Electric Mobility Action Plan

Interreg
CENTRAL EUROPE
European Union
European Regional Development Fund

LAirA

LAirA is financially supported by the European Union's Interreg Central Europe programme, which is a European cohesion policy programme that encourages cooperation beyond borders. LAirA is a 30-months project (2017-2019), with a total budget of €2.3 million.

LAirA PROJECT 2019 COPYRIGHT

AIRPORT REGIONS COUNCIL

Designed by Airport Regions Council

airportregions.org

info@airportregions.org

Table of contents

Project background and programme context

Project objectives

LAirA addresses the specific and significant challenge of the multimodal, smart and low carbon mobility integration of airports in the mobility systems of Functional Urban Areas (FUAs) of Central Europe (CE). Airports are key assets of CE FUAs and important transnational transport gateways for CE citizens. The magnitude and growing trend of air traffic (on average 10% per year in the EU) requires actions for the improved and sustainable landside accessibility of FUAs to airports.

LAirA's ambition is to reduce the energy use and the negative environmental impacts of transport activities in central-European urban centres and their hinterlands by provoking a change of mobility behaviours of passengers and employees of airports. By building novel strategies that are available for public entities, low carbon mobility planning should be improved. The 56 million passengers and 39,000 employees of the airport systems in the FUAs of Vienna, Budapest, Warsaw, Milan, Stuttgart, Dubrovnik and Poznan are addressed by the LAirA developments. LAirA shall develop the capacities of public entities – local and regional authorities and airports - that jointly plan and implement low carbon mobility solutions.

A transnational and innovative comprehensive approach is used integrating seven key thematic areas:

- **Electric mobility,**
- **Air-Rail links,**
- **Walking & cycling,**
- **Shared mobility,**
- **ITS,**
- **Wayfinding,**
- **Road Public Transport.**

LAirA defines in a transnational policy learning dialogue the action plans for low carbon mobility of airport passengers and employees, taking into consideration multiple types of interventions (the seven LAirA thematic areas) not only related to public transport (competence of authorities) but also to further integrate other low carbon mobility solutions (e.g. e-mobility, car sharing).

Strategies for low carbon integration of airports in FUAs are defined in a governance process involving airports, authorities, agencies, transport providers, associations & nodes. WPT2 focuses on action planning low carbon mobility services & changing behaviour for low carbon airports accessibility in FUAs. The expected output is a transnational Action Plan for Multimodal, Smart and Low-carbon Accessibility in Airport FUAs.

Thematic Focus: E-Mobility at LAirA Airports and FUAs

Definition

Within the LAirA project, the topic of e-mobility developments covers the possible landside airport areas and the extensions and connections to the airport FUAs, but not the airside areas, however in some cases there could be a need for a simultaneous development of both airside and landside e-mobility.

E-mobility is a complex field and definitely more than simply electric cars. In case of Airports, various developments are needed to successfully implement e-mobility developments. Therefore in this study e-mobility is approached from most development angles significant for an airport ranging from planning and design until implementing complex projects, which are basic conditions and resources to have in order to be able to plan e-mobility developments at airports.

The EU and national policies and strategies are clearly stating that transport has to use less and cleaner energy, better exploit a modern infrastructure and reduce its negative impact on the environment and key natural assets like water, land and ecosystems, by reducing the use of petrol and diesel cars in cities by half by 2030, phasing them out completely by 2050 and achieve CO2-free city mobility by 2030.

Therefore, new transport patterns must emerge, according to which larger volumes of freight and greater numbers of travellers are carried jointly to their destination by the most efficient (combination of) modes. Individual transport is preferably used for the final miles of the journey and performed with clean vehicles. Information technology provides for simpler and more reliable transfers. All these point to the need of using electric/clean vehicles.

In the age of Mobility as a Service (MaaS)[1] airports need to be connected to cities and regions by different transport modes (car sharing, taxi, bus, rail, cycle and other mobility services) to successfully compete and grow business. In 2017, global air traffic passenger demand increased by 8.1 percent on the year before, 2018 traffic is projected to grow another seven percent. With more people travelling to and from airports, road access becomes more congested and car parking space more scarce and expensive. Worrying about road congestion and finding car parking space significantly increases passenger stress level. Airports Council International (ACI) Best Practice Ground Transport report found that passengers that use public transportation tend to be more satisfied than those that use private transportation to access airports. This is true for both business and leisure travellers. Rail and subway get the highest score, whereas car and taxi get the lowest scores on average. This defines a development path that is needed to overcome these challenges: electric vehicles and smart city developments could offer an additional service to fill the market gaps of current mobility solutions available at most airports.

This thematic report focuses on action plans from project partners to introduce landside e-mobility developments as part of the wider LAirA initiative.

1 Mobility as a Service (MaaS) is the integration of various forms of transport services into a single mobility service accessible on demand. To meet a customer's request, a MaaS operator facilitates a diverse menu of transport options, be they public transport, ride-, car- or bike-sharing, taxi or car rental/lease, or a combination thereof. For the user, MaaS can offer added value through use of a single application to provide access to mobility, with a single payment channel instead of multiple ticketing and payment operations. (Source: MaaS Alliance)

Trends across Europe

Analysing the electricity generation related CO2 emission intensity of the participating countries, there is a declining trend in all of them, as well as in the European Union. In Austria, the value was already relatively low in 1990 (241.9 grams/kWh), but it has been reduced over the years (2016: 85.1 grams/kWh). Although the electricity generation related CO2 emission intensity is still relatively high in Poland (2016: 773.3 grams/kWh), electricity production became significantly less carbon intensive compared to 1990 (1235.6 grams/kWh).

The International Energy Agency has published a review (Global EV Outlook 2018), revealed that electric vehicles have only a narrow market share in the global vehicle fleet. Around 40% of the global electric car fleet is in China, where the number of electric cars on the road surpassed 1 million in 2017, while the European Union and the United States each accounted for about a quarter of the global total. By far, Norway has the world's highest share at 6.4% of electric cars in its vehicle stock. While the number of electric cars is notably on the rise, only three of the EVI member countries have a stock share of 1% or higher: Norway (6.4%), Netherlands (1.6%) and Sweden (1.0%). According to the European Automobile Manufacturers' Association, the market share for new electrically charged cars will range from 3 to 10% by 2020 to 2025, depending on how quickly the challenges can be addressed[1].

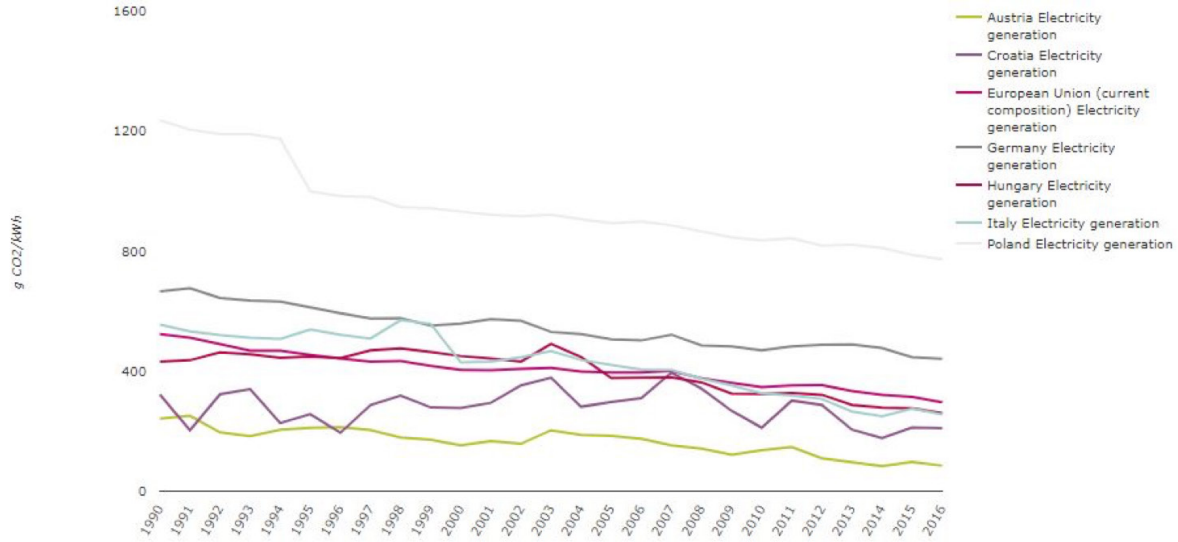


Figure 1. Electricity generation - CO2 emission intensity, 1990-2016
Source: European Environment Agency

1 FIA: Towards E-Mobility – The Challenges Ahead

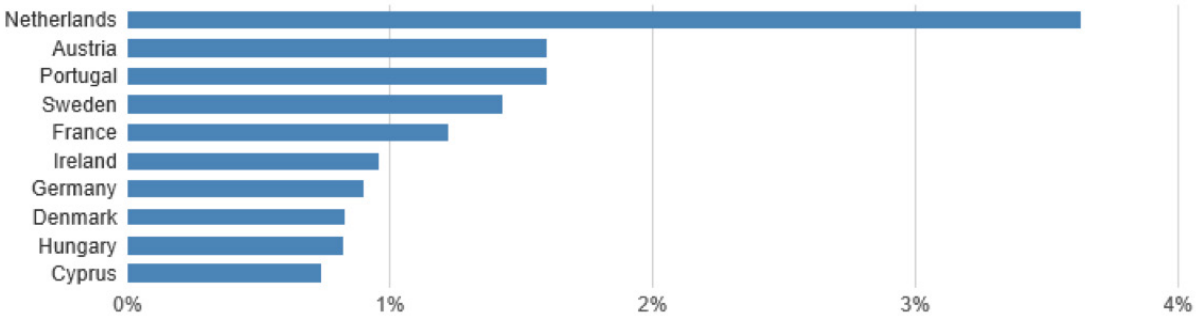


Figure 2. Top 10 PEV (M1) market share Countries in the European Union - BEV, 2018
Source: eafo.eu

Among PEV (plug-in electric vehicle) M1 (passenger cars) market share, the proportion of BEV (battery electric vehicle) has a small value. In 2018, the Netherlands had the highest ratio, all other countries are below 2%. Austria and Hungary are also among the top 10 European countries, however, the proportion of the latter does not reach 1%.

Regarding new BEV M1 registrations, there is a continuous tendency to emerge in the European Union (note: 2018 is not a full year). Growth is due to, among other things, the developed incentive systems, the introduction of new electric car models and the progressive build-up of the charging network.

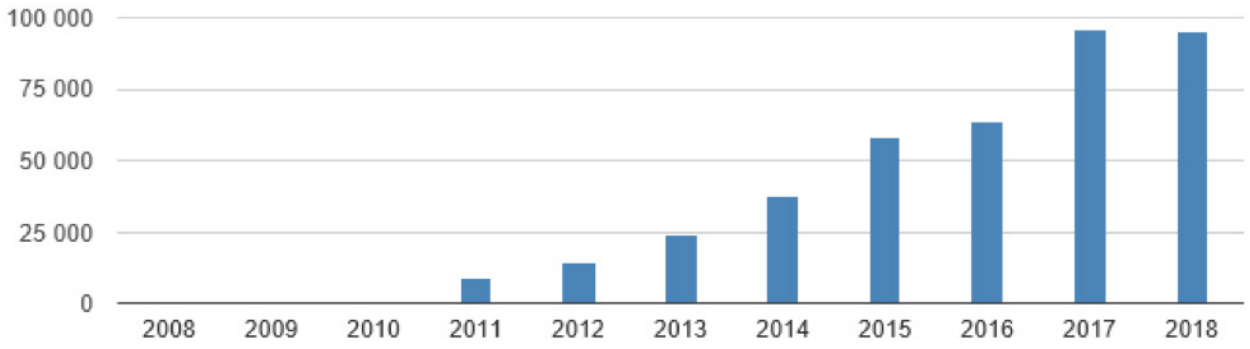


Figure 3. PEV (M1) new registrations in the European Union - BEV, 2008-2018
Source: eafo.eu


ELECTRIC
VEHICLE
CHARGING

E-charging infrastructure

Sufficient accessible charging infrastructure is a key enabler for the accelerated uptake of electric cars. The current and planned future roll-out of EV charging infrastructure in European Member States had been submitted to the Commission as part of the implementation of the Alternative Fuels Infrastructure Directive at the end of 2016[1].

According to the Directive, EU Member States are required to implement common standards, including a common plug for electric vehicles, and roll out infrastructure for alternative fuels.

Country	Charging Power	kW	# charging location
Austria	Normal Power	<= 22	3429
	High Power	>22	699
	Totals		4128
Croatia	Normal Power	<= 22	422
	High Power	>22	88
	Totals		510
Germany	Normal Power	<= 22	22314
	High Power	>22	3848
	Totals		26162
Hungary	Normal Power	<= 22	500
	High Power	>22	80
	Totals		580
Italy	Normal Power	<= 22	2829
	High Power	>22	607
	Totals		3436
Poland	Normal Power	<= 22	470
	High Power	>22	212
	Totals		682

Table 1. Total number of PEV charging positions (based on data available in November 2018) Source: eafo.eu

1 https://ec.europa.eu/transport/themes/strategies/news/2016-07-20-decarbonisation_en

The Member States aims and policies[1] differ in terms of supporting alternative fuels, but 10 Member States (Austria, Denmark, France, Finland, Sweden, Germany, Netherlands, UK, Ireland, and Luxembourg) clearly prioritize electric mobility. Three countries (Italy, Hungary and Czech Republic) have ambitious goals for the roll-out of natural gas fuelled vehicles. Three countries have proposed extremely ambitious estimates for future number of EVs on the road by 2020 (Germany, France, Austria) given there are only 24+ months of sales and are unlikely to achieve their goals, given that they could only achieve their plans if the number of sold EVs will increase considerably over the next ca. 24 months.

Recent charging points installation figures indicate that there are more than sufficient charging points installed in the EU[2]. The European Commission recommends one charging point for each 10 EVs, but a number of countries still lag behind this number. National plans for rollout of public charging infrastructures by 2020 EU-wide are also expected to keep pace with the anticipated growth in the number of vehicles. There will also be sufficient fast chargers alongside the principal highway routes with at least one fast recharger every 40 km. Accordingly, it is not likely that there will be any widespread shortage of recharging points if Member States deliver on their plans, according to the EU. However, there may be local areas of over - and undersupply from two different perspectives. The example of Oslo shows when the need for e-chargers is so high due to the high number of e-cars, that the availability of public e-charging is compromised[3], while at other areas, such as in Central-Eastern Europe, public e-charging is challenging as most e-chargers are located in smaller downtown areas of regional and county capitals.

The EU aims for the deployment of 8 million electric vehicles until 2020. Directive 2014/94 obliges the Member States to deploy publicly accessible e-charging systems, but national aims differ[4].

Austria: Electric Mobility Model Regions Program

The federal Ministry of Transport, Innovation, and Technology (BMVIT) is responsible for planning, financing, and establishing infrastructure fore-mobility. The Electric Mobility Model Regions Program aims for the progressive installation of charging infrastructure, the supply of renewable energy, and the development of new business and mobility models. Other initiatives like for example the Funding Programme “Zero Emission Mobility” are also contributing to the further development of e-Mobility in Austria[5].

Croatia: More charging stations

As the number of EVs on Croatia’s roads is growing, so is the country working to develop the appropriate infrastructure. The director of Croatia’s Environmental Protection and Energy Efficiency Fund (EPEEF) announced that EPEEF will co-finance these projects in 2018 as well[6]. According to EAFO, Croatia has had around 510 EV charging stations in November 2018.

Poland: Programs for installing chargers

According to the new legislation (Act on Electric mobility and Alternative Fuels), a building permit will not be required for charging stations or charging points. Likewise, the Act sets forth that the charging of electric vehicles should not be regarded as a sale of electric energy within the meaning of the Energy Law and, consequently, licences for the sale of electric energy will not be required[7].

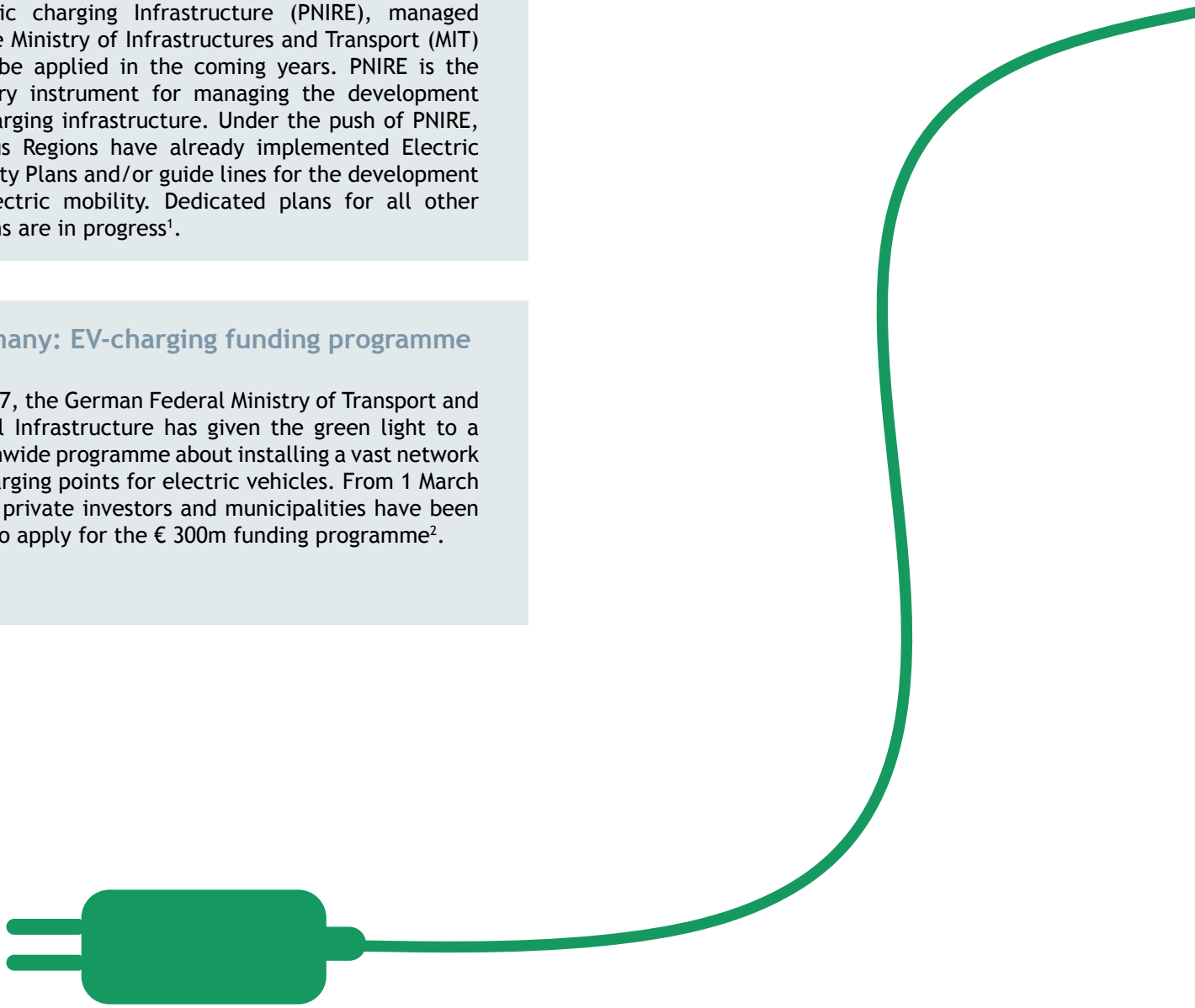
1 https://www.transportenvironment.org/sites/te/files/publications/Emobility%20Platform%20AFID%20analysis.pdf
2 https://www.transportenvironment.org/sites/te/files/Charging%20Infrastructure%20Report_September%202018_FINAL.pdf
3 https://totalcar.hu/magazin/hirek/2017/09/21/norvegiaban_annyira_sok_lett_a_villanyauto_hogy_nem_birjak_toltovel/
4 https://www.ifri.org/sites/default/files/atoms/files/edito_e_mobility_faure.pdf
5 https://www.klimafonds.gv.at/wp-content/uploads/sites/6/Leitfaden_Zero_Mobility_Emission_2018_engl_fnal.pdf
6 https://www.klimafonds.gv.at/wp-content/uploads/sites/6/Leitfaden_Zero_Mobility_Emission_2018_engl_fnal.pdf
7 https://energypost.eu/polands-stunning-e-mobility-plans/

Italy: Electric charging points

In 92 Italian provinces there is at least one public charging point, but charging points are concentrated in the main urban areas and cities. The situation is in a continuous progress, as the National Plan for Electric charging Infrastructure (PNIRE), managed by the Ministry of Infrastructures and Transport (MIT) is to be applied in the coming years. PNIRE is the primary instrument for managing the development of charging infrastructure. Under the push of PNIRE, various Regions have already implemented Electric Mobility Plans and/or guide lines for the development of electric mobility. Dedicated plans for all other regions are in progress[1].

Germany: EV-charging funding programme

In 2017, the German Federal Ministry of Transport and Digital Infrastructure has given the green light to a nationwide programme about installing a vast network of charging points for electric vehicles. From 1 March 2017, private investors and municipalities have been able to apply for the € 300m funding programme[2].



1 http://www.ieahev.org/by-country/italy---electric-charging-infrastrure/
2 http://www.eltis.org/discover/news/government-launches-ev-charging-funding-programme-germany

Industrial trends

Hungary

In Hungary, Zalaegerszeg, a test track will be built by the end of 2019, that will support e-mobility innovations of vehicle manufacturers in cooperation with educational and research institutions[1].

Regarding vehicle production, AUDI just started producing electric cars in its Hungarian factory located in Győr, and cooperates in innovation projects with Hungarian research institutions and universities, such as the Hungarian Academy of Sciences and the Budapest University of Technology and Economics[2 3]. In Komárom, electric buses are produced by the Chinese BYD, while the Modulo Medio Electric, an electric bus developed in Hungary by Evopro Ltd., is assembled by MABI-BUS Ltd[4].

Poland

The 'One million electric cars in Poland' project assumes that by 2025, there will be a million electric cars on Polish roads, as well as introduces the concept of electrification of public transport. These projects are of key importance for the growth of innovation in the Polish economy.

In addition - these activities will cause surplus energy demands which will allow better utilisation of power generation capacities while at the same time reducing mobility related air pollution, especially in large cities[5]. However, in the case of Poland, this advantage can only be met if the Polish energy mix is less carbon-based.

Polish manufacturing is making its mark in the electric bus market, with companies such as Solaris, Ursus and Solbus. The electric version of the Solaris Urbino 12 won the accolade of bus of the year 2017 at the IAA (Internationale Automobil-Ausstellung) motor show in Germany, the first time a Polish or a battery-driven vehicle won the contest since it was inaugurated in 1989.

Poland's e-mobility ambition is also supported by the presence of global advanced materials company LG Chem which has an EV battery plant near Wroclaw in Poland, currently operating with an annual production capacity of 100,000 batteries. Anticipating a massive shift to electric cars from European automakers during the next decade, LG Chem plans to soon triple the annual production capacity to 300,000 units. In addition, Impact Clean Power Technology, a domestic battery producer, is a major player in e-bus battery production in partnership with key bus production producers, including Solaris[6].

Germany

Germany and German e-mobility producers have ambitious e-mobility plans abroad, especially in the USA and emerging economies. Economic growth, the changing mobility requirements of the younger portion of the population, and the relatively low number of passenger cars per inhabitant is driving demand in the emerging economies. This will allow manufacturers located in Germany to successfully follow their proven strategy of increased imports and on-site production[7].

Croatia

Hrvatski Telekom and Kaufland Croatia installing fast electric vehicle charging stations in Zagreb as part of the project "Comprehensive fast-charging corridor network in South East Europe". This project is co-funded under the EU's Connecting Europe Facility (CEF or Instrument to connect Europe) program, and will enable the development of green corridors of e-mobility in Central and South-Eastern Europe, part of a wider global project for connecting countries from South East Europe. The project is planned to open as many as 69 fast and 4 ultra fast EV charging stations at a total of 31 locations on corridors across Croatia and Romania. The project will last until the end of 2020, while its total value is 4.3 million euro[8].

1 https://zalazone.hu/
2 https://audi.hu/hu/hirek/hirek/reszletek/554_audi_hungaria_25_eve_tarto_sikertortenet/
3 http://old.mta.hu/vi_osztaly_hirei/az-mta-es-az-audi-hungaria-egyutt-fejleszti-a-jovo-autoit-egyuttmukodes-az-alapkutatastol-az-innovacioig-136592/
4 https://rekk.hu/downloads/academic_publications/REKK_Hungary_Energy_Innovation_Report_1207.pdf
5 http://www.emobilitypoland.pl/en/about-the-project.html
6 https://energypost.eu/polands-stunning-e-mobility-plans/
7 Germany Trade & Invest – The Automotive Industry in Germany
8 https://www.t.ht.hr/en/Press/press-releases/4410/Hrvatski-Telekom-has-set-up-the-first-fast-EV-charging-station-at-the-ROX-gas-station-in-Croatia.html

Austria

The automotive industry is one of the top five industrial sectors in Austria. More than 700 companies with an estimated 150,000 to 200,000 employees generate annual revenues of about EUR 21.5 billion. Together with related industries and services, the automotive industry secures employment for some 370,000 people, or close to every 8th job in Austria. According to recent studies, a total of 200,000 electric cars powered by green electricity could be operating on Austria's roads by the year 2020. Top-notch firms in the energy sector as well as industrial companies and research institutions are pursuing a common goal within the framework of the Austrian Mobile Power platform, i.e. to lead Austria into the age of e-mobility. Accordingly, the partners want to invest EUR 50 million by 2020[1].

Italy

Enel X is implementing the Infrastructure Plan it launched in November, 2017. One year later, there were around 1,600 charging stations with Enel technology in Italy and agreements for around 4,300 charging infrastructure elements have been signed with companies, business and local governments[2].

According to a study by a consortium of stakeholders in the Italian mobility and energy sector, coordinated by the European Climate Foundation, Transport & Environment and Enel Foundation, Italy could boost its economy and create 19,225 net additional jobs in 2030 through the transition from a mobility system fuelled with imported oil and diesel to one that is driven by domestically produced renewable energy[3].

1 http://www.investinaustria.at/
2 https://corporate.enel.it/en/stories/a/2018/09/e-mobility-revolution-mobility-electric-italy
3 https://corporate.enel.it/en/stories/a/2018/09/e-mobility-revolution-mobility-electric-italy

Customer habits

According to the Airport Service Quality – Best Practice Report by ACI, on average 37% of European airport passengers choose the private car to get to the airport, which makes it the most popular option (however, it must be added that car usage rate is significantly higher in other regions). Studies show that private car use is still the most common way among the passengers to approach airports. Research suggests that journey time and cost, journey distance and ease of baggage handling are key factors in travel mode choice. Passengers favour using private cars because of the perceived comfort, availability, flexibility, reliability, low marginal costs, ease of transporting heavy luggage and the short door-to-door journey time they provide[1].

In 2018, Budapest Airport conducted a survey to assess its employee mobility habits[2]. According to the respondents, when choosing travel mode, the three main decision factors are travel time, travel comfort and flexibility in time. Although 62% of employees live within cycling distance, more than half of the respondents prefer car in all circumstances, regardless the weather conditions, and they have used the car to get to their workplace in last year. Car usage is followed by urban public transport, railway and regional bus, while cycling and walking, company shuttle, taxi and carpooling are the least popular choices. It can be seen that employee preferences in traveling to the workplace clearly favour the car at the moment.

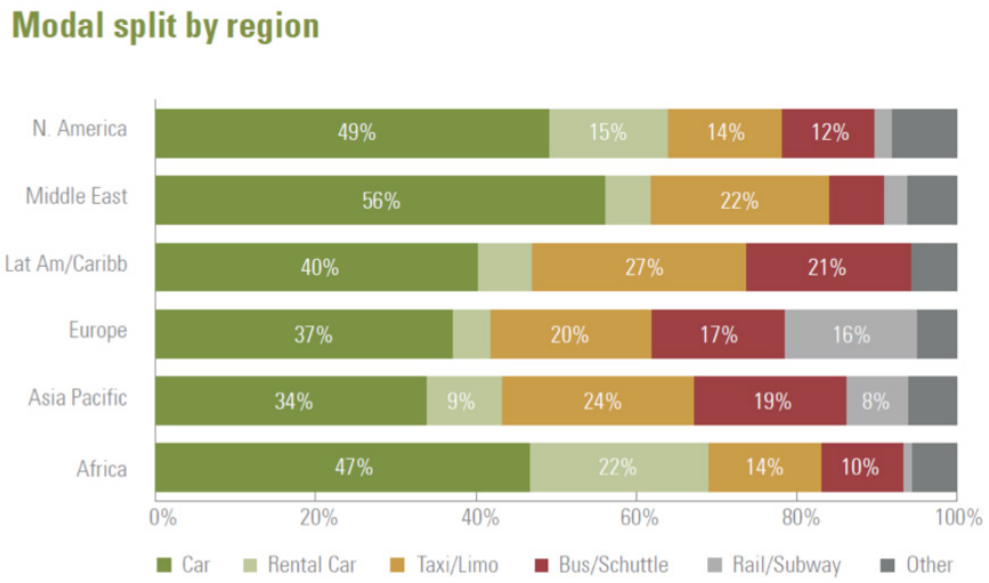


Figure 4. ASQ Best Practice Report Ground Transportation Modal Split by Region

1 https://www.researchgate.net/publication/292770325_Airport_surface_access_management_issues_and_policies
2 https://www.bud.hu/file/documents/2/2724/20180711_laira_greenairport_munkavallaloi_felmeres.pdf

Customer acceptance is a major driver in e-mobility development. If customers accept the new technology, and they consider electric vehicles to be similar or even better than other transportation options, they will move gradually to electric vehicles in their choices. Furthermore, the most relevant issues from the customer's point of view are the following: cost, lifetime, cruising range, access to charging infrastructure, environmental protection, safety, reliability and comfort[1].

Customers are mostly interested in the purchase prices and operating costs: although currently electric vehicle prices are higher than conventional ones, in the longer term, the price surplus could be offset by savings on operating costs. At the same time, with the current price differences the customer needs to use the EV extensively otherwise the payback period of the investment increases over the acceptable timeframe (10 years). It is also true though that lower maintenance costs are not fully factored in by the consumer at the time of purchase[2]. There are also uncertainties in the customer's mind about affordability, efficiency over the long term, durability and warranty, as well as the residual value of the used car. As such, it is hard to estimate the customer's final choice and the aspects that leads to these decisions.

Importantly, the question of cruising range is also a key issue for customers. Although several surveys and studies show that most daily trips are within the range of BEVs, market research shows clearly the existence of 'range anxiety' among customers, leading to practical decisions to limit trips to little more than half the nominal range. Although it would be desirable to change drivers' perception on this issue, it is thought that BEVs will require some sort of range-extending capability before achieving wide customer acceptance. In addition, surveys clearly show that while customers are basically prepared to switch from conventional cars to electric vehicles, they are unwilling to accept any compromise in comfort and technicalities[3].

1 Automotive World: Technology Roadmap – Battery electric vehicles, 2013
2 FIA: Towards E-Mobility – The Challenges Ahead
3 FIA: Towards E-Mobility – The Challenges Ahead

Relevance of topic for airports

Policy background

All projections suggest that transport activity across Europe will continue to grow[1]. From 2010 to 2050, it is estimated that passenger transport will grow by about 42 percent. Freight transport is expected to increase by 60 percent. This makes achieving a mobility system that is sustainable all the more challenging.

Transport represents almost a quarter of Europe's greenhouse gas (GHG) emissions and is the main cause of reduced air quality in cities, which poses a serious threat to public health. Road transport alone is responsible for almost a fifth of total EU emissions and 73 percent of emissions from transport[2].

Unless action is taken to cut its emissions, transport risks becoming the largest source of emissions, offsetting the progress being made in other sectors and jeopardizing the EU's ability to meet its overall emission reduction goals. Decisive action on emissions from transport is therefore essential.

The ambition of low-emission mobility is embedded in the EU's core strategies in this area and especially in the Energy Union Strategy of February 2015, which identified the transition as energy efficient, decarbonised transport sector as of critical importance. This was followed up by concrete measures outlined in the Strategy for Low-Emission Mobility adopted in July 2016. In response to the profound transformations underway in the transport sector, the 'Europe on the Move' initiative presented an agenda for a socially fair transition towards clean, competitive and connected mobility for all, accompanied by a first package of proposals.

White Paper

On 28 March 2011, the European Commission adopted the White Paper entitled 'Roadmap to a Single European Transport Area — Towards a competitive and resource efficient transport system' (the 'White Paper'[3]). The White Paper aims at reducing the greenhouse gas emissions of the transport sector by at least 60% by 2050 compared to 1990.

According to the White Paper, new transport patterns must emerge, according to which larger volumes of freight and greater numbers of travellers are carried jointly to their destination by the most efficient (combination of) modes. Individual transport is preferably used for the final miles of the journey and performed with clean vehicles. Information and smart technology, infrastructural developments provide for simpler and more reliable transfers and transportation, which could contribute to more efficient traffic organization and transportation, less congestion, more information, better service, higher safety and reduced emissions; therefore, compatibility and common standards of traffic and transportation related infrastructure is key for future developments.

As far as infrastructure is concerned, the White Paper aims at establishing a fully functional and Union-wide multimodal TEN-T core network by 2030. Interoperability could be enhanced by innovative solutions that improve compatibility between the systems involved. The White Paper also aims at optimising the performance of multimodal logistic chains, including making greater use of more energy-efficient modes, and the EU offering various funds[4] to set up e-mobility related solutions and infrastructure along the TEN-T network and major transportation routes.

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0675
2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0675#footnote7
3 https://ec.europa.eu/transport/sites/transport/files/themes/strategies/doc/2011_white_paper/white-paper-illustrated-brochure_en.pdf
4 https://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/project-funding_en


201, 202
21
21
22
国際線 乗り継ぎ
International Transfer
到着
Arrivals

The Commission is increasing financial support to leverage public and private investment for the roll-out of Alternative Fuels Infrastructure; up to €800 million is being made available for this purpose[1]. This will be combined with the substantial funds already being devoted to this area under the Connecting Europe Facility and the European Structural and Investment Funds.

This comprehensive strategy for transport seeks to create a competitive transportation system that will increase mobility, remove major barriers in key areas of development, fuel growth and employment by 2050. It is complemented by initiatives, such as:

- Horizon 2020 programme with its support for research and innovation on smart, green and integrated transport;
- Connecting Europe Facility (CEF), which provides finance for 10 transnational transport infrastructure projects;
- Roadmap to a low-carbon economy by 2020 in which transport is a key sector to reach that goal;
- Various energy efficiency measures to reduce Europe's use of primary energy by 20% by 2020.

The White Paper also emphasizes the importance of infrastructural and smart city developments related to mobility. No major change in transport will be possible without the support of an adequate network and more intelligence in using it, which in case of e-mobility calls for e-charger infrastructure and support policies.

According to the strategy established in the White Paper, emissions from transportation will be reduced along 10 very challenging goals, which are designed to guide policy actions and measure progress — including phasing out conventionally fuelled cars from cities by 2050, and a 50% shift in middle distance passenger and longer distance freight journeys from road to other modes by the same date — to achieve a 60% reduction in CO2 emissions and comparable reduction in oil dependency.

Other policy items and considerations

The EU states in the **European Strategy for Low-Emission Mobility**[2] (2016) that transport represents almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities and that Europe's answer to these challenges is an irreversible shift to low-emission mobility in terms of carbon and air pollutants. The EU's ambition is: by 2050, greenhouse gas emissions from transport will need to be at least 60% lower than in 1990 and be firmly on the path towards zero. Emissions of air pollutants from transport that harm our health need to be drastically reduced without delay.

Large part of alternative fuels (including electricity) requires specific infrastructures outside the current refuelling system. The Alternative Fuels Infrastructure Directive[3] addresses the provision of common standards on the internal market, the appropriate availability of infrastructure and consumer information on the compatibility of fuels and vehicles. A methodology for fuel price comparison is being prepared.

Based on this Directive, by November 2016, Member States designed policy frameworks (NFCs) for rolling-out publicly available electric recharging points and natural gas filling stations, and optionally hydrogen filling stations. In order to achieve mass acceptance and deployment of electric vehicles, charging and maintenance infrastructure needs to become widely available throughout Europe. The ultimate objective is to allow an electric car journey across Europe, making electric vehicle charging as easy as filling the tank.

1 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0675#footnote26
2 https://ec.europa.eu/transport/sites/transport/files/themes/strategies/news/doc/2016-07-20-decarbonisation/com%282016%29501_en.pdf and https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0675
3 https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32014L0094

These aims had been strengthened by the EU on 09 October 2018[1] as the EU set a 35% reduction of emission for car manufacturers until 2030. The gradual phasing out of 'conventionally fuelled' vehicles from the urban environment is a major contribution to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution. While some German cities and Northern-Italian Regions already introduced bans for fossil fuel cars[2], other cities are planning to phase out conventional fuelled cars from their centre areas until 2025[3], the Council agreed to adjust the Commission proposal on an incentive mechanism for zero- and low-emission vehicles such as fully electric cars or plug-in hybrid vehicles as regards passenger cars.

The overall aim of the proposal is to contribute to achieving the goals of the Paris Agreement and to reaching the EU-wide 30% reduction target by 2030 compared to 2005 of the non ETS (Emissions Trading System) sector set by the European Commission, which is translated into national targets in the Effort Sharing Regulation.

The proposed measures and targets are based on the 2030 climate and energy framework and with the energy union strategy, which aims at a reduction in transport emissions and energy consumption.

The use of smaller, lighter and more specialised road passenger vehicles must be encouraged. Large fleets of urban buses, taxis and delivery vans are particularly suitable for the introduction of alternative propulsion systems and fuels. These could make a substantial contribution in reducing the carbon intensity of urban transport while providing a test bed for new technologies and opportunity for early market deployment. Road pricing and the removal of distortions in taxation can also assist in encouraging the use of public transport and the gradual introduction of alternative propulsion. The use of electric, hydrogen and hybrid technologies would not only reduce air emissions, but also noise, allowing a greater portion of freight transport within the urban areas to take place at night time. This would ease the problem of road congestion during morning and afternoon peak hours. According to the Committee of Regions, that fleets of vans, taxis, buses are ideal test grounds of ecological and alternative propulsion systems.

LAirA airports should consider, obtain financial and expert resources and apply e-mobility solutions as well to comply with these aims.

1 https://www.euractiv.com/section/transport/news/disappointed-eu-capitals-agree-on-car-co2-cuts/
2 http://urbanaccessregulations.eu/countries-mainmenu-147/italy-mainmenu-81/lombardia/milano
3 https://www.theguardian.com/environment/2018/feb/28/rome-to-ban-diesel-cars-from-city-centre-by-2024-italy

Austria

Tax Benefits

A bonus-malus (tax credit and tax penalty) system was introduced in July 2008 for the acqui¬sition of new vehicles (NoVA - Normverbrauchsabgabe). The purchase of electric vehicles is exempted from the NoVA - Registration tax - which in Austria can increase a vehicle's price by up to a maximum of 16%.

Exclusively electrically-powered vehicles are also exempted from the motor-based insurance. A tax reduction of €300 is applied for vehicles with CO2 emissions lower than 120 g/km.

A further tax increase of the NoVA-Malus applies as of January 1st, 2011:

• Emissions over 160 g CO2/km: €25 tax increase for each additional gram of CO2
• Emissions over 180 g CO2/km: the incremental penalty increased from €25 to €50/g CO2
• Emissions over 220 g CO2/km: the incremental penalty increased from €25/g CO2 to €75/g CO2

This tax will be followed by a further tax increase for each additional gram of CO2 since January 2013, as follows:

• Emissions over 150 g CO2/km: Tax increase is €25 /g CO2
• Emissions over 170 g CO2/km: Tax increase is €50 /g CO2
• Emissions over 210 g CO2/km: Tax increase is €75 /g CO2

Purchase Subsidies[1]

Private customers:

• €3,000 per BEV (€1,500 from the federal government; €1,500 additional rebate by the industry)
• €1,500 per PHEV (€750 by the federal government; €750 additional rebate by industry)
• 2 additional conditions: Purchase price not over €50.000 incl. VAT & minimum electrical range of 50 kilometres (for PHEVs)
• €200 for a Wallbox in one-family-houses and €600 for a Wallbox in multy-family-houses but only with the purchase of an e-car
• €400 for cargo and e-cargo bikes (€200 from the federal government; €200 from sporting goods retailers)
• Additional funding for two-wheeled vehicles (€700 or €1,000, co-financed by the 2wheelers industry with €350 and €500)

Businesses, municipalities:

• €3,000 per BEV (€1.500 from the federal government; €1,500 additional rebate by the industry)
• €1,500 per PHEV (€750 by the federal government; €750 additional rebate by industry)
• 2 additional conditions: Purchase price not over €60.000 incl. VAT & minimum electrical range of 50 kilometres (for PHEVs)
• Additional funding for other vehicle categories, buses, LDV, HDV for businesses (up to €60,000) as well as for charging infrastructure (up to €10,000

Further incentives to enhance the deployment of e-vehicles in Austria are for example: green licence plates for electric vehicles, the extension from permissible total weight from 3.5 tons up to 4.25 tons and the auxiliary sign „Parking, stopping and standing prohibited – except electric vehicles".

1 https://www.bmvit.gv.at/verkehr/elektromobilitaet/downloads/emoboffensive.pdf

Croatia

In 2018, Croatia's Environmental Protection and Energy Efficiency Fund (EPEEF) approved €1.62 million in subsidies to individuals to buy 133 electric cars, one plug-in car, 224 electric bikes, and 56 electric motorcycles.

According to an announcement on the EPEEF's website, an invitation will be issued soon to local governments and other direct and indirect budget beneficiaries to apply for assistance, and to companies and entrepreneurs to apply for subsidies, to set up EV charging stations. The EPEEF will approve co-financing of up to 40% of individual project costs, but no more than HRK 200,000 (around €27,000) per user[1].

Poland

The Polish government has adopted a new law on electric mobility aimed at turning Poland into an e-mobility leader in Europe. The new Act is the first set of rules in Poland on electrifying transport and is intended to promote electric mobility and alternative fuel vehicles. It transposes a key European directive (Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014) on the deployment of alternative fuels infrastructure.

The Act defines basic terms such as charging point, charging station, electric vehicle and alternative fuels. Most importantly, it establishes a framework for building a basic alternative fuels infrastructure (including electric energy, LNG, CNG and hydrogen) and vital administrative benefits for the development of such infrastructure.

Subsidies are on offer for the construction of the charging infrastructure for public transport and charging stations for electric vehicles that are used by the local authorities. The market is already moving: in 2017, the Polish Development Fund (PFR) (along with several ministries, amongst others) signed an agreement with 41 local governments for the purchase of 780 electric buses.

Italy

The National Plan for Electric Charging Infrastructure (PNIRE) was issued by the Ministry of Infrastructures and Transport (MIT) in in 2013, updated in 2014 and, more recently, in 2015: this last version became effective in 2016. The plan dedicates €4.5 million for projects to build public charging infrastructure in the main urban areas with high traffic congestion, about €29 million to incentivize domestic charging, the renewal of fuel stations, private charging infrastructures in public areas, public charging infrastructures.

Looking at the legislation on charging infrastructure, the updated version of the National Plan for Electric Charging Infrastructure (PNIRE) became effective, further the Legislative Decree for the reception of 2014/94/UE Directive, Directive Alternative Fuel Initiative (DAFI), was issued, and finally, the 'Quadro Strategico Nazionale' was adopted: they all together define the national strategy for the widespread diffusion of electric vehicles charging infrastructure. In this strategy, some interesting arguments can be highlighted:

- a target of 4,500-13,000 slow/accelerated charging points and more than 2,000-6,000 fast charging stations on the national territory at 2020 is defined, giving priority to urban areas which belong to metropolitan cities and, successively, suburban areas, extra-urban roads, state roads and highways;
- the 'technology neutral' approach is used as a total strategic vision, able to appreciate the contribution of each fuel type to realize environmental targets;
- it is established that new fuel stations – or the ones under renewal – must provide methane or natural gas and install charging stations for electric vehicles;
- it is established the constraint for Public Administrations to buy at least 25% of methane, natural gas or electric vehicles, when substituting their fleets;
- until 31 December 2017, Municipalities must update their building regulations to meet the requirements of the provision on alternative fuels and, starting from 1 June 2017, new buildings or the ones under significant renovations must provide connections to install charging stations[2].

1 https://balkangreenenergynews.com/croatia-co-finance-installation-ev-charging-stations-2018/
2 http://www.ieahev.org/by-country/italy-policy-and-legislation/

Hungary

In 2015, the Hungarian government adopted the Jedlik Ányos Action Plan, whose general objectives were reducing the environmental impact of emissions, introducing innovative technologies and modernization of urban and suburban traffic. The introduced measures between 2015 and 2017 were the following:

• Introduction of green registration plate for electric vehicles (electric, hybrid, other zero-emission vehicles)
• Free parking for electric cars in the capital and other major cities of Hungary
• Owners of green cars are exempted from various administrative taxes and fees (registration tax, release fee, local vehicle tax, corporate vehicle tax)
• Hungarian government provided direct financial support of 2 billion in 2016 HUF for the purchase of electric vehicles up to 21% of purchase price with an upper limit (1.5 million forints, approx. €4,700). Local governments receive full funding for building new e-charging infrastructure that is supposed to make up a network of charging stations every 80 km in the country[1].

In October 2018, the Innovation and Technology Ministry announced that the former subsidy programme will be replaced by another one with simplified conditions. The 2 billion forints (€6.2 million) funding allocation for the current programme will be topped up with 300 million forints.

Germany

The German Federal Government is subsidizing battery electric and fuel cell cars with 2,000 euros and plug-in hybrids with 1,500 euros. The manufacturers add the same amount again for each purchase. By the deadline of 31 January 2019, however, a total of only 97,645 applications were made for the purchase premium. Of these, 62,912 were for purely battery electric vehicles, 34,690 were for plug-in hybrids and 43 for fuel cell vehicles. Originally, the purchasing premium was intended to increase purchasing numbers to around 300,000 passenger cars. The German government is reportedly considering extending the available time period beyond June 2019[2].

1 http://www.measures-odyssee-mure.eu/public/mure_pdf/transport/HUN18.PDF
2 https://www.electrive.com/2019/02/13/german-govt-considers-expanding-subsidies/

Best practices in and around airports

For a successful e-mobility development, numerous factors and circumstances should be presented. The most important aspects are the following:

• **The airport as a central player in the value chain**. Regarding e-mobility, the airport has a platform role, as it is in a central position in the value chain, and as such can influence mobility solutions end-to-end. The airport may connect the following key stakeholders:

- customers,
- landside mobility providers,
- business partners inside and outside airport areas,
- local/national authorities.

• **Strategy integration**. An integrated strategy can ensure the viability of the business model and provides a higher level of certainty for successful implementation. Some of the stakeholders lack the funds required to instantiate the necessary investments (e.g. purchase electric vehicles), therefore they need the help of an experienced partner to get outside financial support.

• **E-mobility limitations and alternatives**. E-mobility has a high sustainability advantage, however, it can be seen that due to current technological limitations, larger Western airports electrify only a part of their fleet. Since CNG eliminates some of the drawbacks of e-mobility as of now, in Western examples it is used extensively as an alternative solution.

• **Cooperation with landside mobility providers**. Cooperation with, and connection to urban transport service providers is essential for an integrated strategy in leveraging different mobility solutions for different customer segments. Typical Western implementations include transit integration with track-based transportation modes (railway).

• **Leveraging the potential in car-sharing**. E-mobility car sharing services provide flexibility for consumers in two ways: (1) they don't have to make substantial investments and they can still test / enjoy the advantages of electric mobility, (2) car-sharing service would offer nearly as much flexibility to consumers as if they were using a rental car. As such, leveraging car sharing for the advancement of e-mobility is a crucial point in airports' strategy. Given that the length of trips as well as potential end-points can be easily estimated (given that hubs can be established in high-traffic city areas), airports can potentially utilize car sharing efficiently as a point-to-point service.

E-mobility benchmarking in practice: German Airports leading in e-mobility

Hamburg Airport

At the Hamburg Airport, pilot projects, strictly enforced company strategies and the use of innovative new technologies are in focus. Their fleet mostly consists of alternative energy (CNG, LPG, electric, fuel cell, biodiesel) powered vehicles. Approx. 30% of the annual energy need is covered by the airport's own alternative energy power plant. In 2013, the Mobility Concept 2020 was launched, according to which, only purchase of alternative or partially alternative powered vehicles is allowed. Based on this strategy, 50% of the baggage handling vehicles and 100% of the fleet cars, vans and buses will be alternative powered.

Their current vehicle fleet:

• Cars and light commercial vehicles: 65 x natural gas, 2 x LPG, 17 x electric, 1 x fuel cell, 1 x plug-in hybrid
• Trucks and buses: 9 x natural gas
• Special vehicles and baggage tractors: 48 x natural gas, 8 x electric, 1 fuel cell tug
• All diesel vehicles of the airport use biodiesel.

Hamburg Airport

https://www.hamburg-airport.de/en/index.php

Mobility Options to/from the airport:	
Bus	No
Car Sharing	No
Long-distance Bus (Flixbus)	Yes
Long-distance Train	Not at the airport
Subtrain / train	Yes
Taxi	Yes
Rental Car	Yes

Subtrain / train

With the S1 S-Bahn (metro rail network) line, passengers can travel from Hamburg's Hauptbahnhof (central railway station) to the airport and back; the journey takes only 25 minutes one-way, and the service operates every 10 minutes. The station, 'Hamburg Airport (Flughafen)' is directly in front of the terminals and is quick and easy to reach by elevator, by escalator, and by stairs. The U1 U-Bahn (underground rail) passes through Ohlsdorf, a junction station for U-Bahn and S-Bahn lines. From there, the S1 operates directly to Hamburg Airport.

Taxi

Flughafen Hamburg GmbH, the airport operating company, concludes contracts with taxi companies, precisely defining quality criteria. These contracts are open to all taxi operators willing to adhere to the contractually agreed quality standards. Taxi operators who sign the agreement are issued with one entry permit card per vehicle, allowing them to drive into the taxi rank and the boarding zones in front of the terminals. The fulfilment of the quality criteria is regularly checked by Flughafen Hamburg GmbH.

Rental Car

Several vehicle hire companies operate in Terminal 2: Avis, Budget, Buchbinder, Global Drive, Enterprise, Alamo, National, Europcar, Hertz, Dollar, Thrifty and Sixt.

E-mobility - Airport fleet

Half of the airport's fleet to run on renewable energy by 2020 - VIP service already running on electricity. More than half of Hamburg Airport's fleet will be powered by alternative energy by 2020 as part of the Mobility Concept. Standard vehicles such as cars, vans and buses will run entirely on such fuels by 2020. The fleet has already added three new limousines that run on electricity and/or fuel to bring VIP passengers to and from aircraft without causing emissions.

Stuttgart Airport

At Stuttgart Airport, most e-mobility developments are performed via European Union, Stuttgart Regional or Federal Ministry projects, in partnership with R&D institutions and the Stuttgart Airport. The basis of these projects is the strong partnership of the airport with the ground handling firms and the state institutions to form the project consortiums. The federal program entitled 'e-Mobility Showcase' is to create public awareness for electric cars. The Stuttgart Airport participated in this program via their 'eFleet Stuttgart – Flottenp' project and purchased 6 electric ground handling vehicles (pushbacks, conveyor belts, baggage and cargo tugs and passenger buses) and had built 6 charging facilities. The 'Decarbonized passenger transport at European airports' EU CEF project, the airport purchased 6 electric buses (eCobus3000), so their entire bus fleet is electric powered. The project 'Scale-up!' is purchasing 40 electric ground handling vehicles and chargers until August 2019. Also a lithium battery powered baggage tug was purchased via the 'Li-Fleet' project.

Stuttgart Airport https://www.stuttgart-airport.com	
Mobility Options to/from the airport:	
Bus	Yes
Car Sharing	Yes
Long-distance Bus	Yes
Long-distance Train	By the end of 2025
Subtrain / train	Yes

Taxi	Yes
Rental Car	Yes

Bus

The Stuttgart Airport Busterminal (SAB) is located in front of Terminal 4 of Stuttgart Airport. The three lanes include a total of 18 bus platforms, with platforms 1 to 3 serving regional transport.

Several local bus lines are leading to Stuttgart Airport. From the South the Line 828 called "Airport Sprinter" connects Tübingen and other municipalities on the track to the airport. Another bus line from the south is the "eXpresso X3" which operates between Reutlingen and the airport. The "Relex" buses "X10" and "X60" operate tangential between bigger Cities and other important destinations like the university or airport and fair. Thus, these bus lines create direct connections, without going via the main station. The bus lines 122 and 806 operate between the airport and surrounding municipalities.

Long-distance Bus

Besides the local bus transport, also long-distance bus services are connected to the Stuttgart Airport. Providers like Flixbus, Eurolines, ÖBB-Postbus, Deinbus and 60 other companies connect the airport with destinations all over Germany and Europe. There are around 20 domestic destinations and 50 destinations in other European countries offered. National and international long-distance bus services leave from platforms 4 to 18. The bus terminal is just one street away from the airport, meaning that passengers can also use the services provided in the terminal building.

Subtrain / train

Stuttgart Airport can be reached easily and quickly, thanks to excellent travel infrastructure. You can continue your journey to the airport from Stuttgart Central Railway Station (Hauptbahnhof) with the municipal rail lines (S-Bahn) S2 or S3 every 15 minutes.

The journey between Stuttgart Central Railway Station and Stuttgart Airport takes 27 minutes.

Rental Car

Car rental services available at the airport. Companies present are Avis, Buchbinder, Budget, Enterprise, Europcar, Global Drive, Hertz, Thrifty and Sixt.

More alternatives for the near future

In future, there will also be more options for arriving by rail. Alongside the current local train station (S-Bahn) at the airport, there will also be a tram terminal nearby from 2019. The Stuttgart 21 rail project will also see the construction of a station for high-speed ICE trains. All this will be less than 500 m away from the bus terminal, and therefore easily within walking distance.

E-mobility

The airport is accelerating towards climate protection with two reduction targets: they intend to halve their greenhouse gas emissions by 2030 as compared to 1990. By 2050 Stuttgart Airport's operations are to be entirely carbon-neutral.

E-mobility - Airport fleet

By 2020, Stuttgart Airport wants to reduce CO2 emissions from the handling plant by 80% compared to 2009. To achieve this goal, the airport's existing e-fleet will be expanded by 40 additional units within three years (scale-up project). A first phase of the project started in 2013 with only six electric vehicles (Erfleet project).

Munich Airport

Munich Airport aims to become Germany's first climate-neutral airport by 2030. In order to reach this aim, EUR 150 billion will be invested until that time. The Airport cites the Paris Climate Agreement and UN SDS Goals as part of their motivation. As part of its climate protection program, Munich Airport uses alternative fuels from renewable energy sources within its vehicle pool, in order to reduce emissions caused by vehicles. In addition to fuels from renewable raw materials such as bioethanol, 23 cars now also run on biogas. Since 2013, some 32 apron buses (which is over half of all buses) have the 'Blue Angel' eco-label, the sign of particularly low levels of emitted noise and pollutants. The vehicle pool also contains four electric vehicles. The car parks at the airport now have 36 charging points for electric vehicles. Of the 1,250 items of aircraft handling equipment, 270 vehicles, units or machines are already electrically operated. This reduces noise and emissions, and avoids motors idling. Munich Airport also currently operates 84 baggage tugs as diesel-electric hybrid vehicles, which run on electric power alone inside terminal baggage areas. Additionally, around 100 other electric vehicles are predominantly in use inside buildings at Munich Airport and its subsidiaries Cargogate, Allresto and Eurotrade.

The determining character of the developments at Munich Airport is that the airside handling services had been divided into three sub service categories (passenger and aircraft handling, cargo handling, ground handling) and on this basis, three separate firms are operating at these areas and all of them are fully owned by Munich Airport.

Munich Airport
https://www.munich-airport.com/

Mobility Options to/from the airport:	
Bus	Yes
Car Sharing	Yes
Long-distance Bus (Flixbus)	Yes
Long-distance Train	Not at the airport
Subtrain / train	Yes
Taxi	Yes
Rental Car	Yes

Bus

The airport is easy and convenient to reach by bus from the Munich city centre as well as from Ingolstadt and Landshut.

Car sharing

Several providers offer car sharing services at Munich Airport.
The parking spaces for car2go and DriveNow are located in the P20 parking garage on Level 1 in the car sharing area. Flinkster cars can be booked through Hertz and only for a full day.

Long-distance Bus (Flixbus)

Intercity bus connections to and from the airport.

Long-distance Train

Lufthansa express Bus connects Munich Airport the main train station (Munich Hauptbahnhof). The Journey from Munich Hauptbahnhof (main station) takes approx. 45 minutes with departures every 15 minutes. There is no long-distance train station at the airport.

Subtrain / train

The S1 and S8 S-Bahn lines connect the airport with the centre of Munich, with departures every 10 minutes.

Taxi

Taxi ranks can be found in the departure and arrival areas of Terminal 1 and 2.

Rental Car

Car rental centre at the airport to hire cars for more than 24 hours with different companies, e.g. Avis, Budget, Europcar, Alamo, Enterprise, National, Sixt, Hertz, Thrifty, Buchbinder, dollar, FLIZZR and Global Drive Rent-a-Car.

E-mobility - Airport fleet

Munich Airport currently operates a fleet of 280 electric vehicles – mostly specialized equipment such as baggage tractors, lifts and passenger boarding bridges. In the future, however, the airport plans to make electric vehicles part of its fleet of passenger cars, too. Over the coming three years, millions will be invested in e-mobility, with 121 gasoline or diesel-powered vehicles slated for replacement through electric models. By 2030, the airport plans for its fleet to consist almost entirely of electric vehicles. At the same time, efforts are continuing to expand the necessary infrastructure of charging stations.

Creating incentives for employees

To make using public transport more attractive, Munich Airport grants all group employees an allowance of ten percent toward the cost of the “IsarCard’ pass from the local transport company Münchner Verkehrs- und Tarifverbund.

Frankfurt Airport

Frankfurt am Main Airport is the largest commercial airport in Germany and one of the most important hubs for the aviation industry worldwide at the same time. Emissions (like air pollutants, greenhouse gases and noise on the ground) form the focus of the electric mobility initiative E-PORT AN, which was launched by the partners Fraport AG, the Lufthansa Group, the German Federal State of Hesse and the Project Coordination Office for the Rhine-Main Model Region for Electromobility.

In order to reduce the ground emissions involved in the entire aircraft handling process on a long-term basis, E-PORT AN uses individual projects (TaxiBot hybrid tractor; 'eSchlepper' tractor; eTaxi; eLift; eFleet operated by Fraport) to develop different electric mobility technologies and procedures, to test them in day-to-day aircraft handling activities and to conduct corresponding scientific research. One of the key elements of E-PORT AN is the 'Green Gate', which will facilitate aircraft handling using electrically-powered vehicles in the future. E-PORT AN was awarded the Federal government's 'Lighthouse' accolade in 2013, and won the GreenTec Award 2014 in the 'Aviation' category.

Frankfurt Airport https://www.frankfurt-airport.com	
Mobility Options to/from the airport:	
Bus	Yes
Car Sharing	Yes
Long-distance Bus	Yes
Long-distance Train	Yes
Subtrain / train	Yes
Taxi	Yes
Rental Car	Yes

Bus and Long-distance Bus

Various bus companies serve the long-distance bus station at Frankfurt Airport.

Car Sharing

Passengers can find car sharing spaces on parking lot P29 at Terminal 1.

Car2Go users don't have to refuel vehicles when returning them. They only need to park them on the provided spaces and end the rental period.
Book n Drive users only have to refuel returned vehicles if the tank is less than a quarter full. Each vehicle contains a fuel card that can be used at either of the fueling stations near the airport. This offer is free. The cars can be picked up at the airport and be returned at other car sharing pools or in the business area of Frankfurt. Borrowed vehicles are allowed to park up to 3 hours free of charge in the parking area.

Long-distance Train

The long-distance train station operated by German Rail (Deutsche Bahn) at Frankfurt Airport makes it simple to get there by train from anywhere in Germany or Europe.

Rental Car

All major rental companies are represented at Frankfurt Airport. The companies can be found at the Car Rental Centers in both terminals.

E-mobility - Airport fleet

More than 3,000 motorised vehicles account for around 15 per cent of the CO2 emissions of Fraport AG. As a fundamental component of the Group's climate protection activities, it is currently being checked where combustion engines can be replaced by electric drives. Around ten per cent of the vehicle fleet of Fraport AG are already powered by electricity today.

The electric drive is particularly suited for special-purpose vehicles for aircraft handling - for instance, tow tractors, conveyor belt vehicles or elevating platform trucks as they only have to cover short distances but cause the largest proportion of the CO2 emissions.

After successful tests, a first pallet lifting vehicle was procured at the end of 2010 for aircraft loading. In 2015, 20 per cent of these vehicles are to be powered by electricity. The same goal applies for serial hybrid tow tractors in baggage handling. Conveyor belt vehicles are to be converted entirely to electric drive by 2015.

After successful practical tests of several cars with different battery concepts, further electric cars are to be used over the next few years.


Lufthansa
RL-3

Limitations and potentials

Limitations

Transportation planning, regional planning, environmental planning and commerce development strategies have a significant role during the implementation of an airport's electric mobility plans. Moreover, a project like that might pave the way towards forward thinking cooperation and coordination of various stakeholders.

The following limitations can be identified regarding the e-mobility of airports:

• **EV technology limitations**. Current EV technologies have limitations regarding ease of use, driving range, time-to-charge, and are more expensive than equivalent conventional vehicles. Moreover, the use of electric vehicles requires an adequate charging and electric grid infrastructure, as well as dedicated solutions for vehicle charging and storage that are optimally integrated into the built environment. This implies that careful planning and substantial investments are needed to realise e-mobility development goals. However, airport related routes are typically easy to estimate, which may enable airport operators to design an efficient infrastructure.

• **Passenger alternatives**. Passengers can approach (or leave) the airport by various means (typically bus, taxi, rental car or own vehicle). Therefore, the benefits of using electric cars have to be determined and effectuated in contrast to each alternative (i.e. passengers can have the benefits of private car usage, e.g. by more convenient luggage handling). In order to achieve this, it is also important for the airport to work closely with regional governments, taxi companies and various car rental and car sharing companies in a way that would help to gradually shift these fleets to electric vehicles.

• **Managing the expectations of various stakeholders**. Various authorities and ground handling companies operate at the airport, and there might be substantial potential in electrifying their fleets. These stakeholders have varying needs, preferences and operational characteristics. Therefore the airport has to identify specific solutions for each area. This requires intensive cooperation and a proactive attitude from the airport in persuading these stakeholders to electrify their fleets.

• **Needs-based development**. Many airports need substantial developments to match future demand, and as such, infrastructure development needs to be optimised, so that charger developments follow user demand (i.e. in terms of location and capacity).

Potentials

Airports have a lot of potential to ensure the efficient and environmentally compatible transport of people and goods. To shape electrified intermodal traffic or transportation hubs within airport regions, it is important to understand how people access and make use of them and their services.

The potential of airport in e-mobility lies in the following main aspects:

• **Airports have high degree of freedom in their internal infrastructure developments**. Airports have their own electrical and internal transportation infrastructure, and typically airport areas are considered as private areas. Therefore, in terms of their internal developments (e.g. airport-owned chargers inside the airport territory, which can be used by airport staff only), airports have higher degree of freedom, they can define their own services for themselves. Due to the listed aspects, airports can be forward thinkers about the structure, business model and operation of e-mobility.

• **Manageable travel distances**. The range of an EV is limited when compared to the range of a standard vehicle. However, in case of airport operations, vehicles are moving within a present area, therefore operating range problems can be lighter than in the case of general mobility applications. As customer airport transfers are also relatively easy to plan and are well within EV range, the usual range considerations might not be a problem for customer airport trips either, if services are structured effectively (e.g. through point-to-point airport transfers via car sharing).

• **Charging efficiency - airport operations**. Due to the different charging time requirements, charging infrastructure can be relatively efficiently shaped. Because of the overlapping airport processes, vehicle usage can be well structured and is plannable. As waiting times are relatively frequent during the various operations, interim recharging is possible. Since the vehicles do not leave the airport at night in the majority of cases, night-time can be used for longer charging times of e-vehicles.

• **Plannable charging needs - customer-facing services**. Since it is possible to plan how many cars stay at the airport in the longer term (e.g. based on the reservations of long-term parking lots), it can be planned reasonably well how many normal and fast chargers are needed. For cars staying on the airport for a longer period of time (the cars of the employees and passengers who are on a longer journey), it is enough to provide chargers with longer charging time. However, for those who only bring a friend or relative to the airport and do not stay there for a longer period of time, it is important to provide a sufficient number of fast chargers. It is also important to mention that overall, the smallest potential is in employee mobility, but at the same time, it is a relatively easily realized potential and it can have a multiplier effect through e-mobility advantage evangelization.

• **Structuring airport fleet demand coverage**. At the beginning, conventional vehicles can cover continuous demand and electric mobility could be reserved for peak periods, which could limit the usage of electric vehicles to manageable distances / timeframes. It is also reasonable due the fact that EVs need a “rest-period” for charging. This would certainly require cooperation with other stakeholders, and the airport or an experienced partner could handle the demand management. Later, as the fleet will being continuously replaced, EVs will be not only complementary vehicles.

• **Customer journey and customer experience management**. The airport is in a position where it can potentially understand customer journeys end-to-end. In such a position, with a holistic approach on shaping airport-related mobility, airports could effectuate an integrated vision for mobility services that enables premium customer experience in airport-related mobility. As customer experience is a key factor in customer choices around mobility, the quality of the customer experience regarding e-mobility services is on the one hand crucial for its adoption, and on the other hand, can substantially enhance adoption efforts.

Project partners insights

FUA Stuttgart (WRS)

1. Charging infrastructure and parking for electric vehicles at the Stuttgart Airport

As mentioned in several reports the Stuttgart Airport offers up to 11.000 parking lots. Since January 2018, 48 electric charging points are offered for electric vehicles in the public area[1]. All parking lots are fee required, however the user can charge its vehicle for no fee. The parking spot price range is between 23 and 35 euros per day and between 53 and 125 euros for the first week[2]. According to this, several passengers have the chance to drive with their electric vehicle to the airport.

2. Car-sharing: electric vehicles at the Stuttgart Airport

Car-sharing is offered by car2go at the airport. This provider offers cars according to the free-floating principle. With a total of 550 electric vehicles of the brands smart (500 cars) and Mercedes-Benz B-Class Electric Drive (50 cars)[3]. But this service is only provided between the "home area Stuttgart" (operating area of car2go) and the airport area.

3. E-Taxi service at Stuttgart Airport – GuEST project by the City of Stuttgart

GUEST is a joint project of Bosch, DEKRA, FKFS, Taxi Center Stuttgart and the University of Stuttgart. The goal of the project is to communicate the potential of electro mobility through the practical operation of purely five electric taxis (e-taxis) and to investigate whether the electric vehicles prove themselves in taxi mode. The e-taxis can be charged at the Stuttgart Airport.

4. E-Bus -RELEX and electrical-hydrogen bus line

The express bus "Relex" to the Stuttgart Airport, called "RELEX", are operating as tangential lines to the city railway lines. Therefore, RELEX improves the airport accessibility of FUA Stuttgart, while creating new, fast and direct connections, as well as a sustainable mobility options, between the city railway lines to the Stuttgart Airport.

There is also an electrical bus with a hydrogen tank offered. The bus is operating the line 79 from Plieningen to the Stuttgart Airport. The bus can recharge at the hydrogen gas station at the airport.

5. Fairport strategy and e-mobility operation projects of Stuttgart Airport

Besides the economic success of Stuttgart Airport, also a big aim of the Stuttgart Airport is sustainability. The airport is committed to have a positive influence on the economy, society and the state of local and global environment. On that account they developed the fairport strategy, which is based on binding values and guidelines for all employees compiled in the fairport code. This code defines values and norms for the behaviour of all employees among each other as well as towards customers, competitors, business partners, public authorities and other stakeholder groups.

The biggest aim of the strategy is to become one of the highest-performing and most sustainable airports in Europe. The airport operator contributes to reducing noise, greenhouse gases, energy consumption and waste as well as to protecting surrounding waters and biodiversity. To reduce its environmental impact to a minimum the Stuttgart airport intends to reduce half its greenhouse gas emissions by 2030, in comparison to 1990. By 2050 the airports operations are to be entirely carbon-neutral. To realize this ambitious plan they started efficiency and reduction projects.

Therefore, the FSG counts on technological innovations to be introduced in the coming 30 years, such as a more efficient energy production in solar plants and better storage facilities. On the compound already exist a surface of 15.000 m2 solar plants. One third of the produced energy is used by the airport itself and the remaining is fed into the public power supply system. Energy that is not produced at the airport is purchased to 100 percent from renewable sources.

1 https://ecomento.de/2018/01/10/stuttgarter-flughafen-jetzt-mit-48-elektroauto-ladepunkten/
2 http://www.flughafen-stuttgart.de/an-abreise-und-parken/parken/parkplatz-buchen
3 https://www.stuttgart.de/car2go

At the Stuttgart Airport more and more diesel vehicles are replaced by electric vehicles. Since 2018, electric vehicles are transporting passengers and luggage. This results in reduction of local emissions at the airport and causes less noise.

The already mentioned project “e-fleet” was the beginning of the electrification at the Stuttgart Airport in 2013. In a period of 3 years the electrical vehicles dragged 12.000 airplanes, transported 1.5 Mio items of luggage and carried 300.000 passengers. The result was that electric vehicles are really suitable at airports.

Concurrently proceeded a similar project which focused especially on decarbonised passenger transport at European airports, in order to prove if the entire passenger transport could be managed with electric buses. With the aid of the European Union fast chargers and an electrical infrastructure was built. As a result, the electrical buses are as good as the diesel buses at passenger transport but with a 70% higher energy efficiency.

From 2015 to 2017 they tested an alternative energy storage beside the established lead acid batteries, the project was called “Li-fleet”. The lead-acid batteries used at Stuttgart Airport have proven their worth in day-to-day operations. To test an alternative energy storage system, the Li-Fleet pilot project has expanded the apron fleet with a lithium-ion baggage tug. For example, the extent to which the two memory cells differ in terms of their service life and charging time was investigated. During the project, a guideline for other companies was also developed to facilitate a switch to electric drives[1].

SCALE-UP! is a project that realises the aim to reduce the CO^2-emission of the fleet by 80 % until the year 2020 as compared to 2009. Electric vehicles are particularly suitable at airports. On the one hand distances are short and on the other hand the breaks are long enough to recharge the battery consistently.

The project consortium includes the airport operator, the check-in service provider Losch Airport Service GmbH as well as other users at the airport location and the Öko-Institut e.V., which provides scientific support for the practical application. The coordinator of the research project is Stuttgart Airport. The project is funded by the Ministry of Environment, Nature Conservation, Building and Reactor Safety (BMUB) within the framework of the program Renewable. The total cost of the project amounts to € 4.5 million, the Federal Ministry supports the project consortium in the amount of € 1.94 million[2].

6. Planned e-mobility option – U6 – city railway line to the Stuttgart Airport

Currently the airport isn´t yet connected directly to regional- and long-distance trains. As in earlier reports mentioned, in the near future there will be a train station at the airport called “Filderbahnhof”. With the high-speed track it will be possible to reach the main station in 8 minutes or Ulm in 29 minutes. Also there will be a station for the city railway “U6”. The extension of the U6 to the Stuttgart Airport is planned until 2025. This sustainable mobility option will most likely have the greatest impact for changing behavior of passengers and employees using public transport in comparison to other mobility options such as busses.

7. Outlook and improvements - E-Bicycle infrastructure

In conclusion, Stuttgart Airport is increasingly involving e-mobility in airport operations, also multiple sustainable e-mobility options are offered for passengers traveling from and to the airport. Due to the various usage of e-mobility, the Stuttgart Airport is well advanced regarding e-mobility in comparison to other airports. However, the airport has one additional opportunity to take advantage of, for example, offering e-bikes to rent or lease for passengers and employees. This would improve immensely the accessibility of Stuttgart Airport in case of carbon free mobility for passengers and employees. In the future, the WRS suggests to plan and build charging stations and additional road infrastructure for e-bicycles.

1 https://www.flughafen-stuttgart.de/fairport-str/klimaschutz-ressourcen/elektromobilitaet

2 https://www.flughafen-stuttgart.de/newsroom/pressebereich/pressemitteilungen/2016/flughafen-stuttgart-setzt-auf-elektroflotte-bundesumweltministerium-foerdert-projekt-scale-up, 10.01.19

Vienna International Airport (VIE)

The e-mobility measures from VIE are as follows:

- Publicly accessible charging infrastructure is available and will be further expanded;
- Charging infrastructure for electric company cars is currently under construction;
- Charging boxes for e-bikes and e-scooters are available;
- The purchase form electric company cars should be expanded;
- Vienna Airport Lines have tested the first fuel cell bus between the main station in Vienna (Wien Hauptbahnhof) and the airport;
- Car Sharing is available but mostly with ICE-cars;
- Taxis are available but mostly with ICE-cars.

Warsaw-Modlin Mazovia Airport (WMI)

For commuters living within c. 25km of the airport, electric bicycles can be a lower-threshold starting point for encouraging e-bike commuting. These could be vehicles subsidized by the airport/employers or even bought by them and loaned to employees. Alternatively, a system of subsidies for employees commuting by bicycles, including electric bicycles, could be implemented. Of course, appropriate parking+charging facilities have to be provided, but these require lower investments than in the case of electric cars.

SEA Milan Airports (SEA)

Electric mobility is an important component of SEA Milan Airports' sustainable surface access strategy and SEA Milan Airports (SEA) are working at e-mobility projects in cooperation with SEA Energia (the energy provider owned by SEA Milan Airports).

In particular, SEA analysed the electric mobility demand by 2030, assuming that the e-mobility market share will be 8%[1]. This informed the e-mobility infrastructure dimensioning at Linate and Malpensa Airports[2], which will have **150 charging stations by 2030**. More in detail:

Linate Airport

- The existing **2 recharging stations**[3] will serve the **electric car sharing** demand which is estimated at 5 vehicles per day by 2030;

- Additional **38 fast charging stations** will serve other users' demand (**passengers**) which is estimated at 1,114 vehicles per day (with each station charging 2 vehicles simultaneously).

Malpensa Airport

- The existing **2 recharging stations**[4] will serve the **electric car sharing** demand which is estimated at 11 vehicles per day by 2030;

- Additional **108 fast charging stations** will serve other users' demand (**passengers**) which is estimated at 3,118 vehicles per day (with each station charging 2 vehicles simultaneously).

1 Source: ENEL, E-Mobility revolution, 2017
2 Source: PwC for SEA, Piano Strategico dell'Accessibilità Terrestre degli aeroporti di Milano Linate e Milano Malpensa, February 2018
3 Currently the two charging stations at Linate Airport serve the E-VAI electric car sharing. An additional charging station is available.
4 Currently the two charging stations at Malpensa Airport serve the E-VAI electric car sharing.

Key objectives from airport's perspective for future developments

Short term

Establishing a core concept for long-term strategies

In the short term, it is an important goal for the airport to begin experimenting with technological solutions and business models that can be scaled later. The idea of an integrated vision about the future operation of the whole e-mobility system (within the framework of the wider mobility ecosystem) will have to be laid down. Wide-scale adoption can only be achieved if the customer journey and customer experience models are well-developed.

Exploring, channelling and learning from international best practices

It is worth learning about the examples and experiences of the countries and airports having experience in e-mobility development. International benchmarks can provide both best practices to follow and pitfalls to avoid. As a result of knowledge sharing, airports do not need to experiment unnecessarily with solutions that have not been successful in other countries.

Long term

Gradually adapting to changing customer expectations and scaling solutions

The distribution of generations in the world's population will be changed in the next ten years: by 2025, the proportion of Generation X (born between 1960-1980) will decrease from 45% to 32%, while the proportion of Generation Y (born between 1980-1995) and Z (1995-) will increase from 48% to 60%. Social responsibility becomes increasingly important for Y and Z generations. As they will have a growing role in the market, their expectations will increasingly influence customer expectations as a whole and, in our opinion, airports will have to match services to these changing customer expectations to be able to scale their e-mobility services. At the same time, it is worth emphasizing that for the older age group, where the strength of habit is more dominant in this field, education is a particularly important factor. Much more energy should be invested in their persuasion than in the younger generation.

The new dominant customer base will increasingly require that services meet their specific expectations (airport services are no exception from this) and a much higher level of personalization will be required in services provided. This at the same time presents a prominent opportunity for e-mobility development as customers demanding e-mobility solutions will turn down alternatives if they have the choice. However, to achieve economies of scale in e-mobility effectively, airports will have to go through a relatively long process of technological and business model innovation, which has to start in time as it will be an iterative process.

Brand building and awareness-development

The air transport industry is one of the most significant GHG emitters. The fact that flying has become relatively cheap is quite attractive to consumers from a market demand point of view. However, from the aspect of sustainability and brand building it is important for the entire air transport industry, including airports, to make visible and effective steps towards sustainability. Part of this may be investment in e-mobility and leveraging the electrification potential in airport-related ground traffic. The key pillar of this is of course the fact that customers can experience e-mobility directly in their personal usage of the technology. At the same time, it is also important to see that even temporary e-mobility usage has a multiplier effect: if a passenger is using e-mobility, he meets the technology and its benefits. It can be a gateway to personal investments in an electric vehicle.


P
alleen voor
opladen
elektrische
voertuigen

Actions

Two approaches to developments

E-mobility related developments can be effectuated regarding airport ground services and customer facing applications. The two development paths are distinctly different in their development strategies, and as we see it now, synergies are limited between them.

1. Airport development - internal driver. Airport ground service development is mostly an internal matter for the airport. Several statistics are available on ground operations and the related services have only an indirect relationship with customer needs. As such, these developments are almost exclusively governed by airport and ground services partner management decisions, ranging from vision/strategy to financial viability.
In this case, development planning and implementation framework follow the usual practice:

- Technical assessments, necessary developments related to the electricity grid;
- Which vehicles could be replaced based on movement patterns;
- Analysing potential synergies between ground handling service companies in terms of co-financing/co-utilisation;
- Assessment of investment costs;
- oCost efficiency, economic return on development.

2. Customer related e-mobility developments - external driver. Customer related e-mobility services are certainly governed by the evolution of customer demand and preferences. As such, we believe that the airport should follow a phased development strategy which enables the testing of the solutions fit to customer needs (e.g. scope of services, capacity, pricing), and especially how it fits into the multimodal transportation framework in place. In our vision, the end goal of airport related e-mobility developments should be an organic bundling of airport airline services and e-mobility services (car usage, charging). In each phase, a detailed financial feasibility needs to be carried out before investments or partnerships are made. However, it is crucial to do this phase-by-phase as it ensures that realistic assumptions can be made on future demand.

- **Phase 1: Pilot process**. Goal: leveraging different service propositions to finance developments and to gauge customer preferences and viability of services. It is expected that initially there will not be many customers with charging needs, therefore dealings with taxi companies and e-car sharing companies are required (e.g. they would have to pay in return for parking and charging).
- **Phase 2: Customer needs**. Assessing costumers' charging habits through targeted surveys both to early adopters (what kind of needs they have) and to the entire population.
- **Phase 3: Bundled products**. In cooperation with airlines, providing various bundled offers (e.g. free charging or free e-car sharing service for business-lounge members).

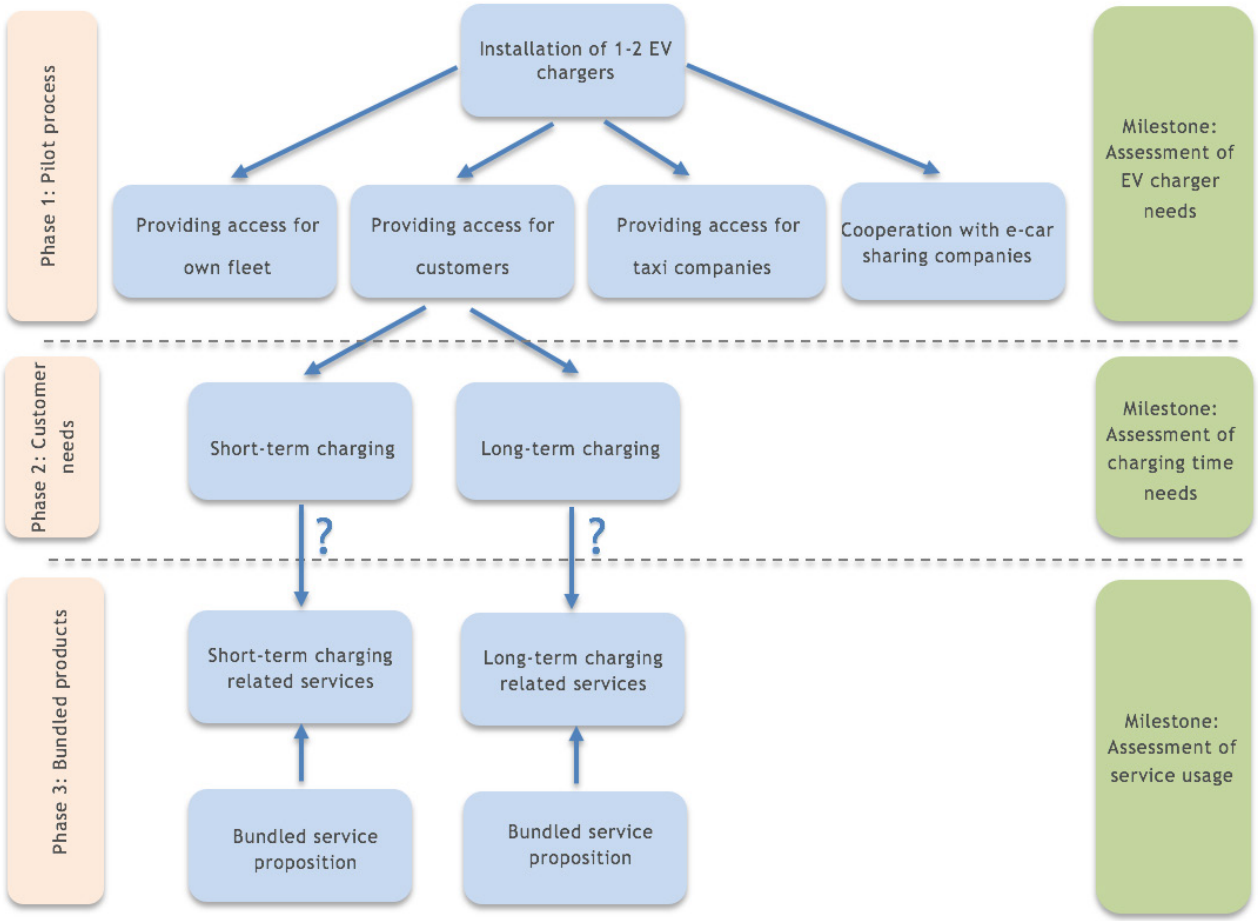


Figure 5. Customer related e-mobility developments - Phases, milestones and synergies

Gradual replacement of the airport fleet

• **Gradual replacement of the airport fleet**. The airport should gradually replace its fleet by electric-driven vehicles. Airport vehicles are moving on a well-planned route within a narrow area, therefore limited EV range does not mean a problem. The electrification of airport owned ground handling vehicles (e.g. aircraft baggage loaders, forklifts, aircraft tractors) and apron buses is also recommended.

• **Alternative options**. As can be seen from other international benchmarks, it would be a temporary solution if one part of the fleet would be electrified, and the other part would be powered by other alternative energy (e.g. CNG).

• **Close cooperation with other stakeholders**. Since not only the airport fleet is present at the airport, in order to strive for the most complete electrification, it is necessary to cooperate with other stakeholders as well.
• **Charging infrastructure**. Charging stations are required for vehicles used within the airport area.
• **Workshops and training of technical service personnel**. Electric cars are a novelty for the vehicle repair team, therefore the current service and repairs can be complicated for non-specialized technical staff.

Overview on measures

Action	Actors involved (Target groups and agents of change and their role)	Barriers	Timeline	Proposed changes/improvements in general addressing airports and their FUA
Gradual replacement of the airport fleet	Airport Business partners inside airport areas Authorities inside airport areas Government Mobility groups Public opinion	Collecting financial support Related ownership procedures Technical conditions Specific vehicles	2-3 years	Airport vehicles would use electric power. Electric fleet helps reduce and avoid emissions of CO2, air pollutants and noise. Public awareness

Sustainability Potential and Impact

By replacing their fleet with electric vehicles, the airport would make a clear message about CSR, which gives public credibility to the airport and the whole airport industry as well. Since it is a mostly autonomous area, it has every opportunity to become a flagship of electrification by responding flexibly to emerging needs.

Risk Mitigation Measures

Replacing the fleet of ground handling operators may be problematic since they typically use specialized vehicles with a narrow, monopoly market, therefore the price difference could be even higher than in case of electric cars. However, most of the ground handling firms are lacking the funds to purchase electric vehicles, so they need outside financial support (EU, federal/national/regional policy actors). The main role of an airport in this process is to foster the cooperation and lead the project consortiums in case of applications.

Appropriate equipment to the appropriate location - meet the short-term, medium-term and long-term parking needs

• Understanding the customer. Parking customers of each airport parking type have differing needs and priorities.
• Differing charging station technologies. Understanding the purpose for the visit and length of time the customer will be parked at a given facility, can provide insight into the appropriate level of charging to install.
• Short-term parking: max. 1 day, typically drop off/ pick up or short-stay business trips. Due to the short time spent there, short-term parking facilities are good candidates for fast chargers.
• Medium-term parking: 1-2 days, the greater speed of fast chargers is not needed in these facilities.
• Long-term parking: 2 days or more, installation of conventional chargers are sufficient.
• Preliminary indication of charging needs. Long-term parking customers would be able to indicate in the reservation system that they would charge their car - full charge by the time they arrive, no need for fast charger.
• Renewable energy sources. Parking lots could be equipped with renewable energy sources (e.g. solar panels).

Overview on measures

Action	Actors involved (Target groups and agents of change and their role)	Barriers	Timeline	Proposed changes/improvements in general addressing airports and their FUA
Appropriate equipment to the appropriate location	Airport Business partners inside and outside airport areas Mobility groups Customers	Time of construction Location of the station Technical conditions Providing online background	1-2 years, gradual increase of initial capacity	Enhance customer experience Improving customer experience may imply greater usage of electric cars Adequate capacity in the right place Public awareness

Sustainability Potential and Impact

By installing fast chargers only in the required places, the maintenance of the chargers will be sustainable. The requirements would be plannable if customers could indicate in the booking system that they would come with an EV and would like to use the charging service.

Prior to construction, taking into account siting issues such as the presence of existing electrical infrastructure, visibility, connectivity, and accessibility can reduce costs and increase customer satisfaction with respect to the EV charging stations. Once the stations are installed, proper signage and wayfinding are also required.

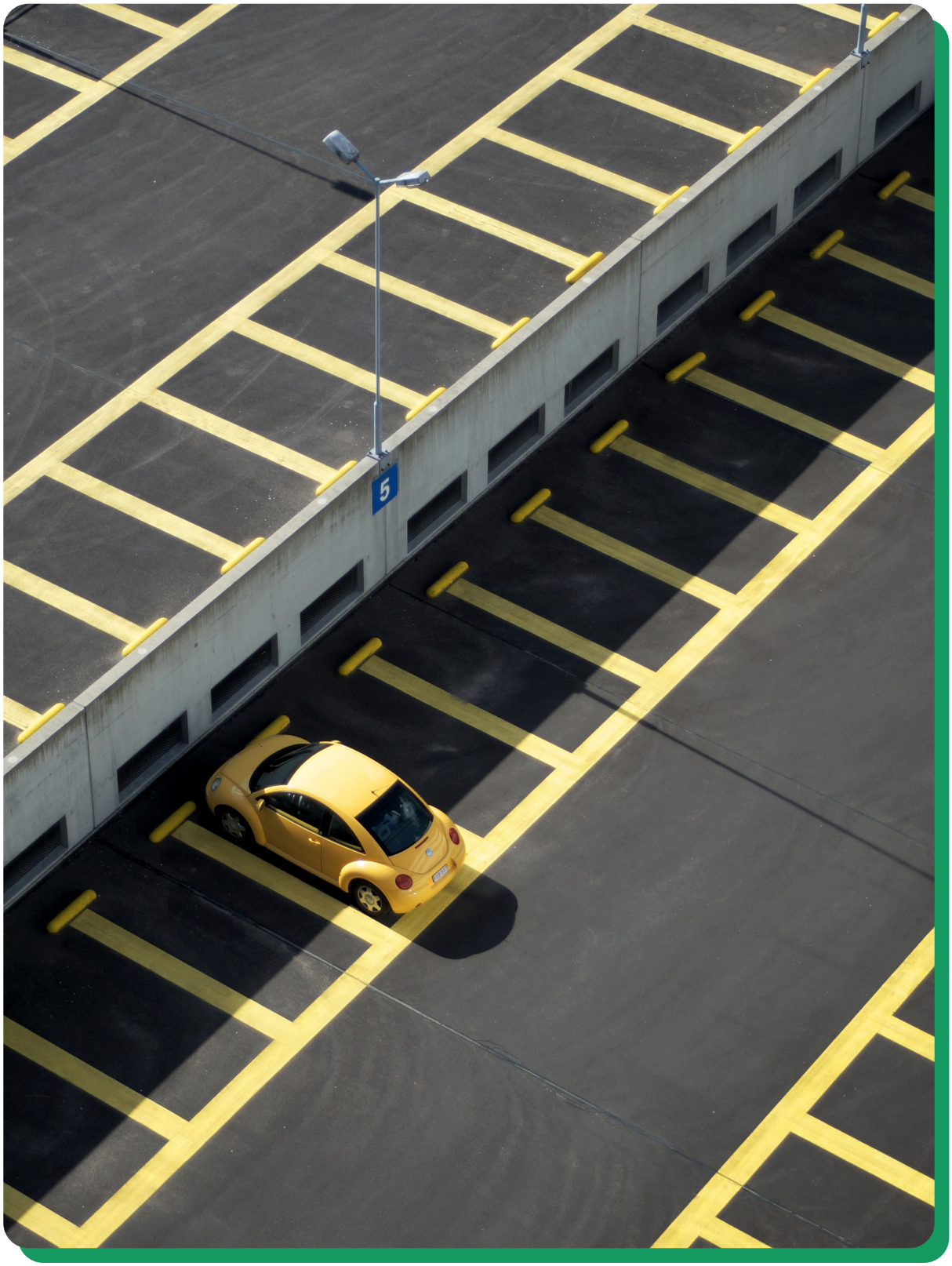
If the capabilities of the airport could allow, in the longer term the usage of renewable energy sources would also be advisable to provide the necessary energy.

Risk Mitigation Measures

An intelligent charging system would be needed to capitalize on the timing of charge allocation. Suggested topics for further research with respect to EV charging stations at airport parking facilities include implications of collecting access fees and charging for electricity.

Impact on other modes

Depending on the capacity, taxi, rental car and car-sharing companies would also be able to charge their cars here.


5

Providing parking lots with EV-chargers for business partners

• Semi-public parking lots with EV-chargers. Creating parking lots in which the airport's business partners (e.g. taxi and rental car companies) could park their EV fleet, passengers would not have (or would have only limited) access.

• Creating incentives. Business partners would be encouraged to replace an increasing share of their airport fleet with EVs.

Overview on measures

Action	Actors involved (Target groups and agents of change and their role)	Barriers	Timeline	Proposed changes/improvements in general addressing airports and their FUA
Providing parking lots with EV-chargers for business partners	Airport Business partners inside and outside airport areas Mobility groups Customers	Time of construction Location of the station Technical conditions	1-2 years, gradual increase of initial capacity	Providing charging opportunities increases the supply of electric vehicles by the business partners Improving customer experience may imply greater usage of electric cars Public awareness

Sustainability Potential and Impact

The airports should encourage their business partners to electrify their airport fleets as much as possible. One way is to provide them charging opportunities. It will create an alternative transport option to the environment conscious passengers as well. When calling a taxi, customers ever more frequently ask for an environmentally friendly vehicle, and they look for the companies offering these.

Risk Mitigation Measures

Tariff calculation is needed.

Impact on other modes

Depending on the capacity, passengers would also be able to charge their cars here.

Cooperation with e-car sharing companies

• The lack of e-car sharing companies. The presence of e-car sharing companies should be ensured at those airports where it is not currently solved.
• Deal opportunities. Outlining possible deals in the initial phase: providing parking lots, allowing the usage of installed chargers in exchange for a certain fee.
• Unchanged comfort. Customers can switch their own conventional cars to electric power vehicles while retaining all the benefits of car usage.

Overview on measures

Action	Actors involved (Target groups and agents of change and their role)	Barriers	Timeline	Proposed changes/improvements in general addressing airports and their FUA
Cooperation with e-car sharing companies	Airport E-sharing companies Mobility groups Customers	Willingness, flexibility and reliability of e-sharing companies Location of the station Conflict of interest with taxi and rental car companies	Within 1 year	Decreasing own-car usage by e-car replacement

Sustainability potential and impact

The spread of car-sharing companies can be experienced everywhere. However, according to the international benchmark, airports are not all concerned at this stage. Provision should be made for these service providers to be able to carry passengers from/to the airport. It is likely that the usage of shared EVs would be a consideration for consumers, as it could mean an almost equivalent alternative.

Risk Mitigation Measures

The action could damage the interests of taxi and car rental companies, however, they would also be encouraged to provide EVs.

Impact on other modes

It would be a considerable alternative to car users, which would reduce the number of conventional vehicles.

Installation of charging stations combined with various services

• Well-segmented customers with different charging requirements. Based on targeted surveys, different charging needs of customers can be measured and implemented in the charger installation process.
• Accompanying services for customers with electric cars. Providing opportunities for consultation about the properly use of the technical service.
• Bundled products. Installing charging stations, where the customer would feel to spend the waiting time usefully. Providing various services at the station (e.g. coffee, sandwich, newspaper), where other, tourism-related services would also be available (cooperation with airlines is required).

Overview on measures

Action	Actors involved (Target groups and agents of change and their role)	Barriers	Timeline	Proposed changes/improvements in general addressing airports and their FUA
Installation of charging stations combined with various services	Airport Business partners inside and outside airport areas Mobility groups Customers	Time of construction Location of the station Operational issues Cooperation with current service providers	2 years, enlargement every six months depending on demand	Enhance customer experience Improving customer experience may imply greater usage of electric cars Public awareness

Sustainability Potential and Impact

The construction of such charging stations would be gradually based on demand, so it would be relatively flexible to reflect costumer demand. The offered services could be expanded depending on the feedback. Electric car owners would be encouraged to use their EV during their airport trip and try out the services. It would also be advisable to consult the operation of these stations with taxi and car-sharing companies.

Risk Mitigation Measures

Cooperation is recommended with airport partners providing similar services, in order to make their services available at the charging stations. However, involvement of new partners should also be considered. Great emphasis should be put on marketing as early as possible, in collaboration with business partners.


Hadselfjorden

Implementation plan

The listed actions cannot be considered as independent from each other, as the various actions are built on each other during the process of the electrification of the airport. From the aspect of the airport, these actions create a process in which the airport has a unifying role among the customers and the service providers, and in which the airport participates in the journey experience even before and after the passenger has reached the airport.

• **Infrastructure development**. Parallel with the gradual electrification of the airport fleet, charging stations should be established. In the next step, these stations should be made publicly available. Once the charging stations have been built in the city, there will be an infrastructure which helps EVs move station-to-station, avoiding the range limitation of electric vehicles. Chargers installed outside the airport area could raise awareness and could be used jointly with other stakeholders.

• **Commercial potential**.

- As taxi companies are existing and dominant actors in airport mobility, the airport should first negotiate with them in order to send hybrids or just electric cars to the airport. It is then necessary to cooperate with them to co-finance the operation of the stations.
- It would be followed by an agreement with car-sharing companies. Benchmark examples show that charging stations have a jointly usage.
- If the airport could agree with e-car sharing companies to provide part of their fleet for airport transfer, it would be possible to capitalize on the potential to have a station with sufficient car stock in the centre, from which passengers could transport to the airport. The station could also operate under co-financing.
- In cooperation with airlines, combined products could be offered to customers, which can be offered on the partners' website or among their deals. It is worth to start it early, as early adopters will do this, and they can provide a certain level of return.

• **Electrification of ground-handling vehicles**. The electrification of ground-handling vehicles is an important factor from the aspect of an airport's e-mobility strategy. However, the market of these vehicles is narrow, indicating that they are rather expensive. Therefore, it may be problematic to replace their vehicle fleet. In that case, a project would be needed to benchmark the costs, while also making a technical feasibility (e.g. what are the typical movements, where to install a charger, what charging time is needed for the vehicles).

Conclusions

The rise of electric cars in the following period will be a trend that every market player has to adjust to. Market forecasts also predict that more and more EVs will be encountered on the roads. All these processes will be reinforced by regulatory changes and even more stringent environmental standards than ever before.

In parallel, the annual passenger traffic of airports is growing steadily, and the most popular approach to airports is still the car. As a result, it is particularly important for the airports to adopt the challenges from e-mobility. The airports need to respond to the increased demand for services soon, and they need to develop a strategy that goes beyond charging needs. Airports have to realize that they are in an exceptional position where they can experiment with solutions to e-mobility.

E-mobility development has two different approaches: the internal-driven airport development and the external-driven customer related developments. It is recommended that airports gradually replace their own fleet with EVs, or as a temporary alternative, with other alternative fuelled vehicles. On the other hand, they must provide the charging infrastructure, so that customers can use electric cars during their journey. It is also important that charging services should be adapted to the needs of users. During all these processes, airports should be in close cooperation with their partners, and measure the customers' attitudes in each phase of the process.

Bibliography

Air Transport and Airport Research (September 2010). *Airport Accessibility in Europe*. Cologne. Release: Final Report 1.02.

Airports Council International (2012). *Airport Service Quality - Best Practice Report, Ground Transportation*.

Aurélie Faure-Schuyer (September 20, 2016). *E-mobility: European Energy and Transport Policies at cross-roads*. Paris. ISBN: 978-2-36567-625-0

Budd et al. (2011). *Airport surface access management: issues and policies*.

Bundesministerium Verkehr, Innovation und Technologie, Bundesministerium Nachhaltigkeit und Tourismus (January 2019). #mission2030 „*E-Mobilitätsoffensive*“. (Available in German)

Civil Aviation Authority (November 2011). *Passengers' airport preferences, Results from the CAA Passenger Survey*. London.

Climate and Energy Fund, Austria (June 2018). *Guide for proposers Zero Emission Mobility*. Vienna.

Department of Transport, Tourism and Sport (November 2016). *Progress Report to the National Civil Aviation Development Forum on the National Aviation Policy Action Plan*. Dublin.

ENEL (2017). *E-Mobility revolution*.

European Commission DG for Mobility and Transport (2011). *Roadmap to a Single European Transport Area - Towards a Competitive and Resource-Efficient Transport System*. Brussels. ISBN 978-92-79-18270-9

European Commission, DG for Research and Innovation, DG for Mobility and Transport (2011). *Flightpath 2050 Europe's Vision for Aviation*. Brussels. ISBN 978-92-79-19724-6

FIA (2011). *Towards E-Mobility - The Challenges Ahead*.

Germany Trade & Invest (Issue 2018/2019). *The Automotive Industry in Germany*.

Innovation and Networks Executive Agency (July 2015). *Connected Europe Facility, Transport 2014 Calls for Proposals, Proposal for the selection of projects*. Brussels.

International Energy Agency. *Austria - Charging Infrastructure*.

International Energy Agency. *Italy - Electric Charging Infrastructure*.

International Energy Agency. *Italy - Policies and Legislation*.

Murphy, Michael and Kahl, Martin – Automotive World (2013). *Technology Roadmap: Battery electric vehicles*.

OECD/International Energy Agency (2018). *Global EV Outlook 2018*.

PwC (February 2018). *Piano Strategico dell'Accessibilità Terrestre degli aeroporti di Milano Linate e Milano Malpensa*.

REKK Foundation for Regional Policy Co-operation in Energy and Infrastructure (November 2017). *CEDE 2017 Country Report - Hungary*.

Transport & Environment (2018). *Roll-out of public EV charging infrastructure in the EU*.

Websites

Audi Hungária (Published on September 20, 2018). *Audi Hungaria: 25 éve tartó sikertörténet*. (Available in Hungarian)
https://audi.hu/hu/hirek/hirek/reszletek/554_audi_hungaria_25_eve_tarto_sikertortenet/

Electrive.com (Published on February 13, 2019). *Germany considers extending EV subsidies*.
https://www.electrive.com/2019/02/13/german-govt-considers-expanding-subsidies/

Eltis (Published on March 21, 2017). *Government launches EV-charging funding programme (Germany)*.
http://www.eltis.org/discover/news/government-launches-ev-charging-funding-programme-germany

European Climate Foundation (Published on September 27, 2018). *Fuelling Italy's Future: How the transition to low-carbon mobility strengthens the economy*.
https://europeanclimate.org/fuelling-italys-future-how-the-transition-to-low-carbon-mobility-strengthens-the-economy/

European Comission (Published on July 20, 2016). *Commission publishes Strategy for low-emission mobility*.
https://ec.europa.eu/transport/themes/strategies/news/2016-07-20-decarbonisation_en

Hrvatski Telekom (Published on December 7, 2018). *Hrvatski Telekom has set up the first fast EV charging station at the ROX gas station in Croatia*.
https://www.t.ht.hr/en/Press/press-releases/4410/Hrvatski-Telekom-has-set-up-the-first-fast-EV-charging-station-at-the-ROX-gas-station-in-Croatia.html

Hungarian Academy of Sciences (Published on June 25, 2015). *Az MTA és az Audi Hungaria együtt fejleszti a jövő autóit - együttműködés az alapkutatástól az innovációig*. (Available in Hungarian)
http://old.mta.hu/vi_osztaly_hirei/az-mta-es-az-audi-hungaria-egyutt-fejleszti-a-jovo-autoit-egyuttmukodes-az-alapkutatastol-az-innovacioig-136592/

Jovanović, Svetlana – Balkangreenenergynews.com (Published on May 3, 2018). *Croatia to launch EV grants for companies, as round for individuals closes*.
https://balkangreenenergynews.com/croatia-to-launch-ev-grants-for-companies-as-round-for-individuals-closes/

Kozák, Balázs - Mobilissimus Kft. (Published on July 11, 2018). *A BUD és Greenairport partnerek munkavállalói körében elvégzett Mobilitási Igények Felmérés eredményeinek bemutatása*. (Available in Hungarian)
https://www.bud.hu/file/documents/2/2724/20180711_laira_greenairport_munkavallaloi_felmeres.pdf

Máth, Dávid – Totalcar.hu (Published on September 21, 2017). *Norvégiában annyira sok lett a villanyautó, hogy nem bírják töltővel*. (Available in Hungarian)
https://totalcar.hu/magazin/hirek/2017/09/21/norvegiaban_annyira_sok_lett_a_villanyauto_hogy_nem_birjak_toltovel/

Morgan, Sam – Euractiv.com. (Published on October 10, 2018). *'Disappointed' EU capitals agree on 35% car CO2 cuts*.
https://www.euractiv.com/section/transport/news/disappointed-eu-capitals-agree-on-car-co2-cuts/

Reuters – Theguardian.com (Published on February 28, 2018). *Rome to ban diesel cars from city centre by 2024*.
https://www.theguardian.com/environment/2018/feb/28/rome-to-ban-diesel-cars-from-city-centre-by-2024-italy

Taylor, Clare – Energypost.eu (Published on May 22, 2018). *Poland's stunning e-mobility plans*.
https://energypost.eu/polands-stunning-e-mobility-plans/

Transport & Environment (Published on February 27, 2018). *How EU Member States roll-out electric-mobility: Electric Charging Infrastructure in 2020 and beyond*.
https://www.transportenvironment.org/sites/te/files/publications/Emobility%20Platform%20AFID%20analysis.pdf

Urbanaccessregulations.eu. *Urban Access Regulations In Europe – Milano Province*.
http://urbanaccessregulations.eu/countries-mainmenu-147/italy-mainmenu-81/lombardia/milano

Regulations

Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure Text with EEA relevance.

Project partners

Municipality of 18th District of Budapest, Lead Partner, Hungary

SEA Milan Airports, Italy

Stuttgart Region Economic Development Corporation, Germany

City of Dubrovnik Development Agency, Croatia

Austriatech LTD – Federal Agency for Technological Measures, Austria

Budapest Airport LTD, Hungary

Regional Government of the Mazowieckie Voivodeship, Poland

Dubrovnik Airport LTD, Croatia

Airport Regions Council, Communication Partner, Belgium

City of Poznan, Poland

Associated partners

Stuttgart Region, Germany

Flughafen Wien AG, Austria

BKK Centre For Budapest Transport, Hungary

Warsaw/Modlin Airport, Poland

Interreg
CENTRAL EUROPE

European Union
European Regional
Development Fund

LAirA

LAirA_project

LAirAproject

Designed by

ARC
AIRPORT REGIONS COUNCIL

Produced by

bud Budapest Airport