Czech-Austrian Winter and Summer School

E-MOBILITY IN URBAN AREAS: COMPARISON OF POLICIES AND LESSONS LEARNED

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Co-operating Universities

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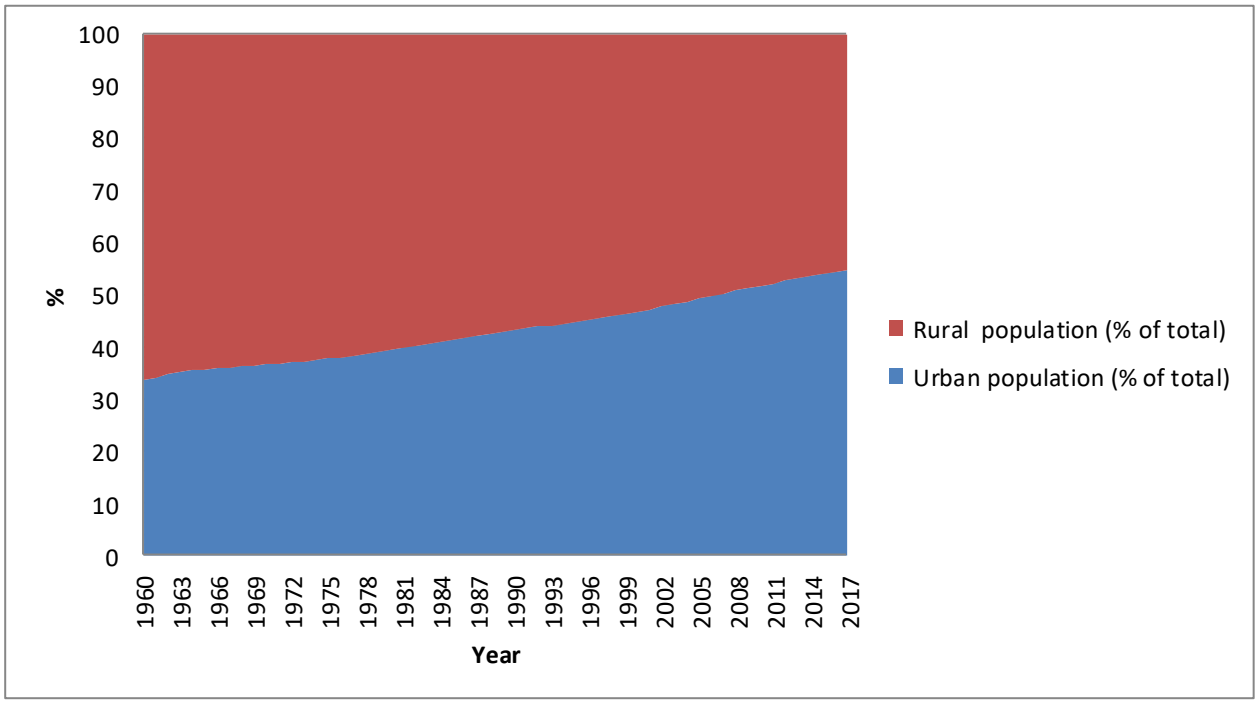
Abstract

Mobility in Urban areas is reaching its limit with current technologies and use. The number of privately owned vehicles is rising; urban areas are getting larger and denser. The space for more vehicles is limited from the point of infrastructure (both capacity of roads and parking spots). Increased transportation has also negative effect on the pollution in city centres that is undesirable. E-mobility can potential tackle several of these issues but probably not without support. It is necessary for cities to foster policies, which can tackle the issues of mobility from several angles. Policy instrument will boost this trend more effective. Since the EU has launched low emission transport, aiming to reduce CO_2 to cope with climate change. Austria and Czech Republic, particularly the capital cities; Vienna has a very significant vision for using E-mobility in the city which this willing can be transferred to Prague for the better improvement on the environmentally friendly transportation system.

Motivation

Urbanization and mobility are correlating in the present time and play an important role in the future of urbanism era. Transport policy-makers are concerning on the environmental impacts as well as climate change issue for their decision, in particular for urban area.

Figure 1 Comparison on Global Population in Urban and Rural



Source: https://population.un.org, Accessed 15 June 2019

The UN population indicates in the World Development Indicators report, 2019 that urban population is increasing while being seen declining trend in rural area around the globe. This trend is occurring very clear in the EU as well as country scale such as Austria and Czech. As urbanization increases an additional more than 50 % of world population live in cities by 2017 – cities and suburbs will undergo significant transformations to create sustainable living conditions for their residents.

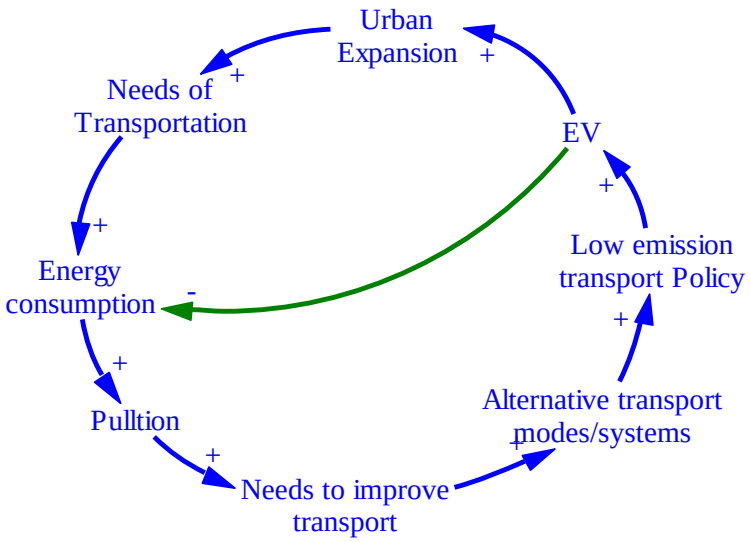
Problem statement

The analysis is main policy measures that are trying to promote the electric mobility in the broader context of mobility in urban areas. To promote change in mobility in general requires a lot of initial investments. Cities are currently not built for electric cars. The assumption will be that many cities are approaching the same issues with different measures (or lack of them) but the overall goal of emission free, inhabitant more friendly city centres should be relatively undisputable. The core objective is to find key policy measures which are implemented in certain cities and which could be transferable to other regions.Comparing data for Low carbon urban areas by finding study specific measures in E-mobility context which are implemented (mainly) in Europe. The objective should be to find data which would show (probably positive) impact of electric mobility (and possibly policies promoting the e mobility) to environment in city centres.

Approach

The core objective is to find key policy measures which are implemented in certain cities and which could be transferable to other regions.Comparing data for Low carbon urban areas by finding study specific measures in E-mobility context which are implemented (mainly) in Europe. The objective should be to find data which would show (probably positive) impact of electric mobility (and possibly policies promoting the e mobility) to environment in city centres.Urban expansion is the driver for the needs of transport in urban area. Transportation is one of the energy intensity activities in the cities which can lead to more pollution and conjunction. It is very important for urban planning to revision on the low carbon emission transport modes or alternatives for urban areas. One of a good example for low carbon emission is electric mobility. In urban area, electric mobility can be; personal cars, public transport, train as well as taxi which will show detail contents in this paper. The conclusion of clausal loop diagram can show cause and effect of policy for driving EV as a urban clean mobility in the future because it consumes less energy and generates less pollution respectively.

Figure 2 Clausal Loop Diagram showing cause and effect on policy for EV in urban transportation



Source: Author

Results

Energy and mobility are the twin pillars of these transformations, and both will require radical adaptation to meet the demographic and economic growth without increasing congestion and pollution. The question is whether policymakers and business leaders can harness and combine them in ways that maximize their benefits for cost efficiency, economic growth and environment footprint.[1]

A new approach to electrification of transport is required[2]

The World Economic Forum indicates that electric mobility is widely seen today as a way to improve air quality and meet climate goals, but rarely is it integrated in a comprehensive vision for smarter cities. EVs continue to be associated with traditional ownership and use models, and are still generally considered as just cars: innovative uses and services relating to batteries, or to integration with smart buildings, are ignored, or at least not explored enough. The Charging stations are still developed with limited or no consideration for energy issues, or without exploiting a full range of digital technologies, overcomplicating the customer experience. Therefore, the World Economic Forum developed a report in cooperation with Bain & Company, suggests following three general principles as follow;

1) Take a multi-stakeholder and market-specific approach. The investment and infrastructure required to support electric mobility will vary significantly from one place to another. Any roadmap to electric mobility should be adapted to three main characteristics of the specific market: local infrastructure and design; energy system; and mobility culture and patterns. All relevant stakeholders should be engaged to collectively define a new paradigm for cities that go beyond the today's industry divisions, in search for complementary municipal, regional and national policies.

2) Prioritize high-use electric vehicles. Electric taxis and public transportation will have a great impact in reducing carbon emissions. These types of vehicles are driven far more than personal-use vehicles, so commercial and public EV fleet development should be encouraged. For example, Schneider Electric and BMW are part of a consortium of companies in Bangkok that is partnering with King Mongkut's University of Technology Thonburi to encourage the use of electric vehicles across Thailand, initially through car-sharing and a campus-based electric bus.

3) Deploy critical charging infrastructure today while anticipating the mobility transformation. EV charging infrastructure should be developed along highways, at destination points and close to public transportation nodes. This is critical for three reasons: first, to keep pace with current demand. Secondly, to address a range of anxiety issues by making charging stations accessible, convenient and easy to locate. And, lastly, to promote the adoption of EVs in commercial and private markets.

E-Mobility is globally at a rapid increasing trend due to decarbonisation. Transport is one of the few sectors in the EU where emissions are actually growing.

The EU believes that electric vehicle uptake is one of the main solutions to halt this trend, but what steps are actually being taken to decarbonise our roads? The Paris Agreement and air quality rules mean that Europe has to get serious about reducing the transport sector's impact on the environment, if total cuts of 40% by 2030 are to remain feasible. Global sales of new electric vehicles topped a million units for the first time in 2017 but that milestone was

[1] https://www.indesignlive.sg/insight/electrification-transport-smarter-city-transformations
[2] https://www.weforum.org/agenda/2018/02/mobility-future-electric-cars-fourth-industrial-revolution/

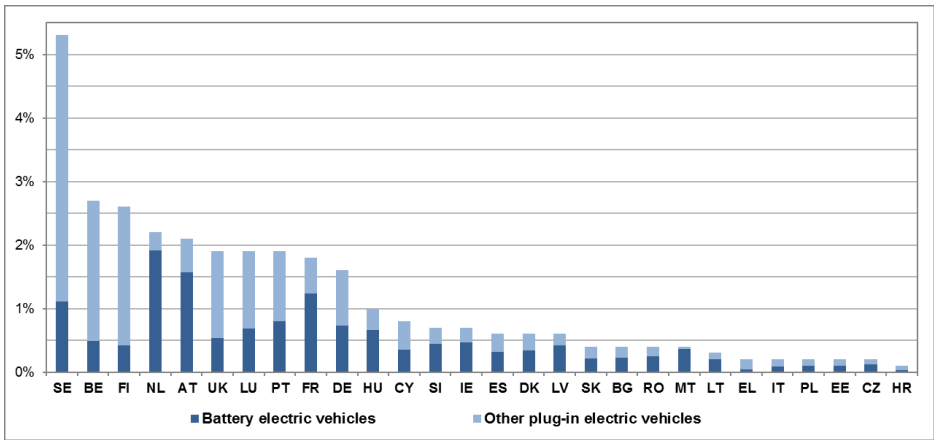
largely driven by mass expansion in China, whose market is now larger than Europe and the United States combined. The benefits of electrifying the sector are becoming clearer and recent figures compiled by Bloomberg show that EVs could reduce global oil consumption by 279,000 barrels a day, roughly equivalent to Greece's daily oil needs. Electric buses account for 233,000 of those barrels. Long-term planning up to 2050 is taking into account that growing EV use will increase electricity consumption from 0.03% in 2014 to an estimated 9.5% by mid-century, according to data provided by the European Environment Agency.[3]

This paper will indicate and compare E-mobility from the EU framework and Austria along together with Czech. Since, GHG has considered as akey factors for mobilty. E-mobility is driven for the EU transport policy under the frame work of Low Emsission Mobility (LEM). An aviation issue is the main source of CO2 emission from transport sector, in the EU. Nevertheless, it is not concern only for EU scale but also in the global scale. Therefore, the International Civil Aviation Organization (ICAO) adopted the new regulation, that lunches in 2019.

Considering on the shift to alternative fuels a vehicle that varies substantially across EU countries, although there is a general positive trend. The share of plug-in electric vehicles (PEV) in new passenger car registrations indicates the progress in deployment of electric cars. In 2017, according to (the European Alternative Fuels Observatory, Sweden was leading, mainly owing to a large number of newly registered plug-in hybrid vehicles (PHEV) that represented around 4% of the new registrations of passenger vehicles.

Sweden was followed by Belgium and Finland. The Netherlands and Austria have the highest share of battery electric vehicles (BEV) in new registrations. The lowest shares are held by Poland, Estonia, Czechia (EU-report called Czech Republic as Czechia) and Croatia with 0.1% share of PEVs in new registrations of passenger cars. (Policy challenges overview of performance in the EU countries)[4]

Figure 3 PEV market share in new passenger cars (M1) registrations (2017)



Source: European Alternative Fuels Observatory.

Since the highest share of CO_2 emissions in transport comes from the road sector, it is also the area where EU countries have made the most effort to mitigate this impact. However, they often apply different approaches. There is a need to provide consistent incentives to

[3] https://en.euractiv.eu/wp-content/uploads/sites/2/special-report/EURACTIV-Special-Report-Europes-e-mobility-gamechangers.pdf
[4] Policy challenges: overview of performance in the EU countries

users to promote the most energy efficient lorries. An effective way would be to differentiate tolls according to the CO_2 performance of lorries. Other measures besides taxation that can address negative externalities consist in:

1. Deploying clean fuels for transport;
2. Deploying intelligent transport systems;
3. Setting efficiency standards for vehicles;
4. Sharing best practices (including eco-driving); and
5. Encouraging the use of more energy efficient transport modes, in particular collective transport.

These measures have been reiterated in the Communications "A European Strategy for Low- Emission Mobility" and "Europe on the Move".

Table 1 Comparison on percentage of modals split in 2016 (%)

Countries/Region	Modals split for passenger kilometer-shared based on passenger -kilometer				Modals split for freight transport - shared base on ton-kilometer			
	Passenger car	Buses and Coaches	Railways	Tram and Metro	Road	Railways	Waterway	Pipeline
EU-28	81.3	9.3	7.6	1.8	72.8	16.6	5.4	4.6
Czech Republic	66.5	15.4	8.0	10.1	71.6	25.7	0.1	2.6
Austria	72.6	9.6	11.4	6.5	57.7	28.4	2.6	11.3

Source: Adopt from EU transport in figures, Statistic pocket Book 2018 and Policy challenges: overview of performance in the EU countries)

Modal split

With 11.4% in 2016, Austria railways passenger transport had the highest share of railways in the modal split for passenger transport among all EU countries (EU average: 7.6%) and Czech was almost equal with the average of EU (8.0%). Railways also played an important role for freight transport for Austria in 2016 (28.4%) as well as Czech which both countries were higher than EU average on railways in freight transport (EU average : 16.6%, Czech : 25.7 % and Austria : 28.4%).

The passenger transport on road in 2016, Austria road passenger transport was lower than EU average, and Czech road passenger transport was lower than Austria and the EU average. (EU average; 81.3 %, Austria; 72.6 % and Czech; 66.5%)

Thus, the modal split on rail appears to be more balanced for Austria and Czech than for the EU average. Nevertheless, the modal split on road appears that for Austria and Czech the balances are less than the EU average.

Table 2 Comparison on alternative fuels in Road transport (%) –All kinds of alternative fuel Vehicle (BEV, PHEV, CNG) in 2017		
Year	Austria	Czech Republic
2011	0.31	0.14
2012	0.34	0.33
2013	0.43	0.26
2014	0.76	0.86
2015	1.07	1.39
2016	1.69	1.23
2017	2.20	1.30

Source: Adopt from EU transport in figures, Statistic pocket Book 2018 and Policy challenges: overview of performance in the EU countries)

Alternative fuels in road transport

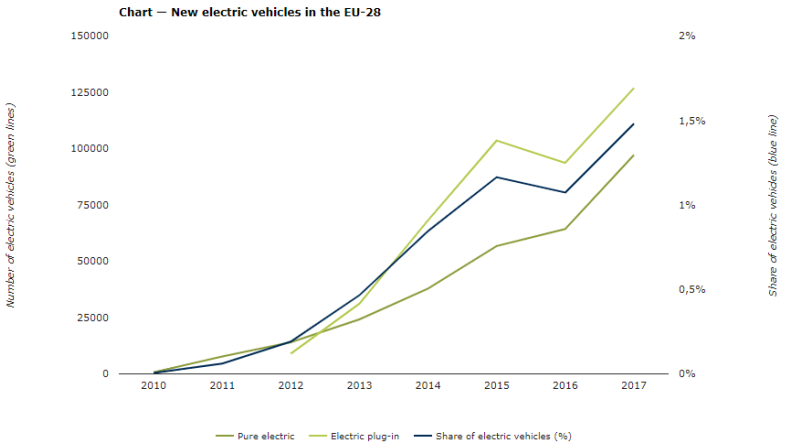
The overall share of passenger cars running on alternative fuels is low both Austria and Czech. However, the market share of new passenger cars using alternative fuels is growing very dynamically. In Austria, electric vehicles are exempt from vehicle tax. For Czech, over the period between 2011 and 2017 of the market share of compressed natural gas in transport has increased significantly in the years 2014-2017, as did the number of electric charging points. According to the European Alternative Fuels Observatory, they amounted to 7 per PEV (8 on average in the EU). The Comparison between Austria and Czech resulted that Austria was slightly leading for the alternative fuels in road transport than Czech.

The fact that, E-mobility policy will use modal split and alternative fuel share for driving policy in countries. Austria has a very strong will to regulate for E- mobility policy in country and city level, for the Czech site; there is the process that needs to be advocated in the future.

Although the number of vehicles is rising steeply, electric mobility is still strongly lacking behind. According to SDA data[5], the number of registered electric vehicles in the Czech Republic was around 1800 as of end of 2018. That represents only 0.02% of the total vehicles count. Although this number is rising very steeply (tenth of percent every year for last five years), compare to other European countries this amount is one of the lowest. The EU average is more than fivefold higher, (around1.5% in 2017).

[5] http://portal.sda-cia.cz/

Figure 4 Chart of new electric vehicles in the EU-28



Source: European Energy Agency

It is obvious that the Czech Republic is not a front runner in promotion of electromobility and other alternative ways of transport compare to classical combustion engine. The question is whether this is due to lack of political support or just an implication of other factors, such as lower GDP per capita compared to other western EU member countries. The front runners in the European Union are indeed comparatively more developed.[6]

Table 3 New electric vehicles by country

Country	Battery electric vehicles	Plug-in hybrid electric vehicles
Germany	24,351	28,618
United Kingdom	13,582	35,175
France	26,118	12,025
Sweden	4,199	15,947
Belgium	2,707	11,859
Italy	1,957	7,630

[6] https://www.eea.europa.eu/data-and-maps/indicators/proportion-of-vehicle-fleet-meeting-4/assessment-2

Table 3 New electric vehicles by country		
Country	**Battery electric vehicles**	**Plug-in hybrid electric vehicles**
Netherlands	8,589	991
Spain	4,013	3,516
Austria	5,431	1,721
Portugal	1,872	2,552
Finland	502	2,509
Denmark	654	563

Source:https://www.eea.europa.eu/data-and-maps/indicators/proportion-of-vehicle-fleet-meeting-4/assessment-2

Sales of PHEVs increased by 35 % in 2017 compared with 2016 and PHEVs comprised 0.8 % of total new passenger car registrations in the EU-28 in 2017. The United Kingdom tops the rankings with 35 175 PHEVs sold in 2017, followed by Germany with 28 618 and Sweden with 15 947. Austria was in the top 12 ranking countries in EU for having new electric vehicles.

Comparative results and transfer possibilities from Vienna to Prague as a primarily analysis data on E-Mobility

Austria [7]

Austria considers, in the system electromobility, the user-friendly development and integration of vehicles and demand-oriented infrastructures, their enhanced energy efficiency, as well as the increased use of cost-efficient renewable energies as contributing to the reduction of emissions caused by transport. It is the overall system electromobility, from research and development, marketable products and services, the generation of energy, automotive technology and components, energy storage, customer-oriented charging infrastructure, ICT systems, and smart-grid integration, to the national inclusion in intelligent transport and energy concepts, the performance of public transport and the energy supply that is taken into consideration her, with international alignment being fundamental.

Austria, therefore, pushes the development of clean, at least partly electrified vehicles for individual and commercial motorised transport, as well as smart integration in innovative mobility features and services. All partly or fully electrically powered means of transport, such as passenger cars, commercial vehicles, busses and trains, especially battery electric

[7] https://www.bmvit.gv.at/en/service/publications/transport/downloads/electromobility_implementation.pdf

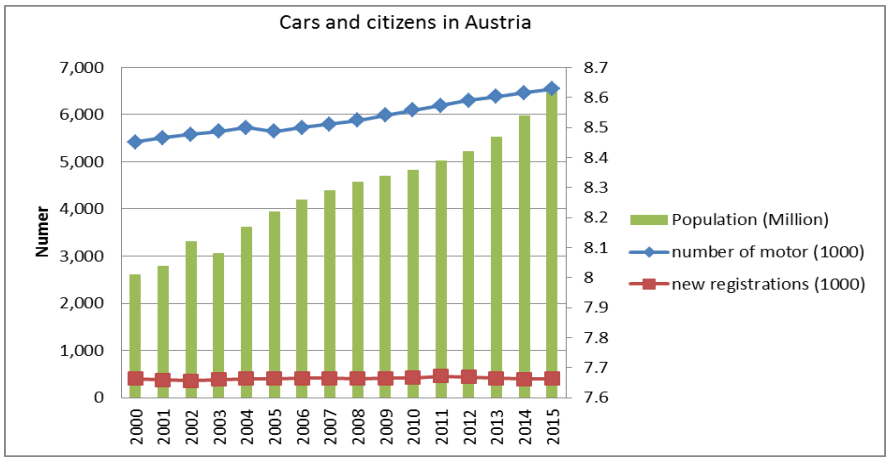
vehicles (BEV), range-extended electric vehicles (REX/REEV), plug-in hybrid electric vehicles (PHEV), and also fuel cell hybrid electric vehicles (FCHEV) come in here. Additionally, there are pedicels, e-bicycles, e-scooters, and e-motorbikes, also off-road and niche vehicles. In the short and medium term, it is the issue of hybrid vehicles, and also range extender solutions that pose unique challenges and opportunities.20

In Austria, an affordable and intelligent future mobility system must contain, as a central component, approaches to an environment-friendly, resources-saving individual mobility, a well-developed public transport system, as well as an optimised and inter-modal overall transport system. By using electromobility, the energy efficiency can be significantly increased. Using more cost-efficient renewable energy sources moreover contributes to the reduction of greenhouse gases. The reductions of greenhouse gases and air pollutants achieved are an important contribution to an environment-friendly mobility in Austria.

Infrastructures for electromobility are important both for moving traffic, and for stationary traffic, as well as the connection with other means of transport or systems. Charging infrastructures for the stationary individual motorised traffic are considered to be relevant.

The popoulation and car population in Austria are still in the in creasing trend in the same pattern. Figuure 4 shows number of cars and citizens in Austria are incresing since the year 2000. The new car registration per 1000 of person is slightly osilation. Overall, Austria passenger transport is still focusing on road tansport is a mian mode of transport.

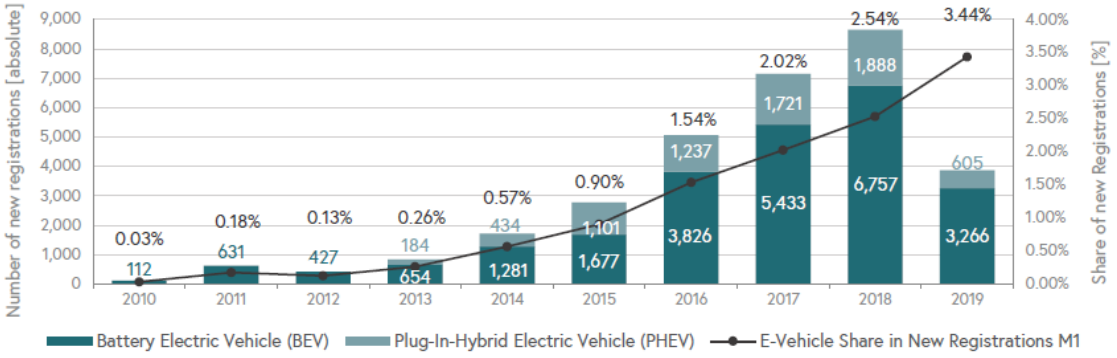
Figure 5 Cars and Citizens in Austria



Source: World Bank, Statistic Austria, 2019

Overall, the cars population has increasing according to the population consensus of Austria See Figure 5 By the E-mobility trend in Austria as shown below about the new vehicles registration as EV.

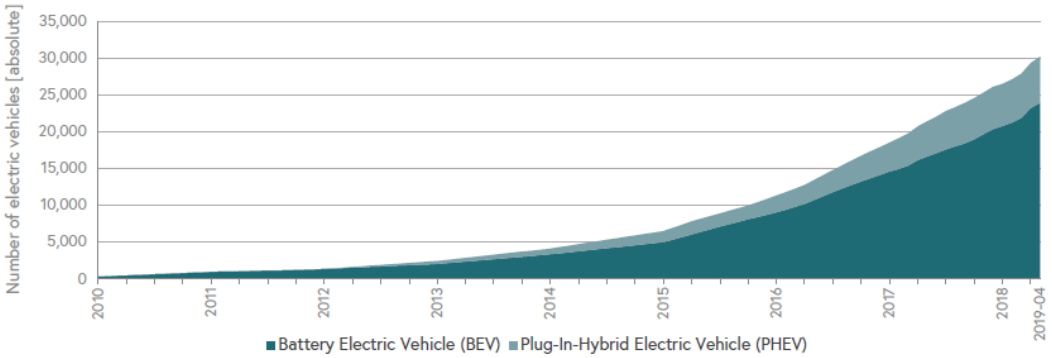
Figure 6 New Electric Vehicles Registrations M1 and their share relative to entire new M1 Registration



Source: Statistics Austria; Data status: 31.12. of the corresponding year respectively 30.04.2019; Hydrogen vehicles are not included in this illustration for illustrative purpose; Illustration: AustriaTech

According to the data,from January to April 2019, 3,266 BEV, 605 PHEV and 6 FCEV were newly registered. Compared to April 2018, new registrations of BEV increased by 32%, PHEV new registrations dropped by 10% and FCEV registrations rose from 0 to 1 unit. (See Figure 7)

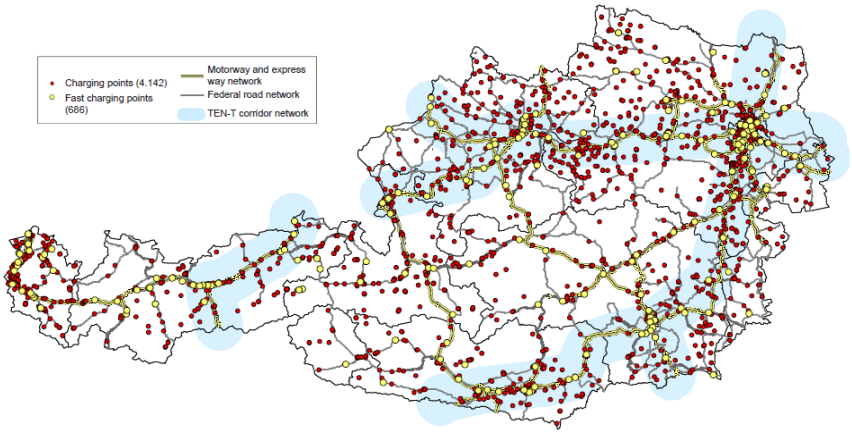
Figure 7 The accumulated number of electric vehicles



Source: Statistics Austria; Data status: 31.12. of the corresponding year respectively 30.04.2019; Hydrogen vehicles are not included in this illustration for illustrative purpose; Illustration: AustriaTech

Figure 8 shows that while the number of battery electric vehicles rose moderately between 2010 and 2012 (approximately 1,400 in 2012), the number of electric vehicles has risen sharply since then, including in April 2019. As of the end of April 2019, 30,304 electric vehicles were on the roads of Austria, corresponding to a share of the total population of 0.61%.

Figure 8 shows publicly available normal and fast charging points in Austria



Source:
https://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/oesterreich2018_en.PDF

The map shows publicly accessible charging points (4.142 charging points and 686 fast charging points) according to the Directive 2014/94/EU. The map is based on data from the charging infrastructure platform (See more information on http://e-tankstellen-finder. com.) Charging points are illustrated in red and fast charging points (> 22 kW loading capacity) in yellow. TEN-T corridors are signed in light-blue. Besides the publicly accessible charging points according to the Directive 2014/94/EU, there are 16 Tesla charging stations with 147 charging points (According to the Tesla Homepage, October 2018). [8]

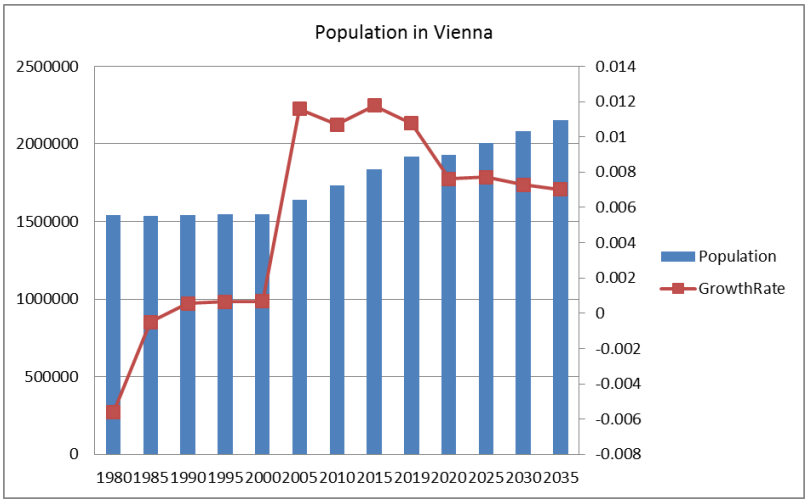
Due to the lack of an official Austrian register for charging points a guarantee for completeness and accuracy cannot be given. The majority of the Austrian fast charging infrastructure is multi-standard. Each fast charging station has two or three charging points depending on the method of counting.

Vienna

Vienna has evolved from an aging, shrinking city to a young, growing metropolis during the past decades because of the influx of migrants. Despite the assumption of further migration gains and the cities relatively young structure (in 2018), it must be assumed that demographic aging will gather some pace in the coming years and decades. Population development in the municipal districts; the more populous municipal districts of Vienna will experience relative population increases surpassing the projected growth at the city-level for the next 20 years. The strongest increases (+16 % and more) are expected.[9] This is the reason for the city planner, particular in transport system should be considered in the future. (See in Figure 8)

[8] https://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/oesterreich2018_en.PDF
[9] Vienna in Figures Population Projection 2018 — Summary 2018

Figure 9 Shows Vienna Population and growth rate



Source: Worldpopulationreview.com, 2019

E- Mobility in Vienna [10]

Vienna has strong policy on the transportation. Under the commitment of "Active Mobility" direction of the city makes Vienna has an outstanding policy on the urban planning. The lesson learnt from Vienna is very clear that the city plans for moving people, supporting climate friendly and less pollution.

Motorised traffic causes roughly 40 per cent of CO_2 emissions in Vienna. Vienna is a city with a longstanding e-mobility tradition due to the fact that electricity powers a large portion of public transport (suburban rail, underground, trams and city buses). In motorised individual transport, there have been recent moves towards electric cars and motorcycles as well as e-bikes. There is also hope that, apart from electric-only cars, plug-in hybrid vehicles, which offer a significantly extended driving range, will become more widespread. Virtually all large automobile manufacturers have announced that electric cars or plug-in hybrids will be added to their product range in the years to come. The future of urban mobility is turning into a great challenge for modern metropolises. It touches many areas, from urban planning to transport policy, from energy and environmental aspects to economic factors. As an environmentally friendly, socially and economically equitable urban transport system is made available, individual mobility needs have to be taken into consideration and new types of mobility must be combined with existing modes. E-mobility is an opportunity of re-thinking mobility. It should trigger a more flexible approach to diversity in mobility and better interaction of different types of transport modes, i.e. multimodality.

The E-Mobility Strategy presented by the City of Vienna is a document covering urban e-mobility in all its aspects – from infrastructure to electric vehicles and users. It reflects the fundamental approach of the City of Vienna to e-mobility and identifies the goals and proposals for the projects of the next few years.

On the one hand, it is aligned to the frameworks and strategies of the European Union and the Austrian federal government; on the other hand, it is in synchronise with the

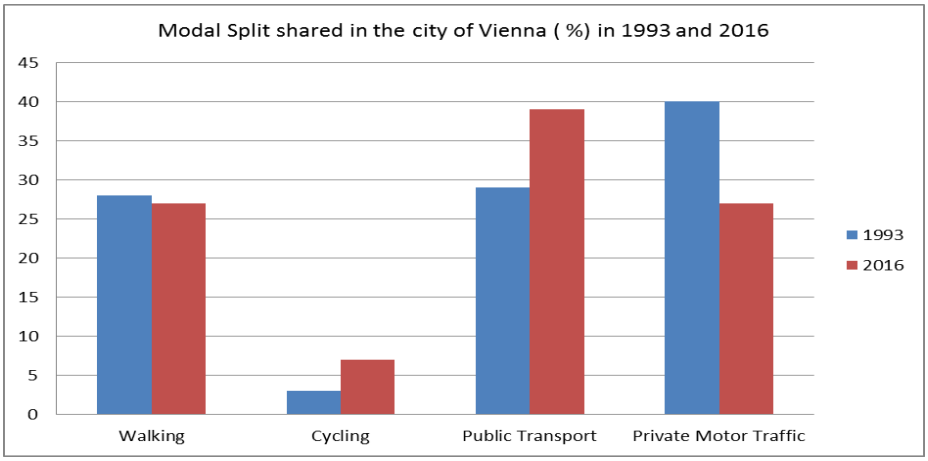
[10] Vienna City Administration, Municipal Department 18 (MA 18) Urban Development and Urban Planning Vienna (2016). The E-Mobility Strategy of the City of Vienna

strategies and objectives of the City of Vienna in the fields of energy, transport and urban planning.Thus, the e-mobility strategy primarily focuses on measures for the electrification of vehicle fleets the installation of the required charging infrastructure.

The fundamental transport policy related objectives of the City of Vienna, such as “the city of short distances”, a lower percentage of trips by motor vehicle, priority to eco-mobility and the reduction of noise and exhaust emissions, are top of the list. According to the STEP 2025 Urban Development Plan and the Urban Mobility Plan, 80% of all trips in Vienna are to be done by public transport, cycling or walking while the share of motorised individual traffic is to decline to 20%. It is expected that the total number of passenger cars in Vienna will decrease slightly in spite of the population growth.

The population projection in Vienna found that total population is continuing increase, but the growth rate will decline from the 2020. This projection has a strong recommend that the city of Vienna needs to plan for the increasing number of resident in the future. The transportation is playing important role for creating city liveable.

Figure 10 Shows shared of modal split in Vienna in between 1993 and 2016



Source: www.statistik.wien.at, 2018

Considering on the modal split in city of Vienna, found the interesting figure that shown in Figure 9. The public transport has risen significantly while private motor traffic has declined from the year 1993 to 2016.

Table 4 Private traffic of Vienna in 2017	
Electric cars	1,532
Bicycle paths and lanes	1,379 km
Private motor vehicles	701,657

Source: www.statistik.wien.at, 2018

Following the statistic of Vienna, Electric car has counted as one of indicator for the city. Figure shown in Table 4, in 2017 number of EV was 1,532 cars, with expectation that number will increase significantly in future.

City of Vienna E-mobility Strategy [11]

1. **Expanding charging infrastructures**

Part of the charging infrastructure expansion falls within the remit of the City of Vienna. By supporting expansion activities or adopting related legislation (e.g. the Vienna act governing indoor carparks, which already requires empty cable ducts to be provided for future charging stations in new carpark buildings), the City can pave the way for progress.

2. **Expansion and Fleet electrification**

This is the cooperative activities from government and business to develop and promote the E-mobility in the city along together with the charging stations as an infrastructure development.

3. **Integrate solution for private and business customers**

Electric vehicles are the environmentally friendly and efficient alternative when it helps city of Vienna reach the target for reducing CO2 emission. The great benefit of electric vehicles is that passengers and goods can be transported with zero emissions, low noise levels and more efficiently (due to a better performance coefficient) as well as more economically, thanks to independence from rising fossil fuel prices.

4. **E-Taxi**

The use of electric vehicles will become another alternative to cars with conventional propulsion systems in taxi operations in the near future. When calling a taxi, customers ever more frequently ask for an “environmentally friendly” vehicle, and they look for the companies offering these.

5. **Public transport**

Rail-bound public passenger transport is the most environmentally and city-friendly transport mode in the e-mobility context. Wiener Linien, the Vienna public transport operator, is testing several hybrid and electric buses in the inner-city area to see how the innovative and environmentally friendly propulsion systems do on a day-to-day basis.

6. **Support Research and Development**

Researchers in Vienna – both in the academic and the corporate worlds – are bringing ground breaking innovations to e-mobility. This is the know-how which the City can build on; it will support further development, with a special focus on enhanced cooperation between businesses and research institutions.

7. **Mobility Labs**

Since February 2015, the research project “e-delivery on demand” has been up and running as a true showpiece of “Transform+”. The aim is to develop and implement a needs-based and cost-effective model for the pooling of logistics using small commercial vehicles with electric drives. Apart from cost savings for users, the pooled use of electric vehicles offers a significant added benefit through reduced emissions.

[11] Vienna City Administration, Municipal Department 18 (MA 18) Urban Development and Urban Planning Vienna (2016). The E-Mobility Strategy of the City of Vienna

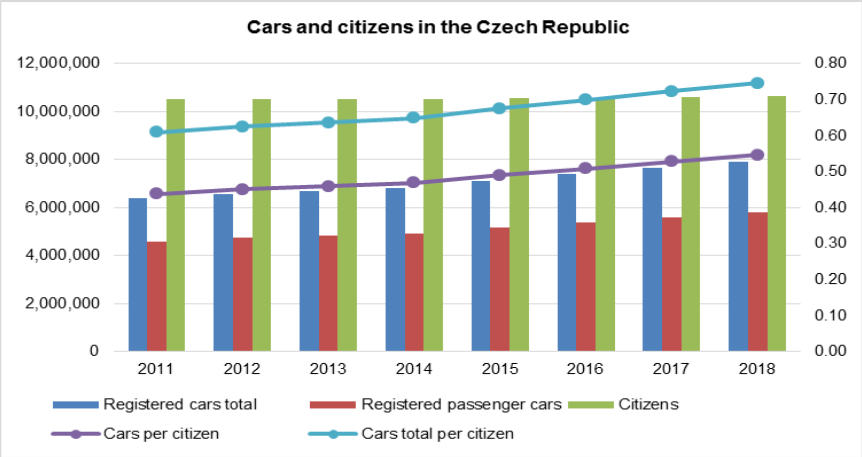
8. Awareness raising and education training

Potential users are often reluctant because they lack knowledge and information about e-mobility. The outcome will form the basis of action to be developed, co-designed and launched with cooperation partners in continuing education and training.

Car fleet in the Czech Republic

Both absolute as well as relative numbers of cars in the Czech Republic is rising. Average number of vehicles per capita is on all time high and it seems that the trend might not stop any time soon.

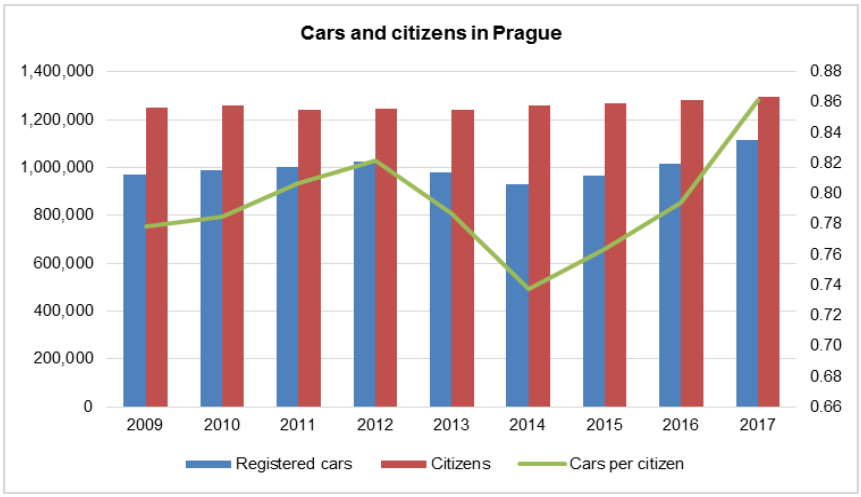
Figure 11 Cars and citizens in Czech Replublic



Source: https://vdb.czso.cz/, 2019

Situation in Prague does not differ at all. It basically follows the same trend.

Figure 12 Cars and citizens in Prague



Soucre: http://www.praha.eu/jnp/cz/doprava/automobilova/statistiky_ridicu_a_vozidel/statistika_registru_silnicnich_vozidel/index.html,2019 and https://vdb.czso.cz/, 2019

The numbers are for illustrative purposes only; the methodology of calculation was changed several times during this time series.

Promotion of E-mobility in the Czech Republic

The promotion of the E-mobility is set in the national context in the Czech Republic. The National action plan[12] includes several measures which should directly and indirectly promote roll up of electric mobility in the Czech Republic. It is divided into several part fostering mainly:

- Easier rollout of charging stations
- Stimulation of demand for electric vehicles
- Better perception of E-mobility on side of potential customers
- Improve conditions for business related to E-mobility
- R&D in area of alternative fuels
- Measures to better the structure of car fleet

Even though the measures listed are very broad, several parts are yet to be implemented and are just staying as proclamation in the national action plan.

Further there is several subsidy programs for purchases of electric vehicles. These are however intended for business, and public administration. For public administration there are targets for alternative vehicles.[13]

There are currently no direct incentives for citizens as such. It is nevertheless intended to subsidy such purchases in the future as well.[14] The support for operating vehicles is made by wave of transport tax and slow rollout of other measures which should decrease operating costs of electric vehicles.

Promotion of E-mobility in urban areas - Prague

Although there are several programs which do focuses on increase used of electromobility in the Czech Republic, measures seem to not influence the actual situation?

Municipalities generally do have several possibilities to promote their intended goals as well. Nevertheless, the situation in Prague is not much more positive towards E-mobility. The only measure which was implemented in Prague relates to parking possibilities. That is generally restricted based on residency of citizen in each Prague district. Electric vehicles (if registered) do not follow this limitation and are able to park anywhere in the center of Prague.[15]

Lack of instruments and political support

The regulatory framework and political interventions can radically change and improve conditions for E-mobility. On bigger scale it can be mainly subsidies for purchase, recharge stations, recharging it, tax exemptions, requirements for new buildings to include recharge stations, special parking spots, special lanes on street, support of R&D and much more.

[12] NAP ČM; MPO 2015
[13] (MPO 2018)
[14] VKR, 2018
[15] Magistrát hlavního města Prahy, 2017

Many of the most influential measures are inherently easier implemented on state level. But there is a lot a municipality can do. Urban planning is in direct supervision of a city hall, yet there has not been done a lot in this respect. The only measure which has been successfully implemented in Prague is free parking area. And that is not a lot.

It is clear that for a general customer the decisive factor is mainly price (for purchase as well as for subsequent operation). However, there is a lot what city can be done to nudge the citizens for use of electric vehicles even though it might be more expensive. Cities can influence the rollout of alternative vehicles. Although on a national level Czech Republic can be considered as a relatively lower GDP region, Prague itself have more possibilities than the rest of the country, and not only financial. The mind set and voting patterns in Prague are different. And high-level view would suggest that Prague is lagging behind its potential and there is a lot what could be done to improve.

Table 5 Analysis on policy statement on E-mobility

Level	Environmental	Health	Pollution	Emission	Facility improvement	Optimization on transport systems	Market Sevilance	Cit Urban planning
EU	√	√	√	√	√	√	√	√
AT	√	√	√	√	√	√	√	√
CZ	√	√	√	√	√	Not clear	Not clear	Not clear

Source: Analysis by Authors

The EU – LEM underlines the fact that electric mobility is a solutions based on sustainable energy sources afford grate potential for de-carbonizing transport, considers, however that optimization of the technology improved and large-scale provision of infrastructure facilities are unlikely before 2030 , which calls for technology innovation.

The analysis in EU context, Austria (used Vienna as a case) and Czech Republic resulted that climate change issue is used as a main target for policy direction, while environmental and health issure are using to provide policy statement respectively. Transport infrastructure development deficiencies are mentioned in policy thate shown very clear in EU and Austria while, these issues need to be improved in the future planning for E-mobility promotion in Czech Republic.

Conclusions

To make electric mobility wide spread possible (and thus also change the mobility options) it is necessary to change the infrastructure of the cities, mainly with respect to charging options, electricity grids etc. It is up to city authorities to shape the environment so that all possible benefits are captured. Rightly set up policy can have fiscal, social and environmental benefits. But it is unlikely that the positive change will happen as quickly without any proactive policy.

Therefore, impact of transport policies in urban area can lead to e.g.:

- Increasing available travel options (eg. Carsharing , E-mobility on variety of public transports)
- Cutting transport costs for passengers (variable costs for electric vehicles should be lower)
- Better conditions for walking or cycling (the policy can decrease the number of vehicles in the center, both operating and parked, and change the urban planning in general, therefore walking or cycling might become more attractive)
- Removing „barriers“ to the place of cars (parking a car in city center is an issue, with increased car sharing and new electric infrastructure this might be less of a problem)
- Decreasing emissions in city centers (e-mobility is emmission free)

Vienna has a very clear vision for leading the city to E-mobility friendly while Prague is on the development stage. However, as a historical city pattern, these two cities have potential to promote E-mobility as the main stream of transportation system in the city.

The main point is the infrastructure need to be planed and developed for promoting users friendly that can make the achievement on low carbon transport in the future.

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