery fleet, Diesel vans, Electric vehicle viability, Taxes & Incentives of electric vehicles, logistics and local delivery.

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Tehdään informoitu päätös paikallis- logistiikan ajoneuvolaivueesta

Sähköajoneuvojen kaupallinen varteenotettavuus verrattuna dieselajoneuvoihin

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Maailma muuttuu. Ympäristöystävälliset ajoneuvot ovat yhä suositumpia vaihtoehtoja liikkumisen tarpeisiin, mutta miten tämä kehitys näkyy logistiikan ja paikallisjakelun liiketoiminnassa? Ajoneuvot ovat merkittävä osa logistiikka-/kuljetusyrityksen resursseja, joten on tärkeää ymmärtää ovatko uudet ekologisemmat vaihtoehdot kaupallisesti varteenotettava vaihtoehto yrityksen päivittäessä kalustoaan.

Tämän tutkimuksen tavoitteena oli selvittää täyssähköajoneuvojen (Battery Electric Vehicles, BEV) liiketaloudellista toimivuutta suomalaisessa paikallisjakelun ympäristössä verrattuna perinteisiin dieselajoneuvoihin (Diesel Vehicles, DV). Määrällistä tutkimusdataa kerättiin julkisista raporteista koskien verotusta ja kannustimia sekä myös ajoneuvovalmistajien teknisistä spesifikaatioista. Tämän lisäksi viittä aihealueen kannalta relevanttia, mutta asiantuntijaprofiililtaan poikkeavaa asiantuntijaa haastateltiin laadullisen datan keräämiseksi.

Tutkimusote oli monimenetelmäinen eli se hyödynsi sekä määrällisen että laadullisen tutkimuksen metodiikkaa. Eri metodeilla kerätyn datan analysoinnin jälkeen tutkimus eteni vastaamaan asetettuihin tutkimuskysymyksiin. Tulokset osoittivat, että nykyisessä tilassaan BEV ei ole kaupallisesti varteenotettava vaihtoehto suomalaiselle paikallisjakeluyritykselle. Isoimmiksi syiksi nousi BEV-ajoneuvojen heikot ominaisuudet (verrattuna DV-kalustoon) sekä heikko tai puuttuva infrastruktuuri, jota tarvittaisiin BEV-ajoneuvojen käyttämiseen ja lataamiseen. DV-ajoneuvoilla sen sijaan on jo olemassa oleva laaja infrastruktuuri (huoltoasemat).

Tutkimus toi esiin myös mahdollisuuksia, joissa BEV-ajoneuvot voisivat hyödyttää jakeluyritystä. Nämä mahdollisuudet olivat markkinoinnillisia, eivätkä siten lisää suoraa toiminnallista kilpailukykyä.

Tällä tutkimuksella on mahdollisuus toimia mallina tuleville tutkimuksille, joissa käsitellään samaa aihetta, vaikka tekniset ja kaupalliset parametrit muuttuvat.

Avainsanat

Sähköajoneuvot, BEV, paikallislogistiikan ajoneuvot, dieselajoneuvot, verot ja virikkeet sähköautojen hankinnalle, logistiikka ja paikallis-jakelutoiminta.

Muut tiedot

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1 Introduction

With environmental trends taking the front stage comes a change to the everyday lives of everyone. Cars and transportation are transitioning to more environmentally sustainable fuels, such as electricity, natural gas and hybrid options (electricity/natural gas + diesel/gasoline).

Every year there is more and more car models that are powered by environmentally sustainable fuels, but these options are almost exclusively for “normal” cars. What about trucks and vans? This field of bigger vehicles is still dominated by the traditional fuels: gasoline and diesel. I hope to shed some light to this topic and see if the transition from traditional fuels to the environmentally sustainable fuels is a viable option in a Finnish local delivery environment.

1.1 Background and motivation

We live in the age of transition; the old ways are starting to feel out-of-date to the public, and the environmental and social issues are taking the front stage in politics. With this transition there is one core aspect of everyday life, transportation. How does this transition effect transportation of people and goods? Will the battery electric powered vehicles (BEVs) replace the diesel powered vehicles (DVs)?

In this study battery electric powered vehicles will be referred to as BEVs, and diesel powered vehicles as DVs.

My interest to this topic comes from my personal background. My father is a third-generation logistics entrepreneur, therefore, this field has been part of my family since the second world war. As a child of an entrepreneur I started working in the family business as soon as I was able; in my case it was when I got my driver’s license at the age of 18. I have worked in the field of logistics for a little over 6 years now,

hence this is somewhat a familiar field to me, and have knowledge on how the daily operations work in practice.

I hope that the findings from this research paper will help small to medium size entrepreneurs, such as my father, to make educated decisions when replacing vehicles in their fleets.

1.2 Research question and objectives

Starting from the assumption that there are two options for delivery vans: BEVs and DVs. This is the approach to this paper and the topic is more weighed towards the cost-efficiency and vehicle capabilities side than the environment side, as the environmental topics of this BEV versus DV are quite well covered in existing research papers. Furthermore, the BEVs are the newcomers in the industry, thus the main research question of this paper is:

Is battery electric powered vans viable alternative to diesel powered vans in local delivery business in Finland?

The secondary research question is a two part question, which will change according to the answer to the main research question. As the main question is a simplistic yes or no, with the help of the secondary research question it is possible to get a more specific conclusion:

If yes, in which areas is the battery electric powered vans better than their diesel powered counter parts?

If not, what are the areas that battery electric powered vans need to improve to be up to par with their diesel powered counter parts?

When it comes to the objective of this paper, the research questions reflect it quite well. The objective is to find out, if in 2020 it is commercially viable option to transition to battery electric powered vans from diesel powered vans. In addition,

another objective is to pinpoint the differences from the economical and the vehicle's capabilities point of view. This gives a clear answer as well as the tools needed when choosing between the two options.

1.3 Structure of the paper

This paper is structured into five chapters. The first chapter is the introduction, which includes background, research question, objectives and the structure.

The second chapter is the literature review. Literature review will go over findings and concepts related to the topic of this paper such as basic functions of BEVs and DVs, environmental differences, tax incentives and professional versus personal beliefs.

The third chapter, methodology, describes and explains the research method, philosophies and the approach to this thesis as well as the implementation of the interviews.

Chapter four is the results, where I will go over the collected data from the interviews in two themes: professional and personal views.

In chapter five, the discussion, the quantitative data from the literature review and the qualitative data from the interviews will be analyzed, triangulated and summarized. This will provide answers to the main and secondary research questions. Also, the fifth chapter will provide practical implications and the limitations of this research paper as well as the assessment of research and research quality. To conclude the final chapter there is recommendations for future research on this topic.

At the end of the paper is list of references and appendices.

2 Literature Review

In this chapter of the paper, topics and concepts that are relevant to this research paper will be presented. The chapter will include information on logistics and the field of local delivery, basics of how a BEV and DV work and function, the environmental impacts of BEVs and DVs, the economic aspects of BEVs and DVs, and professional beliefs versus personal beliefs.

The literature on this subject is varying with environmental topics having more extensive researches than the economical aspect. The literature was reviewed according to the keywords which are in this paper as follows**:** Electric battery vehicle, BEV, Local delivery fleet, Diesel vans, Electric vehicle viability, Taxes and incentives of electric vehicles, Logistics and Local delivery.

2.1 The industry

Logistics as an industry is vast; it contains warehouse work, deliveries and everything connected to these functions. Initially the term logistics was used in military context: it indicated any and every activity that served the purpose of maintaining the fighting ability of the troops (Ghiani, Laporte & Musmanno 2004). From there the use of the term expanded into civilian life and to the private sector (Frazelle 2002, 5-6).

In the private sector, logistics started to develop. Frazelle (2002, 6) expresses this development with five different steps, see Figure 1.

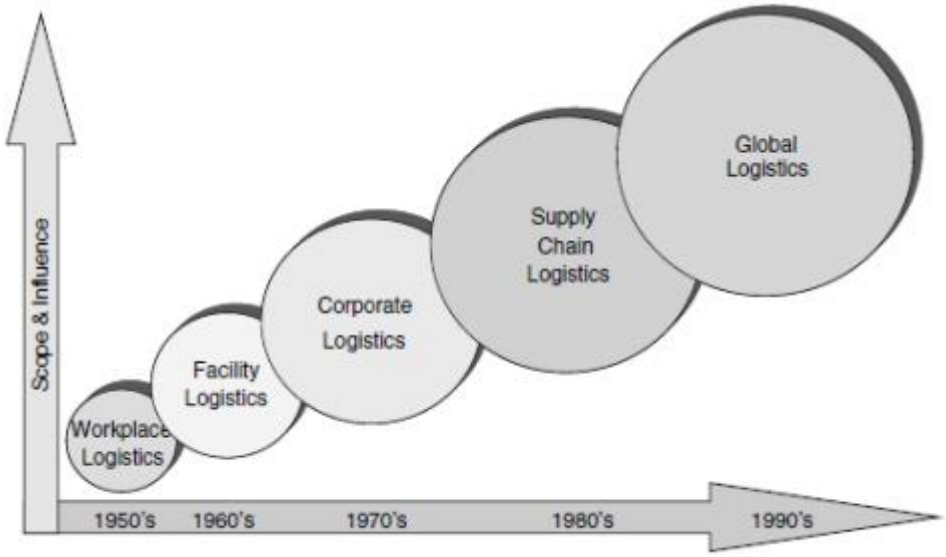

Figure 1 Development of logistics. (Frazelle 2002, 6)

The five steps are workplace logistics, facility logistics, corporate logistics, supply chain logistics and global logistics.

In brief, the workplace logistics refers to actions that take place at work-station and include movement of materials within that unit (ibid.). Next step is the facility logistics which developed from workplace logistics. Facility logistics refer to the movement of materials from work-station to work-station within a singular facility. Actions in facility logistics are differentiated into two groups: business logistics and physical distribution. Business logistics include procurement, marketing, and customer service, while physical distribution is the material handling, warehouse functions and transportation. (ibid.)

After facility logistics the scope was expanded to corporate level, resulting in corporate logistics. The main difference between facility and corporate logistics is the size of the operation; in corporate logistics the material is circulated through various facilities and functions in the corporation. However, the same grouping of actions

from facility logistics is still in place (business logistics and physical distribution). (ibid., 8)

At this point, it is vital to differentiate the terms ‘logistics’ and ‘supply chain’ as there is often confusion when these two terms are mentioned in close proximity of each other. Supply chain is a system which has facilities and operations linked together to create a finished product for the final consumer. Supply chains are formed from warehouses, manufacturing plants, shipment depots, distribution centers, commerce venues and customer destinations (ibid.). While logistics consists of activities that occur within the supply chains as well as the management of these activities. In other words, logistics is what happens in supply chain. (ibid., 8)

According to Frazelle (2002, 5), logistics is “the flow of material, information and money between consumers and suppliers”. While Bowersox and colleagues (Danold, David, Closs, Donald & Bixby 2002, 4) refer to logistics as all the needed activities that need to be done in order to move inventory, which is described by Ghiani (et al. 2004, 6) as “stockpiles of goods waiting to be manufactured, transported or sold”.

Lastly, global logistics has played a major role in connecting different supply chains in different countries and continents, hence, enhancing international flow of material and products globally. (Frazelle 2002, 10-11)

Local delivery

To get an idea of what local delivery is, implement the concept of global logistics but reduce the size of the scope from global to local. Local delivery is about connecting supply chains to your local area and the companies and private individuals within it. This means providing connection between a company producing product X to a consumer in a specific area by offering a delivery service that brings the product from an international shipment depot to a warehouse and from the warehouse to the customer.

Local delivery is not limited to connecting consumers with international companies, but also with national and local companies. The same idea is always present: delivering product from point A to point B, where the point B can be a consumer or a company.

2.2 Technology

In this section there is a basic introduction to each engine type and how they work. This information is useful to know to create an understanding of the maintenance of each vehicle group as well as the costs that go into it.

BEVs

A basic explanation of how electric engines work is that electric car is plugged into a charge point which takes electricity from the grid. The electricity is stored into rechargeable batteries that power the electric motor, which then turns the wheels of the car. (Moses 2020)

According to Moses (2020) electronic vehicles have approximately 90% less moving parts than an internal combustion engine car (traditional gasoline/diesel). The breakdown of the main parts in a BEV is as follows:

- **Charger**, plug into an outlet or electric vehicle charging point in order charge your battery;
- **Batteries**, stores the electricity to operate an electric vehicle;
- **Drivetrain/Transmission**, electric vehicles have a single-speed transmission (this means they only have one gear, unlike in internal combustion engine cars) which sends power from the motor to the wheels;
- **Inverter,** converts the electric current in the form of DC (direct current) into AC (alternating current); and

- **Electric motor/engine**, this is the heart of the car, it provides power to rotate the wheels. The motor can either DC or AC type, however, AC motors are more common than DC.

(Moses 2020)

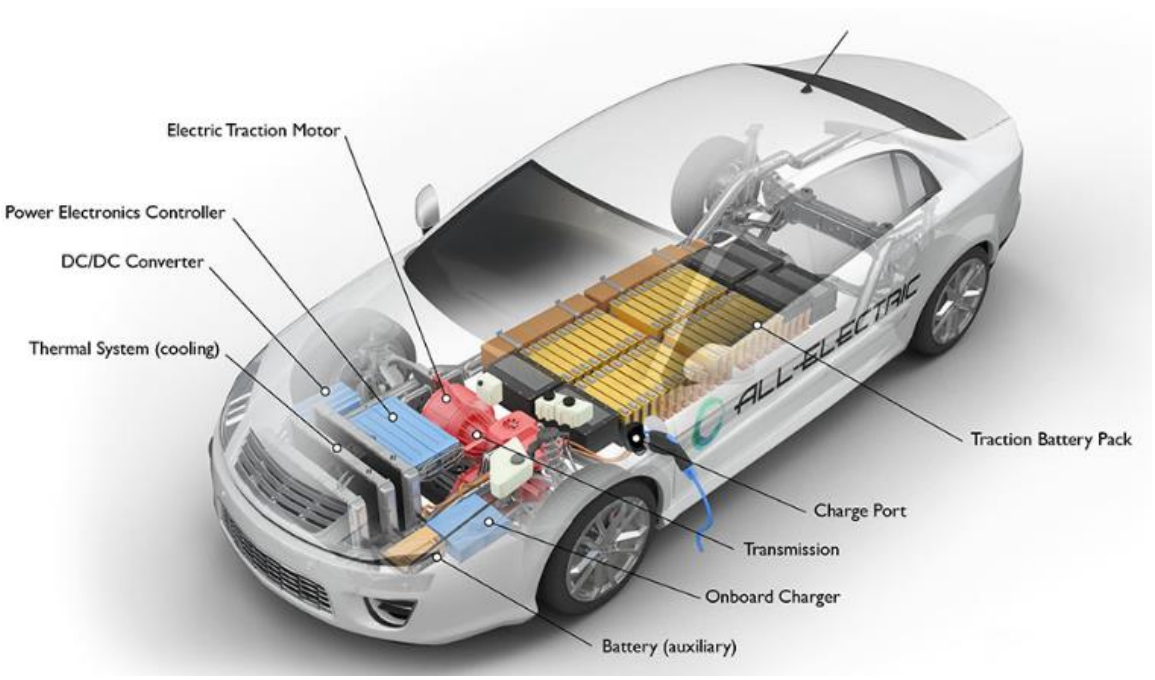

Figure 2 Breakdown of main components in a BEV. (U.S. Department of Energy)

In order to grasp a better understanding of the main components in a BEV, see Figure 2 above. This concludes the basic explanation of how BEVs work as well as the breakdown of the main components in a BEV.

DVs

Vehicles that use diesel as fuel are also called internal combustion vehicles. As mentioned previously, a DV has approximately 90% more moving parts than a BEV. In order to effectively illustrate the breakdown of the main components in a diesel internal combustion engine vehicle, see Figure 3.

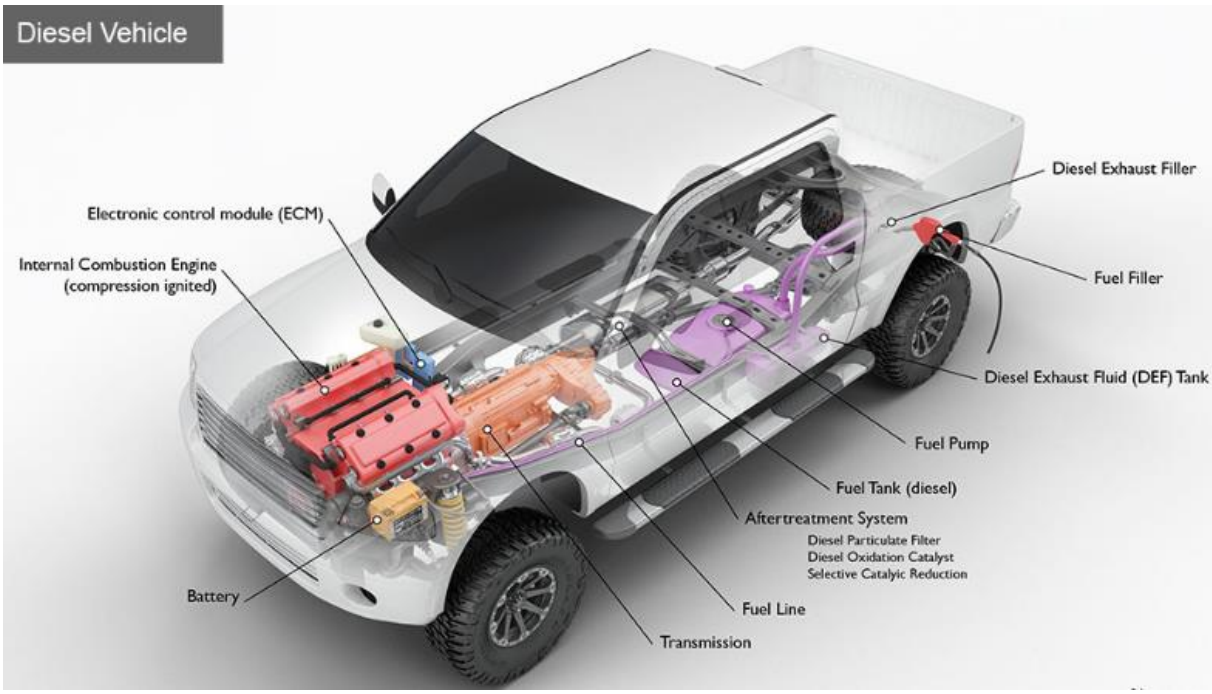

Figure 3 Breakdown of main components in a DV. (U.S. Department of Energy)

A DV requires diesel in order to power the engine. The diesel is first pumped via fuel filler into the fuel tank. The diesel is stored in the fuel tank until it is required for the usage of the engine. From the tank the diesel travels via the fuel lines into the engine where it is injected into the combustion chamber and ignited by the high temperature. The high temperature is achieved when the diesel is compressed in the combustion chamber. Transmission uses the mechanical power of the engine and transfers it to the wheels. (U.S. Department of Energy)

This is the simplified explanation of how diesel internal combustion engine makes the vehicle move. As seen in the breakdown figures of each type of vehicle, BEV is a more simplistic machine than a DV. There is a lot more moving parts and liquids in a DV than in a BEV.

2.3 Environmental aspect of fleet power sources

Due to environmental actions and policies becoming more acknowledged by the public, the amount of studies and research papers done on the environmental issues has grown tremendously. This provides a good up to date selection of studies and research papers on topics such as assessments on BEVs versus conventional vehicles. In the context of this research paper, conventional vehicles refer to diesel and gasoline powered vehicles.

Production and the use of BEVs and DVs

There exists a great number of comprehensive studies on comparative assessments of life cycles between BEV and conventional vehicles (CV). For example, two different research papers provide a comprehensive overview of the existing literature on the BEV and hybrid vehicle life cycle emission compared to CV life cycle emissions (Hawkins, Singh, Majeau-Bettez & Stromman 2012; Nordelöf, Messagie, Tillman, Söderman & Van Mierlo 2014).

Although their studies show that BEV, in most cases, has lower emissions compared to CVs, most of these studies focus on some particular BEV component, thus, they fail to showcase a full environmental assessment.

However, Giordano, Fischbeck & Matthews (2017) conducted a study that made a full environmental assessment comparing DVs and multiple different electric battery technologies that are used in BEVs. Giordano and colleagues created a detailed greenhouse gas (GHG) emission charts for the life cycle of BEVs and DVs.

The charts (see Figure 4 and Figure 5) include data from the production and all the way to the actual usage of the vehicles. Their calculations of fuel consumption and emissions are done for 50% of average load factor calculated according to EMISIA 2014 (Emission Inventory Guidebook 2014, European Environment Agency).

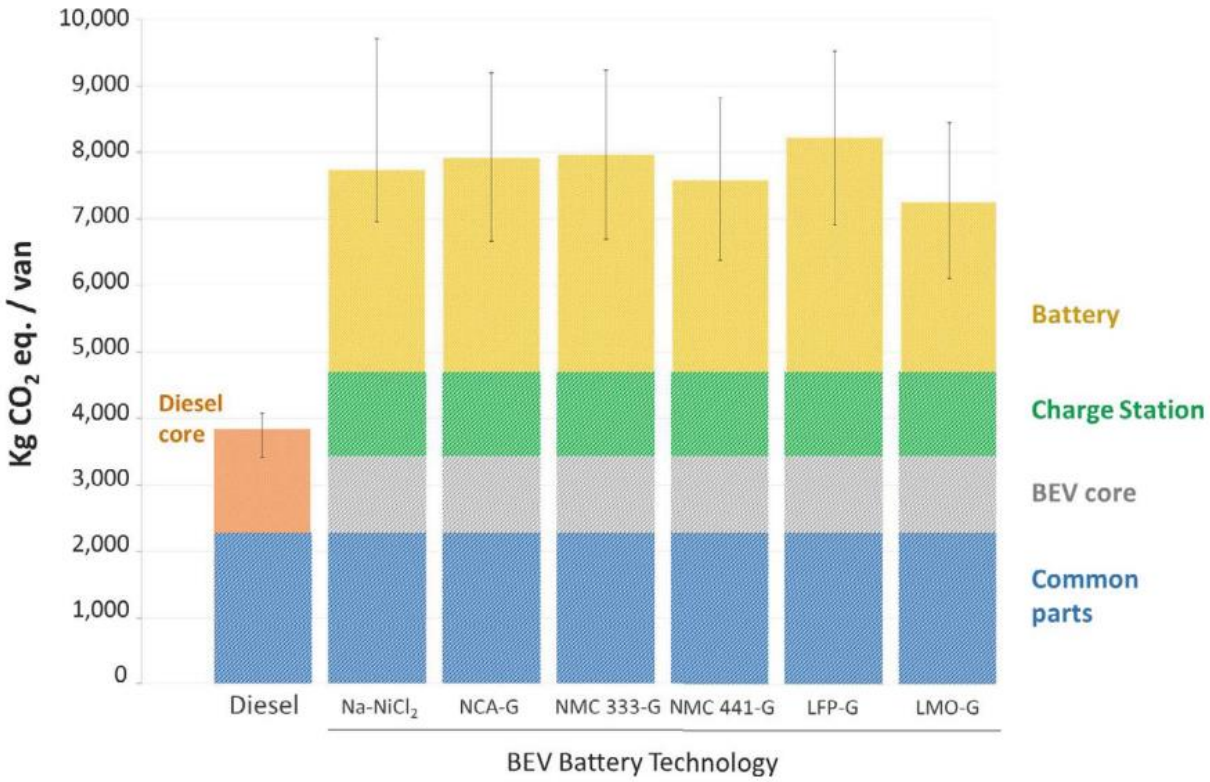

Figure 4 GHG emission from production-phase of BEVs and DVs. (Giordano et al. 2017)

As seen in Figure 4, the production emissions of BEVs compared to DVs emissions are at least 50% higher. The reason BEVs perform worse than DVs on the production phase is due to the materials and the complexity of additional components, with the biggest component being the batteries.

In Figure 4, there are six different battery technologies:

- Na-NiCl2 (nickel-salt),
- NCA-G (lithiumnickel cobaltaluminumoxide),
- NMC 33-G and NMC 441-G (lithiumnickel manganese cobalt oxide),
- LFP-G (lithium iron phosphate), and
- LMO-G (lithium manganese oxide).

There is no standardized battery technology for the BEVs, which creates an opportunity for different companies to try and create their own, better, battery for the BEV. This opportunity is good for new innovations and competition, but on the other hand, the competition creates a lot of stress on the environment since many different battery technologies are being tested and created at the same time.

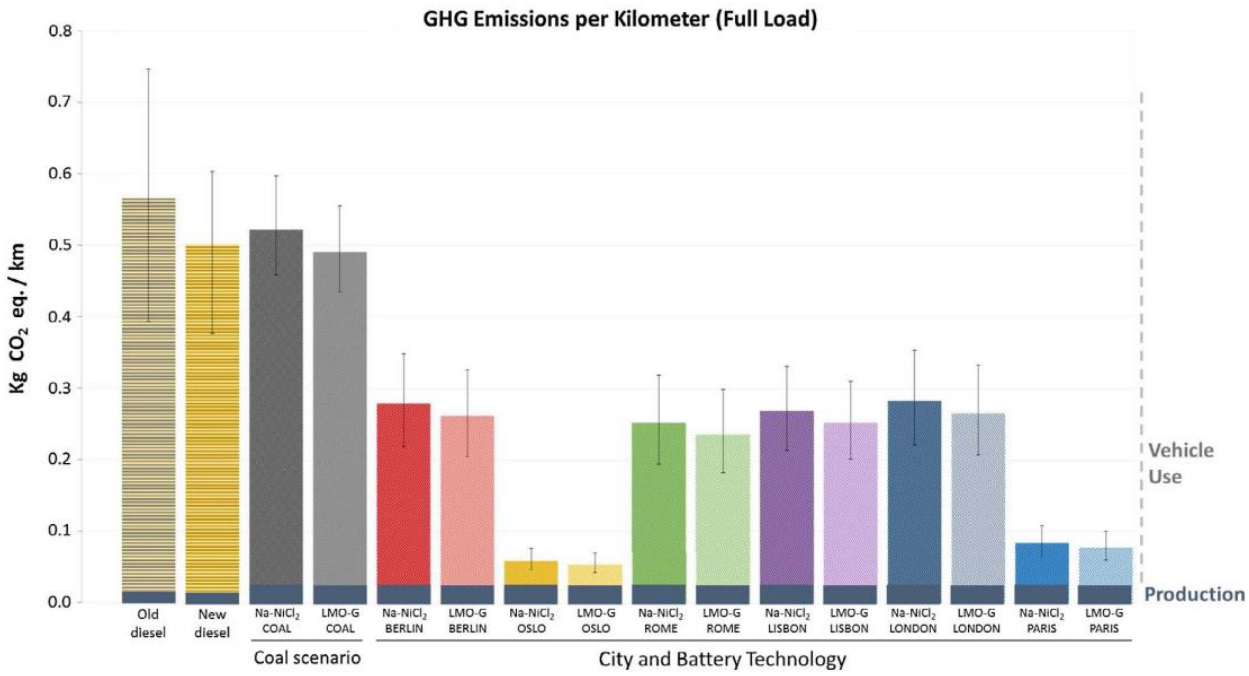

Figure 5 GHG emission per kilometer driven by each vehicle type. (Giordano et al. 2017)

When moving their focus from production to actual usage of the vehicles, Giordano and colleagues collected data from different European cities to showcase the differences of using BEVs in different parts of Europe. When compared, Figure 5 there are only two different battery technologies listed for each city, whereas in Figure 4 there are six. This is due to Giordano and colleagues deciding to summarize the total emissions results for the best and worst cases (Na-NiCl2 and LMO-G).

In line with the previous studies (Hawkins et al. 2012; Nordelöf et al. 2014) the BEVs dominate the use-phase of emission results. The emission results between BEVs differ greatly across the cities due to the different mixes of electricity generation. For example, Paris and Oslo have the lowest emissions due to relying on nuclear and hydro-power. (Giordano et al. 2017)

2.4 Economic aspect of fleet power sources

The economical side of BEVs and DVs consists of two parts: government and business. This means that government effects the economics around these vehicles with taxation and possible incentives. Business, on the other hand, is about companies that produce, sell and set the prices for the vehicles.

Taxes and Incentives

In the EU, when it comes to BEVs, all of the member countries decide their taxes and incentives autonomously. In some member countries, BEVs are exempted from the circulation tax, for example in Czech Republic and Italy. Whereas in other countries, such as Belgium, France and Sweden, on top of the exemption from circulation tax there are incentives for purchasing a BEV and/or exemption from the registration tax. (Cavallaro, Danielis, Nocera & Rotaris 2017)

Table 1 Tax & Incentives of BEVs in EU in 2016. (Cavallaro et al. 2017; ACEA 2016)

Country	Year 2016		
	Purchasing incentives	Registration tax	Yearly incentives
Austria	Local incentives for EVs.	None	EVs: exemption from the fuel consumption tax and from the monthly vehicle tax
Belgium	Incentives for EVs and FCEVs	EVs and PHEVs: exemption from registration tax in the Flemish Region	EVs: minimum rate of the annual circulation. Company cars: 120% deductibility rate from corporate income of expenses for zero-emissions vehicles and 100% for vehicles emitting 1–60 g CO_2/km
Bulgaria	None	None	EVs: exemption from the annual circulation tax
Croatia	None	None	None
Cyprus	None	None	None
Czech Republic	None	None	EVs, HEVs, PHEVs: exemption from the road tax
Denmark	None	EVs: exemption from registration tax	None
Estonia	None	None	None
Finland	None	EVs: minimum rate of the CO_2 based registration tax	None
France	EVs, PHEVs, HEVs: €750 for vehicles emitting 61–110 g CO2/km; €1000 for vehicles emitting 21–60 g; €6300 for vehicles emitting 0–20 g	EVs, HEVs, CNG, LPG, and E85: option for an exemption from the registration tax (100% or 50%)	EVs: exemption from the company car tax. HEVs: exemption for the first two years after registration
Germany	Incentives up to €4000 for BEVs, up to €3000 for HEVs	None	EVs: exemption from the annual circulation tax (10 years validity)
Greece	None	EVs and HEVs: exemption from registration tax	EVs and HEVs: exemption from luxury tax EVs and HEVs up to 1549 cc: exemption from circulation tax
Hungary	None	EVs: exemption from registration tax	EVs and HEVs: exemption from annual circulation tax and company car tax
Ireland	BEVs and PHEVs: grant of up to €5000 on purchase	BEVs, PHEVs, HEVs: benefit from vehicle registration tax up to a maximum of €5000, €2500 and €1500, respectively	EVs: minimum rate (€120) of the road tax
Italy	None	None	EVs: exemption from the annual circulation tax (ownership tax) for 5 years. Afterwards, 75% reduction of the tax rate
Latvia	None	EVs: exemption from registration tax	EVs: minimum rate (€10) for the company car tax
Lithuania	None	None	None
Luxembourg	None	None	EVs: minimum rate (€30) for the annual circulation tax
Malta	None	None	None
Netherlands	None	EVs: exemption from registration tax	Vehicles emitting max. 50 g CO_2/km are exempt from the annual circulation tax
Poland	None	None	None
Portugal	None	EVs: exemption from registration tax	EVs: exemption from the annual circulation tax HEVs: payment of 25% of registration tax
Romania	None	EVs, HEVs: exemption from registration tax	EVs: exemption from the annual circulation tax
Slovakia	None	None	EVs: exemption from the annual circulation tax HEVs: 50% reduction of the annual circulation tax
Slovenia	None	None	None
Spain	None	None	EVs: 75% reduction of the annual circulation tax
Sweden	PHEVs: SEK20,000 EVs: SEK40,000	None	EVs, PHEVs: 5-year exemption from the annual circulation tax; reduction of company car taxation
United Kingdom	None	None	EVs, HEVs, PHEVs below 100 g/km: exemption from the annual circulation tax BEVs: exemption from the company car tax, HEVs, PHEVs < 50 g/km: 5% discount for the car tax

Cavallaro and colleagues composed this table from the data of ACEAs 2016 report on the taxation and incentives of BEVs in the EU in 2016.

As seen in Table 1, in 2016 29% of the EU member countries had no tax incentive for BEVs, and 75% of the EU member countries had no incentives for purchasing a BEV (Cavallaro et al. 2017).

The taxation and incentives in EU member countries, including the United Kingdom, have changed since 2016 which is evident from the amount of different types of incentives and tax exclusions. The change can be seen in the full ACEA 2020 report (see Appendix 6, Tables 6-10), and the adaptation of the same report (see Table 2). ACEA publishes the report on taxation and incentives of BEVs annually.

To highlight changes in taxes and incentives from 2016 to 2020, here are a few comparisons. First, in 2020, only 17% of the member countries do not have any tax benefits for buying/owning a BEV whereas back in 2016 the number was 29%. Another example can be seen when comparing the tax benefits from 2016 to 2020 in Croatia; there were no tax benefits for BEVs in 2016, but in 2020 an exemption from special environmental tax for BEVs exists. On top of that, there is an incentive scheme in which consumer can get up to €9,200 each year for owning a BEV. (ACEA 2020)

The biggest change has come in the incentive for purchasing a BEV. While back in 2016, only 25% of the member countries had a purchasing incentive, the number has risen to 75% as of 2020. Thus, back in 2016 only seven countries had purchasing incentives, whereas now in 2020 only seven countries do not have any purchasing incentives. For example, in 2016, United Kingdom had no purchasing incentives, but in 2020, their government grants incentives through car dealerships for zero-emission cars up to £3,000 if the price is less than £50,000. Vans, taxis and trucks are eligible for these incentives. (ACEA 2020)

A new bracket in ACEA 2020 report is ‘company cars’, which shows that certain EU countries are encouraging companies to move towards more environmental options. For example, in France companies get exemption from CO2-based tax components if the vehicle emits less than 20g CO2/km, which would be the case with BEVs. (ACEA 2020)

While some of the EU countries have made significant changes and progress in the taxation and incentives field, Finland has stayed almost stagnant. In the 2016 ACEA report, Finland only had minimum rate of CO2 based registration tax on BEVs, whereas in 2020 ACEA report, the same minimum rate of taxation has stayed the same, with the addition of €2,000 incentive for purchase or lease of a new BEV that is valued less than €50,000. This is quite insignificant incentive and is only eligible for “private” people, not companies.

Table 2 ACEA report on tax and incentives of EBVs. (Adapted from ACEA 2020)

COUNTRY	ACQUISITION	TAX BENEFITS OF OWNERSHIP	COMPANY CARS	PURCHASE INCENTIVES
CROATIA	No excise duties for electric vehicles.	Exemption from special environmental tax for electric vehicles.	None	Incentive scheme (once a year, limited funds): - €9,200 for BEVs. - €4,600 for PHEVs.
FINLAND	Minimum rate for zero-emission vehicles.	Minimum rate for zero-emission vehicles.	None	Incentive of €2,000 for households to purchase or lease a new BEV with value ≤€50,000 (until 2021).
FRANCE	Regions provide an exemption (either total or 50%) for alternatively-powered vehicles (i.e. electric, hybrid, CNG, LPG and E85).	None	Exemption from CO2-based tax component ('TVS') for vehicles emitting less than 20g CO2/km	Bonus to buy cars or vans with ≤20g CO2/km: - €7,000 for households, vehicle price ≤€45,000. - €5,000 for legal persons, vehicle price ≤€45,000. - €3,000 for households and legal persons: - Vehicle price between €45,000 and €60,000. - FCEV vans and cars or vans with price >€60,000. Scrappage scheme for purchase of second-hand or new vehicles with ≤50g CO2/km, price ≤€60,000: - Cars: - €5,000 for households, depending on income. - €2,500 for legal persons. - Vans: €5,000 (for households or legal persons).
UNITED KINGDOM	Exemption for zero-emission vehicles.	Exemption for zero-emission vehicles.	Minimum rate for zero-emission vehicles: - 0% in 2020-2021. - 1% in 2021-2022. - 2% in 2022-2025.	Government grants (through dealers) for: - Zero-emission cars up to £3,000, if price is <£50,000. - Vans, taxis and trucks

Business

The business aspect of BEVs versus DVs is straight forward; companies and manufacturers set the price of components and vehicles. How do the prices differ between BEVs and DVs? And what are the factors if the prices are different?

According to multiple sources, the battery in a BEV is the most expensive component, which in turn makes BEVs 2 to 2.5 times more expensive than their diesel counterparts. (Braithesite-Smith 2019; Cavallaro et al. 2017; Erneurbar mobil 2016; Renault editorial team 2020)

According to Renault editorial team (2020), in 2019 purchasing a battery of an electric vehicle would cost around 140 euros/kWh. While Erneurbar mobil (2016) estimated that in 2016 the price was about 500 euros/kWh and that it would drop down to 100-250 euros/kWh. Cavallaro and colleagues (2017) stated that the battery prices are not publicly available, however, the prices are estimated to be around 200-270 euros/kWh.

The prices of the batteries in BEVs automatically reflect on the price of the vehicle. In order to highlight the “extra” costs of a BEV compared to its DV counterpart, Mercedes-Benz Vito works as a good example since the van model has both BEV and DV models available in Finland. In this case, I will use the eVito mid-long (A2) and the diesel Vito equivalent.

The base price of an eVito A2 is €64,594. The battery size is 41kWh, total mass 3,200kg and max speed limiter at 120km/h (Veho 2020; Mercedes-Benz 2020). As already mentioned, the battery prices are not public knowledge, therefore the calculation for estimated battery price is: €100*41 or €250*41. Thus, in this eVito the battery would cost roughly between €4,100 and €11,070.

The prices of A2 diesel Vito range from €34,482 to €92,344. The big price range is due to the fact that currently diesel vehicles have more flexibility when it comes to accessories and possibility of front-, rear- and four-wheel drive. In addition, the engine size can vary in each of different configurations. The diesel Vito that has the same specifications as the eVito A2 would cost €45,866. The engine is a 2.1 l diesel, total mass 3200kg and max speed limiter at 160 km/h. (Veho 2020)

The price difference between eVito (€64,594) and diesel Vito (€45,866) is €18,728. While the battery of the eVito is estimated to be from €4,100 to €11,070 it still leaves a price difference of roughly €14,628 - €7,658. Which makes it logical to assume that the costs of production for BEVs are slightly higher than DVs.

2.5 Impact of personal beliefs

When making decisions on asset acquisition, a logical assumption would be that the person/company doing the acquisition would maximize the utility and cost-effectiveness and minimize the costs. However, is this always the case?

Sams, Schwartz and Smith (2016) conducted a research on how personal beliefs impact Business-to-Business buyer decisions. The target group of their study was decision-makers of school bus acquisitions in the USA and Canada. One of the hypotheses of the research was “Owners of hybrid vehicles will be more likely to purchase alternative fuel buses.” (Sams et. al. 2016). That hypothesis was supported, the implication being that personal beliefs and perspectives of the individuals have significant influence on the purchase decisions. The same hypothesis worked to the opposite direction too: “Alternately, if an influencer is not an alternative fuel owner then it will be much more difficult to make the argument for conversion to an alternative fuel bus fleet.” (Sams et. al. 2016).

3 Methodology

In this chapter the following areas of the methodology will be discussed: research philosophies and methods, as well as approaches, strategy and data collection.

3.1 Research philosophy and methods

There are four categories for the research purpose classification: the descriptive, the explanatory, exploratory and a combination of the previous 3 (Saunders, Lewis & Thornhill 2009, 174). In this paper, the first and second, descriptive and explanatory are used.

Descriptive philosophy is about portraying an accurate picture/profile of a person, an event or a situation (Robson 2002, 59). Descriptive research aims to answer what, where, when and how, but it is necessary to have a clear picture of the chosen phenomena that you wish to collect the data about (Saunders et. al. 2009, 140). When viewed from academic point of view, descriptive research is more often than not, insufficient for an academic paper as academic papers are aimed at developing and progressing current knowledge. With this in mind, when a research paper utilizes description it is likely a precursor to explanation. These studies can be called 'descripto-explanatory studies'. (Saunders et. al. 2009, 140)

In explanatory studies the goal is to establish causal relationships between different variables surrounding a phenomenon with the emphasis on studying the situation or problem so that you can explain the relationships between the different variables (Saunders et. al. 2009, 140). Literature review part of this paper, which aims to collect relevant quantitative data, fits the description of a descripto-explanatory philosophy. The literature review provides data on the papers topic with aspects of logistics industry, technology of BEVs and DVs, environment and economic (what, when, where and how). With this data it is possible to create causal relationships

between the different aspects/variables surrounding the topic, thus, it is descripto-explanatory.

According to Greener (2008, 10-15), research methodology is related to understanding, strategizing and approaching the research question in a way that helps answer it.

In different research philosophies there are different research approaches. Two main approaches are quantitative (deductive) and qualitive (inductive). The key difference between the two is that deductive approach starts with a hypothesis, while inductive approach uses a research questions to narrow the study (Saunders er al. 2009, 124-125). Other distinctions between the two are: static vs. process, generalization vs. contextual understanding, and others, as seen in Figure 6.

Quantitative	**Qualitative**
Numbers	Words
Point of view of researcher	Points of view of participants
Researcher distant	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalisation	Contextual understanding
Hard reliable data	Rich deep data
Macro	Micro
Behaviour	Meaning
Artificial settings	Natural settings

Figure 6 Quantitative vs. Qualitative methods (adapted from Greener, taken from Bryman and Bell 2003, 302)

As reported by Greener (2008, 80), Bryman and Bell (2003) state that in order to develop richer profile/picture of the researched phenomena, elements of both quantitative and qualitative methods can be mixed to triangulate results.

Triangulation design model is present when there is need to bring together quantitative data and qualitative data. The idea of this model is to triangulate or gather both types of data at the same time, and to combine the two forms of in order to better understand the research question/problem. (Creswell, Fetters & Ivankova, 2004, 11)

This paper is a mix of quantitative and qualitative methods, therefore creating the need for triangulation method. This means the paper has two types of data, quantitative and qualitative, and with that data the goal is to answer the research questions, which are:

Is electric battery powered vans cost-effective alternative to diesel powered vans in local delivery business?

And:

If yes, in which areas is the electric battery powered vans better than their diesel powered counter parts?

If not, what are the areas that electric battery powered vans need to improve to be up to par with their diesel powered counter parts?

3.2 Strategy and data collection

A good option for qualitative data collection in a research is case study. Yin (2014, 4) defines case study as an observational analysis on contemporary and complex social phenomena. Case study is one of the most used research data collection strategy. It is popular method when the study/research is about organizational behavior, while giving the chance to focus on behavior of small groups, organizational processes and managerial processes. (Krishnaswami & Satyaprasad 2010, 15.)

Case study as a research strategy is one that uses multiple sources of evidence. These multiple sources can be interviews, collection and analyzation of documents etc. (Saunders, Lewis & Thornhill 2012, 179). According to Yin (2014, 12), case study uses a few different techniques to gather information, the biggest two being interviews and direct observations. Although this paper is not a traditional case study, where the study revolves around a singular company/organization and studies the effects of a phenomena on different parts of the company, but this paper utilizes the idea of using multiple sources of evidence and one main source being interviews shows that this paper has similarities to a case study.

Data from interviews and direct observations are called 'Primary Data'. Primary data is data collected by the researcher with methods like interviews, surveys or experiments. Advantage of primary data is that if you want to find out people's attitudes towards the topic, collecting primary data correctly is the only way of doing this (Ghauri & Gronhaug 2010, 100).

Data collection

To collect primary data, I chose to use interviews, more specifically face-to-face interviews. In face-to-face interviews it is easier to read the moment and lead the conversation/interview to topics that the interviewee has more to say about.

When comparing to email interviews/surveys, face-to-face interviews are more flexible and have the possibility to get the interviewee to elaborate on the topics.

The type of interview used in this paper is semi-structured interview. The questions were prepared beforehand and uniquely to each interviewee, see Appendix 1, but there were situations where the interviewee had more to say some specific topic and the interview structure would accommodate that. This creates a flexible environment which makes the interview semi-structured.

The biggest benefit of conducting interviews was the possibility to receive information from the interviewees about their professional opinion and personal opinion. This gives a picture of what the interviewees see in their job and how they experience the phenomena personally. When separating the professional and personal perspective, this shows interviewees real attitude towards the topics while still maintaining the information from the professional side.

The interviews were conducted in the summer of 2020. To get a broad perspective on the topic at hand, I chose to interview professionals from the field of logistics, each of the interviewees are somehow connected to the field of logistics, but their roles in it are different. So, the cast of interviewees included two logistics entrepreneurs, one commercial vehicle sales rep, one mechanic and one logistics manager. This makes a total of 5 interviewees.

The people chosen are professionals in their respected fields with some of them having over a decade of experience. I chose the interviewees based on the possibility of them providing information on the study's topic but from different points of view. As entrepreneurs have different views from managers and sales reps. Also, the topic is about local delivery environment, and all of the interviewees are from the same city and their insights on the local aspect is crucial.

The interviews were recorded with an audio recorder, this gave the interviewer chance to properly engage in the interview. This also provided the material for thorough transcription of the interviews, based on the transcripts I was able to analyze the interviews and pull out key information that can be connected to the research questions.

4 Results

In this chapter I will provide information on the questions used, a profiling of the interviewees as well as the summary of the results after transcribing the audio recordings of the interviews. To see the full structure of the interviews, see Appendices 1 to 5.

The interviews were structured so that the interviewer could modify the questions to accommodate the flow of the interview. In other words, the interviewer could always pursue a certain topic if he sensed that the interviewee had information/interest in it. This proved to be effective as some of the base interview questions did not get more than a few words as an answer. The basic structure of the interview was to first establish the interviewees role in his/her company and how that is connected to the field of logistics. Then the questions targeted the interviewees responsibilities and the topic of BEVs in their company, and how BEVs could be seen in their company. After finding out about the effect of BEVs to the company, the interview moved to the personal view of the interviewee. This provides the possibility to see if the interviewees views are in line with the company that they work for.

The questions used can be themed into three categories, the introduction, theme 1 and theme 2. With introduction being the “profile” of the interviewee, this includes their role/job, relevant information on that and their experience in the field.

Theme 1 is the professional view on the topic, this is shown in what the situation currently is in the companies. Such as if BEVs are in any relevant role in the company and how the company maybe is going to change to accommodate them or not.

Theme 2 is the personal view on the topic. With theme 2 I hope to find out how the experts of the field of logistics are feeling towards BEVs and if they are open minded towards them or if they are openly against BEVs.

Table 3 Profiles of the interviewees

Title	Responsibilities / relevant information	Experience
Interview 1 **Logistics entrepreneur 1**	Owns a small logistics company. The company has two vehicles and four employees. The company offers goods delivery services and has three big clients.	Has been the owner for 30 years and is the third generation running the family business.
Interview 2 **Vehicle sales expert**	Vehicle sales expert (VSE) works at Veho. He is a commercial vehicle sales expert and his client base consists of companies (big and small).	Has worked 22 years at Veho, first seven of them as a team supervisor and the last 15 years as a commercial vehicle sales expert.
Interview 3 **Logistics manager**	Logistics manager (LM) works at Kaukokiito. He oversees day-to-day transportation related operations at Kaukokiito's Tampere terminal. Also, he is in charge of fleet availability in the Pirkanmaa region.	Has worked 5 years at Kaukokiito. The whole 5 years has worked in the logistics operations department. Has history as a van/truck driver.
Interview 4 **Logistics entrepreneur 2**	Owns a small/medium size logistics company. The company has seven vehicles and 12 full-time employees. Provides goods delivery services and has four big clients. Company's work is across Pirkanmaa region and little to the side of Päijät-Häme.	Has worked as a truck driver for 13 years before buying the company and expanding it from one vehicle to seven.
Interview 5 **Mechanic**	Works as a mechanic for Metroauto. He repairs and maintains cars and vans. And he also restores old cars in his free time.	Has worked as a mechanic for 13 years, in several different companies, such as Vianor, Veho and Metroauto.

As seen in the Table 3, five different professionals connected to the field logistics were interviewed. Two logistics entrepreneurs (LE1 and LE2), a vehicle sales expert (VSE), logistics manager (LM) and a mechanic (M). The interviews were numbered in chronological order with 'Interview 1' being the first interview conducted and 'Interview 5' the last.

4.1 Theme 1: Professional view

After conducting all the interviews, I was able to group together two themes with the first being 'Professional view'. See Table 4, for the main takeaways concerning the professional view on the topic of BEVs and DVs from each of the five interviewees. The table has 'excerpts from interviews' and 'summary of point of view' columns, with excerpts having citations from the interviewees and the summary column has the main takeaway from each person's view.

The data collected had vast amounts of information towards the companies and how they operate, however, due to it not being relevant to this topic, such information was left out; unless, that information was somehow related to the topic of BEVs vs DVs. Although in most of the interviews the companies did not have too much operations involving BEVs.

Table 4 Theme 1: Professional view

Theme 1	Excerpts from interviews	Summary of point of view
I1 LE1	"With a full tank of diesel, you get a range of 500km to 700km. Of course, this varies when the weight of the cargo changes, but typically 500 to 700km is the range with a full tank." "There is no real competition from the BEV side of vans. Their capabilities are weak when compared to DVs and in their current state they wouldn't be able to handle the work my company does."	BEVs capabilities are weaker than DVs. Such as the range with a full "tank".
I2 VSE	"Mercedes-Benz Sprinter is, and has been, the most popular commercial vehicle in Veho's catalogue of commercial vehicles. With this trend spanning over several years, I don't see a reason for it to change for a while." "The only BEV we currently have in our catalogue is eVito. There are no incentives by the government to buy BEVs, but there has been some interest towards the eVito from some companies that want to use it in their marketing/PR materials."	A DV is, and has been, the most popular vehicle. And the interest towards the BEV has been in the form of using it in marketing/PR.
I3 LM	"Our vehicle fleet is provided by subcontractors. The subcontractors make the decisions on what type of vehicles they acquire with the guidelines that we give them. Currently the guidelines are about the capabilities of the vehicle, such as how much it can carry cargo (kg) and what size the possible trailer can/has to be." "We don't have any BEVs in our fleet, at least to my knowledge. But in Jyväskylä there is a natural gas powered truck, that endeavor was done in collaboration with one of our biggest clients in that area. The client put their own money to this project."	Kaukokiito does not have BEVs in their fleet. This is partly due to them not owning the fleet. But there is still movement towards lower emissions.
I4 LE2	"My vehicles are unevenly "worked". The biggest truck is driven basically 24/7 while some of the smaller ones only have 2.5 to 8 hours of work a day." "Of course, you can always look at them (talking about BEVs), but in their current state they wouldn't be a smart move. Maybe to the smallest work shift that my company has, the 2.5h one, but other than that there is no good reason to buy a BEV… YET."	The capabilities of BEVs were again discussed, and it came up how they would not be enough for the work.
I5 M	"We have not yet been trained to maintain or repair BEVs, the training was supposed to start in the spring, but COVID-19 came and messed the schedule up. Now starting this fall, we will have remote training on the BEVs that are in our catalogue." "The differences are significant when comparing a DV maintenance to a BEV. When working with a BEV you need to isolate and "neutralize" the area where the work is being done. And to do this you need special tools and special protective gear. A singular maintenance might be cheaper, but how many of those are in a year…. I don't know"	There has not been training on BEVs yet. And the costs of maintenance on BEVs vs DV are still hazy.

When comparing the takeaways from each interview, the similarities and same line of thinking is already quite apparent.

4.2 Theme 2: Personal view

During the interviews, after going through questions regarding theme 1, it was quite easy to move to theme 2: personal view. All of the interviewees had already been thinking about the BEV and DV situation from the professional standpoint therefore it was natural for them to consider the topic from their personal point of view.

The same idea of ‘excerpts from interviews’ and ‘summary of point of view’ columns was used in the table of theme 2, see Table 5. The theme 2 had a little varying in the takeaways as seen in Table 5. But the uniformity of personal views could be seen quite clearly.

Table 5 Theme 2: Personal view

Theme 2	Excerpts from interviews	Summary of point of view
I1 LE1	"If/When the time comes that BEVs are on the same line with DVs, yes, I might buy one. I'm not trying to fight against development, but as long as it is more cost-efficient and "smarter" to buy a DV, I will stick to them."	Open mind towards acquiring a BEV in the future.
I2 VSE	"There is no real reason to buy a BEV. Their capabilities are so much inferior when compare to DVs." "I don't see that in the near future there would be a scenario that would put BEVs in a real competitive position in the market. The development of biodiesel is in good shape so that is the more realistic option."	Not believing that BEVs could take any room in the market in the near future.
I3 LM	"Of course, I believe that Kaukokiito will have BEVs in its fleet in the future, but when? I do not know, as the fleet acquisitions are made by the subcontractors and currently, we can't force them to buy any specific fuel powered vehicles."	Believes that in the future Kaukokiito will have BEVs.
I4 LE2	"If I'm able to stay afloat in this industry long enough then yes. I believe that I'm going to have BEVs in my fleet as soon as they become relevant and competitive. I'm not going to fight against windmills (Don Quijote reference)."	Open minded and even a bit eager to have BEVs in his fleet.
I5 M	"Of course, they will be the future, and as I said, the future. In their current state BEV vans don't really have any chance unless the work is just in downtown area and lasts maybe a few hours." "The price of charging stations is quite rough. €6800 for a rapid charge station + the cord is a tough price to pay. When the chargers become cheaper, the development will speed up."	Believes that BEVs will be the future. But the downsides are still too severe.

5 Discussion

This final chapter summarizes the qualitative data from the interviews as well as compares and combines them with the quantitative data of the literature review in order to provide accurate answers to research questions. Also, this chapter contains the assessment of research and research quality, practical implications, limitations of research and the recommendations for future research.

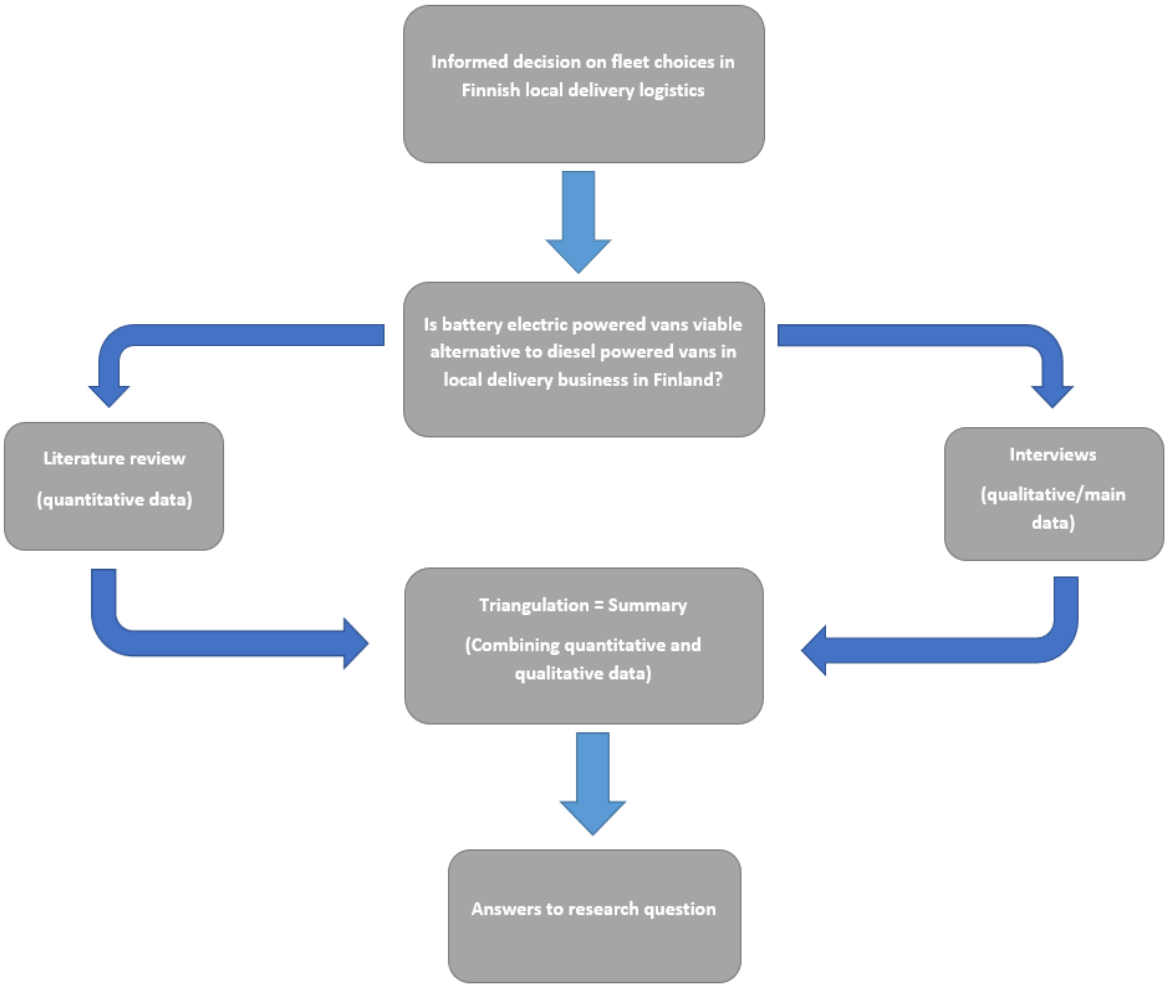

Figure 7 Steps of the research

5.1 Answering the research questions

The aim of this research paper was to find out if now in 2020 BEVs are a viable option for local delivery fleets. The interviewees provided impeccable opportunity to gain perspectives to the topic from their professional and personal view. This was an excellent opportunity for me to connect the literature of the topic to the real world.

The main research question of this research paper is:

Is battery electric powered vans viable alternative to diesel powered vans in local delivery business in Finland?

As already mentioned in this paper, **the secondary research question** changes according to what the answer to the main question is. If it is a positive answer the secondary research question is:

If yes, in which areas is the battery electric powered vans better than their diesel powered counter parts?

However, if the answer to the main research question is negative, the secondary research question is:

If not, what are the areas that electric battery powered vans need to improve to be up to par with their diesel powered counter parts?

The motivation for this research paper arises from the increased interest towards BEVs in the market as well as my personal interest to see if there are viable options in BEVs for local delivery environment. As mentioned earlier, my personal interest arises from my family background in logistics.

The interviews provided a lot of information on multiple different topics, with the most prominent ones being, the current state of local delivery environment, the capabilities of BEVs currently in the market and the interest towards BEVs by different entities that are connected to local deliveries in a way or another.

The interviewees had a lot of similar opinions about the feasibility of BEV vans. The same idea of BEVs being the future was brought up by each interviewee, however, at the same time all of them identified a problem that would hinder the viability of BEVs in their current state; the weak range of BEVs when compared to their DV counterparts (BEVs 150km-200km against DVs 500km-600km).

Interviewees recognized that in short distances the BEV could be a possibility, but when taken into account that most of the delivery routes/areas usually span over three to eight hours nonstop or approximately 70km to 200km a day depending on the branch of local delivery. This makes it extremely difficult to use a BEV constantly on the job. Especially with the addition of most of the vehicles having more than one job during the 24 hours of a day, the possibility to keep the vehicle charged up becomes even more challenging.

Based on the analyzation of the collected data, both qualitative and quantitative, the answer to the main research question '*Is battery electric powered vans viable alternative to diesel powered vans in local delivery business in Finland?*' is negative; BEVs are not commercially viable option at the time of this study.

As the answer to the main questions was negative – BEVs are not commercially viable option at the time of this study, the secondary question that will be discussed is:

If not, what are the areas that electric battery powered vans need to improve to be up to par with their diesel powered counter parts?

When looking at the two interviews where the notion of interest from clients of logistics companies was brought up, there was a clear sign that companies in Finland are starting to pay more attention to the way how their goods are transported. For example, the case with Kaukokiito in Jyväskylä: a client and Kaukokiito made a collaboration project on the natural gas truck which could become more widespread phenomena, but that would need a research paper of its own.

Three of the interviewees (LE1, VSE and M) brought up the fact that there are no tax incentives towards companies; the only incentive by the government is towards acquiring a BEV is for private use, not companies and it is only applicable to “normal” vehicles, which means vans and trucks are excluded from this incentive. This topic of tax incentives was introduced in literature review in detail. The ACEA reports showed a clear sign of the member countries of the EU developing the tax incentives on BEVs, but one country that showed no significant progress was Finland. As mentioned earlier, the interviewees were aware that government of Finland does not provide any tax incentives to companies if they would acquire a BEV.

The logistics entrepreneurs, LE1 and LE2, were on the same line about acquiring BEVs over DVs; they saw it as a plausible course of action in the future. However, they brought up that it would need to be economically viable and the capabilities of the BEV would need to be up to par with DVs.

The environmental side of this BEV versus DV was not extensively discussed in the interviews, but in the brief discussions about the environmental side that I had with M, and LM, they both brough up the emission categories of Euro 5 and Euro 6. This Euro system is an emissions classification system. The higher the number the lower the emissions. According to M, Euro 6 and in the future Euro 7 classification can be even more environmentally friendly than a BEV. As discussed in the literature review, BEV in itself does not produce emissions, but the way the electricity is produced for that BEV creates emissions.

M said that depending on the means of making electricity the Euro 6 and 7 will be better for a while. As the biofuels are continuously researched and developed.

The areas that BEVs are lacking, compared to DVs, are cost-efficiency, vehicle capabilities and the lacking infrastructure. The cost-efficiency is obvious, as seen in the literature review a BEV costs approximately €20,000 more than its DV counterpart. This paired up with Finland not having any tax incentives for companies to acquire these BEVs is alone a quite big deciding factor for many logistics companies/entrepreneurs. To make it even less cost-efficient, the maintenance costs of BEVs are still unknown but according to M's estimations the prize difference is small, as BEVs will probably have check-ups on its systems which will increase the yearly maintenance costs to about the same level as DVs.

Vehicle capabilities is the second big problem when comparing BEVs to DVs. In vehicle capabilities the range with full charge/tank is one of the biggest factors, and this was something that came up in all of the interviews. As currently a DV van can go 500km-600km with a full tank of diesel and BEV van can go approximately 150km-200km with fully charged battery. According to M, the charge times are long, normal charger takes approximately 24 hours to fully charge and even rapid charger takes at least 45min. When you compare this to filling up a full tank of diesel, which takes about 1-5min, the loss of time is significant, especially if the vehicle runs out of charge during a workday.

Lastly the lacking infrastructure. According to M and VSE there is a low amount of rapid charging stations in the area of Tampere, with most of them located at the parking lots of super/hypermarkets which makes it quite inconvenient for work vans to go and charge up at a parking lot of a store.

An idea of constructing rapid charge stations to major local delivery terminals, such as Alma Manu's paper press, Posti Groups three major terminals in the area of Tampere and Kaukokiito's Tampere terminal, came from M.

He was hesitant about the possibility, as one charger with the cable would cost at least €6,800 and if there would be a minimum of three chargers at each terminal, this would quickly add up. But hopefully in the future the government of Finland makes some incentives for companies to make it more cost-effective to move to BEVs.

5.2 Assessment of research and research quality

According to Saunders and colleagues (2009, 156): “Reliability refers to the extent to which your data collection techniques or analysis procedures will yield consistent findings.”.

In this paper, the methods used to collect primary (interviews) and secondary (ACEA reports) data were clearly explained in the methodology chapter and seen through the whole paper as such. The reliability of this paper stems from the existing quantitative data, ACEA reports on tax & incentives and the technical data of the vehicles (found from the manufacturers websites). This makes the study and results highly reliable at this specific point in time.

“Validity is concerned with whether the findings are really about what they appear to be about.” (Saunders, Lewis & Thornhill 2009, 157)

Validity of this paper comes from the fact that the interview questions were derived from the research questions, this way the questions could provide main data that is directly relevant to this study. The questions were also influenced by the quantitative part of the study (literature review), which helped the triangulation of the data. As there was same themes and topics in the interviews and in the quantitative parts of the literature review. The credibility gets the finishing touch from the fact that the interviewees were chosen to represent different sides/perspectives of the phenomena that was being studied.

The overall credibility of this paper/study is highly dependent on the time and locational factors. If this study would be performed again right after this paper, in the same area, the results could be theorized to be similar. But if this type of study would be performed a year from now and in India, the results would theoretically be extremely different. But the basic idea of how to get the results would stay the same, you could say that this study could be used as a framework/tool for future studies of the same nature to gain localized knowledge on this topic.

5.3 Practical implications

Entrepreneurs and companies should stay up to date with the different possibilities about their fleet. This is something that could save them money and at the same time they can take part in making the world a cleaner place.

For the people who make the decision on fleet replacements, they should always check the following three things when comparing DV to a BEV:

1. Cost-effectiveness, this includes the initial price, possible tax incentives and the price of maintenance.

2. Vehicle capabilities, if the BEV version of a DV can do the same range as a DV, carry the same amount of cargo as a DV and charge up as effectively as a DV can fuel up, you should seriously consider the BEV option.

3. Charge station infrastructure in your area of action, this is a major concern, as the vehicle is useless if there is no proper infrastructure supporting the use of a BEV.

5.4 Limitations of the research

The main limitation of this research was that it was conducted on a specific area. This makes the research outcomes viable in that area, the area being Tampere, Finland. The possibility to apply the research outcomes to whole of Finland is plausible, due to Finland being quite small country and the difference in electricity production is not

dramatic and the vehicle models that were mentioned in the paper are sold across Finland. And the basic idea of using BEVs only in cities is feasible in other cities of Finland.

Also, a limitation to this study is the fact that is performed in a cross-sectional manner, as the collection of quantitative data and conduction of interviews are done within a small timeframe. This means that the results of this paper are, as already mentioned in section 5.2, highly dependent on the time and location factors. This means that this study and the results are accurate in the point in time when this study was performed, but outside of those factors the accuracy of the results is significantly lower.

But this also enables us to learn something from this specific point in time. To have this kind on snapshot gives us the data on how this topic was evolving during the time that this paper/study was done. There being ACEA reports from 2020 on taxes & incentives which are current information now but not in the future. Therefore, this limits the usability of the results in the future, but serves as a good basis on a future research or as a comparison data set.

5.5 Recommendations for future research

In this research paper there was five interviews conducted and each of them were in the area of Tampere, Finland. This makes it so that the outcomes of the research paper are feasible in this given area, but outside of it they cannot be held 100% accurate.

To further study this BEV vs. DV topic, I would suggest expanding the area where the interviews are conducted, for example, whole of Finland or maybe the whole Nordic Europe. Also, one factor that could be expanded is the number of interviews and try to get interviews from many different sizes of logistics entrepreneurs/companies.

In the future, this same exact research could be conducted to see how the BEV vs. DV situation has developed. The development of BEVs and development of biofuels is moving with a good phase, so even five years to the future this whole research could give out totally different outcomes. And even the possibility of logistics entrepreneurs having their first BEVs by then is likely.

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7 Appendices

Appendix 1. Logistics Entrepreneur 1 interview

Date: 12 May 2019

Interviewer: Markus Kaitala

Interviewee: Logistics entrepreneur 1

Questions:

- What is your name and occupation?
- What is the timeframe for you to change from old to new vehicle?
- What are the requirements for the vehicle?
- How much does one vehicle get driven in 24h?
- How far can you drive with a full tank of diesel?
- What is your perspective on acquiring and/or using a BEV in your line of work?

Appendix 2. Vehicle Sales Expert interview

Date: 15 July 2020

Interviewer: Markus Kaitala

Interviewee: Vehicle Sales Expert

Questions:

- What is your name, what do you do here at Veho and how long have you worked here?

- What is currently the most popular commercial vehicle here at Veho? And is there BEV option or is it only diesel?
- How do BEVs differ from DVs in maintenance costs/interval?
- How does your client base consist? Companies or private individuals?
- How many of your clients are “regulars” and how often do they buy a new commercial vehicle?
- Have your clients shown interest towards BEVs or other non-diesel options?
- What is your perspective in BEVs coming into commercial vehicle market? And do you believe they can replace DVs?

Appendix 3. Logistics Manager interview

Date: 19 July 2020

Interviewer: Markus Kaitala

Interviewee: Logistics manager at Kaukokiito

Questions:

- What is your name and what is your job at Kaukokiito?
- What size are the vehicles at Kaukokiito? And are they owned by Kaukokiito or subcontractors?
- Are the local routes always the same or is there changes on day to day basis?
- How many hours/km are the routes?
- Are the vehicles used in other jobs than Kaukokiito?

- Does Kaukokiito have any BEVs in use? Or has there been requests/interest by clients or management towards BEVs?
- What is your perspective on BEVs in local delivery use?

Appendix 4. Logistics Entrepreneur 2 interview

Date: 20 July 2020

Interviewer: Markus Kaitala

Interviewee: Logistics entrepreneur 2

Questions:

- What is your name and occupation?
- How many vehicles do you have? And how many employees?
- What size are your company's vehicles?
- How much does your vehicles get driven in 24h? How long breaks do they get?
- What are the requirements for the vehicles?
- What is the timeframe for you to change from old to new vehicle?
- Have you considered other options than DVs?
- What is your perspective on using BEVs in your line of work?

Appendix 5. Mechanic interview

Date: 20 July 2020

Interviewer: Markus Kaitala

Interviewee: Mechanic

Questions:

- What is your name, where do you work and what is your role there?
- How long have you worked in this occupancy?
- What kind of vehicles do you maintain in your work?
- Have you been involved with BEVs at your work? Has there been training on BEVs?
- How much does a BEV maintenance differ from DV maintenance?
- What is the maintenance interval for your typical diesel van? And what is the maintenance interval for a BEV?
- What is your estimate on price difference on BEV vs DV maintenance?
- What is your perspective on BEVs used in Finland?

Appendix 6. ACEA 2020 report on tax and incentives of EBVs

Table 6 ACEA report on tax and incentives of EBVs (pt1). ACEA 2020

COUNTRY	ACQUISITION	TAX BENEFITS OF OWNERSHIP	COMPANY CARS	PURCHASE INCENTIVES
AUSTRIA	VAT deduction and exemption from tax for zero-emission cars (e.g. BEVs and FCEVs).	Exemption for zero-emission cars.	Exemption for zero-emission cars.	Bonus (until the end of 2020) for the purchase of new cars and vans with fully-electric range of 50km and gross list price of ≤€60,000: - €3,000 for BEVs and FCEVs. - €1,250 for PHEVs and EREVs.
BELGIUM	- Brussels and Wallonia: minimum rate for zero-emission vehicles (€61.50). - Flanders: BEVs, PHEVs and FCEVs emitting 50g CO2/km (or less) under NEDC are exempted until the end of 2020. As of 1 July 2020, newly-registered leased zero-emission vehicles are exempted.	- Brussels and Wallonia: minimum rate for zero-emission vehicles (€76.32 + 10% municipal tax). - Flanders: BEVs, PHEVs and FCEVs emitting 50g CO2/km (or less) under NEDC are exempted until the end of 2020. As of 1 July 2020, newly-registered leased zero-emission vehicles are exempted.	Deductibility of 100% under (corporate) taxation of expenses for vehicles emitting no more than 42g CO2/km (NEDC).	None
BULGARIA	None	Exemption for electric vehicles.	None	None
CROATIA	No excise duties for electric vehicles.	Exemption from special environmental tax for electric vehicles.	None	Incentive scheme (once a year, limited funds): - €9,200 for BEVs. - €4,600 for PHEVs.
CYPRUS	Exemption for vehicles emitting less than 120g CO2/km.	Minimum rate for vehicles emitting less than 120g CO2/km.	None	None
CZECH REPUBLIC	- Exemption from registration charges for BEVs and FCEVs emitting up to 50g CO2/km (upon request of a special number plate). - Exemption from vignettes for BEVs and FCEVs emitting up to 50g CO2/km	Exemption for alternatively-powered vehicles (i.e. electric, hybrid, CNG, LPG and E85).	None	- Incentives for companies to buy BEVs and EREVs - Incentives for public sector to buy BEVs, FCEVs, EREVs, PHEVs and natural gas vehicles - Incentives for public transport operators to buy BEVs, FCEVs, CNG or LNG road vehicles
DENMARK	- Exemption for FCEVs until the end of 2021. - BEVs and PHEVs pay 20% of the registration tax in 2020 (set to increase to 65% in 2021, 90% in 2022 and 100% in 2023). - Plus a reduction of DKK 40,000 for BEVs and PHEVs in 2020	Taxes on ownership are based on fuel consumption. The electric energy consumption of BEVs, PHEVs and FCEVs is recalculated to the equivalent fuel consumption of petrol vehicles.	Temporary deduction in taxable personal income for private users of (company) BEVs and PHEVs of up to DKK 3,333 per month, valid from 1 April to 31 December 2020.	None
ESTONIA	None	None	None	Bonus of €5,000 for the purchase of a full-electric car or van with a price below €50,000.

Table 7 ACEA report on tax and incentives of EBVs (pt2). ACEA 2020

FINLAND	Minimum rate for zero-emission vehicles.	Minimum rate for zero-emission vehicles.	None	Incentive of €2,000 for households to purchase or lease a new BEV with value ≤€50,000 (until 2021).
FRANCE	Regions provide an exemption (either total or 50%) for alternatively-powered vehicles (i.e. electric, hybrid, CNG, LPG and E85).	None	Exemption from CO2-based tax component ('TVS') for vehicles emitting less than 20g CO2/km	Bonus to buy cars or vans with ≤20g CO2/km: - €7,000 for households, vehicle price ≤€45,000. - €5,000 for legal persons, vehicle price ≤€45,000. - €3,000 for households and legal persons: - Vehicle price between €45,000 and €60,000. - FCEV vans and cars or vans with price >€60,000. Scrappage scheme for purchase of second-hand or new vehicles with ≤50g CO2/km, price ≤€60,000: - Cars: - €5,000 for households, depending on income. - €2,500 for legal persons. - Vans: €5,000 (for households or legal persons).
GERMANY	From 1 July 2020 until 31 December 2020, temporary VAT reduction from 19% to 16%.	10-year exemption for BEVs and FCEVs registered until the end of 2020.	- Reduction of the taxable amount for BEVs and PHEVs (from 1% to 0.5% of the gross catalogue price per month). - Additional reduction of the taxable amount for BEVs with a gross list price of up to €60,000	Until 31.12.2021, an 'innovation bonus' temporarily increases the environmental bonus for new and used BEVs, PHEVs and FCEVs - Bonus for cars with net list price ≤€40,000: - €9,000 for BEVs and FCEVs. - €6,750 for PHEVs. - Bonus for cars with net list price >€40,000: - €7,500 for BEVs and FCEVs.
GREECE	- Exemption for BEV cars. - 50% reduction for HEV and PHEV cars. - Exemption for trucks with electric motors	Exemption for cars emitting less than 90g CO2/km (under NEDC).	- Exemption for BEVs and PHEVs emitting up to 50g CO2/km with net retail price of up to €40,000. - 30% deduction to lease expenses for BEV and PHEV cars.	- 15% cashback on the net retail price of BEV cars (up to €5,500), plus extra €1,000 if an old car is scrapped (10 years or older). - 25% cashback for BEV taxis of up to €8,000 (15% for PHEVs with ≤50g CO2/km), plus extra €2,500 if an old taxi is scrapped. - 15% cashback for vans (up to €5,500 for BEVs; €4,000 for PHEVs), plus €1,000 for scrapping.

Table 8 ACEA report on tax and incentives of EBVs (pt3). ACEA 2020

HUNGARY	Exemption for BEV and PHEV cars	Exemption for BEV and PHEV cars	Exemption for BEV and PHEV cars	From 15 June 2020, purchase incentives for electric cars: - €7,350 for gross price of up to €32,000. - €1,500 if price between €32,000€ and €44,000.
IRELAND	Reduction for: - BEVs up to €5,000 (till end 2021). - PHEVs with ≤65g CO2/km up to €2,500 (until the end of 2020). - HEVs with ≤80g CO2/km up to €1,500 (until the end of 2020).	- Minimum rate (€120 per year) for BEVs. - Reduced rate (€170 per year) for PHEVs with ≤60g CO2/km.	'Benefit-in-kind concession' for electric cars and vans with a market value of less than €50,000 (until the end of 2022).	Purchase incentives for individuals: - Up to €5,000 for BEVs (until the end of 2021). - Up to €5,000 for PHEVs with ≤50g CO2/km that can travel in full-electric mode for a minimum of 50km (until the end of 2020). - Up to €3,800 for BEV vans.
ITALY	None	- Five-year exemption for electric vehicles from the date of first registration. - After this period, 75% reduction of the tax rate applied to equivalent petrol vehicles	None	Bonus-malus scheme: - Bonus: a one-off amount (max €6,000 for cars emitting ≤70g CO2/km and a price less than €50,000 (excluding VAT). - Malus: up to €2,500 for cars emitting more than 250g CO2/km.
LATVIA	Exemption for electric vehicles (first registration).	Exemption for cars emitting 50g CO2/km or less registered after 31 December 2009.	Minimum rate (€10) for BEVs	None
LITHUANIA	None	None	None	None
LUXEMBOURG	None	Minimum rate for vehicles emitting 90g CO2/km or less.	Minimum rate for BEVs and FCEVs.	Incentives as part of people's annual tax return: - €5,000 for BEVs and FCEVs. - €2,500 for PHEVs emitting <50g CO2/km
MALTA	Minimum rate for vehicles emitting less than 100g CO2/km.	Minimum rate for vehicles emitting less than 100g CO2/km.	None	None
NETHERLANDS	Exemption for zero-emission cars	Exemption for zero-emission cars	Minimum rate (8%) for zero- emission cars with catalogue price of up to €45,000 (no price limit for FCEV cars).	- Subsidy scheme (SEPP) for private individuals to buy or lease a new or used BEV. - Environmental investment deduction (MIA) for BEV and FCEV light commercial vehicles and BEV taxis. - Arbitrary depreciation of environmental investments scheme (Vamil) for FCEV cars or taxis and BEV cars equipped with solar panels.

Table 9 ACEA report on tax and incentives of EBVs (pt4). ACEA 2020

POLAND	Exemption for BEVs and PHEVs ≤2,000cc (until the end of 2020)	None	None	Incentive scheme for natural persons buying a car (until the end of 2027). Up to: - PLN 37,500 for BEVs with price ≤PLN 125,000. - PLN 90,000 for FCEVs with price ≤ PLN 300,000.
PORTUGAL	VAT deduction for BEVs (with value of less than €62,000) and PHEVs (with value of less than €50,000).	Exemption for electric vehicles.	Autonomous corporate income tax: - Exemption for BEVs. - Reduction for PHEVs	- Private: €3,000 to buy a new BEV (car or van), limited to one vehicle per person. - Companies (limited to four vehicles): - €2,000 for cars. - €3,000 for vans
ROMANIA	None	Exemption for electric vehicles	None	Renewal scheme (RABLA) for passenger cars: - €10,000 to buy a new BEV. - €4,250 to buy a new PHEV with ≤50g CO2/km. - In addition, €1,250 for scrapping an old vehicle
SLOVAKIA	BEVs, or PHEVs combined with other fuel types or energy sources, are depreciated for two years.	Exemption for BEVs.	None	Incentive scheme: - €8,000 for BEVs. - €5,000 for PHEVs.
SLOVENIA	Minimum rate (0.5%) for vehicles emitting less than 110g CO2/km.	None	None	Incentive scheme: - €7,500 for BEVs (cars). - €4,500 for BEVs (vans and heavy quadricycles). - €4,500 for PHEVs (cars and vans) and EREVs. - €3,000 for BEVs (light quadricycles).
SPAIN	- Exemption from 'special tax' for vehicles emitting up to 120g CO2/km. - Canary Islands: VAT exemption for alternative-powered vehicles (i.e. BEVs, FCEVs, PHEVs, EREVs, HEVs, CNG, LPG) emitting up to 110g CO2/km.	Reduction of 75% for BEVs in main cities (e.g. Madrid, Barcelona, Zaragoza, Valencia, etc.).	None	Incentive scheme (MOVES Plan): - Cars: €4,000-€5,000 for BEVs and €1,900- €2,600 for PHEVs for private individuals, depending on whether a vehicle older than seven years is being scrapped. - Vans and trucks: between €4,400 and €6,000 for private individuals, depending on scrapping.
SWEDEN	None	Reduced annual road tax (SEK 360) for zero-emission vehicles.	Reduction for BEVs and PHEVs of 40% (up to SEK 10,000).	Climate bonus: - SEK 60,000 for new zero-emission cars and light trucks. - SEK 10,000 for PHEVs with ≤70g CO2/km. - Premium for purchase of new electric buses and trucks.

Table 10 ACEA report on tax and incentives of EBVs (pt5). ACEA 2020

UNITED KINGDOM	Exemption for zero-emission vehicles.	Exemption for zero-emission vehicles.	Minimum rate for zero-emission vehicles: - 0% in 2020-2021. - 1% in 2021-2022. - 2% in 2022-2025.	Government grants (through dealers) for: - Zero-emission cars up to £3,000, if price is <£50,000. - Vans, taxis and trucks