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TRANSNATIONAL ACTION PLAN

MULTIMODAL, SMART AND LOW CARBON ACCESSIBILITY IN AIRPORT FUNCTIONAL URBAN AREAS

Version 2
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Written by SEA Milan Airports

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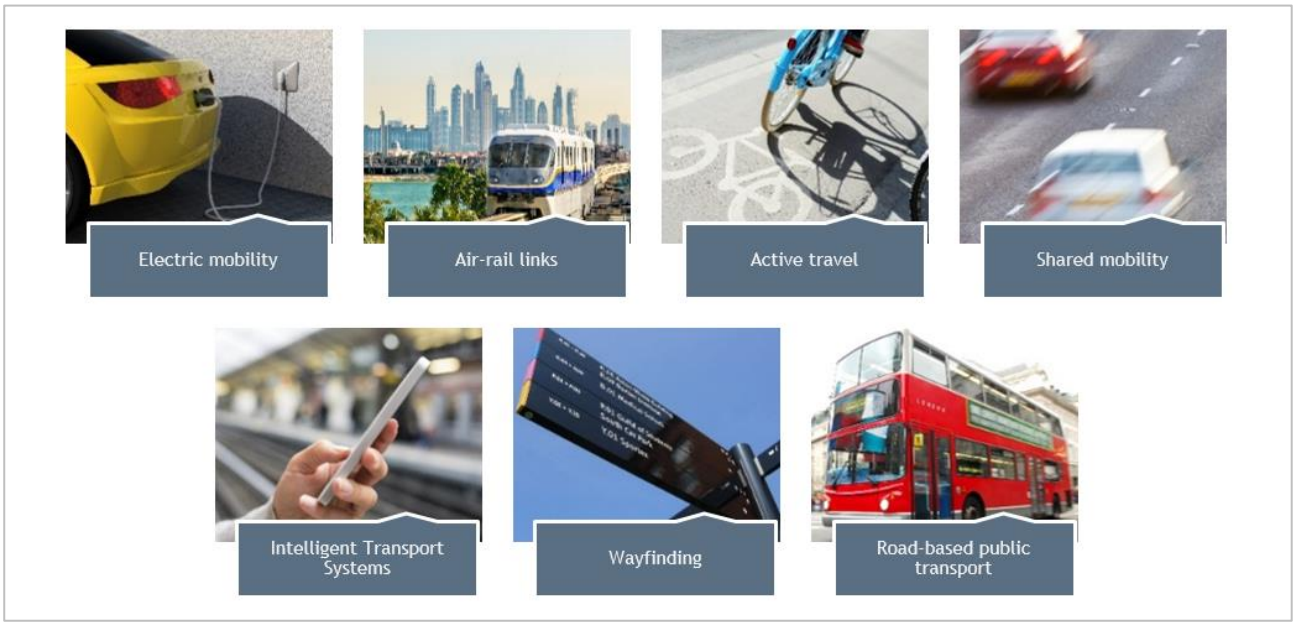
1. Introduction

The LAirA project addresses the challenge of multimodal, smart and low-carbon airport landside accessibility. It focuses on integrating airports in the mobility systems of Functional Urban Areas (FUAs) and more generally of urban and regional contexts which are part of their catchment areas.

A key project activity concerns defining actions for sustainable surface access in the 7 key topics reported in the following figure.

Figure 1. LAirA key topics



Source: LAirA project

This report specifically focuses on identifying actions for sustainable surface access at the LAirA airports.

The report has two core objectives:

- guiding the LAirA airports in drafting strategies for sustainable surface access; in particular the LAirA partners will prepare airport strategies based on the actions identified in this report;
- supporting non-partner airports in better understanding which actions they can deliver to improve landside accessibility, by bringing the LAirA partners' experience and presenting international best practices.

The report is structured as it follows:

- Chapters from 2 to 8 each focus on one LAirA topic. Each chapter includes:
  - the topic relevance to airports and the EU policy background;
  - highlights on the state of art and a qualitative assessment of the LAirA airports' maturity level in the topic;
  - the presentation of selected best practices;
  - details of the actions planned at the LAirA airports and the assessment of their priority, complexity and timing;
  - indications of constraints, opportunities and recommendations to deliver actions.

- Chapter 9 (conclusions) presents the summary of the LAirA airports' actions for sustainable surface access in the seven project topics.

The main inputs to this report are:

- thematic action plans that partners prepared for each LAirA topic and the related presentations that partners delivered during a LAirA conference in Brussels in January 2019[1];
- inputs from partners concerning the maturity level and state of the art at the LAirA airports for each topic[2], the actions planned for each topic, and an assessment of their priority, complexity and timing. SEA Milan Airports collected the information via an *ad-hoc* questionnaire to the LAirA partners;
- outcomes of a project workshop held in Stuttgart in May 2018 during which partners discussed future actions for airports' sustainable surface access;
- the LAirA analysis on international best practices in landside accessibility to airports.[3]

The following table reports:

- the list of the LAirA partners and countries;
- the list of the LAirA airports;
- indication of which partners delivered each thematic action plan in the LAirA topics;
- indication of which partners provided (in green in the table) the questionnaire information concerning the state of the art, maturity, priority, complexity and timing of actions per topic;
- if the Airport has directly contributed and/or validated the information provided by partners, in particular:
    - the Airport has contributed and validated (in green in the table);
    - the Airport has contributed but not validated (in orange in the table);
    - the Airport has not contributed nor validated (in red in the table);

Table 1. Partners and input summary

LAirA partner (country)	Airport (Code)	Thematic action plan input	Questionnaire input	Airport contributes or validates
Municipality of 18th District of Budapest (Hungary) Budapest Airport (Hungary)	Budapest (BUD)	Active travel Electric mobility	●	✈
AustriaTech – Federal Agency for Technological Measures (Austria)	Vienna (VIE)	▫ Shared mobility ▫ ITS	●	✈
Airport Regions Conference (Belgium)		▫ Air-rail links ▫ Wayfinding	N/A	N/A

[1] For more details on the conference please see: http://www.central2020.eu/Content.Node/Smart-and-low-carbon-mobility.html

[2] These inputs also rely on previous project analyses concerning the demand and supply of mobility services at the LAirA airports.

[3] The report is available at: https://www.interreg-central.eu/Content.Node/Laira-best-practices.pdf

LAirA partner (country)	Airport (Code)	Thematic action plan input	Questionnaire input	Airport contributes or validates
▫ City of Dubrovnik Development Agency (Croatia) ▫ Dubrovnik Airport (Croatia)	Dubrovnik (DBV)	Road-based public transport	●	✈
City of Poznan (Poland)	Poznan (POZ)	-	●	✈
Regional Government of the Mazowieckie Voivodeship (Poland)	Warsaw Modlin (WMI)	-	●	✈
SEA Milan Airports (Italy)	Linate (LIN) and Malpensa (MXP)	-	●	✈
Stuttgart Region Economic Development Corporation (Germany)	Stuttgart (STR)	-	●	✈

2. Electric Mobility

2.1. Airport thematic relevance and EU policy background

Access by car for customers and staff, either as a driver searching for a parking at the airport or pick up/drop off by family member, friend or taxi, remains a key mode of travel for airport accessibility. In many cases car is the most convenient option (often from a subjective point of view), particularly for those travelling from locations not directly connected by public transport or at times when public transport is less frequent.

The continued development and increasing availability of electric vehicles (EVs) has allowed some airports to consider opportunities to use this technology to maintain the flexibility of car and taxi travel but with a lower level of CO_2, NO_x and particulate emissions than those associated with traditionally-fuelled vehicles.

Despite electric mobility (e-mobility) at airports is not a specific EU policy goal, low-emission mobility is embedded in EU core policies and strategies, and e-mobility is a substantial topic in following main EU strategic documents:

- **White Paper (2011)**: it sets the goal to reduce greenhouse gas (GHG) emissions in the transport sector by at least 60% in the period 1990-2050. It includes the goals to deploy new and sustainable fuels and propulsion systems, and in particular to halve the use of 'conventionally-fuelled' cars in urban transport by 2030 and phase them out in cities by 2050[4].
- **Urban Mobility Package (2013)**: it encourages EU Member States to create the framework conditions for local authorities to develop and implement integrated and comprehensive strategies for better and more sustainable urban mobility. In particular, it indicates the early market introduction of vehicles powered by alternative fuels as leverage to improve urban transport sustainability[5].
- **Alternative Fuels Infrastructure Directive (2014)**: it establishes that each EU Member State must adopt a national framework for the development of the alternative fuels market and infrastructure[6]. With specific reference to electric mobility, it sets technical standards for the charging infrastructure and provides indication that an appropriate number of recharging points is accessible to the public, at least in urban/suburban agglomerations and other densely populated areas, and, where appropriate, within networks determined by the Member States[7].

Further than the above-mentioned EU policy documents, in 2018 the European Commission renewed its commitment to reduce CO_2 emission of at least 40% till 2030 with a proposal for new targets for the EU fleet (new passenger cars and vans) average CO_2 emissions[8].

[4] Source: White Paper - Roadmap to a Single European Transport Area – *Towards a competitive and resource efficient transport system*, COM (2011) 144 final

[5] Source: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Together towards competitive and resource-efficient urban mobility*, COM (2013) 913 final

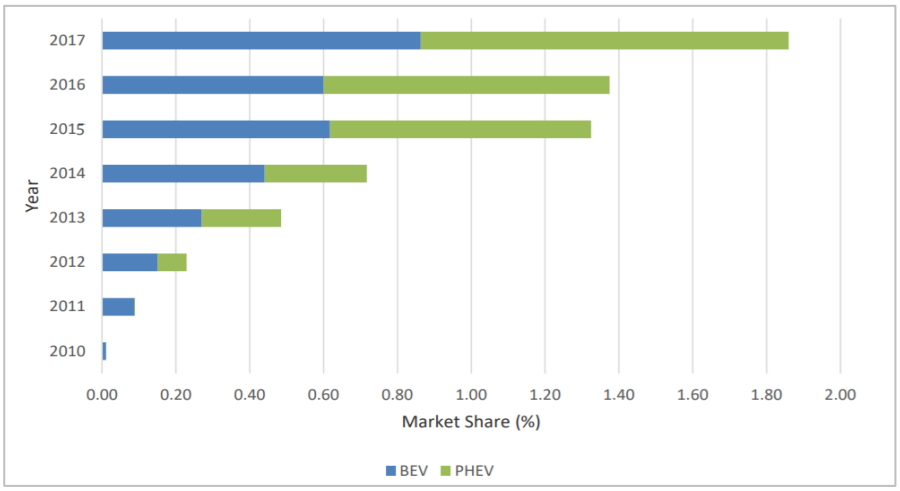
[6] Source: Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure

[7] The Directive indicates that the appropriate average number of recharging points should be at least one recharging point per 10 cars (also taking into consideration the type of cars, charging technology and available private recharging points).

[8] Source: https://ec.europa.eu/transport/modes/road/news/2017-11-08-driving-clean-mobility_en?utm_source=Regions+and+Airport+Newsletter&utm_campaign=b20f7e1f3d-Regions_and_Airports_82_COPY_01&utm_medium=email&utm_term=0_b8d5a5ddc7-b20f7e1f3d-107869137&mc_cid=b20f7e

Concerning e-mobility development in Europe, a recent study of the European Commission Joint Research Centre reports that the market share of electric passenger cars in Europe (Battery Electric Vehicle – BEV and Plug-in Hybrid Electric Vehicle – PHEV) significantly increased in the period 2010-2017, but was still below 2% in 2017, as reported in the following figure.[9]

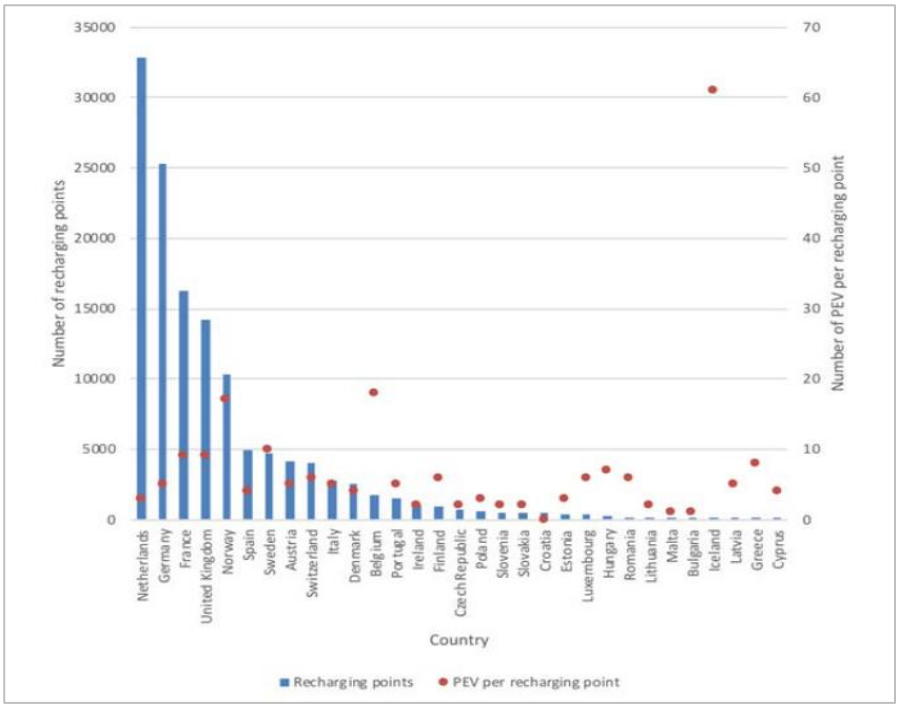
Figure 2. Market share passenger car in Europe between 2010 and 2017



Source: European Commission Joint Research Centre (2018)

Concerning the charging infrastructure, the state of the art in the EU is very heterogenous, as reported in the following figure; Central Europe countries (except Germany and to some extent Austria and Italy) have a lower number of charging points compared to other EU countries.

Figure 3: Recharging points and PEV (Plug-in Electric Vehicle) per point by level of power across Europe

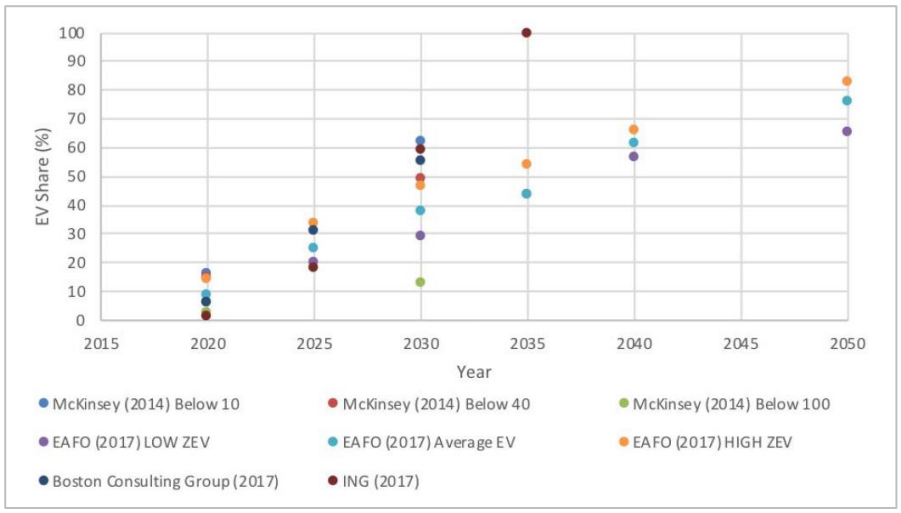


Source: European Commission Joint Research Centre (2018)

[9] Source: Tsakalidis A., Thiel C., European Commission Joint Research Centre, *Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning?* (2018)

Despite the low current market uptake, e-mobility is expected to significantly grow in the long term. The following figure reports forecasts concerning the percentage market share of electric vehicle sales at different time horizons according to different sources.

Figure 4. Percentage share of electric vehicle sales (BEV + PHEV) in Europe until 2050



Source: European Commission Joint Research Centre (2018)[10]

The potential of electric mobility calls for actions by transport infrastructure managers to serve a growing demand. Almost all the LAirA airports are developing e-mobility projects, as reported in the following table which summarises their state of the art and maturity level in e-mobility. The table relies on inputs from the LAirA partners, which also assessed the maturity level on a 1 to 3 scale as it follows:

1. E-mobility is a new topic and actions and plans are not in place (●);
2. E-mobility actions are not in place but there are development plans (●●);
3. E-mobility actions were implemented and there are eventual development plans (●●●).

Table 2. Electric Mobility - maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●●	▫ The Airport is active in designing and implementing an E-Mobility Strategy[11].
WMI	●●	▫ The Airport planned actions concerning electric mobility, in particular e-vehicle rentals, but the idea was abandoned due to the lack of chargers in the surrounded area. ▫ Few e-cars are currently used by airport staff.
STR	●●●	▫ The Airport is very active in e-mobility. There are recharging infrastructure and parking for e-vehicles and multiple initiatives are ongoing[12]. ▫ An e-taxi service is available (GuEST project by the City of Stuttgart).

[10] The legend refers to selected projections (other studies) on the future of EV sales share for the EU until 2050 (for more details please see: Tsakalidis A., Thiel C., European Commission Joint Research Centre, Electric vehicles in Europe from 2010 to 2017: is full-scale commercialisation beginning? (2018))

[11] For more details please see: https://www.bud.hu/en/budapest_airport/responsibility/environmental_responsibility/e_mobility

[12] For more details please see: https://www.stuttgart-airport.com/fairport-str/network

Airport	Maturity level	State of the art
		▫ E-mobility is also part of the Airport's air-side operations: the Airport is hosting pilot technology projects related to e-mobility development (*e-fleet*, *SCALE-UP* and *Li-fleet*) and since 2018 electric vehicles are transporting passengers and luggage.
DBV	-	-
VIE	●●●	▫ Vienna Airport is currently expanding the charging stations for electric vehicles and is active in e-mobility projects[13].
POZ	●	▫ E-mobility is a new topic and currently there are not active projects nor plans for the airport e-mobility development.
MXP-LIN	●●●	▫ E-mobility is part of SEA Milan Airport's sustainable access strategies. ▫ There are 3 electric charging station for electric vehicles at Linate Airport. ▫ The electric car sharing provider EVAI operates at both Linate and Malpensa Airports.

Source: LAirA partners

We note there is a direct correlation between the declared maturity level and the level of deployment of e-mobility infrastructure at national level (in particular for Germany, Austria and Italy). We understand this is due to the fact that the development of the charging infrastructure in airports' catchment areas (and more generally the presence of regional and national policies for e-mobility) is a fundamental enabling factor to develop of e-mobility projects at airports.

2.2. Best practices

International best practices in electric mobility both concern airside operations and airports' surface access. The following table reports 3 examples of e-mobility airport projects with focus on passenger's landside accessibility.

Table 3. E-mobility - best practices

	Amsterdam	Stockholm	Vancouver
Focus	Electric vehicle taxi fleet	Electric charging infrastructure built into road on 2km test track for 18-ton truck that will be carrying goods for *PostNord* and connecting the airport and a logistics site outside the capital city	Public e-vehicle charging points and free charging, plus taxi incentive for fuel efficient vehicles.
Objective - actions	Schiphol Airport seeks to reduce its impact on the environment and to expand the use clean transport to, from and at the Airport.	The project aims to solve the problems of keeping electric vehicles charged and the manufacture of their batteries affordable.	Vancouver Airport has a Master Plan (YVR 2037) which is a 20-year strategy supporting sustainable airport growth and an Environmental Management Plan which sets targets for 2020.

[13] For more details please see. https://www.viennaairport.com/jart/prj3/va/uploads/data-uploads/Konzern/Investor%20Relations/Nachhaltigkeitsbericht/NHB%202018_EN.pdf

	Amsterdam	Stockholm	Vancouver
Timing	The electric vehicle taxi fleet was introduced in 2014.	The development of the e-Road has progressed since 2012; procurement began in 2013 and the road opened in May 2018.	The Taxi Incentive programme was launched in 2004. The first electric vehicle charging points were introduced in 2013.
Critical success factors	▫ Vehicle type – Tesla Models S and X suitable for business travellers and passengers with lots of luggage; ▫ Supportive policy context - policy context for EVs in the Netherlands; ▫ National characteristics - 'range anxiety' for EVs less of an issue in a small country, plus high fuel prices.	▫ An effective consortium to deliver the project (eRoadArlanda consortium); ▫ Supportive national government programme aimed at creating a fossil-free transportation infrastructure by 2030; ▫ Suitable test location.	▫ Free charging offered; ▫ Adequate levels of charging points to ensure availability; ▫ Government incentives for EVs.
Impacts	In 2015 Schiphol Airport retained its 3+ status in Airport Council International's Airport Carbon Accreditation system.	It is estimated that two-thirds of truck transportation in Sweden could be on electrified roads by 2030, reducing energy consumption by approximately 10 TWh or three million tons of fuel.	Vancouver Airport recorded 1,836 charges (2016) at public and employee charging stations, with an increase of 79% over 2015.

Source: SEA Milan Airports LAirA project analysis

2.3. Actions

This section presents the details of the actions planned by the LAirA airports in e-mobility. As reported in the following table, Budapest, Warsaw Modlin, Stuttgart, Poznan, Milan Linate and Malpensa Airports have plans to enhance e-mobility; we understand that the lack of future actions for the other airports may be due to the fact that these airports have not provided inputs to this report, rather than to the actual lack of plans in e-mobility.

Table 4. E-mobility – planned actions

Airport	Planned actions
BUD	▫ Continuing the E-Mobility Strategy implementation; ▫ Gradually replacing the airport fleet with electric vehicles (EVs); ▫ Providing parking lots with EV-chargers for business partners; ▫ Cooperating with e-car sharing companies; ▫ Installing charging stations combined with other commercial services; ▫ Hosting pilot technology projects related to e-mobility; ▫ Developing airport regulations supporting e-vehicles use.
WMI	▫ Increasing the number of e-vehicles used by airport staff.
STR	▫ More e-charging stations and a targeted expansion of the fast charging network (e-grids) are planned.
DBV	-

Airport	Planned actions
VIE	-
POZ	▫ Developing electric bicycles and scooters sharing schemes[14].
MXP-LIN	▫ Upgrading the electric charging infrastructure with new charging stations (108 MXP/ 38 LIN).

Source: LAirA partners

The following table summarises the partners' assessments on the priority, complexity and delivery time horizon of the planned e-mobility actions.

Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 5. E-mobility actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●●	●●●	Medium term
WMI	●	●●●	Long term
STR	●●●	-	-
DBV	-	-	-
VIE	-	-	-
POZ	●●	●	Short term
MXP-LIN	●●●	●●	Short term

Source: LAirA partners

Airport contexts with a higher maturity in e-mobility (Budapest, Linate and Malpensa) assess that actions have high priority, a medium-high level of complexity and that they will deliver actions in the short-medium term.

Concerning Modlin Airport, increasing the number of e-vehicles used by airport staff is assessed by Mazovia Region (the LAirA partner) having high complexity and low priority. This is associated with a longer timing to deliver the action.

Concerning Stuttgart Airport, E-mobility has high priority, and this is in line with the plan to enhance the charging infrastructure.

Concerning Poznan, the delivery of electric bicycles and scooters sharing schemes has medium priority and low complexity, and the City of Poznan (the LAirA partner) plans to deliver them in the short term. We note that the action does not specifically concern the airport but extends to the airport area.

[14] We note the project focuses on the city of Poznan and not specificlly on the Airport.

2.4. Constraints, opportunities and recommendations

We identify the following constraints to the development of e-mobility at airports:

- **EV technology**. Despite technology is progressing, current EV technologies still have constraints regarding ease of use, driving range, time-to-charge, and are more expensive than equivalent conventional vehicles.
- **Traffic impacts**. E-mobility does not contribute to reduce wider transport issues such as congestion or parking pressure.
- **Policy framework**. Despite airports play an important role as generators/attractors of passenger surface traffics, the development of e-mobility projects at airports strongly depends on the availability of recharging points at the wider territorial level, and regional – national polices for the take-up of electric mobility have a fundamental role.

The main opportunities for e-mobility at airports concern:

- **Travel distances**. The range of an EV is limited when compared to the range of a standard vehicle. However, in case of airport operations (air side e-mobility), vehicles are moving within a pre-set area, therefore operating range problems can be lighter than in the case of e-mobility applications for airport surface access.
- **Planning charging needs**. Airports can derive electric mobility charging needs based on parking and vehicle access information. This also allows planning the number and location of normal and fast chargers based on clients' needs (e.g. employees and passengers on a long journey, passengers staying for short periods because they pick-up/drop-off friends and relatives at the airport, or people visiting airport businesses).
- **Demand development**. Despite e-mobility is still a niche market, it is developing fast and many public and private stakeholders are developing projects to foster e-mobility. Airports are in a central position in the transport chain and can understand customer journeys end-to-end. Their cooperation with other territorial stakeholders can foster e-mobility diffusion at the wider regional level.

Finally, we identified the following recommendations to implement actions in e-mobility at airports:

- Working with local and national governments to develop a supportive policy environment for EVs;
- Following a phased development strategy which enables testing the solutions to fit customer needs (e.g. scope of services, capacity, pricing), and the multimodal transportation framework in place;
- Providing attractive incentives for public landside access by EVs *versus* traditionally-fuelled vehicles e.g. paid parking but free charging;
- Providing adequate mix of charging types for different parking needs;
- Developing "bundled" products (e.g. free charging or free e-car sharing service for business-lounge members, providing additional passenger services at the recharging stations);
- Where electric taxis are considered, ensuring vehicles are appropriate design and that appropriate charging infrastructure is introduced to support specific taxi operational requirements;
- Providing incentive programmes to encourage low emission taxis; and
- Fostering customers' experience in e-mobility service delivery.

3. Air-rail links

3.1. Airport thematic relevance and EU Policy background

Where available, rail provides the opportunity for fast, efficient and attractive links to key destinations such as city centre sites. Research shows how the introduction of direct air-rail services can dramatically impact mode share (e.g. Stansted Airport car mode share reduced from 69% in 1991, when its rail link began operations, to 29% in 2013[15]).

Many airports have direct air-rail links, with the rail station either being constructed within the terminal building (such as Amsterdam Schiphol), within short travel distance of the main terminal building (such as Newark) or within a short bus journey way (such as London Luton).

Rail connections that are of good quality provide an attractive alternative to road-based solutions, particularly at congested times on the road network. Airports may rely on standard rail services, also serving the local commuter market, national or international services in the wider catchment area, and/or dedicated express services.

Airport surface access is also a driver of the airport choice and this is especially true for domestic and short-haul international flights, for which travel time to the airport may be long compared to the overall end-to-end journey time.

Finally, developing or improving rail connections can help with environmental challenges, as a significant proportion of the CO_2 emissions at airports are generated by passenger and staff journeys to and from the airport. For example, in 2017 Avinor reported that 23% of total CO_2 emissions at Oslo Airport came from surface access.

The topic of air-rail multimodal transport is directly addressed by the following main EU policy documents:

- the **EC White Paper (2011)**, which includes the goal to optimise the performance of multimodal chains and to connect all core network airports to the rail network, preferably high-speed, by 2050.
- the **EC 6th Report on Economic, Social and Territorial Cohesion (2014)**, which includes in its conclusions the need to improve rail connections in Central and Eastern Europe to make airports more accessible[16].
- **COM (2015) 598 final "An aviation strategy for Europe"**, which has the goal to improve airports' multimodal connections, leading to a more efficient transport network and improved passenger mobility[17].

The LAirA airports are committed to develop or improve air-rail connections. The following table summarises their state of the art and maturity level. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

[15] http://iaro.com/sitefiles/startup2.pdf

[16] https://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion6/6cr_en.pdf

[17] http://ec.europa.eu/transparency/regdoc/rep/1/2015/EN/1-2015-598-EN-F1-1.PDF

1. Air-rail links are a new topic and actions and plans are not in place (●);
2. Air-rail links are not in place but there are development plans (●●);
3. Air-rail links were implemented and there are eventual development plans (●●●).

Table 6. Air-rail links - maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ Budapest Airport has not rail connections. ▫ There is an air-rail project, but the Airport has not a financial role in its implementation. In particular, the project decision, as well as its financing, are of national and municipal competence.
WMI	●●	▫ The Modlin station – airport rail link project is at the environmental assessment stage. The Airport has not a financial role in its implementation. In particular, the project decision, as well as its financing, are of national competence.
STR	●●●	▫ There is an "S-Bahn" city train underground station with direct access to the Airport entrance hall. The city railway lines "S2" and "S3" are operating daily between 05:00 am and 01:00 am with four runs per hour. The train journey is 27 minutes to/from Stuttgart main station. ▫ The Airport has further rail connection plans (high-speed connection).
DBV	-	-
VIE	●●●	▫ There are three types of train connections (CAT, S-Bahn and Regional train). Rail services directly connect the Airport with the city of Vienna (and surrounding municipalities) and Linz. ▫ Plans concern the rail connection expansion direction east.
POZ	●●	▫ Currently there is not an air-rail link. ▫ There are three concepts for a rail connection between the Airport and Poznan city centre (developed in 2007, 2012 and 2017).
MXP-LIN	●●●	▫ Malpensa Airport has rail connections. Future actions concern the implementation of the final study on the rail link between Terminal 2 and RFI (the railway infrastructure manager) railway line in Gallarate and the enhancement of the MXP Express service (in terms of frequency and capacity). ▫ Linate Airport has not rail connections but the extension of M4 underground line to the Airport is in progress.

Source: LAirA partners

We note that all the LAirA airports present a medium/high maturity level on the topic of air-rail links. Vienna, Stuttgart and Malpensa have active rail services, Linate has works in progress, and Budapest, Warsaw Modlin and Poznan Airports have plans for air-rail links.

3.2. Best practices

The success of airport rail links depends on many factors and on local circumstances which define their technical and economic viability. Despite each air-rail project needs a specific assessment, we identify 5 key factors to consider when delivering projects:

- **Location**: positioning the railway station at the airport is a key element to consider when planning a successful airport rail link; wayfinding to the station also plays a key role to foster rail service use.
- **Service frequency and journey time**: these factors determine rail competitiveness compared to other surface access services; for example, "turn-up-and-go" rail services (if these are possible according to the specific airport case) will be more attractive to passengers than trains running every half an hour; moreover, communicating rail frequency in a clear and simple way fosters passengers to use rail over other transport modes.
- **Price**: price influences mode choice and different types of services will have different pricing schemes (e.g. addressing business travellers with a fast rail connections or low-cost travellers with traditional rail services).
- **Airline-railway ticketing integration**: there are several airline-ground transport partnerships around the world, encouraging passengers to book a combined air and rail transport ticket for their travel to/from the airport; these ease door-to-door travel and better airport accessibility.
- **In-town check-in**: offering passengers the possibility to check-in and leave luggage at the departure railway station improves journey quality and fosters rail travel to the airport.

The table below reports four airport best practices in developing air-rail links.

Table 7. Air-rail links - best practices

	Manchester	London Stansted	Oslo	Stockholm Arlanda
Focus	Airport rail integration in the catchment area	Stansted Express	*Flytoget* service	Arlanda Express
Objective - actions	The Manchester Airport Station Travel Plan has objectives which focus on encouraging travel by all users to/from the station by sustainable modes.	The core objective is improving airport accessibility from London and the wider catchment area (Midlands and east England).	In 1992 the Norwegian Parliament decided on Gardermoen to be the main airport and trains to be the main access means of transport.	The objective of the rail link was to allow the airport growing without increasing the road traffic to the airport.
Timing	Manchester Airport's dedicated rail station opened in 1993 and was extended in 2008 and 2015. The current travel plan dates 2018.	Stansted Airport rail station opened in 1991. Platforms were extended in 2011.	Works started in 1994, allowing the line to be opened in 1999. In June 2003 services began running at 210 km/h.	Plans for a railway line from Stockholm city centre to the Airport started in the early 1990s and the line was opened in 1999.
Critical success factors	▫ Manchester Airport serves the regional and wider 'Airport City' employment area; ▫ Airport Advance Fares are available.	▫ "Express" branding; ▫ High frequency; ▫ Special ticket deals; ▫ Direct access to central London.	▫ Punctuality; ▫ High frequency; ▫ High speed; ▫ Services in the Greater Oslo urban area.	▫ Strong leadership in project delivery; ▫ High quality of service; ▫ Ticketing incentives for group travel; ▫ Good design/marketing.

	Manchester	London Stansted	Oslo	Stockholm Arlanda
Impacts	During 2016/17 passengers lowered their carbon footprint by an average of 15% *vs* ten years ago.	The airport's CSR summary report (2016/17) highlights a target to grow rail mode share from 22% in 2015 to 25% in 2019. In 2016/17 this was 28.5%.	Oslo Airport has the highest public transport mode share in Europe (68%) with majority (70%) using *FlytoGet*.	More than 60 million passengers have travelled by train to Arlanda since the service started to operate.

Source: SEA Milan Airports LAirA project analysis

3.3. Actions

The following table reports the actions planned by the LAirA airports in air-rail developments. Airports plan to build air-rail links or improve services.

Table 8. Air-rail links - planned actions

Airport	Planned actions
BUD	▫ The new air-rail should connect East and West Hungary to the Airport. ▫ The project includes the construction of a two-platform underground railway station near Terminal 2. ▫ Additional developments for the new connection include redeveloping the train station at Kőbánya-Kispest.
WMI	▫ There is project of an air-rail link from Modlin railway station to the Airport, including a new rail station at the Airport; additional plans concern a railway connection to Płock (a city at about 70 km west from the Airport).
STR	▫ Air-Rail development plans by 2025 concern: a high-speed track between "Filderbahnhof" (a new airport train station) and the main Stuttgart rail station, which will allow travelling to Stuttgart in 8 minutes and to Ulm (about 90 km south-east from Stuttgart) in 29 minutes; as well as the extension to the Airport with a new station for the "U6" line.
DBV	-
VIE	▫ Future plans concern the construction of a train line to close the gap between the Airport and Bratislava / Budapest, with travel times 25 min to Bratislava and 95 min to Budapest; the identification of the appropriate lines is ongoing (together with the concerned municipalities).
POZ	▫ Future plans concern assessing the viability of rail transport connections to Poznan Ławica Airport.
MXP-LIN	▫ MXP: future plans concern strengthening long-distance rail connections, connections to rail hubs (Centrale, Rogoredo, Lambrate) and improving Malpensa Express service level. ▫ LIN: M4 metro line works to connect the Airport and Milan city centre are in progress.

Source: LAirA partners

The following table summarises the LAirA partners' assessments of the priority, complexity and timing of their air-rail link projects.

Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 9. Air-rail actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●●	●●●	Medium term
WMI	●●●	●●●	Medium term
STR	●●●	●●●	Medium term
DBV	-	-	-
VIE	●●●	●●●	Long term
POZ	●●	●●●	Long term
MXP-LIN	●●●	●●●	Medium term

Source: LAirA partners

Partners indicated a high level of priority to implement air-rail projects, despite these have high complexity. Except Poznan and Vienna Airports, project delivery is planned by 2025.

3.4. Constraints, opportunities and recommendations

The main constraints to air-rail link development concern:

- investment costs;
- cooperation between many stakeholders that may have different agendas;
- potential rail capacity problems;
- perceived threat to airport parking revenues.

Demand for air travel is growing both in Europe and globally and it is important that airports ensure their infrastructure is ready to efficiently serve it. Developing or improving rail access allows exploiting the following main opportunities:

- welcoming more passengers from wider catchment areas and increasing aviation and commercial revenues[18];
- opening commercial and real-estate opportunities around the airport region (e.g. the Ring Rail Line introduction to Helsinki Airport entailed over 40,000 new jobs);
- making airport access more sustainable.

Finally, we identified the following recommendations to deliver air-rail links:

- Developing station travel plans to support sustainable access to stations;
- Promoting ticketing incentives such as Interline tickets and Airport Advance Fares for air passengers;
- Providing discounted ticket options for staff;
- Developing suburban rail links for airports, to improve the wider direct accessibility for passengers and airport employees;

[18] With reference to aviation revenues, we note that this report does not explore the topic of air and high-speed rail competition.

- Ensuring Express services offer an easy to understand level of service in terms of travel time and quality of service;
- Ensuring that air-rail services are high frequency, reliable, provide modern facilities (such as Wi-Fi) and provide direct connections to city centre transport hubs;
- Where new infrastructure is built, ensuring careful risk management, including contingency planning should it be needed;
- Ensuring procurement criteria in PPP (Public-Private Partnership) projects include consideration of interaction of other services and future infrastructure and rolling stock needs; and
- Ensuring ticket pricing is set at a level that is attractive for the user so not to suppress demand and maximise opportunities for CO_2 reduction.

4. Active travel

4.1. Airport thematic relevance and EU policy background

Some airports can reduce transport negative externalities by fostering active travel (cycling and walking), thanks to their layouts and locations. Active travel is generally addressed with reference to mobility management and to employees' systematic trips.

The topic of active travel is addressed by the EC White Paper[19]. This has a section dedicated to clean urban transport and commuting which highlights that "facilitating walking and cycling should become an integral part of urban mobility and infrastructure design".

Promoting active travel strongly depends on the airport proximity to urban areas. We identified three LAirA Airport groups with reference to the distance to their reference city / functional urban area:

- **Close distance**: Poznan and Linate Airports are within 7 km from the city centre;
- **Medium distance**: Stuttgart Airport is 13 km from the city centre, whereas Budapest, Vienna and Dubrovnik Airports are about 20 km;
- **Large distance**: Warsaw-Modlin and Milan Malpensa Airports are respectively 40 and 50 km from the city centres.

There may be opportunities for active travel in each group, though urban proximity determines active travel demand and potential. Concerning the first group, urban density and close city distance are great assets to facilitate active travel. Concerning the second and third groups, the airport location might be close to suburban areas which are near enough to commute by bike if proper infrastructure is available.

The main reasons for airports to promote active travel include:

- optimizing and reducing budget allocated to rent parking spaces;
- improving employee wellness and travel experience;
- rationalize the use of private vehicles; and
- contribute to solve environmental issues.

The following table summarises the state of the art and maturity level in active travel at the LAirA airports. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

1. Active travel is a new topic and actions and plans are not in place (●);
2. Active travel is not in place but there are development plans (●●);
3. Active travel actions were implemented and there are eventual development plans (●●●).

Table 10. Active travel - maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ The Airport is designing investments in active travel infrastructures and facilities.
WMI	●●	▫ There are bicycle stands at the Airport and bicycle paths to Nowy Dwór Mazowiecki (the city where the Airport is located).

[19] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52011DC0144&from=EN

Airport	Maturity level	State of the art
STR	●●	▫ There is a plan for e-bicycle infrastructure from the city to the Airport (after the city railway U6 will be build).
DBV	-	-
VIE	●●●	▫ A 17-Km cycling path connects Vienna Airport, the City of Vienna and other municipalities in Vienna functional urban area. ▫ Two stations of the bike sharing operator *Nextbike* are available at the Airport (however with a low level of use).
POZ	●	▫ The topic is new to the Airport and there are not additional plans than including the Airport in the city e-bike sharing scheme (described under the electric mobility chapter of this report).
MXP-LIN	●●	▫ SEA wants to develop a plan for a bike path at Malpensa Airport.

Source: LAirA partners

Vienna Airport has a high maturity level in active travel, cycling infrastructures in place and the share of employees cycling to work is about 2%.

Budapest, Modlin, Stuttgart and Milan Airports have a medium level of maturity, with additional plans in place. Despite a lower level of maturity than Vienna Airport, we note that the share of employees cycling and walking to work is 4% at Budapest Airport and 11.4% at Linate Airport (on the other hand, the share at Malpensa is 2.8% and we understand this is due to its distance from Milan). The share of commuters by bike and on foot at Modlin Airport is about 3%.

We also note that despite the City of Poznan indicates a low maturity level in active travel at the Airport, previous LAirA analyses reported that thanks to the short distance from the city and the existing safe cycling infrastructure, the Airport has 6% cycling and 3% walking commuting shares.

Concerning Dubrovnik Airport, previous LAirA analyses indicate that it is hardly accessible safely on foot or by bicycle and the modal share of walking is 1.0%.[20]

4.2. Best practices

The table below reports two airport cases of active travel.

Table 11. Active travel - best practices

	Geneva	Vancouver
Focus	Cycling development project	Cycling development project
Objective - actions	▫ Reducing private vehicles modal share; ▫ Reducing noise and air pollution; ▫ Reducing congestion in nearby airport areas.	Encouraging cycling to reduce carbon emissions as set out in the Airport Environmental Management Plan (EMP).
Timing	2004 – ongoing	2011 - ongoing

[20] Data sources on modal share are the LAirA surveys to employees dated 2018. Notes: data for Milan Airports refer to the percentage frequency of the answers to the LAirA surveys at Linate and Malpensa indicating that cycling is one of the transport modes to commute to work; data for Vienna Airport predate the LAirA project.

	Geneva	Vancouver
Critical success factors	▫ Supportive local transportation policy; ▫ High level of accessibility to facilities by foot and bike; ▫ E-bike support and incentives; ▫ Provision of easily accessible cycle parking; ▫ Provision of cycle awareness campaigns.	▫ Inclusion of cycling as an area of focus within the EMP; ▫ Availability of a cycle network providing access by bicycle to the Airport; ▫ Availability of cycle parking for staff and passengers; ▫ Integration of cycling to other public transport modes; ▫ Detailed information available on cycle routes; ▫ Participation by the airport in promotional activities.
Impacts	Concerning staff, private vehicles mode share decreased from 60% (2007) to 48% (2017). Sustainable mode share increased to 38% in 2017 including a 7% share for cycling.	Vancouver Airport continues to report growth in cycling. Its bike trackers recorded 87,688 cyclists on Sea Island in 2017, a 4% growth over 2016.

Source: SEA Milan Airports LAirA project analysis

4.3. Actions

All the LAirA airports are interested in the active mobility topic and have foreseen actions to foster it[21], as reported in the table below.

Table 12. Active travel – planned actions

Airport	Planned actions
BUD	▫ Improving cycling infrastructure (new internal cycle tracks and connections to the existing cycling network); ▫ Delivering auxiliary facilities at workplace e.g. safe bike storage and parking; ▫ Fostering bike use by a corporate bike-pool system and promoting behavioural change; ▫ Integrating the Airport soft mobility plans (cycling and walking) into the local and regional mobility planning; ▫ Awareness raising activities for employees.
WMI	▫ Further improving infrastructure near the airport (pavements/sidewalks, new bicycle paths and stands) to Zakroczym and Pomiechówek; ▫ Improving intermodal accessibility through public bike-sharing services from Nowy Dwór Mazowiecki, including Modlin train station, to the Airport. ▫ Providing bike (and e-bike) sharing system for employees to move at the airport area.
STR	▫ Delivering e-bicycle infrastructures in the Airport surrounding area.
DBV	▫ Improving infrastructures and facilities for commuters (pedestrians and cyclists) to improve safety on routes connecting the Airport.
VIE	-

[21] We note that Vienna Airport information on future actions were not provided by the LAirA partner, but this does not necessarily mean that there are no plans to foster active travel in the future.

Airport	Planned actions
POZ	▫ Providing a cycle docking station at the Airport; ▫ Integrating the Airport within the public bike-sharing system.
MXP-LIN	▫ LIN: developing greenways for employees (walking and cycling).

Source: LAirA partners

The following table summarises the partners' assessments on priority, complexity and timing of the active travel projects.

Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 13. Active travel actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●	●●	Medium term
WMI	●●	●	Short term
STR	●●●	●	Medium term
DBV	-	-	-
VIE	-	-	-
POZ	●●	●●	Medium term
MXP-LIN	●	●●	Medium term

Source: LAirA partners

Actions have an average medium priority and level of complexity. On average project delivery is planned in the medium-term (by 2025). We understand that this time horizon is related to cycling infrastructure works (which also need public authorities' engagement and relevant planning), more than to behavioural change actions and to facilities procurement, which typically need shorter times.

4.4. Constraints, opportunities and recommendations

Walking and cycling has an optimal range in daily commuting deriving from the journey average speed. Depending on the lifestyle and attitude of an employee, the range of walking is up to 2-3 km, but it might reach 5 km. Nevertheless, residential areas are rarely located in the close vicinity of airports, therefore walking has limited potential. Opportunities exist in terms of improving walking infrastructure between public transport facilities and the airport.

Cycling can cover higher distance ranges and can be competitive compared to car. Distances covered typically reach 5 km, but they can be higher (e.g. up to 25 km) in case of e-bikes.

Constraints to cycling concern:

- lack of safe, barrier-free infrastructure;
- weather conditions;
- topography;

- lack of facilities at the workplace (safe parking places, changing rooms, lockers and showers);
- individual behaviours, social patterns and culture.

Finally, we identified the following recommendations to deliver active travel projects:

- Promoting employee campaigns on sustainable mobility to improve awareness and participation;
- Introducing award systems and discounts to motivate employees to behaviour change;
- Supporting e-bikes (e.g. charging points, incentives, as well as e-bike sharing schemes) where topography and journey length are likely to be key barriers to cycling;
- Including consideration of cycling as a key mode choice within airport surface access strategy/environmental management plan;
- Developing on-site cycle routes to connect key destinations at the airport with the wider cycle network;
- Providing clear information on the cycle network and cycle parking to place emphasis on access to the airport by bike, including a site-specific cycle map; and
- Developing relationship with local transport and road infrastructure authorities to ensure that the wider cycle networks support airport access from the local community.

5. Shared mobility

5.1. Airport thematic relevance and EU policy background

Car-sharing and car-pooling can be effective ways to reduce carbon emissions for airport landside access[22].

Car-sharing services complement more traditional car rental companies and taxis by providing a cost effective and convenient option for those who require access to a vehicle for more than one single journey (where a taxi may be most convenient) but do not require longer term car hire.

Car-pooling has been a key measure within the wider workplace travel plan field for many years and case studies show the applicability of the approach and associated incentives in an airport context. Despite car-pooling at an airport can be challenging due to a range of shift patterns that staff work (which may limit the potential for demand matching), services now increasingly offer dynamic matching options for more *ad-hoc* journeys.

We have not found a specific EU policy addressed to shared mobility at airports, but the topic is part of the European Strategy for low-emission mobility which includes shared mobility schemes, such as car-sharing and car-pooling, as solutions to reduce congestion and pollution[23].

The following table summarises the maturity level and state of the art in shared mobility at the LAirA airports. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

1. Shared mobility is a new topic and actions and plans are not in place (●);
2. Shared mobility actions are not in place but there are development plans (●●);
3. Shared mobility actions were implemented and there are eventual development plans (●●●).

Table 14. Shared mobility – maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ The Airport will test an employee car-pooling application within the LAirA project and enhance car-sharing.
WMI	●●	▫ 10% of employees are currently car-pooling. ▫ The Airport will test an employee car-pooling application within the LAirA project. ▫ Panek car-sharing is available at the Airport (special zone outside Warsaw).
STR	●●●	▫ The Airport is cooperating with the car-sharing company *Car2Go*, which provides services with electric vehicles.
DBV	-	-
VIE	●●●	▫ *Car2Go* and *DriveNow* are available at Vienna Airport. ▫ A car-pooling platform "Drive2VIE" for employees is active.
POZ	●●	▫ There are 4 car-sharing companies in Poznan that offer the possibility to travel to the airport district (but not to the private parking next to the airport).

[22] In this report we define: car-pooling the scheme in which people share rides and the driver makes the vehicle available; car-sharing the scheme in which a car-sharing operator has a fleet and people hire cars. Moreover, we do not focus in this chapter on bike sharing schemes which were described in the previous chapter on active travel.

[23] Source: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A European Strategy for Low-Emission Mobility*, COM(2016) 501 final (available at https://ec.europa.eu/transport/themes/strategies/news/2016-07-20-decarbonisation_en)

Airport	Maturity level	State of the art
MXP-LIN	●●●	▫ SEA Milan Airports will test an employee car-pooling application within the LAirA project for both Linate and Malpensa. ▫ The *E-Vai* electric car-sharing operator provides services at Malpensa and Linate Airports. ▫ The car-sharing operators *CAR2GO*, *ENJOY* and *DRIVENOW* provide services at Linate Airport.

Source: LAirA partners

The LAirA airports have a medium-high level of maturity in shared mobility (car-pooling or car-sharing). Concerning car-sharing we understand this is related to the fact that the shared mobility market is growing, and airports are interesting customers for car-sharing mobility providers. Concerning car-pooling services, actions focus on the LAirA pilot projects at Budapest, Modlin, Linate and Malpensa Airports.

5.2. Best practices

The following table reports three airport cases of shared mobility.

Table 15. Shared mobility – best practices

	Brussels	London Stansted	Vienna
Focus	*DriveNow* and *Zipcar* car-sharing schemes	Car-pooling scheme	*DriveNow* and *Car2Go* car-sharing schemes
Objective - actions	Brussels Airport has an objective to reduce dependence on fossil fuels, postponing depletion of oil reserves and greening its energy policy. This includes fostering shared mobility schemes.	The scheme's objective is reducing impacts (including carbon emissions) of staff commuting.	The car-sharing schemes aim at reducing impacts (including carbon emissions) at the airport and widening surface access offer.
Timing	In 2010 Brussels Airport set its targets to reduce its emissions. In 2018 the airport committed to permanently reduce CO_2 emissions. We have not found information on the car-sharing services start date.	Stansted's car pool programme has been in place for over a decade.	*Car2Go* began operating in Vienna in 2011.
Critical success factors	▫ Availability of vehicles that meet users' needs; ▫ Passengers' demand; ▫ Ease of booking and use; ▫ Location of car vehicles at airport terminal; and ▫ Availability of parking at destinations.	▫ Provision of incentives for participating staff; ▫ Provision of an Emergency Ride Home scheme; ▫ Provision of a private car pool group for Stansted Commuter Centre (a centre at the Airport supporting commuters); ▫ Promotion by the Commuter Centre.	▫ Partnership of car-sharing operator with airline for additional incentives; ▫ Corporate account for business use; ▫ Same car-sharing provider available at many key European destinations allowing use at start and end of journey; ▫ Flexible parking locations.

	Brussels	London Stansted	Vienna
Impacts	We did not find information on specific impacts; however, UK research indicates car club vehicles emit over 33% fewer CO_2 emissions per kilometer than the average UK car.	In 2017, the car pool programme had approximately 2,000 members.	▫ We did not find information on the specific environmental impacts, however UK research indicates car club vehicles emit over 33% fewer CO_2 emissions per kilometer than the average UK car. ▫ 27% of Viennese DriveNow clients use the car-sharing offer for rides to access the airport (23% of car2go users do so).[24]

Source: SEA Milan Airports LAirA project analysis

5.3. Actions

Shared mobility schemes are available at most of the LAirA airports and planned actions mainly focus on improving available services and testing new car-pooling schemes.

Table 16. Shared mobility – planned actions

Airport	Planned Actions
BUD	▫ The Airport will introduce an on-line car-pooling platform for employees, aimed to foster the joint use of company/manager/pool cars for commuting to/from the Airport and to reduce car traffics at the Airport by using shared cars to attend business meetings (LAirA pilot project). ▫ The development of a new commercial area for car-sharing companies has started.
WMI	▫ The Airport will test a car-pooling application for employees (LAirA pilot project). ▫ There is a plan to start closer cooperation with car-sharing companies.
STR	▫ Plans concerns continuing cooperation with the car-sharing company *Car2go*.
DBV	-
VIE	▫ Plans concern the expansion of dedicated parking spaces for car-sharing vehicles at the Airport.
POZ	▫ The is a plan to extend the car-sharing sharing system (parking in the commercial or public area next to the airport).
MXP-LIN	▫ SEA Milan Airports plan to improve the car-sharing service supply and test car-pooling services for employees (LAirA pilot project).

Source: LAirA partners

[24] Further than impacts concerning the specific Airport case, a recent report by the City of Vienna concerning car-sharing indicates that (please see https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008470.pdf):

- approximately one third of the Viennese car-sharing users does not have a season ticket for public transport;
- about 60% of users choose car-sharing for comfort and travel time or because cabs are too expensive;
- few users choose car-sharing for environmental reasons.

The following table summarises the partners' assessments on priority, complexity and timing of shared mobility projects.

Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 17. Shared mobility actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●	●●	Short term
WMI	●●	●	Short term
STR[25]	●●●	●	Short term
DBV	-	-	-
VIE	●●	●●	Short term
POZ	●●	●	Short term
MXP-LIN	●●	●	Short term

Source: LAirA partners

Actions have an overall medium priority, low-medium complexity of implementation and all Airports plan to deliver them in the short term.

5.4. Constraints, opportunities and recommendations

Shared mobility actions include some risks and constraints, in particular:

- Bikers and public transport users shift to car-pooling/sharing;
- Low use of services/absence of a critical mass of users of car-pooling services (e.g. non-acceptance by users due to lack of matching between demand and supply);
- Enough availability of car-sharing services to comply with users' needs;
- Seasonal variations in demand / supply;
- Service maintenance; and
- Fears of personal security in car-pooling services.

Opportunities for shared mobility concern:

- Partnerships between airlines and car-sharing providers;
- Integrating car-sharing services into web-services; and
- Car-pooling technology catering for more dynamic matching.

Finally, we identified the following recommendations to deliver shared mobility services:

Car-sharing

- Ensuring car-sharing vehicles can meet the needs of airport passengers e.g. availability, room for luggage, free-floating parking at the final destination;

[25] We have not received inputs concerning the level of complexity and timing; nevertheless, considering that the future action concerns follow-up cooperation with the car-sharing provider we assume that the complexity is low and that the time frame to deliver the action is short.

- Considering potential for inclusion of electric vehicles in the vehicle offer dependent on local wider context of EV adoption;
- Encouraging partnerships with airlines to act as an additional incentive for car-sharing;
- Ensuring car-sharing offer is tailored to passenger demographic e.g. make available corporate accounts for business travellers if these are a core demographic; and
- Early defining distinct responsibilities and respective monetary (company/department-wise) budgeting for a certain period of time (for which the service should be operated).

Car-pooling

- Providing a full package of car-pooling incentives and support e.g. priority parking and emergency ride home;
- Balancing need for security with need for large potential car share population to maximise possibilities for matching; and
- Setting-up socially and ethical acceptable rules for service use and safety/security measures for strengthening the subjective perception of user safety, by also implementing experience sharing options (e.g. reviews of rides).

6. Intelligent Transport Systems

6.1. Airport thematic relevance and EU policy background

The topic of Intelligent Transport Systems (ITS) is extremely wide and includes advanced applications to provide innovative services relating to different modes of transport, traffic management and enable various users to be better informed and make safer, more coordinated and 'smarter' use of transport networks. ITS integrate telecommunications, electronics and information technologies with transport engineering to plan, design, operate, maintain and manage transport systems[26].

In July 2010 a legal framework (Directive 2010/40/EU) was adopted at EU level to accelerate the deployment of ITS technologies across Europe.[27] The Directive includes eight priorities actions:

a. the provision of EU-wide multimodal travel information services;

b. the provision of EU-wide real-time traffic information services;

c. data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users;

d. the harmonised provision for an interoperable EU-wide *eCall*[28];

e. the provision of information services for safe and secure parking places for trucks and commercial vehicles; and

f. the provision of reservation services for safe and secure parking places for trucks and commercial vehicles.

In the LAirA context, ITS focus the first two priority actions and in particular on multimodal travel and traffic information on landside airport accessibility. Among the different tools to provide passengers travel and traffic information, Airport Apps play a key role. In fact, the number of mobile phone users in the world is expected to pass the five billion mark by 2019. In 2016, an estimated 62.9% of the population worldwide already owned a mobile phone. The mobile phone penetration is forecasted to continue to grow, rounding up to 67% by 2019. The development of good quality Apps is therefore of crucial importance when it comes to conveying customers real-time information. Apps allow travellers to have information about flights (gate, delays or cancellations), shopping opportunities, car parking and accessibility via public transport, car or taxi on their smart phone. In addition to that, they also offer marketing and advertising opportunities.

The following table summarises the state of the art and maturity level in ITS at the LAirA airports. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

1. ITS is a new topic and actions and plans are not in place (●);
2. ITS actions are not in place but there are development plans (●●);
3. ITS actions were implemented and there are eventual development plans (●●●).

[26] Source: Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport

[27] Please see: https://ec.europa.eu/transport/themes/its/road/action_plan_en

[28] eCall is a European initiative that aims to provide rapid assistance to motorists involved in road accidents, wherever they are in the European Union. The device is mandatory in every new car sold within the EU starting from April 2018.

We note that:

- airports provide information on surface access in their websites and most of them developed airport Apps;
- the partners' assessments on the maturity level is quite heterogeneous;
- some partners report road traffic management projects and plans, which are nevertheless urban mobility projects not directly related to Airport ITS applications.
- Milan Airports are developing a Mobility as a Service project.

Table 18. ITS – maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ Ongoing stakeholder negotiations (with road maintenance companies, technology providers, road owners), to explore the Airport's future role in ITS development in the airport region. ▫ Budapest Airport App.
WMI	●	▫ No specific plans except ITS solutions in Warsaw.
STR	●●●	▫ Stuttgart Airport App. ▫ Stuttgart Airport website mobility information provision: https://www.flughafen-stuttgart.de/an-abreise-und-parken/anreise-mit-bus-und-bahn/
DBV	-	▫ Dubrovnik Airport App.
VIE	●	▫ Vienna Airport App.
POZ	●●●	▫ Traffic management technologies along Bukowska street, the main road to the airport from the city centre (e.g. coordination of green lights at crossroads, priority for public transport, etc.)
MXP-LIN	●●●	▫ Milan Airports App. ▫ Mobility as a Service project ongoing.

Source: LAirA

6.2. Best practices

We focused the analysis of international best practices on 2 airport Apps.

Table 19. ITS - best practices

	Munich	Gatwick
Focus	*Passngr* App and airport website	Gatwick App
Objective - actions	The objective is supporting passenger seamless travel across multiple transport modes.	The objective is providing airport customers with information about the airport, including landside travel information and information on disruptions.
Timing	The "travel assistant" is a core part of the Munich Airport Website. The *Passngr* App is available wince late 2018 and focuses on Munich, Hamburg, Düsseldorf and Münster-Osnabrück airports.	The current Gatwick App was introduced in winter 2017/18 and most recently updated in summer 2018.

	Munich	Gatwick
Critical success factors	The critical success factor is the close relationship between the airport, public transport agencies and technology companies.	▫ Dynamic information connected to real-time journey information; ▫ Linkage with Google maps journey planning facility; ▫ Well designed, intuitive App.
Impacts	The website already provides full journey planning information, removing the necessity for different journey planners and websites (e.g. ticket costs information).	Information is limited on the impact of Apps on travel patterns and how the App can support reductions in carbon emissions from landside access. The App itself seems well received with a rating of 3.9 out of 5 on the App Store.

Source: SEA Milan Airports LAirA project analysis

6.3. Actions

The following table summarises the actions planned at each LAirA airport. Only Milan Airports and Budapest Airport focus on specific airport applications. The City of Poznan reports about a project which is not airport specific. We note that the lack of actions for the other LAirA airports may be due to the fact that these did not provide direct contributions to this report (STR, DBV, VIE).

Table 20. ITS - planned actions

Airport	Planned actions
BUD	▫ Developing smart road applications in Budapest functional urban area road network. ▫ Reconstructing the main road connecting Budapest City and the Airport by including ITS equipment.[29] ▫ Piloting state-of-the-art technologies in the airport FUA. ▫ Integrating the functional urban area and Airport ITS mobility developments. ▫ Airport parking booking on-line system, plus connecting smart parking, travel info and e-charging systems.
WMI	▫ No actions planned.
STR	-
DBV	-
VIE	-
POZ	▫ Updating the “Poznan City Guide” application.
MXP-LIN	▫ Enhancing passenger digital experience and delivering a Mobility as a Service project at Linate and Malpensa Airports: real-time information, smart parking, digital wayfinding at terminals, surface access planning – booking – payment, disruption management.

Source: LAirA partners

[29] Several feasibility and technology studies were prepared by the Hungarian State. ITS developments and installation of basic ITS infrastructure is planned for the first phase of the reconstruction (expected until 2022).

The following table summarises the partners' assessments on priority, complexity and timing of the ITS projects. Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 21. ITS actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●	●	Medium term
WMI	-	-	-
STR	●●●	-	-
DBV	-	-	-
VIE	-	-	-
POZ	●●●	●●	Short term
MXP-LIN	●●●	●●●	Short term

Source: LAirA partners

ITS has a medium-high priority. Complexity varies, and we understand this is related to the diversity of actions at the different airports.

6.4. Constraints, opportunities and recommendations

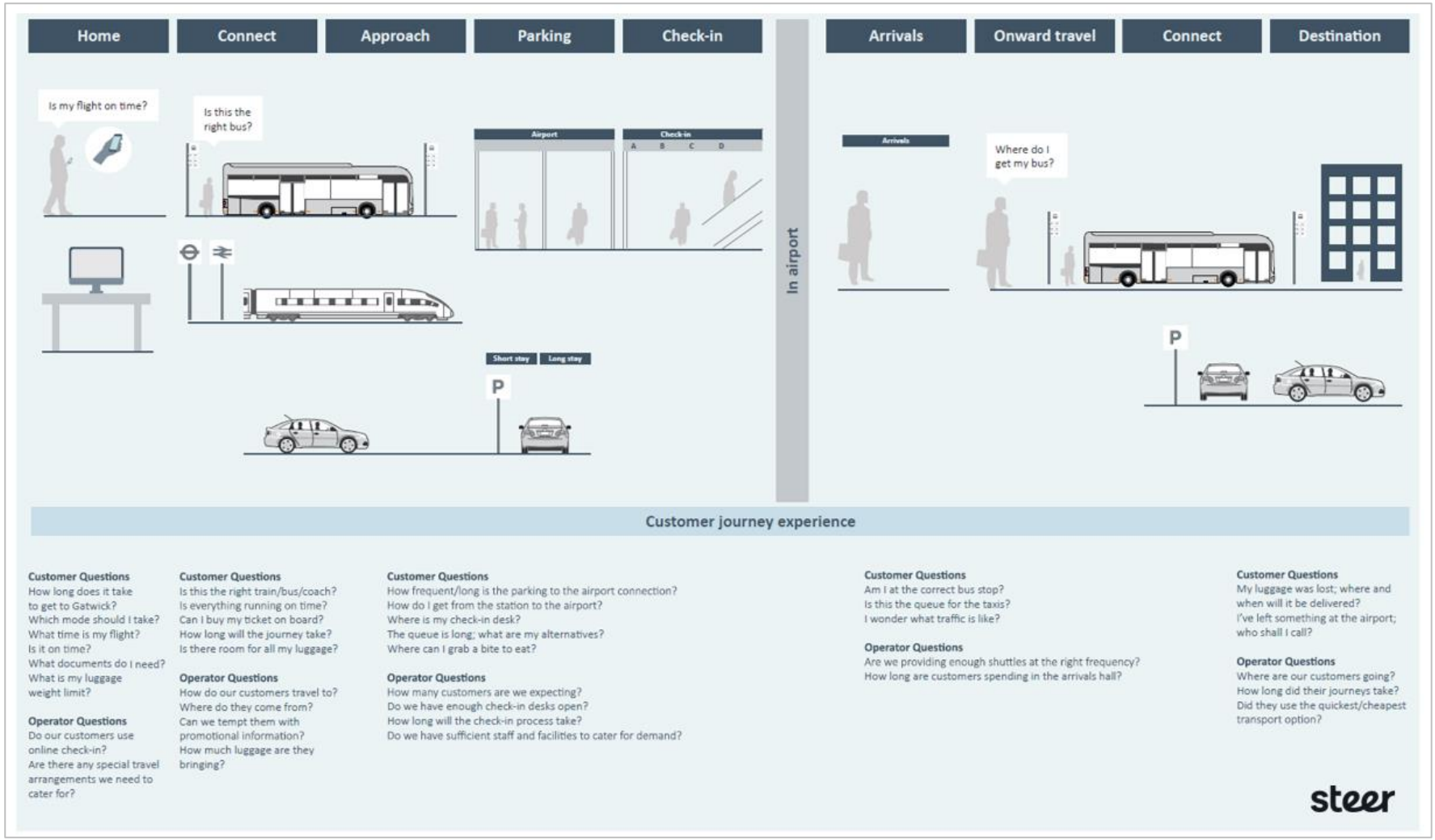
ITS developments are generally complex and a core challenge concerns stakeholder management and cooperation. In their role of multimodal hubs, airports have the potential to activate transport chain stakeholders' cooperation and consolidating travel information for passengers. Multimodal travel applications can nevertheless have different development levels, from information provision to ticket selling, and consequent different levels of complexity (e.g. concerning commercial agreements with transport providers).

ITS applications can bring significant opportunities to airports, such as:

- Understanding and influencing the travel of passengers and employees;
- Managing travel demand and raise awareness of more sustainable travel options;
- Getting better intelligence of passenger and employee movement patterns, removing the need for costly surveys;
- Learning from ITS data to understand how influencing landside passenger travel can link through to increased passenger satisfaction at the terminal and an uplift in retail spend;
- Using data to optimise staff and system operations (security, check-in, etc.); and
- Building over time richer digital experiences, adding retail, flight info, boarding passes functionalities.

A key element to deliver ITS applications for passengers is understanding customers' need. The following figure reports an example of the customer journey experience and associated passenger and airport's information needs. It shows how airport Apps can benefit passenger journey and airport management.

Figure 5. Customer journey experience



Source: Steer

Finally, additional recommendations to deliver travel information systems are:

- Raising the profile of dynamic landside multi-modal travel information within airport websites and Apps;
- Ensuring the landside travel information is consistent across all media e.g. airport App, airport website, operators' information and other key journey planning options; and
- Allocating responsibilities and ensuring compliance regarding data privacy and protection.

7. Wayfinding

7.1. Airport thematic relevance and EU policy background

The provision of effective wayfinding and intuitive information design for users forms a fundamental part of the airport user experience. It provides passengers with more control over their journey and this in turn results in direct benefits not just for the passenger, but also for the airport. For the travellers, simply knowing where they are, where they need to be and how to get there give them more control over their journey and reduce stress. For the airport, having a passenger who is in control of the journey leads to increased satisfaction levels, an important benchmark for airport efficiency.

Wayfinding is more than just signs, it is a physical extension of a brand, a reflection of a destination's physical character and an information system. It is important to understand there are a number of factors that influence how users, including persons with reduced mobility (PRM), interact with a wayfinding system. These factors can be broadly grouped into three different types: people, environmental and information factors. In particular, broadly speaking, wayfinding is important to:

- **Passengers and their greeters** – need to locate facilities in a timely manner as to reach their next transport mode with a minimum of stress. If they cannot find the facilities on their own, they may instead ask airport staff, distracting them from their main duties, increasing staffing requirements and costs.
- **The airport as a transport facility** – the efficient movement of people between transport modes is the main role of an airport. Wayfinding can be used to help move passengers through the facility, reducing congestion and the risk of delays to transport services. Moreover, a passenger's journey does not stop once they exit the airport; on-ward and post journey information are important elements of the user journey and should be considered part of the responsibility of the airport operator.
- **The airport as a business** – the commercial sustainability of an airport means meeting the needs of its customers (passengers, airlines and tenants). Wayfinding can help to enhance the viability of commercial units but also to contribute to the atmosphere within the airport, which will make it more attractive to each customer type.
- **The airport city** – when the scope of activity at an airport increases to provide the hub of many non-aviation activities, the need to help people navigate through these functions is a key. Users need to know when they are in the airport zone, with its greater level of security overlay, versus when they are in the ancillary commercial neighbourhood with its less formal supervision.

Effective wayfinding and information design will: better connect users to destinations, use consistent nomenclature, maintain a safe movement, be predictable, disclose information progressively, help users learn, keep information simple and be accessible.

We have not found a specific EU policy background related to wayfinding. Nevertheless, wayfinding should take into considerations EU legislation concerning PRMs for different transport modes.

The following table summarises the state of the art and maturity level in wayfinding at the LAirA airports. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

1. Wayfinding is a new topic and actions and plans are not in place (●);
2. Wayfinding actions are not in place but there are development plans (●●);
3. Wayfinding actions were implemented and there are eventual development plans (●●●).

Table 22. Wayfinding – maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ The public transport company in Budapest has a wayfinding/travel application project on services (road public transport, rail, bicycle, car-sharing) and traffic information. The Airport intends to join this project.
WMI	●●●	▫ New signs and time tables are available at the Airport terminal building and parking areas; there are further plans for improvement.
STR	●●	▫ There is a wayfinding system at the Airport, including a relatively new real time availability of the city-railway schedule and wayfinding to the railway at the baggage claim in the arrival hall.
DBV	-	-
VIE	●●●	▫ Wayfinding is assessed by the LAirA partner as a mature topic at Vienna Airport.
POZ	●●●	▫ In 2014 the City implemented the "Poznan City Guide" application[30].
MXP-LIN	●●	▫ There is a study on MXP Terminal 2 wayfinding improvement.

Source: LAirA partners

Partners' inputs indicate a medium-high level of maturity in wayfinding actions.

7.2. Best practices

The table below shows 3 best practices in airport wayfinding projects.

Table 23. Wayfinding - best practices

	Catania	Toronto Pearson	New York
Focus	Optimization of internal and landside wayfinding and signage systems	Travel information poster	Wayfinding master system for John F. Kennedy, Newark Liberty, and LaGuardia Airports
Objective - actions	The project aimed at optimizing viability and passenger's awareness during airport surface transits.	The primary objective was to better connect passengers to surface transit for all onward journeys from the airport.	The challenge was to develop one master system that could be applied to all airport terminals, roadways, and parking facilities, and which had the sophistication to direct passengers from all over the world within an environment of hundreds of possible destinations.

[30] We note the project does not specifically focus on the airport wayfinding.

	Catania	Toronto Pearson	New York
Timing	Wayfinding and information system design took 8 weeks to develop and was implemented in a couple of months.	The project duration was seven weeks, this included design to implementation.	The manual for Pedestrian Signage and Wayfinding was published in 2013.
Critical success factors	A critical success factor was the analysis of the access system and of users' flows and decision points to identify the quality of the information provided within internal and landside areas and improve user experience.	A critical success factor was providing the transit information in a unified format that is easily accessible to the variety of user types passing through the airport and making onward connections.	Color-coding increased visibility and information comprehensibility, allowing passengers to follow only signs that are relevant to them at a given moment.
Impacts	Not assessed.	Positive feedback from Greater Toronto Airports Authority.	Survey of the new system at LaGuardia Central Terminal confirmed significantly improved consumer satisfaction.

Source: SEA Milan Airports LAirA project analysis

7.3. Actions

Wayfinding is addressed by the LAirA airports by improving the existing signage system and by developing new wayfinding facilities for landside accessibility. The following table summarises the planned actions at each LAirA airport.

Table 24. Wayfinding - planned actions

Airport	Planned actions
BUD	▫ Providing one information platform for all transport modes. ▫ Improving transportation signs (road signs, directions, locations of services, etc.). ▫ Installing new directional signs and information displays ("BUD+ Program"). ▫ Revising traffic signs within the terminals.
WMI	▫ Improving signs and timetables at the airport and at nearest train station. ▫ Improving road signs.
STR	-
DBV	-
VIE	-
POZ	▫ Updating the "Poznan City Guide" application.
MXP-LIN	▫ Improving airports (esp. LIN) wayfinding to mobility services and facilities.

Source: LAirA partners

The following table summarises the partners' assessments on priority, complexity and timing of the wayfinding projects. Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 25. Wayfinding actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●	●●●	Medium term
WMI	●●	●	Short term
STR	-	-	-
DBV	-	-	-
VIE	-	-	-
POZ	●●●	●●	Short term
MXP-LIN	●●	●●	Medium term

Source: LAirA partners

Partners assessed the topic having on average medium priority; complexity varies across airports. All wayfinding actions are planned to be delivered in the short and medium term.

7.4. Constraints, opportunities and recommendations

We have not identified specific constraints to the development of wayfinding projects, but there are challenges which concern:

- Developing a strategy that maintains various brand identities across transit providers;
- Considering different type of users that could presents different needs and behaviours inside and outside the airport;
- Keeping a wayfinding system updated over time as an airport develops;
- Lack of standardized global iconography leading to possible confusion;
- Ensuring best practice approaches across multiple sites through development of guidance applicable to a range of locations.

Wayfinding opportunities mainly concern improving passenger experience, improving airport efficiency and fostering public transport use. In particular, recommendations concerning wayfinding towards sustainable surface access concern:

- Orientating the passengers as early as possible upon arrival, as soon as they are inside the terminal;
- Promoting public transport and other low CO_2 alternatives and introducing related iconography to make options known;
- Avoiding any risk of doubt and stress that would lead to "losing" the passenger and providing reassurance along the whole way;
- Identifying the transport destination, letting the passenger know that they have reached the transport hub; and
- Drawing pictures for complicated transport connections.

8. Road-based public transport

8.1. Airport thematic relevance and EU policy background

Road-based public transport can provide direct connections between an airport and surrounding destinations for both passengers and commuters. Local buses, dedicated airport links and bus/coach services serving hotels, tourist markets and business centres provide connection to cities. Coach services offer options from locations further afield[31].

Road-based mode share for access to airports does not appear to be compiled at the European level, though research indicates an average European mode share of around 17%[32]. Road-based mode share varies from airport to airport. Taking five UK airports (Heathrow, Gatwick, Stansted, Luton and Manchester) as an example[33], road-based transport ranges from 9% at Heathrow to 37% at Gatwick.

Dedicated bus services often provide a high level of quality, with high service frequencies, vehicles being modern, spacious with ample luggage space, services running across 24 hours, Wi-Fi, and easy to purchase ticket options. Increasingly tickets can be purchased via Apps in advance.

Often road-based transport competes with rail services covering similar routes, though road-based transport options are usually lower cost. Where bus services share road space with private cars, congestion can be challenging, particularly at peak times.

Concerning the EU policy background of road-based public transport, despite there is not an airport specific policy on the topic, two main EU regulations concern it:

- **Regulation (EC) No 1073/2009** on common rules for access to the international market for coach and bus services, laying down common rules applicable to the international carriage of passengers by road[34].
- **Regulation (EC) No 1370/2007** on public passenger transport services by rail and by road, which lays down the conditions under which competent authorities, when imposing or contracting for public service obligations, compensate public service operators for costs incurred and/or grant exclusive rights in return for the discharge of public service obligations[35].

The following table summarises the state of the art and maturity level in road-based public transport at the LAirA airports. The information relies on a qualitative assessment by the LAirA partners; the maturity level was assessed on a 1 to 3 scale as it follows:

1. Road-based public transport is a new topic and actions and plans are not in place (●);
2. Road-based public transport actions are not in place but there are development plans (●●);
3. Road-based public transport actions were implemented and there are eventual development plans (●●●).

Almost all the LAirA Airports have a high level of maturity and road-based public transport has an important role in the airports' accessibility.

[31] For the purpose of this report we both consider publicly and privately-operated road transport services.

[32] Source: http://fsr.eui.eu/wp-content/uploads/14030317-Hylen.pdf

[33] Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661933/tsgb-2017-report-summaries.pdf

[34] Please see: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R1073&from=EN

[35] Please see: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007R1370&from=EN

Table 26. Road-based public transport - maturity level and state of the art at the LAirA airports

Airport	Maturity level	State of the art
BUD	●●	▫ There are regular public transport services to/from the Airport, including a direct bus line connecting the Airport and the city centre. ▫ Moreover, there is an Airport shuttle service.
WMI	●●●	▫ There is a bus service between the Airport and the nearest railway station, plus private bus operators.
STR	●●●	▫ The Airport has a bus station with 18 platforms and regional and national/international bus services (about 20 domestic and 50 European); the bus station fostered airport passengers increase since 2016. ▫ Bus fleets includes electric (within the RELEX /express services) and electric-hydrogen buses.
DBV	●●●[36]	▫ Public and private bus services operate at the Airport.
VIE	●●●	▫ Bus connections are available – connecting the City of Vienna (Vienna Airport Lines) as well as other destinations in Vienna functional urban area (regional bus lines) and beyond (e.g. Bratislava).
POZ	●●●	▫ There are regular public transport services to/from the Airport.
MXP-LIN	●●●	▫ There is multiple road transport (bus and coach) connection to MXP and LIN. ▫ SEA is moreover carrying out an analysis on increasing road public transport services in Linate.

Source: LAirA partners

8.2. Best practices

The table below reports three airport best practices in road-based public transport.

Table 27. Road-based public transport - best practices

	Helsinki	London Stansted	Paris Charles De Gaulle
Focus	Finnair CityBus and Line 615	Commuter Centre for employees	*Filéo* demand responsive service
Objective - actions	As part of the work to achieve a carbon neutral rating with the Airport Carbon Accreditation programme, Helsinki Airport cooperates with wider stakeholders including Pohjolan Liikenne, the operator of Finnair City Bus.	Road based transport options are measures within the Airport's Travel Plan to improve airport commuting sustainability.	The objective is to provide improved accessibility both for staff living in the Airport area, as well as opening employment opportunities for others who may not have been able to work the required shift patterns.

[36] According to the description of the 3 levels of maturity and considering that the Airport has road-based public transport services, SEA has assessed the Airport having a high level of maturity.

	Helsinki	London Stansted	Paris Charles De Gaulle
Timing	The Airport redevelopment programme began in 2013. It is expected to continue until 2022 at which point a new multimodal travel centre will be in place.	The Airport Saver Tickets were launch in 2007.	The service began operating as *Allobus* and started services to the Airport in 1998. It operated by Keolis.
Critical success factors	▫ Express service has good frequency, travel time, 24hr operation and Wi-Fi; ▫ Local service has cost fares via App; ▫ Direct bus connectivity to other cities.	The Commuter Centre and Commuter Centre Coordinator facilitates the promotion of Airport Saver Ticket and Airport Travel Card.	▫ Bookable online, App and via phone; ▫ Use of small capacity vehicles operating efficiently and accessing narrow streets; ▫ Attractive to those previously using private car.
Impacts	The carbon footprint of Helsinki Airport is zero and it has received the international Airport Carbon Accreditation (ACA) certificate for this achievement.	Travel Card has seen an increase in demand by 25% year on year. Travel Cards generate over £1 million of annual revenue for public transport operators.	The service reliability and versatility initially attracted 1/3 of its passengers from car users.

Source: SEA Milan Airports LAirA project analysis

8.3. Actions

The LAirA Airports planned various actions aimed to improve road-based public transport services and infrastructures, as reported in the following table.

Table 28. Road-based public transport - planned actions

Airport	Planned actions
BUD	▫ Developing road public transport services to the centre of Budapest (in cooperation with BKK, the transportation company of Budapest City), to major Hungarian cities and to international destinations. ▫ Increasing capacity and frequency of the existing public bus lines. ▫ Renewing the public bus fleet (electric buses).
WMI	▫ Improving bus service connections between the Airport and the town of Nowy Dwór Mazowiecki and timetable coordination. ▫ Developing on-demand bus services.
STR	-
DBV	▫ Improving the Airport road access network to reduce travel time, increase safety and reduce bottlenecks. ▫ Developing a park and ride system. ▫ Modernising the fleet for city and suburban public transport services.
VIE	▫ Preparing the operational concepts, management models and business cases for sustainable micro-public-transport offer in the airport region (in cooperation with neighbouring local authorities and the region 'Römerland Carnuntum') ▫ Expanding highway A4 in the section between the node Schwechat and Fischamend, new junction at highway A4 for 'Airport West", construction of local bypasses of many surrounding municipalities such as Fischamend, Klein-Neusiedl etc.

Airport	Planned actions
POZ	▫ Developing dedicated bus lanes.
MXP-LIN	▫ Extending services to regional transport hubs (e.g. Lampugnano, San Donato); ▫ Improving service level (e.g. frequency, plus e-ticketing); ▫ Developing on demand e-shuttle services and/or dedicated public transport services.

Source: LAirA partners

The following table summarises the partners' assessments on priority, complexity and timing of road-based public transport projects.

Priority and complexity were assessed on a 1 (minimum) to 3 (maximum) scale. Timing refers to three time horizons: short term (by 2021), medium term (2021-2025) and long term (after 2025).

Table 29. Road-based public transport actions – priority, complexity and timing

Airport	Priority	Complexity	Timing
BUD	●●●	●●	Short term
WMI	●●●	●●	Medium term
STR	●●●	-	-
DBV	-	-	-
VIE	●●●	●●●	Long term
POZ	●●●	●	Short term
MXP-LIN	●●●	●●	Short term

Source: LAirA partners

Partners assessed a high level of priority for future actions and on average a medium level of complexity, with project to be delivered in the short and medium term (except Vienna considering the actions concern road infrastructures).

8.4. Constraints, opportunities and recommendations

There are not major constraints to the development of new road-based public transport services, expect the need for funding and careful analysis of their integration within the airport surface mobility system. With reference to projects concerning road infrastructure works, traffic disruptions should be carefully faced.

Main opportunities concern:

- High quality express bus services provide lower cost alternatives to rail links;
- Bus fare discounts can support bus use by staff;
- Discount multi-journey tickets can encourage sustainable travel choices;
- On-demand services can provide an opportunity to improve access to staff outside of core working hours, supporting Corporate Social Responsibility and environmental objectives;
- On-demand services are developing with the advent of new technology presenting opportunities for this option to become more common.

Finally, we identified the following recommendation in the development of a road-based public transport services:

- Providing low cost fares for passengers;
- Providing fares via app;
- Providing high quality premier bus service that is high frequency, have 24hr service and modern facilities such as wi-fi;
- Providing high-quality transport interchange facilities;
- Providing discounted ticket options for staff which include both season tickets for full time staff and multi-journey tickets for shift workers;
- Providing a Commuter Centre Coordinator to facilitate promotion of ticketing discounts and work to encourage take-up by staff;
- Ensuring accurate bus information is promoted by linking to operators own information;
- Considering need for on-demand services to improve access for employees to the airport site in locations or at times when traditional services are unavailable; and
- Considering application of emerging best practice with App for on-demand bus services.

9. Conclusions

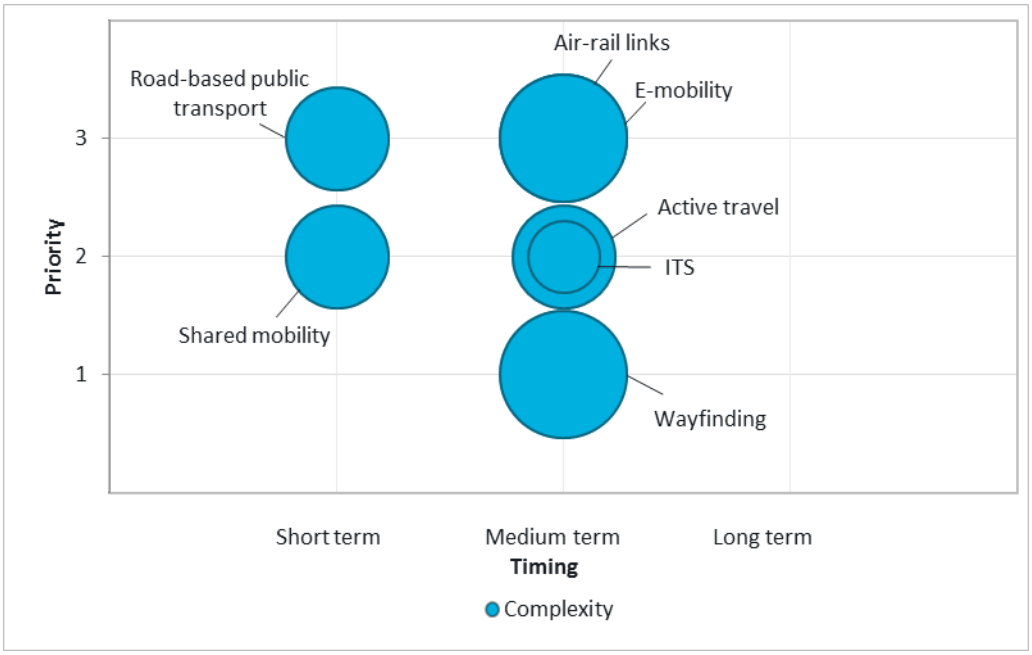
This chapter presents the summary of the LAirA airports' actions for sustainable surface access in the seven project topics.

The following figures show the priority (on a 1 to 3 scale) and timing (short term / by 2021, medium term / 2021 – 2025 and long term / after 2025) of actions at each Airport. Actions are the ones described in the previous chapters of this report. Bubble dimensions show the complexity to deliver actions (on 1 to 3 scale).

Budapest Airport

The Airport plans actions in all the LAirA topics, with priority on **road-based public transport**, **air-rail links**, and **e-mobility**; these also have medium-high levels of complexity. The Airport will deliver all the planned sustainable surface access actions by 2025, and shared mobility and road-based public transport actions by 2021.

Figure 6. Budapest Airport sustainable surface actions



Source: SEA Milan Airports analysis of LAirA partners' inputs

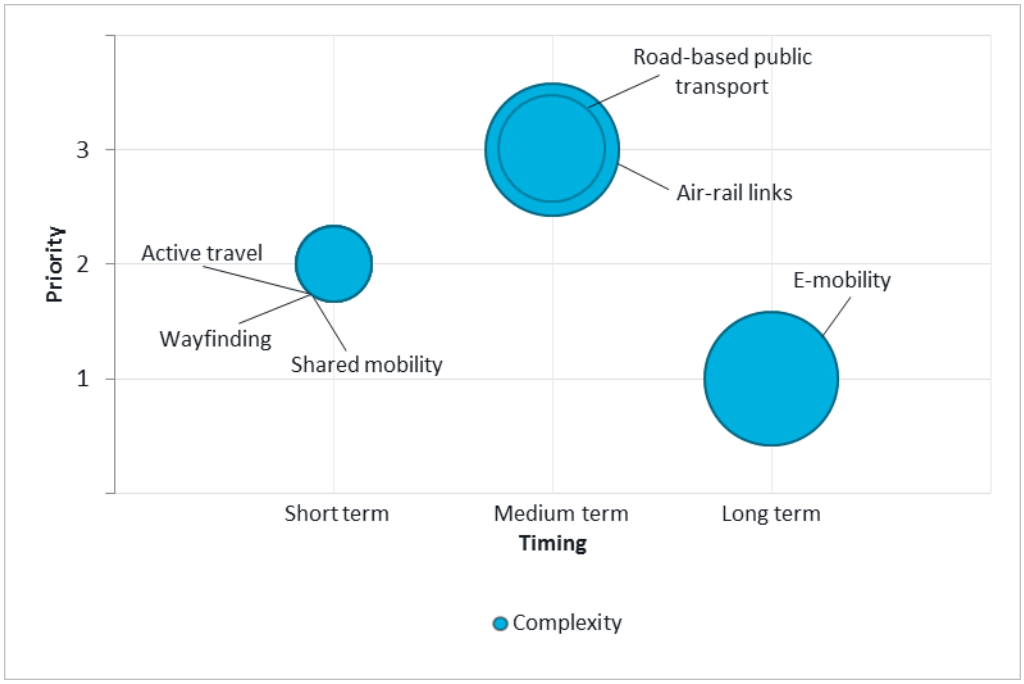
Warsaw Modlin Airport

The Airport plans actions in all the LAirA topics but ITS, with priority on **road-based public transport** and **air-rail links**. These have a medium level of complexity.

Active travel, shared mobility and wayfinding actions are planned in the short term and present a low level of complexity.

The Airport will deliver electric mobility actions in the long term and these have low priority and high complexity.

Figure 7. Warsaw Modlin Airport sustainable surface actions

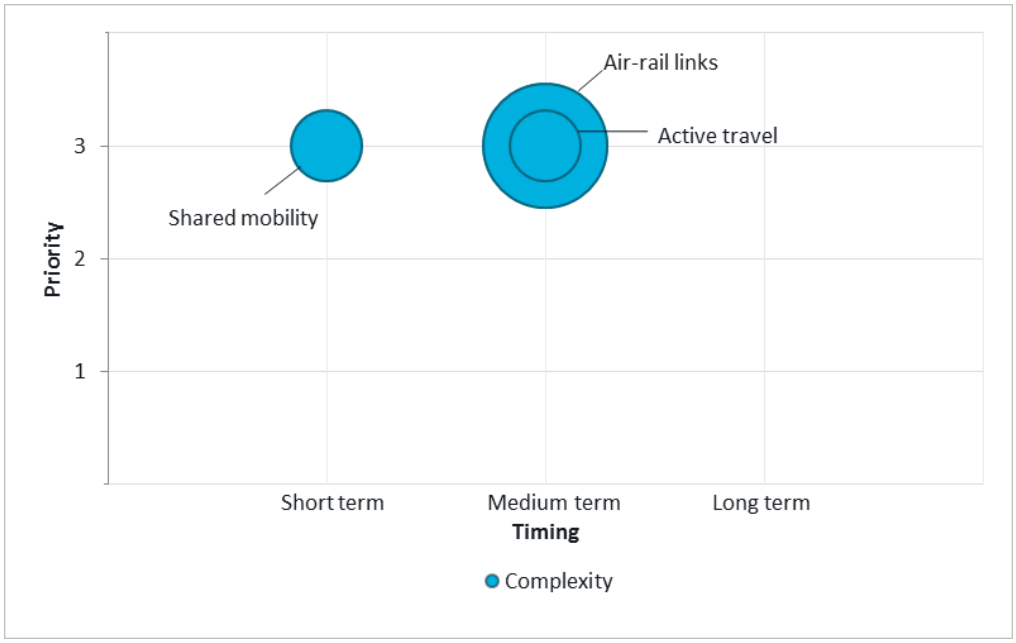


Source: SEA Milan Airports analysis of LAirA partners' inputs

Stuttgart Airport

Based on the LAirA partner's (WRS) inputs[37], there are three high priority topics: **shared mobility**, **air-rail links** and **active travel**. E-mobility is not reported in the figure below because we did not receive indication concerning the timing and complexity; nevertheless, actions are planned, and the topic is a priority.

Figure 8. Stuttgart Airport sustainable surface actions



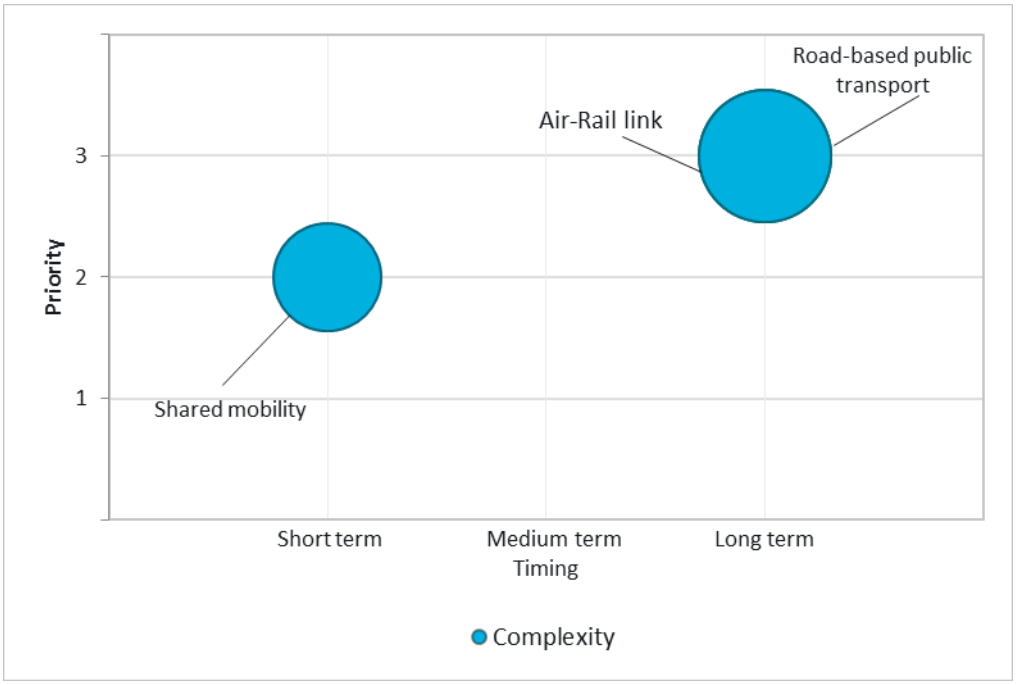
Source: SEA Milan Airports analysis of LAirA partners' inputs

[37] These were not validated by Stuttgart Airport.

Vienna Airport

Based on the LAirA partner's (AustriaTech) inputs[38], there are three LAirA topics in the Airport's future plans: **shared mobility**, with medium priority, **road public transport** and **air-rail links**, both with high priority (infrastructure that connects the airport with the city) and a long-term time horizon.

Figure 9. Vienna Airport sustainable surface actions



Source: SEA Milan Airports analysis of LAirA partners' inputs

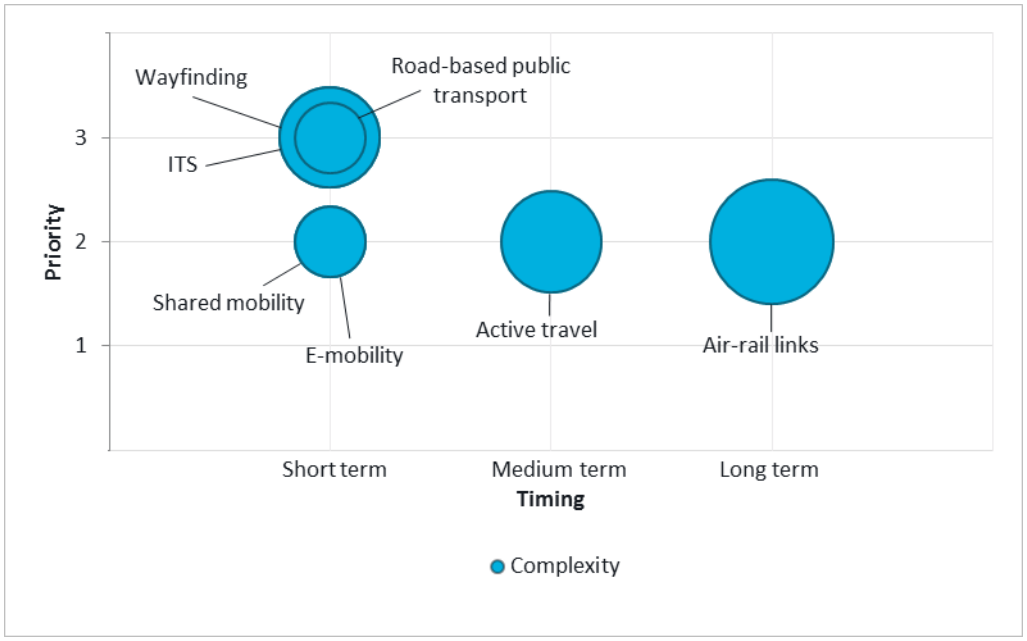
Poznan Airport

According to the LAirA partner (City of Poznan)[39], the Airport plans actions in all the LAirA topics. **Wayfinding**, **ITS** and **road-based public** transport have high priority and the Airport will deliver actions in the short term. All the actions in the other LAirA topics have medium priority, with air-rail links presenting higher complexity.

[38] These were not validated by Vienna Airport.

[39] The City's assessment was not validated by Poznan Airport.

Figure 10. Poznan Airport sustainable surface actions



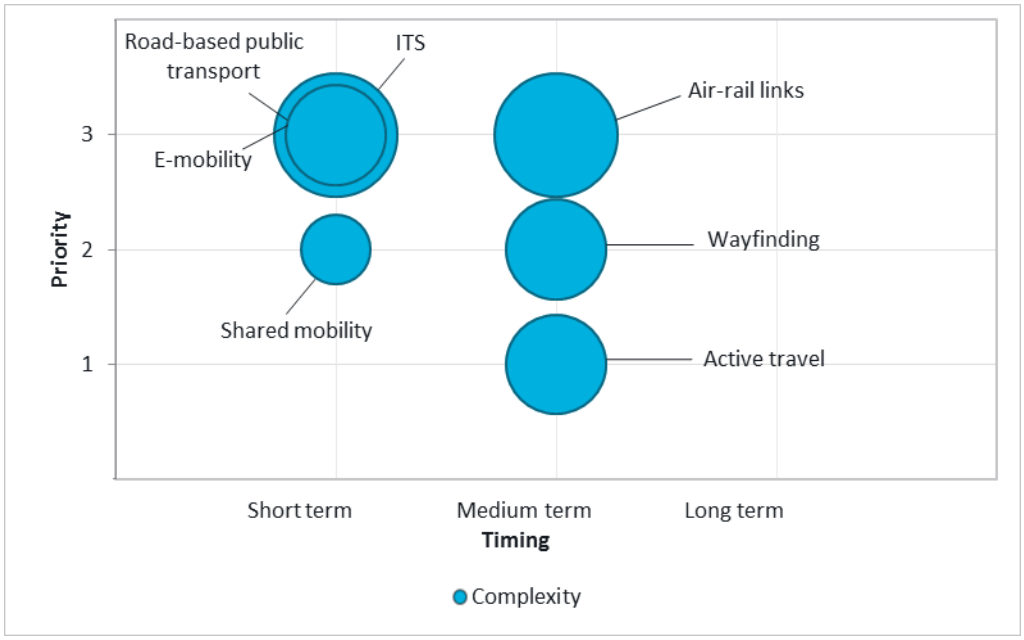
Source: SEA Milan Airports analysis of LAirA partners' inputs

Linate and Malpensa Airports

Milan Airports plan to deliver actions in all the LAirA topics by 2025. High priority topics are: **road based public transport**, **e-mobility** and **ITS** in the short term, and **air-rail links** in the medium term.

Only shared mobility is assessed having a low complexity level.

Figure 11. Milan Airports sustainable surface actions

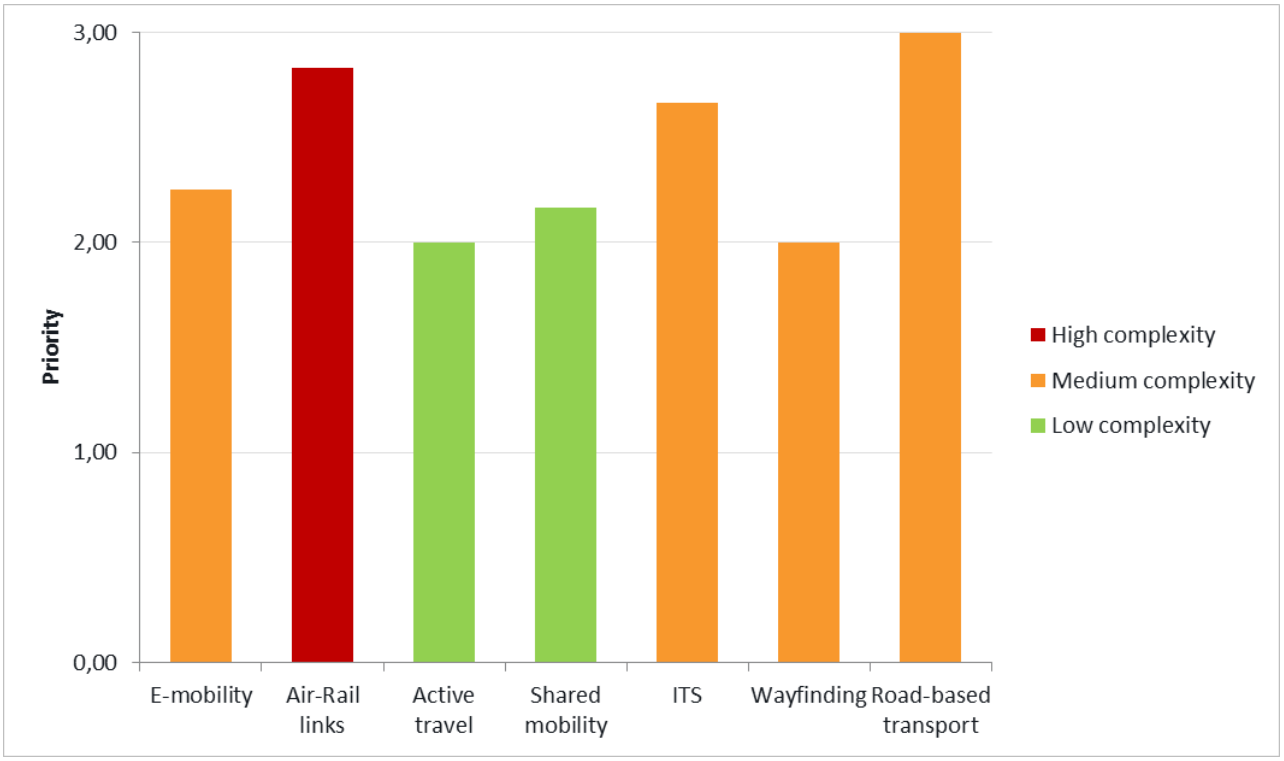


Source: SEA Milan Airports analysis of LAirA partners' inputs

The following figure shows the overall partners' assessment concerning the priority and complexity of actions in the seven LAirA topics. In particular:

- colours identify the complexity level[40];
- the height of each bar shows the average priority.

Figure 12. Priority and complexity per topic

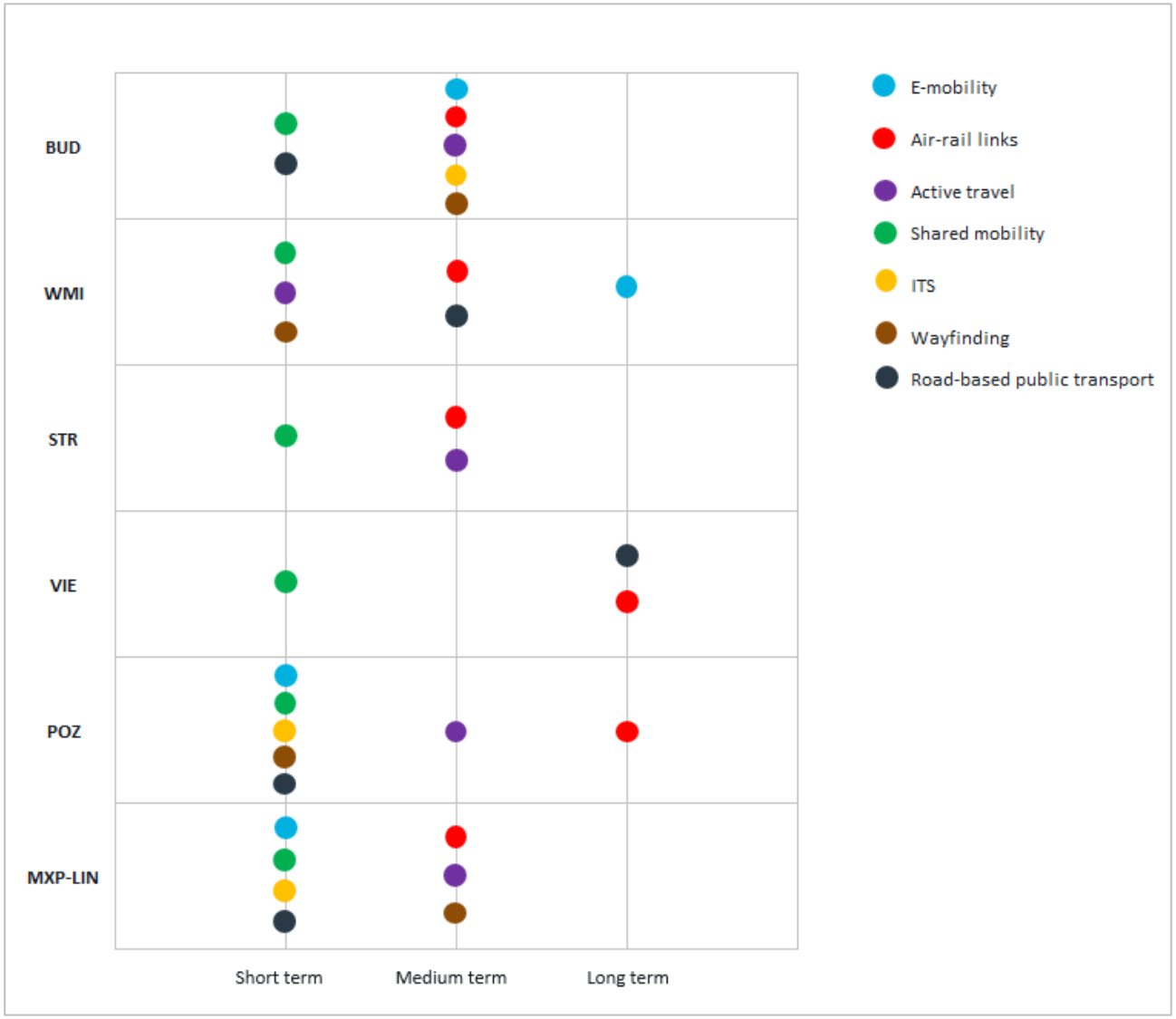


Source: SEA Milan Airports

Finally, the following figure reports the summary of the timing of actions in each LAirA topic by airport.

[40] We assumed that actions with average ranking below 1.75 have low complexity, between 1.75 and 2.25 medium complexity and over 2.25 high complexity.

Figure 13. Summary of actions - LAirA topics, timing and airport



Source: SEA Milan Airports

We note that:

- Airports will deliver almost all the actions for sustainable surface access by 2025. We note actions refer to the ones included in the previous chapters and that this does not necessarily mean that there are not strategies with a longer time horizon.
- There is not a specific correlation between the topics addressed by airports and the types of airports (e.g. by passenger traffic volumes, types of carriers operating at the airport, type of passengers) to allow generalising which topics best fit types of airports.
- Short term actions (by 2021) strongly focus on shared mobility (in green in the figure); we understand this is because:
    - shared mobility actions concern the LAirA car-pooling pilot projects ending in 2019;
    - the start-up of shared mobility schemes presents lower complexity than other types of actions; in particular they do not need specific infrastructure development and focus on transport services which are available on the market.

- E-mobility actions time horizon varies at the different Airports. We do not find a correlation between the time horizon and the maturity levels of e-mobility in the LAirA countries, which would be sensible considering that e-mobility market and infrastructure development is likely to influence airports' actions in e-mobility.
- Air-rail link is a topic for all the LAirA Airports and most actions are planned to be delivered by 2025.
- Active travel is a topic for almost all the LAirA Airports with actions delivered by 2025. Only Modlin Airport will deliver actions by 2021.
- Four of the eight LAirA airports (Budapest, Poznan, Malpensa and Linate) will implement actions in ITS and five airports will deliver actions in wayfinding (Budapest, Modlin, Poznan, Malpensa and Linate). Timing varies for the different LAirA airports.
- Road-based public transport is a topic for almost all the LAirA Airports both in the short and medium term. Vienna Airport's actions have a long term-time horizon because they encompass road infrastructure works.