ECONOMICS OF E-MOBILITY: COSTS, FUEL & ELECTRICITY PRICES, TAXES

Martin Knápek

Co-operating Universities

Financial support by

Prague and Vienna, 2019

CONTENT

1. INTRODUCTION:

With the world becoming ever more concerned about the climate change, the efforts to find ways how to reduce the impact of our way of live on the environment have probably never been higher. The main focus of these efforts is the reduction of carbon emissions and consequently our dependence on fossil fuels.

So far great progress has been made and continues to be made in the energy sector. Thanks to subsidies the share of renewables in the energy sector is continuing to grow and plans already exist for the closure of the old coal fired power plants. The share of wind (both offshore and onshore) turbines, solar PV and other renewables in energy production is expected to grow above 30 % by 2030.

Another sector which depends on fossil fuels and therefore is a major producer of carbon emissions is transport. Currently the most popular way of reducing the dependence on fossil fuels in this sector is by massive electrification of transport.

Furthermore, electric vehicles have several benefits over conventional combustion engine cars. For example they can help us with the reduction of NOX emissions, particulate matter and noise. In comparison to conventional combustion engine cars they also require less maintenance.

Despite the above mentioned benefits, cars with conventional combustion engine still make the bulk of sales. For example in 2018, according to Czech Car Importers Association, the share of gasoline and diesel cars together accounted for roughly 97 % of car sales in the Czech Republic. In many countries this number is not much different.

The above mentioned disproportion seem to indicate that, at present time, customers still find conventional cars with combustion engine more convenient. Since the costs of purchasing and operating a car are key factors for customers in their decision-making, in this paper I inspect and compare them with the conventional passenger cars.

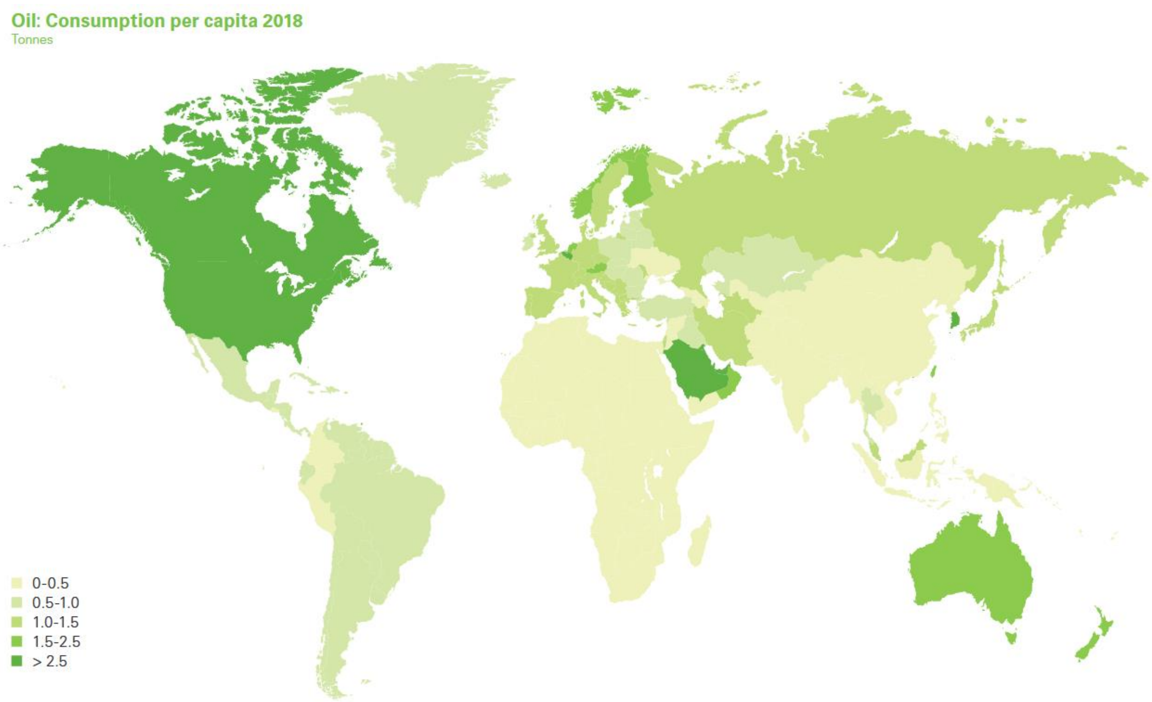
PART 1: WHY IS THERE NEED FOR THE SUBSIDIES AND OTHER BENEFITS

Before we inspect the actual costs of purchasing and owning a personal vehicle, which wary greatly depending on the type of the car, its technical parameters and the costs associated with the particular brand, we should have a look at the policies that are related to them and that affect the conventional cars with combustion engine.

The current situation in transport industry

In the very beginning it should be explained, why the transport sector is currently undergoing such a significant transformation. In the past probably the most important factor that influenced the type of cars that were made (and consecutively sold) and the way how they were being used was the affordability of the fuel. This for example is easily shown by comparing the average vehicle fuel intensity of cars that are being made in the USA and in European countries.

Worldwide oil consumption per capita in 2018 [1]



Even though the prices of fuels are constantly changing depending on the international crude oil production and political situation (embargoes, conflicts), there was no global shortage or a significant price increase in recent time, despite

[1] BP Statistical Review of World Energy (2019, 68th edition). [online] Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-oil.pdf [Accessed 11 Jun. 2019].

the growing consumption. One of the reasons why the prices have been relatively stable is because the growing demand has been matched by growing production allowed by advances in technology and new oil fields.

Consecutively, thanks to the rising standard of living and the increasing purchasing power "relatively" low price of fuels has allowed the rise in demand for bigger and more powerful cars.

Nowadays there is another and in many ways much more important factor in play – the issue of climate change and hence carbon emissions.

The climate goals set up by the EU

Given that the effects of climate change are increasingly felt and observed worldwide, the issue of greenhouse gas emissions has become the biggest driver in many sectors. In an effort to at the very least mitigate their impact, the European Union has committed itself to reducing its carbon emissions. In accordance with this goal, the EU introduced legally binding carbon emissions standards for new cars. The current limit for cars is 130 grams of CO2 per kilometre, in 2021 this limit will decrease to mere 95 grams.

Despite the technological improvements in fuel efficiency, the transport sector is still responsible for approximately one quarter of the European Union's total carbon emissions[2], and unlike in many other sectors, they have not been significantly reduced. The current goal of the EU is to cut carbon emissions from cars by 37.5 % compared to 2021 levels.

The mechanisms of subsidizing electric vehicles and hybrids

As was already mentioned in the introduction, while the sales of electric vehicles are rising, the majority of cars sold have a combustion engine. This is due to the fact, that in the beginning electric cars could not compete with their counterparts in terms of range, economy and comfortability. In order to incentivize the sales of electric vehicles and thus allow the continuation of their development, every state of the EU has created its own system of incentives. These typically consists of:

- Exceptions from taxes
- Reductions of taxes
- Scrappage schemes
- Capital subsidies
- Other benefits (for example cheaper or even free parking)

Some of the reasons why the system of subsidies is not universal in all European countries is because individual countries have a slightly different system of taxes, they are somewhat limited by their budgets and also are not equally prepared for or committed to the large electrification of transport.

Because the system of taxes and the tax rates are different in every country and the systems of subsidies differ as well, it is very difficult to compare the system of subsidies in

[2] Niestadt, M. and Bjørnåvold, A. (2019). *Electric road vehicles in the European Union*. [online] Europarl.europa.eu. Available at: http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637895/EPRS_BRI(2019)637895_EN.pdf [Accessed 10 Jun. 2019].

one country with the system in another country. Moreover, some schemes are only available to businesses.

It should be emphasized that, in some cases, other than financial benefits granted to the owners of Evs may actually have much greater impact than any form of subsidy. For example the exemption from paying for parking, the right to park in the so called “blue zones” designated for residents of particular areal, or even the right to use special dedicated lanes can outweigh the higher purchasing price of the vehicle. The disadvantage of this form of support is that it does not make the electric vehicles more accessible to the general population. Only the people who can afford the more expensive electric vehicle will be able to take advantage of these benefits.

Table 1: Simplified overview of the subsidy systems for individuals used in particular country[3]

Country	Tax exceptions	Tax reduction	Scrappage schemes	Capital subsidies
Austria	Yes	Yes		
Belgium	Yes	Yes		Yes
Bulgaria	Yes			
Croatia				
Cyprus	Yes	Yes		
Czech Republic	Yes			
Denmark		Yes		
Estonia				
Finland		Yes		
France	Yes	Yes	Yes	Yes
Germany	Yes			Yes
Greece	Yes			
Hungary	Yes			
Ireland		Yes		Yes
Italy	Yes	Yes		
Latvia		Yes		
Lithuania				
Luxembourg		Yes		
Malta		Yes		
Netherlands	Yes	Yes		
Poland	Yes			
Portugal	Yes	Yes		
Romania	Yes			Yes
Slovakia	Yes	Yes		
Slovenia		Yes		Yes
Spain		Yes		
Sweden	Yes	Yes		Yes
United kingdom		Yes		

[3] ACEA. *OVERVIEW ON TAX INCENTIVES FOR ELECTRIC VEHICLES IN THE EU*. [online] Available at: https://www.acea.be/uploads/publications

System of subsidies in the Czech Republic

In the Czech Republic there currently is no government subsidy for individuals purchasing an ecological car, however such a scheme is being considered by the Ministry of industry and trade and the Ministry for environment. The precise amount of money and who will be eligible for it is still being determined. There however exist subsidy program for entrepreneurs and authorities.

Electric passenger cars are exempted from road tax. For passenger vehicles this tax is determined by the engine capacity.

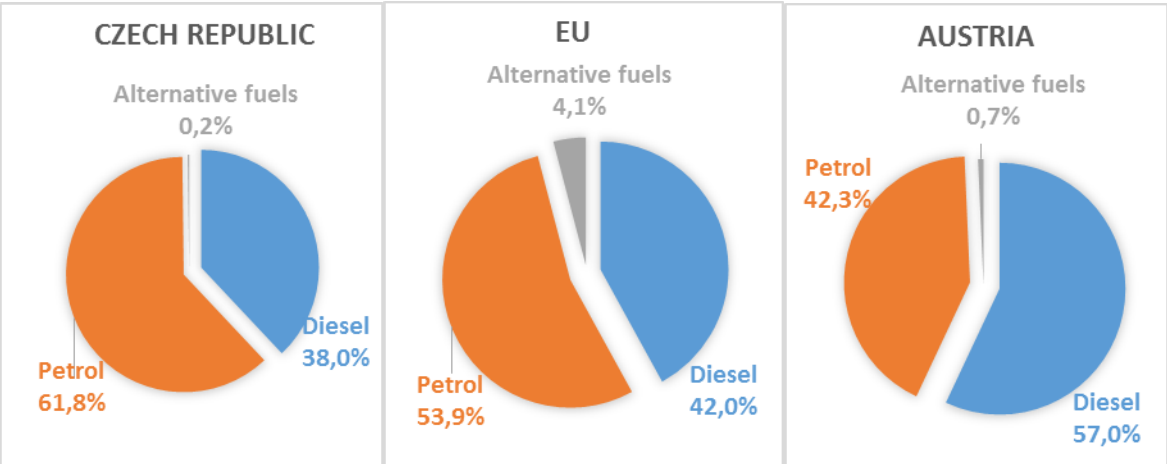
Table 2: Calculation of road tax for conventional passenger vehicles in Czech Republic

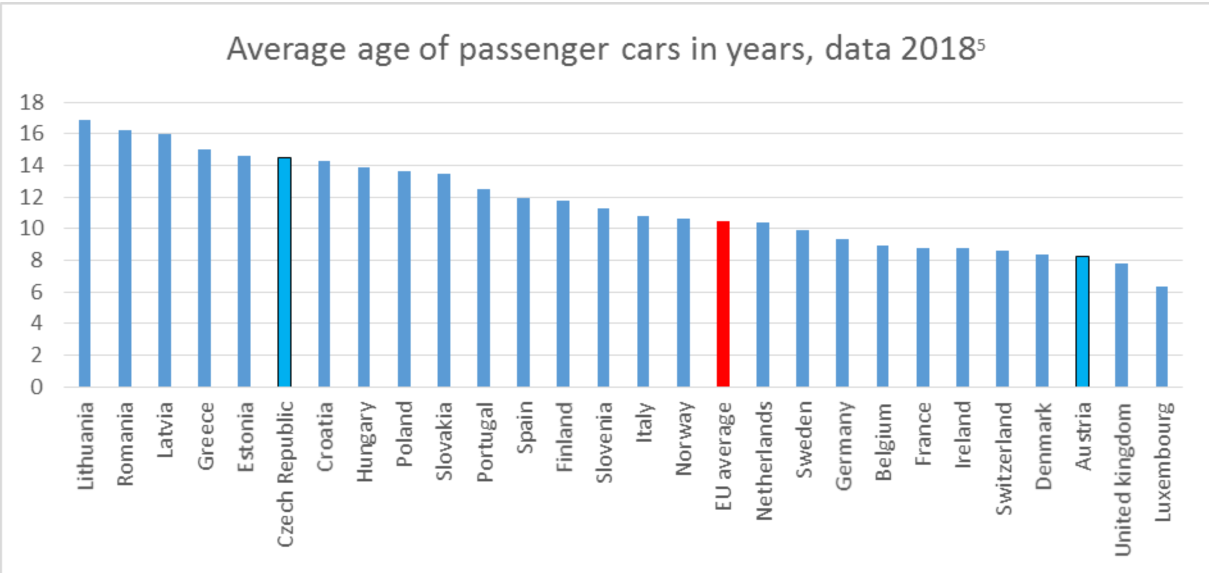
Engine capacity	Tax rate
up to 800 cm^3	1 200 CZK
from 800 cm^3 to 1 250 cm^3	1 800 CZK
from 1 250 cm^3 to 1 500 cm^3	2 400 CZK
from 1 500 cm^3 to 2 000 cm^3	3 000 CZK
from 2 000 cm^3 to 3 000 cm^3	3 600 CZK
above 3 000 cm^3	4 200 CZK

PART 2: PURCHASE COST OF ELECTRIC VEHICLE

When people consider buying new car, there are many factors that influence their decision making. It is without a doubt that for many the initial purchase price of the car is a key factor for many customers. After all, cars are among the most expensive things people buy. Because of the high initial cost, many customers choose to finance their purchase of a car via leasing. Furthermore, a large part of newly bought vehicles has been financed by companies. Because of the high initial expenses, people will generally use their cars until they break down or start requiring high investment in repairs. Because of this fact, the overall share of electric vehicles is still relatively small.

Passenger Car Fleets by Fuel Type (% of share, data 2016)[4]





[4] Acea.be. (2019). *Vehicles in use Europe 2018*. [online] Available at: https://www.acea.be/uploads/statistic_documents/ACEA_Report_Vehicles_in_use-Europe_2018.pdf [Accessed 10 Jun. 2019].

As shown in the graph above, there is a significant difference in the average age of passenger cars registered throughout the EU. In in Eastern European countries the average age of passenger cars is significantly higher than in the west. While the average age of passenger cars registered in the Czech Republic is approximately 14.5 years, the average age of the same type of cars in Austria is “only” 8.2 years. This disparity indicates, that in eastern countries, people cannot afford to buy brand new cars as often as in the west. More importantly, buying used cars is becoming more and more common. While over a quarter of a million new cars are sold every year in the Czech Republic, the sales of used cars are three times higher.

According to ASEK, in 2016 there were 4 821 557 passenger cars in Austria, 5 368 660 passenger cars in the Czech Republic and 257 061 713 passenger vehicles in the EU.

Table 3: Available electric vehicles in the Czech Republic and their respective starting price

Type of car	EV	Starting price (CZK)	Power (kW)	Battery capacity (kWh)	Weight (t)	Length x width (m)
Executive car	**Tesla Model S**	1 800 000	310	70-90	2,1	5 × 2
Subcompact	**BMW i3**	1 014 000	125	18,8	1,2	4 × 1,8
Compact	**Nissan Leaf**	950 000	80	30	1,5	4,4 × 1,8
B-CUV	**Kia Soul EV**	850 000	81	27	1,6	4,4 ×1,8
Compact	**Hyundai ioniq Electric**	730 000	88	28	1,9	4,5 × 1,8
Subcompact	**Renault Zoe**	837 000	68	41	1,9	4,1 × 1,9
Compact	**Volkswagen e-Golf**	960 000	85	24	1,6	4,2 × 1,8
City car	**Volkswagen e-Up!**	605 000	40	18,7	1,2	3,5 × 1,6
Compact MPV	**Mercedes-Benz B ED**	1 020 000	132	28	1,8	4,3 × 1,8
Crossrover SUV	**Audi e-tron**	2 140 000	265	95	2,6	4,9 ×1,9

In the table 3, we can see all electric vehicles that are available in the Czech Republic and their respective starting price. On first glance we can observe the fact that there is great disparity in price and in technical specifications. In addition to different starting prices, the individual carmakers are offering other benefits such as ecological bonus.

In comparison, in table 4 we can observe the prices of new passenger cars with conventional combustion engine. By comparing the starting prices of conventional and the starting price of their respective electric counterparts, we can clearly see that electric vehicles are still significantly more expensive.

[5] Acea.be. (2019). *Vehicles in use Europe 2018*. [online] Available at: https://www.acea.be/uploads/statistic_documents/ACEA_Report_Vehicles_in_use-Europe_2018.pdf [Accessed 11 Jun. 2019].

Table 4: Starting prices of selected conventional cars available in the Czech Republic

Type of car	Name	Starting price (CZK)	Power (kW)	Consumption	Fuel
Compact	Škoda Octavia	437 900	85 kW	4,9 l/100 km	Petrol
Compact	Škoda Scala	370 000	85 kW	5 l/100 km	Petrol
Compact	Volkswagen Golf	449 000	85 kW	4,9 l/100 km	Petrol
Subcompact	Volkswagen Polo Trendline	305 000	59 kW	4,8 l/100 km	Petrol
Compact MPV	Mercedes-Benz B	680 020	100 kW	5,4 - 5,6 l/100 km	Petrol

When considering the purchasing costs of any new product, a good indicator of how much is the product affordable in the particular country, is the comparison of the purchasing cost with the average salary and median salary in the given country.

The average gross monthly salary in the Czech Republic in the first quarter of 2019 was 32 466 CZK. The median of gross wage was 27 582 CZK.[6]

Table 5: Comparison of how many months of average and median gross salaries are necessary to accumulate in order to be able to afford the given vehicle

Type of car	EV	Starting price (CZK)	Number of average gross monthly wages	Number of median of gross monthly wages
Electric vehicles				
Executive car	**Tesla Model S**	1 800 000	55	65
Subcompact	**BMW i3**	1 014 000	31	37
Compact	**Nissan Leaf**	950 000	29	34
B-CUV	**Kia Soul EV**	850 000	26	31
Compact	**Hyundai ioniq Electric**	730 000	22	26
Subcompact	**Renault Zoe**	837 000	26	30
Compact	**Volkswagen e-Golf**	960 000	30	35
City car	**Volkswagen e-Up!**	605 000	19	22
Compact MPV	**Mercedes-Benz B ED**	1 020 000	31	37
Crossrover SUV	**Audi e-tron**	2 140 000	66	78

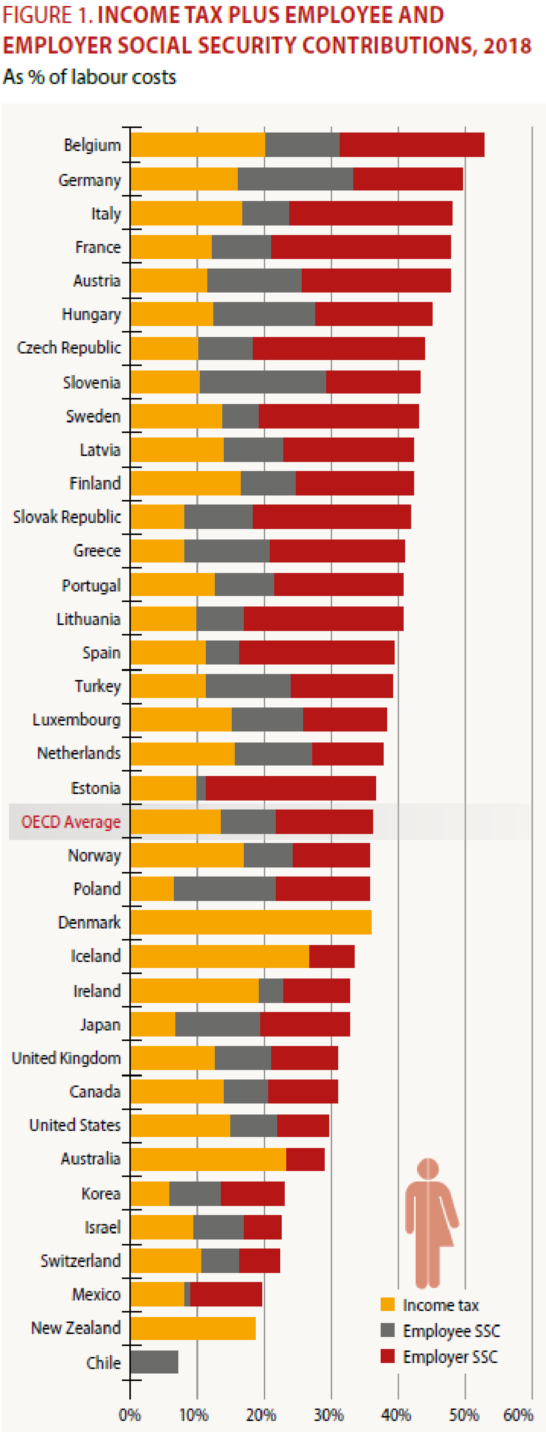
[6] Czso.cz. (2019). *Průměrné mzdy - 1. čtvrtletí 2019* | *ČSÚ*. [online] Available at: https://www.czso.cz/csu/czso/cri/prumerne-mzdy-1-ctvrtleti-2019 [Accessed 20 Jun. 2019].

Type of car	EV	Starting price (CZK)	Number of average gross monthly wages	Number of median of gross monthly wages
Conventional vehicles				
Compact	Škoda Octavia	437 900	13	16
Compact	Škoda Scala	370 000	11	13
Compact	Volkswagen Golf	449 000	14	16
Subcompact	Volkswagen Polo Trendline	305 000	9	11
Compact MPV	Mercedes-benz B	680 020	21	25

In comparison, according to STATISTICS AUSTRIA's General Income report[7] the gross annual median income for employees without apprentices in Austria in 2017 was 27 545 Euros, 26 848 Euros if we include apprentices. The median for blue and white collar workers is slightly lower at 25 460 Euros. If we take the lowest gross median income, divide it into 12 months and subsequently convert the euros to Czech crowns (CZK) at a current exchange rate of 1 EUR to 25,605 CZK, we get the monthly gross median income of 54 323 CZK. Approximately double the gross median monthly income in the Czech Republic. And even though the system of taxation is not the same in both countries, as can be seen in the following figure, the average tax burden in both countries is not considerably different.

[7] STATISTICS AUSTRIA. (2019). *General Income Report*. [online] Statistik.at. Available at: https://www.statistik.at/web_en/statistics/PeopleSociety/social_statistics/personal_income/general_income_report/index.html [Accessed 11 Jul. 2019].

Income tax plus employee and employer social security contributions 2018, as % of labour costs[8]



[8] OECD (2019), *Taxing Wages 2019*, OECD Publishing, Paris, https://doi.org/10.1787/tax_wages-2019-en.

PART 3: HOME CHARGING OF ELECTRIC VEHICLES

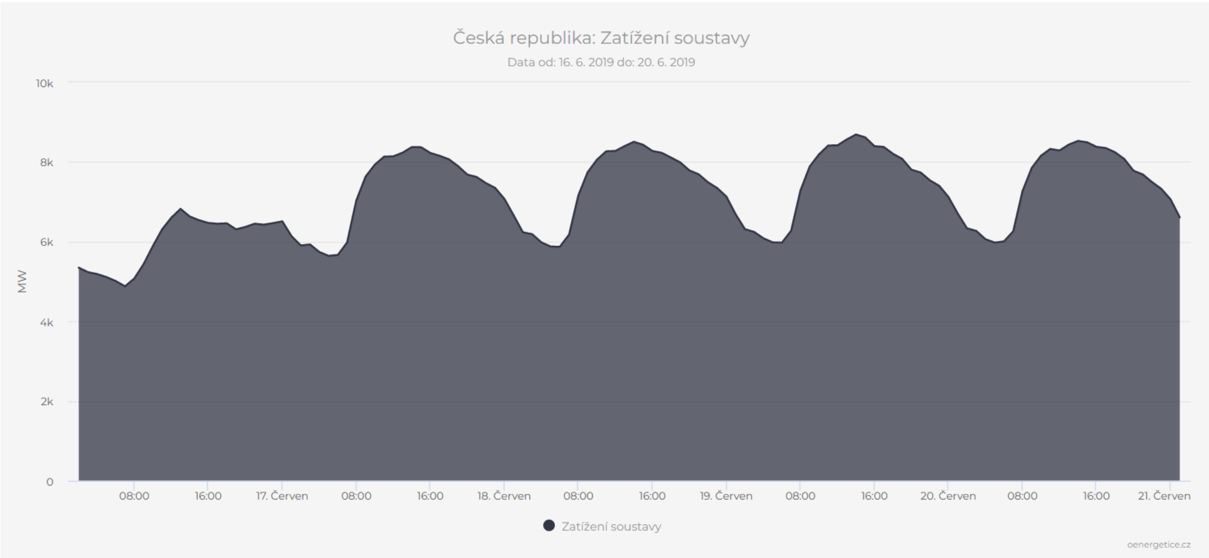
Why home charging is necessary

As the capacity of the batteries in the electric cars are getting bigger and bigger, it inevitably takes more time to charge them to full capacity. Although public fast DC charging stations are being installed, their higher price and greater requirements from the grid make them an unlikely solution for regular charging. Therefore, the “slow” charging stations are best way how to fully utilize the available capacity of the batteries.

Because of the prophesised lack of public charging stations, having a possibility of home charging is going to be a significant advantage and probably a necessity. However, installation of home charging stations is not without its problems. Even the “slow” charging stations usually work with charging power of at least 36 kW, or higher. The charging currents are therefore usually between 16 and 32 A. This large consumption can therefore severely impact the rest of the household, as it may not be possible to charge electric vehicle and use other powerful appliances such as electric heating systems, electric boilers or electric cookers. In order to reduce this negative effect the household would have to charge their electric vehicles during the nights or other times when the consumption is very low, or increase their increase the main circuit breaker amperage (if it is possible).

Charging of the electric vehicle during the night hours can also help reduce the fluctuations in the consumption during night hours. Not only that, electric cars in future may to a degree serve as a decentralized battery storage for providing ancillary services thus offering another benefits for their owners.

The load diagram of the Czech electric grid from 16.6. To 20.6. 1019[9]



[9] Oenergetice.cz. (2019). *Oenergetice - energostat*. [online] Available at: https://oenergetice.cz/energostat [Accessed 24 Jun. 2019]. Source of the data used: ENTSO-E Transparency Platform

Available solutions for home charging

The cheapest way how to home charge electric car is to use the standard 230 V socket, albeit at the cost of extending the charging time. Another simple way of charging is using multiphase 16 A socket. This solution allows faster charging and the only necessary accessory is a relatively cheap adapter for the particular vehicle.[10] Another way of charging is by using a device named wallbox. The advantage of these devices is the ability to significantly reduce the charging time.

When the electric vehicle is being charged from these sockets, electric cars use their own chargers to transform the AC currents to do DC. This is where the technical specifications of the electric vehicle come in play. When using the more conventional AC chargers, the charging power is limited not only by the power output of the charger or socket, but also by the technical specifications of the onboard charger. Electric cars are being made with chargers with power from 3.7 to 22 kW. For example, if a car that has only a 3.7 kW onboard charger, when using an AC charger with higher power output, the charging power of the car will only be the 3.7 kW.

Table 6: Overview of selected cheap charging stations

Home charging station	**Charging power**	**Price (CZK)**	**Charging current**
Basic work	3,6 kW	15 304	16/32 A
Basic Home	3,6 kW/7,2 kW	13 074	16/32 A
Mini Home	3,6 kW/7,2 kW	10 931	16/32 A
EVlink Wallbox	3,7/7,4 kW	22 898	16/32 A
P30 e-series	4,6 kW	17 385	20 A

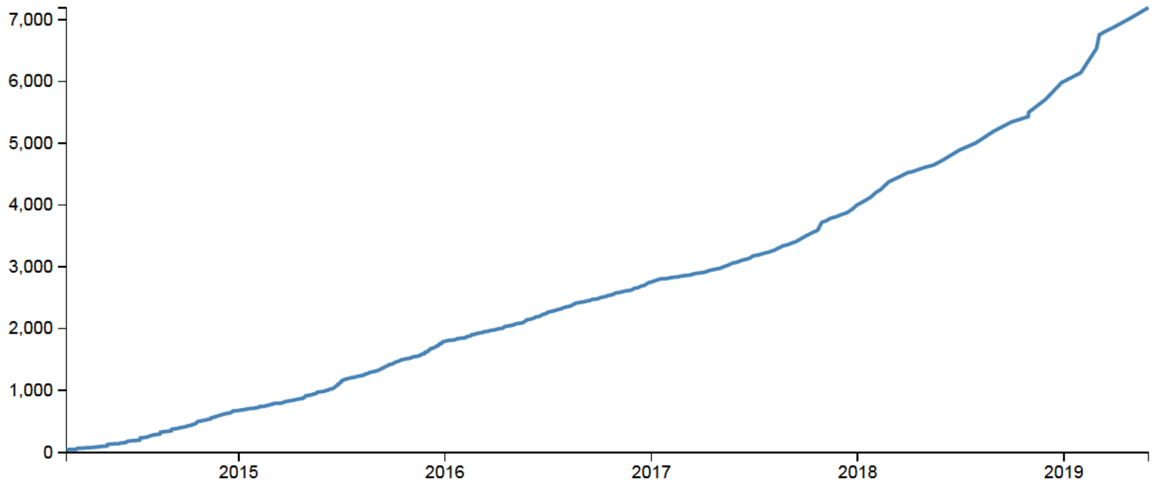
In table 6 we can see the prices of the cheapest charging stations. If we compare these prices to the prices of the electric vehicles themselves, we can see that the purchase of a wallbox charger will not significantly increase the purchasing price of the vehicle.

[10] ecoFuture. (2019). *Jak na domácí nabíjení elektromobilu*. [online] Available at: https://www.ecofuture.cz/clanek/jak-na-domaci-nabijeni-elektromobilu [Accessed 24 Jun. 2019].

PART 4: COSTS AND AVAILABILITY OF PUBLIC CHARGING IN CZ, AT AND OTHER EU COUNTRIES

At the moment there are several different grids of charging stations spread all across the Europe. Probably the most known of these are the superchargers owned and operated by the American company Tesla Motors, another technology of DC chargers is CHAdeMO or CCS. While the most searched out of these are the DC fast charging stations, the majority of these stations are using AC. However both systems are being continuously expanded.

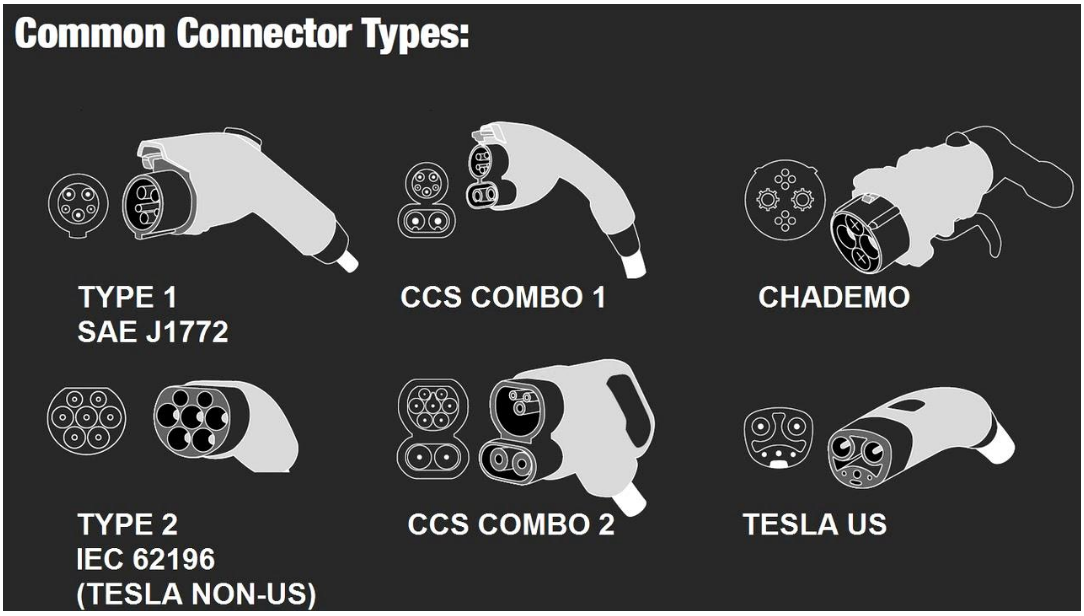
Total number of chargers in Europe[11]



Proper examination of the availability of public chargers in given area is greatly complicated by the fact, that there exists several different types of charging sockets which are not compatible. Therefore it is not entirely correct to simply compare the number of registered cars in the given area with the number of charging stations located there.

[11] Ccs-map.eu. (2019). *CCS/Combo Charge Map - Europe*. [online] Available at: http://ccs-map.eu/stats/ [Accessed 24 Jun. 2019]

Overview of the most common connector types found in EU[12]



According to CCS Charge there are currently approximately 6000 CCS charging stations in Europe. However, the vast majority of these stations are located in only a few countries.

Table 7: The statistics of CCS[13]

	Country	Total CCS chargers
1	Germany	1 491
2	UK	1 106
3	Norway	548
4	France	544
5	Sweden	367
6	Austria	266
7	Switzerland	211
8	Denmark	162
9	Netherlands	161
10	Italy	152
15	Czech republic	100

[12] ecoFuture. (2019). *Z konceptu do provozu: co si užijeme z Vision iV?*. [online] Available at: https://www.ecofuture.cz/clanek/z-konceptu-do-provozu-co-si-uzijeme-z-vision-iv [Accessed 24 Jun. 2019].
[13] Ccs-map.eu. (2019). CCS/Combo Charge Map - Europe. [online] Available at: http://ccs-map.eu/stats/

PART 5: TOTAL COSTS OF OWNING AND USING ELECTRIC VEHICLES

In part 2 we have already discussed the initial prices of new electric vehicles. In this part we will focus more on the variable costs of using the electric vehicle.

As we have already established, the conventional combustion cars are still cheaper than their respective electric counterparts. However the variable costs of using the conventional car are much higher.

Fuel prices

One of the most important part of variable costs of using any vehicle are the fuel prices.

The conventional combustion engine cars need petrol or diesel to run. The price of both fuels is highly dependent on the current situation on the market and can change in time. Moreover an excise duty is imposed on both fuels, which increases their price.

The average price of petrol in the Czech Republic is approximately 33 CZK (or 1,289 EUR) per litre, the price of diesel is approximately 32 CZK (or 1,250 EUR) per litre.[14] If we multiply this price with the consumption of the cars shown in table 4, we get the estimated price of fuel for 100 km.

Table 8: The estimated fuel costs for selected conventional combustion engine cars

Type of car	Name	Price of fuel per 100 km in CZK	Price of fuel per 100 km in EUR
Compact	Škoda Octavia	162	6
Compact	Škoda Scala	165	6
Compact	Volkswagen Golf	162	6
Subcompact	Volkswagen Polo Trendline	158	6
Compact MPV	Mercedes-benz B	178	7

On the other hand, estimating the actual fuel costs of charging an electric vehicle is much more complicated than in case of conventional cars. The reason for this is the fact that the electric vehicle can be either charged at home from a private charging station (wallbox, or conventional 1 or 3 phase sockets) or at public charging stations.

The prices of charging at a public charging station are not unified, they depend on the output power of the station, the type of charging station (DC/AC). What

[14] Kurzy.cz. (2019). *Aktuální ceny benzínu, cena nafty*. [online] Available at: https://www.kurzy.cz/komodity/benzin-nafta-cena/ [Accessed 7 Jul. 2019].

complicates the situation even more is the fact, that in many cases the driver is charged a price not based on the “consumed” energy, but can be based on the time spent at the charging station. Sometimes the actual charging is “free” and the costs are included in the price for parking.

The approximate price of charging at an public charging station is for DC stations (up to 50 kW) approximately 7,5 CZK/min, for AC chargers (32, 16 A) it is approximately 1,5 CZK/min.[15] In order to more accurately estimate the fuel costs of using an electric car, I will use the official price of MWh specified in an dedicated tariff D27d[16] using a price list of utility company ČEZ a.s. During low tariff the price of 1 MWh is 78,8 EUR (2022,29 CZK). If we calculate the estimated fuel costs for 100 km we get the following table.

Table 9: The estimated fuel costs for selected electric cars

Model	Home Charging CZK	Home Charging EUR
BMW i3	10,2	0,398
Mercedes B-Class ED	13,1	0,512
Nissan Leaf	11,8	0,463
Renault Zoe	11,5	0,450
VW e-golf	10,0	0,392
VW e-up	9,2	0,361
Tesla	12,5	0,487

When we compare the fuel costs of Evs and conventional cars, we can clearly see, that using the electric vehicles is much cheaper that using conventional combustion engine cars.

Service cost

Another advantage of the electric vehicles is their relatively low service costs in comparison to the conventional cars. This due to the fact that electric vehicles require less maintenance as they are in comparison much simpler. The disadvantage is that with an electric car you cannot go to just any car service, but have to go to a service which has specially trained mechanics and is suited for work with electric vehicles. The only part that

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[15] ČEZ, *Ceník jednorázového dobíjení,* http://www.elektromobilita.cz/edee/content/file/pro-media-2018/10-rijen/cenik-primych-plateb-za-jednorazove-dobiti-cj.pdf
[16] ČEZ, *Ceník, smlouva na dobu neurčitou,* https://www.cez.cz/edee/content/file/produkty-a-sluzby/obcane-a-domacnosti/elektrina-2019/moo/web_new_cenik_elektrina_dobu_neurcitou_moo_20191_cezdi.pdf

has to be monitored and more frequently replaced are tires, brake linings, brake fluids and coolants.

In a comprehensive calculation of total costs of ownership the costs of maintenance have to be considered. However, since it is relatively difficult to acquire specific data for given cars, we will not consider these costs in the following calculation. It is important to emphasize, that should these cost be considered, it would be to the electric vehicles advantage in comparison to the conventional cars.

Total costs

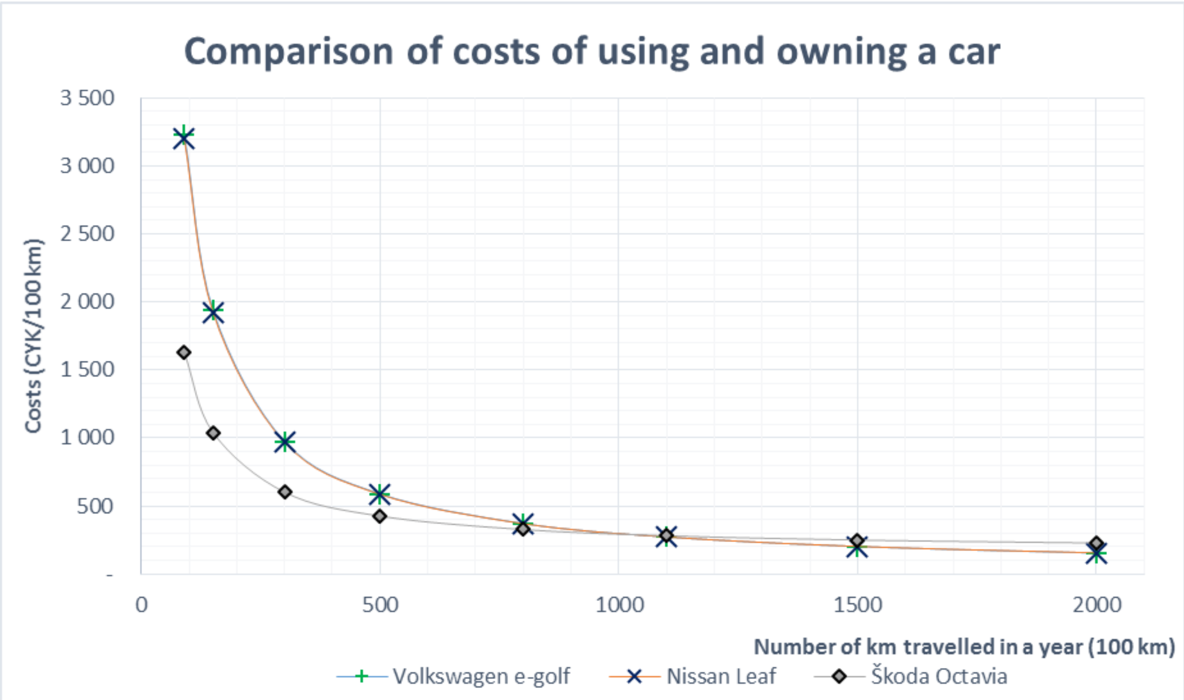
In order to fully compare the electric and conventional vehicles, we have to calculate combined investment and fuel costs for a given car. For this calculation we will use the following equation:[17]

$$TC = \frac{INV * \propto}{skm} + Fpp$$

TC – total costs in CZK per 100 km
INV – initial investment into the vehicle in CZK
skm – specific number of kilometers driven
Fpp – Fuel price per 100 km
α - capital recovery factor

For the calculation we have selected three cars – Nissan Leaf, Volkswagen e-golf and Škoda Octavia. All three cars can be considered to be the same category (Compact). The prices were calculated with the interest rate of 10 % and 4 yearly payments (annuities).

Comparison of costs of using and owning a car



[17] Ajanovic, A. (2019). *Introduction: Energy Economics in Transport*., 6.2.2019

As can be seen from the figure above, the calculated costs depend greatly on the capital recovery factor, and the estimated distance travelled with the car. The moment, when under these conditions electric vehicles become cheaper is approximately 110 000 km. If the car would not have driven this far, the conventional combustion engine car would be more cost efficient. If we would consider the fact that conventional car would have higher maintenance costs, the distance required would be shorter.

CONCLUSION:

Electric vehicles are one of the ways, how to help achieve decarbonization in the transport sector. Although there exists other possible solutions such as hybrids or hydrogen cars, the electric vehicles are at the moment the most developed and implemented alternative technology.

Even though the price of electric cars is continuing to drop and their technical parameters, especially the capacity of the batteries, are improving with every new generation, the conventional cars are still cheaper to buy, despite the heavy regulations they are currently subjected to. Until the prices of electric cars will decrease and will be similar to the conventional cars, the demand for conventional combustion engine cars, be it new or old, will remain high.

If we consider the cost of using a vehicle as well as its initial price, the electric vehicles are already more cost-effective than their conventional counterparts. The reason for this are lower maintenance costs and significantly lower fuel costs. Even though it is very difficult to estimate the prices of petrol, diesel and electricity in the future, it is unlikely that the costs of charging will increase to the levels of refueling costs. Therefore, should the prices of electric cars decrease significantly, and people will be able to afford them, any additional incentives will no longer be necessary. The electric cars are also expected to have some end-of life residual price, as large battery storages composed of old car batteries are envisioned.

People who live in family houses, or already have 3-phase sockets available in their homes should be able to home charge their vehicles with relative ease. There already exists dedicated tariffs for electric cars, in many cases the installation of a wallbox may not be necessary. These households may however be forced to increase their main circuit breaker amperage, so that the charging of electric car will not have a significant effect on the use of other appliances.

For the people who live in cities, the situation will be much complicated. Since people who live in prefabricated houses, or similar buildings, do not have the ability to homecharge their electric vehicle, they will have to rely on the public charging stations in garages or parking lots. Because of the higher demand and lack of space the implementation and network management will be more difficult and costly. Although the networks of charging stations are continually expanded, significantly more will be required.

Lastly, if the electric vehicles are to truly contribute to reduction of carbon emissions, the electricity they use has to come from carbon-neutral sources. Therefore the implementation of renewable sources, nuclear power and gas-fired power plants as a backup power stations is necessary.

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