LOCAL STRATEGY – GUIDELINES FOR STUTTGART AIRPORT LOW CARBON EMISSION LANDSIDE ACCESSIBILITY

D.T3.1.6 - Building the strategy for Stuttgart Airport long term mobility integration into the FUA – final version

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1. INTRODUCTION

Strategies for airports low-carbon landside mobility planning in Functual Urban Areas (FUAs) should have the target to reduce the CO2 emissions produced by access to the airports. The threats for the living environment and the provision of ecological services should be recognized in decision procedures in order to make places more eco-friendly. The objective of the project partners local strategies is to use the experience and knowledge of the partners to build a common transnational format of strategies, which will enhance the integrated environmental management of functional urban areas (FUAs) regarding the mobility.

1.1 Aims and subject of the Strategy

In WPT3 project partners are supposed to develop local strategies for their low carbon mobility integration of their airports in a governance process involving airports, authorities, agencies, transport providers, associations & nodes. The strategies will be mainstreamed in official acts of partners according to their statutory missions & in agreement with the FUA stakeholders. Strategies will be implementation acts of mobility measures within already approved policy frameworks. LAirA will develop a transnational process of roll-out & transfer of its results in CE FUAs also engaging Macro-Regional Strategies. The specific objective is related to a change in terms of novel strategies within the LAirA FUAs and in the development of a blueprint (transnational strategy) transferred to CE FUAs.

2. METHODOLOGY OF WORK

The target groups of the strategy are all institutions, organisations and individuals, who are in the position to affect or contribute to the mobility access of airports. The strategy is addressed to local and regional stakeholders, the development agencies, authorities, businesses and civil organisations whose actions and attitudes are determinant for the future of the area and durability of the project results.

The time perspective for the measurements of the strategy is divided in established, short term (until 2025), medium term (until 2030) and long term (until 2050) partly because the pursuit of sustainable development thus requires and partly because the attainment of the objectives set needs persistent efforts.

Due to the positive development of the Stuttgart Region, demand records in the public transport sector as well as in private transport have been recorded in the Stuttgart region in recent years. Already due to the demographic development, increasing traffic is expected in the foreseeable future. To cope with this, considerable investment and operating costs will be incurred in public transport.

A strong business location needs an equally strong transport infrastructure and attractive offers for all modes of transport. With the aim of demonstrating how to design an appropriate range of transport services, the Regional Assembly passed the updated Regional Traffic Plan by a large majority on 18 July 2018, thereby setting the guidelines for future-oriented transport development in the region.

What measures can be taken to ensure future mobility in the Stuttgart Region and make it sustainable? The Regional Traffic Plan gives detailed answers to this central question.

This local strategy document is the english version and summuary of the regional traffic plan in regards of the projects of the rail and street development to the Stuttgart Airport. The following measurements regarding surface access of Stuttgart Airport are taken mainly from the Regional Traffic Plan. It takes into account all transport systems, by land, sea and air. The plan also considers the interactions between settlement, open space and infrastructure development, which are important for regional planning. This integrated action plan forms the basis for many regional policy decisions, such as the improvements of transport services in the area of responsibility of the Verband Region Stuttgart (VRS) or opinions of the region with regard to transport. In addition, the regional transport plan is an important instrument for influencing investment decisions by the federal and state governments.

The Regional Assembly adopted the updated Regional Traffic Plan on 18th of July, 2018 by a large majority. It is the result of a multi-year, multi-level, transparent and participatory process in which authorities, associations, cities and municipalities, public authorities and citizens repeatedly contributed to participation procedures and contributed to the plan improvement, most recently in spring 2017.

The Regional Traffic Plan shows with which measures mobility can be guaranteed and made sustainable in the Stuttgart Region in the future. To this end, more than 280 road and rail construction projects as well as improvements to rail services were examined, evaluated and classified according to urgency levels. In this local strategy are only measurements summarized, which are improving the street and rail connection to the Stuttgart Airport within the FUA. Various criteria were used for the evaluation. In addition to traffic and spatial planning aspects, this also includes climate and environmental effects. For the first time in regional traffic planning, a Strategic Environmental Assessment and a Climate Proofing were carried out to investigate the effects on CO2 emissions. The results, together with information on the relief effects, investment costs and the respective urgency, are summarized.

In addition, other strategies from the federal state of Baden-Würrtemberg and the Stuttgart Airports „Fairport" strategy are summarized and taken into account.

3. BASELINE SITUATION

3.1. LAirA FUAs mobility plans and policies analysis

Thanks to the Interreg project LAirA, WRS did an in-depth analysis of Stuttgart Regions mobility plans and policies analysis in WPT1 at the beginning of the project. Multiple strategies and action plans were identified. Most important strategies for this document are the ones on local level:

Document type	Local Level
Strategy	Stuttgart Airport • Report – Sustainability Strategy "fairport STR" ("Nachhaltigkeitsstrategie fairport STR", 2017)
Action plan	City of Stuttgart • Mobility Action Plan – Sustainable Mobility in Stuttgart („Nachhaltig mobil in Stuttgart", 2017)
Mobility/ Transport	Verband Region Stuttgart (VRS) • Draft of Regional Mobility Plan ("Entwurf des Regionalverkehrsplan", 2018)

Table 1: local strategies and plans relevant for the FUA Stuttgart

After reviewing the mobility plans and policies, conclusions can be made, that as far as the physical transport network is considered, the Stuttgart Airport gets mentioned in all documents as well as the importance of its surface access. Especially the national and regional documents only contain of very general information about Stuttgart Airport and it´s accessibility. However, referring to local mobility plans, specific measures concerning the landside airport accessibility of FUA Stuttgart to the airport are contained.

According to the measures presented in the report, there is a high priority on developing physical connections to the airport such as the so called "Stuttgart21" project (S21) or "Bahnprojekt Stuttgart-Ulm". The German railway company "Deutsche Bahn" runs the railway and urban development project in Stuttgart, with an investment volume of more than 8 billion Euro.

In the case of landside airport accessibility from other FUAs, the new RELEX bus line connection to the airport is a great advantage for the FUA Stuttgart, it operates on tangential lines in addition to the city railway connection. The tangential bus lines majorly improve the landside airport accessibility from surrounding areas and not just the connections to the airport from the city centre. In this document new bus lines connection close surrounding areas with the Stuttgart airport are planned as measurement.

In general, there is a lack of landside airport accessibility considering public transport from cities close to Stuttgart such as Karlsruhe, Pforzheim, Heilbronn, Tübingen, Reutlingen, Ulm in mobility plans and policies. From Karlsruhe and

Pforzheim there are only connections by long-distance buses to the airport. When the S21 project is realised, the other cities will have an easy access to the airport by regional trains. Measurements are planned and summarized in this document. By approximately the end of 2025, this project will hopefully improve the landside airport accessibility of FUA Stuttgart immensely.

Important to mention is, that the Stuttgart Airport has its own strategy paper, called „FAIRPORT". Mobility projects take also part in this strategy. The following chapter summarizes the most important thematic aspects of the strategy paper concerning landside airport access.

3.2. In detail: Airport Stuttgart "FAIRPORT" - sustainability strategy [1] [2] [3]

LONG-TERM GOAL WITH SEVERAL MID-TERM AND SHORT-TERM GOALS – 2050

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

To reach the aim, becoming one of the highest-performing and most sustainable airports in Europe they defined steps to achieve on the way to fairport Stuttgart. One of these steps is the environmental policy. Running an airport has an impact on the environment. The airport operator contributes to reducing noise, greenhouse gases, energy consumption and waste as well as to protecting surrounding waters and biodiversity. To reduce its environmental impact to a minimum the Stuttgart airport intends to half its greenhouse gas emissions by 2030 and be entirely carbon-neutral by 2050. To realize this ambitious plan they started efficiency and reduction projects. This means that the electric fleet will have to be increased. More energy will have to be produced from alternative sources and energy storages will have to be massively expanded. Therefore, the FSG counts on technological innovations to be introduced in the coming 30 years such as a more efficient energy production in solar plants and better storage facilities. On the compound already, exist a surface

[1] https://www.flughafen-stuttgart.de/newsroom/pressebereich/pressemitteilungen/2017/fairport-str-flughafen-soll-bis-2050-klimaneutral-betrieben-werden/ 04.06.19
[2] https://www.flughafen-stuttgart.de/media/271941/stuttgart_airport_bericht_2017.pdf S. 50 f, 04.06.19
[3] https://www.flughafen-stuttgart.de/newsroom/pressebereich/pressemitteilungen/2018/ziel-erreicht-elektrische-busflotte-am-flughafen-stuttgart-ist-komplett/

of 15.000 m2 solar plants. On third of the produced energy is used by the airport itself and the remaining is fed into the public power supply system. Energy that is not produced at the airport is purchased to 100 percent from renewable sources.

With its "Fairport" concept, Stuttgart Airport strives for becoming one of the most sustainable airports in Europe.

- **Long-term:** By 2050, Stuttgart Airport is to be operated in a climate-neutral manner. Through structured energy management and the use of new technologies, the airport is working to reduce CO_2-emissions on the ground and in the air.
- **Medium-term:** By 2030, the airport company wants to reduce its greenhouse gas emissions by 50% compared to 1990 levels. So far, the airport has succeeded in reducing its emissions by 26% compared to 1990 levels.

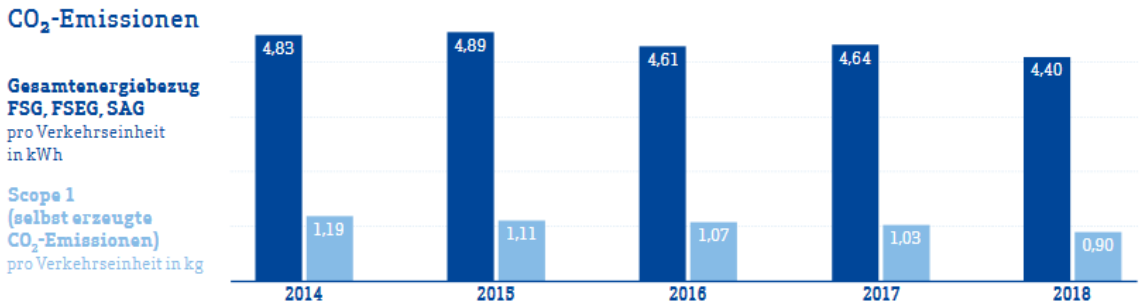

FIGURE 1 CO_2-EMISSIONS OF STUTTGART AIRPORT ARE SLIGHTLY DECREASING SINCE 2015[4]

More and more diesel vehicles on the airside are replaced by electric vehicles. Since the year 2018 the passengers and the luggage is transported by electric vehicles. Therefore, local emissions are reduced at the airport and less noise is caused. That has a positive impact on the environment and the conditions for the employees. Within the "fairport STR" - strategy are also projects introduced, which will be finalised in short-term. These projects are in line with objective five "Growth of electrical fleet". Since electric vehicles are particularly suitable at airports. On the one hand, the distances are short and on the other hand, the breaks are long enough to recharge the battery consistently.

In the following, the short-term projects of Stuttgart Airport:

Electric passenger buses — Established in 2018

Since 2018, the 16 passenger buses run completely electric on airside operations. Concurrently proceeded a similar project, which focused especially on decarbonized passenger transport at European airports, in order to prove if the

[4] https://www.flughafen-stuttgart.de/media/306484/stuttgart_airport_bericht_2018.pdf, p. 3, 31.07.19

entire passenger transport could be managed with electric buses. With the aid of the European Union, fast chargers and an electrical infrastructure were built. As a result, the electrical buses are as good as the diesel buses at passenger transport but with a 70 % higher energy efficiency.

Expansion of the e-fleet — Short-term goal – 2020

The existing e-fleet will be expanded by 40 additional vehicles by 2021. The project e-fleet was the beginning of the electrification at the Stuttgart Airport in 2013. In a period of 3 years the electrical vehicles dragged 12.000 airplanes, transported 1.5 Mio items of luggage and carried 300.000 passengers. The result was that electric vehicles are really suitable at airports. Now, the e-fleet consists of 47 vehicles. SCALE-UP! is a project, that realises the aim to reduce the CO^2-emission of the fleet by 80 % until the year 2020 as compared to 2009. Furthermore SCALE-UP! links to the already concluded project e-fleet. Through the major number of vehicles a wide amount of data admits specific statements about ecological and economical effects by electro mobility used on airports. The results are supposed to be assigned to all airports worldwide.

C/sells – project of Stuttgart Airport [5] [6] [7] — Short term - 2017 – 2020

C/sells is the first superregional intelligent power grid (Smart Grid) in Germany. From 2017 to 2020, the project will be funded by the Ministry of Economics and Energy. In this advanced energy system, autonomously acting cells interact in a coordinated manner within a regional network. More than 50 partners from industry and research are realizing an intelligent, decentralized power supply based on renewable energies. The use and provision of electricity is optimized together with heat, gas and mobility. The Stuttgart Airport acts as prosumer: Two-thirds of the produced energy are supplied into the grid while one-third of it is consumed by the airport itself. Currently about 2.3 gigawatt hours are generated per year.

3.3. Analysis of the multimodal mobility system in the Stuttgart Airport FUA

One achievement that can be approached during enhancing the LAiRA project is the initiation of a stakeholder process that brings together local and regional actors for gathering information on their problems, needs and expectations towards more sustainable mobility options. Stuttgart Airport plays an important role for the local economy and tourism. Many global players like Daimler, Porsche or Bosch have their headquarters in the functional urban area of Stuttgart. Their employees rely on a

[5] https://www.smartgrids-bw.net/csells/csells-ueberblick/ 05.06.2019
[6] https://www.flughafen-stuttgart.de/fairport-str/klimaschutz-ressourcen/im-fokus-intelligente-energiesysteme/ 05.06.2019
[7] https://www.iee.fraunhofer.de/de/projekte/suche/laufende/C_Sells.html 06.06.2019

good connection into the world. Various projects around the airport will create an even more important European transport hub in the coming years. In addition to this infrastructure projects, there is another focus on reducing the environmental impact. One aim of the Stuttgart Airport company is to be carbon-neutral in 2050. The following report describes the transport systems of passengers and luggage on and around the airport.

The Stuttgart Airport is located about 13 kilometres south of the city of Stuttgart and is on the edge between the nearby municipalities of Leinfelden-Echterdingen, Filderstadt and Stuttgart. Stuttgart is the capital city of the federal state of Baden-Württemberg. Vehicle design and production as well as engineering in general are a vital part of the region's economy. Besides its traditional strengths, the Stuttgart Region is also well known for its strong creative industries and its enthusiasm for research and development. All these factors make the Stuttgart Region one of the most dynamic and efficient regions in the world[8]. The city of Stuttgart has a population of approximately 610.000 inhabitants by 2018[9].

The functional urban area (FUA) of Stuttgart comprises 95 municipalities. The total population of the Stuttgart FUA (DE007) were 1.965.942 inhabitants in 2014.[10] Besides the FUA Stuttgart there are other FUA`s in the direct catchment area of the Stuttgart Airport:

- FUA Sindelfingen (DE068) as a medium-sized urban area with 306.122 inhabitants.
- FUA Reutlingen (DE537) as a medium-sized urban area with 235.737 inhabitants.
- FUA Tübingen (DE050) as a small urban area with 189.252 inhabitants.
- FUA Heilbronn (DE529) as a medium-sized urban area with 372.093 inhabitants.
- FUA Pforzheim (DE533) as a medium-sized urban area with 243.262 inhabitants.

All these other FUAs are less than 60 minutes away from the Airport (by car). This five other FUAs combined with the FUA Stuttgart have a population of more than 3.3 million people.

[8] https://www.region-stuttgart.de/englisch/overview.html
[9] Statistisches Amt Stuttgart, https://www.stuttgart.de/item/show/55064, opened 06.03.2018
[10] Functional urban areas in OECD countries: Germany (June 2016)

A highlight of the airport is its proximity to the state´s exhibition centre and the airport city. The fair has a total exhibition area of 120,000 m^2, spread over 10 halls. In addition, a convention center called "ICS" with over 10,000 seats is available. In 2017 there were more than 1.2 million visitors at the fair.[11] Due to its proximity to the airport, the fair is used by an international audience. Fair and airport benefit from each other. Many companies use the proximity to the international airport and settle in Airport City. Stuttgart airport is developing a services and office location in the northern part of the airport, between the terminal facilities and the state's exhibition center. According to the airport company, about 170,000 m2 of office space will be created over the next few years. The German headquarter of the consulting firm EY is already located in the newly built office complex called "Skyloop" with an office space of more than 33.000 m^2.

Looking at all this together, Stuttgart Airport is part of a strong economic sector in the middle of an international transport hub.

The Stuttgart Airport spreads out over an area of 4 square kilometres in the south of the city of Stuttgart. With an annual passenger volume of 10.5 Mio, which consists of 28 % national and 71 % international flights, the airport is an essential factor for the economy of the federal state of Baden-Württemberg. Furthermore it provides jobs for more than 10 000 people in more than 300 companies, organizations and agencies. There are 39 shops and 21 restaurants, bars and cafés spread over all 4 terminals. Up to 400 flights with over 100 destinations and about 55 Airlines are landing and taking off daily on the runway.[12]

The Stuttgart Airport is managed by the Flughafen Stuttgart GmbH (FSG). The federal state Baden-Württemberg (65%) and the city of Stuttgart (35%) have a stake in the FSG. The FSG compromises the two business segments aviation and non-aviation. The first segment it is about air traffic planning and management, ground traffic service and passenger clearance. The business activities of the second segment are construction of the runway and the infrastructure, rental and leasing of restaurants, parking blocks and plots and supply services inclusive electric power, water, heating, cleaning, waste disposal, information- and communications

[11] http://www.messe-stuttgart.de/en/company/about-us/facts-figures/
[12] http://www.flughafen-stuttgart.de/unternehmen/zahlen-und-daten

technology. In 2016 the FSG had an turnover of 269,8 Mio Euros, 165,1 Mio Euros in the segment of aviation and 104,8 Mio Euros in the segment of non-aviation.

It is the aim of the FSG to be steady one of the most powerful and sustainable airports in Europe – the fairportSTR. All projects should be done in terms of the strategy of the "Fairport" strategy. The aim is to be economically successful though as well as containing social responsibility and environmental compatibility. Measurements of the Fairport strategy are also mentioned specifically in the following.

In conclusion, Stuttgart Airport is well accessible by road from every part of Stuttgart FUA and wider catchment, by rail from the city centre and by bus for some close surrounding areas. However not every part of the FUA is connected equally as the others. To change this several measurements are summarized in this local strategy document. The past mobility developments around the airport were dominated by road transport system; however due to the new rail project Stuttgart 21, investments are planned in the railway infrastructure to enhanced the accessibility of the Stuttgart airport from other FUAs such as Heilbronn, Ulm or Pforzheim. Currently the airport isn´t yet connected directly to regional- and long-distance traffic by train. In the near future there will be an additional train station at the airport called "Filderbahnhof". Also the expansion of the streetcar line "U6" from city centre to the Stuttgart Airport is under construction. The final destination of the streetcar "U6" will be in addition at the airport/fair. The planned measures (introduced in detail and summarized in this document) are a great step forward in enhancing surface access through public transport to the airport in FUA Stuttgart. Especially, if the travel time from the city centre to the Stuttgart airport and reverse will be reduced from 27 minutes to just 8 minutes by train in the future.

Nevertheless, there is still room for improvement concerning surface access at the Stuttgart Airport. For example, there is a lack in a more peripheral connection by rail from the airport to rural areas in the FUA. However, other public transport modes, such as busses already connect airport some of the rural residential areas of the FUAs.

In conclusion, the planned projects/ measures, together with the existing city railway station and the bus terminal between airport and fair, will be an important

interchange of the public transport, connecting air, rail and road. With these improvements, the operator expects up to 1.2 million additional passengers per year.

3.4. FUA reports on passengers landside mobility demand, needs and behaviours

N/A

3.5. FUA reports on airports employees mobility needs and behaviours

The report on employee mobility needs and behaviours of the Stuttgart Airport gives an overview on the identified satisfaction level with the transport supply and hints on possible behavioural changes or solutions towards low carbon mobility in the FUA. The report is based on survey data from 2018/03. In accordance with the Airport of Stuttgart the decision was made to choose this reference for the employee's mobility report.

The report provides a compact introduction to the methodology of the survey and a summary of major results that are relevant to the LAirA project in accordance with the methodology from D.T1.4.1. Besides the quantitative data, also qualitative data, covering ideas and suggestions for improving the transportation system in the FUA Stuttgart will be presented.

In regards of the methodology of the study, the aim of the study was to investigate the mobility behaviour of the airport campus employees, a sample of 11,000 employees by an online survey. The timeframe of the online survey was between 20th March and 25th of April 2018. In total 1,114 people answered and returned the questionnaire, which is about 10% of a share.13 The biggest share of the employees belonged to the campus of the airport (72%). 28% of the survey answers were from employees of the Stuttgart Airport. 14 The airport has approximately 1,000 employees.

[13] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.4, 27.04.2018
[14] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.4, 27.04.2018

The questionnaire had in total 48 questions: 22 questions for employees from the Stuttgart Airport, 23 questions for employees working on the airport campus and 3 open questions.[15]

Approximately 1/3 of the survey participants are always commuting by public transport to the airport. 27% of the survey participants use public transport up to 10 times a month and 41% never use public transport.

Regular public transport users mostly arrive with the S-Bahn (72%) at the campus of Stuttgart Airport, followed by public buses (19%) and RELEX express buses (6%).

There are two main peaks on arrival and departure between 06:30 - 09:00 and 16:00 - 19:00 with about 20% of shift workers. Also the times between 23:00 - 00:30 and 04:00 - 06:00 are used well by employees. In general, the weekdays (Monday to Friday) are about 5 times more frequented by employees than the weekend. The majority of employees (53%) travel from the surrounding area Stuttgart centre to Filderstadt (70). The distribution of employees in northern / western (71), southern (72) and eastern (73) areas is each about 15%.

Reliability and timing are the main key issues for campus employees. The current users of public transport are largely dissatisfied with both aspects. Potential users would use public transport more often, if these aspects would be improved or solved. In addition, increased clocking of the city railway per hour was conspicuously often addressed as a topic in the free text fields of the survey. [16]

Grants and benefits from the employer seem to be attractive for employees. 28% of survey participants receive a travel allowance, which is limited in the vast majority (64%) only to the use of public transport. Also, 76% of respondents indicated that the employer provides parking space for the employees, which, for the vast majority (62%), is also paid by the employer.[17]

The management summary of the survey focuses on the five most important topics[18]:

- Increased clocking on the one hand in the peaks (morning, evening, and fair) as well as on the marginal times to the city centre, Vaihingen and Filderstadt.

[15] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.4, 27.04.2018
[16] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.6, 27.04.2018
[17] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.7, 27.04.2018
[18] Verbesserung Servicequalität ÖPNV, Stuttgart Airport, p.7, 27.04.2018

- Direct connection or faster connections and introduction of an express train (regional train) from the airport to FUA Tübingen, FUA Reutlingen, Esslingen, Göppingen and the city centre.
- Better transfer links such as the timing of the S-Bahn trains with regional trains and buses to FUA Tübingen, FUA Reutlingen, Esslingen, Göppingen and Böblingen.
- Better reliability (punctuality, failure prevention).
- As well as lower prices and better pricing options!

On the basis of these findings, concrete suggestions for improvement were derived in the next step.

According to the survey data, most of the airport employees commuted by car. 41% of the employees do not use public transportation on their way to work and 97% of them drive by car to (and from) the airport in 2018.

As stated in the presentation from Stuttgart Airport (Annex I), survey results show a significant link between the chosen mode of transport and the residential location. Whereas the employees living close to the city centre of Stuttgart rather decided to commute by public transportation, other employees living in the surrounding – rather rural - areas chose to commute by car.

Another reason for such a high share of employees using their private car to work, is that the Airport Stuttgart offers free parking space for its employees. Such employees need a significant financial incentive to voluntary give up their spot. In the future, Stuttgart Airport plans to rent out such parking spaces to customers, instead of offering it to employees for free. Now, Stuttgart Airport and WRS are collecting ideas how to attract employees to sustainable mobility options such as public transport, car/ride sharing and offering incentives for e-bike leasing instead of onward commuting by car. Therefore, we decided to develop by means of LAirA project a workshop to better understand operational mobility management and getting to know best practices.

Furthermore, the study authors concluded, that the missing public transport connection between the airport and its surrounding FUAs, such as Tübingen or Reutlingen, could be one decisive reason for the employees' car-focused travel behaviour.

In the last section of the survey, respondents were asked about general suggestions for improving the public transport connection to the Airport of Stuttgart. Survey participants addressed in particular requests for direct or faster connections with shorter travel times as well as the introduction of an express train from the airport to the different close FUAs. The project S21 is establishing such a connection possibly by the end of 2025.

Participants also recommended better reliability and customer service, especially in case of disruptions and an increased frequency of the city railway, better connection between modes or options of interchanges and cheaper prices/conditions of public transport for airport employees.

At the beginning of December 2018, the new timetable of VVS was introduced. In general, the new timetable enhanced the airport connection by increasing the clocking of the city railway to the airport. For line S2, between Schorndorf and Filderstadt, the 15-minute o'clock is extended until 10 o'clock. During early morning hours, the first connection is moved to 3.48 o'clock from Schorndorf to Schwabstraße. The line S3 between Backnang and the airport / trade fair also increased the frequency by running every 15 minutes until 10 o'clock. An additional train from Backnang to the airport leaves at 3.56 o'clock in the morning, monday through friday, too.[19]

Other solutions to attract employees to use sustainable mobility, could be the development of a long-distance bicycle path between the surrounding areas and the airport. As well as improving the existing ride-sharing platform on the intranet of the Stuttgart Airport. But most important is the active advertisement of alternative transport modes, such as the promotion of information about mobility options and the employers offered incentives, along with strongly encouraging employees to use sustainable mobility.

In conclusion, the majority of employees stick to commuting by car instead of shifting to public transportation. Because this mode of transportation, is fast and easy to handle and often the only available transport supply. Solutions to change this mobility behavior are elaborated further in the following.

[19]https://www.stuttgarter-zeitung.de/inhalt.fahrplanwechsel-beim-vvs-das-aendert-sich-in-stuttgart-zum-9-dezember.6f4e1911-2ef3-49a6-aedc-d0d7995c65e0.html

3.6. Potentials

Based on the local analysis, there can be identified potentials of low CO2 mobility for Stuttgart Airport. Today the majority of employees is still commuting by car. However in the future, people may shift to public transport, if the connections, especially to/ from the surrounding rural area/ FUAs, would be improving in terms of operating hours, intervals and availability. In this case, a great potential is the planned and already started project S21, which will enhance and improve the connections by regional/ long-distance trains from other FUAs such as Reutlingen, Tübingen or Ulm. According to the regional traffic plan, the proposed train station for regional and long-distance trains at the airport will shift 25% of passengers and employees from road to rail.

Another potential is a soft measurement for improving the sustainable transport situation at the airport, which was introduced in WPT2. Within LairA, WRS cooperated with the Stuttgart Airport administartion on the establishment of a behavioural change campaign for employees. Especially since Stuttgart Airport offers a wide portfolio of incentives for its employees to increase the shift of employees to public transportation. Since Stuttgart Airport has also already incentives for employees to use carbon free mobility to the airport, such as discounted ticket options for staff. However, these incentives don´t find the needed attention of Stuttgart Airport employees. One reason is that the taken measures are not communicated well enough with the staff. Stuttgart Airport will especially focus on the communication of measures and the sustainable mobility needs of its employees.

Besides WRS is not developing a carpooling employer commuter strategy, or other car-pooling incentives as some of the other project partners, because the Stuttgart Airport has already a car-pooling platform on the intranet.

In conclusion, there are two potentials, which were identified in the process of LAirA project. One “hard” infrastructure measurement, the S21 project as well as one “soft” measurement, which focuses on the change of behaviour of employees at Stuttgart Airport. However, such planned measurements always bear problems and barriers within the establishment. This will be elaborated further in the following chapter.

3.7. Problems and challenges

In general, the Stuttgart Region has serious land use and traffic problems on all levels, and these problems are increasing. The region also faces air pollution and noise problems, for which the region must find sustainable solutions in order to ensure the necessary mobility of people. Those problems are accounted in the just finalized new regional traffic and transport plan.

The project S21 will immensely improve the landside airport accessibility of Stuttgart and surrounding FUAs, though the finalisation of the project is still far away. Plans are being reconsidered and changed for several times. Now, the construction of tracks and bridges has started, but the constructions are very delayed. At the moment, the aim for the finalisation of S21 is set for the end of 2025 instead of being finalized in 2021. This means that those citizens, who live in rural surrounding areas will have to be patient in terms of the improvement of the public transport surface access to the Stuttgart Airport. The project has been planned centuries ago and is very complex, which means that there will come up even more problems and difficulties from time to time. Another factor is the composition of the cooperation within the S21 project.

The project consist of a diverse cooperation between the railways, the federal government, the state, the city and the region. The EU and the airport are also involved. This cooperation and the project itself is very unique: a total of almost 60 kilometers of new railway line as well as three new passenger stations (Stuttgart main station, station Airport / Convention Centre and the city-railway station “Mittnachtstraße” at the new Rosenstein district) are jointly launched. The region south of the provincial capital will be connected to the long-distance and regional traffic with the new station Airport / Convention Centre. This only reflects and sums up minorly the complexity and diversity of the project S21.

Another problem is the clocking of trains in the Stuttgart Region. The clocking is already at the capacity limit, which results in always packed city-trains during rush hours as well as a unreliable overstrained rail-system. This effects the punctuality and reliability of public transport.

One key finding of the WP1-analysis was that the existing plans and policies lack of concrete recommendations as well as measurements for sustainable active mobility

modes to and from the airport. While train concepts are strongly represented in different mobility plans of FUA Stuttgart, bicycle paths especially connecting the surrounding areas to the airport are underrepresented in corresponding mobility plans and need to be improved. This is a pity; since the immediate surrounding areas that serve the airport with employees should be well connected by bicycle/walking routes to the airport. These concrete measures could include fast lanes for bicycle, as well as car sharing options for employees. In the regional traffic plan, there is unfortunately no chapter on active travel modes. However, a bicycle path to the airport is considered and planned above the U6 line to the airport by the traffic ministry of the state of Baden-Württemberg. Yet, this mode of transport is not considered in this strategy document, since this measurement is discussed and planned by the state ministry.

One challenge regarding the soft measurement – the behavioural change campaign for employees - is the lack of flexibility of people, when it comes to behavioural change in regards of the shifting the transport mode. The difficulty is to estimate/understand the willingness of employees to switch modes of transport. The acceptance as well as the actual change of behaviour is quite hard to assess.

All those problems and challenges will be closely taken into account when developing in the following chapter the aims, objectives and investments to improve the landside airport accessibility.

4. VISION AND OBJECTIVES

Results of the in-depth analysis of the mobility plans and policies, the actual status of the mobility infrastructure of the FUA Stuttgart as well as the mobility behavior survey for employees, were taken in account when WRS identified aims and objectives to develop investments accordingly. In general, LAirA project aims on reducing energy use and environmental impacts of transport activities by changing mobility behaviours of passengers and employees. That´s why WRS came up with two overall general aims, which are also in line with the European climate goals:

- **Aim 1:** Reduction of CO2-emission within the Stuttgart Region
- **Aim 2:** Development / Improvement of varied sustainable public transport infrastructure from city centre and surrounding FUAs to the Stuttgart Airport

The aims are also in line with the "Fairport" concept of Stuttgart Airport. The Stuttgart Airports long-term goals are defined in this concept with several milestones by 2050. In summary, Stuttgart Airport strives to become one of the most sustainable airports in Europe. By 2050, Stuttgart Airport is to be operated in a climate-neutral manner. Through structured energy management and the use of new technologies, the airport is working to reduce CO_2-emissions on the ground and in the air. By 2030, the airport company wants to reduce its greenhouse gas emissions by 50% compared to 1990 levels. So far, the airport has succeeded in reducing its emissions by 26% compared to 1990 levels. The goals will be achieved through new efficiency and reduction projects on the premises of the airport. Potentials for avoiding CO2-emissions and saving energy are, for example the construction of new buildings or the refurbishment of buildings, the continuous electrification of the vehicle fleet, use of renewable energy sources, the installation of additional energy storage systems. Concrete measurements and projects how to establish these aims at the Stuttgart Airport will be provided in the following chapter "Other strategies and Investments". In consideration of the overall aims, the investments and measures assigned are to the following objectives that are more specific:

- ***Objective 1:*** Improvement of public transport options from surrounding FUAs to the Stuttgart Airport
- ***Objective 2:*** Improvement of sufficient wayfinding
- ***Objective 3:*** Rise of rail capacity → shifting from road to rail
- ***Objective 4:*** Efficiency Improvement of the road network close to the Stuttgart Airport
- ***Objective 5:*** Growth of electrical fleet
- ***Objective 6:*** Greater frequency and longer operating hours

In the represented list, one important objective, the active mode of mobility or also called "soft mobility" such as cycling and walking, is missing in regards of the sustainable topics in LAirA project. This mode of mobility was taken into consideration during the organised workshop between FSG and VRS. The FSG is considering soft mobility especially as form of mobility for its employees and building a bicycle path to the airport right now. The regional pedelec sharing operator "RegioRad" also already requested for locations at the Stuttgart Airport. More about this field of mobility in the last chapter.

5. INTERVENTIONS/INVESTMENTS

5.1. Former actions: pilot activities: visions and results

Employee pilot: behavioural change campaign for Stuttgart Airport

WRS is planning a workshop series to establish grounded and accepted sustainable employee mobility management measures in cooperation with staff in interdisciplinary groups from HR, workers committee, parking management, operations, executive management, administration etc. The objective is to analyse and plan a corresponding systematic mobility concept for employees of Stuttgart Airport.

The aim is to establish a sustainable cooperation with the Stuttgart Airport administration and transfer the measurements established in the employee pilot to other companies from the airport city with more than 11.000 employees.

Objectives of employee pilot:

- Reduction of CO2-emission (it is in line with the FAIRPORT strategy from Stuttgart Airport)
- Promotion of sustainable mobility options for Stuttgart Airport employees
- Enhancement of health and motivation of Stuttgart Airport employees
- Target value: 20 percent shift from vehicle use to sustainable mode of transport 20
- Sustainability: If the interdisciplinary workshop series is successful in changing the behaviour of Stuttgart Airports employees, the administration staff of Stuttgart Airport will extend the employee mobility management to the airport city with more than 11.000 employees!
- Rising awareness of sustainable mobility options, especially for the city-railway connection from the Stuttgart Airport and the planned S21 opportunities

[20] According to S. Haendschke, ACE, expert for employee mobility management, 20% is the relocation potential of employee mobility management. That was identified during a relatively large project, called "efficient mobile" (efficientmobil), in 80 companies nationwide in Germany. Of course, this is an average value, which was achieved only after a complete implementation of a systematic employee mobility management – mostly not immediately after the workshops.

5.2. Interventions and investments – Short-term

Interventions/investments are considered as projects, interventions and sometimes even already adapted good practices, which are already implemented in the Stuttgart Region, which help achieving the objectives identified above.

Public Transport

Objective Title: Establishment/ Improvement of diverse public transport options from city centre and surrounding FUAs to the Stuttgart Airport / Growth of electrical fleet	**Objective Number: 1 / 5**
Intervention/Investment: Bus connections to/ from the airport - **Regional express buses „RELEX“** [21] [22] [23]	**Intervention/investment number: M1/M2**
Origin of the action: (x) **Transfer** ( ) **New Concept** ( ) **Other**	
Action description - What will be done	
M1: Bus line X 10 | Leonberg - University Stuttgart - Stuttgart Airport **M2: Bus line X 60 | Kirchheim unter Teck - Denkendorf - Stuttgart Airport** Regional express buses are creating new and fast direct connections between the branches of the city train Stuttgart. In December 2016, the lines X 60 Leonberg - University Stuttgart – Stuttgart Airport and X 10 Kirchheim/ Teck – Denkendorf – Stuttgart Airport went into operation. Final destination of both lines is at Stuttgart Airport. The X 10 takes about 38 minutes for the 24 km route, the X 60 takes about 34 minutes for the 30 km route. During rush hour, the buses run every 30 minutes, otherwise every hour.	
Minimum viable action	
According to VRS and its regional traffic plan, in case of strong demand, the lines Nürtingen - Stuttgart Airport as well as Esslingen - Stuttgart Airport will also be planned in the future. Must Have: Monitoring of costs and benefits in regards of passenger demand	
Responsibility - Who will implement the action?	

[21] https://www.region-stuttgart.org/relex/ 04.06.2019
[22] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Regionalverkehrsplan S. 79-81, 04.06.19
[23] http://www.vvs.de/download/Expressbus-Liniennetz.pdf source: figure 1

VRS is responsible for the RELEX Bus line and will implement further lines if the passenger capacity using those RELEX Busses is reached by 2020.
Estimated budget and resources
N/A
Measuring success
Monitoring of lines X10 and X60 is still ongoing.
Timeline - Start and end dates
Established in 2016, ongoing for other lines
City/region vision and beyond
The advantage of this bus lines is the fast connection of surrounding FUAs to the airport. With these measurements, passengers have a direct connection instead of commuting much longer across the Stuttgart main station. In addition, this bus lines build tangical lines to the city railway system.

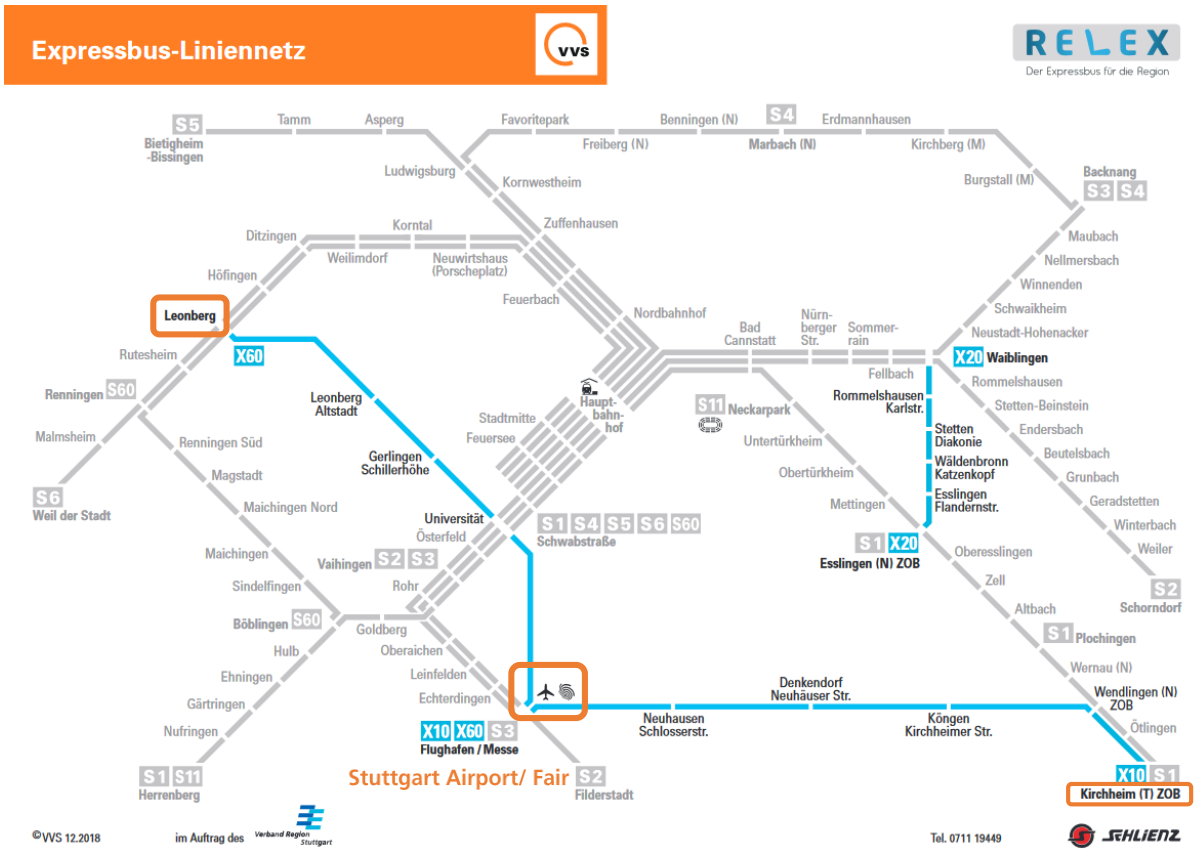

figure 1: “RELEX“ express bus lines X 10 and X 60 to/ from the Airport Stuttgart

Objective Title: Establishment/ Improvement of diverse public transport options from city centre and surrounding FUAs to the Stuttgart Airport / Growth of electrical fleet	**Objective Number: 1 / 5**
Intervention/Investment: Stuttgart Airport Busterminal (SAB)	**Intervention/investment number: M3**

Origin of the action:

( ) **Transfer** ( ) **New Concept** (x) **Other**

Action description - What will be done

M3: Construction of Stuttgart Airport Busterminal (SAB) [24] [25]
In 2016, the Stuttgart Airport Busterminal (SAB) opened. The long-distance bus station with 18 bus platforms is designed for over 400 bus stops per day. Around 1 million passengers are expected each year. By 2030, it can reach up to 3 million passengers. More than 100 national and international destinations can be reached.

Minimum viable action

According to VRS and its regional traffic plan, in case of strong demand, the lines Nürtingen - Stuttgart Airport as well as Esslingen - Stuttgart Airport will also be planned in the future.

Must Have: Monitoring of costs and benefits in regards of passenger demand

Responsibility - Who will implement the action?

The City of Stuttgart is responsible for the bus terminal.

Estimated budget and resources

The City of Stuttgart financed the project costs of 5.8 million euros.

Measuring success

N/A

Timeline - Start and end dates

Established in 2016

City/region vision and beyond

[24] https://stuttgart-airport-busterminal.com/de, 03.06.19
[25] https://www.flughafen-stuttgart.de/newsroom/pressebereich/pressemitteilungen/2016/stuttgart-airport-busterminal-geht-in-betrieb/ 03.06.19

The SAB replaces the former long-distance bus station at Stuttgart Central Station. For example, the before mentioned RELEX buses depart from the SAB-terminal.

FIGURE 2: THE BUS TERMINAL SAB HAS 18 TRACKS AND HAS A CAPACITY OF 2700 STOPS PER WEEK TO 100 NATIONAL AND INTERNATIONAL DESTINATIONS

Objective Title: Improvement of Wayfinding	**Objective Number:** 2
Intervention/Investment: Wayfinding to Stuttgart Airport Busterminal (SAB)	**Intervention/investment number: M4**
Origin of the action: ◯ **Transfer** (x) **New Concept** ◯ **Other**	
Action description - What will be done	
Currently, passengers have problems on finding the SAB from the arriving terminal. VRS wanted to cooperate with FSG (Stuttgart Airport) on wayfinding signs for SAB bus terminal connection to the airport. FSG has now expressed the wish to do it themselves. Signs on the floor are planned by 2021.	
Responsibility - Who will implement the action?	
Stuttgart Airport	

Figure 3: Example of a ground marking to facilitate the wayfinding to public transport services [26]

[26] https://www.stuttgarter-nachrichten.de/media.media.5ab02d00-a614-4b89-a11a-6930dfb699c0.original1024.jpg

Objective Title: Increase of rail capacity → shift commuters from road to rail / Growth of electrical fleet	**Objective Number:** **3 / 5**
Intervention/Investment: Extension of the streetcar line U6	**Intervention/investment number: M5**

Origin of the action:

( ) **Transfer** (x) **New Concept** ( ) **Other**

Action description - What will be done

The streetcar line U6 coming from Gerlingen is to be extended by 3 km from Fasanenhof to the Stuttgart Airport. From there, it is only a few meters to the airport terminals and about 150 meters to the main entrance of the Stuttgart fair. The line will take 30 minutes from Stuttgart Airport to the Stuttgart City centre. Coming from the airport, the city center of Stuttgart can be reached within half an hour through the direct connection. To Degerloch, it takes 20 minutes and to Möhringen only 15 minutes. Between 6 am and 8 pm trains will depart every 10 minutes, otherwise every 15 minutes.

Responsibility - Who will implement the action?

The cost of the project is to be shared by the builder Stuttgarter Straßenbahnen AG (SSB), the federal state Baden-Württemberg, the city of Stuttgart, the district of Esslingen and the city of Leinfelden-Echterdingen and the Stuttgart Airport.

Estimated budget and resources

The project will cost about 100 million euros.

Measuring success

The measure is expected to save 17 tonnes CO_2 / day.

Timeline - Start and end dates

The construction work has begun in July 2018. The extended line is expected to go into operation at the end of 2021.

City/region vision and beyond

The line can transport a capacity up to 3.000 passengers/ hour. Fair visitors, passengers and commuters will benefit from this additional public transport service.

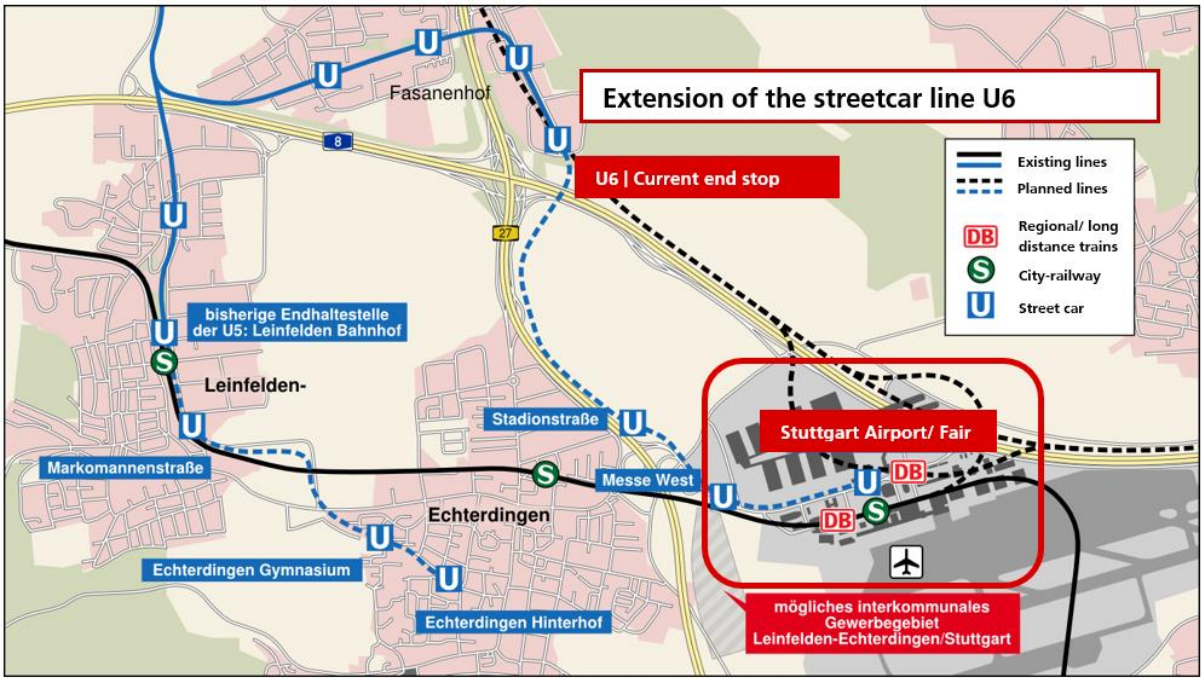

FIGURE 4: PLANNED EXTENSION OF STREETCAR LINE U6 TO THE STUTTGART AIRPORT (BLUE U-SIGN) [27]

FIGURE 5: AT THE END OF 2021, FAST CONNECTION WITH THE U6 TO THE TRANSPORT HUB STUTTGART AIRPORT

[27] http://www.bahnprojekt-stuttgart-ulm.de/uploads/tx_smediamediathek/Flughafenanbindung_Detail_U5_U6_1366x768.png

Objective Title: Increase of rail capacity → shift commuters from road to rail / Growth of electrical fleet	**Objective Number: 3 / 5**
Intervention/Investment: Extension of the city-railway line S2 [28] [29] [30] (in Germany so-called "S-Bahn")	**Intervention/investment number: M6**
Origin of the action: ◯ **Transfer** (x) **New Concept** ◯ **Other**	
Action description - What will be done	
It is planned to extend the S2 city-railway line from "Filderstadt" to "Neuhausen auf den Fildern" by 4 km. According to current planning, trains will run at 15-minute-intervals.	
Responsibility - Who will implement the action?	
VVS in cooperation with Deutsche Bahn and Stuttgart Airport.	
Estimated budget and resources	
The estimated total cost is 130 million euro.	
Measuring success	
The measure is expected to save 8 tonnes CO_2/ day.	
Timeline - Start and end dates	
The extension is expected to be completed in 2023.	
City/region vision and beyond	
Through this extension, more citizens obtain access to a direct connection to the airport and to the planned long distance railway station.	

[28] https://www.stuttgarter-zeitung.de/inhalt..4510830f-a977-47d9-b46f-62fb9fb25340.html 03.06.19

[29] https://www.stuttgarter-nachrichten.de/inhalt.filderstadt-neue-plaene-fuer-neue-s-bahn.c904b30a-4a7a-4abf-adf6-3b789f242c49.html 03.06.19

[30] https://www.region-stuttgart.org/video/RVP_Anhang_180610_mit-Karten.pdf Anhang Regionalverkehrsplan S. 57+58

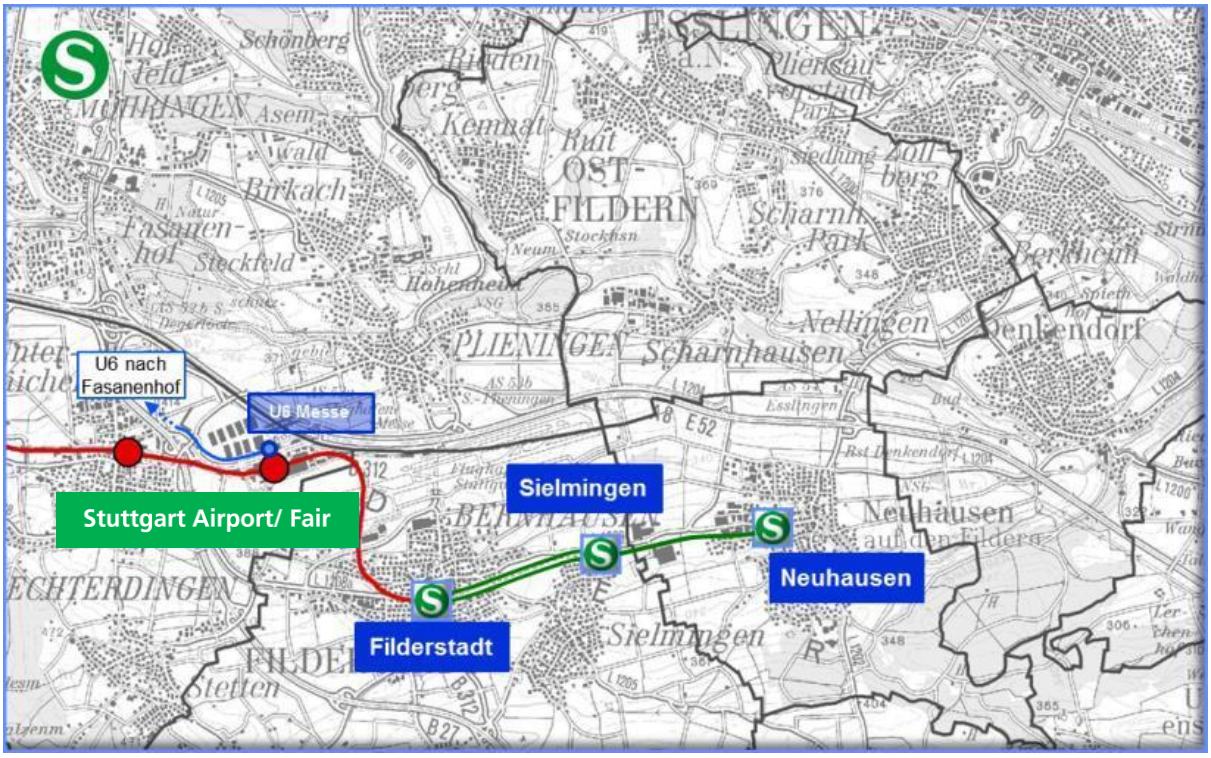

Figure 6: Planned extension of the city-railway line S2 from Filderstadt to Neuhausen (green line) [31]

[31] https://docplayer.org/docs-images/74/69874333/images/43-1.jpg 28.06.19

Objective Title: Increase of rail capacity → shift commuters from road to rail / Growth of electrical fleet	**Objective Number: 3 / 5**
Intervention/Investment: Regional and long-distance trains to the Stuttgart Airport – Construction of third track at the airport terminal[32] [33] [34]	**Intervention/investment number: M7**

Origin of the action:

◯ **Transfer** (x) **New Concept** ◯ **Other**

Action description - What will be done

In future, not only city-railways will run to the new Stuttgart Airport station but also regional and long-distance trains. For this purpose, the German rail provider Deutsche Bahn (DB) will build a third track at the airport terminal for the connection of the Gäubahn which connects to Wendlingen. This international railway line between Stuttgart and Singen will have connections to Switzerland and Italy. Originally, the expansion should have taken three and a half years, with numerous track closures. At the end of 2018, DB presented another solution through which the construction work could be completed within just one year. For the realization of this alternative, it would be necessary to completely close the stop at Stuttgart Airport. During this one-year interruption of the city railway service between Echterdingen and the airport, a replacement traffic system with busses would be set up. Whether DB is actually allowed to put their plans into action must first be examined by the authorities. Therefore, a beginning of the possible track closure is not known yet. However, the track closure should not take place before the extension of the streetcar line U6 is completed (end of 2021) so that passengers can use this line as an alternative.

Responsibility - Who will implement the action?

The project consist of a diverse cooperation between the Deutsche Bahn (DB), the federal government, the state, the city and the region. The EU and the airport are also involved.

Estimated budget and resources

[32] https://www.swr.de/swraktuell/baden-wuerttemberg/stuttgart/Anbindung-an-den-Stuttgarter-Flughafen-Stuttgart-21-Baugesellschaft-will-Plaene-zur-Gaeubahn-vorstellen,stuttgart-21-gaeubahn-flughafen-100.html 03.06.19

[33] https://www.swr.de/swraktuell/baden-wuerttemberg/stuttgart/Anbindung-an-den-Stuttgarter-Flughafen-Stuttgart-21-Baugesellschaft-will-Plaene-zur-Gaeubahn-vorstellen,stuttgart-21-gaeubahn-flughafen-100.html 19.06.19

[34] https://www.stuttgarter-nachrichten.de/inhalt.s-bahnsperrung-auf-den-fildern-das-fahrrad-als-schienenersatzverkehr.602045f5-38fa-48ed-8e4f-4cc6605bd313.html 19.06.19

The German railway company “Deutsche Bahn” runs the railway and urban development project in Stuttgart with an investment volume of more than 8 billion Euro. The VRS will contribute 20 million euro to build the third track. In total, the VRS is investing 100 million euro in the S 21 project. FSG will invest 395 million €.[35]
Measuring success
N/A
Timeline - Start and end dates
Finalisation approximately by 2022.*
City/region vision and beyond
N/A

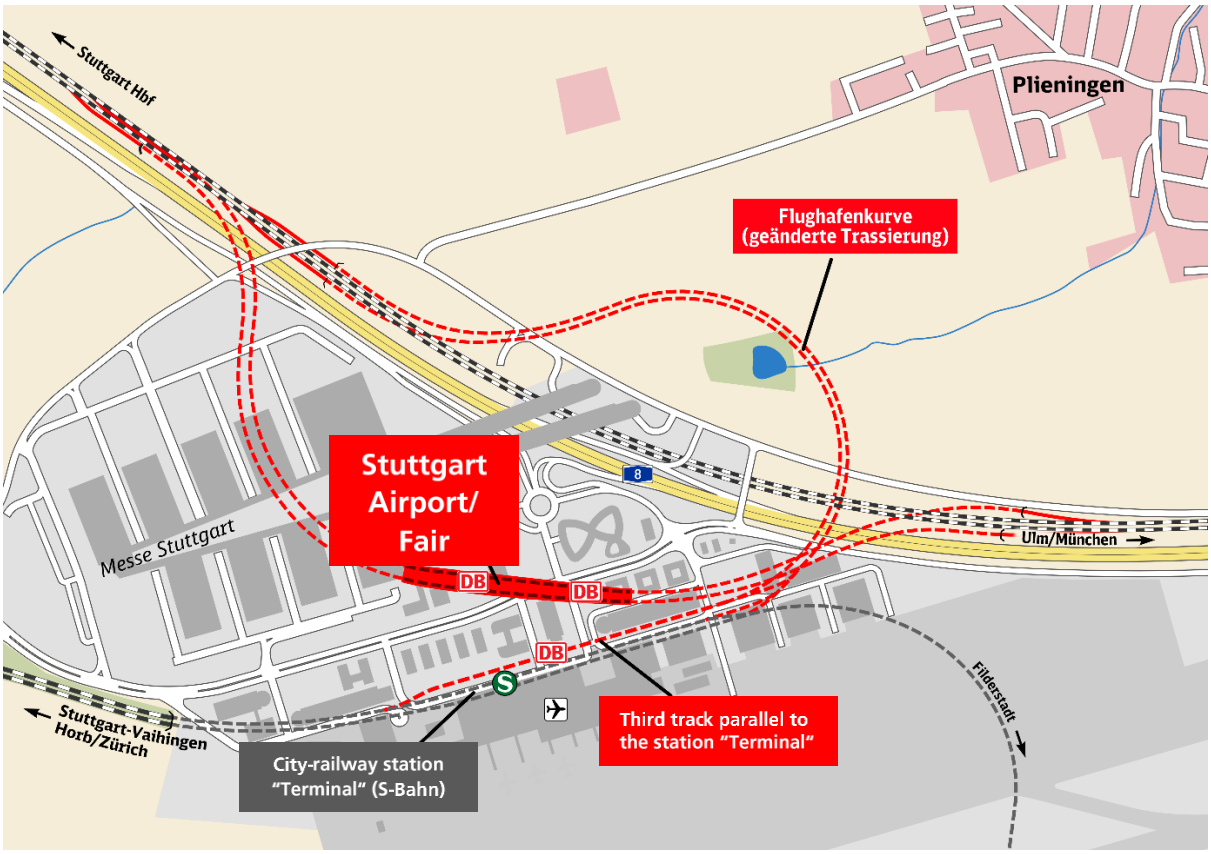

Figure 5: Planned third track parallel to the city-railway station "Terminal" (green S-sign)

*Project is in delay. Sources say, that the construction will take until the end of 2025.

[35] https://www.flughafen-stuttgart.de/media/306484/stuttgart_airport_bericht_2018.pdf, p. 39, 31.07.2019

Objective Title: Greater frequency and longer operating hours	**Objective Number: 6**
Intervention/Investment: New timetable of city railway lines	**Intervention/investment number: M8**

Origin of the action:

◯ **Transfer** ◯ **New Concept** (x) **Other**

Action description - What will be done
At the beginning of December 2018, the new timetable of VVS was introduced. In general, the new timetable enhanced the airport connection by increasing the clocking of the city railway to the airport. For line S2, between Schorndorf and Filderstadt, the 15-minute o'clock is extended until 10 o'clock. During early morning hours, the first connection is moved to 3.48 o'clock from Schorndorf to Schwabstraße. The line S3 between Backnang and the airport / trade fair also increased the frequency by running every 15 minutes until 10 o'clock. An additional train from Backnang to the airport leaves at 3.56 o'clock in the morning, monday through friday, too.[36]
Responsibility - Who will implement the action?
VVS
Estimated budget and resources
N/A
Measuring success
N/A
Timeline - Start and end dates
By beginning of December 2018.
City/region vision and beyond
N/A

[36]https://www.stuttgarter-zeitung.de/inhalt.fahrplanwechsel-beim-vvs-das-aendert-sich-in-stuttgart-zum-9-dezember.6f4e1911-2ef3-49a6-aedc-d0d7995c65e0.html

Improvement of Road connections: Motorway, federal highway [37] [38]

The airport and its FUA are connected via the motorway “A8” and the national road “B27”. In the point of traffic density the Stuttgart Region is highly fraught. Often, especially to the rush hour traffic, it’s faster to take public transport instead of the own car. However, in the near future, the extensions of the motorway A 8 and the federal highway B 27 is planned. These extensions will significantly increase in the efficiency of the road network around the airport (**objective 4**) and, as a result, the reliability of road traffic “Auf den Fildern”. However, these measures (M9 and M10) increase the impact in terms of CO2 emission. The impact will be negative – increase of capacity and consequent increase of car traffic and CO2 emissions.

M9: Extension of the motorway A 8 – objective 4

The 9 km long route section of the motorway A 8 between Stuttgart-Degerloch and Esslingen will be extended from 6 to 8 lanes. Therefore, approximately 9,800 additional vehicles can be driven on the section every day, increasing the capacity to a total of 126,000 vehicles/ day. The CO_2-emissions will increase by 9 tons/ day. The investment costs amount to 51 million euros.

[37] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Regionalverkehrsplan p. 125

[38] https://www.region-stuttgart.org/video/RVP_Anhang_180610_mit-Karten.pdf Appendix Regionalverkehrsplan A 8 p. 173+174, B 27 p. 235+236

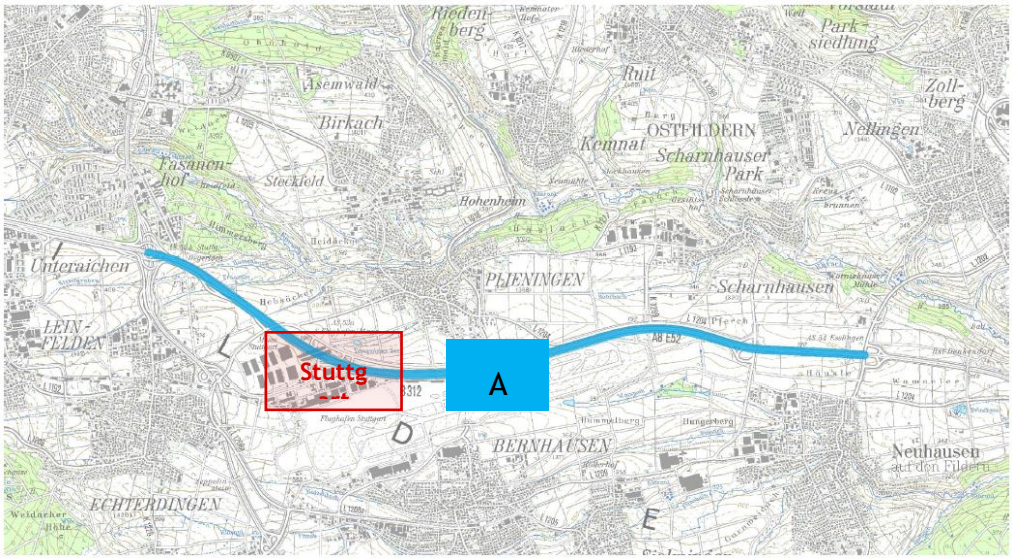

figure 7: Planned extension of the motorway A 8: Route section Stuttgart-Degerloch – Esslingen [39]

Moreover, the 6.1 km long route section of the motorway A 8 between Esslingen and Wendlingen will also be extended from 6 to 8 lanes. Consequently, approximately 6,600 additional vehicles can be driven on the section every day, increasing the capacity to a total of 116,200 vehicles/ day. The CO2-emissions will increase by one ton/ day. Per vehicle, 1.4 minutes of time will be saved on the route section. The investment costs amount to 77 million euros.

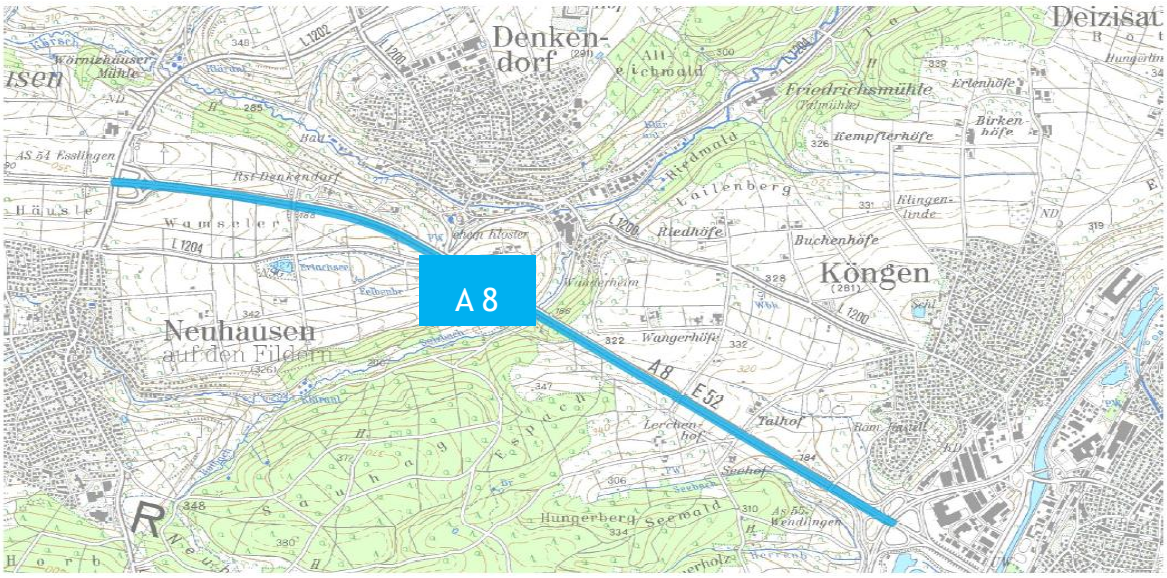

figure 8: Planned extension of the motorway A 8: Route section Esslingen – Wendlingen [40]

[39] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Appendix Regionalverkehrsplan p. 173

[40] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Appendix Regionalverkehrsplan p. 175

M10: Extension of the federal highway B 27 – objective 4

The 8.2 km long route section of the federal highway B 27 between Aich and Leinfelden-Echterdingen will be extended from 4 to 6 lanes. This will increase the capacity of additional vehicles by 10,200 to a total of 93,400/ day. The CO2-emissions will increase by 1 ton/ day. Per vehicle, 1.1 minutes of time will be saved on the route section. The investment costs are up to 59 million euros. The propsed measurements are in executive responsibility of the state administration of Baden-Württemberg, which builds routes. The legislative responsibility has the federal state of Germany.

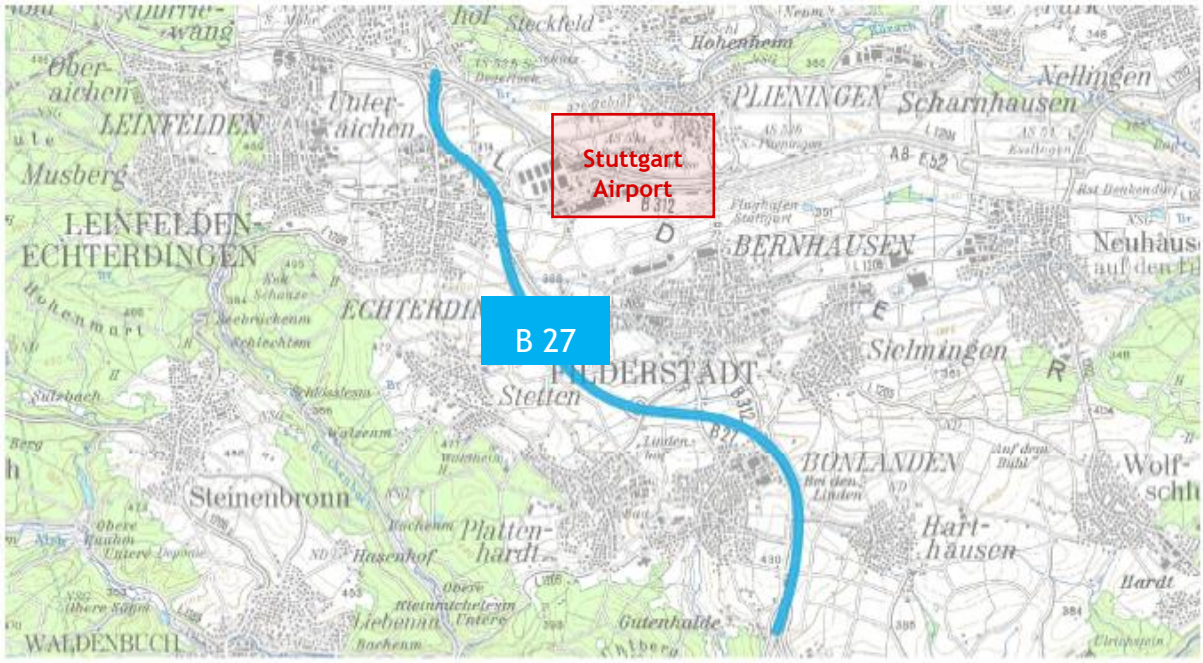

Figure 9: Planned extension of the federal highway B 27 [41]

[41] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Appendix Regionalverkehrsplan p. 235

5.3. Summary and Conclusions

In summary, the surface access of Stuttgart Airport will improve drastically in regards of all the established, exciting and planed projects / measurements in the next couple of years. If the finalisation of S21 will go well in 2025, the Stuttgart Region will have an airport as mobility and transport hub in the future. The presented measurements are set in line with the two overall aims, which are also in line with the European climate goals and the project goals:

- **Aim 1:** Reduction of CO2-emission within the Stuttgart Region
- **Aim 2:** Development / Improvement of varied sustainable public transport infrastructure from city centre and surrounding FUAs to the Stuttgart Airport

In consideration of the overall aims, WRS stated more specific objectives to connect the investments stated in this strategy:

- **Objective 1: Improvement of public transport options from surrounding FUAs to the Stuttgart Airport**
- **Objective 2: Improvement of sufficient wayfinding**
- **Objective 3: Rise of rail capacity → shifting from road to rail**
- **Objective 4: Efficiency Improvement of the road network close to the Stuttgart Airport**
- **Objective 5: Growth of electrical fleet**
- **Objective 6: Greater frequency and longer operating hours**

In the following table (2) are shown the Interventions and investments in Stuttgart Region combined with the set objectives at a glance. WRS collected in total ten measurements, which support six individual objectives. To conclude, the improvements in road (individual car and bus) and rail transport described above will result in a highly efficient and attractive transport connection to the Stuttgart airport and fair/ convention area and will improve the accessibility significantly. Even in the case of the forecast growth of passengers (up to 14 million by 2030), sufficient capacity is guaranteed.[42] However, the Investments M9 and M10 – the extension of the road network - are not quite in line with the overall aim to reduce CO_2, since the extensions only helps to increase capacity but doesn´t reduce CO_2-

[42] https://www.region-stuttgart.org/index.php?eID=dumpFile&t=f&f=7871&token=13563bbe0330943d5b300da897cba069b9c43590 Regionalverkehrsplan S. 126

emmission. These extensions will significantly increase in the efficiency of the road network around the airport (objective 4) and, as a result, the reliability of road traffic “Auf den Fildern”. On the contrary, due to the extension, a rising number of cars and even more CO2-emissions are expected. Consequently, for example approximately 6,600 additional vehicles can be driven on the extension of B27 (M10) every day, increasing the capacity to 116,200 vehicles/ day. The CO2-emissions will increase by one ton/ day. In conclusion, the extension is important for the Stuttgart Airport, as future mobility and transport hub, however, there need to be found solutions to decompensate the additional traffic and the additional increased CO2-emissions.

The express buses connect middle-order centres and important traffic junctions in the Stuttgart area in which so far no city train connections are established. The existing city train network is largely star-shaped aligned to the centre of Stuttgart. The express bus lines “RELEX” close the cross-connections in this network. As mentioned before, two regional express bus lines, one starting from Leonberg (X 10), the other from Kirchheim unter Teck (X 60), have already been established and serve as fast connections to the Stuttgart Airport. Moreover, the lines Nürtingen - Stuttgart Airport as well as Esslingen - Stuttgart Airport could also be established in the future.

TABLE 2 SUMMARY TABLE OF MEASUREMENTS IN LINE WITH THE DEFINED OBJECTIVES

Vision: Improvement of surface access of Stuttgart Airport until 2030				
Objective	**Intervention/investment title**	**Responsible**	**Budget in €**	**Timeline**
Objective 1	*Intervention/investment M1*	*VRS*	*N/A*	*2016-2020*
	Intervention/investment M2	*VRS*	*N/A*	*2016-2020*
	Intervention/investment M3	*City of ST*	*5,8 million*	*2016*
Objective 2	*Intervention/investment M4*	*FSG*	*N/A*	*N/A*
Objective 3	*Intervention/investment M5*	*SSB*	*100 million*	*2018-2021*
	Intervention/investment M6	*VVS*	*130 million*	*till 2023*
	Intervention/investment M7	*DB*	*8 billion in total, 359 million (FSG), 100 million (VRS)*	*12/2025*
Objective 4	*Intervention/investment M9*	*Federal State*	*128 million*	*N/A*

	Intervention/investment M10	*Federal State*	59 million	*N/A*
Objective 5	*Intervention/investment M5*	*SSB*	*100 million*	*2018-2021*
	Intervention/investment M6	*VVS*	*130 million*	*till 2023*
	Intervention/investment M7	*DB*	*8 billion*	*By 2022*
Objective 6	*Intervention/investment M8*	*VVS*	*N/A*	*12/2018*

Explanation / Legend:

VRS – Verband Region Stuttgart (regional authority)
City of ST - City of Stuttgart
FSG – Flughafen Stuttgart Gesellschaft (Stuttgart Airport)
SSB – Stuttgarter Straßenbahnen AG (passenger transport operator of Stuttgart)
DB - Deutsche Bahn
VVS – Verkehrs- und Tarifverbund Stuttgart (regional transport operator)

6. WORKSHOP MEETING STUTTGART AIRPORT, VERBAND REGION STUTTGART AND WRS

On 24th of July 2019, WRS organized a meeting to discuss the regional strategy of surface access of Stuttgart Airport. Participants were Mr. Witzemann, rail project - S21 representative of the Stuttgart Airport, Mr. Schmidt, speaker of the management of the Stuttgart Airport and traffic planner Mr. Lönhard of the regional administration "Verband Region Stuttgart" with WRS. Within 1.5 hours the participants discussed finalized projects such as the completed construction of the new international bus terminal, as well as planned projects for example S21 and the extension of the U6 railway and the extension of the motorways (B27 and A8). The meeting was concluded with some future visions such as e-taxi projects, flight taxis / volocopters and the finalization of S21.

6.1. Key findings in the Meeting

In preparation of WRS, the LAirA project was presented to the audience. After the short presentation, WRS prepared questions in regards of the strategy regarding surface access investments of the Stuttgart Airport as well as questions on future visions to get the discussion rolling.

First, Stuttgart Airport presented an internal prognosis of "Intraplan", which states that the Airport will experience 41% of growth until 2030. In 2030, 14 million passengers will be expected and an increase of public transport from 23 % (2019) to 45 % in 2030.

The passenger numbers will continue to increase in the next ten years, in 2018, 11.83 million passengers were counted. Alone the rail project Stuttgart 21, which will provide even more long-distance and regional connections, enlarges the catchment area of the state airport and additionaly bring up to 1.2 million travelor per year.[43] To handle the expected prognosis, the current infrastructure needs to be improved drastically. That´s why multiple infrastructure projects are set in place presented before as measurement such as S21, the extension of U6 and many other aspects. However, the airport city cannot develop as it is needed and wanted,

[43] https://www.flughafen-stuttgart.de/media/306484/stuttgart_airport_bericht_2018.pdf, p. 38, 31.07.2019

because of the usual lack of existing areas in the Stuttgart Region. That´s a reason why Stuttgart Airport is in favor of the extension of the motorways B27 and A8 (from 3 to 4 lanes), since they need to expand the traffic capacity to the airport from any direction and transport mode. Nevertheless, this project is still away in the future. It is planned to decide about the route- / line management for B27 from Aich to Leinfelden-Echterdingen by the end of 2020. The extension of B27 and A8 will not be achieved before approximately the year 2025.

Due to the expected growth, public transport capacities need to be improved in the upcoming years as it is planned in regards of the established investments. However, demand is steadily rising but supply can only be improved to a certain limit. This might lead in a lack of comfortability for passengers using public transport. Nevertheless, the security of passengers using public transport will not suffer.

The Stuttgart Airport staff also prognoses that passengers and employees will need to change their mobility behavior. Stuttgart Airport would like to reduce peak hours on individual and public transport, that´s why they introduced flexible working hours and Home Office. So, employees can choose when and where to work to discharge the transport system. However, Stuttgart Airport has also many shift workers, who start work from 4 o'clock in the morning. This intervenes with the clocking of the city railway, during early morning hours; the first connection is moved to 3.48 o'clock from Schorndorf to Schwabstraße. Nevertheless, this is not early enough for the shift workers. Shift workers could only use public transport, if the operating hours would be better adapted to the requirements of all airport employees. For the future, VRS noted that the airport staff would support an even earlier clocking of the city railway.

Another problem and one cause for the failure of the SAP mobility platform for employees of Stuttgart Airport is the difficulty of the temporal and spatial distribution of employees within the Stuttgart Region. For the future, Stuttgart Airport wants to expand their employee mobility platform and include all the employees of the airport city (in total 11,000 employees).

In addition, the close nearby convention centre is a disturbance factor and challenge of the Stuttgart airport transport system. Thirty days within one year are

effected by a large onslaught of people visiting the fair at the convention centre. This is a factor, which is quite hard to take under control.

In the long-term, Stuttgart Airport is supposed to be built as an important traffic junction. In regards of the finalisation of all the infrastructure investments, Stuttgart Airport already plans to set up new park and ride places, for commuters, who would like to take advantage of the multiple modes of transport and switch from road to rail. Especially since the train only takes 9 minutes from the airport to the city centre. Stuttgart Airport is planning a new parking area for additional 1400 vehicles.[44]

In this strategy, soft mobility didn´t take a big part, since most passenger travel with luggage and Stuttgart Airport is too far away from the city centre. However, this mode of mobility is quite common for employees. FSG is currently working on a cycling concept for its employees on the airport city, for example a special signage or a bike-sharing offer will promote cycling, as well as a transition to cross highway and railway from close surrounding areas. FSG improved already the accommodation for bicycles (280 m^2) in parking garages or in front of buildings and built changing rooms with showers for employees.[45]

Nevertheless, FSG wants to support intermodal transport to combine bicycles and other transport options as well. Especially the possibility of carrying bicycles on train and busses needs to be more respected and supported by the public transport operator VVS. It seems, as there is a need for enhancing the intermodal aspects by the means of infrastructure. Other factors in the past seemed to be the missing bicycle/walking connections between the airport and the immediate surrounding area/municipalities. FSG mentioned that, connected walking and bicycle routes to the surrounding areas would be established after the finalization of the extension of the U6 in late 2021.

Various mobility solutions have already been established to promote intermodal mobility. For example, since 2018, 700 bicycles and 150 pedelecs are available in the regional bike rental system “RegioRadStuttgart". The bycicles do not need to be

[44] https://www.flughafen-stuttgart.de/media/306484/stuttgart_airport_bericht_2018.pdf, p. 38, 31.07.2019
[45] https://www.flughafen-stuttgart.de/media/306484/stuttgart_airport_bericht_2018.pdf, p. 39, 31.07.2019

returned to the starting point; they can simply be handed over to one of more than 100 rental stations.[46] RegioRad already asked the FSG for areas, where they can place such pedelecs at the Stuttgart Airport to expand their reach. Another example is the car sharing service "Stadtmobil". The network consists of over 200 stations with vehicles of various sizes - from small cars to minibuses. 350 vehicles can be rented in the city of Stuttgart, another 150 vehicles can be found in the region of Stuttgart. The stations are usually located near the city trains. These services enable an easy change between means of transport. For example, taking a shared car from a more rural area to the next station and then people can take the city railway to the Stuttgart Airport.[47]

E-mobility has several aspects of usage. For example in trains and cable cars in public transport but also individual traffic and car-sharing providers are offering using electrical vehicles. Stuttgart Airport has 37 charging station for electric vehicles. However, if there is the case that a charging station is blocked, the Stuttgart Airport designed parking garages with 4 spots per charger, so more customers can actually use the charging infrastructure. In one of the newer parking garages there is a project taken into account, which is called ultra-e. This Bosch parking garage is built in consideration of multiple fast charging stations taken place in the future.

Future Vision: Stuttgart Airport as transport hub

In summary, Stuttgart Airport develops in big steps to an intermodal transport hub in a class of its own. At the end of a fruitful meeting, we discussed the future vision of the surface access of Stuttgart Airport. For Mr. Witzemann, Stuttgart Airport will develop to an intermodal transport hub in the Stuttgart Region. For him, it is important that the planned projects will be established without any great delay. Mr. Schmidt is voted positively in case of the surface access developments of Stuttgart Airport. He is thrilled to see what the future will bring, for example the market readiness of volocopter, one flight taxi manufacturer and if a connection between Stuttgart Airport and the city centre is possible in the near future. In the following

[46] https://www.vvs.de/regioradstuttgart/ 25.06.19
[47] https://www.vvs.de/rundum-mobil/unterwegs/carsharing/stadtmobil-carsharing/ 25.06.19

picture, you can see all the planned infrastructure project of Stuttgart Airport at a glance, marked in different colors.

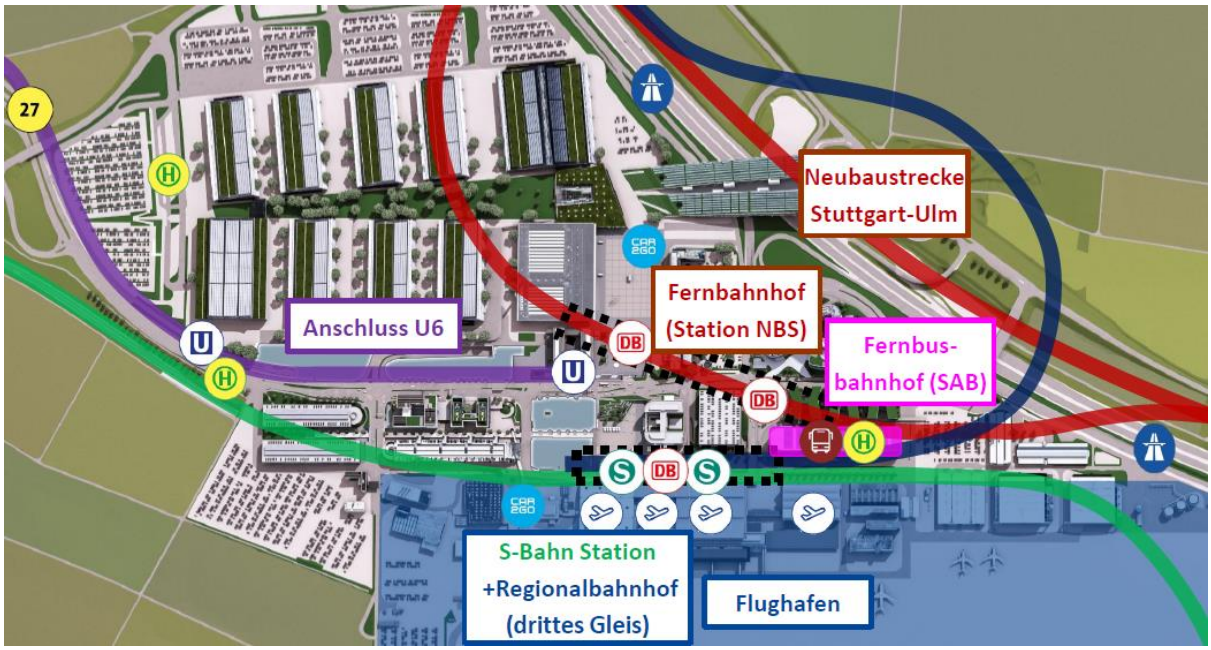

FIGURE 10: PROJECTS AT A GLANCE: AIRPORT (BLUE), U6 EXTENSION (PURPLE), LONG-DISTANCE RAILWAY (RED), INTERNATIONAL BUS TERMINAL (PINK), CITY RAILWAY EXTENSION (GREEN)

In conclusion, the meeting between FSG and VRS, WRS was important to find out the several views on projects, as well as getting to know each other and the already planned future project, which are not available in public. For example, one benefit was, that VRS is in the knowledge now, that the city railway clocking offering is for a huge portion of shift workers at the Stuttgart Airport still not enough. VRS with VVS will consider the expansion of the clocking of the city railway in the future. As well as the knowledge of the expansion of the routes B27 and A8.