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Policy Report

The perspectives of the Czech automotive industry's decarbonization

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Executive Summary

This paper examines the up-to-date state of the Czech automotive industry and its possible decarbonization in connection with the transport emissions. The focus is particularly given to the BEV market. While the EU-wide emissions targets are clearly set, the path along the industrial change is not. This scene-mapping paper evaluates the ways of electromobility adaptation in the Czech Republic and the possibilities given to the original equipment manufacturers. Moreover, it gives an overview of the best practice in selected countries. The Czech Republic ought to follow the best practices in the socio-economic boundaries of the Czech national economy and strengthen the convenience of electromobility and its infrastructure. The aim is to put the proper policy framework in motion in order to preserve the high competitiveness of the Czech automotive industry, while managing a socially fair transition to low-carbon economy.

The major findings of this paper are the following:

- The Czech fleet of passenger cars does not reflect the shift towards the electric vehicles in a way witnessed elsewhere in the EU. France, Italy, and Germany are boosting BEV purchase subsidies as part of their recovery plans to accelerate the pace of the transition – the Czech Republic does not incentivize private purchase and the Czech National Recovery Plan as well as the National Plan for Clean Mobility do not offer any ambitious solution regarding electromobility. While the acquisition prices of BEVs remain higher or equal to ICEVs and the charging infrastructure is neither built nor made convenient, status quo persists.

- Without the well-established innovative environment and financial subsidies for startups and corporates, the green (and simultaneously digital) transition is not easily attainable. To establish a strong competing position in the EU, the time to invest is now, otherwise the financial and networking environment will grow outside of the Czech Republic, while resources are allocated to where new technologies arise. However smart strategy the Czech corporates have, they cannot compete with foreign corporates being subsidizes by their respective governments.

- Gradually shifting mobility to BEVs and PHEVs might be protecting jobs more easily compared to an immediate shift towards BEVs only. While Škoda Auto has a long experience with manufacturing of the PHEV battery cells and Hyundai Kona or Škoda Enyaq are built in the Czech Republic, such scenario would seem optimal for local employment in the segment. Czech "Gigafactory" for battery cells should be made a priority.

- A vast majority of the Czech automotive-oriented corporates, and their employees, are automotive parts manufacturers, suppliers, and face a question of future critical components demand shock (fuel, motor, gearbox, or tailpipe systems). The up-to-date research shows slightly negative (2%) impact on the employment in the EU motor vehicle industry, yet a positive spillover effect is predicted in other fields – electricity or hydrogen supply, electrical equipment and service providing – for which the EU will need highly educated labour force.

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Recommendations

- **Bolster green investments** – to establish a strong competing position in the EU, the time to invest is now, otherwise the financial and networking environment will grow outside the Czech Republic, while resources are allocated to where new technologies arise. Hence, support and incentivization for green and digital companies and startups is a necessary step in order to compete with foreign OEMs. Czech "Gigafactory" for battery cells should be made a priority.

- **Financial incentives are the change-drivers** – as seen throughout the body of up-to-date research, the acquisition price of cars is usually the key factor of car purchase. While the price of BEVs is higher compared to ICEVs, non-financial incentives may act as if placed in a vacuum. Differentiated taxation or bonus-malus systems should be considered. Czech consumers should have the opportunity to buy BEVs conveniently, possibly the locally produced ones such as Škoda Enyaq or Hyundai Kona. While the post-covid recovery should be forward-looking, non-financial incentives will not go a long way.

- **Boost charging infrastructure** – as outlined in the Czech National Recovery Plan,[1] as of May 2021, further strengthening of the electromobility infrastructure is the necessary step towards the future ecosystem of new mobility. However, supporting only 52 charging points in Prague, 1,940 company charging points and 2,880 household charging points up to 2026 seems inadequate given the 2030 best scenario target of 500,000 BEVs. Prague itself cannot afford to be the latecomer,[2] and 52 charging points from the Czech National Recovery Plan and, hence, the National Plan for Clean Mobility, is a separate goal lacking any ambitions, while in the Operational Programme "Transport" it is promised to support 10,000 charging points up to 2027.

- **Support the corporate BEVs fleet market** – while it is firstly the corporate fleet that achieves the price parity between BEVs and ICEVs, supporting corporate fleet could lead to achieving the stability on the used BEVs market and therefore help rebuilding the overall fleet and its average age much quicker compared to status quo. Financial incentives designated for corporations should reach CZK 990 million by 2026. This lump sum of money allocated for corporate e-mobility support is supposed to incentivize the purchase of approximately 3,600 BEVs[3] and 1,000 trucks (not specified). This sum is insufficient and should be increased. Currently, no ambition and long-term strategy can be identified.

- **Ban on ICEVs is not the solution per se** – while having a significantly higher average age of the fleet compared to the EU average, banning ICEVs without proper financial incentives, or without achieving the price parity between BEVs and ICEVs, may lead to further ageing of the fleet used and, therefore, higher total CO2 emissions. Strategy of BEV and PHEV gradual incentivization is also more pro-employment oriented, as producing these vehicles requires higher labour input. However, no public support is seen to incentivize such shift.List of Abbreviations

[1] The Czech National Recovery Plan, 2021, Národní plán obnovy (planobnovycr.cz).
[2] Portal of Prague, "Praha podnikla další krok směrem k rozvoji elektromobility na svém území", 02/2021, https://www.praha.eu/jnp/cz/o_meste/magistrat/tiskovy_servis/tiskove_zpravy/praha_podnikla_dalsi_krok_smerem_k.html.
[3] The Czech National Recovery Plan, 2021, Národní plán obnovy (planobnovycr.cz).

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I. Introduction

The implementation of the EU Regulation 2019/631 delivered a vast change in the automotive industry and raised a question for all the OEMs to tackle their respective direction of business development. From 2025, new EU-wide CO_2 emissions standards will be implemented. Compared to 2021 as a base year, fleet-wide emissions in the category of passenger cars are to be reduced by 15% from 2025, and by 37.5% from 2030.[4] However, after announcing the ambitious economy-wide 55% net emission reduction target by 2030, the regulation will probably see changes in the 2Q of 2021.[5] The Czech National Recovery Plan and the National Plan for Clean Mobility do not offer any ambitious solutions regarding electromobility[6], as of May 2021. While guidelines exist for climate action implementation with respect to all the socio-economic realities of the EU member states,[7] the main pressure will be on the OEMs, energy providers, infrastructure enablers, and, lastly, on consumers themselves, if being handed towards, so far, more expensive new ways of mobility without proper incentives. **Neither the OEMs themselves nor the end consumer will adapt on the new ecosystem of mobility without a proper policy support.** As reported in 2019, multiple studies confirm the efficiency of financial incentives and tax policies (such as the VAT exemption on low-carbon vehicles or levies on fossil-fueled ones), while the infrastructure is built simultaneously. [8] **The decarbonization of the Czech automotive industry may well go against the national stream of thought and become a short-term challenge, however, in the long run, the inevitable change will be beneficial for all the member states.**

II. Beer, cars, and carbon intensive industries

Together with good beer, domestically made, affordable yet high quality cars form the foundation of the Czech national narrative. Carbon intensive industries such as automotive are the backbone of the Czech economic system, making the Czech economy the fourth most carbon intensive in the EU.[9] However, it is precisely the emission-intensive industries that will face the most disruptive challenges in the times marked by digital and green transformations.

In 2018, the total CO_2 emissions of the Czech Republic were more than 135 mt[10] and even before then it had been rising consecutively for five years. Energy industries were responsible for approximately 40%, while transportation, including aviation, was responsible for approximately 16% of the total emissions. Industrial processes were responsible for approximately 13% of Czech emissions. To stress the importance of the car manufacturing industry, **a share of roughly 10% of the Czech GDP and a share of 14% of the total output of non-financial corporations, can be attributed to it, while employing around 180,000 people.**[11] In 2019, almost 1,5 million of cars was produced, followed by more than 1,1 million in

[4] The EU Regulation 2019/631 of 17 April 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0631-20210111.

[5] CAR, "Tightening of EU - CO_2 Requirements and the effects on Jobs in the European Auto Industry", 2020, https://www.car-future.com/media/center-automotive-research/CO2_Studie/CAR_Jobs_Study_EN.pdf.

[6] The Czech National Recovery Plan, 2021, Národní plán obnovy (planobnovycr.cz).

[7] The Katowice Climate Package, Katowice Climate Change Conference, 2018, https://unfccc.int/process-and-meetings/the-paris-agreement/katowice-climate-package.

[8] I. Zvěřinová et al., "Rozvoj trhu s elektromobily v České republice: veřejná podpora a zkušenosti ze zahraničí", 05/14/2019, https://energetika.tzb-info.cz/energeticka-politika/19010.

[9] EEA, "Greenhouse gas emissions per capita", 03/06/2021, https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table?lang=en

[10] European Environment Agency, EEA greenhouse gas – data viewer, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

[11] Czech Statistical Office, Public database, https://vdb.czso.cz/vdbvo2/faces/en/index.jsf?page=statistiky#katalog=30832.

2020[12] (due to the covid-19 pandemic restrictions and the demand shock).

In contrast to the relative share of the automotive industry on the total economy, one may be surprised by the up-to-date state of the fleet market in Czechia. **In 2020, the average age of a passenger car was more than 15 years compared to the EU average of 11 years**[13], while the average age of trucks was more than 17 years and more than 16 years for buses. Since this paper focuses on passenger cars, it ought to be mentioned that passenger cars are solely responsible for 64% of GHG emissions in the transportation sector. [14] **The Czech fleet of passenger cars does not reflect the shift towards electric vehicles in a way witnessed elsewhere in the EU.** Let us consider the pre-pandemic year of 2019 and see the comparison of selected European countries in table no. 1. Although Norway has the highest BEV/PCP ratio, their private charging points do balance it. Its BEV market penetration is the highest, too. Further explanation is given in the seventh chapter.

By selecting the respective countries, one cannot obtain a full picture of the up-to-date state of electromobility across the whole EU, yet the direction of the role-modelling countries can be seen. **In 2020, electric passenger vehicle sales (excluding the PHEV, HEV and FCEV) were equal to approximately 3,200,[15] compared to the overall BEV fleet of 3,897[16] cars at the end of 2019.** Nevertheless, the average emissions of newly registered cars in the Czech Republic were roughly 129 gCO_2/km compared to roughly 98 gCO_2/km in the Netherlands,[17] while having the EU fleet-wide limits set to 95 gCO_2/km and paying penalties for excess emissions. Furthermore, Czechia's charging infrastructure seems inadequate even for such low number of BEVs, having a BEV/PCP ratio of 5. A report from late 2020 shows that more than 75% of all European charging points are still located in the Netherlands, Germany, and France.[18]

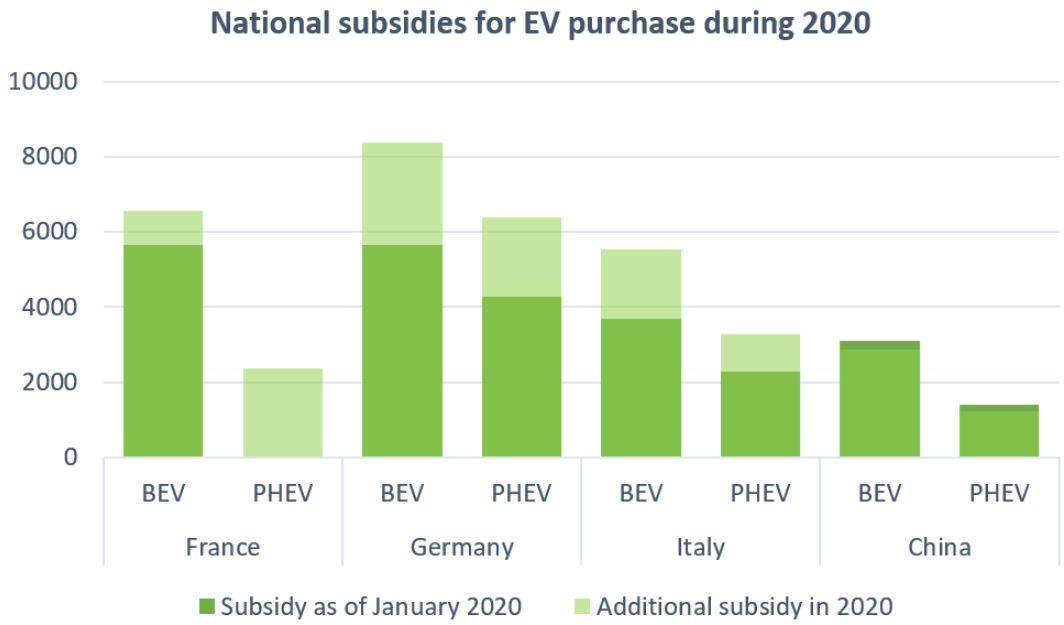
Yet, the ecosystem of electromobility needs further explanation. Green transition must be two-fold. On the one hand, scaling up the e-mobility ecosystem must be achieved, on the other hand, the electricity must come from renewable power sources. Rapid BEV market scaling is predicted around 2024 and by that time, strategic low-emission technology investments and critical partnership forgings are too late to plan.[19] **Hence, France, Italy, and Germany are boosting BEV subsidies as part of their recovery plans to accelerate the pace of the transition, as seen in 2020, too.** As seen in picture no. 1, China (given for example) is the only selected country to lower the total subsidies during 2020 (denominated in EUR). Table no. 2 shows a clear boom in the BEV market in 2020, especially in Germany, which may be given by the subsidies – the public authorities doubled the federal subsidies.[20]

[12] AutoSAP, Statistiky, https://autosap.cz/wp-content/uploads/2021/02/vyroba-12-2020-1.pdf.
[13] SDA, Registrace nových OA, http://portal.sda-cia.cz/stat.php?n#rok=2020&mesic=12&kat=OA&vyb=pt&upr=ptznacky&obd=r&jine=false&lang=CZ&str=nova.
[14] McKinsey & Company, "Pathways to decarbonize the Czech Republic", 11/12/2020, https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic#.
[15] Elektrickevozy.cz, "Prodeje elektromobilů v ČR (2020): prosinec byl nejsilnějším měsícem v roce, jenže…", 01/08/2021, https://elektrickevozy.cz/clanky/prodeje-elektromobilu-v-cr-2020-velky-prehled-pravidelne-aktualizovano.
[16] EAFO, Passenger cars, Passenger cars | EAFO.
[17] ACEA, "Making the transition to zero-emission mobility 2020 progress report", 10/2020, https://www.acea.be/uploads/publications/ACEA_progress_report_2020.pdf.
[18] McKinsey & Company, "Pathways to decarbonize the Czech Republic", 11/12/2020, https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic#.
[19] Bain & Company, "Electric and Autonomous Vehicles: The Future Is Now", 10/2020, Electric and Autonomous Vehicles: The Future Is Now | Bain & Company.
[20] C. Randall, "Germany doubles EV subsidies, no more diesel support", 06/04/2020, https://www.electrive.com/2020/06/04/germany-doubles-ev-subsidies-no-more-diesel-support/.

2019	BEV	PCP*	BEV market	PCP/km²	PCP/km**	BEV/PCP
Czechia†	3,897	808	0.1%	0.01	0.6	4.8
Denmark	15,507	2,817	0.6%	0.07	2.1	5.5
France	155,125	30,367	0.5%	0.06	2.6	5.1
Germany	136,617	40,517	0.3%	0.11	3.1	3.4
Netherlands	106,558	50,824	1.2%	1.22	18.2	2.1
Norway	260,689	13,763	9.3%	0.04	13.7	18.9

* Public charging points
** PCP per highway km
† 8,180 BEVs (Eurostat) vs. 3,897 BEVs (EAFO, The Ministry of Transport)

Table no. 1 – Passenger BEVs across selected European countries in 2019[22]



Picture no. 1 – BEV and PHEV subsidies in selected countries (EUR), 2020[21]

[21] IEA, "Global EV Outlook 2021", 2021, https://iea.blob.core.windows.net/assets/ed5f4484-f556-4110-8c5c-4ede8bcba637/GlobalEVOutlook2021.pdf.
[22] Eurostat, Passenger cars, Statistics | Eurostat (europa.eu); EAFO, Passenger cars, Passenger cars | EAFO; ACEA, "Making the transition to zero-emission mobility 2020 progress report", 10/2020, https://www.acea.be/uploads/publications/ACEA_progress_report_2020.pdf.

The Czech Republic has decided to opt-out of the sixth call of corporate subsidies of CZK 150 million during the autumn of 2020,[23] while the Ministry of Industry and Trade looked at areas with higher investment priority due to the ongoing pandemic.[24] In the meantime, Von der Leyen proposed the new fleet-wide limit of 47.5 gCO_2/km/car for 2030[25] and cities and countries are moving to limit fossil fuel vehicles – consider the phasing-out process and ban on new diesel cars from 2019 in Copenhagen, Rome proposing a ban on diesel cars from 2024, Paris from 2025, Munich, Stuttgart and Dusseldorf from 2030, while Norway is proposing a ban on internal-combustion vehicle sales from 2025,[26] Denmark, Netherlands, Sweden or Slovenia from 2030.[27]

	2019	+ 2020	+ % change
Czechia	3,897	3,218	83%
Denmark	15,507	13,895	90%
France	155,125	110,405	71%
Germany	136,617	187,536	137%
Netherlands	106,558	72,298	68%
Norway	260,689	73,036	28%

Table no. 2 – Change in passenger BEVs across selected European countries in 2020[28]

III. Life cycle analysis – where the grave is?

The Czech Republic produced approximately 1.5 million passenger cars in 2019 and their carbon footprint over the life cycle is around 40 million tCO_2. **For such cars, the fleet-wide CO_2 European target of 95 gCO_2/km is still highly unachievable, and the EU manufacturers are facing penalties equal to EUR 3.3 billion in 2021.**[29] These could be omitted in 2020 with European flexibilities of super credits for vehicles under 50 gCO_2/km and phase-in, as only 95% of newly registered passenger cars in 2020 were counted into the fleet average – the overall reduction in final CO_2 average was equal to 16.5 gCO_2/km. **Due to such yearly limits and flexibilities, more than 1100 out of 3200 BEVs sold in 2020 was registered in December 2020 (741 Škoda Enyaq vehicles).**[30] Not a single Enyaq went to the end customer, it was rather allocated to Škoda Auto close stakeholders.[31]

Another subject to comply with in 2021 is the mandatory transfer of NEDC-based emission targets converted into WLTP-based targets. While the former is now regarded as somewhat inaccurate in assessing real emissions, the latter should lead up to 23% higher CO_2 emissions reported.[32] Yet the super credits for vehicles still count, for a car under the limit 50 gCO_2/km there is a multiplier of 1.67 in 2021 for the newly registered cars of the OEM.

[23] L. Srb, "Dotace na elektromobily v roce 2021 v ČR pravděpodobně nebudou", 02/15/2021, https://elektrickevozy.cz/clanky/dotace-na-elektromobily-v-roce-2021-v-cr-pravdepodobne-nebudou.

[24] L. Srb, "Další dotace na elektromobily v ČR jsou nakonec zrušené. Kvůli koronaviru", 08/14/2020, Další dotace na elektromobily v ČR jsou nakonec zrušené. Kvůli koronaviru (elektrickevozy.cz)

[25] CAR, "Tightening of EU - CO_2 Requirements and the effects on Jobs in the European Auto Industry", 2020, https://www.car-future.com/media/center-automotive-research/CO2_Studie/CAR_Jobs_Study_EN.pdf.

[26] Oliver Wyman, „Governmental bans that steer car owners to electric vehicles", 03/2018, Governmental-Bans-That-Steer-Car-Owners-To-Electric-Vehicles (oliverwyman.com).

[27] IEA, "Global EV Outlook 2021", 2021, https://iea.blob.core.windows.net/assets/ed5f4484-f556-4110-8c5c-4ede8bcba637/GlobalEVOutlook2021.pdf.

[28] EAFO, Passenger cars, Passenger cars | EAFO.

[29] Deloitte, "Cutting CO_2 emissions from passenger cars", 02/2020, https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/Deloitte-POV-cutting-CO2-emissions-from-passenger-cars.pdf.

[30] EAFO, Passenger cars, Passenger cars | EAFO.

[31] L. Srb, "Škoda Auto registrovala rekordních 741 Enyaqů. Ani jeden však není pro zákazníky", 01/07/2020, Škoda Auto registrovala rekordních 741 Enyaqů. Ani jeden však není pro zákazníky (elektrickevozy.cz).

[32] In 03/2021, the EU also implemented regulation regarding the on-board fuel consumption monitoring (OBFCM) devices in order to gather real-world emission data. Please see EUR-Lex - 32021R0392 - EN - EUR-Lex (europa.eu).

According to a Deloitte report, 13 of 21 European OEMs will not be able to apply for the super credits due to reaching the maximum super credit limit in 2020 already.[33]

Following the LCA analyses and calcuating when the emission parity is achieved between ICEVs and BEVs, **selected studies[34] show that depending on the electricity mix used in the calculation and the life cycle mileage driven, the emission break-even point is usually achieved with higher mileage of BEVs.** Yet, the vast body of research is in favor of BEVs from the LCA point of view.[35] To understand the clean energy mix of the EU countries, please see picture no. 6 in the sixth chapter – it may be taken as an approximation of how clean the e-mobility is depending on the source of electricity, opposite to the idea of zero tailpipe CO_2 emissions measurement. The battery itself can be used either for high-capacity energy accumulation or for recycling of precious materials.[36] However, the recycled materials are, so far, more expensive than newly mined ones.

IV. BEVs for the planet, TCO for the budget

Whatever the CO_2 efficiency of the car is, the average end customer and consumer of the services is not considering the environmental impact of the car use per se. **The consumer generally first and foremost looks for the acquisition costs, convenience of the brand and the car model itself, and operational expenditures.**[37] Surveys show an evidence of green consumer segments, and in the Czech Republic such segments do exist too.[38] However, both the private and corporate customers have a rich experience with ICEVs, and while the total cost of ownership is lower or equal to BEVs, customers may not be in favor of adopting the BEVs. According to a survey done by Deloitte, almost 50% of respondents are not willing to pay more than 400 EUR to adopt an alternative engine vehicle.[39] **Meanwhile, 30% of the manufacturing costs are due to battery prices. Even though the prices decrease gradually,[40] the higher prices of BEVs are predicted to prevail in the very recent years.** The margins of OEMs are about to stay negligible until 2025[41] (currently seeing a negative 15% margin in the segment of BEVs). See picture no. 2 for the CZK price difference of selected models – while Škoda Superb represents the change from ICEV to PHEV, Hyundai Kona represents the change from ICEV to BEV, which is even a more significant change in terms of percentage difference.

[33] Deloitte, "Cutting CO_2 emissions from passenger cars", 02/2020, https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/Deloitte-POV-cutting-CO2-emissions-from-passenger-cars.pdf.

[34] ADAC, "E-Autos: Top CO_2-Bilanz in der Kompaktklasse", 03/20/2018, E-Autos: Top CO2-Bilanz in der Kompaktklasse (adac.de) or E. Emilsson and L. Dahllöf, "Lithium-Ion Vehicle Battery Production", 11/2019, Lithium-Ion Vehicle Battery Production (ivl.se).

[35] F. Del Pero et al., "Life Cycle Assessment in the automotive sector: a comparative case study of Internal Combustion Engine (ICE) and electric car", in Procedia Structural Integrity, 2018 (12), p. 521-537, https://pdf.sciencedirectassets.com/314029/.

[36] Volkswagen, "Druhý život pro baterie z elektromobilů", 2021, https://www.volkswagen.cz/elektricke-a-hybridni-vozy/vse-o-elektromobilite/druhy-zivot-pro-baterie-z-elektromobilu.

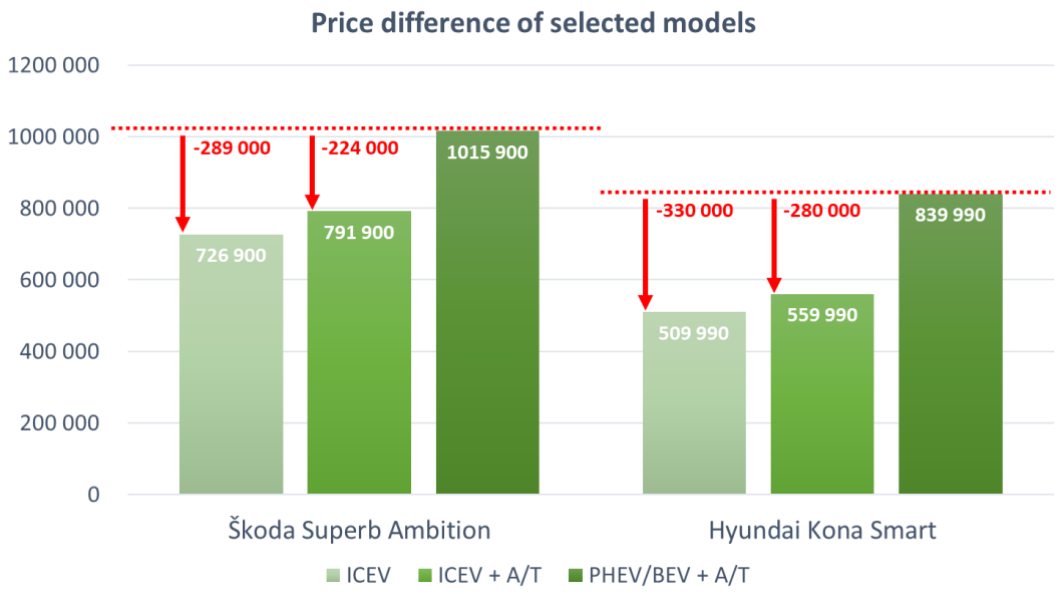
[37] N. Doronin, "Návrh nástrojů marketingové komunikace elektromobilů vůči českému zákazníkovi", 2020, Diploma thesis, ŠKODA AUTO University.

[38] E. Jaderná et al., "Green and Extra Green Consumers in the Czech Republic: Effect of Greenness in Automotive", 2020, in review procedure E&M Economics and Management.

[39] Deloitte, "2020 Global Automotive Consumer Study", us-2020-global-automotive-consumer-study-global-focus-countries.pdf (deloitte.com).

[40] Bain & Company, "Electric and Autonomous Vehicles: The Future Is Now", 10/2020, Electric and Autonomous Vehicles: The Future Is Now | Bain & Company.

[41] *Ibid.*



Picture no. 2 – CZK price difference of selected models in 2021[42]

On the one hand, the BEVs are still significantly more expensive; on the other hand, price parity is expected to be reached gradually in the upcoming years. **Currently, it is only the commercial fleet to achieve TCO parity due, partly, to their extensive mileage. ICEVs are still 8% cheaper compared to BEVs when talking about low mileage, yet BEVs are 9% cheaper when higher mileage (+25,000 km/year) is reached**.[43] Another study predicts electric passenger cars, short-haul trucks, and city buses to become the favored alternative due to price parity in the 2020s and FCEV trucks in 2030s,[44] yet other research conclusions predict the price parity for BEVs only in 2030s, too.[45] Although the former study offers the cost-optimal pathway and assumes to reach the 50% milestone of BEVs in the total sum of newly registered passenger cars in 2030, equal to 600,000 BEVs operating in the Czech Republic, it reaches only 3.5% extra reduction from the 14% emission reduction target in transportation as set out by the European Renewable Energy Directive.[46] **With approximately 7,600 BEVs currently operating in the Czech Republic (as of March 2021),[47] a vast change in BEVs adoption must follow.** However, while the initial acquisition costs remain high, the turning point cannot be attained.

[42] Škoda Auto and Hyundai official price lists valid in 05/2021, 2021, https://www.skoda-auto.cz/modely/novy-superb/novy-superb and https://www.hyundai.cz/modely/kona-2020.

[43] Bain & Company, "Electric and Autonomous Vehicles: The Future Is Now", 10/2020, Electric and Autonomous Vehicles: The Future Is Now | Bain & Company.

[44] McKinsey & Company, "Pathways to decarbonize the Czech Republic", 11/12/2020, https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic#.

[45] J. Miller, "Electric car costs to remain higher than traditional engines", 08/31/2020, Electric car costs to remain higher than traditional engines | Financial Times (ft.com).

[46] McKinsey & Company, "Pathways to decarbonize the Czech Republic", 11/12/2020, https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic#.

[47] EAFO, Passenger cars, Passenger cars | EAFO.

V. Providing services, not just manufacturing cars

The new ecosystem of mobility calls for cost sharing, economies of scale and technical development to reach the price parity between BEVs and ICEVs. **Joint ventures are increasingly important to every classic OEM, while the business model is changing from product itself to platform services and, finally, to the landscape of smart mobility**.[48] In late 2018, 88% of Tier 2 and higher suppliers in the Czech Republic predicted to stay competitive in the new e-mobility environment and 76% predicted to start e-mobility particles' manufacture in 2020 the latest, yet 40% of their sales were coming from the critical components (such as fuel systems, ICE manufacturing, tailpipe systems, or gearbox systems), not adaptable for the new environment.[49] CzechInvest is listing 232 companies with focus on these four mentioned critical components within all 3 tiers and 926 automotive companies overall.[50] As witnessed in the Tesla case, companies are aware of the possibilities and necessity to achieve the tech company-like valuation and the narrative of up-to-date smart mobility services provider, [51] yet the investments in digital services and R&D, especially in the Czech Republic, are necessary.

Not only the green and digital transitions affect vehicle OEMs. The ecosystem includes micro-mobility such as e-scooters and e-bikes, ride hailing in the form of single occupant or ride sharing, car sharing on the P2P basis and car subscriptions. This inevitably leads to the need of further financing and new insurance models. The vast change in the value chain of energy supply compared to fossil fuel supply is another aspect, as it presents a new competition in the field of energy supplies, infrastructure developments or platform content extension. [52] 90% of the investments in mobility startups is made by new, non-automotive players, and more than 15 new electric drive suppliers are emerging[53] with the new e-axle system solution for BEVs.

Without the well-established innovative environment and financial subsidies, such green (and simultaneously digital) transition is not easily attainable. Accordingly, to establish a strong competing position in the EU, the governmental support is needed now.[54]

VI. It's the EX – Employee experience

The motor vehicle industry and its supply chains are facing a disruptive change of green transition, which might inevitably lead to job losses in this respective industry, yet not in the economy-wide picture. **The electricity or hydrogen supply, electrical equipment and service providing will face the opposite – job gains and further strengthening of the overall networking groups.**[55] While previous studies assessed job losses without the emerging battery cell manufacturing, such studies may not be valid anymore.

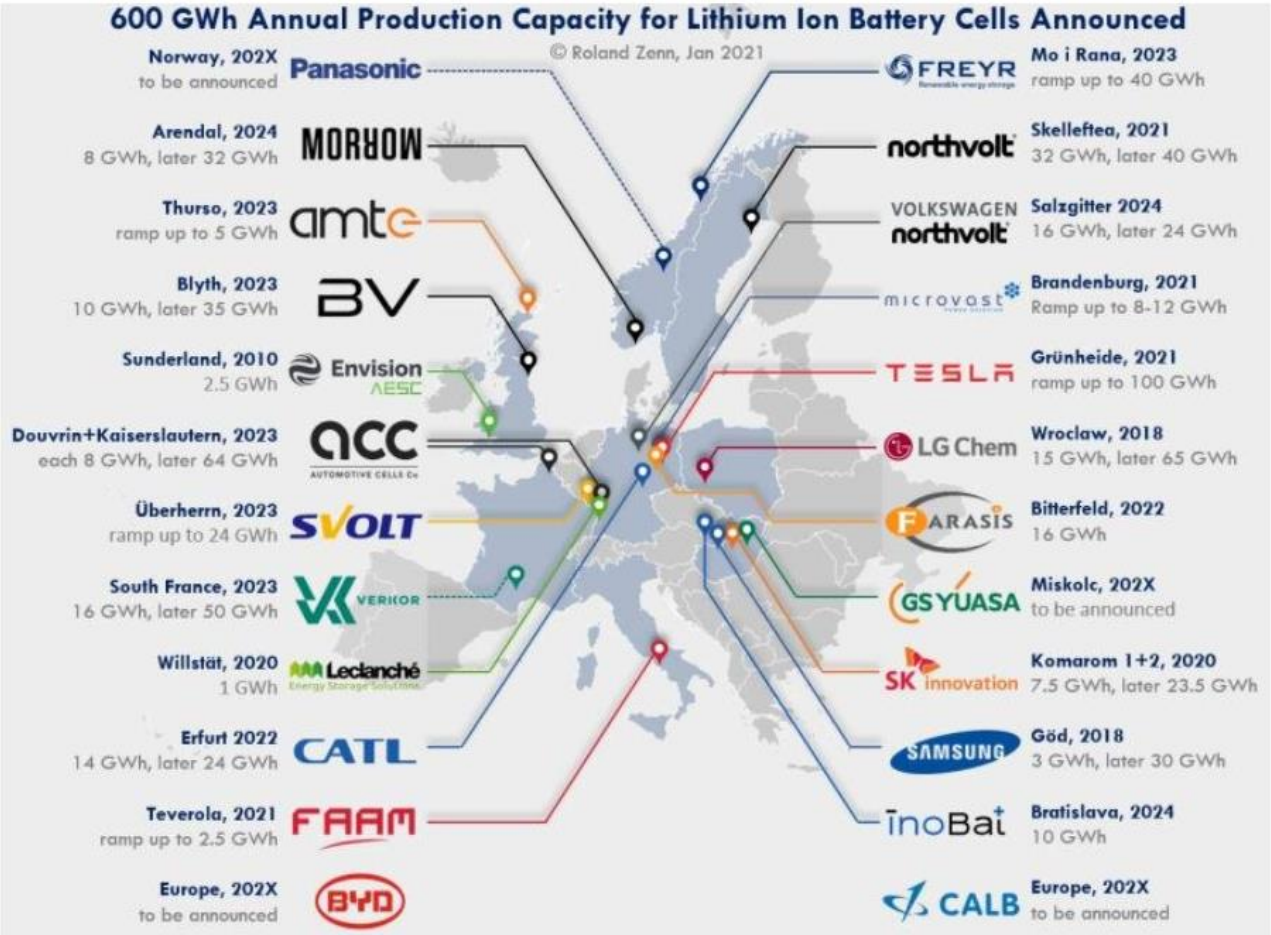
[48] McKinsey & Company, "Mastering new mobility", 2019, Mastering-new-mobility-Perspectives-on-navigating-an-uncertain-future.pdf (mckinsey.com).
[49] EY and AutoSAP, "Je český automobilový průmysl připraven na nárůst elektromobility?", 09/2018, https://autosap.cz/wp-content/uploads/2018/09/ca-3-4-2018.pdf.
[50] CzechInvest, Sektorová databáze dodavatelů, 2021, https://suppliers.czechinvest.org/Aplikace/sup-public-x.nsf/index.xsp?a=login.
[51] H. Greimel, "Toyota expands from hardware to software", in Automotive News, 03/08/2020, https://www.autonews.com/technology/toyota-expands-hardware-software.
[52] G. Fournier, "The new mobility paradigm. Transformation of value chain and value proposition through innovations", in The Automobile Revolution. Springer, 2017, p. 21-47.
[53] McKinsey & Company, "Mastering new mobility", 2019, Mastering-new-mobility-Perspectives-on-navigating-an-uncertain-future.pdf (mckinsey.com).
[54] Confederation of Danish industry, "Together We Create Green Growth", https://www.danskindustri.dk/globalassets/english-sitet/lastest-from-di/analysis-and-reports/dis-2030-plan-2019_pixi_190x165_enkeltsider_web.pdf?v=210423.
[55] Cambridge Econometrics, "Reviewing the impact of the low-carbon mobility transition on jobs", 09/21/2018, https://www.camecon.com/what/our-work/reviewing-impact-low-carbon-mobility-transition-jobs/.

Germany, France, Italy, Spain, Slovakia – the group of countries responsible for approximately 70% of the EU passenger car production in 2019 – **are facing only negligible job losses, and the decrease of automotive employment is predicted to prevail in the interval from 1.6% to 2.1%. Therefore, on average, only 1.9% of employees should face the possibility of job loss.**[56] Such prediction is based on a model of static microeconomic single sector and it takes no positive employment spillover into account. Other positive employment effects may be predicted in construction, electricity, or hydrogen services.[57]

As witnessed in Germany, with the planned battery cell manufactures, 30,000 new employees will be needed in the inner employment effect. Hence, the job loss effect will probably not occur in the way formerly predicted. [58] However, the plans are different in all respective EU countries, as made evident by picture no. 3. The Czech Republic holds talks with Volkswagen to build one of the six planned battery cell manufactures in the home country of Škoda Auto.[59] As of May 2021, no final agreement was signed. Going forward, such "Gigafactory" should be made a priority. However, Škoda Auto has been producing the battery cells for the concern's PHEVs since 2019[60] and its Enyaq is also the only MEB platform vehicle to be manufactured outside of Germany.[61] Hyundai was the first company to build its BEV in the Czech Republic, Hyundai Kona.[62]

As reported in March 2021, LG announced to build the largest battery cell manufacture in the world, located in Poland. Although the foreign direct investments are obvious, the EU also wants to preserve its self-sustainability on the battery cell market,[63] which raises issues in terms of availability of the critical raw materials, production, recycling, and disposal impacts or toxicity and safety of the manufacture. [64] Different scenarios exist, too. **Gradually shifting the mobility to PHEVs and BEVs might be protecting jobs more easily compared to an immediate shift towards BEVs only.** Since technology improvements in ICEs can increase labour input required for ICEVs, and the same applies for PHEVs, the job transition may run smoothly. [65] **While Škoda Auto has a long run experience with manufacturing of the PHEV battery cells, such scenario would seem optimal for local employment in the segment.**

[56] CAR, "Tightening of EU - CO_2 Requirements and the effects on Jobs in the European Auto Industry", 2020, https://www.car-future.com/media/center-automotive-research/CO2_Studie/CAR_Jobs_Study_EN.pdf.
[57] *Ibid.*
[58] A. Mönnig et al. "Electromobility 2035: Economic and labour market effects through the electrification of powertrains in passenger cars", 2019, IAB Working Paper, https://www.econstor.eu/bitstream/10419/204855/1/1664536213.pdf.
[59] ČTK, "Volkswagen v Evropě chystá továrny na baterie, uvažuje i o Česku", 03/15/2021, https://www.ceskenoviny.cz/zpravy/volkswagen-v-evrope-chysta-tovarny-na-baterie-uvazuje-i-o-cesku/2008973.
[60] Škoda Auto, "Výroba vysokonapěťových trakčních baterií ve společnosti ŠKODA AUTO byla obnovena podle plánu", 2020, https://www.skoda-storyboard.com/cs/tiskove-zpravy-archiv/vyroba-vysokonapetovych-trakcnich-baterii-ve-spolecnosti-skoda-auto-byla-obnovena-podle-planu/.
[61] L. Srb, "Enyaq iV je první elektromobil Škoda „Made in Czech Republic". Vyrábět se má 350 vozů denně", 11/25/2020, https://elektrickevozy.cz/clanky/skoda-enyaq-iv-je-prvni-elektromobil-made-in-czech-republic-vyrabet-se-ma-az-350-vozu-denne.
[62] *Ibid.*
[63] M. Strzałkowski, "Budou Evropu jednou pohánět polské baterie?", 03/19/2021, https://euractiv.cz/section/politika/news/budou-evropu-jednou-pohanet-polske-baterie/.
[64] European Parliament, Briefing EU Legislation in Progress: New EU regulatory framework for batteries, 12/2020, https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689337/EPRS_BRI(2021)689337_EN.pdf.
[65] Cambridge Econometrics, "Reviewing the impact of the low-carbon mobility transition on jobs", 09/21/2018, https://www.camecon.com/what/our-work/reviewing-impact-low-carbon-mobility-transition-jobs/.



Picture no. 3 – Announced battery cell manufactures (as of January 2021)[66]

Rather strong evidence from the 2008-2015 period shows that the automotive industry stayed competitive and increased employment during the strengthening of the CO_2 regulations in the EU.[67] As stressed in the first chapter, a share of roughly 10% of the Czech GDP and a share of 14% of the total output of non-financial corporations can be attributed to the automotive sector.[68] However, the value added of the whole automotive industry is vastly attributable to foreign-controlled corporates, as seen in the table no. 3, which concerns all three tier suppliers. **Therefore, the shift towards higher product value added depends on the ownership and organizational decisions made by the respective boards of directors.** In the table, production value and value added is given in EUR million, "Total" stands for total value of the Czech automotive industry according to CZ-NACE C29 – manufacture of motor vehicles, trailers and semi-trailers.

[66] R. Zenn, "Li-on Battery Gigafactories in Europe (January 2021)", 2021, https://www.orovel.net/insights/li-on-battery-gigafactories-in-europe-january-2021.

[67] CAR, "Tightening of EU - CO_2 Requirements and the effects on Jobs in the European Auto Industry", 2020, https://www.car-future.com/media/center-automotive-research/CO2_Studie/CAR_Jobs_Study_EN.pdf.

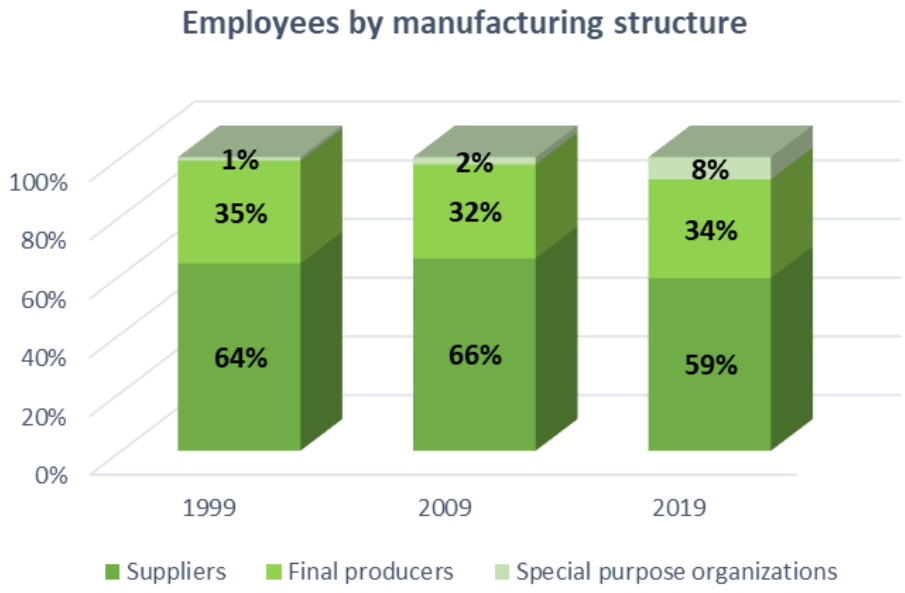
[68] Czech Statistical Office, Public database, https://vdb.czso.cz/vdbvo2/faces/en/index.jsf?page=statistiky#katalog=30832.

2018	Foreign	Total
Production value	**96%**	50,093
Value added	**93%**	8,353
Employees	**86%**	179,166
Enterprises	**22%**	1,089

Table no. 3 – Share of foreign control enterprises by economic activity[69]

The Czech Republic should create the right incentives for foreign investors to continue the growth regarding the green and digital transitions and preserve the employment in automotive industry.

Yet, undoubtedly, a **vast majority of the Czech automotive-oriented corporates, and their employees, are only automotive parts manufacturers,[71] suppliers (as seen in picture no. 4), and face the question of future critical components demand shock (fuel, ICE, gearbox, or tailpipe systems).** Regardless of the working environment in the Czech Republic, it may be natural to the foreign parent corporates to locate its R&D centers in the home country – especially when one keeps the higher value added of such services in mind. As the migration of the Czech economy towards low carbon technologies is necessary, not only incentivization is the precondition, but also the shift towards employees' higher education and transition into the fields of science such as engineering physics, machine learning or mechatronics. [72] Higher value added of Czech products could therefore be achieved.



Picture no. 4 – Employees by manufacturing structure (AutoSAP members)[70]

[69] Eurostat, Structural Business Statistics – Overview, https://ec.europa.eu/eurostat/web/structural-business-statistics/overview.

[70] AutoSAP, Statistiky, https://autosap.cz/zakladni-prehledy-automotive/.

[71] M. Pícl, "The Future of Employment in the Automotive Industry in the Czech Republic", 06/2019, in Friedrich-Ebert-Stiftung, "The Future of Employment in the Car Sector", https://www.syndex.ro/sites/default/files/files/pdf/2020-01/The%20future%20of%20employment%20in%20the%20car%20sector_EN.pdf.

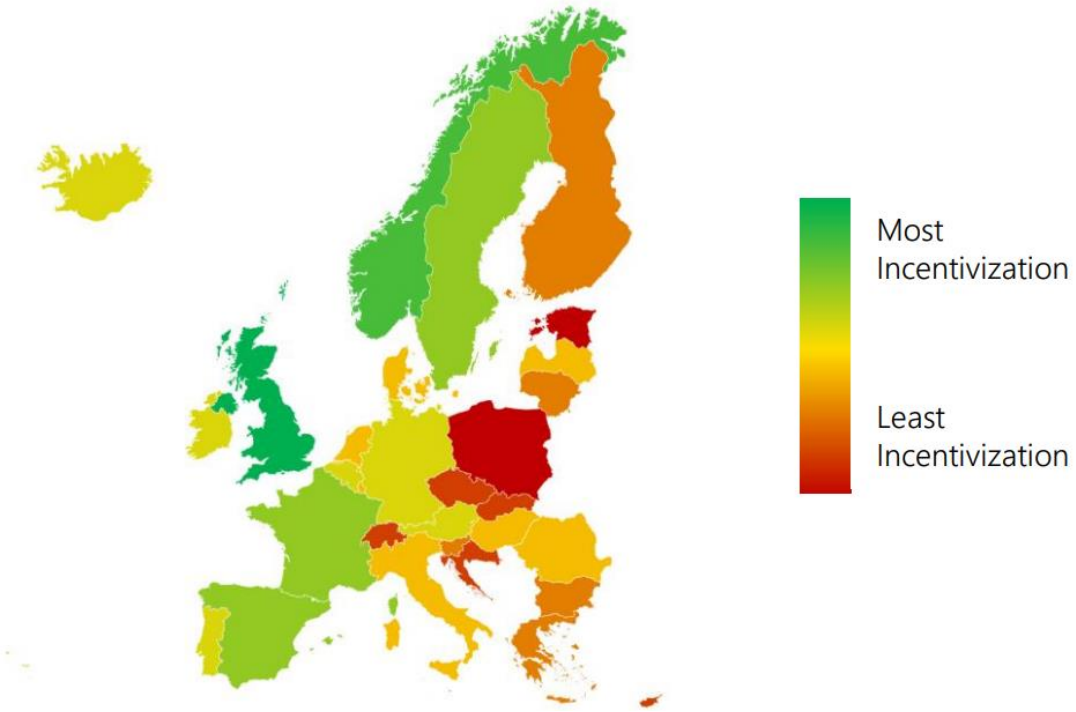
[72] McKinsey & Company, "Pathways to decarbonize the Czech Republic", 11/12/2020, https://www.mckinsey.com/cz/our-work/pathways-to-decarbonize-the-czech-republic#.

The possible job losses could also be managed through retirements from the existing workforce;[73] however, such strategy would raise more questions and issues regarding the Czech Republic retirement age and social security scheme.

VII. Incentivization – Lessons from Denmark and Norway

According to EAFO [74] and SBD, [75] the Czech Republic is considered the country with little or no incentives regarding the BEV purchase, which is evenly translated into the number of BEV sales.

Although the registration for tax benefits and the ownership tax benefits exist (even though the subsidies for corporate clients were postponed and for private clients they never really existed),[77] the Czech incentive system lacks depth and forward-looking strategy. To give a quick overview about the levels of incentivization across Europe, please see picture no. 5.



Picture no. 5 – Level of incentivization across Europe[76]

[73] Cambridge Econometrics, "Reviewing the impact of the low-carbon mobility transition on jobs", 09/21/2018, https://www.camecon.com/what/our-work/reviewing-impact-low-carbon-mobility-transition-jobs/.
[74] EAFO, Incentives and Legislation, 2021, Country detail incentives | EAFO.
[75] SBD Automotive, "The electric vehicle guide", 2021, https://insight.sbdautomotive.com/EVGuide.html.
[76] *Ibid.*
[77] L. Srb, "Dotace na elektromobily v roce 2021 v ČR pravděpodobně nebudou", 02/15/2021, https://elektrickevozy.cz/clanky/dotace-na-elektromobily-v-roce-2021-v-cr-pravdepodobne-nebudou.

To consider a role-model example of incentivization, one may examine the examples set by Denmark and Norway. With the Transport Agreement of 4 December 2020**, the Danish government has set a new regulatory framework that is expected to facilitate the phasing in of about 775,000 zero or low emission passenger cars up to 2030** and to reduce a 1 million tCO_2 emissions by 2025 and 2.1 million tCO_2 by 2030. In order to achieve this, the government will set aside 2.5 billion DKK (8.7 billion CZK). Under the new deal, taxes and levies on cars powered by fossil fuels will gradually increase, and taxes on new cars will depend on how much carbon dioxide they emit, replacing a system which calculates tax based on cars' mileage.[78]

The Confederation of Danish Industry (DI), with its long-term financial plan "Together we create green growth",[79] aims at accelerating the green transition and increasing growth for the benefit of all the Danish population. **The strategy aims to reduce Denmark's CO_2 emissions by at least 70% compared to 1990 levels (embracing the government's goal),[80] with the allocation of 13 billion DKK (45 billion CZK).** With regards to automotive, the plan highlights that:

- cars that do not emit greenhouse gases, or those that emit very little, such as electric cars, hydrogen cars and plug-in hybrid cars should be made more affordable;
- zero and low-emission cars must be exempt from registration tax and subject to an ongoing owner's tax based on weight and energy efficiency;
- the tax base for employees with a company car must be adjusted to support the green choice;
- the share of sustainable biofuels needs to be increased and biogas must be promoted in heavy transport – however, one must not forget about environmental concerns connected to biofuels, too;
- the infrastructure for new zero and low-emission technologies needs to be expanded.[81]

In recent years, e-mobility has become a mainstream part of Norwegian mobility culture. One reason for that can be found in its energy system – it has abundant natural energy resources and a relatively small population, a large energy export, and a power sector already among the most decarbonized globally.[82] To stress the importance of energy mix of the EU countries, please see picture no. 6. The Czech Republic had a share of approximately 57% of fossil fuels in total electricity generation in 2019.[83]

[78] Reuters, "Denmark agrees deal to have 775,000 electric cars by 2030", 4/11/2020, https://europe.autonews.com/automakers/denmark-aims-have-775000-electrified-cars-2030.

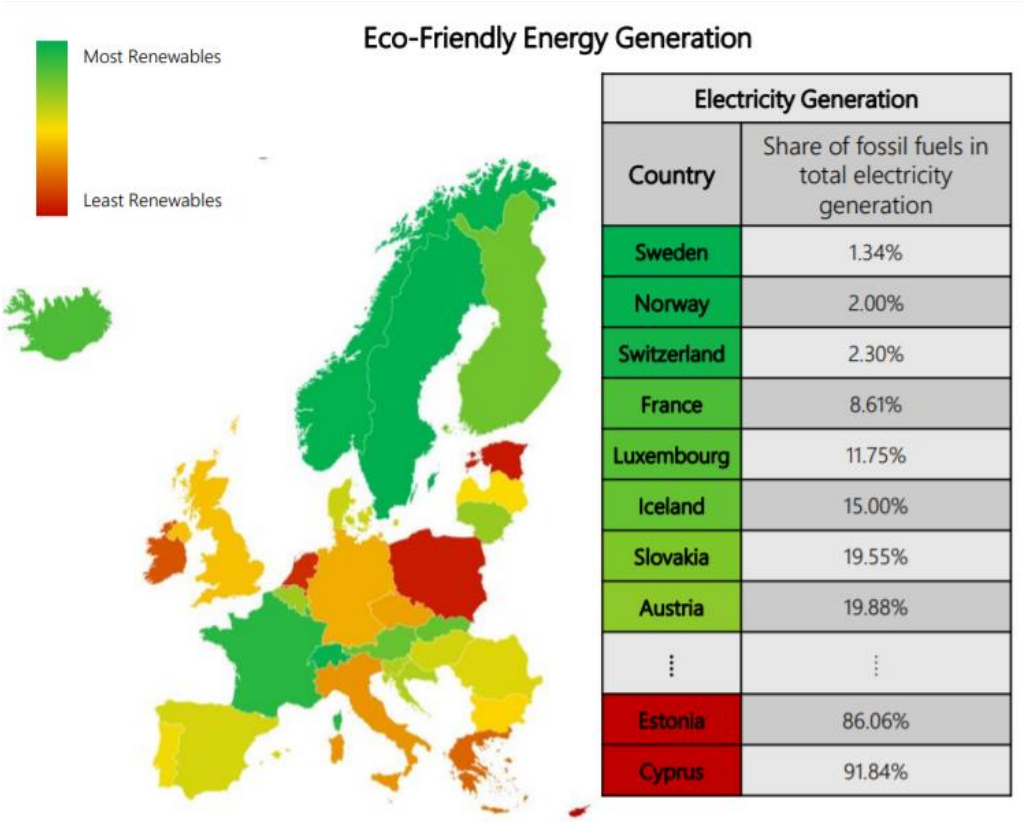
[79] Confederation of Danish industry, "Together We Create Green Growth", https://www.danskindustri.dk/globalassets/english-sitet/lastest-from-di/analysis-and-reports/dis-2030-plan-2019_pixi_190x165_enkeltsider_web.pdf?v=210423.

[80] Danish Ministry of Climate, Energy and Utilities "Climate Act", Act. No 965 of 26 June 2020, https://en.kefm.dk/Media/1/B/Climate%20Act_Denmark%20-%20WEBTILGÆNGELIG-A.pdf.

[81] *Ibid*. Also see: "The 160 proposals in DI's 2030 plan", https://www.danskindustri.dk/globalassets/english-sitet/lastest-from-di/analysis-and-reports/dis-160-proposals_a4_web.pdf?v=210423; "Technical description of DI's 2030 Plan", https://www.danskindustri.dk/globalassets/english-sitet/engelsk-planchesat-december-2019.pptx.

[82] T. M. Skjølsvold and M. Ryghaug, "Temporal echoes and cross-geography policy effects: Multiple levels of transition governance and the electric vehicle breakthrough", in Environmental Innovation and Societal Transitions, Vol. 35, 06/2020, p. 236, https://www.sciencedirect.com/science/article/pii/S2210422418302946.

[83] OTE, Národní energetický mix, https://www.ote-cr.cz/cs/statistika/narodni-energeticky-mix.



Electricity Generation	
Country	Share of fossil fuels in total electricity generation
Sweden	1.34%
Norway	2.00%
Switzerland	2.30%
France	8.61%
Luxembourg	11.75%
Iceland	15.00%
Slovakia	19.55%
Austria	19.88%
⋮	⋮
Estonia	86.06%
Cyprus	91.84%

Picture no. 6 – Energy generation across the EU[84]

What really stands out in the Norwegian automotive case study, is that the country is seeking to become the first nation to end the sale of petrol and diesel cars by 2025. The Parliament will reach this goal with a strengthened green tax system, not a ban (like the neighbouring Denmark). A positive sign is that the BEVs made up 54.3% of all new cars sold in the Nordic country in 2020, up from 42.4% in 2019, thereby setting a global record.[85] **A key incentive in place since 2001, namely the VAT exemption for the purchase of zero-emission vehicles (whereas the VAT on fossil fuel cars is 25%), has been approved by the EFTA Surveillance Authority (ESA) to last until the end of 2022.**

Other incentives are:

- zero road tax;
- free parking in some municipal car parks;
- reduced tax on company electric cars (at a lower rate than fossil fuel vehicles);
- reduced or free tolls in some areas;
- driving in a bus lane if carrying a passenger;
- 50% discount on some car parks, tolls and ferry fares.[86]

[84] SBD Automotive, "The electric vehicle guide", 2021, https://insight.sbdautomotive.com/EVGuide.html.
[85] V. Klesty, "Electric cars rise to record 54% market share in Norway in 2020", in Reuters, 05/01/2021, https://www.reuters.com/article/us-autos-electric-norway-idUSKBN29A0ZT.
[86] E. Ulven and T. Sutterud, "Norway's electric car drive belies national reliance on fossil fuels", in The Guardian, 09/01/2021, https://www.theguardian.com/business/2021/jan/09/norways-electric-car-drive-belies-national-reliance-on-fossil-fuels.

VIII. The future is in-EV-itable

So far, it can be assumed that the latest economic cycle – green and digital – has already begun. To conclude the first scene-mapping paper on automotive industry and its decarbonization, some caveats must be stressed. Firstly, for obvious reasons, **the cradle-to-grave (or LCA) emission assessment must be carefully examined in all mobility services**. While this paper examines mainly the automotive sector, 40% of all Czech emissions come from the power sector.[87] The task is to continue with the implementation of the net zero target through power sector transformation, simultaneously strengthening the power grid. Secondly, **the time to invest is now, otherwise the financial and networking environment will grow outside the Czech Republic, while resources are allocated to where new technologies arise.**[88] If the price parity is achieved within the next five years, [89] the necessary infrastructure ought to be built by that time. **However smart strategy the Czech corporates have, they cannot compete with foreign corporates being subsidizes by their respective governments**. Lastly, behavioral nudges towards both private and corporate sector are needed. **While the acquisition prices of BEVs remain higher or equal to ICEVs, and the charging infrastructure is neither built nor made convenient, status quo persists**, and the competitiveness of the Czech automotive industry disappears. In order to protect it, the Czech Republic should consider the following recommendations.

[87] European Environment Agency, EEA greenhouse gas – data viewer, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

[88] McKinsey & Company, "Mastering new mobility", 2019, Mastering-new-mobility-Perspectives-on-navigating-an-uncertain-future.pdf (mckinsey.com).

[89] Bain & Company, "Electric and Autonomous Vehicles: The Future Is Now", 10/2020, Electric and Autonomous Vehicles: The Future Is Now | Bain & Company.

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List of abbreviations

	Abbreviation	Explanation
Battery electric vehicle	**BEV**	Fully electric vehicle with no combustion engine and a battery
Hybrid electric vehicle	**HEV**	Full hybrid electric vehicle able to run in pure EV mode for a limited period
Plug-in hybrid electric vehicle	**PHEV**	Vehicle with chargeable battery and an ICE, can be plugged in to recharge
Fuel cell electric vehicle	**FCEV**	Hydrogen fueled vehicle with fuel cell and a battery-powered electric motor
Internal combustion engine vehicle	**ICEV**	Conventional vehicle with petrol/diesel fueled internal combustion engine
Original equipment manufacturer	**OEM**	Equipment manufacturers of motor vehicles
CO_2 equivalent	**CO_2**	Metric measure to compare the emissions from various greenhouse gases on the basis of their global warming potential
Life cycle assessment	**LCA**	Technique for assessing the environmental aspects in all stages of the product's life
Total cost of ownership	**TCO**	Financial estimate of all the costs incurred during the product's ownership
New European driving cycle	**NEDC**	Certification test cycle used in the EU until September 2017
Worldwide harmonized light vehicle test procedure	**WLTP**	Certification test cycle used in the EU since September 2017
Peer-to-peer	**P2P**	Service with a decentralized platform whereby two individuals (peers) interact directly with each other, no third party

Table no. 0 – Abbreviations used

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