Nantes | Hamburg | Helsinki

Deliverable due date: M12 – November 2017 (Interim M8)

D3.1 Baseline report of Hamburg demonstrator area

WP3. Task 3.1

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D3.1 Baseline report of Hamburg demonstration area
Diss. Level	PU
Status	☐ Working ☐ Verified by other WPs ■ Final version
Due date	30/11/2017
Work Package	WP3
Lead beneficiary	HAM
Contributing beneficiary(ies)	KON, ENH, HCU, HAW, CAR
Task description	This task will set and assess, according to WP5, a baseline for Hamburg demonstration. Analysis of the district in which the interventions will be implemented with information about the main architectural issues, energy facilities and energy consumption, mobility data and urban infrastructures are necessary for the definition of the baseline and for identifying the improvements potential. More details are needed in the case of the existing urban plans, public procurement and the current citizen engagement strategies in Hamburg.

Date	Version	Author	Comment
06/07/2017	0.1	Johannes Mielchen (HAM-BGD)	Interim Version
07/07/2017	0.2	Johannes Mielchen (HAM-BGD)	Interim Version (Language corrections)
11/07/2107	0.3	Johannes Mielchen (HAM-BGD)	Chapter land use, green and public spaces structure, traffic completed
12/07/2017	0.4	Johannes Mielchen (HAM-BGD)	Chapter Environment: air quality, Nature protection
12/07/2017	0.5	Jutta Wolff (HAM-BGD)	Chapter Environment: CO2-emission, waste and water Chapter Energy characterisation Chapter Urban plans
13/07/2017	0.6	Jutta Wolff (HAM-BGD)	All remaining chapters updated incl. indicators, chapter 4 and 5 checked
13/07/2017	0.7	Johannes Mielchen (HAM-BGD)	Chapter 6, 7 checked. References checked.
13/07/2017	0.8	Johannes Mielchen, Jutta Wolff (HAM-BGD)	Language corrections and final reviewing

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17/072017	0.9	Johannes Mielchen (HAM-BGD)	Correction in Table 4 - Total no. of single households 1994: 45,6% Correction page numbers
25/07/2017	0.10	CARTIF	Alignment of contents and final review
	0.11	CARTIF	Review
18/10/2017	0.12	Johannes Mielchen (HAM-BGD)	Remove of the footer, to reduce the documents Data
18/10/2017	0.13	Johannes Mielchen (HAM-BGD)	Comments and text responsibilities
23/10/2017	0.14	Johannes Mielchen (HAM-BGD)	Part 11, City Transportation
25/10/2017	0.15	Johannes Mielchen (HAM-BGD)	Part 11, Local Bicycle traffic
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03/11/2017	0.21	Johannes Mielchen (HAM-BGD)	Maps insert
03/11/2017	0.22	Johannes Mielchen (HAM-BGD)	Text from partners insert
06/11/2017	0.23	Johannes Mielchen (HAM-BGD)	Selection of Indicators
06/11/2017	0.24	Jutta Wolff (HAM-BGD)	Selection of Indicators, update part on Co2 emissions
07/11/2017	0.25	Johannes Mielchen (HAM-BGD)	Insert of statistical data
07/11/2017	0.26	Johannes Mielchen (HAM-BGD)	8.5 Actual Plans Developments
07/11/2017	0.27	Johannes Mielchen (HAM-BGD)	Correctionsfrom HAM-SK
07/11/2017	0.28	Johannes Mielchen (HAM-BGD)	Insert energy text from HAW
09/11/2017	0.30	Jutta Wolff (HAM-BGD)	Insert corrections for section 4-7 (here only few comments left), chapter 8 sent to Katharina for corrections
09/11/2017	0.31	Jutta Wolff (HAM-BGD)	All sections are inserted and completed, final corrections missing
09/11/2017	0.33	Jutta Wolff (HAM-BGD)	All sections are inserted and completed, final spelling and orthographic mistakes are corrected
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28/11/2017	0.36	Jutta Wolff (HAM-BGD)	Correction of indicators
29/11/2017	0.37	Johannes Mielchen (HAM-BGD)	Submitted Version
30/11/2017	0.38	CARTIF	Review

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Abbreviations and Acronyms

Acronym	Description
BauGB	Baugesetzbuch *(English: German federal building code)*
BeschA	Beschaffungsamt des Bundesministeriums für Innern
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (*English: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Savety*)
BMVI	Bundesministerium für Verkehr und digitale Infrastruktur *(English: Federal Ministry of Transport and digital Infrastructure)*
BMWI	Bundesministerium für Wirtschaft und Energie *(English: Federal Ministry for Economic Affairs and Energy)*
BSU	Behörde für Stadtentwicklung und Umwelt (*English: Ministry of Urban Development and the Environment)*
BUE	Behörde für Umwelt und Energie *(English: Ministry of Environment and Energy)*
CAR	Fundación Cartif (beneficiary from Spain/project coordinator)
cf.	confer (*English: compare)*
e.g.	exempli gratia (*English: for example)*
EG	Europäische Gemeinschaft (*English: European Union)*
EnEV	Energieeinsparverordnung, German federal direction for energy efficiency
ENH	EnergieNetz Hamburg eG (beneficiary from Germany)
EU	European Union
EV	Electric vehicles
FHH	Freie und Hansestadt Hamburg *(English: Free and Hanseatic City of Hamburg)*
GDP	Gross domestic product
GW	Giga watt
GWB	Gesetz gegen Wettbewerbsbeschränkungen *(English: Act against Restraints of Competition)*
HAM	Hamburg (beneficiary from Germany)
HAM-BGD	Hamburg-Bergedorf (beneficiary from Germany)

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HAW	Hamburg University of Applied Sciences (beneficiary from Germany)
HCU	HafenCity University Hamburg (beneficiary from Germany)
HVV	Hamburger Verkehrsverbund *(English: Hamburg Transportation Association)*
i.e.	id est *(English: that is)*
IATA	International Air Transport Association
ICT	Information and Communications Technology
KON	Konsalt GmbH (beneficiary from Germany)
LGV	Landesbetrieb Geoinformation und Vermessung (State Agency for Geoinformation & Surveying)
LSBG	Landesbetrieb Straßen, Brücken und Gewässer (State Agency for Roads, Bridges & Waters)
MiD	Mobilität in Deutschland (*English: Mobility in Germany, German mobility study)*
n.d.	no date
NO_X	Nitrous oxide
PE	Primary energy
RES	Renewable Energy Source
tbd	to be defined
TEC	Fundación Tecnalia Research and Innovation (participant from Spain)
TEU	Twenty-foot Equivalent Unit
TWh	Terra watt hour
VergRModG	Vergaberechtsmodernisierungsgesetz *(English: Procurement Modernisation Act)*
VgV	Verordnung über die Vergabe öffentlicher Aufträge *(English: The Executive Order concerning Public Procurement)*
VoB/A	Vergabe- und Vertragsverordnung für Bauleistungen, Teil A *(English: Regulation for Procurement and Contract Procedures for Construction Works, part A)*
VOL/A	Vergabe- und Vertragsverordnung für Leistungen Teil A *(English: Regulation for Procurement and Contract Procedures for Supplies and Services, part A)*
WP	Work Package

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1. Executive Summary

The main objective of mySMARTLife project is the definition of an Innovative Urban Transformation Strategy in which the main lines of the project are depicted; highlighting that all interventions in the city must answer to real city challenges, identified following a city led approach and counting on with the active participation of the citizens through citizens' engagement strategies.

Figure 1: mySMARTLife Project concept

There are four different frameworks in which this Innovative Urban Transformation Strategy is deployed:

- **Technological framework,** in which all the actions foreseen will be delivered in three sectors: Energy, Mobility and ICT.
- **Non-technical framework,** covering the urban plans and business models.
- **Innovation framework,** that are focused in the three pillars of the project, smart people, smart economy and ecosystem.
- **Temporary framework,** that represents the evolution of the project from the city challenges and audits until the evaluation of the performance of the actions, passing through the design and implementation of the solutions.

This Urban Transformation Strategy aims at giving response to in a holistic and integrated manner to the transformation process, following its main phases (City Audit, Design of the Solutions, Demonstration and Evaluation or final assessment), for these priority sectors (Energy, Mobility and ICT) and for the key frameworks of this process, the non-technological framework through the integration in Urban Plans of existing and innovative City Business Models overcoming the financial barriers, and the innovation frameworks, which aim is twofold: technical support to the phases in the sense of existing methods and tools supporting these phases and technologies innovation and integration in each of the priority sectors.

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This Urban Transformation Strategy, as well as its implementation, demonstration and replication stages, will be depicted and fully described within WP1, while this document aims at covering the implementation of its first phase (Cities Audit) within the Hamburg lighthouse city.

In this framework, the D3.1 aims to collect all data and information for the first step of the process: the City Audits and diagnosis. This is a key phase for the process because by an accurate diagnosis it can be identified the priority action lines. It includes the assessment of the current state of each of the fields of study and the identification of the main opportunities and capabilities of the city to meet several strategies that may arise.

After the City Audit (Part I of this deliverable), the baseline values for the demonstration actions will be defined in Part II of this report. Both the results of the Part I on City Audit and Part II on the action specific baselines use indicators (City and Project level indicators) defined in close collaboration with WP5 to summarise the current state in Hamburg in the beginning of the project. The action specific KPIs are specified together with the partners involved in the actions. With help of the baseline values, the impacts of Hamburg demonstration actions will be monitored in WP5 (during and) at the end of mySMARTLife project.

This deliverable was originally due by month 12. However, at month 12 the deliverable cannot take into consideration the final detail of the interventions, crucial inputs to build a complete reference baseline. Moreover, these final details are especially necessary to be considered to build the energy part of this reference baseline, following de facto standard protocols like IPMVP.

Considering that an Amendment was requested in September (month 10) and that the process of negotiation and approval can still take several months, it was agreed with the Project Officer to submit an interim report at the original due date, month 12, that will include the Hamburg City Audit. The final version, including the complete Hamburg Baseline will be submitted in month 42.

The related Milestone MS4, which is also in line with these final baseline of Hamburg demonstrator area is also requested to be updated, considering on one hand the City Audit reports ready, justified with the interim versions in month 12 and the Final baseline (new Milestone MS13) with the final version of Nantes, Hamburg and Helsinki baseline reports to be delivered in month 42.

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2. Introduction

2.1 Purpose and target group

This report presents the current state of the Hamburg lighthouse city in the beginning of the mySMARTLife project with regard to the demonstration actions that will take place during the project. The report is divided into two parts: Part I Hamburg City Audit and Part II Baseline assessment. The first part aims at giving an overview of the city of Hamburg in the beginning of the project and with regard to the main topics addressed in mySMARTLife project. The key characteristics are summarised with help of City level indicators. The second part of the deliverable focuses on the actions that will take place in Hamburg demonstration and set the baseline values for those with help of Project level indicators restricted to the scope of the actions (buildings, districts, local energy supply units etc.).

More specifically the City Audit (Part I) collects information from the Hamburg lighthouse city and it carries out an accurate diagnosis of its current status within the framework of the Urban Transformation Strategy. The data to be collected will cover the three main sectors where Urban Transformation Strategy is focused on: building, mobility, and urban infrastructures including ICT. In addition, it covers the analysis of other non-technical aspects that may affect the project goals implementation. Thus, it covers the diagnosis for seven fields: buildings and district, energy supply, city transportation, suitable urban infrastructures for integration, existing urban plans for promoting low energy districts and sustainable mobility, public procurement procedures, regulations and normative; and existing actions for citizens' engagement. The City Audit (Part I) provides the context within which the demonstration actions take place and for which the baseline values and KPIs are set in the Part III of the deliverable. This diagnosis, as well as those developed in D2.1 and D3.1, will also serve as a starting point for the replication plan for the three follower cities, which will be also developed within task 6.1. However, the City Audit (Part I) can be of interest for any reader interested in Hamburg city's current state and readiness with regard to different smart city topics.

The present deliverable is structured as follows:

PART I: Hamburg City Audit

Chapter 3: shows the overview and scope of the city audits to be implemented in the three lighthouse cities. This includes the description of the Urban Regeneration model focusing on the city audits, the city characterisation scope and the predefinition of the evaluation framework through the indicators.

Chapter 4: shows the characterisation of Hamburg lighthouse city, collecting information about the following aspects: socioeconomic structure, climatic conditions, environmental issues, urban morphology, land use, green and public spaces structure.

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Chapter 5: shows the analysis of the existing urban plans for promoting low energy districts and sustainable mobility. In particular, the urban plans to promote clean vehicles that are creating a preliminary context in the city and that will be strengthened with mySMARTLIfe.

Chapter 6: shows the analysis of public procurement procedures, regulations and normative that may affect the project implementation. Moreover, it is identified the potential for improvement on them.

Chapter 7: shows the existing actions for citizen engagement, focused on the current practices and other initiatives for empowering citizens to be part of the city life, as well as the potentiality for creating an innovative, replicable and effective citizen engagement strategy.

PART II: Borough of Bergedorf Audit

Chapter 8: shows the characterisation of the Borough of Bergedorf, collecting information about the following aspects: spatial structure, social and economic characterization and it collects the actual plans and future developments of the borough.

Chapter 9: shows the diagnosis of the energy supply network as well as the potential local energy resources suitable for integration. This information is essential in order to estimate the foreseen contribution of the proposed solutions for improving energy supply facilities. As the main project target is to supply energy by means of centralised systems based on renewables, it is necessary to collect information about the barriers, needs and potential to substitute the existing systems.

Chapter 10: shows the city transportation current status, focused on the mobility city profile and the statistics of internal movements, typology of the public transport, rate of sustainable vehicles, existence and main characteristics of the charging infrastructure for EV, etc.

Chapter 11: shows the diagnosis of suitable urban infrastructures for achieving benefits in a possible integration. Although several specific actions have been planned in the demo sites for the pillar of integrated infrastructures, it has been collected information about the potential that some relevant city infrastructures have to be integrated in order to take advantages about a jointly operation. Information about electrical grids, broadband infrastructure, traffic management systems, and so on, has been analysed.

Chapter 12: shows the conclusions of city diagnosis for take an overview of the city characterisation and the main findings of the analysis done in each field of study at both scales, Hamburg and Bergedorf scales.

PART III: Hamburg demonstrator area baseline

Chapter 13: shows the preliminary analysis of the districts that will be retrofitted. Information about the main architectural issues, energy facilities and energy consumption will collected for the definition of the

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baseline and for detecting the improvement possibilities. This part will be further developed in the following months in order to complete the reference baseline.

The final version, including the complete Hamburg Baseline will be submitted in month 42.

Chapter 14: references and bibliography.

Chapter 15: annex in which all Hamburg city level indicators are collected.

2.2 Contributions of partners

The following table depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
CAR	Overall content to sections 1, 2 and 3
ENH	Chapter 9,10,12
HAM	Chapter 4, 5, 6, 7,8,9,10,11,12,13,14
HAW	Chapter 4,9,10
HCU	Chapter 4, 5, 6, 7
KON	Chapter 5, 7,10,12

2.3 Relation to other activities in the project

The following Table 2 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D5.1	This deliverable provides the overall description of the evaluation framework, and the selection of indicators at city and project level.
D1.12	This deliverable provides the overall description of the 3D models for each pilot.
D3.2	This deliverable will provide the baseline report Hamburg lighthouse city and the simulation models of the building stock, energy system, transportation and urban infrastructure.

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PART I: Hamburg city audit

3. City audit overview

3.1 City characterisation

The characterisation of Hamburg lighthouse city, and its supporting data collection, provides the citywide integrated documentation and analysis of the current conditions required to identify the priority action lines as well as their management needs.

Through a range of city descriptors and indicators, information about the existing conditions including some of the key aspects for the sustainable development are collected and shown in a standardised manner: social, economic and environmental aspects. This information is essential to promote actions and management plans for implementing the sustainable urban regeneration model aiming in mySMARTLife project.

The characterisation model will provide the entry point to extensive available data sets, to be regularly updated with numerous sources, which will enable to detail the lighthouse and followers cities analysis. Moreover, it will facilitate the replicability assessment and adaptation of the Innovative Urban Transformation Strategy.

The characterisation will follow the approach developed for the evaluation framework developed in WP5. While the overall framework and the full set of indicators will be depicted in WP5 related documents, this report includes a selected list of indicators aiming at covering the city characterisation.

3.2 Predefinition of the Evaluation Framework

A specific Evaluation Framework is being defined in task 5.1, and developed in mySMARTLife to assess the project activities from a holistic point of view and to replicate the project in other cities. This framework will be based on indexes, which can be built by integration of an objective set of key indicators, grouped and classified by categories that represent the main aspects of cities processes.

The Evaluation Framework of mySMARTLife is currently under definition but in this first stage of city diagnosis, a preliminary set of indicators at City Level can be considered to obtain some information about the starting point of every city.

This pre-selection of indicators at City Level is mainly connected with parameters or information related with the main aspects considered in the city audit, which are the following:

- City characterisation.

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- Existing urban plans for promoting low energy districts and sustainable mobility.
- Public procurement procedures, regulations and normative.
- Identification of existing actions for Citizen Engagement.
- Building and District baseline
- Local Energy supply and resources diagnosis.
- City transportation current status.
- Suitable urban infrastructures for integration.

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4. City characterisation

4.1 General overview and geographic positioning

The Free and Hanseatic City of Hamburg, one of the 16 states of the Federal Republic of Germany, is the second largest city in Germany with its 1.8 million inhabitants in the city and 5 million inhabitants if the large metropolitan area is considered. Hamburg is a city as well as a state, with 7 administration districts (boroughs) and 104 city districts. Economically and culturally, with an airport within its boundaries, a seaport in its centre and number of large industrial sites, Hamburg can be seen as the centre of Northern Germany.

In addition to the City of Hamburg, two cities without districts (Lübeck and Lüneburg) and 17 other areas from the federal states of Schleswig-Holstein in the North, Mecklenburg-Vorpommern in the East and Lower Saxony in the South, form the Hamburg Metropolitan Area. The Metropolitan Area covers a total area of 26,103 km^2 and has a population of 5.1 million citizens.

Because of the size of the City of Hamburg the boroughs are an important part of the administrative structure. The administration of the boroughs are responsible for a number of decentralized administrative tasks, in particular in the social, health, construction, reporting, housing and real estate sectors as well as in the area of economic monitoring. Therefore they undertake development planning on their own responsibility (local planning autonomy).

According to that specific situation, the City Audit is divided in two parts. The first parts deals with the situation in the whole City of Hamburg. The second part is focused on the structure of the Borough of Bergedorf, in which the demonstration side of the project is located and its administration is responsible for the coordination of the implementation of the project tasks regarding the project area.

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Figure 2: Hamburg administrative districts (Date of Issue: December 31th in 2015) (Statistikamt Nord, 2017c)

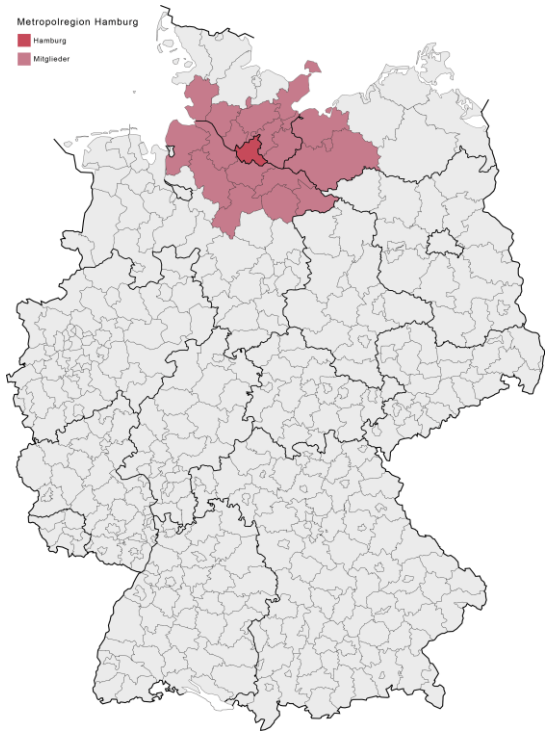

Figure 3: The Area of Metropolregion Hamburg (Wikipedia 2017)

4.2 Socioeconomic characterisation

Population growth has been well above the national average for Hamburg due to its dynamic economy and to the variety of available career opportunities, as well as the wide offer of education, leisure and culture, that attracts a big proportion of people from outside the city. This is reflected and summarised in figure 4 and described in this section.

4.2.1 A growing multicultural city

Hamburg is a growing city. Since the last census in 2011, Hamburg has grown from around 1.7 million to more than 1.8 million since August 2016 (Statistikamt Nord, 2016a). Only 44% of all citizens were born in Hamburg. The remaining 56% were born in another federal state or abroad (Statistikamt Nord, 2016b). This underlines that especially younger people are attracted to Hamburg by the city's dynamic economy and the large number of jobs it offers as well as by the variety of educational institutions and the large range of leisure facilities and cultural events.

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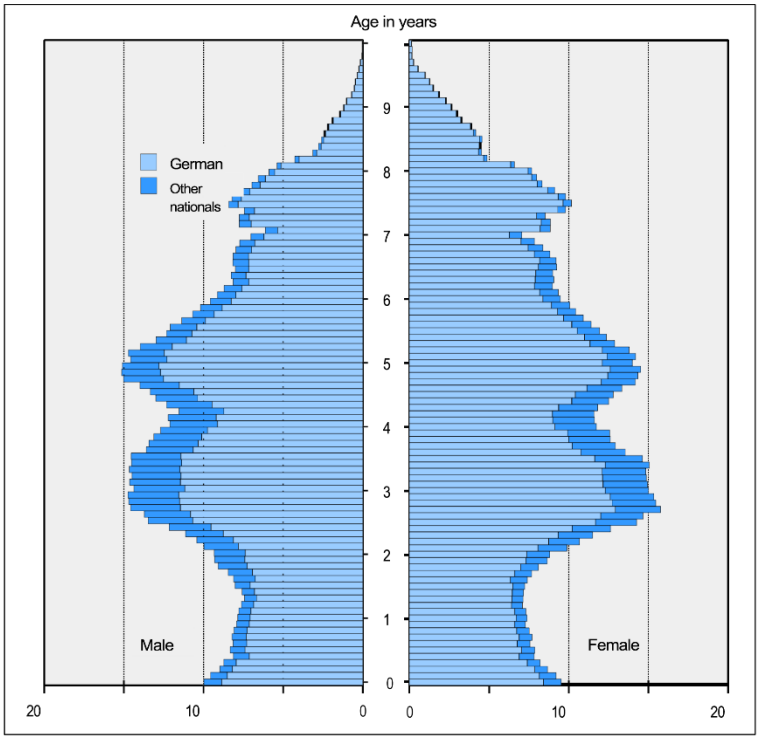

Figure 4: Population pyramid 2015 of Hamburg (Statistikamt Nord, 2017a)

The city is very multicultural and with 14% it has one of the highest proportions of foreign residents in Germany. Most of the foreign inhabitants originate from Turkey, Poland, the former Yugoslavia and Afghanistan (Statistikamt Nord, 2017a).

Table 3: Demography Overview of Hamburg (Statistikamt Nord, 2017c)

Hamburg Demography	2015[a]	2005[b]	1995[b]
Total population	1,787,408	1,743,627	1,707,901
Women	914,346	894,160	885,278
Men	873,062	849,467	822,623
Up to age 18 (in %)	16.2	15.7	16.0
18 – 60 years old (in %)	60.2	60.2	61.8
60 years and older (in %)	23.6	24.1	22.3
Other nationals	262,252	247,912	254,369
Other nationals (in %)	14.7	14.2	14.9
Total no. of households	987,000	939,000	882,000
Single households (in %)	52.1	48.7	45.7

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Hamburg Demography	2015[a]	2005[b]	1995[b]
Moves to Hamburg	110,023	81,726	75,104
Moves away from Hamburg	89,110	71,602	68,671
Births	19,768	16,179	15,872
Deaths	17,565	17,374	20,276

[a] Population after May 9, 2011 will be determined by extrapolation of the observed census result in 2011 with the arrivals and departures and the births and deaths.

[b] Population determined by the census from 1987

4.2.2 Economic context and employment in Hamburg

In Germany, Hamburg is one of the federal states with the most energetic economic performance.

In 2016, the inhabitants of Hamburg achieved a real gross domestic product (GDP) of 111 billion Euro in 2016 (Statistische Ämter des Bundes und der Länder, 2017a) and year-on-year economic growth of 1.4% in 2016 compared to 1.7% of German economic growth (GDP at current prices, year to year change) (Statistische Ämter des Bundes und der Länder, 2017b).

In 2016, there were on average 70,666 registered unemployed persons in Hamburg, which matches to an unemployment rate of 8.1% overall (5.6% persons <25 years, 16.1% foreigners) (Statistikamt Nord, 2017d).

Traditionally, Hamburg is Germany's largest trading centre. Accordingly, the logistics industry and companies involved in foreign, wholesale and retail trade, together with banks and insurance firms, are among the city's major employers. The media and creative industry is also an important source of employment. Furthermore, there are jobs in industry too, such as shipbuilding and repair, aircraft construction, as well as in the chemical industry. Many farms are located in the surroundings of Hamburg, like dairy farming, fruit and vegetable farms.

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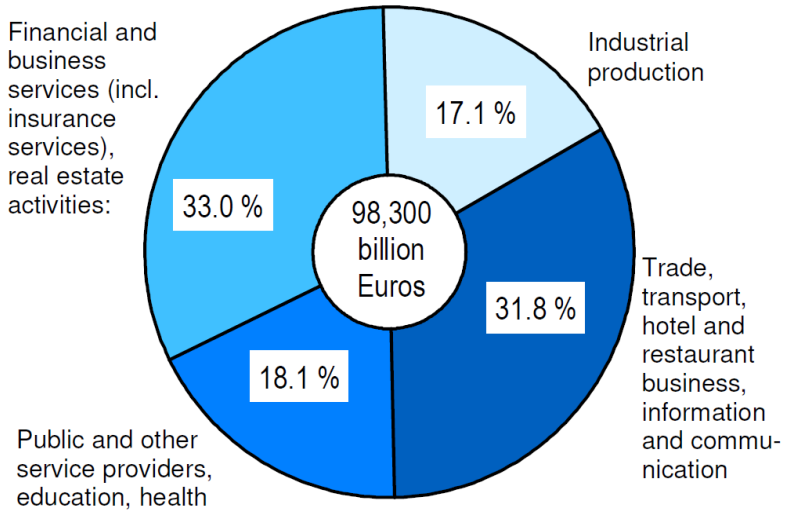

Figure 5: Gross value added (i.e. excluding price increase) (Statistikamt Nord, 2017c):

The main sources of employment in Hamburg are financial and business services, followed by trade and transportation, hotel and restaurant business, information and communication.

The workforce in Hamburg of 1,202,000 people in total in 2015 can be distributed to the sectors as follows (Statistikamt Nord, 2017c):

- Trade, transport, hotel and restaurant business, information and communication: 33%
- Public and other service providers, education, health: 28.4%
- Financial and business services (incl. insurance services), real estate activities: 25.7%
- Industrial production: 12.7%

Hamburg's economy is still dominated by companies with names known around the world, such as Airbus, Beiersdorf, Hapag Lloyd, Helm, Olympus, Otto Versand or Tchibo. However, these big names should not vague the fact that the growing numbers of small and medium-sized enterprises are also attractive employers. The gross monthly earnings of full time employees (including public servants) are for women: 3,843 Euro and for men: 4,854 Euro. Further 30.2% of the Hamburg workforces are commuters who live outside the city (Statistikamt Nord, 2017c).

4.3 Climatic characterisation

Hamburg is located in the warm moderate climate zone and is characterised by a maritime climate. Due to its proximity to the coast and influences of winds from the west, the climate is humid all year, milder in winter and cooler in summer than in the eastern hinterland.

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The warmest month is July with an average of 17.9°C and the coldest is January with 3.2°C. Temperatures around 28°C are not uncommon in summer, with 1,597 hours sunshine (36.7% of total possible hours) hours per year. In the course of a year an average of 763 mm precipitation falls (Statistikamt Nord, 2017c - all averages of the years 2006 to 2015). In the winter half a year it can be very stormy with a high number of misty days.

Climatic descriptors	
Total annual precipitation	763 mm
Average annual temperature in winter	3.2 ° C
Average annual temperature in summer	17.9 ° C
Average annual temperature	10.1 ° C
Average annual global solar radiation [kWh/m^2/yr]	1500 kWh/m^2
Average wind speed [m/s]	5.1 m/s
Average annual precipitation [mm/day]	66 mm
Annual number of sunshine hours	1,597

Figure 6: Climate descriptors of Hamburg

4.4 Urban morphology and land use characterisation

The city is located on the North German Plain in the lower reaches of the Elbe River, about 100 km from the coast where the Elbe flows into the North Sea. The total area of the city is about 755.2 km^2, of which the port area covers 74.4 km^2. The largest distance in East-West as well as North-South direction is approximately 40 km (Statistikamt Nord, 2017c).

The dominant natural element in Hamburg is the river Elbe with its tributary waters Alster and Bille and a wide range of town canals. The topography of the city is flat, which is typical for the North German Plain and consists of wet marchlands in the centre and the eastern shores of the Elbe and sandy soil (German “Geest”) in the rest of the area. The highest natural elevation with 116 metres above sea level is to be found in the Harburg Mts. in the south auf the city area (Statistikamt Nord, 201c).

The main aspects in terms of urban morphology and land use are summarised in Figure 9 and described in the following subsections.

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4.4.1 Urban morphology

Over the past 100 years, the urban structure has been formed by the concept of Hamburg's first Chief Planning Officer, Fritz Schumacher, which was to let the city grow along rail lines leading out of the city into the region.

The building style range from the two-storey garden city of the 1920s to the style of the City North, which is comprised of office blocks in a park, characterised by free standing high rises based on concepts from the 1960s. Considerable demand for inner city neighbourhoods shows that the Wilhelminian quarters are still associated with good quality homes and lifestyles, both for their urban density and the six to seven floor heights of the buildings. They are to be the benchmark for all future new building in all parts of the city where multi-storey buildings predominate - without being the blueprint for the entire city (see FHH, 2014).

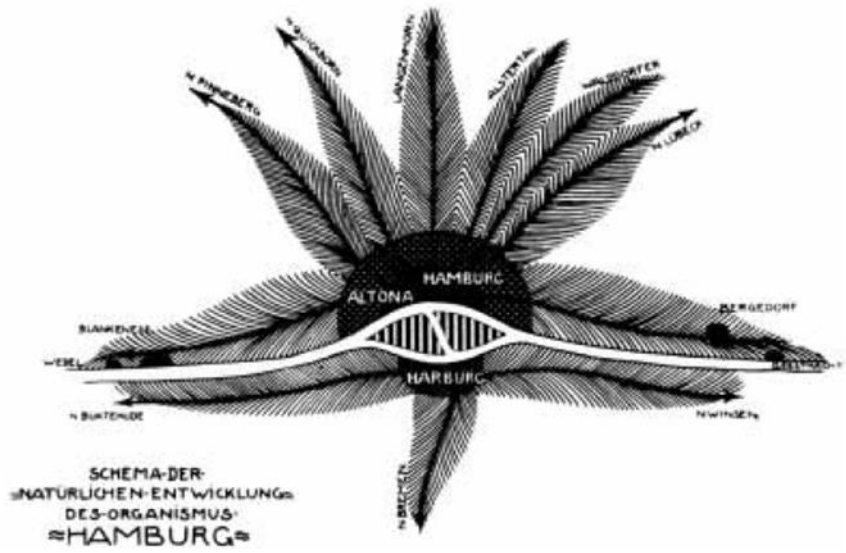

Figure 7: Scheme of the natural development of the organism Hamburg from Fritz Schuhmacher, 1919 ("Featherplan") (FHH, 2007)

However, there are already excellent examples of high-rises that, in selected locations, are attractive and harmonise with the skyline. Historically, this means the inner-city church towers; however, the old city gates, Dammtor, Berliner Tor, Lübecker Tor and Millerntor are now marked by striking, highly visible buildings that announce their specific location. (Tor = gate).

The "Port Crown" section of the river bank and the Elbe Bridges are also prominent sites that lend themselves to more spectacular projects. The Elbphilharmonie concert hall stands on the most prominent of such site, adding a new entrance gate to the city panorama. However, the inner city area bounded by Wallring is taboo for any development higher than the Wilhelminian benchmark. Here, the traditional silhouettes of the church towers will continue to dominate the skyline (see FHH 2015).

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4.4.2 Green and public spaces structure characterisation

Hamburg is famous for being a Green Metropolis. Watercourses framed by lush greenery are typical – from the rivers Elbe, Alster and Bille to the small streams, canals, lakes and ponds. Many parks, cemeteries, allotments and nature reserves also contribute to the city's green image as do woods, fields and meadows and last but not least the large number of trees lining the streets. These around 245,000 trees lining the streets not only beautify the city, they are also vital for the micro-climate, the mitigation of air pollution, and they are habitats for a variety of wildlife, especially birds (see FHH n.d).

Watercourses, open space and trees combine to form a green network within the town: 16.3% of the municipal area is made up of parks, recreation areas and woodlands with bodies of water accounting for a further 8.4%, thus contributing significantly to the city's recreational value. 68 km^2 (9%) are declared national parks, an additional 166 km^2 (22%) nature reserves (Statistikamt Nord, 2017c).

They form the basis for the "Green Network Hamburg" (Grünes Netz Hamburg), the public space concept of the city, which consists of radiating landscape axes and two green rings, complemented by key recreational areas, such as borough parks, district parks and urban recreational areas. A finely woven network of smaller green open spaces and green links for outdoor activities and relaxation close to residential areas exists between the landscape axes and the green rings. Many destinations can be reached by bicycle or on foot on various paths within the "Green Network".

The landscape axes of the "Green Network Hamburg" consist of connected green open spaces that stretch from the surrounding countryside right into the city centre, lying between built-up areas. North of the river Elbe they radiate outwards from the ring of the former fortifications and are between 18 and 25 km long. The districts of Bergedorf and Harburg have their own radial system of landscape axes, which are 5 to 6 km long (see FHH n.d).

On the periphery, the landscape axes still consist of large stretches of unspoiled countryside, agricultural land, woodland and semi-natural landscapes like the "Vier- und Marschlande" with vegetable and flower production in the Borough of Bergedorf.

Further towards the city, these large areas are continued by green corridors with parks, allotments, cemeteries and sports grounds, which serve urban recreation close to residential areas.

They are also important public open spaces in their own right. The further the landscape axes continue towards the city, the narrower, thinner and more fragmented they become. At the city centre, where the axes meet the first green ring along the former fortifications, they are often no more than footpaths framed by trees or shrubs (see FHH n.d).

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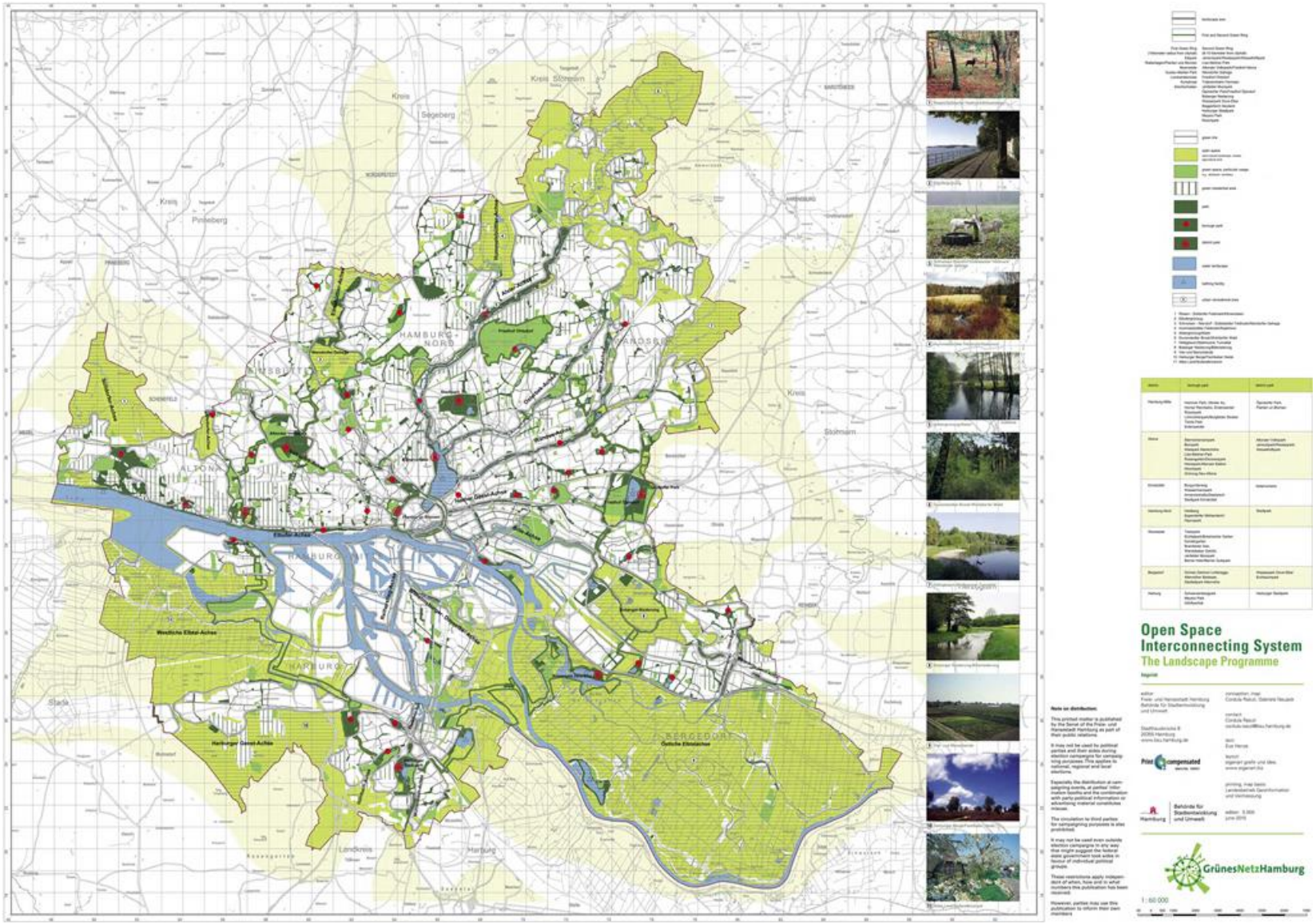

Figure 8: Open space interconnecting system "Green Network Hamburg", (FHH, 2010)

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Borough	Area in total	From that							
		Buildings and open space	Plant area	Recreation area	Traffic area	Agricultural land	Forest area	Water area	Area with other use
	ha								
Hamburg-Mitte	14 227	5 700	139	1 007	1 917	1 518	310	3 471	165
Altona	7 793	3 755	10	825	975	839	603	641	144
Eimsbüttel	4 982	2 834	8	485	921	374	230	102	27
Hamburg-Nord	5 777	2 854	2	763	1 428	58	104	184	384
Wandsbek	14 755	7 246	67	1 101	1 654	2 706	1 744	196	42
Bergedorf	15 474	2 930	166	940	980	8 543	668	1 183	65
Harburg	12 512	3 443	242	486	1 155	4 425	1 983	551	227
Hamburg	**75 520**	**28 762**	**633**	**5 607**	**9 030**	**18 463**	**5 643**	**6 329**	**1 054**

Source: Land survey on the basis of the official real estate cadastre

Figure 9: Land use in the Boroughs of Hamburg at the 31.12.2015 by type of use (Statistikamt Nord, 2017a)

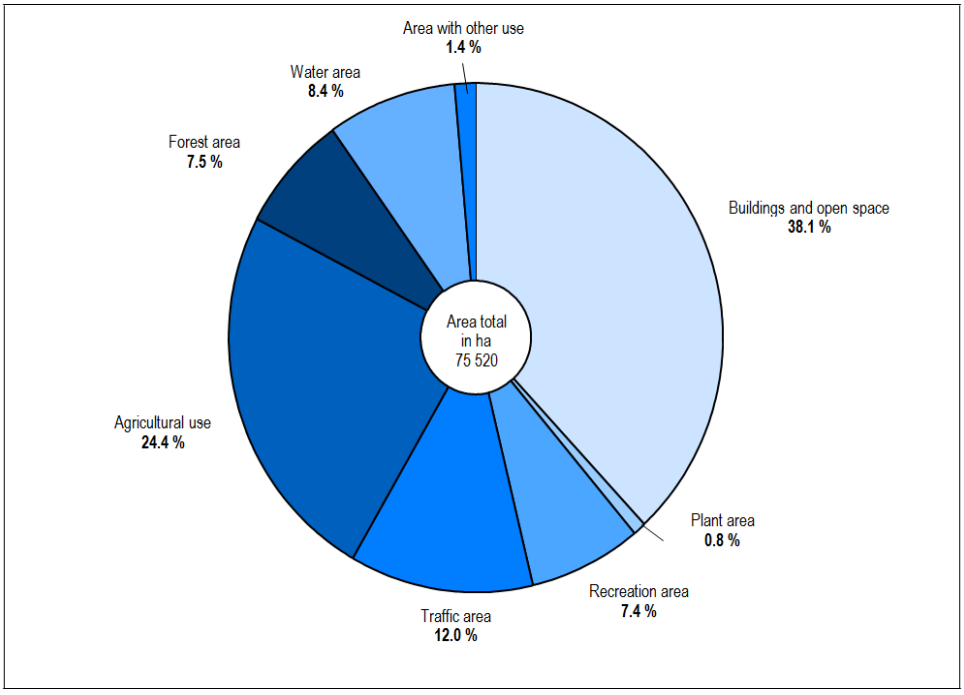

Figure 10: Land use in Hamburg at the 31.12.2015 by type of use in % (Statistikamt Nord, 2017)

4.4.3 Traffic characterisation

The traffic situation in Hamburg is influenced in particular by the natural barrier of the river Elbe and the Port of Hamburg with its location directly in the middle of the city. As Europe's third-busiest port in TEU throughput, it is a main source and destination for supra regional long-distance traffic flows. At the same time, the possibilities for an expansion of traffic infrastructure due to the high structural density in Hamburg are very limited.

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Furthermore, Hamburg is the most important railway hub in Northern Germany and one of the central junctions in European rail freight transport. In this regard, the main station, with only eight available platforms for the handling of long-distance and regional transport, considers a significant bottleneck (FHH 2013a).
The two motorways A 1 and A 7, which are crossing the Elbe with the already eight-striped Elbtunnel are of outstanding importance for the European supra regional traffic. In addition, both motorways have been extended continuously on four or six lanes within Hamburg. They manage an average working traffic volume of over 100,000 cars / 24h (see FHH 2013a).

Hamburg Airport (IATA code: HAM) is the busiest airport in Northern Germany. In 2012 the volume increased to 13.7 million passengers. Approximately 18 million passengers will be forecasted for 2020. However, the increase in flight movements is below that of passenger traffic. This is the result of a trend towards the use of larger aircraft and higher capacity utilisation (see FHH 2013a).

As a city with a rapid transit system, which expanse beyond the city borders into the surrounding region, combined with a sophisticated bus system (metrobus, express bus, city bus), Hamburg has good conditions for the handling of intensive traffic flows in the area. Under the umbrella of the Hamburg Transport Association (HVV) exists a uniform offer (appearance, timetable, pricing) of the different transport companies.

The German wide survey "Mobility in Germany" (German: Mobilität in Deutschland, MiD), conducted in the years 2002 and 2008, found that the population of the whole HVV area, performs 10.9 million trips per day – thereof 5.79 million trips in Hamburg and 5.10 million trips in the surrounding area. The survey also revealed that residents of Hamburg are less using motorised private transport (MIV) than surrounding residents and travel shorter distances (see FHH 2013a).

The average travel distance for the citizens in Hamburg is 32 km, the average distance of the people in the region is 40 km. The choice of traffic mode is also different. The citizens, which perform trips in the surrounding area, use more often the car, the public transport or the combination of both. The bicycle and walking only play a subordinate role. The residents of Hamburg's inner city area frequent much more the public transport or walking than the people in the suburbs (see FHH 2013a).

The modal split analysis shows changes between the traffic segments. The decrease in the share of the MIV by a total of 5% within six years and the increase in the share of bicycles from 9% to 12% are remarkable. The proportion of public transport has declined by one percentage point between 2002 and 2008. However, as overall transport performance has increased as a result of longer distances and population growth, this still means a considerable increase in passenger and driving performance for public transport. It is assumed that these measures will continue to develop in similar dynamics in the future (see FHH 2013a).

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An important area of action for Hamburg is the commuter traffic. The growth dynamics of the population is higher in the surrounding region than in Hamburg. The evaluations of the survey "Mobility in Germany" show that in the hinterland the distances of trips are longer and are more frequently travelled with the motorised private transport. For people in the surrounding areas, the "CO_2 footprint" is almost a quarter higher than for people in the core city - here, less by longer day trips, but above all by the high rate of motorised private transport travel. The composition of car fleet also has a different effect on the "carbon footprint". For many years, a decline in the number of weaker motor vehicles could be observed, with a simultaneous increase in the higher performance classes.

Overall, there is a change in the mobility culture. This development is especially noticeable for young people, with the focus on the absence of a private car and the share of public transport and an increasing bicycle use (see FHH 2013a).

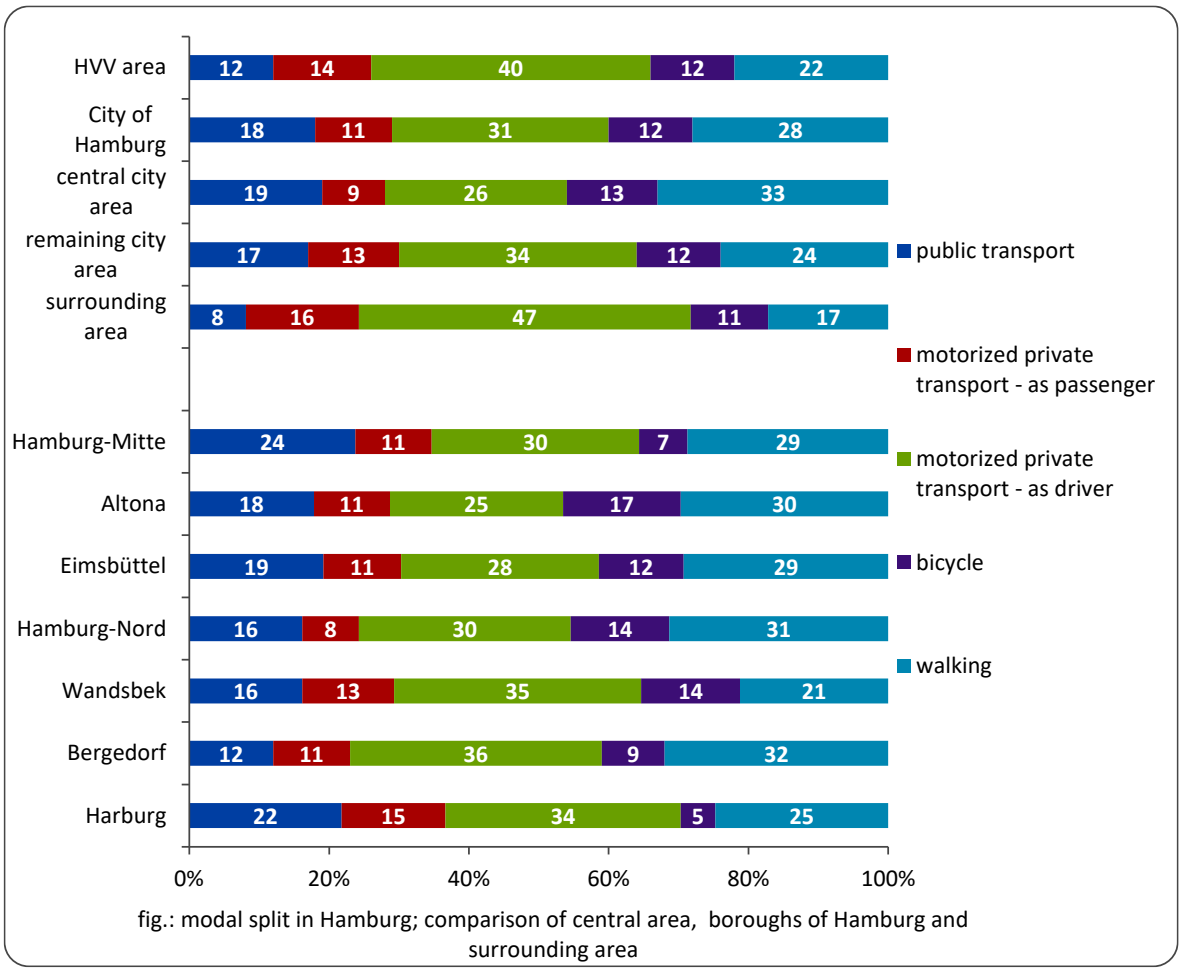

Figure 11: Modal split in Hamburg; comparison of central area, Boroughs of Hamburg and surrounding area (MiD 2008 seen in FHH 2013a)

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4.5 Energy characterisation

In the following chapter the energy characterisation of Germany and Hamburg will be shown.

4.5.1 Energy characterisation of Germany

Germany strives hard to turn its energy usage to greater shares of renewable energies. Within the electricity sector this is done with far greater success than in the energy usage sectors “heat” and “mobility”. As a result, the share of renewable energies in power generation has increased by a factor of five since the year 2000. During the same period the share of nuclear power has halved. Opposed to this, the sum of the fossil fuels gas (mainly for heating) oil (mainly for mobility) and coal (mainly electricity production) declined only slightly. Figure 12 displays this development.

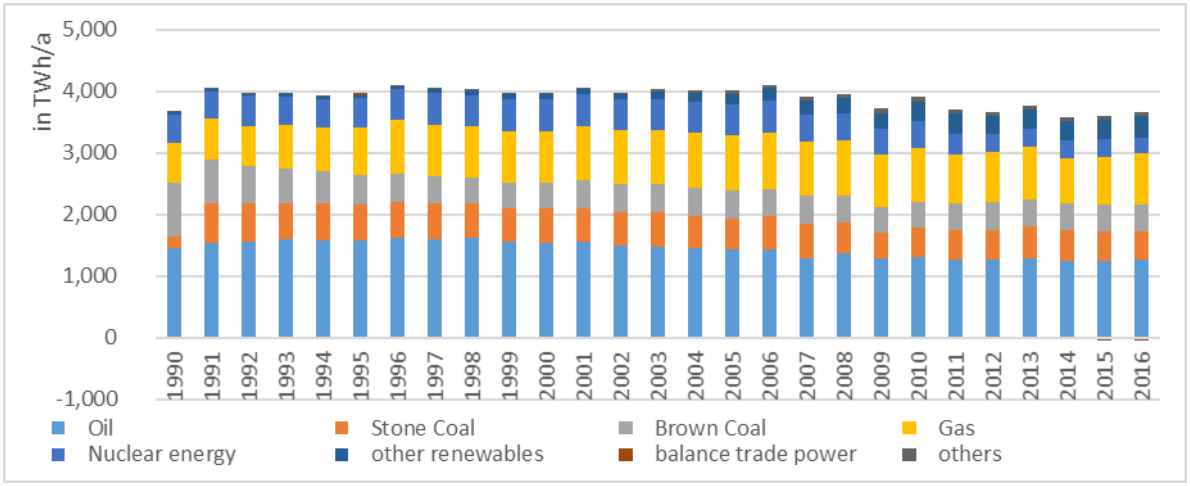

Figure 12: Development of primary energy consumption in Germany between 1990 and 2016 (BMWi, 2017)

The overall primary energy consumption accounted to 3,700 TWh of which 12% (14% final energy) originated from renewable sources. About 21% (783 TWh) of that primary energy was used for space heating and hot water. An additional 15% was used for process heat. In total about 55% of the primary energy was used to derive heat. About 30% (730 TWh) were used in the mobility sector. Space cooling, process cooling ICT and lighting only require smaller shares of the primary energy demand. Figure 13 displays the German primary energy mix for 2016.

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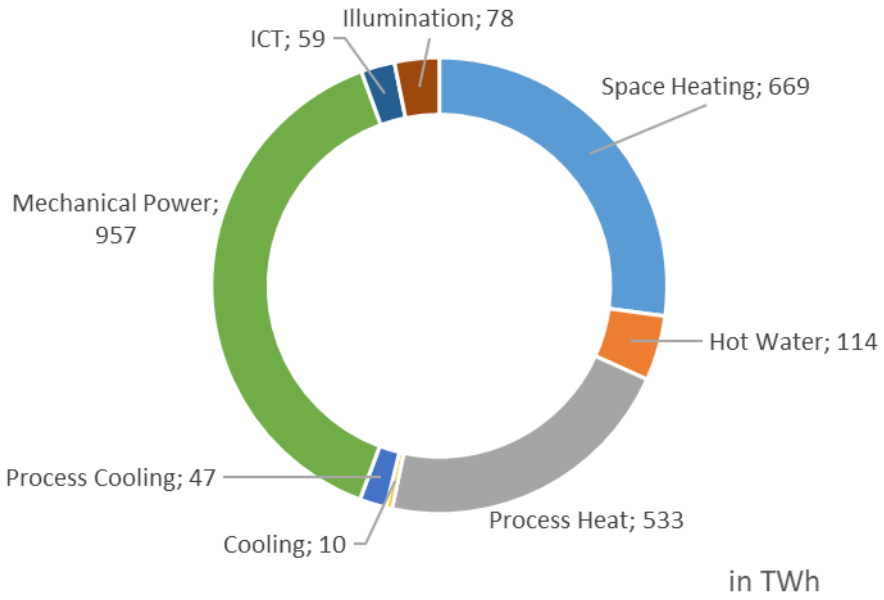

Figure 13: Primary energy consumption for different usages in Germany 2016 (BMWi, 2017)

The renewable energies share of the gross electricity production is now at nearly 32% and exceeds the political aims. At the same time the overall share of renewables on the total final energy consumption is still below 15% and remains too low in order to successfully meet the political aim of a share of 18% by 2020. Figure 14 displays this development.

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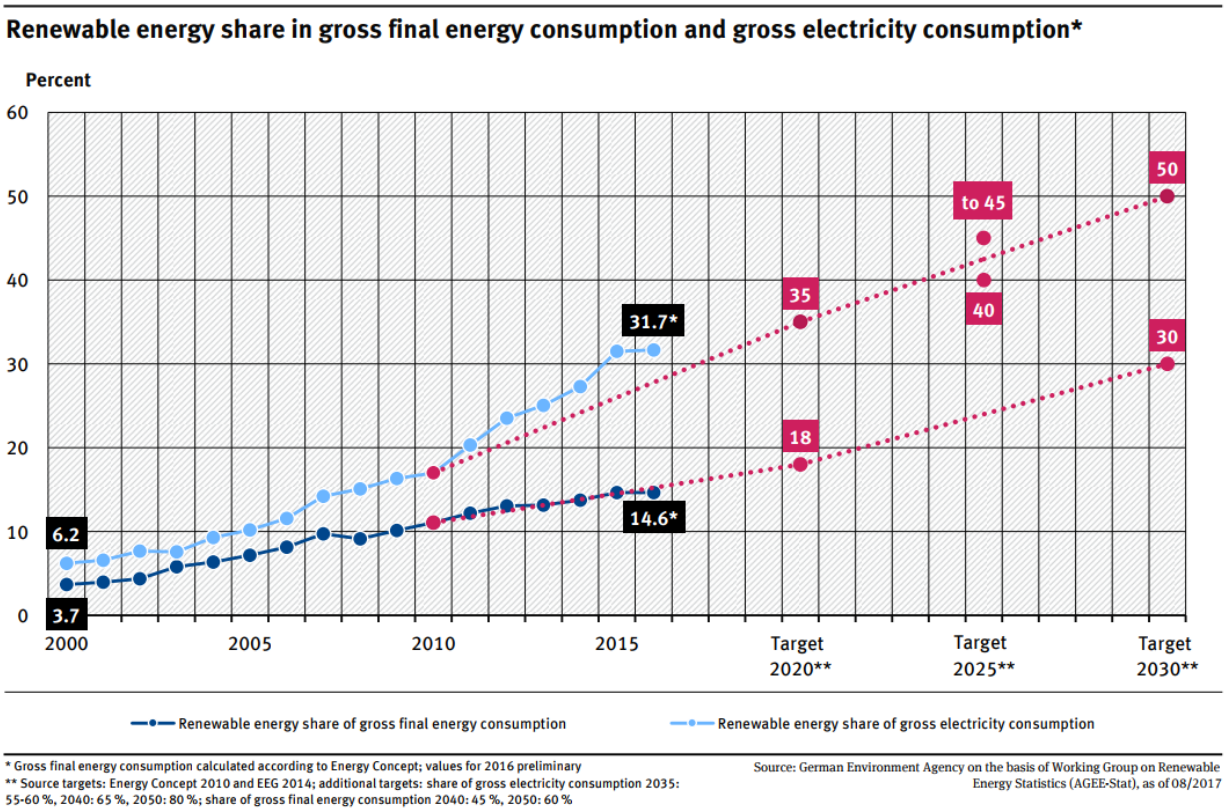

Figure 14: Comparison of the renewable energy share in gross final energy consumption and electricity production between 1990 and 2016 (Umweltbundesamt, 2017)

Overall the primary energy consumption has decreased by about 10% (final energy by 6%) since 1990. This seems a small decline given the large efforts being made in Germany in terms of energy savings and energy efficiency. It though needs to be taken into account that during the same period the German gross domestic product rose by nearly 50%. A decline in the energy consumption could still be achieved due to much higher energy productivity (energy efficiency). This development is displayed by Figure 15.

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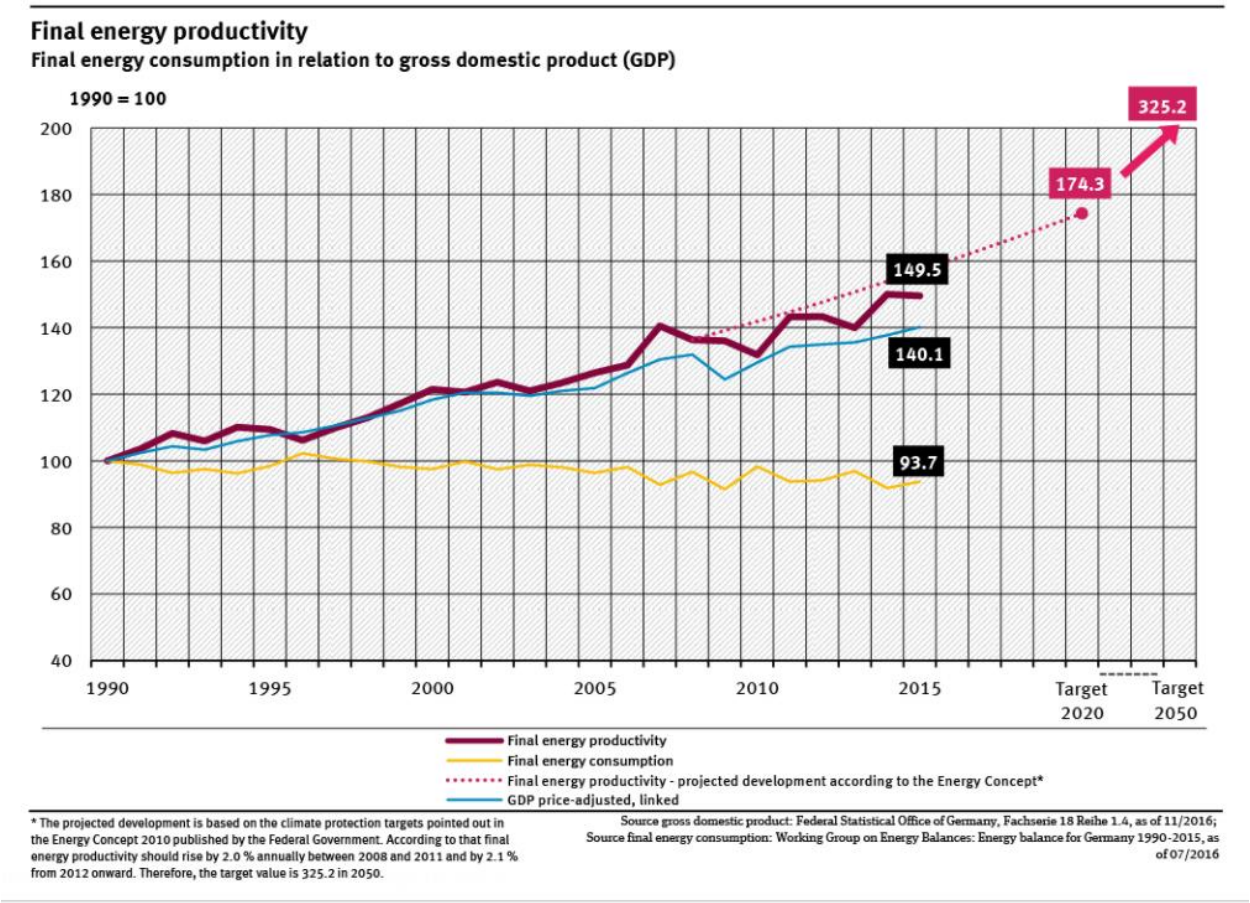

Figure 15: Development of the energy productivity, GDP and final energy consumption between 1990 and 2016 (BMWi, 2017)

4.5.2 Energy characterisation of Hamburg

The development of the primary energy (PE) consumption in Hamburg has been more or less stagnant between 1990 and 2014 at a level of about 55 TWh/a, +/-5 TWh. In 2015, Hamburg set into operation a large new stone coal fired power plant which led to the rise in PE consumption from that year on. Due to this development the PE consumption in Hamburg rose by about 8% compared to 1990. Figure 16 displays this development. Note the rise in stone coal (dark blue at the bottom) in 2014/2015 due to the new fossil power plant (Moorburg). The largest share in the PE consumption of Hamburg is mineral oil with about 30 TWh/a due to the large energy consumption in the mobility sector.

Energy data for Hamburg have not been statistically evaluated between 1998 and 2002 which explains obvious gaps. Latest statistics are from 2015 (Lak 2017).

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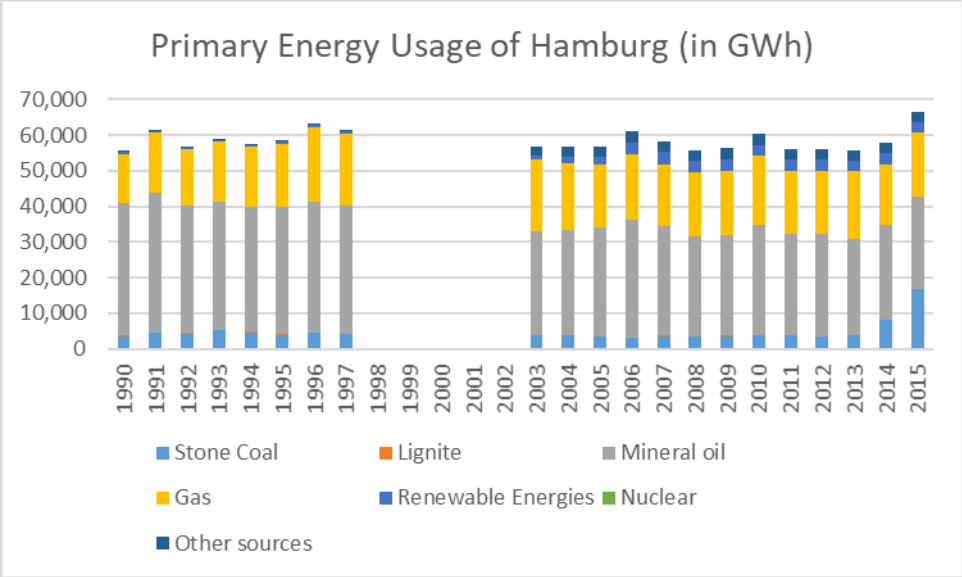

Figure 16**: Primary energy consumption in Hamburg 1990-2015 (Source: own design based on Lak 2017)**

The final energy usage declined by about 14% compared to 1990 and now (2015) adds up to 48.150 GWh/a. The strongest contribution to this reduction came from ships (reduction by 62%) and trains (reduction by 38%) in the mobility sector. The largest share of the final energy consumption is caused by households and the tertiary sector (22,884 GWh/a) (unfortunately figures for these two sectors are always given jointly in the statistical tables).

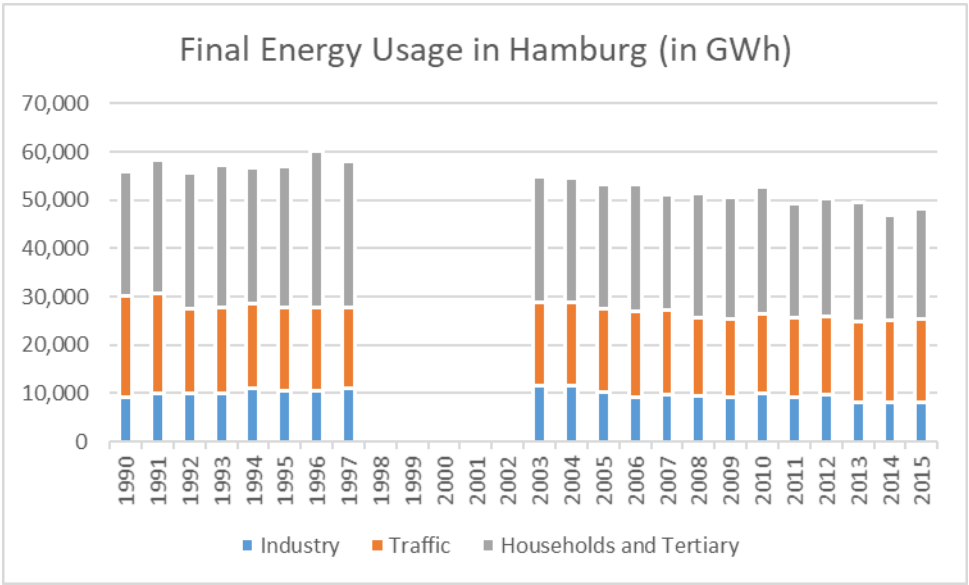

Figure 17: Final energy consumption in Hamburg 1990-2015 (Source: own design based on Lak 2017)

The share of renewable energies in the total PE consumption in Hamburg is a modest 4.4% (3,137 GWh/a). The by far largest part in it (84%) is derived from biomass. This includes the bio-share in the

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household waste, which in Hamburg is incinerated. Heat and power derived from it (CHP processes) is fed into the district heating system. Wind and solar energy together account for only 5% of the RES share and a meek 0.2% of the total PE consumption of the city.

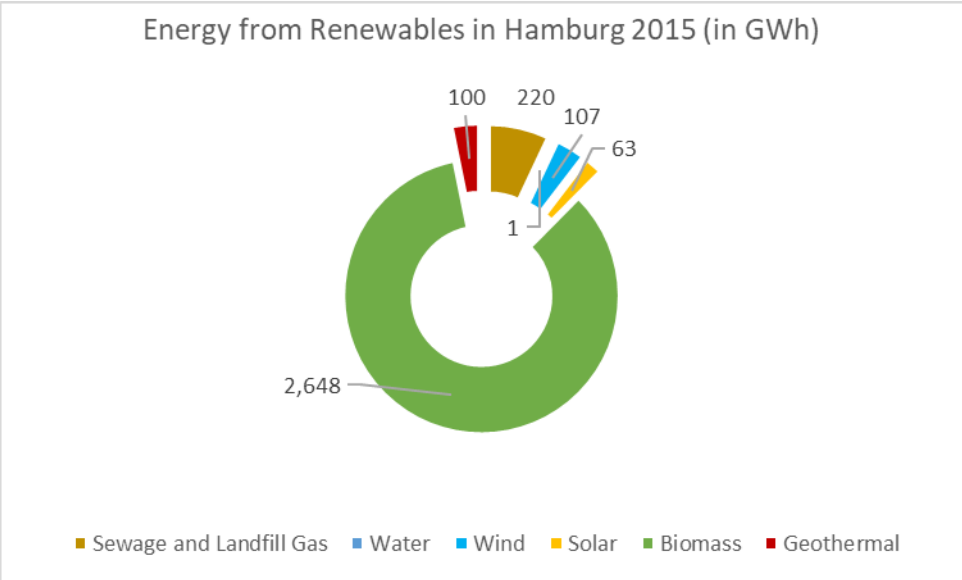

Figure 18: Shares of different renewable sources in the total RES consumption in Hamburg 2015 (Source: own design based on Lak 2017)

The RES share in the electricity production drastically declined after the new coal fired power plant started operations in 2014/2015. Before that the RES share in the electricity production in Hamburg was about 16%. It now has declined to 6% due to the large power production by coal. If the relation is made to the total primary energy or the electricity consumption the shares of RES slowly (but constantly) increase to 4% (for both relations) in 2015.

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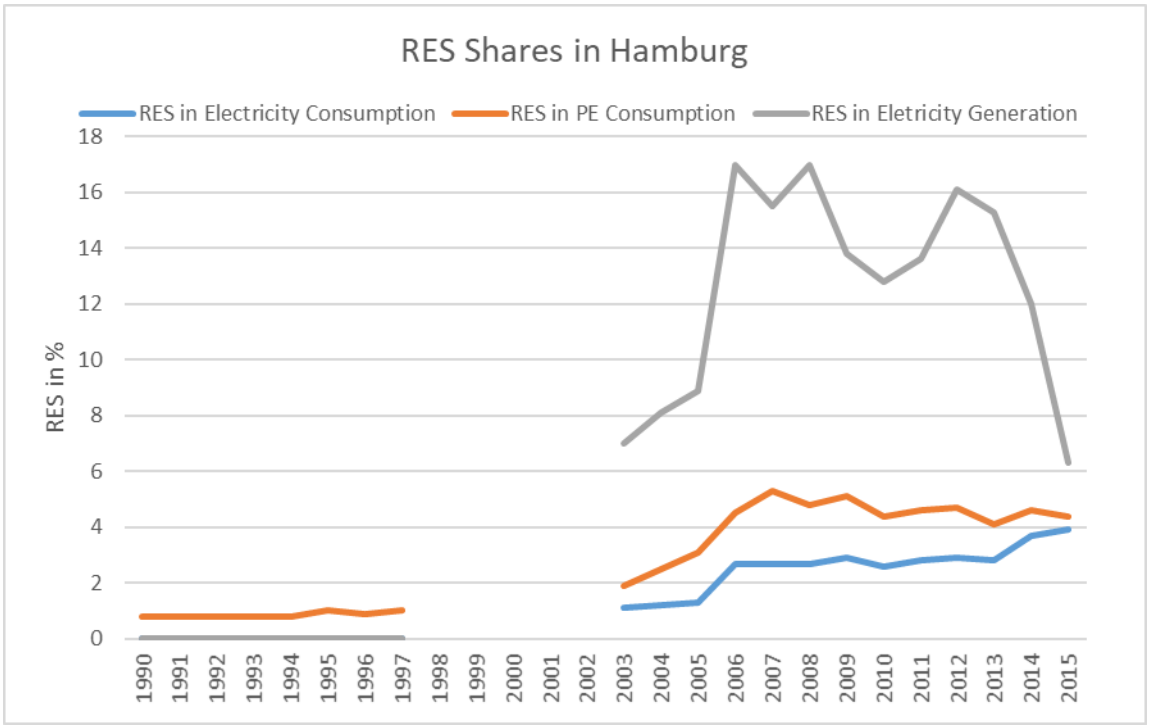

Figure 19: Comparison of Shares of RES in Primary Energy Consumption, Electricity Generation and Electricity Consumption (Source: own design based on Lak 2017)

As well as for the whole of Germany it can be said for Hamburg that the energy productivity has increased largely. If compared to the value of 1990 the increase is about 57%. In the same time the final energy consumption has declined by 14% due to higher energy efficiency.

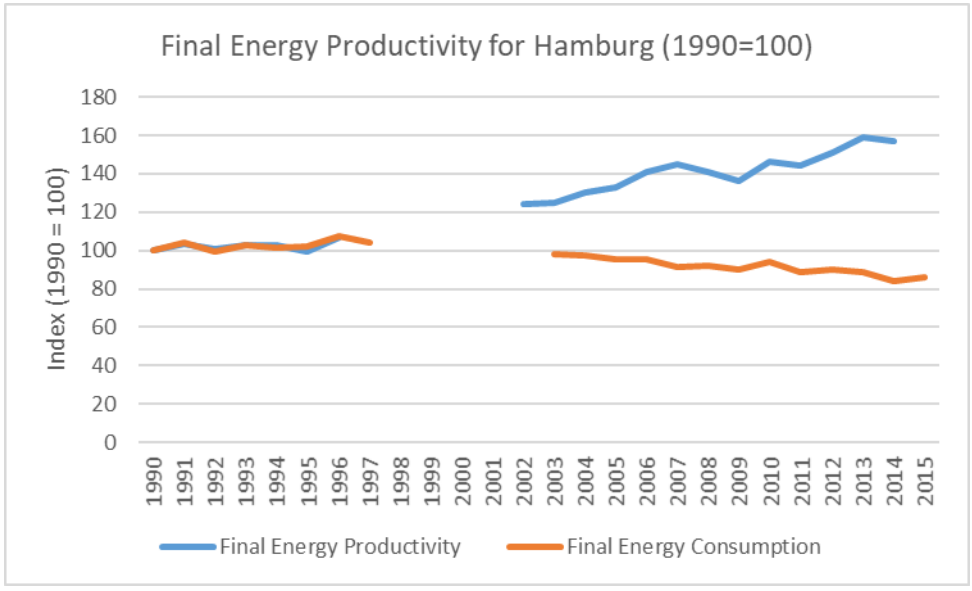

Figure 20: Comparison of Shares of RES in Primary Energy Consumption, Electricity Generation and Electricity Consumption (Source: own design based on Lak 2017)

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4.6 Environmental characterisation

The City of Hamburg sees itself as a green metropolis on the water. In February 2009, Hamburg was designated “European Green Capital 2011” by the European Commission. Therefore, environment protection is of great importance for the development of the city. The Administration wants to preserve the high quality environmental standards, which are already attained, and to develop them further and to see them as a spur to meeting future challenges.

Due to this, Hamburg wants to preserve the precious green spaces and landscape areas of the city, as a natural and easy to access recreation area for the citizens and furthermore protect them as habitats of indigenous plant and animals. With programmes and measurements to increase air quality and reducing the noise pollution, the city wants to persist as a liveable place its residents. Figure 23 below shows a summary of Hamburg environmental aspects:

4.6.1 Air Quality

The air quality is monitored by the Hamburg air measurement network with continuous measurements in stationary observation containers. In addition to the stationary measurements, measurements are carried out using so-called passive collectors, which provide values for air pollution based on a simplified measuring method.

The measuring results show that in Hamburg prevails overall a good air quality, however, on roads with heavy traffic and high buildings at the sides the NO_2 concentrations can increase. These increased concentrations are particularly noticeable near to the roadways and decrease rapidly with a greater distance to the roadside as well as in greater height.

The Hamburg air measurement network has been operated for more than 30 years and currently maintains 15 continuously measuring stationary stations. The measurement results are published at http://www.luft.hamburg.de (see FHH, 2017b).

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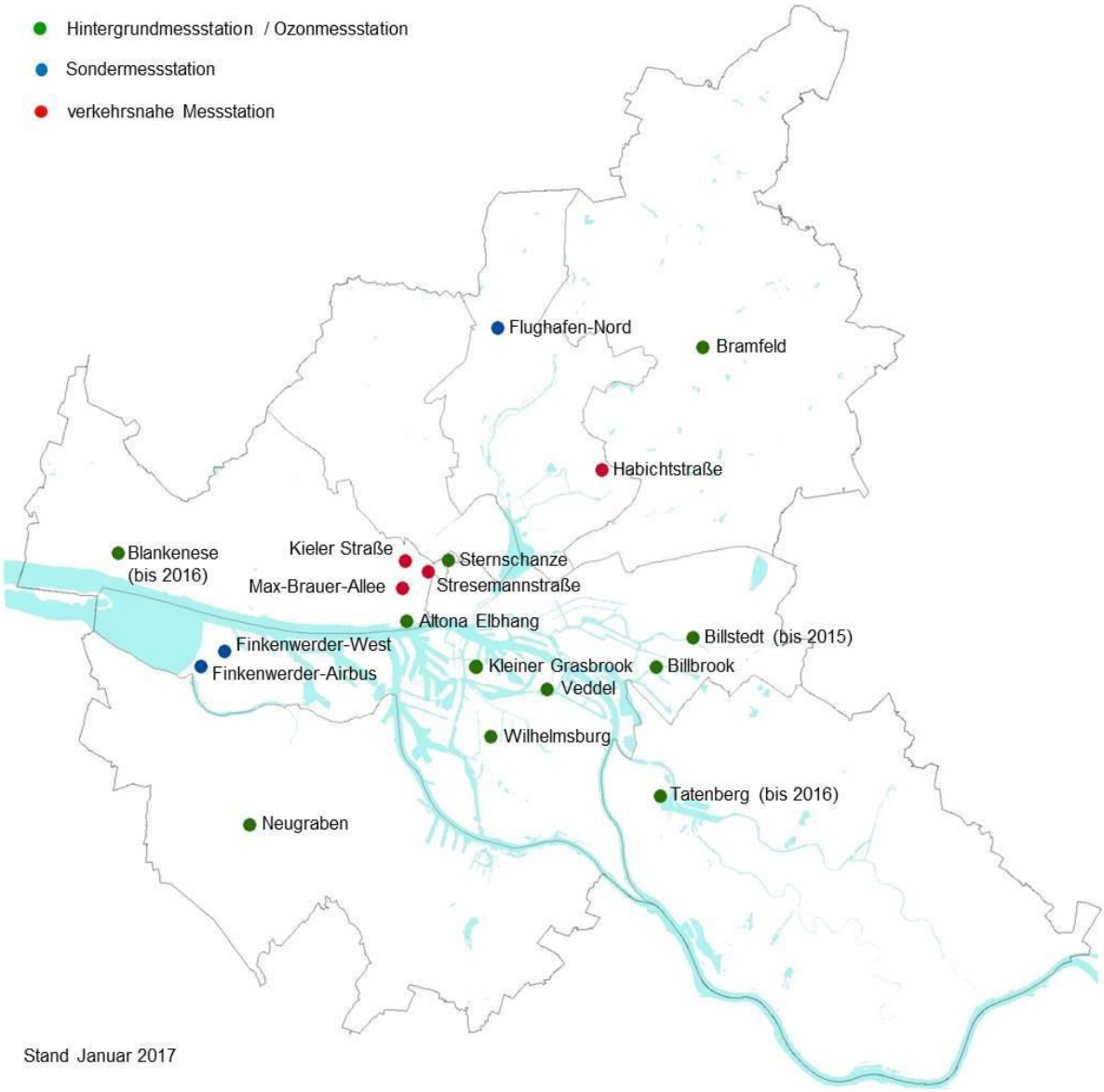

Figure 21: Localisation of the stationary observation stations in Hamburg (FHH, 2017b)

The following table 4 summarises the emission levels of the most important source groups from 2014 and 2013 and 2012, based on approximation values, since the data could only be recorded by means of estimating (model) calculations for the most emission sources.

The dominant share of NOx emissions comes from ship and motor vehicle traffic as well as from industry sources. Emissions from the other sources play a smaller role in Hamburg (see FHH, 2017b).

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Table 4: Emissions source and amount of NO_x (FHH, 2017b)

Emission source	Nitrous oxide (NO_x) in tons	Basic year
Automotive traffic	5,949	2014
Shipping traffic	7,944	2013
Air traffic	442	2014
Rail traffic	131	2013
Harbour railway	257	2013
Off-road traffic	585	2014
Equipment for port handling and logistic	797	2013
Industry	3,286	2012
Fire incidents and small business	1,080	2014
Total	**20,471**	

4.6.2 Noise

Based on directive 2002/49/EG relating to the assessment and management of environmental noise, the EU member states are obligated to assess the exposure of population to noise by strategic noise maps. After the transposition into national law, Hamburg created the first strategic noise map in 2007. Since then, noise maps are reviewed and if necessary adapted at least every five years. The responsibility for the mapping of noise mainly lies with the Ministry for Urban Development and the Environment (BSU). In addition, the Federal Office for Railways is responsible for the noise of rail transport. There are prescribed definitions describing the respective occurrence of noises from traffic, railroads, air traffic, and industrial noise (including harbour). Noise burdens resulting e.g. from road traffic are considered to arise out of the number of vehicles per time, their velocity, the amount of trucks, and the road surface. Further provisions are regulating the detailed methodology for calculating environmental noise (FHH, 2017h).

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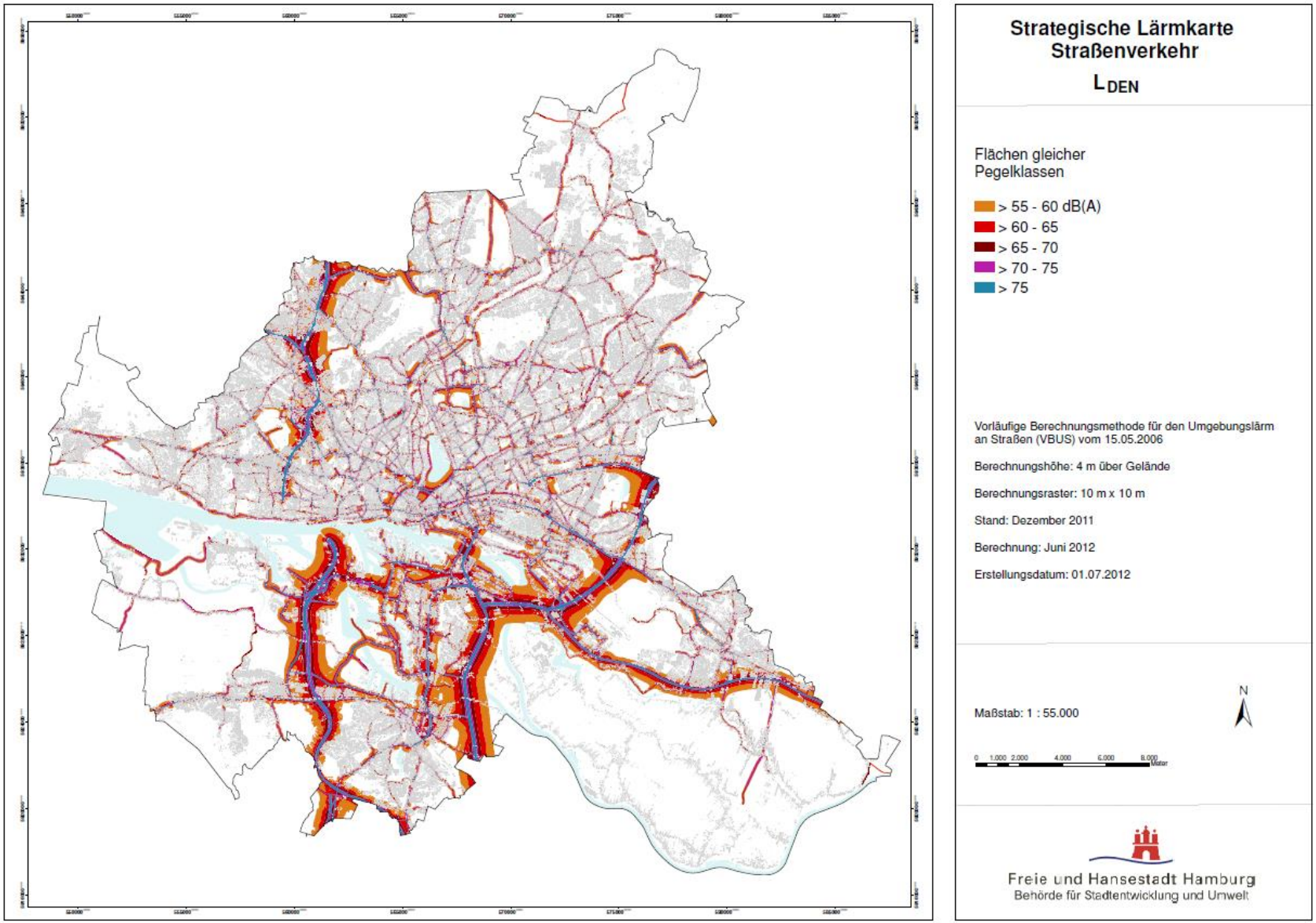

Figure 22: Extract of the strategic noise map "Traffic Noise in Hamburg" (FHH, 2017h)

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In order to reduce noise in Hamburg, the Ministry for the Environment and Energy (BUE) has implemented a new noise action plan in 2013 (cf. 5.1.2). The noise action plan considers nine packages of measures aiming for the reduction of traffic noise. This includes the promotion of environmentally compatible mobility as well as an integrated traffic development plan. In connection with the noise action plan Hamburg has also initiated the “programme of the loudest streets”. In this programme, it is analysed in which way measures, such as noise-reducing road surfaces, reduction of permitted speed, and passive sound insulation might be implemented in the 40 loudest street sections of Hamburg (FHH, 2017e).

4.6.3 Nature and protection areas

Hamburg is characterised by a high variety of habitats for wild plants and animals. From watercourses to the cultivated agricultural landscape, with its high share of extensively used grassland to forests, Hamburg offers many, even rare species a habitat. Also parks, tree-lined streets and gardens, roofs and towers are important wildlife habitats in the city. Altogether is more than 9% (21,545 ha) of Hamburg`s area protected by nature. In addition, there is also the national park "Hamburgisches Wattenmeer" (Hamburg Wadden Sea) with its protected areas.

The focus of nature conservation is on the protection of rare endangered species and the development of the Hamburg biotope network, to strengthen the populations of all animal and plant species and the designation of new protected areas. Therefore, development targets and measures for the protection, maintenance and development of the habitats of indigenous plant and animal species, are defined for all areas of the city. All habitat such as forests, moors, heathland or grassland are included as well as the residential areas (see FHH, 2017e).

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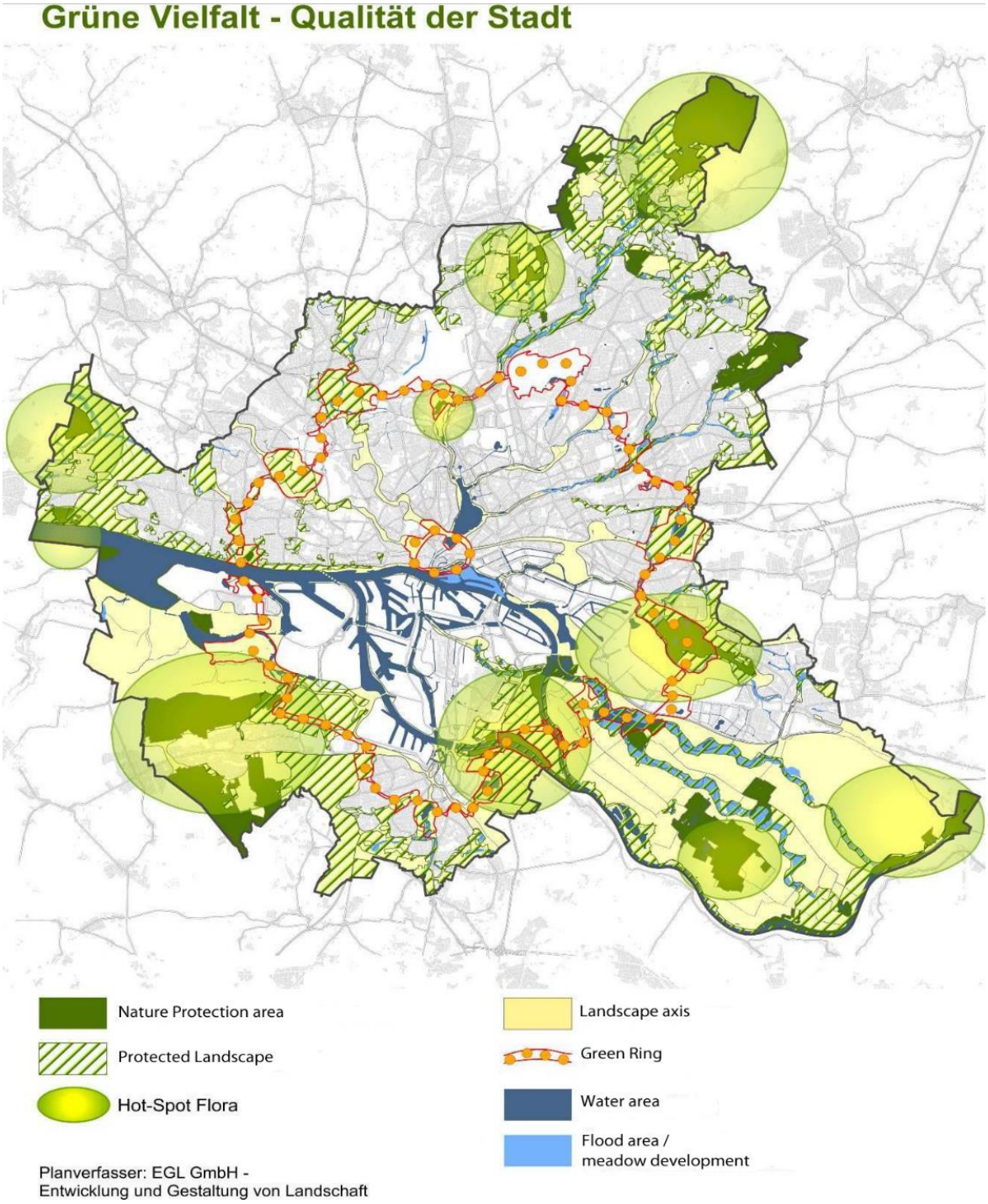

Figure 23: Green areas in Hamburg (FHH, 2012a)

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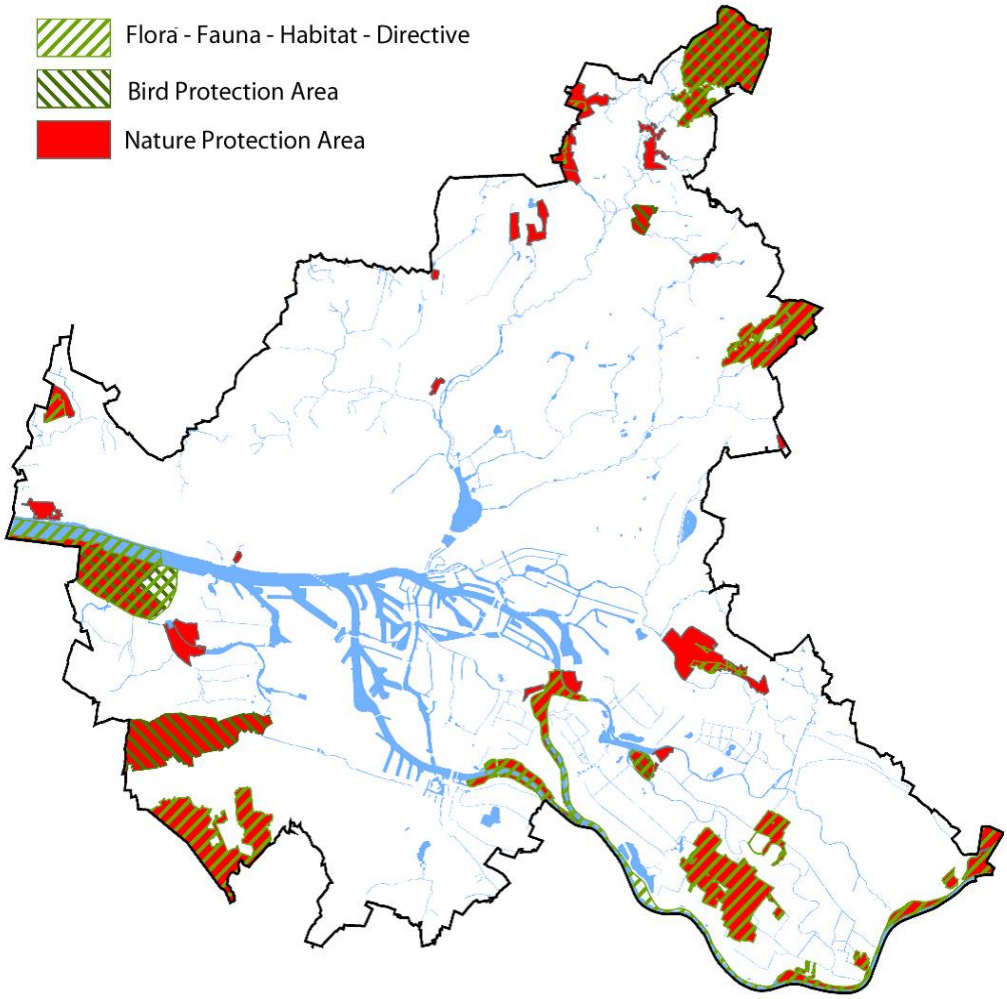

Figure 24: Network of protected areas in Hamburg (FHH, 2012a)

4.6.4 CO_2-emissions

The amount of CO_2-emissions is the core indicator for Hamburg's climate plan. The target for 2050 is to reduce Hamburg's CO_2-emissions at least by 80% (reference year is 1990). Intermediate targets are 50% by 2030 and 2 Mio tons of CO_2 less than in 2012 (FHH, 2015c).

CO_2-accounting by the German federal states is done from two perspectives: one is considering the primary energy consumption directly in Hamburg (Quellenbilanz). Here, in particular all big industries including power generation causing CO_2-emissions are summarised. Another perspective is on the overall CO_2 resulting from final energy consumption (Verursacherbilanz). This represents the consumption behaviour of economy and private households and is taken as the major indicator for climate accounting. Final energy consumption and resulting CO_2-emissions are always higher as the primary energy consumption. One reason is the high share of imported power in Hamburg (FHH, 2017c).

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Considering the last years, it can be stated that there was a slight decline from 17.41 in 2014 down to 17.26 million tons CO_2 in 2015. First, this is explained by a decrease in CO_2-emissions resulting from electricity use mainly commercial use. Second, a general trend of a climate friendly power mix can be observed in Germany that also applies in Hamburg. However, it can also be stated a higher use of natural gas (mainly from heating due to the warm weather).

In the long term CO_2-emissions decreased in comparison to the basis year 1990 by 16.6%. Therefore the following reasons can be accounted: isolation, more energy efficiency in heating and warm water supply, as well as then increase of gas and renewable energy supply (ibid.).

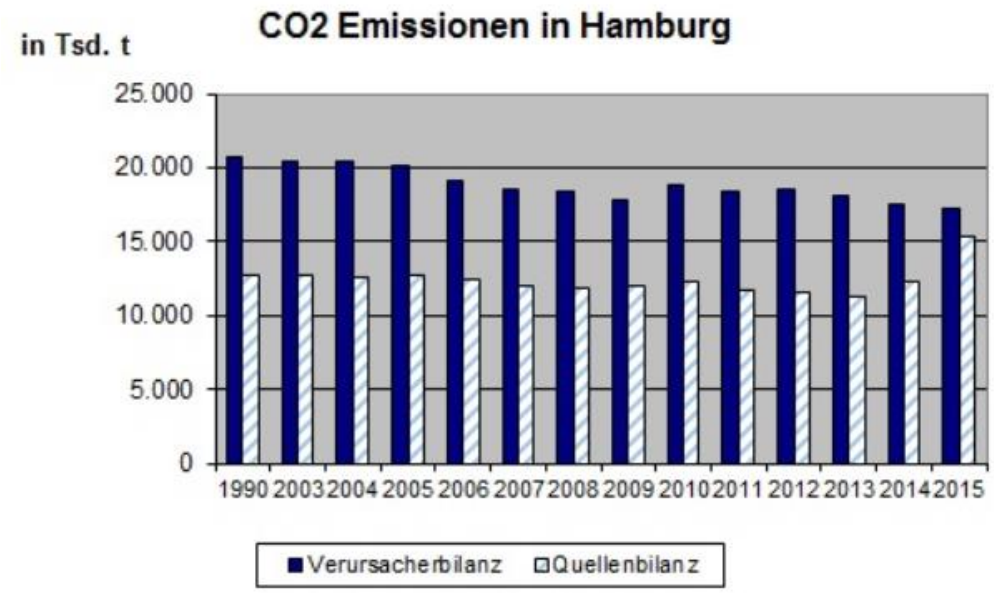

Figure 25: CO2-emissions in Hamburg resulting from final energy consumption (dark blue) and primary energy consumption (light) (scale is in thousand tons) (FHH, 2017c)

The main share of Hamburg's CO_2-emissions is caused by households and small commercial users (43.9%). Almost a third (30.3%) is caused by industry and the remaining 25.9% by transportation. Culminating emissions by small commercial users, industry and commercial transportation round about a half of Hamburg's CO_2-emissions result from commercial activities. However, a decoupling of CO_2-emissions and growth of economy since 1990 can be observed (ibid.).

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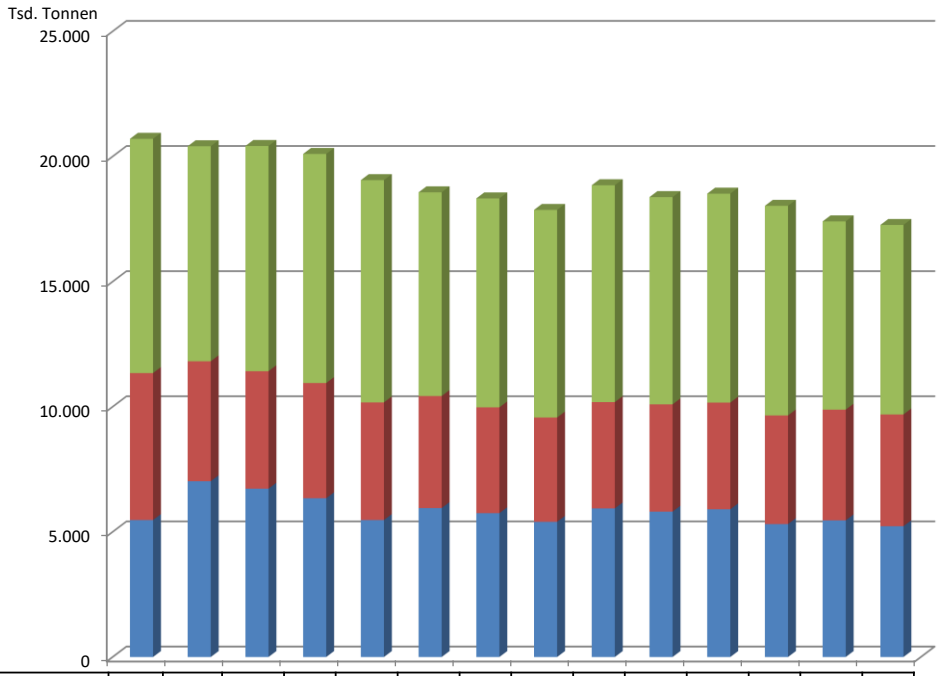

	1990	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
households and small commercial users	9.360	8.591	8.999	9.154	8.882	8.139	8.350	8.296	8.666	8.281	8.348	8.376	7.523	7.571
Industry	5.473	7.023	6.726	6.343	5.472	5.951	5.747	5.401	5.939	5.809	5.903	5.310	5.460	5.226
Transportation	5.872	4.794	4.694	4.603	4.700	4.477	4.227	4.168	4.246	4.286	4.263	4.342	4.423	4.466
Total	20.705	20.408	20.419	20.101	19.055	18.567	18.324	17.865	18.850	18.376	18.514	18.028	17.407	17.263
Changing rate to 1990 in %		1,43	1,38	2,92	7,97	10,32	11,50	13,72	8,96	11,25	10,58	12,93	15,93	16,62

Figure 26: CO2-emissions in Hamburg according to sectors (scale is in million tons) (FHH, 2017c)

Summarising, the Hamburg ministry for energy and environment still sees potential for improvement and therefore refers to the Hamburg climate plan with regard to climate protection goals (ibid.).

4.6.5 Water and waste

Hamburg is known as a city at the waterfront. Being a port city at the river Elbe and having the inner city lake Alster as well as a multitude of other smaller rivers, canals, fleets, waterways and brooks Hamburg always was determined and shaped by water in its urban development (FHH, 2016a).

Topics like flood control and storm surge protection always have been of importance for the city. A big expansion of flood defence along the dykes was finished in 2016. However, rising sea levels due to climate change are to be considered as well and a new construction programme is currently being developed for the next 20 to 25 years. Necessary measures to broaden and raise the dykes lead to interventions in “ecologically valuable land” and require compensation. Above developments are according to the Integrated Management Plan – Elbe Estuary, describing ecological guidelines for the Lower Elbe (ibid.).

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Climate change moreover leads to heavy rainfall events which likewise are the case in Hamburg. Planning authorities and the water supply (and waste water disposal) company launched a project for the adaption of rain water infrastructure (FHH, 2017d).

In Hamburg, all drinking water stems from groundwater sources and thus safeguarding the availability of drinking water is of high priority. Therefore, five water protection areas were assigned in the Hamburg area, two more are planned (FHH, 2017e).

When it comes to water quality, the implementation of the EU Water Framework Directive provides guidance. In recent years several measures to raise water quality were implemented. However, progress is reported cautiously as many measures unfold their effect retarded and external effects are difficult to exclude (FHH, 2017d).

With regard to water consumption, Hamburg decreased its consumption from 190 down to ca. 110 litres per capita and day (Zukunftsrat, 2016).

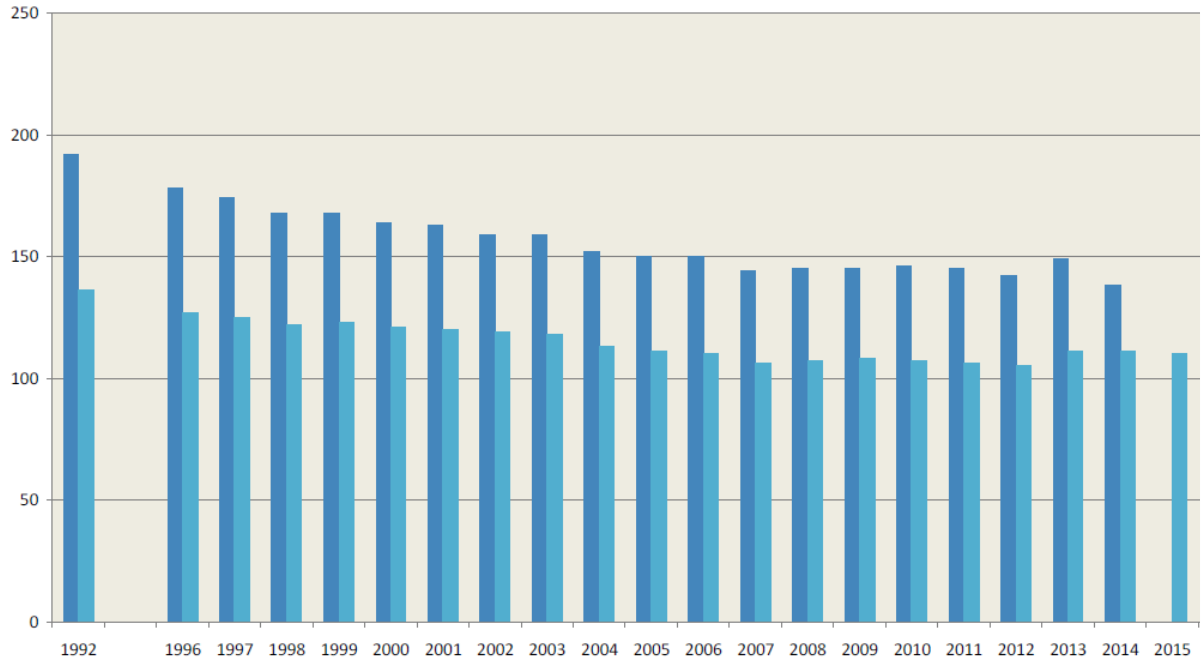

Figure 27: Water consumption in litres per capita and day (dark blue: all, light blue: private households) (BSU, n.d. seen in Zukunftsrat, 2016)

Regarding waste, an increase can be accounted in comparison to 1990. In recent years, waste disposal oscillates around 450 kg per capita and year (Zukunftsrat, 2016).

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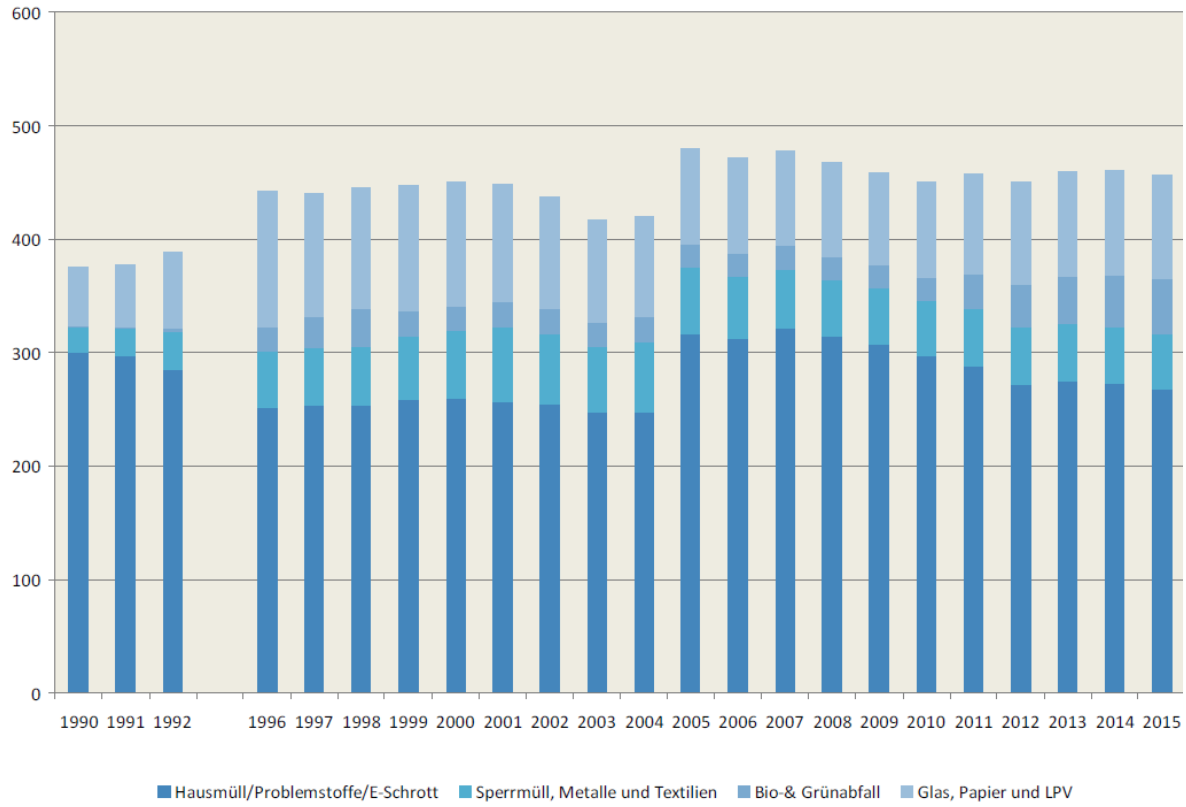

Figure 28: Waste in kg per capita and year (from dark to light blue: domestic waste/e-waste, bulky waste/metals/textiles, bio and green waste, glass/paper/plastic) (BSU, n.d. seen in Zukunftsrat, 2016)

4.7 The Urban Platform of the City of Hamburg

The current Urban Platform of the City of Hamburg is a data storing unit containing open and non-open data of different authorities, third parties and few sensor data. It holds geospatial information to several categories, e.g.: education, culture, urban development and planning, environment or traffic which are distributed via standardised web services to view, download and process the data. Each dataset is connected to a metadata catalogue web service interface, which is based on a city metadata catalogue (Hamburger Metadatenkatalog - HMDK) for government information. E-Government applications and services use the standardised web interfaces for domain specific solutions via intranet and internet. Many additional services/data are already planned to be deployed i.e. supervision of streetlights, charging station management, traffic light and many more.

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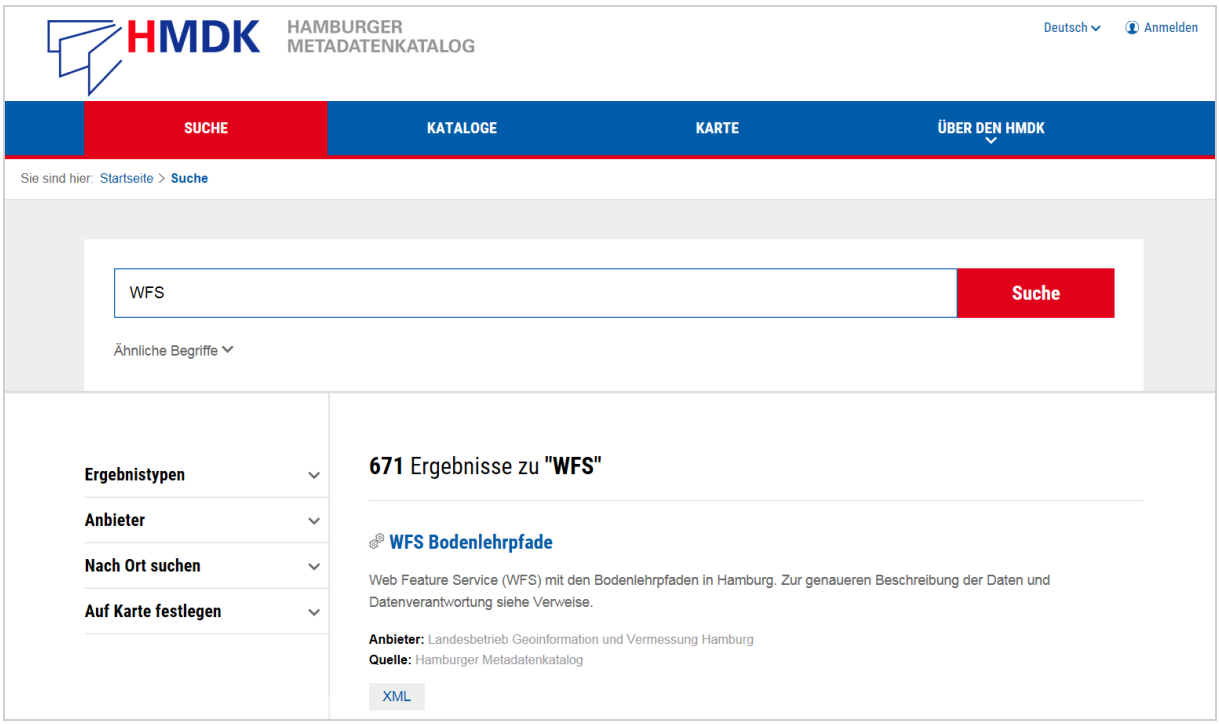

Figure 29: The metadata catalogue HMDK web service interface

4.7.1 Architecture of the Urban Platform

The open Urban Platform of Hamburg follows the common architectural framework developed in the EU Project Espresso and a System of Systems approach. Heterogeneous systems or platforms can easily be connected and at times incorporated. The core of the data management of the Hamburg Urban Platform is divided in five modules: Data Web Services, Metadata Web Services, Processing Web Services, Data Analytics and Sensor Web Services. While the former four are fully deployed and extended regularly, the latter is under development. The five modules are substantiated by the Data Warehouse where all data is stored and extracted for the different services. The data from neighbouring systems are integrated using ETL techniques with different adaptors. The Urban platform is under continuously development and follows an iterative approach. New capabilities will be incorporated by using the EIP-SCC model as a reference.

4.7.2 Applications and services of the Urban Platform

The current Urban Platform of Hamburg exists for a couple of years now. As of May 2017 the Urban Platform provides more than 3300 datasets, 93 applications as geoportals (e.g. “Melde-Michel” see section 6) and more than 400 distinct services which receive more than 310 million requests per year (>849000 request per day). The datasets cover a wide range of urban data. The services are provided using standard APIs and data models usually based on specifications of the OGC i.e. WFS, WMS, GML, etc. The Urban Platform also started to provide near real time data (sensor data) e.g. occupation of

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charging stations for electro mobility, availability of city bikes at the specific bike stations, and availability of parking slots on parking decks.

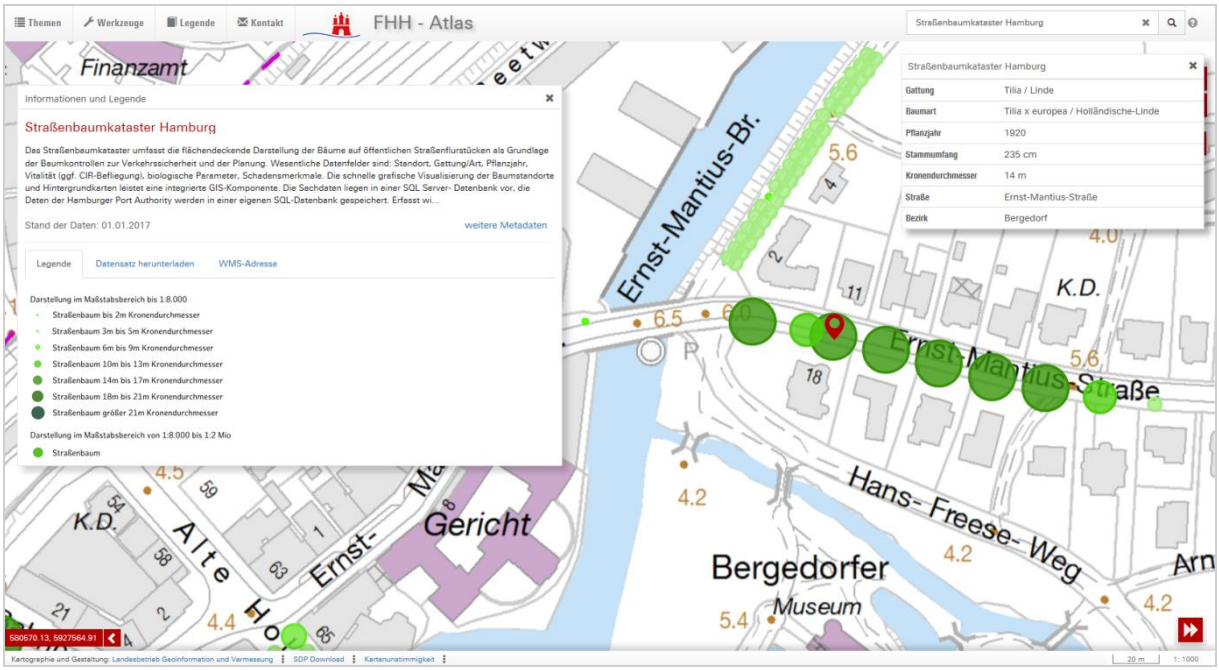

Figure 30: Example of a geoportal application, the FHH-Atlas showing the data of the tree cadastre

While developing the Urban Platform following solutions have been developed and are made available to the public as Open Source Software (https://www.hamburg.de/geowerkstatt/): One solution is the “Masterportal” a toolbox to build geoportals on the Web. Another one is the “Dienstemanager” (tr. service manager), which allows the management, documentation, and configuration of web services in a geodata infrastructure for a subsequent visualisation with a Masterportal. How the Urban Platform has developed and grown over the years can be seen in Figure 31.

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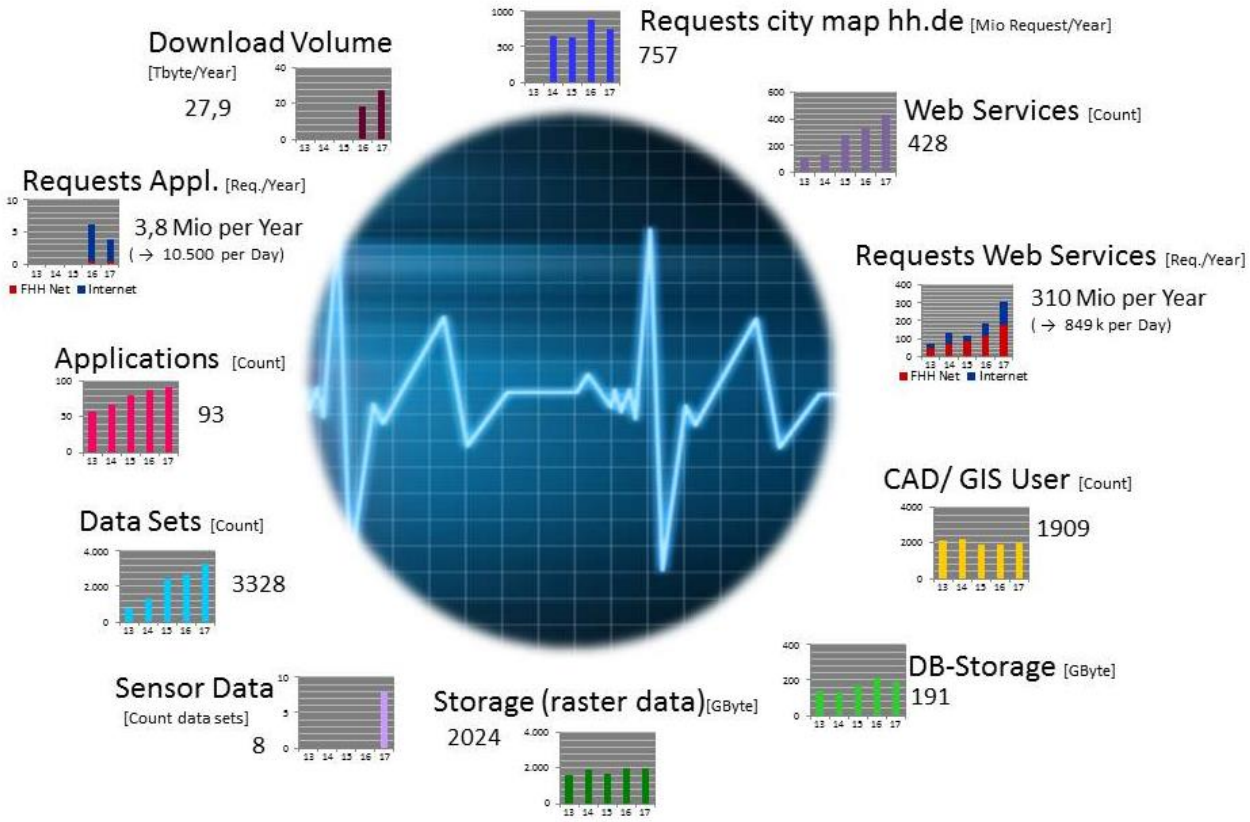

Figure 31: Urban Platform Statistics (May 2017)

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4.8 Calculation of indicators

4.8.1 Indicators for city characterisation

The indicators selected for City Characterisation are being calculated and they are mentioned in the following table.

Table 5: Indicators for city characterisation

Indicator	Units	Value
Size	km^2	755.2
Population	Inh	1,805,320 (2016)
Population density	Inh./km^2	2391 (2016)
Average population age	#	42.3 (2015)
People > 75 years	%	9.6% (2015)
Type of city		metropolitan
Land consumption	nº build/Km^2	326.4 (2011)
Total built surface/ Total city surface	Km^2/Km^2	0.59 (2015)
Balance between residential and no-residential building use	%	3.66 (2015)
Overall CO_2-emission reduction target	%	80%by 2050, 50% by 2030
Tourism intensity	nights/100000	738,428.64 (2016)
Climate koppen geiger classification		Dfb (humid continental climate)
Smart energy meters	% of buildings	Not applicable *
Greenhouse gas emissions per capita	tonnes CO_2/capita	9.7 (2015)
Greenhouse gas emissions (tertiary)	Mtonnes CO_2/year	3.911 (2014)
Greenhouse gas emissions (transport)	Mtonnes CO_2/year	4.466 (2014)
Greenhouse gas emissions (Residential)	Mtonnes CO_2/year	3.657 (2014)
Percentage of renewable energy use in public transport	%	Not available**
Water consumption	m3/cap/day	0,14 (2013)
NOx emissions	g/cap	11,453 (2014)
Recycling rate	% tonnes	69.1% (for Germany in 2013)
Exposure to noise pollution	%of people	6.2%***

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Indicator	Units	Value
Amount of solid waste collected	tonnes/capita/year	2.21 (2014)
Urban Heat Island	°C UHImax	Not available ****
Voter participation	%	56.5% (2015)
Unemployment rate	%	7.4 (2015)
Youth unemployment rate	%	5.4 (<25 years, 2015)
GDP	€/cap	61,729 € (2014)
Median disposable income	€/household	23,596 € (per inhabitant, 2014)
New businesses registered	#/100.000	1096.758 (2016)
New startups	#/100.000	6508.541 (2016)
Research intensity	% in euros	2.6% (2016) (2.45 million € for research in Hamburg as federal state)
Population Dependency Ratio	#/100	44.21 (2015)

* There are already 200.000 electric meters in 2017. The rollout of smart meters according to 2009/72/EG will be executed within the next 16 years.

** The U-Bahn rapid transit metro rail network uses 100% renewable energy. Percentages for other rail networks and bus services are not available.

*** In Hamburg 112.500 people are (all day) exposed to traffic noise > 65 dB (A), that seriously could harm their health (2013).

**** Areas in Hamburg differ a lot in the share of green and in their proximity to the river Elbe. Thus UHImax indicators differ in a range from 0.6 K to 1.1 K.

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4.8.2 Indicators for energy supply network

The indicators selected for energy supply network are being calculated and they are showing in the following table.

Table 6: Indicators for energy supply network

Indicator	Units	Value
Final energy consumption per capita	MWh/capita	26,256
Final energy consumption (Transport)	TWh/year	17.06
Final energy consumption (Buildings, equipment/facilities and Industries)	TWh/year	Not available
Final energy consumption (Municipal)	TWh/year	Not available
Final energy consumption (Tertiary)	TWh/year	11.76
Final energy consumption (Residential)	TWh/year	11.13
Final energy consumption (Public lighting)	TWh/year	Not available
Final energy consumption (Industry)	TWh/year	8.21
Final energy consumption (electricity)	TWh/year	12.37
Final energy consumption (Heat/Cold)	TWh/year	Not available
Final energy consumption (Fossil fuels)	TWh/year	30.61
Final energy consumption (Renewables)	TWh/year	0.87
Share of local energy production to overall final energy consumption	%	non-relevant, (because Hamburg is an oil exporting federal state)
Renewable electricity generated within the city	% of electricity consumption (final energy)	6.3
Non-RES Heat/ Cold production	TWh/year	Not available
RES Heat/Cold production	TWh/year	Not available
Total buildings energy consumption per year	GWh/inhab.year	Not available

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Indicator	Units	Value
Renewable energy per carrier	GWh/RES_supplier	Sewage gas: 218.7 Water power: 0.555 Wind: 106.7 PV: 73,9 Biomass: 2,647.5 Others: 100 (all*)
Percentage of renewable energy (of prim. energy consumption.)	%	4.36%
Primary energy consumption in the city per year	GWh of PE/year	71,923.4
Primary energy consumption per capita	MWh/capita	39.22
Primary energy consumption (Transport)	TWh/year	Not available because Hamburg is an oil exporting federal state the primary energy balance is negative for fuels
Primary energy consumption (Buildings, equipment/facilities and Industries)	TWh/year	Not available
Primary energy consumption (Municipal)	TWh/year	Not available
Primary energy consumption (Tertiary)	TWh/year	Not available
Primary energy consumption (Residential)	TWh/year	Not available
Primary energy consumption (Public lighting)	TWh/year	Not available
Primary energy consumption (Industry)	TWh/year	Not available
Primary energy consumption (electricity)	TWh/year	Not available
Reduction of primary energy use	%	Not available
Maximum Hourly Deficit (MHDx)	kWh	Not available
Reduction in lifecycle energy use	% in kWh	Not available
Reduction in lifecycle CO2 emissions	% in tonnes	Not available
Green electricity purchased	%	Not available

(the comma (,) divides thousands the dot (.) whole numbers)

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4.8.3 Indicators for city transportation current status

Table 7: Indicators for city transportation current status

Indicator	Units	Value
Total number of public transport vehicles	Number of vehicles	2,186
Traffic accidents/Fatalities	#/100 000 people	0.00026 (2016)
Total charging points	#	600 (October 2017)
Recharges per year	#/month (not per year)	5,000
Number of vehicles available for sharing per 100.000 inhabitants	#/100 000 people	0.0084 (2015)
Number of electric vehicles in the city per 100.000	#/100.000	0.0096 (2016)

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5. Existing urban plans for promoting low energy districts and sustainable mobility

5.1 Current status

In the following, existing urban plans and programmes promoting low energy districts and sustainable mobility are portrayed which are relevant for the demosite area. The intervention area is situated in the Borough of Bergedorf, which is one out of seven Boroughs in Hamburg. Beyond the Borough level, there are likewise plans and programmes on city and national level which have an impact.

5.1.1 Federal plans and programmes

There are several federal plans and programmes promoting low energy districts and sustainable mobility that have an impact by e.g. providing funding or guidance on city level.

A detailed description of all relevant programmes would go far beyond the intention of this paper. Thus, in the following the relevant and overarching ones are shortly mentioned.

The **climate plan 2050** determines the strategic corridor of Germany in terms of climate goals. Therein all required steps are described to achieve domestic targets in line with the Paris Agreements. Action fields are energy, buildings, transport, trade and industry, agriculture and forestry. By 2050 Germany intends to achieve greenhouse gas neutrality. Therefore guiding principles and transformative pathways are provided. For the mid-term perspective (2030) milestones and targets are specified for all sectors (BMUB, 2016).

The so called '**Energiewende'**, i.e. the transition of the German energy systems has two major building blocks: the expansion of renewable energies and energy efficiency. The first results in the **German Renewable Energy Act** that intends to ensure a sustainable development of energy supply, to reduce macroeconomic costs by internalising external costs, to save fossil resources, and to fund technologies fostering renewable energies (Die Bundesregierung, 2017). The latter takes shape in the **National Plan for Energy Efficiency**. Core measures are the increase of funding for refurbishment of the existing housing stock as well as the provision of tax advantages for measures increasing the energy efficiency of buildings. Furthermore, it is intended to establish innovation clusters with the business and industry sector (BMWI, 2014).

Regarding mobility, the **National Strategic Framework for the Expansion of Alternative Fuels** determines goals and measures fostering the expansion of electricity, hydrogen and gas as alternative fuels in Germany. The framework partially implements the EU directive 2014/94/EU. Overall the framework includes one billion € of investment. It incorporates a funding programme for charging infrastructure (300 million €), one funding programme for electric mobility within municipalities (140

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million), the national innovation programme for hydrogen and fuel cell technology (247 million), and the (continuous) development of the national strategy for mobility and fuels (BMVI, 2016).

5.1.2 City plans and programmes

The most remarkable city plans and programmes that have been developed for the City of Hamburg since 2007 are described in some detail in this section.

They cover varied fields, ranging from water to ICT, including climate, mobility and noise.

There is an overarching **guiding principal for spatial development** from 2007 called '**Growing city - green metropolis at the waterfront**' determining urban development in Hamburg. Therein were included five guiding principles for urban development until 2020. Primary goal was 'more city in the city', i.e. to increase urban density. Others are to raise the quality of residential areas for families, to strengthen the sustainable growth of economy, to become an attractive and liveable city for citizens and tourists, and to develop Hamburg as part of the metropolitan region. In recent years many projects have been developed according to that plan (FHH, 2007).

A current contribution to the debate about the future of development in Hamburg was published by the Ministry of Urban Development and Environment in 2014. Within the paper 'Green, inclusive, growing city by the water - Perspectives on Urban development in Hamburg' focus topics for urban development until 2030 are pointed out as shown in Figure 32 (FHH, 2014).

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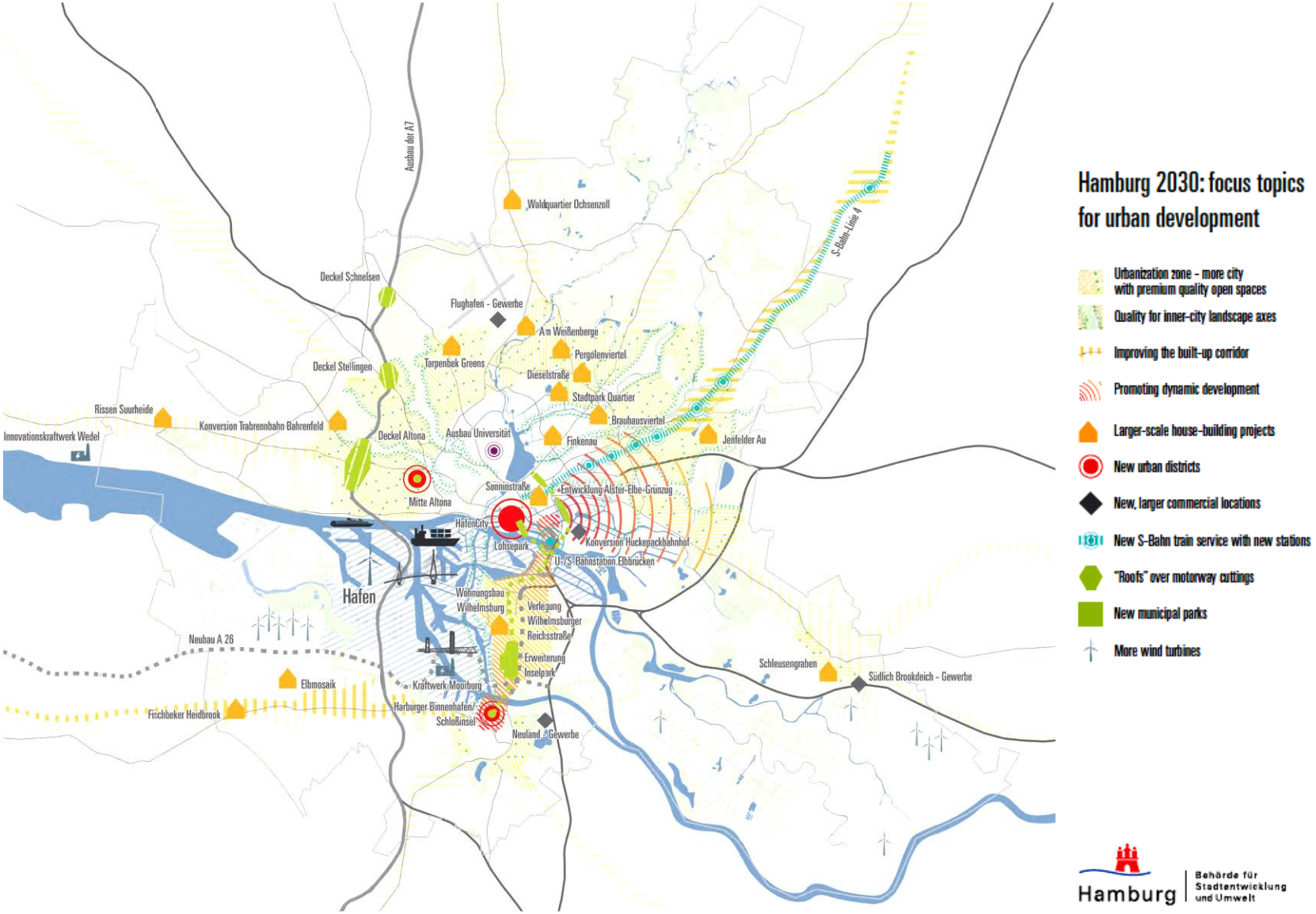

Figure 32: Hamburg 2030: Focus topics for urban development (FHH, 2014)

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The **Climate Plan Hamburg** is the core plan 'promoting low energy districts and sustainable mobility' at city level in Hamburg. The plan incorporates climate change protection and climate change adaption; two challenges, which had been treated separately before. The target for 2050 is to reduce Hamburg's CO_2-emissions at least by 80% (reference year is 1990). Intermediate targets are 50% by 2030 and 2 Mio tons of CO_2 less than in 2012. The climate plan has so called four strategic clusters: Urban transformation (urban/ quarter development), green economy, public sector as role model, climate communication. They incorporate several action fields: urban development, energy, buildings, mobility, economy, consumption and waste management, flood protection at coasts and inland waterways, water management, protection of nature and soil, human health, infrastructure, catastrophe protection and prevention, education, and research. Regarding the administration itself a CO_2 neutral administration is anticipated by 2030. Core measures include a 50%-share of electric vehicles within the public fleet by 2020. For all public building a retrofitting concept will be developed until 2017, a special focus is on school and university buildings. Another big focus in Hamburg is cycling: the modal share is targeted to 25% (doubling today's share). In the field of mobility public transportation and low emission buses will be fostered (FHH, 2015c).

In 2013 the City of Hamburg adopted a **mobility programme**. The last overarching traffic development plan in Hamburg was adopted in 2004 and the current mobility programme is the basis for continuous traffic development planning leading to a new traffic development plan anticipated for 2017/2018. One major tool of traffic planning in Hamburg will be a traffic model that is developed and elaborated parallel to the development plan. The mobility programme 2013 defines five guiding principles: ensuring transregional accessibility, fostering public transportation, making mobility more efficient and integrated, strengthening electric mobility, designing traffic and living spaces, and continuous mobility planning. Based on that, the programme includes a large amount of measures. Every year the list of measures is updated and links to other action plans (like the noise action plan, the clean air plan etc.) are documented (FHH, 2013a).

The **masterplan for public charging infrastructures** is one building block to strengthen electric mobility in Hamburg. It includes guiding principles and measures for implementation such as responsibilities, a concept for an accounting system and renewable energy as source of electricity (FHH, 2017f).

The **noise action plan** results from implementing the European Environmental Noise Directive. At first, the directive requires noise mapping to identify noise focus areas, which was implemented in the year 2008 in Hamburg. This process incorporated a broad participation of citizens and interest groups in order to identify noise sources and solutions. Based on that, the action plan was developed. Main focus of the action plan is dealing with noise resulting from road traffic. Hence, many measures are intended to mitigate noise from road transportation such as electric mobility (FHH, 2013b).

Likewise the **clean air plan** results from the implementation of EU law. In case that limit values (e.g. if nitrous oxides) are exceeded the Federal Emission Control Act requires the development of a clean air

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plan. Measures are situated in the following action fields: fostering public transportation, strengthening cycling, intermodality and mobility management, traffic management, modernisation of public bus and city rail fleets, electric mobility, harbour logistics, maritime transportation, and public sector as role model. Finally, there is a bundle of measures in the energy sector such as funding programmes for solar thermal energy and heating, insulation of the building stock, and modernisation of rental apartments (FHH, 2017b).

In 2015, Hamburg has adopted the **Digital City Strategy**. In addition to e-government and IT strategies being in place before, it comprises more than increasing the efficiency of the administration as well as digital interfaces to specific customer groups of the administration. Moreover it considers the digitisation of value creation processes in both the economy and citizens' everyday life. Main intention is to shape this development and use it to improve the quality of life and strengthen the economic power of the city. Therefore digitisation and its opportunities will be considered in all suitable initiatives and projects supported by the city. To ensure citizens' support, the Senate will make sure that appropriate participatory processes, IT security and data protection are in place as required. In particularly, Hamburg's economic clusters and in particular start-ups must be involved in the process. Several government agencies and public institutions have already come up with approaches in their area of responsibility, (FHH, 2017g).

The **solar offensive Hamburg** developed through the initiative of the climate protection organisation Hamburg Climate Week and the citizen energy association "EnergieNetz Hamburg eG". The open alliance comprises of companies and cooperatives acting in the field of energy transition as well as organisations for customer protection and organisation of climate protection in Hamburg. As an open alliance that is promoting the implementation of solar energy the solar offensive Hamburg has set the goal of using at least 5.000 roofs of Hamburg for the production of solar energy and heat. The current amount of energy generation by photovoltaic should be increased fivefold compared to the level of 2016 (Solar offensive Hamburg, 2017).

Hamburg and the neighbouring region Schleswig-Holstein initiated the **North German energy transition 4.0** (NEW 4.0, Norddeutsche Energiewende 4.0) as an innovation alliance comprising of economy, science and politics. The cross-regional project aims to demonstrate in which way the total demand of energy in Hamburg und Schleswig-Holstein, with a total population of 4.5 million, can be realised with regenerative energies in the year 2035. Moreover, NEW 4.0 aims to strengthen the sustainability and future viability in the entire project region. Within the duration of the project from 2016 until 2020 around 60 partners collaborate in order to identify solutions for implementing energy transition in North Germany (new 4.0, 2017).

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Table 8: Plans and programmes on city level

Plan/ Programme	Description	Year/Status	Further information
Guiding principal for spatial development (Draft) - 'Growing city - green metropolis at the waterfront' Räumliches Leitbild (Entwurf) – ‚Wachsende Stadt - grüne Metropole am Wasser'	The spatial master plan determines urban development in Hamburg until 2020.	2007	http://www.hamburg.de/contentblob/155068/65b62ad9195e940e29ed0453626acd90/data/raeumliches-leitbild.pdf
Climate Plan (Klimaplan) Hamburg	The climate plan Hamburg incorporates integrated climate change protection and adaption strategy as well as a vision of a climate-smart city.	2015	http://www.hamburg.de/hamburger-klimaplan/ueberblick/6831216/hamburger-klimaplan-langfristperspektive/
Mobility programme (Mobilitätsprogramm) Hamburg	The mobility programme 2013 includes action fields and measures for future transportation and is the basis for continuous traffic planning in Hamburg.	2013	http://www.hamburg.de/contentblob/4119700/50fd34e0e06432b8ea113bf40cfc6ca7/data/mobilitaetsprogramm-2013.pdf
Noise action plan (Lärmaktionsplan)	The noise action plan focuses on the expansion of low-emission mobility.	2013	http://www.hamburg.de/laermaktionsplan/
Clean air plan (Luftreinhalteplan)	The clean air plan covers measures to mitigate air pollution in Hamburg.	2017	http://www.hamburg.de/contentblob/9024022/7dde37bb04244521442fab91910fa39c/data/d-lrp-2017.pdf
Masterplan for charging infrastructure (Masterplan zur	This plan includes measures to implement the expansion of public charging infrastructure	2014	http://www.hamburg.de/klima/4382232/masterplan-zur-ladeinfrastruktur/

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Ladeinfrastruktur)	for electric mobility.		
Digital City Strategy (Strategie Digitale Stadt)	Urban strategy to foster the digitisation in Hamburg.	2015	http://www.hamburg.de/digitalisierung/
Solar offensive Hamburg (Solaroffensive Hamburg)	The solar offensive Hamburg is an alliance promoting the implementation of solar energy and heating on roofs.	2017	http://solaroffensive-hamburg.de
North German energy transition 4.0 (Norddeutsche Energiewende 4.0)	The North German energy transition is a cross-regional project promoting energy transition in Hamburg and Schleswig-Holstein.	2016	http://www.new4-0.de/

5.1.3 District / Borough plans and programmes

In Borough district there are a number of initiatives going on. The main ones have been included in next figure.

Regarding climate protection, the Borough of Bergedorf is outstanding by carrying out the first **climate protection concept** on Borough level in Hamburg. Therein concrete measures to reduce CO_2-emissions are presented in the fields of energy, mobility and resource conservation. The concept addresses different actors such as the municipality, schools and nurseries, households, companies as well as actors in horticulture and agriculture. Apart from concrete mitigation measures and guidelines for funding, one goal of the concept is to raise awareness and social acceptance for change by the citizens of Bergedorf and encourage all kind of efforts for climate protection (FHH 2015a).

Furthermore, the Municipality has started to work on an **overarching development concept** for the borough. Within the next years, it is anticipated to elaborate a common strategy for development that incorporates all existing plans and is accompanied by broad participation of all relevant stakeholders (FHH 2015b). The work will be done in cross section to all departments.

Regarding mobility, a **traffic concept** has been elaborated already in 2015, even though the concept is not published yet and officially still in progress. However, for departments dealing with traffic issues, it is used as general guidance. In 2017 a **cycling concept** was published for Bergedorf incorporating measures to foster cycling in the area (Argus 2017).

With regard to **housing development**, here a city wide programme was broken down to all districts comprising district wide targets and projects. An update is provided every year (FHH 2017a). Regarding the housing development programme it should be mentioned that Bergedorf bears a big potential in

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comparison to other Hamburg districts as in Bergedorf there is still potential for new construction programmes or for conversion.

The planning authorities have elaborated **development concepts** or guidelines for specific areas in Bergedorf that are in the proximity of the intervention areas. More information on these concepts as well as on the before mentioned plans are provided in Table 9.

Table 9: Plans and programmes on borough level

Plan/ Programme	Description	Year/ Status	Further information
Integrated Climate Protection concept Bergedorf (Integriertes Klimaschutz-konzept Bergedorf)	Targets, milestones and strategic measures for climate change protection in the district of Bergedorf.	2016	https://www.klimazeichen-bergedorf.de/herzlich-willkommen/klimaschutzkonzept/
Development concept Bergedorf (Entwicklungskonzept Bergedorf)	Comprehensive development concept for the district that incorporates existing strategies and plans that were developed in different departments of the municipality	in progress	not published yet
Traffic concept (Verkehrskonzept) Bergedorf	The concept aims at a comprehensive traffic concept for Bergedorf i.e. covering the whole district and its connectivity to neighbouring districts and regions including all transport modes as well as private, public and commercial transportation.	in progress	not published yet
Cycling concept (Radverkehrskonzept) Bergedorf	This concept aims to foster cycling within the district and to improve connectivity to public transport and neighbouring cycling routes.	2017	http://www.hamburg.de/contentblob/8946720/0b8e1f04a1e3b75d1b2216bbc15d09de/data/radverkehrskonzept-do.pdf

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Plan/ Programme	Description	Year/ Status	Further information
Housing Programme (Wohungsbauprogramm) Bergedorf	This programme is an implementation of a city wide housebuilding programme on district level.	2017 Updated every year	http://www.hamburg.de/contentblob/8426948/2196137724a51362615e9cca1e9f40bf4/data/wohnungsbauprogramm-2017.pdf
Development concepts or guidelines for specific development areas	e.g. • Masterplan Schleusengärten (2011) • Gestaltungsleitfaden Schleusengraben (2014) • Serrahn 2030 – Ein Zukunftsbild für den Bergedorfer Hafen (2014)	/	e.g. http://www.hamburg.de/contentblob/2766102/aaf69fbea458f1d129797460bf1bc99c/data/schleusengaerten-masterplan.pdf http://www.hamburg.de/contentblob/4280224/89e4dfab08b7e918bcedeb8a93f032be/data/gestaltungsleitfaden-schleusengraben.pdf http://www.serrahn2030.de/wp-content/uploads/2015/04/zukunftsmagazin_web.pdf

5.2 Improvement potential identification

Considering the fact that the spatial master plan was published in 2007 and provides guidance until 2020, the question arises if there will be a new spatial master plan or a comparable programme developed in Hamburg. Currently, there is no insight on that.

There are several plans relevant for sustainable energy and mobility measures in Hamburg. Sometimes measures, e.g. electric mobility, are overlapping and named in several plans. However, the mobility programme from 2013 already tackles the lack of transparency and provides links to other existing action plans for each measure.

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5.3 Calculation of diagnosis indicators for Existing Urban Plans for promoting low energy districts and sustainable mobility

The indicators selected related to existing urban plans for promoting low energy districts and sustainability mobility are being calculated and they are showing in the following table.

Table 10: Indicators related to existing urban plans for promoting low energy districts and sustainable mobility

Indicator	Units	Value
Existence of plans/programmes to promote energy efficient buildings	Number of plans	Difficult to count. Depending on the level of detail there are plenty of plans taking these aspects into account. For a general overview and qualitative description see above.
Existence of plans/programmes to promote sustainable mobility	Number of plans	There is one overarching mobility concept. For a detailed description see above.
Existence of local sustainability action plans	YES/NO	YES, on district level.
Existence of local sustainability plans	YES/NO	YES
Existence of Smart Cities strategies	YES/NO	YES
Existence of an Agenda 21	YES/NO	No. Currently there are action plans on district level (representing the municipality in Hamburg). However, Hamburg is working on the implementation of the Sustainable Development Goals 2030.
Signature and compliance of the Covenant of Mayors	YES/NO	YES

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6. Public procurement procedures, regulations and normative

6.1 Current status

This section provides an insight on public procurement procedures, regulations and normative at European, national and city level. Next figure shows a general summary of the presented approach. At the end of this section a table shows a comprehensive list with all the regulations described, along with corresponding references.

EU	GERMANY	HAMBURG
• Transposition of Directive 2014/24/EU on Public Procuremment into national German law. • Realisation of Electronic European Single Procurement Document	• "Alliance for sustainable procurement" initiated by Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) • Parliamentary Act against Restraints of Competition • Executive Order concerning Public Procurement: sections 14...19 • Regulation for Procurement and Contract Procedures for Suppliers and Services, part A • Regulation for Procurement and Contract Procedures for Construction Works, part A	• Implementation of general guidelines for "Green Procurement" • Hamburg Procurement Act • The Procurement Order • The Hamburg Budget Regulation Act • Waste Management Act of Hamburg • General Vehicle Regulations of the Free and Hanseatic City of Hamburg • Additional Contractual Conditions VOL/B of Hamburg

Figure 33: Current regulation on public procurement procedures at EU, national and city level

In order to guarantee fair, efficient, and sustainable public procurement contracts the German laws for procurement regulate the corresponding processes. Different legal norms provide detailed provisions on how public principals may proceed when awarding procurements. The laws regulating public procurement generally aim for competition, transparency, and equal treatment and try to ensure an economic and sustainable use of public budgets. The German procurement regulation is strongly influenced by the legislative provisions of the EU. If a public contract exceeds a specific threshold level these contracts need to be publically announced throughout the EU member states due to different European directives. Contracts with a lower economic volume are announced in accordance with the national German and regional budgetary acts. Thus, procurement regulations in Germany consist of two different fields, depending on whether the contract value reaches the specific threshold considered by the EU or not (Federal Ministry for Economic Affairs and Energy (BMWI, n.d.).

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In April 2016, the transposition of Directive 2014/24/EU into national German law by the Procurement Modernisation Act (so-called *"Vergaberechtsmodernisierungsgesetz (VergRModG)"),* the German procurement acts and orders were modified in many ways. Besides the implementation of new procedures, the reform also included the implementation of staff suitability or qualification, as well as social and ecological aspects. Furthermore, the electronic **European Single Procurement Document** was realised (VergRModG).

According to that, the modified German procurement law prescribes a greater consideration of environmental aspects within procurement procedures. In order to promote sustainability within public procurement procedures many of the new regulations are linked with environmental issues. In this regard, public principles are asked to put stronger emphasis on aspects of sustainability. Moreover, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) initiated the "**alliance for sustainable procurement**", in which the federal government, federal states, and municipalities are represented. The alliance serves as an information platform and aims to support and promote sustainable procurement on federal, regional, and local level as well as the exchange of information between involved instances. Specific current topics, such as electric mobility, sustainable construction, and resource efficiency, which are also relevant for smart cities, are worked out in individual groups of experts within the alliance (BMUB, 2017).

In addition to the national formal and informal purposes, the federal states also make approaches to implement sustainability in public procurement. The Free and Hanseatic City of Hamburg has implemented the need for sustainability in public procurement in various ways: since 2016 there are general guidelines for "***Green Procurement***" that aim to support the responsible local authorities in considering ecological aspects in public procurement (FHH, 2016b). Moreover, there are different regulations considering e.g. the use of recycling paper, and the prohibition of tropical timber from unsustainable forestry (Umweltbundesamt, 2014). In the field of procurement of new public vehicles regulations consider the purchase of cars with low levels of CO_2 and pollutant emissions (Umweltbundesamt, 2014). In the case of replacement procurement of vehicles electric cars have priority over conventional cars with combustion engine. Therefore, a change in the burdens of proof (Beweislastumkehr) was implemented in 2014. In a procurement process the public consumers no longer have to justify why an e-car should be purchased but why exceptionally no e-car is considered. With a number of more von 300 e-cars in the public sector Hamburg ranks among the leading European cities in this field (FHH, n.d.)

In total, the Free and Hanseatic City of Hamburg is considered as a forerunner federal state in regard to environmental-friendly and sustainable public procurement. This is mainly due to the fact that in Hamburg, in contrast to other federal states, objectives and measures for green public procurement are formally regulated by law (Umweltbundesamt, 2014).

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6.1.1 Public procurement procedures

Procurement regulations provide legal requirements concerning the different forms of procedures as well as their contents. The respective procedure of contract awarding generally depends on the estimated net contract value. A thorough validation needs to prove whether the contract value exceeds the EU threshold or not.

The **Executive Order concerning Public Procurement** (so-called *"Verordnung über die Vergabe öffentlicher Aufträge (VgV)"*)) defines details concerning different procedures of public procurement above the EU threshold. Those are the *open* and the *closed procedure including a competition for participation*. Public institutions in Germany can generally choose between these two types of procedures according to §14 VgV. The *open procedure* is defined in detail in § 15 VgV; the *closed procedure* is described in § 16 VgV. Others than these two procedures are only allowed under the conditions of §14 (3) and (4) VgV. Possible other procedures are the *negotiation procedure with and without a competition for participation,* which is described in detail in § 17 VgV, the *competitive dialogue* (§ 18 VgV), as well as the *innovation partnership* (§ 19 VgV).

Procurement procedures below the EU threshold are specified in the **Regulation for Procurement and Contract Procedures for Supplies and Services**, part A (so-called "*Vergabe- und Vertragsverordnung für Leistungen Teil A* (VOL/A)") and in the Regulation for Procurement and Contract Procedures for Construction Works, part A (so-called "*Vergabe- und Vertragsverordnung für Bauleistungen,* Teil A (VoB/A)"). Those procedures are the *public tender procedure,* the *restricted tender procedure including a competition for participation,* and the *direct award*. In contrast to the regulations of the VgV, public authorities cannot freely choose a procedure. While the public tender procedure needs to be applied in most cases, the other procedures do have special provisions to their use.

Different requirements concerning sustainability within procurement procedures are specified in the **Act against Restraints of Competition** (so-called *"Gesetz gegen Wettbewerbsbeschränkungen (GWB)"*) and in the VgV. The VgV prescribes that environmental aspects have to be taken into account in the procurement procedure (§ 31 VgV). In this regard, public principles can request, e.g. an environmental quality label. The GWB considers social and ecological aspects concerning the suitability of the applying contractors. In accordance with this act, companies that infringe environmental or social obligations can be excluded from a procurement procedure (§ 124 GWB). Concerns of sustainability are also taken into account in the stage of determining the most economical tender and contract awarding (§ 127 GWB). Besides economic aspects like price and costs, qualitative environmental and social aspects of services, as well as the life cycle of products are also taken into consideration. Finally, the supplier of contract can be obligated to focus on environmental and social aspects within the execution of the contract (§ 128 GWB, § 59 VgV). These requirements can be determined as contractual terms.

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6.1.2 Regulations and normative

In Germany there is no separate law for public procurement but rather a variety of different legal norms on European, national, and federal level. There are several legal norms that regulate procurement procedures above and below the European threshold levels.

The main law for procurement regulation above the EU threshold is the GWB, which regulates the general principles of procurement (transparency, competition, equal treatment) and lists the different possibilities of procedures above the threshold in section 119. In addition to this, the VgV and Executive Orders concerning Procurement in Defence and Security Affairs as well as in Affairs of Traffic, Water and Energy Supply define the details concerning procedures, which refer to the requirements of Directive 2014/24/EU.

If the EU threshold is not reached the Federal Budget Code (so-called "*Haushaltsgesetz*"), the VoL, and the VoB, as well as corresponding procurement laws of the 16 German federal states, which basically refer to the national regulations, are applied. For instance, in the City and Federal State of Hamburg there are:

- Hamburg Procurement Act (so-called *"Hamburgisches Vergabegesetz"*)
- the Procurement Order (so-called *"Beschaffungsordnung"*)
- the Hamburg Budget Regulation Act (so-called *"Landeshaushaltsordnung"*).

These regulations mainly consist of references to the national German law besides some isolated special regulations in the federal state of Hamburg. In order to promote sustainability in procurement procedures Hamburg specifies further regulations concerning environmental issues:

- Waste Management Act of Hamburg (so-called "*Abfallwirtschaftsgesetz*")
- General Vehicle Regulations of the Free and Hanseatic City of Hamburg (so-called "*Allgemeine Kraftfahrzeugbestimmungen der Freien und Hansestadt Hamburg*")
- Additional Contractual Conditions VOL/B of Hamburg (so-called Hamburgische zusätzliche Vertragsbedingungen VOL/B) (Beschaffungsamt des Bundesministeriums für Innern (BeschA, n.d.).

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Table 11: Overview: Important procurement regulation laws in Germany

Level	Regulation/law/act/order
European Union *(supranational level)*	• Directive 2014/24/EU on Public Procurement *("Richtlinie 2014/24/EU über die öffentliche Auftragsvergabe")* German version: http://eur-lex.europa.eu/legal-content/DE/TXT/HTML/?uri=CELEX:32014L0024&qid=1493213705287&from=DE English version: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0024&qid=1493213705287&from=DE
Germany *(national level)*	Germany's national procurement law • Parliamentary Act against Restraints of Competition *("Gesetz gegen Wettbewerbsbeschränkungen")* - section 119: list of possible procurement procedures above the threshold German version: http://www.gesetze-im-internet.de/gwb/ (Attention: The offered English version was not updated since the reform of 2016 and is not correct.) • Executive Order concerning Public Procurement *("Verordnung über die Vergabe öffentlicher Aufträge")* - section 14: basic rules for choosing procedures - section 15: open procedure - section 16: closed procedure - section 17: negotiation procedure with or without a competition for participation - section 18: competitive dialogue - section 19: innovation partnership German version: http://www.gesetze-im-internet.de/vgv_2016/index.html • Regulation for Procurement and Contract Procedures for Supplies and Services, part A (*Vergabe- und Vertragsverordnung für Leistungen Teil A*") German version: https://www.bmwi.de/Redaktion/DE/Downloads/V/vol-a-abschnitt-1.pdf?__blob=publicationFile&v=4 • Regulation for Procurement and Contract Procedures for Construction Works, part A ("*Vergabe- und Vertragsverordnung für Bauleistungen,* Teil A") German version: https://dejure.org/gesetze/VOB-A

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Level	Regulation/law/act/order
Hamburg *(federal state level)*	• Hamburg Procurement Act *("Hamburgisches Vergabegesetz")* German version: http://www.landesrecht-hamburg.de/jportal/portal/page/bshaprod.psml?showdoccase=1&doc.id=jlr-VergabeGHA2006rahmen&st=lr • Procurement Order *("Beschaffungsordnung")* German version: *http://www.hamburg.de/contentblob/3992786/d861d757cd32dce3e114ecedfa8e07be/data/4-5-beschaffungsordnung-november-2016.pdf* • Hamburg Budget Regulation Act *("Landeshaushaltsordnung")* German version: http://www.landesrecht-hamburg.de/jportal/portal/page/bshaprod.psml?nid=1q&showdoccase=1&doc.id=jlr-HOHA2014pP58&st=null Detailed collection of procurement law in Hamburg: http://www.hamburg.de/fb/vergaberecht/

6.2 Calculation of diagnosis indicators for public procurement procedures, regulations and normative

The indicators selected for public procurement procedures, regulations and normative are being calculated and mentioned in the following table.

Table 12: Indicators for public procurement procedures, regulations and normative

Indicator	Units	Value
Existence of regulations for development of energy efficient districts	Number of regulations	Difficult to count. Depending on the level of detail there are plenty of plans taking this issue into account. For a general overview and qualitative description see above.
Existence of regulations for development of sustainable mobility	Number of regulations	Difficult to count. Depending on the level of detail there are plenty of plans taking this issue into account. For a general overview and qualitative description see above.
Existence of local/national Energy Performance Certificate (EPC)	YES/NO	YES

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7. Identification of existing actions for citizen engagement

7.1 Current practices

Existing practices for citizen engagement can be classified as formal and informal. The first ones follow a general two-stages procedure, being the aim of the first stage to inform the public at an early state, while the second stage's purpose is to provide more detailed information. Different media tools (e.g. website) are used to reach the widest possible audience among the citizenship. Informal practices are set on a voluntary basis, i.e. they are not mandatory according to German law.

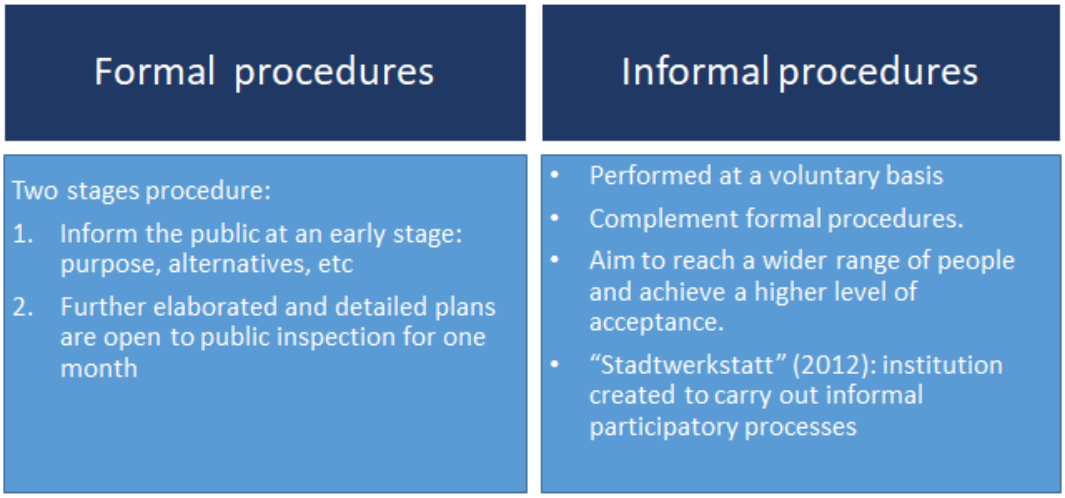

Figure 34: Formal and informal procedures for citizens' engagement

Actions for citizen engagement and participation in Hamburg are mainly taking place in connection with urban planning processes. In this area one can generally distinguish between two forms of participation: On the one hand, there is the formal legally prescribed participation and on the other hand, there are additional informal and voluntary participation procedures.

The formal participation is prescribed in § 3 of the German federal building code (so-called "Baugesetzbuch (BauGB)"). According to this law, citizens, public associations, and further public authorities have to be involved in planning procedures in form of a two-stage participation process. First, there is a public participation on an early stage that aims to inform the public at an earliest possible state about the general aims and purposes, alternative proposals and foreseeable impacts of the plan (§ 3 para 1 BauGB). At this point, citizens as well as institutions of public issues have the opportunity to express their views and gain further clarification. The legislator considers that civic participation at an early stage is increasing the acceptance and quality of the plan. The responsible planning authorities may decide in which form (e.g. public meeting) the participation is carried out (FHH, 2013c).

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At the second stage of participation, further elaborated and detailed plans are opened to public inspection for the period of a month. The place and times at which plans may be inspected have to be announced at least one week in advance in the local customary manner (e.g. official gazette, daily press, internet). Public opinions, recommendations, and concerns regarding the plan must be taken into account within the ensuing final consideration of the plans (§ 3 para 2 BaugGB).

In order to reach more people and facilitate formal participation, Hamburg has implemented the website https://bauleitplanung.hamburg.de/. On this website citizens and registered institutions of public issues have the possibility to attend formal participation procedures online. This tool for e-government considers a complementary opportunity but does not replace conventional forms of formal participation.

While the formal two-stage participation is compulsory in most urban planning processes, informal participation procedures may be performed on a voluntary basis. As planning practice has shown that the formal participation is often not sufficient, additional informal processes of participation can help to reach a wider range of people and achieve a higher level of acceptance. The Free and Hanseatic City of Hamburg has introduced the “Stadtwerkstatt” in April 2012 as a public institution that carries out additional informal participation processes. Stadtwerkstatt aims to involve citizens into urban development processes and can be understood as a platform addressing interested people. Thus, Stadtwerkstatt forms the roof for informal citizen participation in Hamburg. It organises and carries out information as well as participation procedures that complement the formal prescribed participation. The coordination unit of Stadtwerkstatt is part of the council for urban development and housing of Hamburg.

Formal as well as informal participation procedures in Hamburg may also be carried out by private companies. Thus, the City of Hamburg often awards contracts for carrying out participation processes to these companies. Many of them are long-term experienced and have a specific knowledge about local characteristics and local residents in the different boroughs. Thus, the boroughs can benefit from the expertise of professionals and can ensure suitable formats and methodologies of participation that meet local needs.

As a further possibility for direct participation Hamburg has set up “Melde-Michel” (Reporting-Michel http://www.hamburg.de/melde-michel/), an online tool for reporting damages on public infrastructure, such as paths, streets, street lights or playgrounds. If citizens remark any damages on public infrastructure they can easily report it via Melde-Michel website and the report will be forwarded online to the responsible authorities. Thereupon, the responsible authorities are obligated to handle the report and to inform the citizen of it in a fixed period of time.

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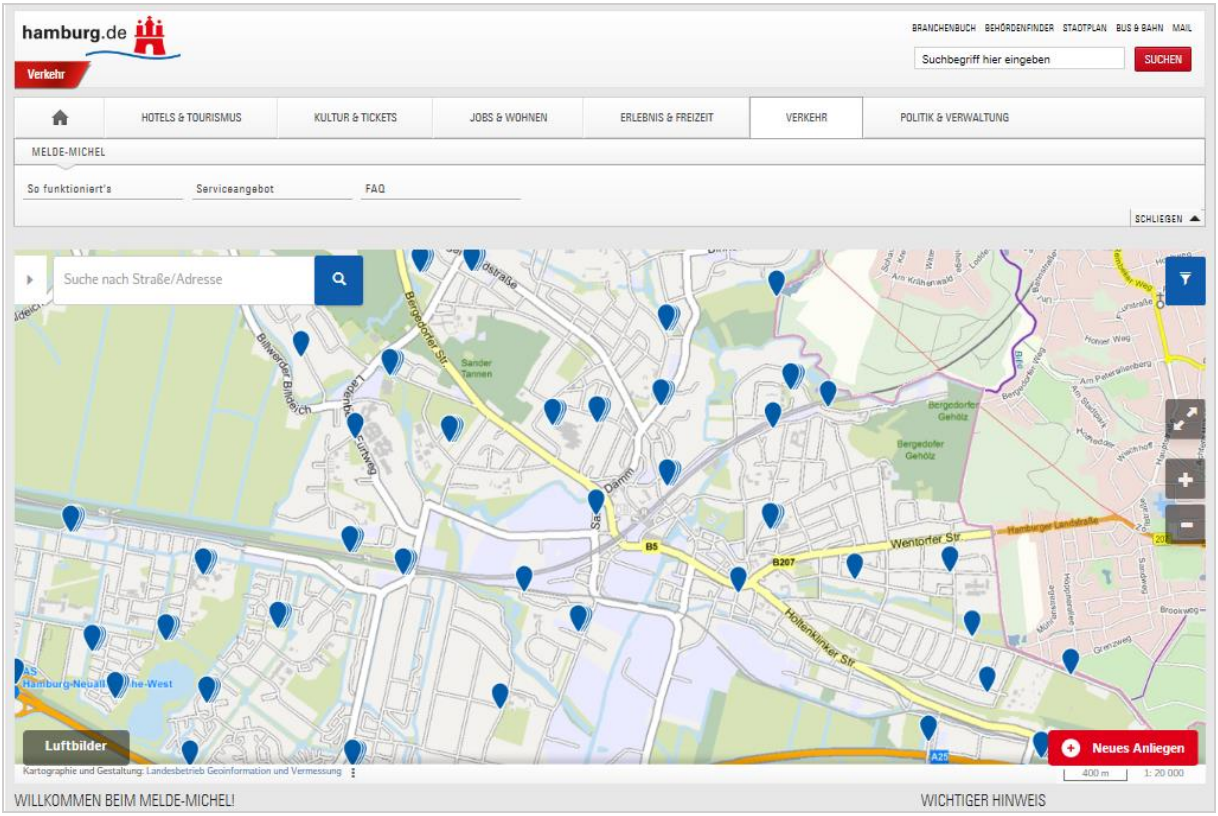

Figure 35: Picture of the Meldemichel from www.Hamburg.de, every blue icon marks a reported damage or littering of public space by a citizen

In order to reach a wide range of citizens, current information concerning urban development and participation opportunities are not only announced in official gazette and newspaper but also on the website www.Hamburg.de and on social media channels, such as Twitter and Facebook.

7.2 Success rates of current practises

At this point of time, there exist no clear valuations or estimations concerning the success rate of citizen engagement in Hamburg. However, there are various factors determining the success or failure of citizen engagement that could be used in order to assess the success rate of current practices in Hamburg.

The Federal Ministry of Transport, Building and Urban Development (BVBS, 2012) e.g. recommends a guideline for successful citizen engagement in planning processes. According to this, the inclusion of different societal groups, such as children, old people or migrants can be considered as a fundamental important aspect. Moreover, it is seen as a key to success that information and participation take place at an early stage and planning processes are carried out in a transparent way (BMVI, 2012). In this regard, possible scopes for decision-making as well as the legitimacy of participation results should be clearly communicated. In addition to this, it is especially important that objectives of respective citizen engagement strategies are defined and methods are chosen in accordance with that (Renkamp, Tillman,

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2013). Last, it can be pointed out that citizen engagement should aim for conflict resolution and achievement on a higher level of social acceptance (Feindt, 2009). Considering these and other factors would be an appropriate way for assessing the success of Hamburg's current practises of citizen engagement.

7.3 Calculation of diagnosis indicators related to existing actions for citizen engagement

With regard to indicator related to citizen engagement, it can be stated that there are no proposed indicators available. In addition, none of them seem to be an appropriate means to indicate the level and quality of citizen engagement. The authors of this text are of the opinion that here qualitative instead of a quantitative measurement should be applied.

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PART II: Borough of Bergedorf audit

Part II of the city audit deals with the local situation of the Borough of Bergedorf, in which the demosite of the project is located. In the administrative structure of the City of Hamburg, the boroughs - each of them as big as a medium size german city - take an important role (see chapter 4.1). Furthermore, the boroughs are an important social reference point for the citizens of Hamburg, and it is expected that they will play a main part in the implementation in a future smart city transformation strategy on local level.

8. Description of the Borough of Bergedorf

8.1 Location of the demosite in the Borough of Bergedorf

Within the framework of the project mySMARTLife new and complex strategies for planning and implementation of smart solutions for a better communal life will be developed and implemented in the project area of Hamburg-Bergedorf with a focus on mobility and energy. In that context, experiences from the project will be used for future city developments, such as the future development area called “Oberbillwerder”, a new large city district with particular importance for Bergedorf and the City of Hamburg.

8.2 Spatial structure

The Borough of Bergedorf is the largest borough in Hamburg (155km²) but has the lowest number of inhabitants (125.000) (Statistikamt Nord (2016d). The spatial structure of the Borough of Bergedorf is characterised twofold – by the urban area of Bergedorf as well as by the huge rural area of the “Vier- und Marschlande”. The urban area of Bergedorf has the character of an autonomous city that takes on important functions for the hinterland of Schleswig-Holstein. Thus, the citizens of Bergedorf can identify themselves with the borough in a special manner. The city centre of Bergedorf displays all functions of a middle-sized city and has a very high living quality due to an attractive pedestrian area, historical buildings and parks as well as through the only existing castle in Hamburg.

A special feature are the cultural landscapes of the “Vier- and Marschlande” that provide the borough with a special rural imprinting. Especially the historical and typical development along the dike streets and the large connected landscape with its old hooves structure and the typical drains are a special characteristic of the area. They need to be protected and carefully enhanced. In this area the dynamic tension between a strongly growing major city and rural areas becomes apparent.

The urban areas are supplemented by large-scale green areas and -connections, which gives Bergedorf the character of “living in green”.

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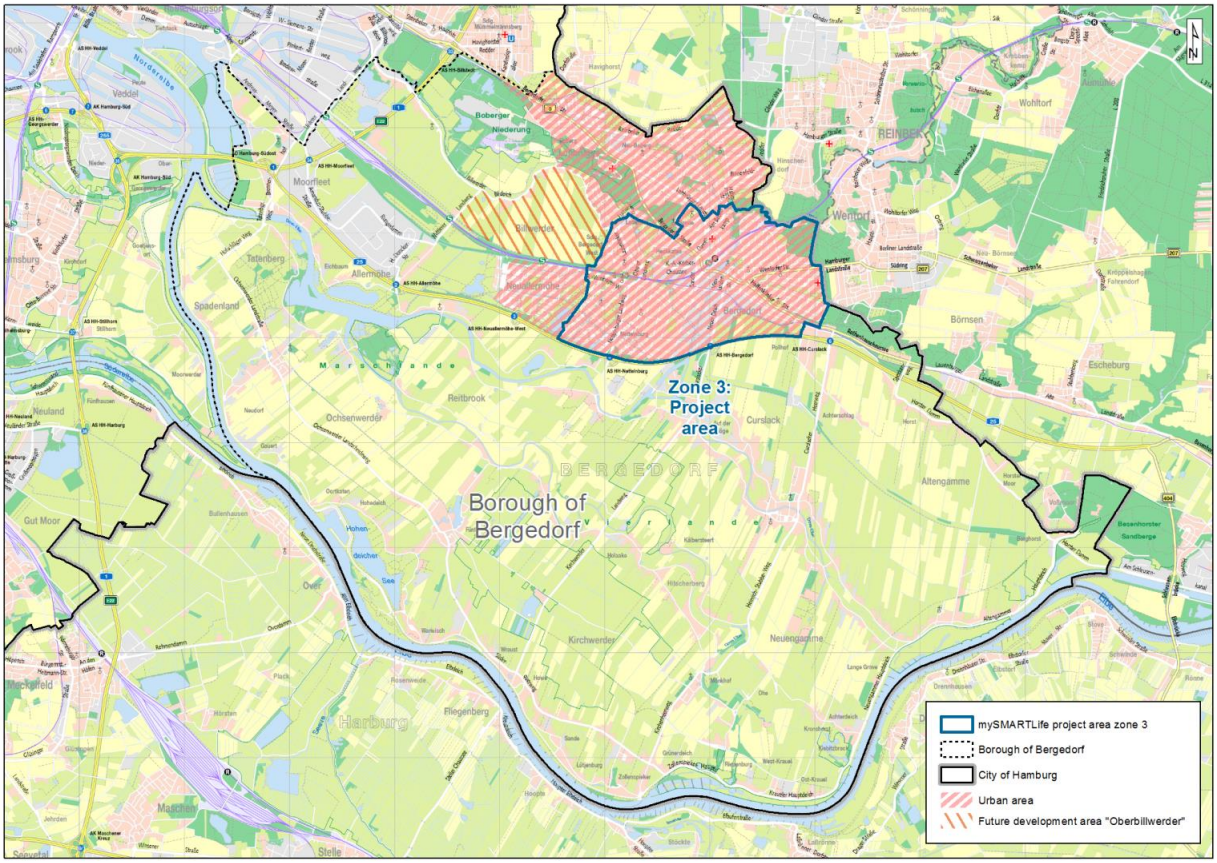

Figure 36: The spatial structure of the Borough of Bergedorf, a dense urban City core witch displays all functions of a middle-size city and the huge rural area of the "Vier- and Marschlande" (own design, background map DISK20 of the LGV)

8.3 Economic structure

As a business location, Bergedorf is home for round 8000 companies. This includes for example businesses of various sizes and fields of activity. Strong sectors within the Borough of Bergedorf are engineering, life sciences and logistics. Above, the successful craft of Bergedorf is an important economic branch.

A specialty for the City of Hamburg is the economic structure of the "Vier- und Marschlande" in which agriculture still plays a substantial role (cultivation of vegetables, flowers etc.). In this rural area a number of landscape gardening companies is located that have grown to midsized companies due to the steep demand of other parts of Hamburg.

In recent years, the percentage of technology driven companies has increased. A breeding ground for research and development is the Life-Science-Campus of the HAW in Lohbrügge as well as the so called "Energy Campus", located in the south of the mySMARTLife project area. In this part of the project area, in

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the direct neighbourhood to the “Energy Campus”, one of three new Hamburg research and innovation parks with a citywide radiance will be founded in 2018.

8.4 Social structure

One crucial tool in the space of social work is social monitoring – a sort of early warning system on the basis of socio-economic data. In the integrated district development is shown which areas still have need for development and which areas could be potential funding areas of the integrated district development.

In the period of 2012 until 2016 the social index of the social monitoring by the Hamburg Authority for Urban Development and Housing has changed in the Borough of Bergedorf: there is a severe deterioration (FHH, 2016c).

Also the growing number of refugees in recent years was and still is a real challenge for the Borough of Bergedorf.

In total, there are three active funding areas with special development needs at the moment in Bergedorf with duration of 7 years, of which the project retrofitting area “Bergedorf Süd” is part of an integrative city development program.

In Table 13 some major indictors are compared for Hamburg and Bergedorf. It shows no significant difference. Only the rate of single households is noticeable lower than the average value for Hamburg.

Table 13: Comparison of key city characteristics from Hamburg and the Borough of Bergedorf

Local Demography Statistic 31.12.2015	Borough of Bergedorf	City of Hamburg
Total population	124,998	1,787,408[a]
Up to age 18 (in %)	17,9	15,9
65 years and older (in %)	18,9	18,5
Other nationals (in %)	12,4	15,7
Citizens with Migration Background (in %)	35,6	32,7
Citizens up to age 18 with Migration Background (in %)	50,9	48,9
Persons per household	2,0	1,8
Single households (in %)	43,1	54,4
Households with kids (in %)	21,9	17,6
Residents change rate	+2,102	+19,998

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Local Demography Statistic 31.12.2015	Borough of Bergedorf	City of Hamburg
Unemployed (in %)	4,8	5,6
Younger unemployed (age 15 to 25 years) (in %)	1,4	2,5
Older unemployed (age 55 to 65 years) (in %)	4,3	4,7

Source: Statistikamt Nord (2016d), [a] Statistikamt Nord (2017d), population December 2015

8.5 Actual plans and developments

Overall, Bergedorf is a growing borough and attractive residential location. The variety of planning tasks and strategic planning are increasing. Besides numerous planning for residential buildings, commercial developments and its effects pose a real challenge for the borough. Especially infrastructure facilities need to get developed. Therefore, the administration in Bergedorf tries to structure the current tasks and challenges of the needs of a fast growing population by the development of a district development program. Furthermore, the Borough is the first of the seven boroughs, which has developed its own climate protection plan.

A broad overview on development plans and programs can be found in section 5.1.3.

Of all the current plans, the housing development plan of the City of Hamburg has the greatest impact on the future development of the spatial structure of the district. The City of Hamburg answers the still ongoing pressure of the housing market with the so called “contract for Hamburg” (“Vertrag für Hamburg”) – a contract that is concluded by the Senate and the seven boroughs of Hamburg with the target of a binding amount of housing constructions. The Borough of Bergedorf has committed itself to realise 800 building permits per year out of 10.000 residential units Hamburg wide and to control its plans by a housing programme. The key objective of this program (living in one or two-family houses, living on the country side, social housing and living suited for elderly people without barriers) have been formulated on the basis of the principle “inner development before outer development”.

It can be anticipated that the potential spaces in the urban area of Bergedorf will not be sufficient for the requirements of the housing market. The credo of the inner development is still valid, however, in parallel the program “more city on new places” (“Mehr Stadt an neuen Orten”) has been launched and follows the objective, with the development of several new living areas along the old industrial channel “Schleusengraben” with about 2,600 thousand housing units, of urbanising rural areas. Each of these new living areas is developed with its own investor and they built the core of the high performance district of the mySMARTLife project. According to the current planning status the developments at the “Schleusengraben-axis” will be finished to the year 2021 and about 70-75 new buildings will be built. The

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majority of these buildings will be apartment buildings, but also offices, laboratory buildings in a new research & development park and a centre for local supply. All of these areas will be connected by a new bike way without crossing to the Bergedorf inner city, which is also a task of mySMARTLife.

Another future development area is the so called new city district “Oberbillwerder”, located in the east of the Bergedorf city centre at the rapid transport line to Hamburg (see Figure 37). Currently, a size from 4000 – 8000 new inhabitants is discussed. The development of a new city district of this size is of particular importance for Bergedorf and the City of Hamburg and the administration of the Borough expected this future development area as a logical replication area of the results of the project mySMARTLife.

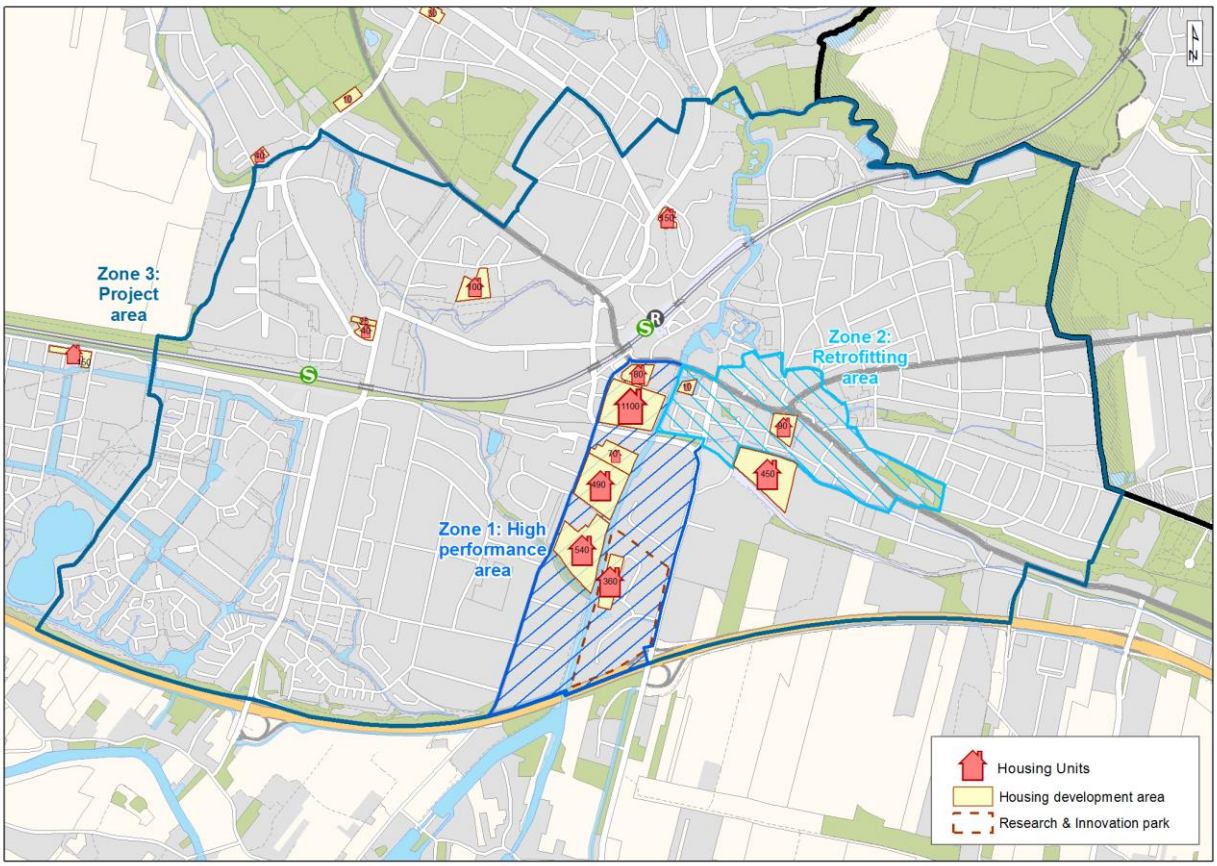

Figure 37: The location of the different parts of the project area in Bergedorf and the location of new planned housing development areas with their planned amount of housing units (own design)

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9. Local energy supply and resources diagnosis

In the following, diagnoses of the energy supply network as well as the potential local energy resources suitable for integration are pointed out.

9.1 Energy supply diagnosis

This section is divided into two subchapters. The first section describes the consumption of electricity as well as its current production from renewable sources in Bergedorf. The second section discusses the heat demand and the sources for space heating in the Borough of Bergedorf.

9.1.1 Electricity production from RES in Bergedorf

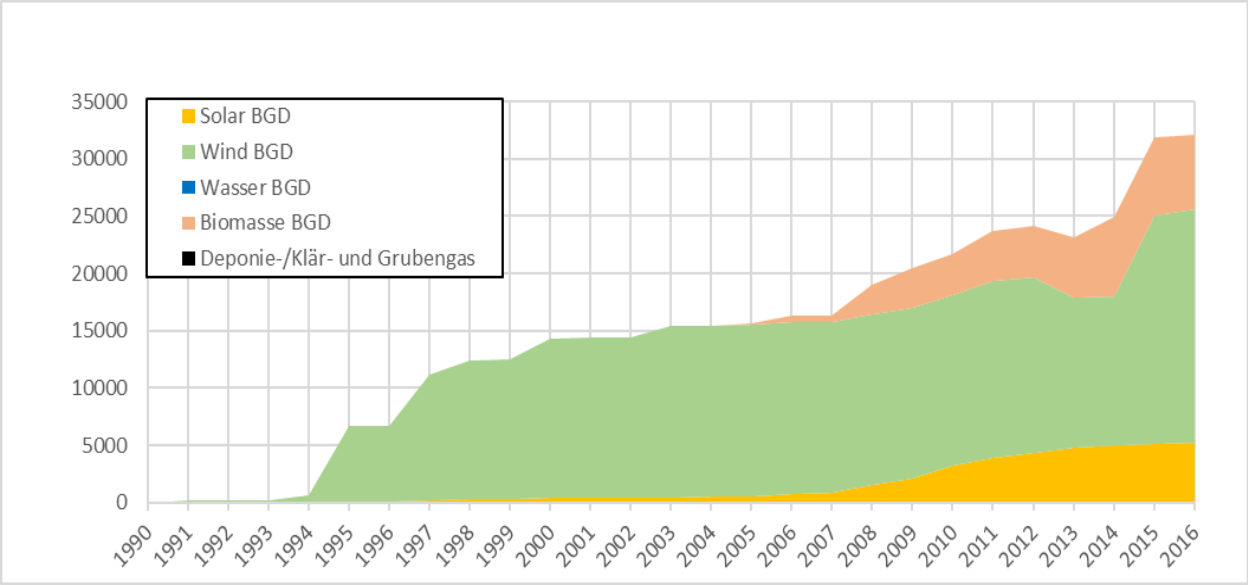

Figure 38: Installed Power of Renewable Energy for BGD (Stromnetz Hamburg, 2017)

The installed production capacity of renewable power in Bergedorf covers the sources solar, wind and biomass and adds up to 32 MW. This accounts for 22.67% of the installed RES power production capacity of Hamburg (total for Hamburg in 2016: 141.5 MW).

The largest share is wind energy. Due to repowering measures between 2013 and 2016, the dismantling of the existing older plants reduced the installed capacity shortly before it increased again due to newer and larger wind turbines. The repowering is described in more detail in chapter 9.2.3.

The shares of biomass and PV rose only slightly over the years. Subchapter 9.2.1 describes the PV potential in Bergedorf and 9.2.5 the biomass potential.

The electricity consumption in Bergedorf declined from about 422 MWh/a in 2012 to 400 MWh/a in 2015. In 2016 it rose again to 461 MWh, probably due to high activities in the building sector. The RES share in

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the local electricity production reached 19.3 % in 2015. Due to less wind and the higher consumption the share was only 16 % in 2016.

Table 14: Electricity consumption in Bergedorf (Stromnetz Hamburg, 2017)

Year	Electricity Consumption (MWh)	Electricity generation from RES (MWh/a)	RES Share in %
2012	422.283,966	71.067,047	16,83
2013	414.583,66	80.873,074	19,51
2014	418.137,617	70.844,572	16,94
2015	400.082,414	77.148,485	19,28
2016	460.943,96	74.106,791	16,08

9.1.2 Heat demand and supply in Bergedorf

The City of Hamburg provides an internet platform called "Wärmekataster - Portal" that displays the heat demand of the city. Parcels are color-coded according to the range of heat demand the buildings on them fall into. In addition to the heat demand, heat generation facilities of larger district heating grids are also shown. The following map shows an extract for the Borough of Bergedorf from the "Wärmekataster Portal".

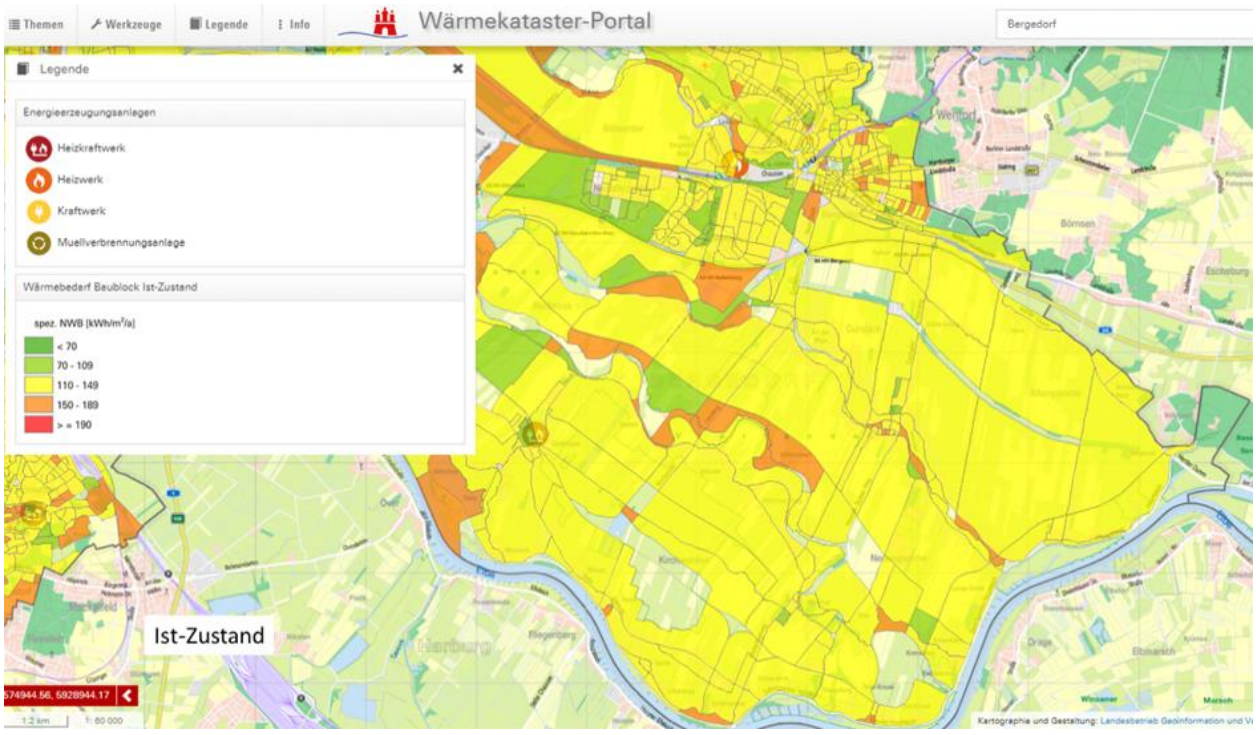

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Figure 39: Heat demand in Bergedorf (FHH, 2017k)

The heat demand of most of the buildings in Bergedorf ranges between 110 to 150 kWh/m²*a (yellow). Some areas, especially with older building stock, range 150 to 189 kWh / m²*a, some have a lower heat demand of between 70 to 109 kWh/m²*a. Overall, the distinction of the heat demand is not very accurate nor does it provide the necessary detail. Therefore, the city is engaged in the research project GEWISS in order to improve the data base on the heat demand of the individual buildings. The HAW is coordinating the GEWISS project.

Here it is important to note that the intended retrofit area in mySMARTLife has a high energy demand (orange to red).

The type of heat supply for the buildings in Bergedorf can also be stated. The predominant heating type is the central heating system for single houses and 69.5% of the buildings are heating that way. Central heating systems operate on either gas (mostly), oil or (in newer or refurbished buildings) are fed by heat pumps (mostly air/water or water/water systems). Another 20% are supplied by either large scale (15.2%) or smaller (4.7% (block heating)) heating grids. The heat supply for 7% of the buildings is done using storey heating units (a system similar to a central heating system but supplying only the rooms of a closed apartment, with the heat generator is usually within this apartment, in most cases a gas boiler). The following table contains an overview of these figures.

Table 15: Comparison of different types of heating (FHH, 2017k)

Type of heating	Share
district heating	15.20%
block heating (CHP)	4.70%
central heating	69.50%
storey heating	6.70%
single oven	3.80%

9.2 Potential local energy resources

In the following, different kinds of local energy resources are portrayed.

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9.2.1 Solar energy

For the City of Hamburg there exists an area-wide „Solar-Atlas“ showing the solar irradiation on every roof surface. The creation of this online service was sponsored by the electric utility company „Hamburg Energie“ and was implemented by Hamburg’s State Agency for Geoinformation and Surveying.

The Solar-Atlas was used for a detailed analysis of the project area. Figure 40 shows the solar irradiation of the construction area the Schleusengraben-axis, which represents Zone 1 of Hamburg’s demonstration site within mySMARTLife. Unfortunately, the atlas does not represent the most current data, as construction developments are quite dynamic. Likewise Figure 41 shows solar irradiation of the retrofitting area Bergedorf Süd, which represents Zone 2 of the project demosite.

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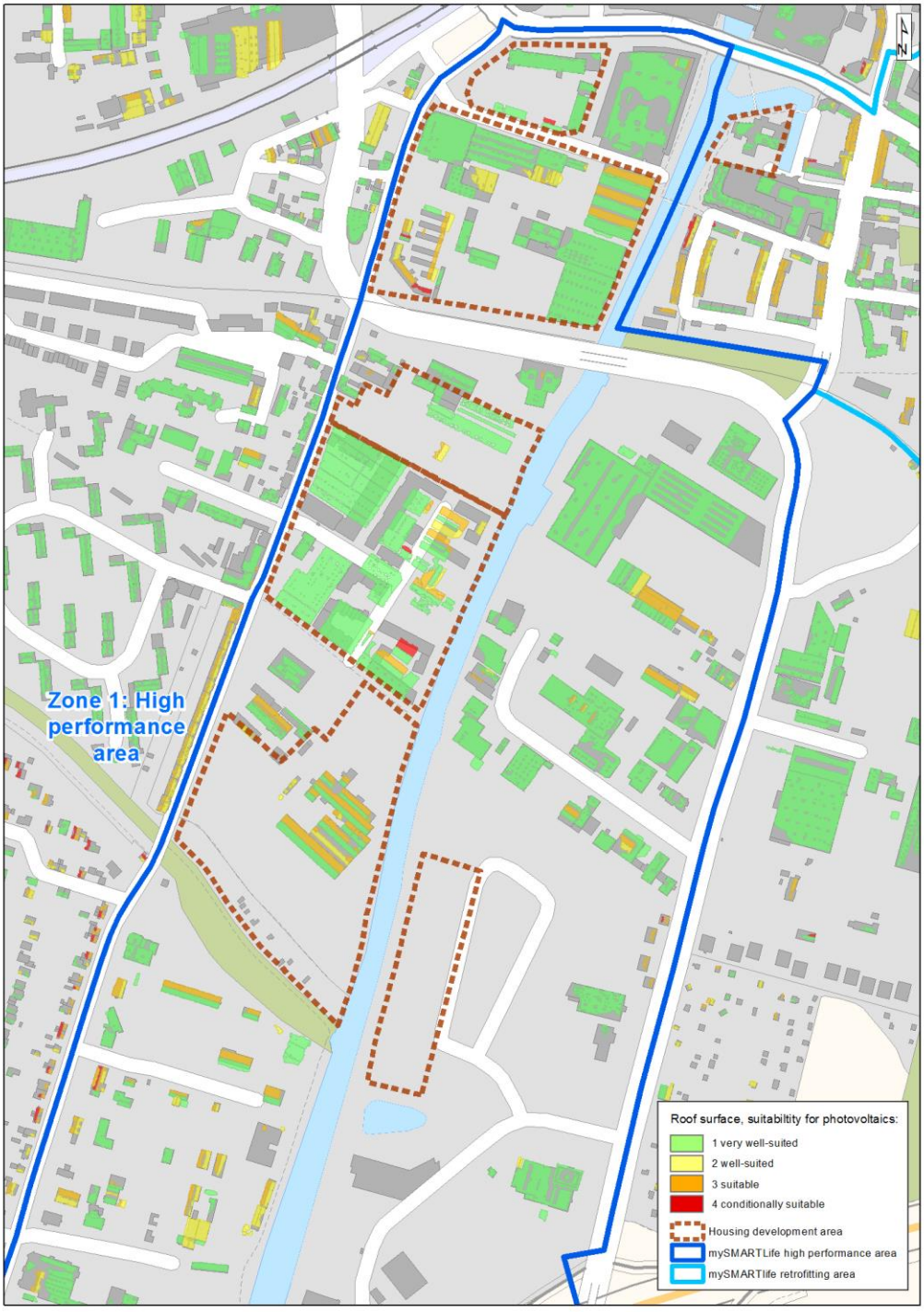

Figure 40: Solar irradiation for the Schleusengraben-axis, project area Zone 1(own design, data source WMS Solarpotenzialflächen Hamburg)

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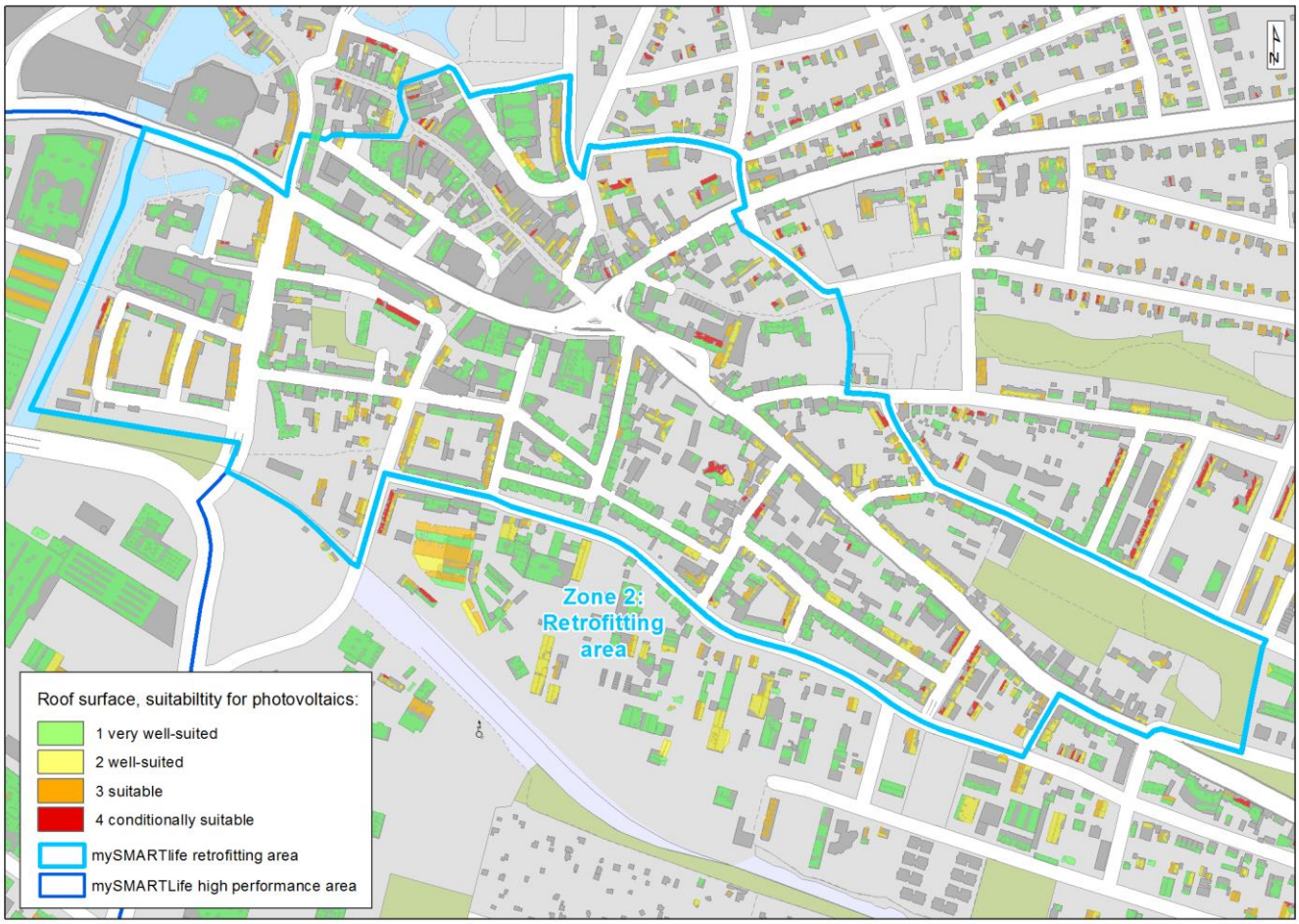

Figure 41: Solar irradiation for Bergedorf-Süd, project area Zone 2 (own design, data source WMS Solarpotenzialflächen Hamburg)

9.2.2 Wind energy

The Borough of Bergedorf allocates four areas for wind energy usage (wind farms). The areas are situated in Curslack, Ochsenwerder, Altengamme and Neuengamme. On the following map section their location is displayed. The wind farm area Curslack is the latest one. Here the HAW Hamburg is involved in the wind farm installation and operation.

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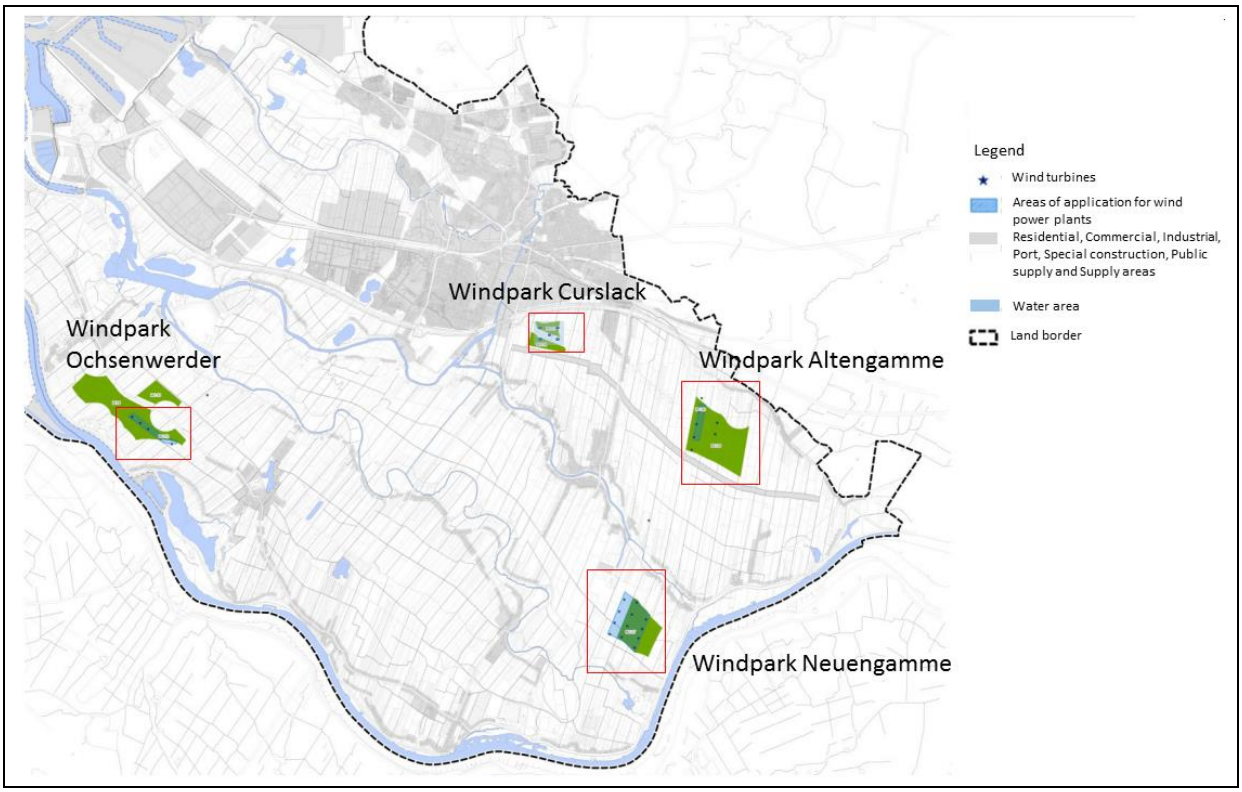

Figure 42: The wind farms Curslack, Ochsenwerder, Altengamme and Neuengamme (own design, based of FHH, 2012b)

The wind parks Ochsenwerder, Altengamme and Neuengamme are older and receive a repowering. Old wind turbines get replaced by newer and larger wind turbines.

Repowering of the wind park Ochsenwerder

The wind park Ochsenwerder was built in 1997. In the original setting 5 NEG Micon wind turbines with a power of 600 kW each had been installed. The total installed power was 3.000 kW and the total yield approx. 5.000 MWh / a.

Three of the five wind turbines were deconstructed and replaced by five new wind turbines. The wind park now consists of four wind turbines with a capacity of 2,400 kW each, one wind turbine with 2,000 kW as well as two old wind turbines with 600 kW each. The installed power for the wind park Ochsenwerder now adds up to 12,8 MW. The new total yield is around 33,000 MWh / a more than six times the old one.

Repowering of the wind park Altengamme

The wind park Altengamme was built between 1996 – 1997. It consisted of

- four wind turbines AN Bonus 600 with a power of 600 kW each
- and three wind turbines Enercon E40 with a power of 500 kW each

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The installed power was 3.900 kW, the total yield was around 6.000 MWh/a.

The current repowering actions will remove all old wind turbines. Instead four new wind turbines Senvion MM 100 with an electrical output of 2000 kW are to be. The new installed power is 8.000 kW and the new yield is expected to add up to around 18.000 MWh/a, three times the old yield.

Repowering wind park Neuengamme

The wind park Neuengamme was built between 1995 and 2000. The original setting included:

- one wind turbine Tacke TW with a power of 600 kW,
- four wind turbines Enercon E40 each with a power of 500 kW and
- one wind turbine Enercon E44 with a power of 600 kW.

Four new wind turbines Senvion MM 100 with an electrical output of 2.000 kW each were built in 2015. The installed power of the wind park was 11.200 kW then and yielded a total of around 24.000 MWh/a.

The four wind turbines from Enercon E40 were destructed recently and the wind park was repowered with two new Enercon wind turbines with a power of 2.350 kW each. The installed power capacity now adds to 13.900 kW and a new total yield is expected to reach about 32.000 MWh/a.

At this point in time further areas for additional wind park are not projected within the limits of the area of the Borough of Bergedorf.

9.2.3 Ambient heat from surface water

The following table provides an overview of the heat energy contained in the water body of the “Schleusengraben” canal under average flow conditions. These values were derived from hydrological data. The Schleusengraben canal is the extension of the river Bille and forms the waterfront of all new buildings in Zone 1 of Hamburg’s demonstration site.

Table 16: Ambient heat energy Schleusengraben Canal – overview (own calculation)

Flow conditions	Energy per year
Average minimal flow	**37574 MWh/a**
Average flow	**93175 MWh/a**

Unfortunately, the given values do not represent an achievable amount of energy which could be extracted by a specific technical process.

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9.2.4 Ambient heat from waste water

The main communal sewage pipe of the district of Hamburg-Bergedorf runs through Zone 1. Hamburg's water utility company „Hamburg Wasser" calculated a theoretical average heat power of 0.9 MW contained in the waste water flow, assuming an average waste water temperature between 12 °C and 15 °C and a temperature change of 1 K by heat extraction. This would lead to an annual average potential heat energy of 7,884 MWh.

The technically possible heat extraction rate would be significantly lower.

Table 17: Power and energy from waste water heat in Zone 1 (own calculation)

Parameter	Value
Average potential power	**0.9MW**
Average potential energy per year	**7884 MWh/a**

9.2.5 Biomass

In 2009 the chamber of agriculture of Hamburg and the department of energy and the environment (then known as "Behörde für Stadtentwicklung und Umwelt") initiated a study on the biomass potential of Hamburg. It bears the title "Studie zum Biomassepotential in der Freien und Hansestadt Hamburg" and states qualities and quantities of the untapped biomass potential. Additionally, it indicates the technical capabilities to make use of this potential within the City of Hamburg and states the demand for new biomass conversion facilities of the full potential was to be exploited. The potential for Bergedorf can be drawn from the study and is illustrated in the two diagrams below. In total, the biomass potential for the borough of Bergedorf adds up to about 30.000 tons dry weight per year from ligneous and gramineous biomass (fig 1). The usable energy content of this adds up to 135.500 MWh/year (see Figure 43 and Figure 44).

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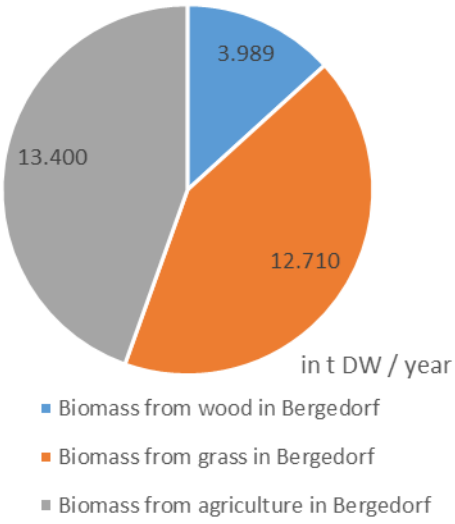

Figure 43: Biomass potential in tons of dry weight per year for the Borough of Bergedorf (own design based on FHH, 2017m)

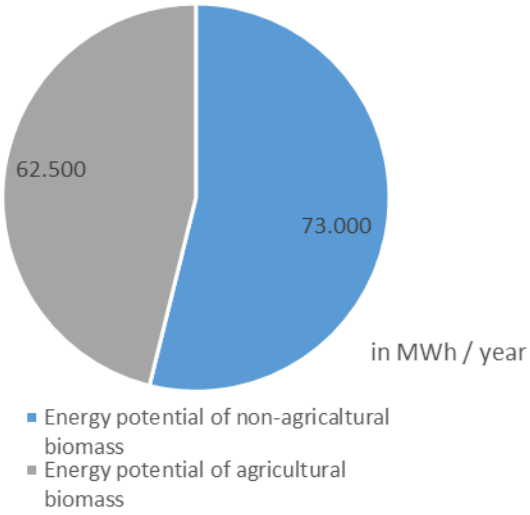

Figure 44: Energy content of the obtainable biomass in the Borough of Bergedorf in Megawatthours per year (own design based on FHH, 2017m)

In order to make use the untapped energy capacities in the biomass potentials the study found that it would require twelve additional bioenergy conversion plants in the City of Hamburg and brings up recommendations for possible sites. Three of these sites were suggested for the Borough of Bergedorf to be placed in Allermöhe, Reitbrook and Kirchwerder with an alternative site suggestion for Boberg. Figure 45 displays a map from the study considering all the site suggestion for Hamburg.

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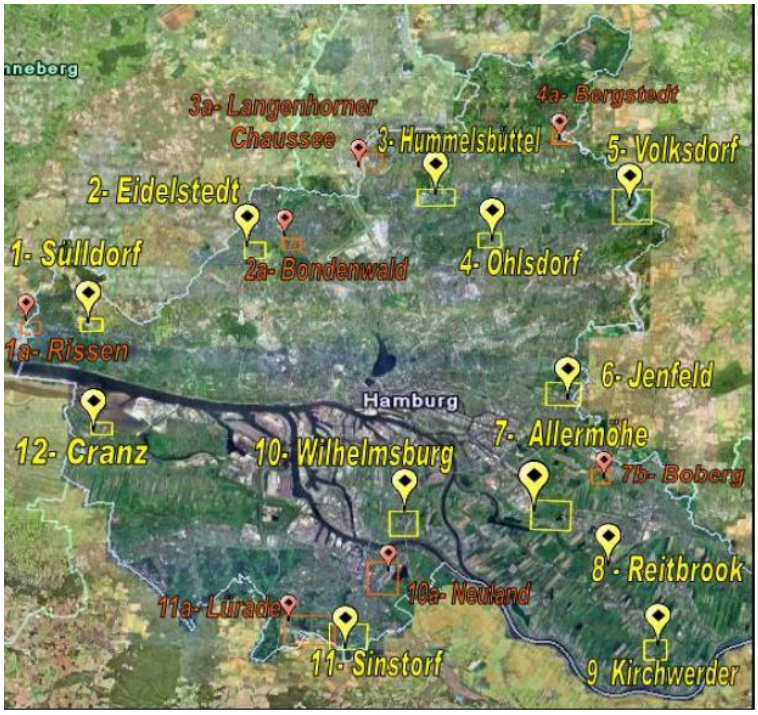

Figure 45: Site proposals for biomass conversion plants (FHH, 2017m), orange: alternative sites

9.2.6 Geothermal energy

The northern German low lands have a fairly high potential for deep geothermal energy. In order to make use of that potential the State Agency for Geoinformation & Surveying compiled a map of existing drill holes that might be used for harvesting geothermal energy. A lot of these holes derive from test drillings and water well drillings as well as older oil and gas drillings that have been exploited in the past.

Figure 46 shows drillings within the area of the Borough of Bergedorf.

The colour coding of the area indicates areas in red where the geothermal exploitation is forbidden (mostly due to drinking water drawing), yellow indicates a potential geothermal usage under legal constraints, green indicates possible exploitation without legal constraints.

The different colours of the dots describe the drilling depths, grey dots mark private drilling holes with unknown or undisclosed depths.

The size of the geothermal potential in Bergedorf is not yet quantified. The map indicates though, that any usage of the geothermal potential will meet legal constraints, as nearly the complete area is marked yellow.

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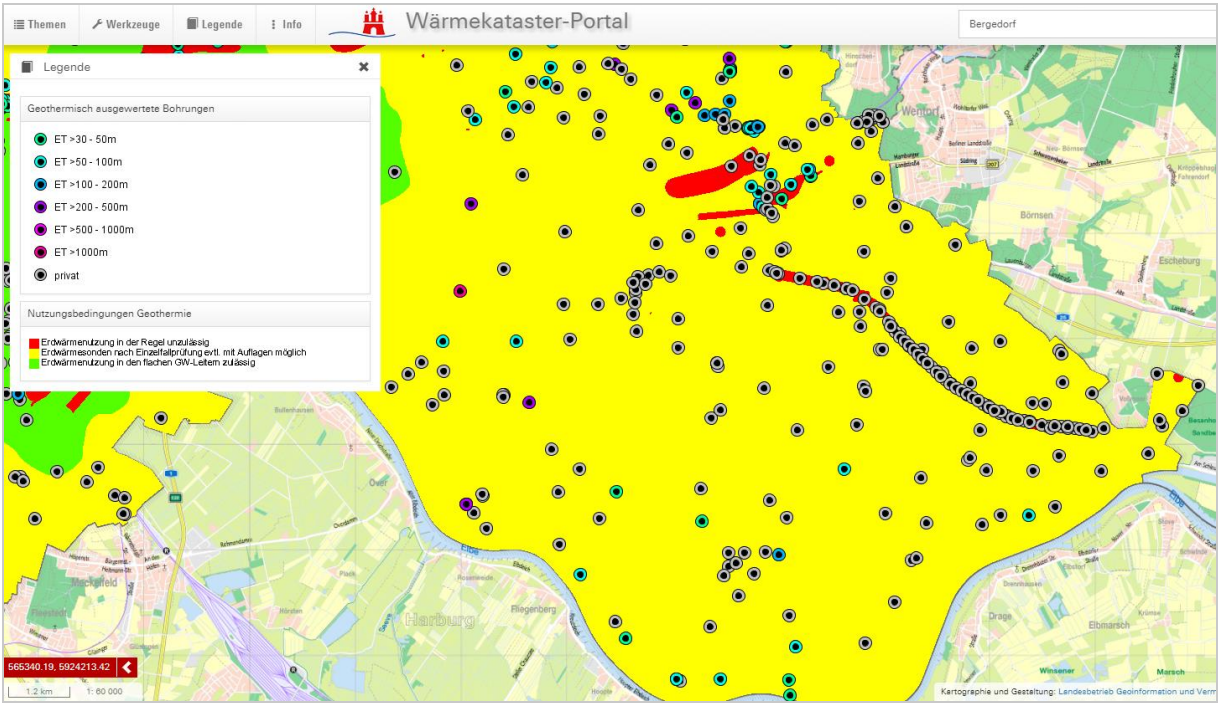

Figure 46: Map of drillings evaluated for their geothermal potential taken from the "Hamburg Wärmekataster-Portal" (FHH, 2017k)

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10. Local transportation current status

10.1 Mobility city profile

The supra-regional traffic infrastructure of the Borough of Bergedorf is characterised by large-scale traffic axes (federal motorways and federal roads) which link the eastern periphery of the City of Hamburg and the federal states of Schleswig-Holstein, Mecklenburg-Vorpommern and Lower Saxony. Due to the location in the middle of these traffic axes, in the case traffic jams on the motorways, often detour routes are used which lead directly through Bergedorf.

The road network is only expendable to a certain limit and especially in the area of the rural area of the “Vier- und Marschlande” with its narrow dike streets, but also in the inner city centre, it can be shown that the breaking point of the existing road network is reached.

Also in the city centre of Bergedorf as well as alongside the channel “Schleusengraben” the increase of several thousand housing units needs to get managed. Therefore, the objective of the new development projects is to reduce the motorised individual traffic.

10.1.1 Local public transport

Due to the location of the borough to the City of Hamburg and the low population density in the southern parts of districts, it is not possible to supply the whole district optimally with the Hamburg rapid transit system. The public transport network in Bergedorf is therefore mainly characterised by bus traffic (Bezirksamt Bergedorf, 2013).

The main traffic hub of the district is the combined railway and rapid transit station, which provides daily connections to regional and interregional destinations (including Rostock, Schwerin) and rapid transit connections in the direction of the Hamburg city centre and other destinations in the surrounding area. Part of the hub is also the central bus station, from which buses travel to Bergedorfer city centre, the rural four- and marshlands as well as other municipalities of the Metropolitan Area of Hamburg. This traffic hub is supplemented by a garage, a bicycle station (bicycle garage and workshop) and parking spaces for car sharing providers.

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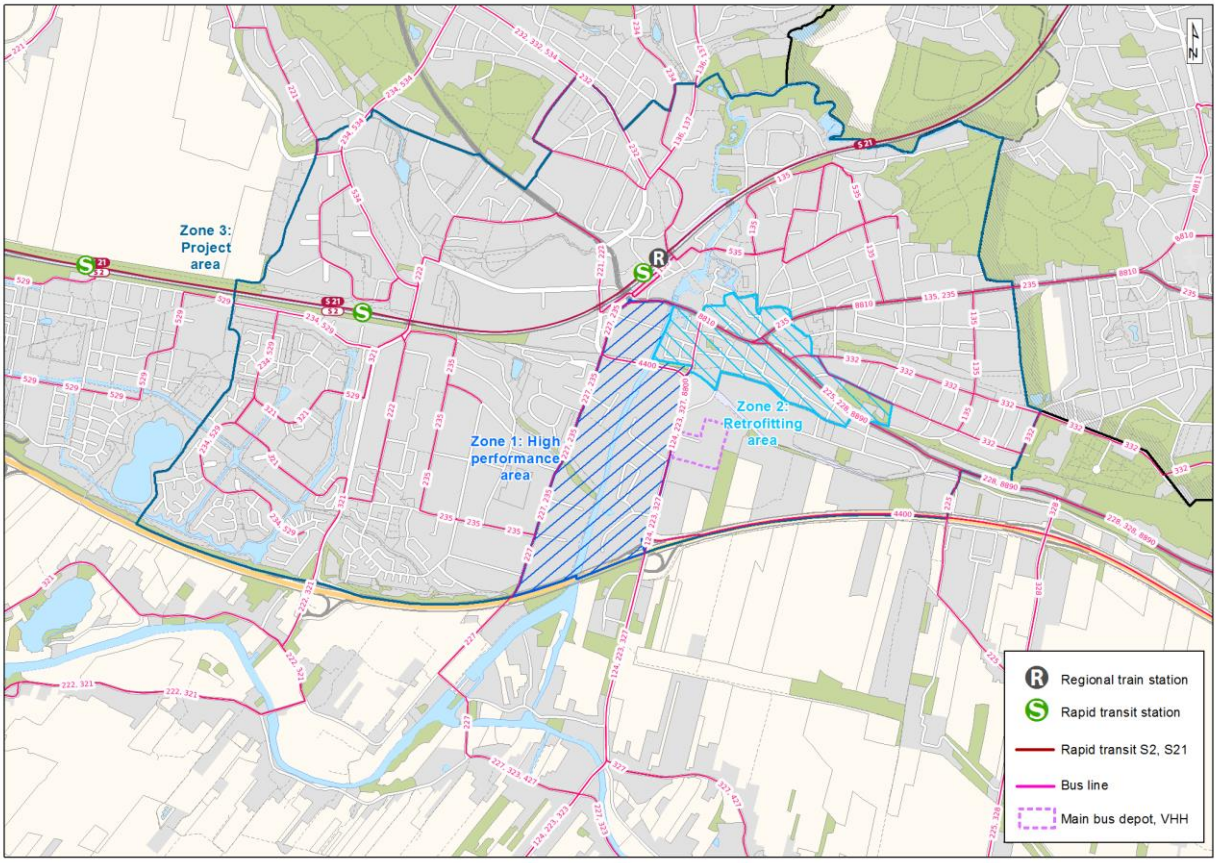

Figure 47: The public transport system in the Borough of Bergedorf is based on rapid transit and bus lines (own design, data source WMS HVV Streckennetz)

10.1.2 Local motorised private transport and electric mobility

The district of Bergedorf is characterised by a central urban area with a historical city centre, but also by the large rural area. Due to this divergence, the mobility behaviour of the young people is not expected to change as much as is generally projected in urban areas (Bezirk Bergedorf, 2013).

Comparing the modal split of the Borough of Bergedorf with the modal split of the central city area of Hamburg, there is a markedly lower use of public transport (the lowest use of all boroughs in Hamburg) as well as a significantly higher utilisation of the motorised individual traffic (highest share in the City of Hamburg). At the same time, however, an almost equal value in the area of pedestrians, this is due to the compact design of the historical centre of Bergedorf, with its own shopping mile.

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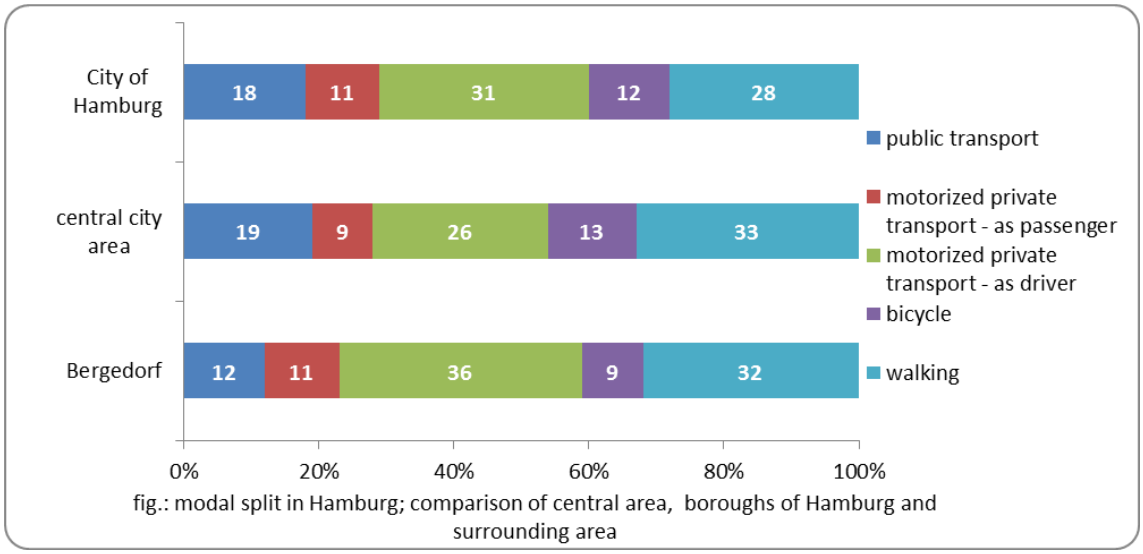

Figure 48: Modal split in Bergedorf; comparison to City of Hamburg and central city area (MiD 2008 seen in FHH 2013a)

In January 2016, the number of cars in private ownership with 387 cars per thousand inhabitants was noticeably higher than the Hamburg average of 339 cars per thousand inhabitants and is the second highest value of all Hamburg districts.

Table 18: Private cars in Hamburg

	Amount	Per 1000 capita
Hamburg	622.036	339
Bergedorf	48.397	387

State 01.01.2016, Source: Statistikamt Nord, 2016a

10.1.3 Charging stations for electric cars

In January 2017 there were 8 public charging stations in the Bergedorf district, all of them with 2 AC charging points with a Typ2/Schuko plug. The amount of e-cars is not statistical registered on borough level, but it is not to be expected, that the registration of e-cars is significant higher than in the rest of Hamburg. 135,946 brand-new cars have been registered in Hamburg in 2016, 1.6 percent more than in 2015. In addition to 59,051 gasoline-powered vehicles (plus 5.5 percent), 75,348 cars with diesel engines (minus 1.5 percent) new to the streets.

The number of newly registered vehicles with alternative hybrid or electric drive increased by 19 percent to 1 402 cars. Most of these were hybrid vehicles (plus 18 percent to 1 044). The number of newly registered electric vehicles grew by 23 percent to 358. In contrast, gas-powered new vehicles found fewer and fewer

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customers in Hamburg. The share of all vehicles with alternative fuel types (gas, electric, hybrid) in new car registrations amounted to 1.1 percent (Statistikamt Nord, 2017f).

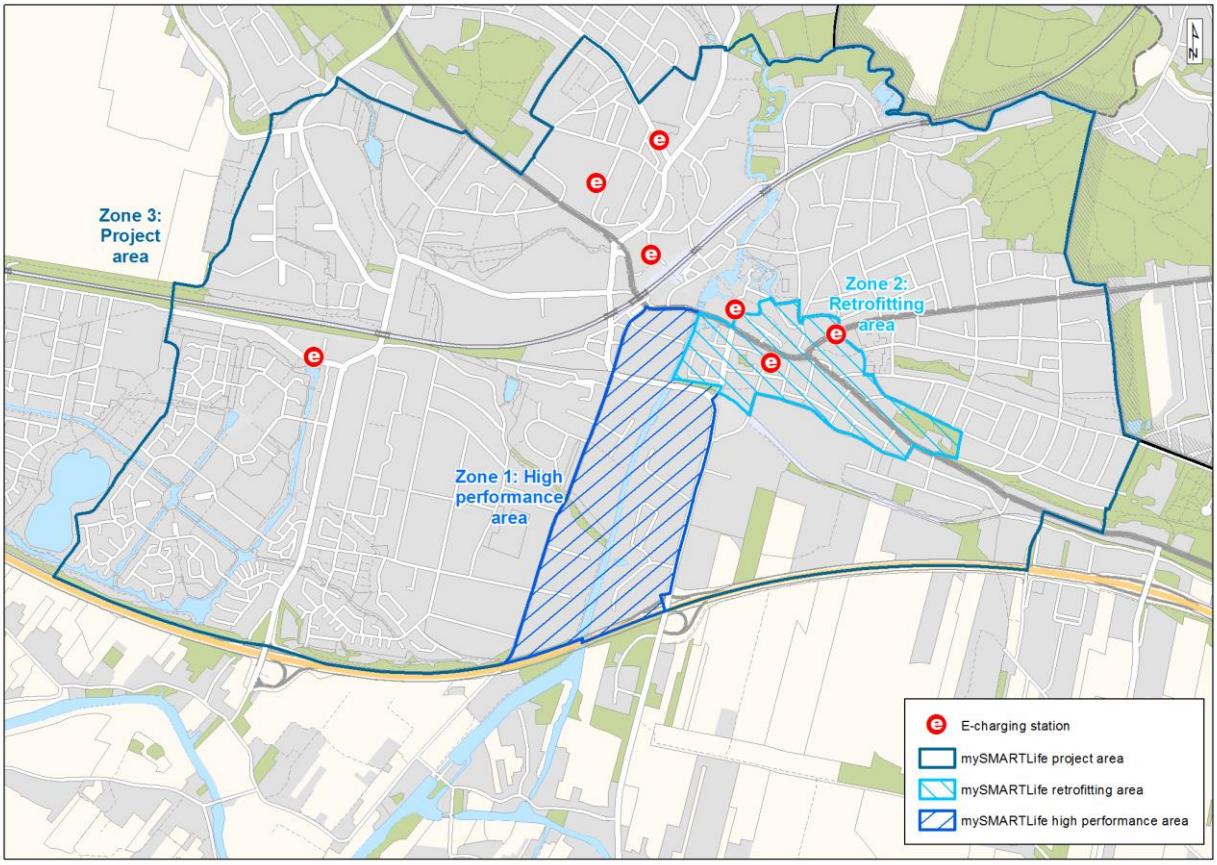

Figure 49: Charging stations in the mySMARTLife project area, January 2017(own design)

10.1.4 Local bicycle traffic

It is the goal of the Hamburg Senate is to increase the share of bicycles by 2030 to 25% at all ways in Hamburg (FHH 2017l).

In addition to the expansion of the so-called Veloroutennetz (bicycle lane network), which links the city's peripheral areas with the inner City of Hamburg via bicycle connections, it is also necessary to create appropriate bikeways on the district level. Therefore the local parliament of the Borough of Bergedorf decided to set up and implement a district cycling concept in 2015 with the aim of analysing and improving the local accessibility of destinations and the conditions for cycling (Argus, 2017).

The development of the cycling concept consisted of two phases, firstly an online survey of citizens on deficiencies in the existing bikeways and route proposals, as well as a final analysis of the submitted responses and the development of proposals for new bicycle traffic axes through traffic planner. The

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implementation of the proposed bikeways has just started - one of them is the bikeway through the high performance district (project zone 1) at the “Schleusengraben Axis” which also a task in mySMARTLife.

Figure 50 shows bicycle corridors in violet that were identified via citizen participation. The planned bicycle connection in mySMARTLife will be the first step to develop the north-south connection in the centre.

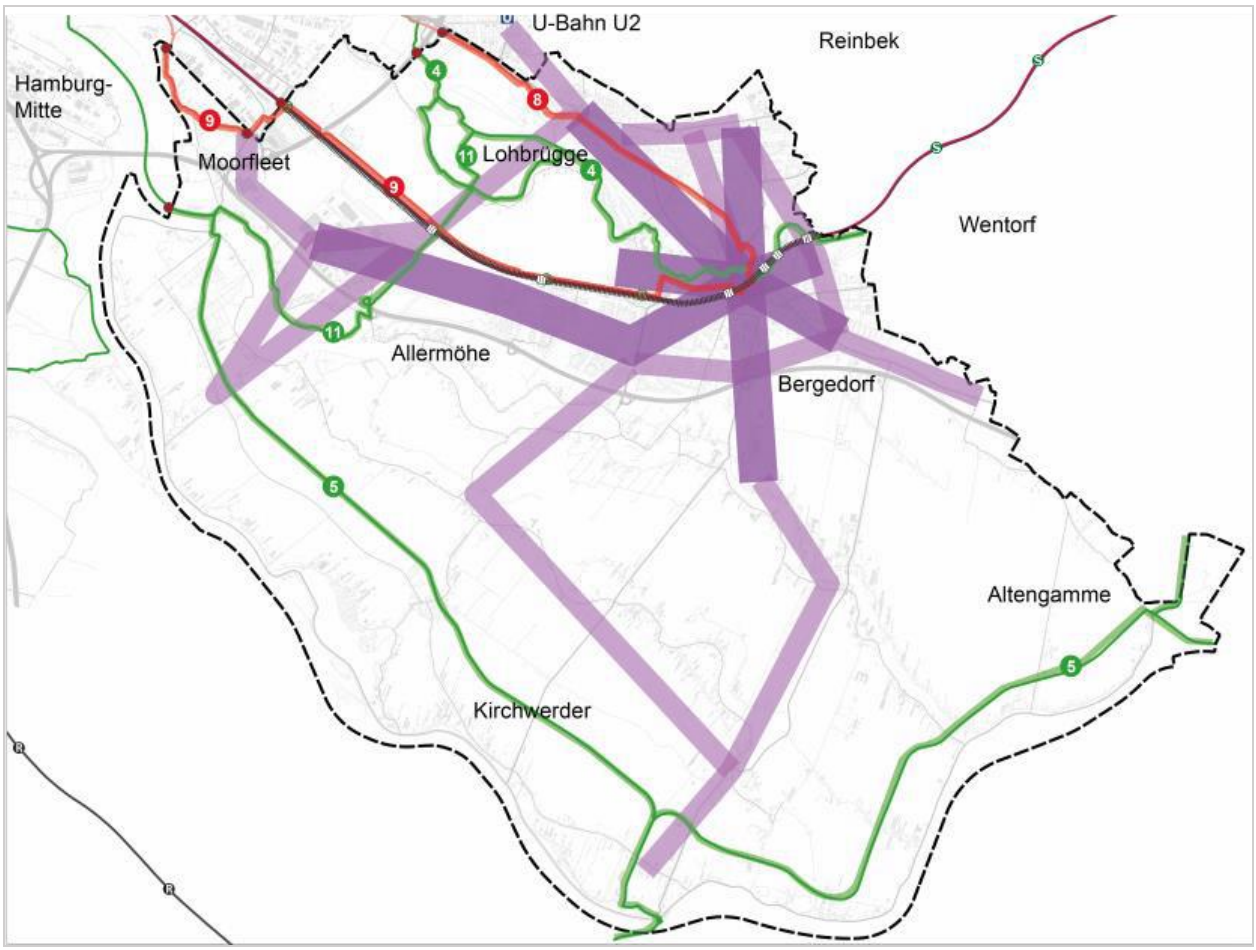

Figure 50: Bicycle corridors in Bergedorf (demanded by citizen participation, Argus, 2017)

10.2 Traffic congestion and emissions

Traffic problems in Bergedorf mainly results from different traffic flows in the city centre. On the one hand the centre is functioning as transfer zone from peripheral areas to the inner City of Hamburg and in case the motorway is congested even from farer. In addition the city centre itself is quite compact with residential and commercial use. The traffic load is therefore correspondingly high in the Bergedorf City and runs off only slowly at peak times, so that even minor incidents (e.g. accidents) can lead to extensive traffic congestion. Especially on the passing federal highways is therefore high noise pollution of residents by road, which has an overall negative impact on the living quality in these areas.

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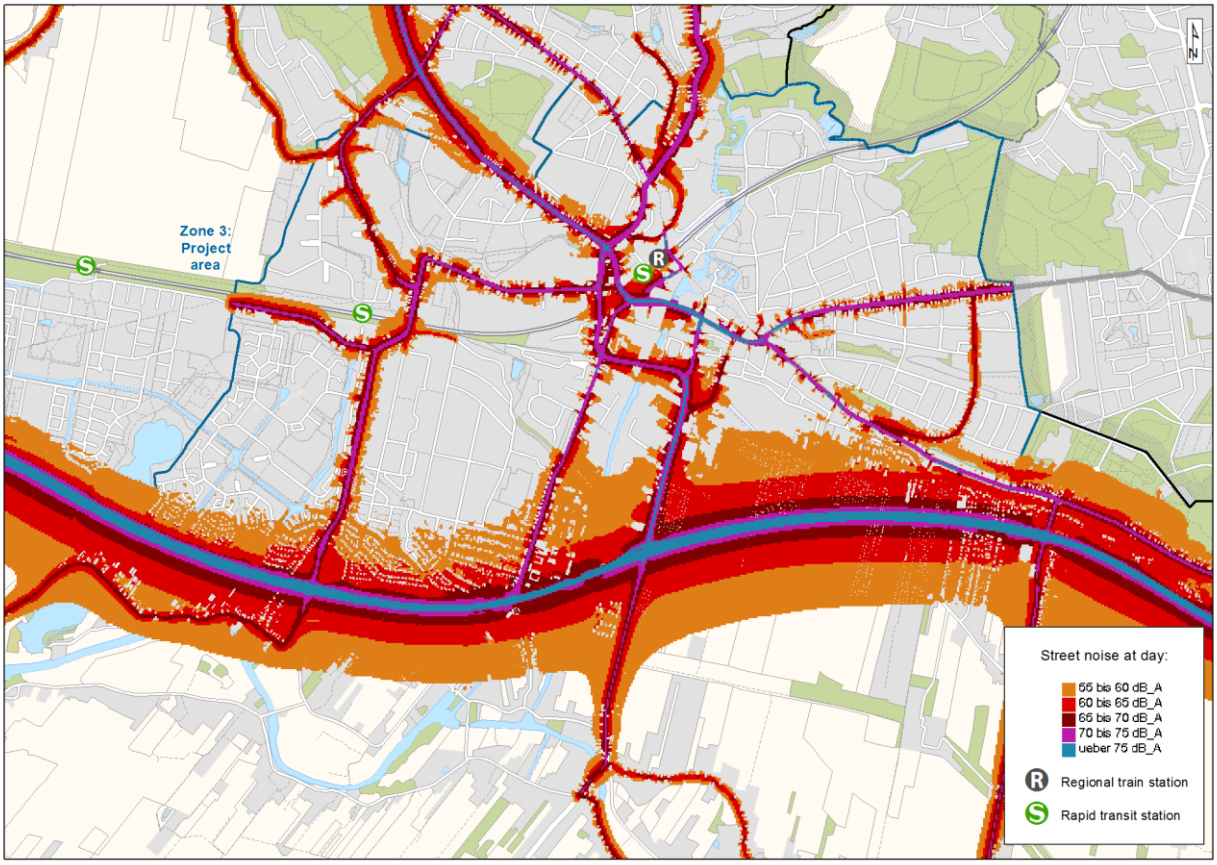

Figure 51: The traffic noise emissions at day with the motorway as major noise issuer (own design. data source WMS Straßenverkehr Hamburg (Lärmkarten)),

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11. Suitable urban infrastructures for integration

11.1 Support structures current status

11.1.1 Public infrastructure: Lighting systems, traffic cameras, Wi-Fi network

The State Agency for Roads, Bridges & Waters (project partner in mySMARTLife) operates in the area of the Borough of Bergedorf a public street lighting system that currently has about 9690 lamps, from that about 97% are installed on a lamppost.

There is only one traffic camera point to guide the car traffic from the motorway and actual no camera installed to record the bicycle traffic.

So far there exists only one public Wi-Fi in the district, which is offered by the public library. However, there are first attempts by the bus operator VHH, who offers public Wi-Fi for passengers in a fast bus line (line 31).

11.1.2 City bikes in Bergedorf

The City of Hamburg is operating a city bike service called “StadtRAD Hamburg” together with a partner company (Deutsche Bahn Connect). The service is supported by a mobile app to rent the bikes which gives information of the availability of bikes at any given station. The Borough of Bergedorf was connected to this system only very late, so that in 2017 only 6 stations are available. A higher number of these stations is desired by the local politics and administration, especially in order to increase the number of users of this system.

11.1.3 Bicycle boxes

The damaging and stealing of bicycles is a serious problem especially in a vibrant city like Hamburg. To encourage the citizens to use their bicycle on their daily way to work, the City of Hamburg has set up chargeable lockable bicycle boxes at the public transport stations (“Bike+Ride”). In Bergedorf are three stations with lockable bicycle boxes. In addition, at the Bergedorf regional station they are combined with a bicycle workshop and bikes to hire for tourists.

11.1.4 Existing multimodal traffic system “switchh”

The Hamburg transportation network (HVV) operates together with a group of car sharing companies and “StadtRAD” Hamburg a multimodal traffic platform called “switchh”. The objective is to give citizens the opportunity to decrease their use of private cars but still being mobile and flexible. Therefore, in the timetable app of the Hamburg transportation network, not only the best connections with the public transport are indicated, but also alternative routes with hired car, taxi or bicycle are suggested. With a “switchh” account it is possible to reserve the vehicles of a group of car-sharing companies (Europcar,

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car2go, DriveNow, Cambio) directly. At 14 strategic rapid transport and underground stations in Hamburg so-called switch points were created, which offer car sharing and city bikes at the same station. There is also one switchh point at the station in Bergedorf, positioned at a parking space.

11.1.5 Electric vehicles - Charging facilities

In December 2016, there are about eight public EV charging facilities in the district and an unknown number pf private charging facilities (cf. section 10.1.3). As mentioned in chapter 5.1, it is the task to raise the number of charging facilities in Hamburg with the “masterplan for charging infrastructure” rapidly in the next two years. At the moment new places for infrastructure are proved and as part of the mySMARTLife project, the supply with charging facilities in the project area should be increased significantly.

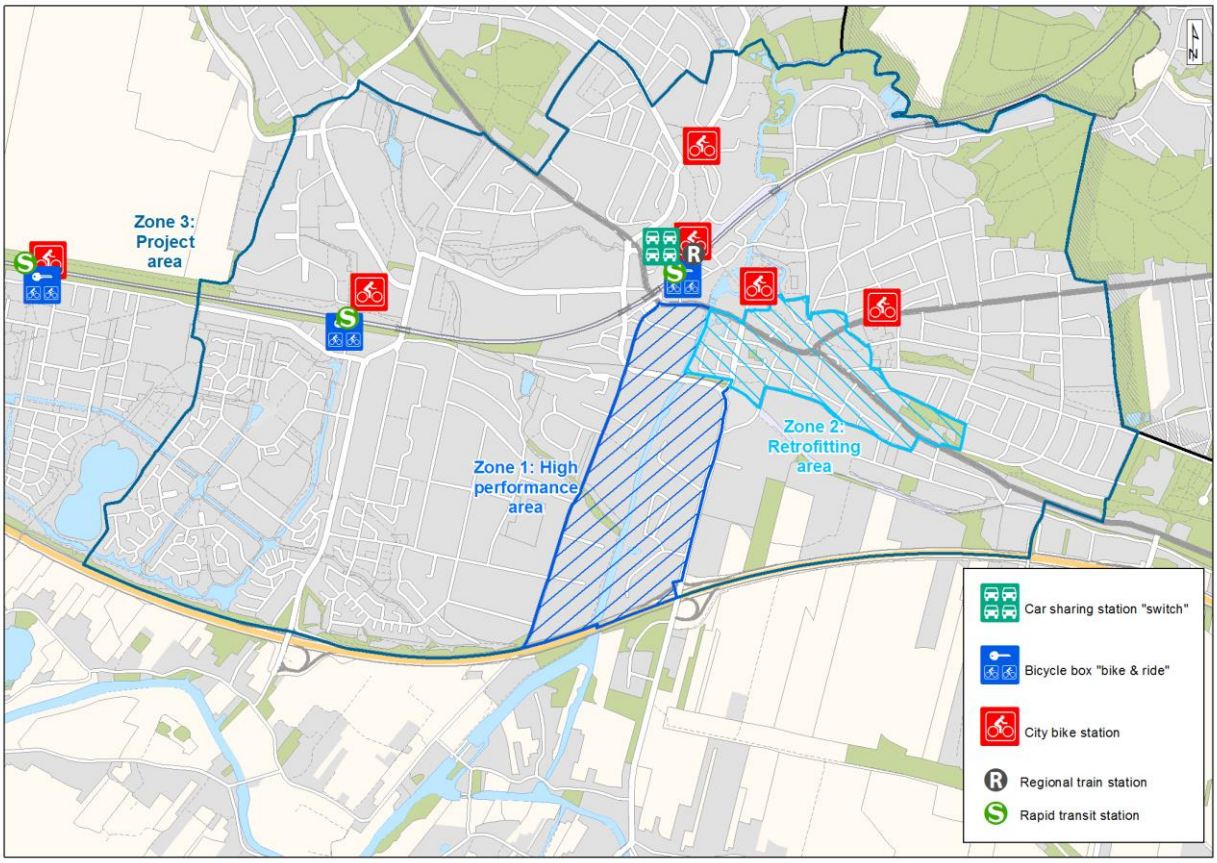

Figure 52: Charging infrastructure for electric vehicles in Bergedorf (own design)

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11.2 Identification of potential integrated infrastructures implementation

11.2.1 Heat island in Bergedorf South

In context of the „Energetische Stadtsanierung Bergedorf Süd“, a heat island approach was conceptualized to tackle primary heating energy demand of the investigated area. The main issue of the analysis, was to undertake the heating demand by retrofitting buildings by preliminary proposals of retrofitting 12 reference buildings, which portray different construction eras and materials. In addition, a decentralized district heating system was proposed (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2014).

An evaluation of major public and commercial buildings was conducted in order to establish a possible district heating network. Overall, the proposal consists of 4 active co-generators to feed the district heating network. Special buildings such as the H4 Hotel and Körber Haus Community in the west, along with Rudolf-Steiner School in the east and Bergedorf-Bille eG in the centre are eligible for solar thermic generation, whereas Glunz Immobilien GmbH near the centre of the project area is considered eligible for a geothermal heat pump generated by bio-Methane. The heat island project for Bergedorf Süd is considered fundamental to the mySMARTLife project, in terms of valuable contractor and stakeholder communication, as well as committed initiatives together.

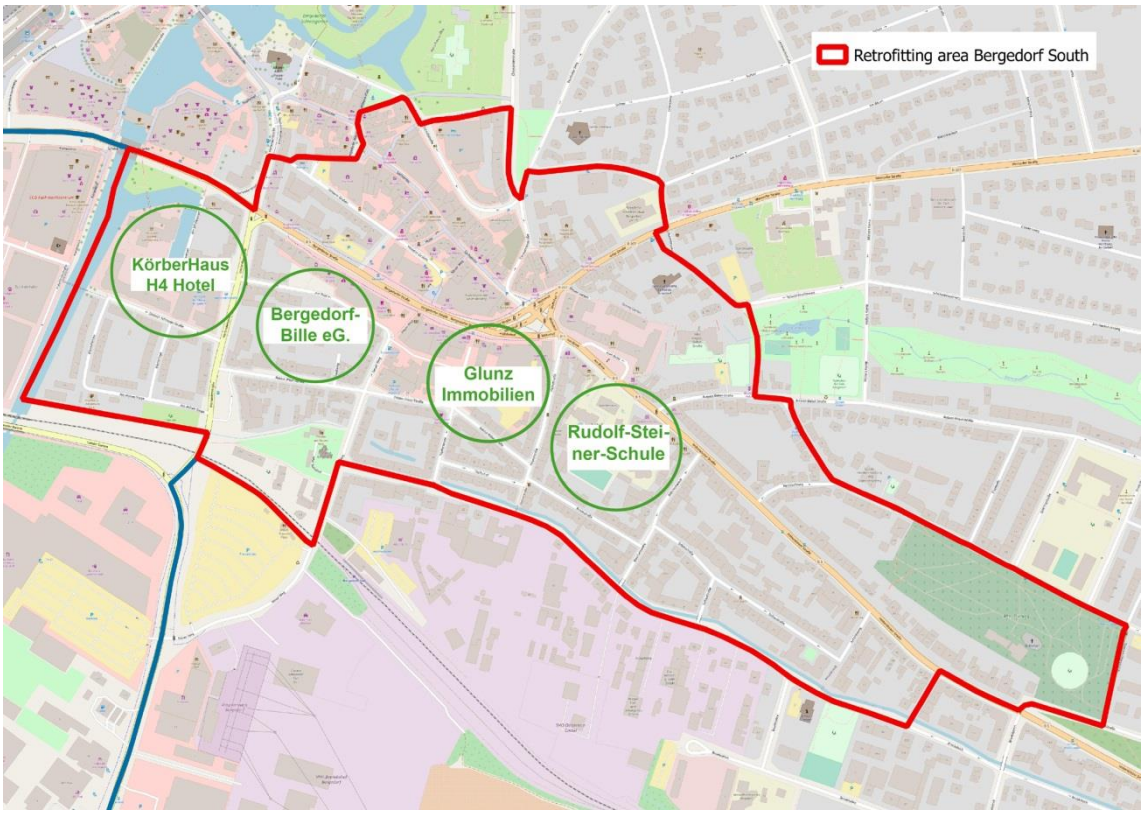

Figure 53: Concept of district heating (map: www.openstreetmap.org; konsalt GmbH)

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11.2.2 Innovative energy/ heat production at the Schleusengraben area

As part of the development area for new buildings within Hamburg's demonstration Zone 1 the planned buildings in the „Schilfpark" quarter are of special interest. The Hamburg project team intensely tries to influence the investors to build a local heating network according to newest technical standards. A densely build-up area with a planned size of 10 buildings and a total of 273 flats is an ideal fit for this type of heat supply. There are no legal requirements implemented for the Schilfpark quarter which could enforce the building of a heat network.

The latest plans for a local heat network supplying 24,579 m² of total living space account for 1977 MWh total energy consumption for heating and hot water per year, calculated and planned according to the German Energy Savings Ordinance for Buildings (EnEV, 2007). This would result in an average heat energy consumption of 80.4 kWh/a·m² compared to an average value of 124 kWh/a·m² for apartment buildings throughout Germany in 2016 (DIW, 2016).

According to current plans the local heating network shall be complemented with local PV installations to further improve local energy production. The newly released tenant supply act in Germany (which is in the process of approving by the EU commission until end 2017) allows for a larger scale of local PV power supply for tenants under economically feasible conditions. Energy efficiency shall be increased by the use of multi metering and home automation.

Also it is planned to initiate community car sharing or innovative last mile delivery solutions in order to reduce the amount of private cars and traffic in the new town quarters.

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12. Conclusion and Fields of Intervention

The following section points out what fields of intervention are anticipated by mySMARTLife Hamburg in conclusion from the city audit and in particular from the demosite baseline. It will be shown how the mySMARTLife tasks will interact and fill these fields with life.

Overall there are five fields of intervention that are dealt with within mySMARTLife Hamburg that are more or less corresponding with the WP3 tasks. By developing **energy**, **mobility** and infrastructure (here **smart points**) we have three graspable fields that are forming a smart district as part of a smart city. In addition there are two more fields cross cutting to that: **urban platform** and ICT developments as well as the **interaction** with involved stakeholder groups. In the following each field is portrayed. However, before switching over to singular fields it is crucial to mention that they are going to be developed in an integrated manner and this integration will be dealt with in the last section on **integrated planning**.

12.1 Smart energy in retrofitting and development areas

Bergedorf with a city size typical for Germany is predestined for being a living smart city lab, as it was shown in the general description of the demosite area. With new development projects like “Schleusengraben” and an interesting retrofitting area like “Bergedorf-Süd” it serves as a suitable testing area for considered intervention fields. The emphasis within the energy action field is on the usage of renewable energy sources, their integrated planning, energy storage as well as energy management and control.

For both, the retrofitting and development area different **renewable energy sources** are foreseen to be used and implemented within mySMARTLife. These are mainly solar energy (thermal energy and photovoltaics) and wind energy. Others are considered as well, such as ambient heat from surface and waste water, geothermal energy and bio mass. In addition to this, other forms of sustainable energy generation are going to be tested such as heat pumps CHPs (see section 9.2).

With this the focus is on the **integrated renewable energy generation** on building, block or even district level. The smart combination of available and adequate sources is the key for very specific solutions. Such a complex system of different energy sources requires sophisticated specification and steering algorithms.

In this context **energy storage** is a crucial element. It is needed to overcome discontinuity of renewable energy generation and to decouple generation and usage. Therefore batteries and ice storage are taken into consideration as technological solutions.

Another important factor is **management and control** including building energy management solutions (BEM) and load management of electric vehicles. With regard to BEM there are different degrees of digital

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metering systems that are going to be tested: from electronic meters over intelligent metering systems up to multi metering including power, heating and water usage. Meters are intended to serve as monitoring solution for private households and increasingly apply to housing companies, public institutions, private companies or other greater entities.

It is also anticipated to implement a **district solution for heating** (and cooling). Here also smart specification and controlling are crucial factors and thus an important element of implementation.

(This intervention field mainly corresponds with task 3.2 and 3.3 of the mySMARTLife project.)

12.2 Smart mobility - electrical and sustainable mobility

Within the mobility action field the main focus is on electric mobility (including charging), mobility concepts intermodality, last mile logistics and parking space detection.

In terms of **electric mobility**, there are different activities planned. First to mention is the electrification of public bus lines. As it was shown in section 10.1 the main public transportation in the borough is done by bus lines. At first 10 electric buses are going to be purchased. Therefore suitable charging infrastructure will be installed and the bus depot adapted accordingly. Mechanics and drivers will need adequate education for this change in technology. Furthermore, electric fleets will be introduced for public and private companies. Due to the rural structure of the borough a certain car affinity can be observed. Thus, a shift to electric cars is here a suitable solution. However, fleets will not only include electric cars but also bikes and eventually other vehicles. For public institutions and private companies the first idea is to replace vehicles of their existing fleets. In parallel it is planned to establish a fleet management system that provides transparency on driving routines and form a basis for improvement. As a second step, the number of vehicles, in particular of cars can be reduced. Likewise to the electric buses, adequate charging infrastructure with energy efficient load management will be provided.

Another important activity deals with residential areas. It is planned to develop a quarter based **mobility concept** including an e-community sharing fleet that is going to be used by residents. Again, suitable charging infrastructure will be installed. Whereas this activity focuses on quarter level, **intermodality** will be also fostered for the whole project area in the center of the Borough of Bergedorf. Besides electric cars, walking and especially biking will be focused on.

With regard to **last mile logistics** the most important topic is trunk delivery. In addition, the Borough of Bergedorf will investigate this topic in depth and try to find suitable solutions for the needs of the citizens by the help of online participation.

Last but not least, **parking space detection** will be used to provide more transparency on the availability of charging points for electric cars.

(This intervention field mainly corresponds with task 3.7 of the mySMARTLife project.)

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12.3 Smart points - urban infrastructure improvements

Regarding urban infrastructure, mySMARTLife Hamburg will develop public lighting lampposts to (so called) smart points. Again within both, the development as well as the retrofitting area, ordinary public lampposts will be amended with useful components such as WIFI, traffic measurements devices, environmental sensors.

The development area is situated at a water canal. Alongside the canal a bicycle and pedestrian route will be built. The smart points will help to raise the quality of stay e.g. with WIFI and foster security for pedestrians and cyclists. Likewise in the retrofitting area smart points with similar functions will be installed or existing lighting posts will be retrofitted.

For both areas, the equipment of smart points will be compiled according to the local conditions and needs.

(This intervention field mainly corresponds with task 3.8 of the mySMARTLife project.)

12.4 Urban platform and ICT developments

This intervention field is focusing on the use case development and creation within the other intervention fields energy, mobility and urban infrastructure. In addition the required new architecture for an Open Urban Platform (compliant to the EU MoU of EIP SCC and H2020 program) is developed. This requires the integration and enhancement of existing solutions and platforms currently available in Hamburg (legacy systems), the interaction between existing systems, and the development of new services. The other major activity is to work on the interoperability of the ICT **architecture** of this platform in accordance to the other mySMARTLife cities. This includes a smart middleware between user access and existing data platforms.

By this the mySMARTLife Open Urban Platform will serve with monitoring and steering **use case** examples for the City of Hamburg

(This intervention field mainly corresponds with task 3.5 of the mySMARTLife project.)

12.5 Smart interaction

Working in these fields of intervention necessarily requires the support of different stakeholder groups. Therefore mySMARTLife Hamburg identified four interaction goals approaching these different target groups with suitable formats. First, there is the **activation** of real estate owners, investors and local enterprises to implement smart solutions. Second, we have **citizen engagement** of local residents in order to enhance participation and citizen contributions to the mySMARTLife activities. Third, we included **institutional engagement** in order to provide room for participation for representatives of the municipality

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and politicians in mySMARTLife. Last but not least we have **information** on overall project activities targeting the general public.

Suitable formats will cover a broad range of activities including face-to-face meetings in low threshold public talks and walks, expert talks, round tables, exhibitions etc. Thereby, an innovative format of online participation will be used that provides easy and smart access for citizens to contribute their ideas and give valuable input to project activities.

(This intervention field corresponds with all task of the mySMARTLife Hamburg project.)

12.6 Integrated planning

In each intervention, field integration is one of the key aspects. Likewise this applies to an overarching level.

In particular in the fields of energy, urban infrastructure and mobility an integrated planning is imperative.

The power demand of an extensive deployment of electric vehicles strongly interacts with the configuration of energy supply and demand systems on building, block, district and city level. Here, mySMARTLife Hamburg will contribute e.g. with insights in the fields of load management for electric cars and for e-buses.

Public and private decision makers are quite often the same for these action fields. Within the administration urban planning departments are responsible for developing binding land use plans that can be powerful instruments to steer energy, urban infrastructure and mobility issues. MySMARTLife Hamburg will evaluate current planning processes and suggestions for their improvement will be made and encouraged. In addition to the involved administration other municipal authorities in Hamburg will also benefit from gained learning effects. Regarding the big Hamburg housing program (see section 5.1.3 and section 8.5) Valuable experiences will be made as well as for future developing projects such as Oberbillwerder. In consequence, these learning effects are going to be a main aspect of inner city replication.

Both cross cutting action fields “Urban Platform and ICT developments” and “interaction” naturally have an integrating function.

A smart city requires the integration of different “vertical” solutions of domains like mobility and energy. To gain more than just a digitized vertical, a horizontal IT system like an urban platform is required. Such an urban platform provides the opportunity of data integration of various verticals, smart data analytics and thus the creation of more valued services towards the city and its citizens.

Regarding interaction, the integrating function is fulfilled in almost all formats and targets. For example public talks and walks will cover all the action fields mentioned above. Within the first event series of talks (4 events, one every 2 months) all action fields are covered. Another example is the initiation of a research

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and development cluster in one of the development areas. During the initial event all action fields were presented.

In summary it can be stated that the concept of integrated planning is the one guiding principle in the upcoming phase of implementation in mySMARTLife Hamburg.

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PART III: Hamburg demonstrator area baseline

13. Buildings and district energy audit

13.1 District building characterisation

The Borough of Bergedorf has a dual settlement structure. The central districts of Bergedorf are densely built and offer, especially around the Bergedorf train station, an inner city area with many catering and retail offers. The southern part of the Borough has a high proportion of agricultural areas and nature reserves with a low density of loosely built one- and two-family detached house structures.

This situation offers a great variety of spatial structures and types of housing areas, which means, that even Bergedorf is a part of the large city Hamburg, its spatial structure is typical for a middle sized German city. This ranges from the villa-housing development from the Wilhelminian era to the settlements of the 20's to 50's until the large housing estates established in the 60s.

13.2 Retrofitting area – Buildings characterisation

Bergedorf-Süd is situated in the Southeast of Hamburg and located to the railway station of Bergedorf. The area of the quarter is approximately 35 ha, which harbours the central shopping district located in the historical centre and the residential area to its south eastern border. With roughly 5.000 inhabitants, Bergedorf-Süd is a steady growing quarter in the borough. Most recently within the project of "Energetische Stadtsanierung Bergedorf-Süd" (tr. Energy Efficient City Retrofitting Bergedorf-Süd) in 2013, a limited area starting from the H4 Hotel until the St. Michael Church in the south of the Bergedorf quarter was evaluated in terms of energy efficient retrofitting. The installation of the refurbishment management has been taking place according to concept since 2014, which will finalise until the end of 2017.

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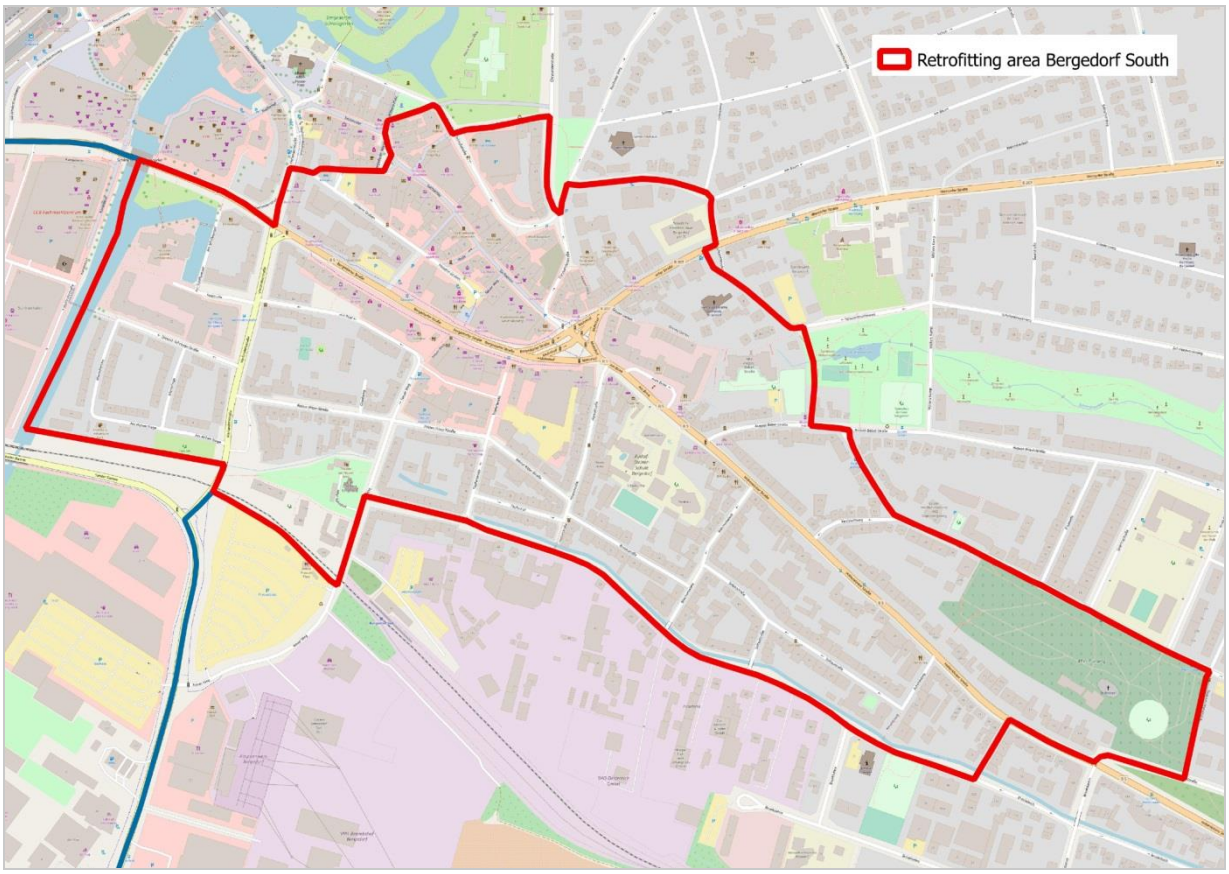

Figure 54: Bergedorf-Süd (map: www.openstreetmap.org; konsalt GmbH)

13.2.1 Cityscape and architecture

The area includes a variety of architectural styles as these different eras of facades are represented by schools from Wilhelminian Style to contemporary buildings, in which a retrofitting concept had been based on their diversity and historical merit. Most commonly, the buildings in the area are no more than 11,5m high, where a large fraction are multi storey and brick buildings, standing in harmony with the cityscape. Furthermore, about 12% of the evaluated area is under protection where the historical value of the buildings are preserved and listed as monuments. As for the rest of the buildings, although they have not been identified as monuments, they nonetheless convey significant historical importance from 1920s to present-day.

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Figure 55: Buildings at the Soltaustraße (source: konsalt GmbH)

Towards the north-western section of the district, the shopping street Sachsentor accommodates a chain of 2-storey buildings where it is a predominantly commercial and pedestrian area.

Furthermore, a mixed-use development is visible towards the centre of the research area, where commercial buildings transition to residential built-up space with the Rudolf-Steiner school in its centre. Furthermore, the southern spectrum of the district harbours multi storey buildings, which represent a fully residential area along the creek near Brookdeich. Aside from single family, terraced and multi-family buildings with residential and commercial purposes, the area consists of a small quantity of public buildings, where multiple civic centre points are scattered around the project area, acting as social hubs for the residents.

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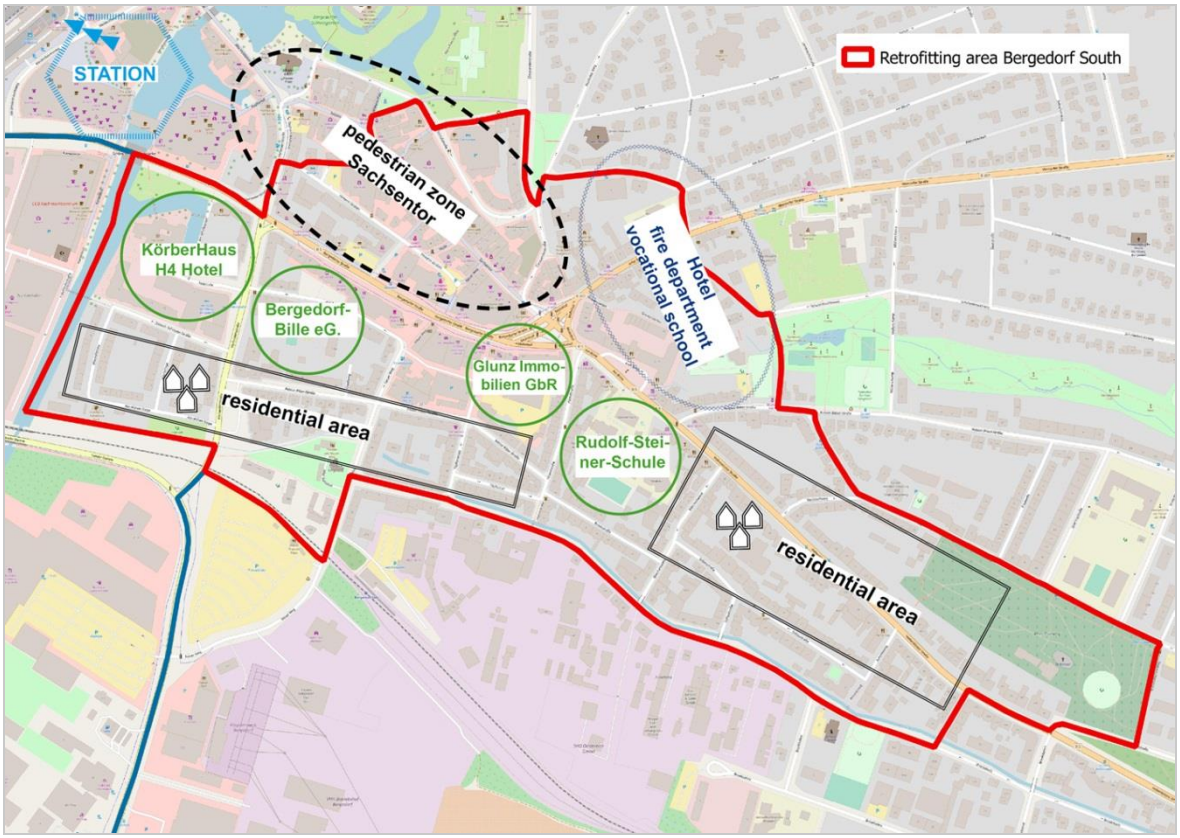

Figure 56: Project area Bergedorf-Süd (map: www.openstreetmap.org; konsalt GmbH)

Today, it is documented that almost half of the buildings in the project area were built before 1950s. During that period, due to architectural restraints, the exterior walls of buildings were built between 36-48 cm deep, whereas the rest of the buildings convey other properties of their years constructed, in opposition to their predecessors constructed with thinner external walls. These characteristics impart the existing state of previous retrofitting, partially due to regulations in early 1990s within the frame of climate protection goals; where up to 24% of the facades in the signified area were either fully or partially retrofitted. In addition, almost every building bear a modernised roof and a large number of these buildings have upgraded from single glazed to double glazed windows.

13.2.2 Energy demand

The heat supply in the area is mainly based on natural gas and to a small extent on night storage heaters (NSH). No data are available on other energy sources for heat supply. In consultation with the district chimneysweeper, the estimated share of other energy sources for 2010 amounted to 3%.

The area is developed through a low-pressure gas network with an overpressure of approx. 60 mbar prevailed in the distribution network, where the house connections are supplied with an overpressure of 23 mbar.

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13.3 High Performance area – Buildings characterisation

The watercourse ”Schleusengraben” and its adjacent areas, which so far played only a minor role in the consciousness of the Bergedorf citizens, has an important function as an link between the urban and the rural Bergedorf. Here highly attractive development areas are located on former old industrial areas. They will benefit from the location advantages of the near town centre, the waterfront location and on the nearby motorway. The backbone and visible link of the developments is the watercourse, with more than 2000 new residential units along its shores. In addition a new bridge in the centre is planned and pedestrian and bicycle connections on the west side of the water. The aim is not only to connect the development area with the centre of Bergedorf, but also to create an attractive continuous cycling and walking connection from the Bergedorf centre to its rural area for the first time.

In the north of these development axis will in a predestined and very central location, with the so-called "Körber Haus" a multifunctional cultural building build up, that various uses such as a theatre, rooms for seniors, a library and a public café will include.

In the following development areas are portrayed in detail Figure 58 and **Figure** 59 show two of the development areas. Figure 57 shows them all on a map.

Figure 57: Planning Schleusengraben (Source: dreidesign in Bergedorfer Zeitung, 2017)

Figure 58: Glasbläserhöfe I (Source: konsalt GmbH)

13.3.1 Bergedorfer Tor

The project “Bergedorfer Tor” provides for a mixed-use district with different forms of living (80 flats in a multi-storey residential building as well as senior citizens' home), offices and a health centre on a former area of the German post in the central urban area of Bergedorf. The construction of the buildings should start in 2018.

13.3.2 Stuhlrohrquartier

Right on the other side of the street, the so-called "Stuhlrohrquartier" is currently being planned as a densely populated urban quarter with about 1100 residential units. The plan is scheduled to start in 2018,

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with still a lot of topics to be coordinated, such as the mobility concept, planning open spaces or energy supply.

13.3.3 Glasbläserhöfe

In the area of “Glasbläserhöfe I”, named after a former Glass factory, is currently a mixed-use district for a total of about 490 residential units with different forms of living, a school, kindergarten, craft and other commercial uses under construction and almost completed. In the northern direction - the area is called “Glasbläserhöfe II” - is also a mixed used quarter in the development. The completion is expected in 2019.

13.3.4 Weidensteg

A few meters in the south, and thus in a central location on the west side of the “Schleusengraben axis”, is the Quartier “Wohnen am Weidensteg” in which in the next few years approx. 540 flats will be built. Here, a mix of family-friendly apartments with other forms of living for different types of residents is added. In the historical and characteristic halls located here in the quarter, a local shopping centre with a market hall character will be built for the future inhabitants of the new neighbourhoods along the “Schleusengraben axis”. The Construction should also start in 2018.

13.3.5 Schilfparkquartier

On the east side of the water body in the so-called "Schilfparkquartier", the construction of about 360 residential units and a not inconsiderable share of commercial uses has started. In the recent past, mainly companies from the field of technology have settled here, so that this quarter will also be part of a future research and development park with a Hamburg-wide appeal. In addition to the HAW energy campus (project partner in mySMARTLive), an institute of the Fraunhofer Gesellschaft, the life science company GALAB, and a research facility of Siemens is also located here.

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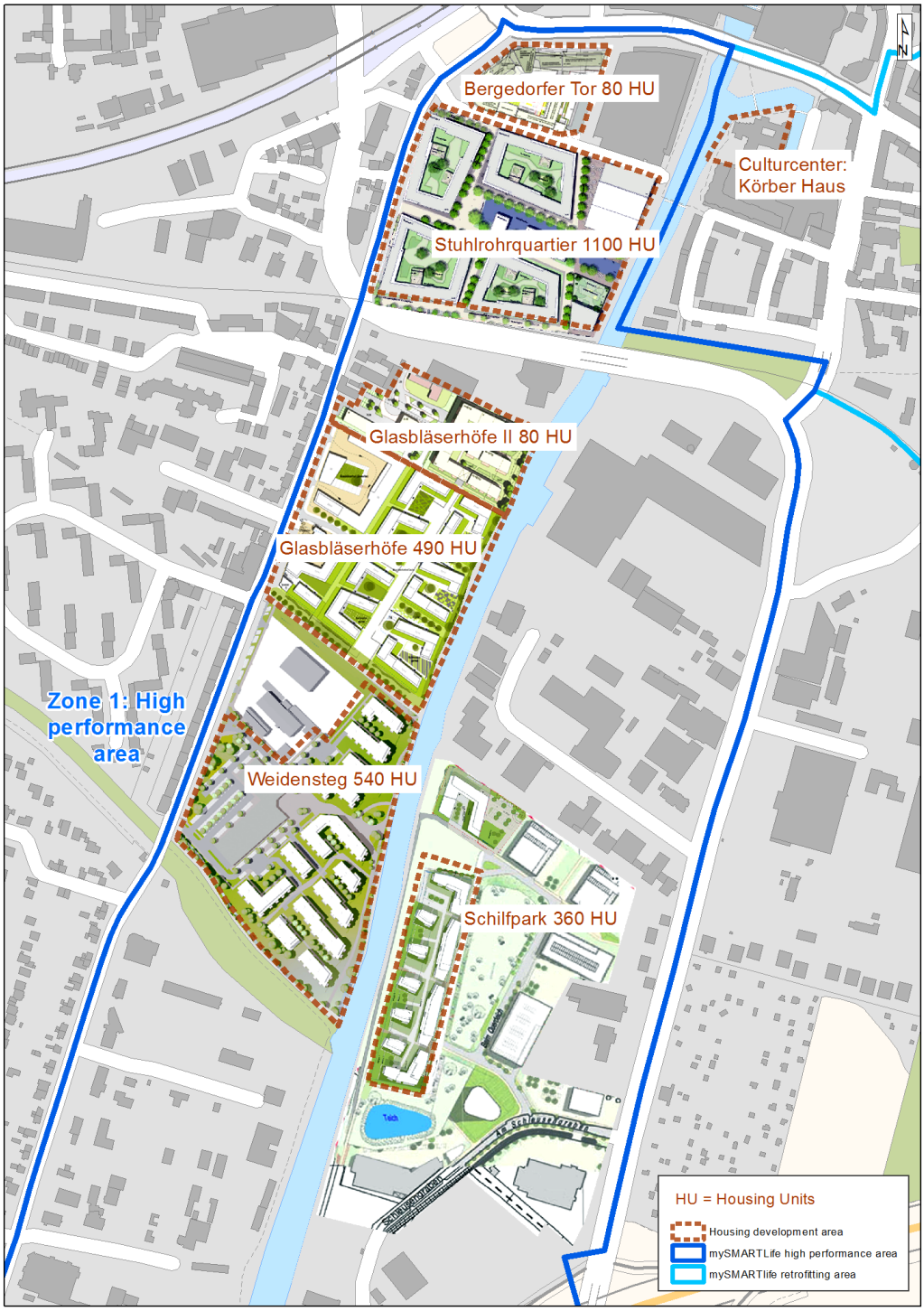

Figure 59: The high performance area of the project along the "Schleusengraben-axis" with a figure of the planned buildings of the actual development areas, taken from several plans (own design)

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13.4 Energy demand

According to the current status, the new buildings in the area of the Schleusengraben axis are planned by their investors to the actual building standard according to the German Energy Savings Ordinance for Buildings (EnEV). The plan of the project mySMARTLife is, to communicate with all different investors and to convince them to develop their buildings with innovative infrastructures such as multi metering, low ex district heating networks, energy storages or smart homes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

14. References

Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH (2014): Energetische Stadtsanierung Bergedorf-Süd. Available at: http://konsalt.de/wp-content/uploads/2014/06/2014-02-17-Endbericht-Bergedorf-Sued.pdf [26.10.2017]

Argus (2017). Radverkehrskonzept für den Bezirk Bergedorf, Erläuterungsbericht. Available at: http://www.hamburg.de/contentblob/8946728/864033284f0d962c04364edd37545512/data/rvk-erlaeuterungsbericht-do.pdf [10.07.2017]

Bergedorfer Zeitung (2017). Available at: https://www.bergedorfer-zeitung.de/bergedorf/article210872203/Bald-Baustart-fuer-370-neue-Wohnungen.html [09.11.2017]

BeschA (n.d). Beschaffungsamt des Bundesministeriums des Innern. Available at: http://www.bmi.bund.de/SharedDocs/Behoerden/DE/bescha_einzel.html [12.07.2017]

Bezirk Bergedorf (2013). „Verkehrskonzept für Bergedorf“ (Entwurf) Stand: 05. November 2013. Unpublished source.

BMUB (2016). Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, Climate Action Plan 2050 - Principles and goals of the German government's climate policy. Available at: http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutzplan_2050_kurzf_en_bf.pdf [10.07.2017]

BMUB (2017). Umweltfreundliche öffentliche Beschaffung. Available at: http://www.bmub.bund.de/themen/wirtschaft-produkte-ressourcen-tourismus/produkte-und-umwelt/umweltfreundliche-beschaffung/ [12.07.2017]

BMWI (2014). Bundesministerium für Wirtschaft und Innovation, Mehr aus Energie machen - Nationaler Aktionsplan Energieeffizienz. Available at: http://www.bmwi.de/Redaktion/DE/Publikationen/Energie/nationaler-aktionsplan-energieeffizienz-nape.pdf?__blob=publicationFile&v=6 [10.07.2017]

BMWI (2017). Bundesministerium für Wirtschaft und Innovation, Energiedaten: Gesamtausgabe. Available at: https://www.bmwi.de/Redaktion/DE/Binaer/Energiedaten/energiedaten-gesamt-xls.xls?__blob=publicationFile&v=61 [09.11.2017]

BMWI (n.d.). Website: Dossier, Öffentliche Aufträge und Vergabe. Available at: https://www.bmwi.de/Redaktion/DE/ Dossier/oeffentliche-auftraege-und-vergabe.html [12.07.2017]

BVBS (2012). Bundesministerium für Verkehr, Bau und Stadtentwicklung - Planung von Großvorhaben im Verkehrssektor, Handbuch für eine gute Bürgerbeteiligung, Berlin. Available at:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

https://www.bmvi.de/SharedDocs/DE/Anlage/VerkehrUndMobilitaet/handbuch-buergerbeteiligung.pdf?__blob=publicationFile [11.07.2017]

Die Bunderegierung (2017). Website: Die Energiewende. Available at: https://www.bundesregierung.de/Content/DE/StatischeSeiten/Breg/Energiekonzept/0-Buehne/ma%C3%9Fnahmen-im-ueberblick.html [10.07.2017]

DIW (2016). DIW Wochenbericht Nr. 38/2017, Wärmemonitor 2016. Avaiable at: https://www.diw.de/documents/publikationen/73/diw_01.c.564837.de/17-38.pdf [09.11.2017]

EnEV (2007). Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden. Available at: https://www.gesetze-im-internet.de/enev_2007/index.html [09.11.2017]

Feindt, P.H. (2009). Gestaltungskriterien und Leistungsanforderungen für diskursive Verfahren. In: Ley, A.; Weitz, L. (eds.): Praxis Bürgerbeteiligung. Ein Methodenhandbuch. Bonn: Stiftung MITARBEIT, Agentur für Nachhaltigkeit GmbH, pp. 291-299

FHH (2007). Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Umwelt, Räumliches Leitbild (Entwurf) – Wachsende Stadt, grüne Metropole am Wasser. Available at: http://www.hamburg.de/contentblob/155068/65b62ad9195e940e29ed0453626acd90/data/raeumliches-leitbild.pdf [10.07.2017]

FHH (2010). The Free and Hanseatic City of Hamburg, Ministry of Urban Development and the Environment, available at: http://www.hamburg.de/gruenes-netz/3907750/karte/ [10.07.2017]

FHH (2012). Freie und Hansestadt Hamburg, Amt für Natur- und Ressourcenschutz, Grüne Vielfalt – Qualität der Stadt, Strategie für die Entwicklung der Biodiversität. Available at: http://www.hamburg.de/contentblob/3809296/91944b054c2e229293cb55341cec8d3e/data/broschuere-gruene-vielfalt-qualitaet-der-stadt.pdf [12.07.2017]

FHH (2012b). Eignungsgebiete für Windenergieanlagen in Hamburg. Available at: http://www.hamburg.de/contentblob/3341712/5280e2060968ffb0788f5320b549d5e9/data/f-xx-xx-wea-praesentation-ag-cu-eignungsgebiete.pdf [09.11.2017]

FHH (2013a). Freie und Hansestadt Hamburg, Behörde für Wirtschaft und Innovation, Mobilitätsprogramm 2013 - Grundlage für eine kontinuierliche Verkehrsentwicklungsplanung in Hamburg. Available at: http://www.hamburg.de/bwvi/mobilitaetsprogramm/ [10.07.2017]

FHH (2013b). Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Umwelt, Lärmaktionsplan Hamburg 2013 (Stufe 2). Available at: http://www.hamburg.de/laermaktionsplan/ [10.07.2017]

FHH (2013c): Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Umwelt - Hamburg gemeinsam gestalten, Bürgerbeteiligung und -information in der Stadtentwicklung. Available at:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

http://www.hamburg.de/contentblob/4126596/bf525e93e4ff197547a5fd2962934777/data/broschuere-buergerbeteiligung.pdf [11.07.2017]

FHH (2014). Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Umwelt (BSU), Green, inclusive, growing city by the water - Perspectives on Urban development in Hamburg. Available at: http://www.hamburg.de/contentblob /4357518/9ac11792edd8de17e3119e1396474718/data/broschuere-perspektiven-englisch).pdf [10.07.2017]

FHH (2015a). Freie und Hansestadt Hamburg, Bezirksamt Bergedorf, Integriertes Klimaschutzkonzept Bergedorf. Available at: https://www.klimazeichen-bergedorf.de/herzlich-willkommen/klimaschutzkonzept/ [10.07.2017]

FHH (2015b). Freie und Hansestadt Hamburg, Bezirksamt Bergedorf/Bezirksversammlung, Drucksachen–Nr.: 20-0582.1, Änderungsantrag Erstellung eines bezirklichen Entwicklungskonzepts mit Wohnungsbauprogramm. Available at: https://sitzungsdienst-bergedorf.hamburg.de/bi/ tmp/tmp/4508103638588 2925/385882925/01021888/88.pdf [10.07.2017]

FHH (2015c). Freie und Hansestadt Hamburg, Bürgerschaft der Freien und Hansestadt Hamburg, Drucksache 21/2521, Mitteilung des Senats an die Bürgerschaft, Hamburger Klimaplan. Available at: http://www.hamburg.de/hamburger-klimaplan.pdf [10.07.2017]

FHH (2016a). Freie und Hansestadt Hamburg, Behörde für Umwelt und Energie, Hamburg – European Green Capital: 5 Years On. Available at: http://ec.europa.eu/environment/europeangreencapital/wp-content/uploads/2011/04/Hamburg-EGC-5-Years-On_web.pdf [10.07.2017]

FHH (2016b). Website: Parliamentary Paper, Exploiting purchasing power to help meet environmental goals. Available at: http://www.hamburg.de/pressearchiv-fhh/5172960/2016-01-19-bue-green-procurement-guidelines/ [12.07.2017]

FHH (2016c). Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Wohnen, Available at: http://www.hamburg.de/sozialmonitoring/8519710/sozialmonitoring-bericht2016/ [06.11.2017]

FHH (2017a). Freie und Hansestadt Hamburg, Bezirksamt Bergedorf, Wohnungsbauprogramm 2017. Available at: http://www.hamburg.de/contentblob/8426948/219613724a51362615e9cca1e9f40bf4/data/wohnungsbauprogramm-2017.pdf [10.07.2017]

FHH (2017b). Freie und Hansestadt Hamburg, Behörde für Umwelt und Energie, Luftreinhalteplan für Hamburg (2. Fortschreibung) (Entwurf). Available at: http://www.hamburg.de/contentblob/9024022/7dde37bb04244521442fab91910fa39c/data/d-lrp-2017.pdf [10.07.2017]

FHH (2017c). Freie und Hansestadt Hamburg, Behörde für Umwelt und Energie, Website: Emissionen in Hamburg Energie-und CO_2-Bilanz. Available at: http://www.hamburg.de/co2-bilanz-hh/ [06.11.2017]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

FHH (2017d). Freie und Hansestadt Hamburg, Behörde für Umwelt und Energie, Website: Wasserwirtschaft in Hamburg - Aktuelles. Available at: http://www.hamburg.de/wasser [10.07.2017]

FHH (2017e). Frei und Hansestadt Hamburg, Senatsdrucksache 21/9700, 21. Wahlperiode vom 04.07.17. Available at: http://www.buergerschaft-hh.de/ParlDok/dokument/58508/umsetzung-der-nachhaltigkeitsziele-der-vereinten-nationen-in-hamburg.pdf [12.07.2017]

FHH (2017f). Freie und Hansestadt Hamburg, Website: Ladeinfrastruktur. Available at: http://www.hamburg.de/ladeinfrastruktur/ [10.07.2017]

FHH (2017g). Freie und Hansestadt Hamburg, Website: Digitalisierung der großen Stadt. Available at: http://www.hamburg.de/digitalisierung/ [10.07.2017]

FHH (2017h). Freie und Hansestadt Hamburg, Website: Strategische Lärmkartierung - Lärmkarten. Available at: http://www.hamburg.de/laermkarten/ [10.07.2017]

FHH (2017i). Freie und Hansestadt Hamburg. Available at: http://www.hamburg.de/contentblob/3476512/e5a7c96b564a16578f2d675d4b9dfc9f/data/lden-strasse-2012.pdf [10.07.2017]

FHH (2017k). Freie und Hansestadt Hamburg. Wärmekataster. Available at: http://www.hamburg.de/energiewende/waermekataster/ [09.11.2017]

FHH (2017l). Radverkehrsförderung. Available at: http://www.hamburg.de/hamburg-auf-dem-weg-zur-fahrradstadt/5691428/radverkehrskoordinator/ [09.11.2017]

FHH (2017m). Biomassen mobilisieren - Energie gewinnen. Studie zum Biomassepotential in der Freien und Hansestadt Hamburg. Mai 2009 (erstellt von projects energy gmbh). Available at:http://www.hamburg.de/contentblob/3978800/9c03b523a6bc9e77f95e4d06954f1ea3/data/biomassestudie.pdf [09.11.2017]

FHH (n.d.). Elektromobilität in Hamburg. Available at: http://www.hamburg.de/contentblob/4612214/1c1c590ad1f3faa1f2ff6d82db95a913/data/elektromobilitaet-in-hamburg.pdf [09.11.2017]

FHH (n.d.). The Free and Hanseatic City of Hamburg, Ministry of Urban Development and the Environment, GrünesNetzHamburg, The Landscape Programme Hamburg. Available at: http://www.hamburg.de/contentblob/3908156/218f43663b3aa2da43df790c40508081/data/erlaeuterungen-freiraumver-engl.pdf [10.07.2017]

Graichen (2017). Patrick Graichen, Mara Marthe Kleiner, Christoph Podewils, AGORA - Die Energiewende im Stromsektor: Stand der Dinge 2016, BERLIN, 5. JANUAR 2017. Available at: https://www.agora-energiewende.de/fileadmin/Projekte/2017/Jahresauswertung_2016/Die_Energiewende_im_Stromsektor_2016_DE.pdf [11.07.2017]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Lak (2017). Länderarbeitskreis Energiebilanzen. Available at: http://www.lak-energiebilanzen.de/energiebilanzen/ [11.07.2017]

New 4.0 (2017). Website: http://www.new4-0.de/ [01.11.2017]

Renkamp, A. ; Tillmann, C. (Bertelsmann Stiftung) (ed.) (2013): Bürger beteiligen! Strategien, Praxistipps und Erfolgsfaktoren für eine neue Beteiligungskultur in Behörden. Gütersloh: Verlag Bertelsmann Stiftung

Solar offensive Hamburg (2017). Website: http://solaroffensive-hamburg.de/die-solaroffensive/ [01.11.2017]

Statistikamt Nord (2010a). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Schleswig-Holstein und Hamburg 2009 – Anteil erneuerbarer Energie in Schleswig-Holstein nahezu konstant, *Statistik informiert Nr. 125/2010.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI10_125.pdf [11.07.2017]

Statistikamt Nord (2010b). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Schleswig-Holstein und Hamburg 2009 – Erneuerbare Energien weiter im Aufwärtstrend, *Statistik informiert Nr. 23/2010.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI10_023.pdf [11.07.2017]

Statistikamt Nord (2011). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Schleswig-Holstein und Hamburg 2010 – Mehr Strom aus Biogas, *Statistik informiert Nr. 147/2011.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI11_147.pdf [11.07.2017]

Statistikamt Nord (2012). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Hamburg 2011 – Deutlich mehr Strom aus Photovoltaik, *Statistik informiert Nr. 149/2012.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI12_149.pdf [11.07.2017]

Statistikamt Nord (2013). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Hamburg 2012 – Deutlich mehr Strom aus Photovoltaik, *Statistik informiert Nr. 198/2013.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI13_198.pdf [11.07.2017]

Statistikamt Nord (2014). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Hamburg 2013 – Deutlich mehr Strom aus Biogas, *Statistik informiert Nr. 187/2014.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI14_187.pdf [11.07.2017]

Statistikamt Nord (2015a). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Hamburg 2014 – Deutlich mehr Strom aus Kohle, *Statistik informiert Nr. 191/2015.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI15_191.pdf [11.07.2017]

Statistikamt Nord (2015b). Statistisches Amt für Hamburg und Schleswig-Holstein – Energiebilanz und CO2-Bilanzen für Hamburg 2015. Available at https://www.statistik-

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

nord.de/fileadmin/Dokumente/Sonderver%C3%B6ffentlichungen/Energie-_und_CO2-Bilanz_Hamburg/EB_CO2_HH_2015.xlsx [09.11.2017]

Statistikamt Nord (2016a). Statistisches Amt für Hamburg und Schleswig-Holstein – Hamburger Stadtteil-Profile 2016, *NORD.regional Band 18.* Available at: https://www.statistik-nord.de/presse-veroeffentlichungen/nord.regional/ [26.10.2017]

Statistikamt Nord (2016b). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord), In Hamburg geborene Bürgerinnen und Bürger 2015 – 44 Prozent in der Hansestadt geboren, *Statistik informiert Nr. 107/2016.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI16_107.pdf [19.06.2016]

Statistikamt Nord (2016c). Statistisches Amt für Hamburg und Schleswig-Holstein – Stromerzeugung in Hamburg 2015, *Statistik informiert Nr. 181/2016.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Presseinformationen/SI16_181.pdf [11.07.2017]

Statistikamt Nord (2017a). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord), Statistisches Jahrbuch Hamburg 2016/2017. Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Jahrb%C3%BCcher/Hamburg/JB16HH_Gesamt_Internet_min.pdf [19.06.2017]

Statistikamt Nord (2017b). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord) (Ed.), Bevölkerung in Hamburg am 31.12.2016, *Statistische Berichte, Kennziffer: A I/S 1 – 16 HH.* Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Statistische_Berichte/bevoelkerung/A_I_S_1_j_H/A_I_S1_j16.pdf [19.06.2017]

Statistikamt Nord (2017c). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord), Facts and Figures. Available at: https://www.statistik-nord.de/fileadmin/Dokumente/Faltbl%C3%A4tter/Faltblatt_Stadtportrait_2016_E_Internet.pdf [07.11.2017]

Statistikamt Nord (2017d). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord), Monatszahlen Bevölkerungsfortschreibung, Available at: https://www.statistik-nord.de/zahlen-fakten/bevoelkerung/monatszahlen/?inputTree%5B%5D=c%3A2&prevInputTree%5B%5D=c%3A2&inputTree%5B%5D=t%3A1&prevInputTree%5B%5D=t%3A1&filter%5Blocation%5D=2&showAllYears=&filter%5BadditionalTopics%5D [07.11.2017]

Statistikamt Nord (2017e). Statistisches Amt für Hamburg und Schleswig-Holstein – Anstalt des Öffentlichen Rechts (Statistikamt Nord), Bevölkerungsfortschreibung Monatszahlen, Available at: https://www.statistik-nord.de/zahlen-fakten/erwerbstaetigkeit-verdienste-arbeitskosten/monatszahlen/?inputTree%5B%5D=c%3A5&prevInputTree%5B%5D=c%3A5&inputTree%5

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

B%5D=c%3A8&prevInputTree%5B%5D=c%3A8&inputTree%5B%5D=t%3A31&prevInputTree%5B%5D=t%3A31&filter%5Blocation%5D=2&showAllYears=&filter%5BadditionalTopics%5D=&filter%5BadditionalTopics%5D%5B%5D=33&filter%5BadditionalTopics%5D%5B%5D=37&filter%5BadditionalTopics%5D%5B%5D=38 [07.11.2017]

Statistikamt Nord (2017f). Statistisches Amt für Hamburg und Schleswig-Holstein – Neuzulassungen und Bestand von PKW in Hamburg 2016 – Mehr Benziner weniger Diesel zugelassen, *Statistik informiert Nr. 95/2017.* Available at: https://www.statistik-nord.de/zahlen-fakten/transport-verkehr/strassenverkehr/dokumentenansicht/neuzulassungen-und-bestand-von-pkw-in-hamburg-2016-59684/

Statistische Ämter des Bundes und der Länder (2017a), Statistische Ämter des Bundes und der Länder – Volkswirtschaftliche Gesamtrechnung der Länder VGRdL, Aktuelle Ergebnisse, Bruttoinlandprodukt, Available at: http://www.vgrdl.de/VGRdL/tbls/tab.jsp?rev=RV2014&tbl=tab01&lang=de-DE [08.11.2017]

Statistische Ämter des Bundes und der Länder (2017b), Statistische Ämter des Bundes und der Länder – Volkswirtschaftliche Gesamtrechnung der Länder VGRdL, Aktuelle Ergebnisse, Bruttoinlandprodukt, Available at: http://www.vgrdl.de/VGRdL/tbls/tab.jsp?rev=RV2014&tbl=tab01&lang=de-DE [08.11.2017]

Stromnetz Hamburg (2017). Energieportal. Available at: http://www.energieportal-hamburg.de/distribution/energieportal/ [10.07.2017]

Umweltbundesamt (2014). Regelungen der Bundesländer auf dem Gebiet der umweltfreundlichen Beschaffung. Available at: https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/texte_44_2014_regelungen_der_bundeslaender_beschaffung_korr.pdf [12.07.2017]

Umweltbundesamt (2017). Indicator: Renewable energy. Available at: https://www.umweltbundesamt.de/en/indicator-renewable-energy

Wikipedia (2017). Metropolregion Hamburg. Available at https://upload.wikimedia.org/wikipedia/commons/2/21/Metropolregion_Hamburg_2017.png [09.07.2017

Zukunftsrat Hamburg (2016). Hamburger Entwicklungs-Indikatoren Zukunftsfähigkeit. Available at: http://www.zukunftsrat.de/fileadmin/HEINZ_2016_DRUCK.pdf [10.07.2017]

Referenced laws and regulations:

BauGB: Baugesetzbuch. Available at: https://dejure.org/gesetze/BauGB [11.07.2017]

GWB: Gesetz gegen Wettbewerbsbeschränkungen. Available at: http://www.gesetze-im-internet.de/gwb/ [12.07.2017]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

VergRModG: Vergaberechtsmodernisierungsgesetz. Available at: www.bgbl.de/xaver/bgbl/start.xav?startbk=Bundesanzeiger_BGBl&start=//*[@attr_id=%27bgbl116s0203.pdf%27]#__bgbl__%2F%2F*%5B%40attr_id%3D%27bgbl116s0203.pdf%27%5D__1499928150007 [12.07.2017]

VgV: Verordnung über die Vergabe öffentlicher Aufträge. Available Aa: http://www.gesetze-im-internet.de/vgv_2016/index.html [12.07.2017]

VoB/A: Vergabe- und Vertragsordnung für Bauleistungen Teil A. Available at: https://dejure.org/gesetze/VOB-A [12.07.2017]

VoL/A: Vergabe- und Vertragsordnung von Leistungen Teil A. Available at: https://www.bmwi.de/Redaktion/DE/Downloads/V/vol-a-abschnitt-1.pdf?__blob=publicationFile&v=4 [12.07.2017]

Datasources of Web Map Services

WMS HVV Streckennetz [09.11.2017]
http://extmap.hbt.de/geoserver/geofox_workspace/wms?REQUEST=GetCapabilities&SERVICE=WMS

WMS Solarpotenzialflächen Hamburg [09.11.2017]
https://geodienste.hamburg.de/HH_WMS_Solaratlas?REQUEST=GetCapabilities&SERVICE=WMS

WMS Straßenverkehr Hamburg (Lärmkarten) [09.11.2017]
https://geodienste.hamburg.de/HH_WMS_Strassenverkehr?REQUEST=GetCapabilities&SERVICE=WMS

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15. Annex_ Hamburg City Level indicators

Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Size	Size	-	km2	Land area of city	755.2
People	City characterization	Population	Population	-	Inh	Total number of persons inhabiting a city	1,805,320
People	City characterization	Population	Population density	-	Inh./km2	Population per unit area in the city	2,391
People	City characterization	Population	People > 75 years	-	%	Population elder than 75 years old	9.6
People	City characterization	Population	Average population age	-	-	Average of the age of the population (man+woman)	42.3
Planet	City characterization	Type of city	Type of city	-	-	Typology of the city under study: metropolitan, urban, suburban - Metropolitan areas are urban areas with more than 500,000 inhabitants - Urban area is a functional economic unit characterised by densely inhabited 'cities' with more than 50,000 inhabitants and 'commuting zones' whose labour market is highly integrated with nearby cities - Suburban areas correspond with a residential district located on the outskirts of a city and with a population less than 50,000 inhabitants	metropolitan
Planet	City characterization	Land use	Land consumption	Nº Buildings/Total city surface	nº build/Km2	Measure of land use intensity and urban areas density	326.4
Planet	City characterization	Land use	Land consumption 2	Total built surface/Total city surface	Km2/Km2	Measure of land use intensity and urban areas density	0.59
Planet	City characterization	Land use	Balance between residential and no-residential building use	[Built surface for terciary sector/Total build surface] x100	%	Measure of land use diversity	3.66

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	CO2 target	Overall CO2 emission reduction target	-	%	That is the objective of each one of the cities according to the SEAP	80%by 2050, 50% by 2030
Prosperity	City characterization	Tourist intensity	Tourism intensity	Number of tourist nights per year per 100,000 inhabitants	(# of tourist nights / total population) *100,000	The ratio of tourists that spent nights at tourist accommodation establishments divided by one million of inhabitants in a year	738,428.64
Planet	City characterization	Climate	Climate koppen geiger classification	-	-	The Köppen climate classification scheme divides climates into five main groups (A, B, C, D, E), each having several types and subtypes. Each particular climate type is represented by a two- to four-letter symbol. http://koeppen-geiger.vu-wien.ac.at/pdf/kottek_et_al_2006_A4.pdf	Dfb (humid continental climate)
Planet	Local energy supply	City energy profile	Final energy consumption per capita	-	MWh/capita	-	26.26
Planet	Local energy supply	City energy profile	Final energy consumption (Transport)	-	TWh/year	-	17.06
Planet	Local energy supply	City energy profile	Final energy consumption (Buildings, equipments/facilities and Industries)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Final energy consumption (Municipal)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Final energy consumption (Tertiary)	-	TWh/year	-	11.76
Planet	Local energy supply	City energy profile	Final energy consumption (Residential)	-	TWh/year	-	11.13
Planet	Local energy supply	City energy profile	Final energy consumption (Public lighting)	-	TWh/year	-	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	City energy profile	Final energy consumption (Industry)	-	TWh/year	-	8.21
Planet	Local energy supply	City energy profile	Final energy consumption (electricity)	-	TWh/year	-	12.37
Planet	Local energy supply	City energy profile	Final energy consumption (Heat/Cold)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Final energy consumption (Fossil fuels)	-	TWh/year	-	30.61
Planet	Local energy supply	Renewable energies	Final energy consumption (Renewables)	-	TWh/year	-	0.87
Planet	Local energy supply	Renewable energies	Share of local energy production to overall final energy consumption	-	%	-	non-relevant

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	Local energy supply	Renewable energies	Renewable electricity generated within the city	The share of renewable electricity produced within the city is calculated as the total consumption of electricity generated from renewable sources (numerator) divided by total energy consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Consumption of renewable sources includes solar, wind, hydro, tide and wave energy, and combustibles used for electric generation, such as biomass. (ISO/DIS 37120, 2013).	%	The percentage of electric energy derived from renewable sources, as a share of the city's total energy consumption	6.30%
Planet	Local energy supply	Renewable energies	Non-RES Heat/ Cold production	-	TWh/year	-	non-available
Planet	Local energy supply	Renewable energies	RES Heat/Cold production	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Total buildings energy consumption per year	-	GWh/inhab. year	Residencial consumption in the city for heating and electricity uses	non-available

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Planet	Local energy supply	Renewable energies	Renewable energy per carrier	-	GWh/RES_ supplier	Energy that each renewable systems provides to the city	Sewage gas: 218.7 Water power: 0.555 Wind: 106.7 PV: 73.9 Biomass: 2,647.5 Others: 100 (all*)
Planet	Local energy supply	Renewable energies	Percentage of renewable energy	RES_energy/total _energy	%	Amount of energy coming from the renewable sources	4.36%
Planet	Local energy supply	City energy profile	Primary energy consumption in the city per year	-	GWh of PE/year	Gross inland consumption of the city excluding non-energy uses	71,923.40
Planet	Local energy supply	City energy profile	Primary energy consumption per capita	-	MWh/capita	-	39.22
Planet	Local energy supply	City energy profile	Primary energy consumption (Transport)	-	TWh/year	-	non-available* (because Hamburg is an oil exporting federal state the primary energy balance is negative for fuels)
Planet	Local energy supply	City energy profile	Primary energy consumption (Buildings, equipments/facilities and Industries)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Municipal)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Tertiary)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Residential)	-	TWh/year	-	non-available

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Planet	Local energy supply	City energy profile	Primary energy consumption (Public lighting)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (Industry)	-	TWh/year	-	non-available
Planet	Local energy supply	City energy profile	Primary energy consumption (electricity)	-	TWh/year	-	non-available
Planet	Local energy supply	Energy mismatch	Maximum Hourly Deficit (MHDx)	The maximum yearly value of how much the hourly local electricity demand overrides the local renewable electricity supply during one single hour	kWh	Energy mismatch	non-available
Planet	Local energy supply	Renewable energies	Green electricity purchased	-	%	The percentage of green electricity purchased from the municipality, as a share of the city's total electtricity consumption	non-available
Planet	Local energy supply	Energy monitoring	Smart energy meters	-	% of buildings	The percentage of buildings in the city with smart meters This indicator shows the coverage on the energy distribution network with energy meters; it could be distinguished for electric and methane or heat networks.	non-available* (There are already 200.000 electric meters in 2017. The rollout of smart meters according to 2009/72/EG will be executed within the next 16 years.)
Planet	Local energy supply	Potential of retrofitting	Refurbished buildings improving energy performance	-	% of buildings	Number of buildings subject to refurbishment improving their energy profile above the EPBD (Energy Performance of Buildings Directive) requirements	non-available

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Planet	Local energy supply	Energy systems	Number of connections to a district heating network	It is calculated as the total number of buildings connected to a DH (numerator) divided by totalnumber of buildings in the city(denominator) .	% of buildings	Percentage of buildings connected to a district heating network of the city	non-available
Planet	City characterization	City environmental impact	Greenhouse gas emissions per capita	-	tonnes CO2/capita	-	9.70
Planet	City characterization	City environmental impact	Greenhouse gas emissions (tertiary)	-	Mtonnes CO2/year	-	3.91
Planet	City characterization	City environmental impact	Greenhouse gas emissions (transport)	-	Mtonnes CO2/year	-	4.47
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Residential)	-	Mtonnes CO2/year	-	3.66
Planet	City characterization	City environmental impact	Greenhouse gas emissions in buildings, equipment/facilities and Industries	-	Mtonnes CO2/year	-	non-available
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Public lighting)	-	Mtonnes CO2/year	-	non-available
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Municipal)	-	Mtonnes CO2/year	-	non-available
Planet	City characterization	City environmental impact	Greenhouse gas emissions (Industry)	-	Mtonnes CO2/year	-	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	City environmental impact	Transport greenhouse gas emissions per capita	Transport GHG emissions, in equivalent CO2 units, generated over a calendar year / Total city population	t /(pers.·a)	Measure of the total greenhouse gas emissions per capita due to public and private transport.	non-available
Planet	City characterization	City environmental impact	Percentage of renewable energy use in public transport	[Renewable energy use in public transport over a calendar year (kWh) / Public transport energy use over a calendar year (kWh)] x100	%	Measure of the use of renewable energy in public transport.	non-available* (The U-Bahn rapid transit metro rail network uses 100% renewable energy. Percentages for other rail networks and bus services are not available.)
Planet	City characterization	Water resources	Water consumption	(City's total water consumption in litres per day)/(total population)	m3/cap/day	Water resources	0.14
Planet	City characterization	Water resources	Water re-used (rain/grey water)	[(houses with grey and rain water reuse capability)/(total number of houses)]*100%	% of houses	Water resources	non-available
Planet	City characterization	Air pollution	NOx emissions	[annual NO2 emissions (g)]/(total population)	g/cap	Air pollution	11.45
Planet	City characterization	Air pollution	PM2,5 emissions	[annual PM2.5 emissions (g)]/(total population)	g/cap	Air pollution	non-available

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Planet	City characterization	Air pollution	Air quality index	((NO2_YEAR_AVERAGE/40) + (PM10_YEAR_AVERAGE/40) + (LOG((PM10daily > 50µg)+1)/LOG(36)) + ((DAYS_WITH_Ozone_8h_AVG >= 120)/25) + (SO2_YEAR_AVERAGE/20) + (Benzene_YEAR_AVERAGE/5)) / 6	index	AQI calculations focus on major air pollutants including: particulate matter, ground-level ozone, sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO). It is a distance to target indicator that provides a relative measure of the annual average air quality in relation to the European limit values (annual air quality standards and objectives from EU directives). If the index is higher than 1: for one or more pollutants the limit values are not met. If the index is below 1: on average the limit values are met. NANTES is involved on this initiatives. http://www.airqualitynow.eu/index.php	non-available
Planet	City characterization	Waste	Recycling rate	[(total amount of the city's solid waste that is recycled in tonnes) / (total amount of solid waste produced in the city in tonnes)]*100%	% tonnes	0	69%
Planet	City characterization	Noise	Exposure to noise pollution	Share of the population affected by noise > 55dB at night time	%of people	0	6.2% (This percentage is Share of the population affected by noise > 65dB at night time)
Planet	City characterization	Waste	Amount of solid waste collected	(Annual amount of genererated municipal solid waste t/yr) / (total population)	tonnes/capita/year	Waste	2.21

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Land consumption	Brownfield use	[brownfield area redeveloped in the last year (km2)] / [total brownfield area in the city (km2)]	% of km2	Share of brownfield area that has been redeveloped in the past period as percentage of total brownfield area	non-available
Planet	City characterization	Urban Heat Island	Urban Heat Island	Maximum hourly difference in air temperature within the city compared to the countryside during the summer months	°C UHImax	Maximum difference in air temperature within the city compared to the countryside during the summer months	Not available (Areas in Hamburg differ a lot in the share of green and in their proximity to the river Elbe. Thus UHImax indicators differ in a range from 0.6 K to 1.1 K.)
Planet	City characterization	Food consumption	Local food production	Share of food consumption produced within a radius of 100 km	% of tonnes	Share of food consumption produced within a radius of 100 km	non-available
Planet	City transportation status	Mobility city profile	Total number of public transport vehicles	#	Number of vehicles	Number of public vehicles that are destinated to public transport (bus, taxis…)	2,186
Planet	City transportation status	Sustainable transport	Number of Electric Vehicles (EV) in the city	Number of electric vehicles in the city per 100.000 (# EVs / total population)*100 000	n/100.000	Number of electric vehicles in the city including private, public and service (taxi and first mile) vehicles including also motobikes	0.0096 (only figures for cars in HAM (no motobikes): thereof 956 BEV, no PHEV counted)
Planet	City transportation status	Mobility city profile	Number of fossil fuelled four wheels vehicles per capita	Number of fossil fuelled vehicles (four wheels) of the city distinguishing by type (public and private) and divided by the population	n/ cao	Number of fossil fuelled vehicles (four wheels) of the city divided by the inhabitants of the city (public and private)	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City transportation status	Transport problems	Traffic accidents	number of fatalities related to transportation of any kind/(totalPopulation/100000)	#/100 000 people	Number of transportation fatalities per 100 000 population in a year. Fatalities includes dead but also hospitalization	0.00026
Planet	City transportation status	Sustainable transport	Public transport use	# of trips made annually in the city with public transport / total population	#/cap/year	Annual number of public transport trips per capita	non-available*
Planet	City transportation status	Sustainable transport	Access to public transport	(Number of inhabitants with a transportation stop <500m/total population)*100 %	%of people	Share of population with access to a public transport stop within 500m	non-available* (In Hamburg we have the rule, that in the core area everyone has access to public transport within 400m, 600m in peripheral but still urban areas and 1000m in the greater region.)
Planet	City transportation status	Sustainable transport	Access to vehicle sharing solutions	(# vehicle for sharing / total population)*100 000	#/100 000 people	Number of vehicles available for sharing per 100.000 inhabitants	46.53
Planet	City transportation status	Sustainable transport	Lenght of bike route network	total Kilometers Of Bicycle Paths And Lanes_(Km/population)*100000	km/100000 people	Lenght of lanes in the city for bikes per 100,000 inhabitants	non-available* (In Hamburg, there are different kinds of bike routes. We only have figures for e.g the commuter-routes (Velorouten) or other advanced lanes.)

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City transportation status	Transport problems	Congestion	((travel times in peak hours - travel times during non-congested periods (free flow*))/travel times during non-congested periods)*100%	% in hours	Increase in overall travel times when compared to free flow situation (uncongested situation)	non-available
Planet	City transportation status	Mobility city profile	Vehicle fuel efficiency	Total energy consumed for vehicules/total amount of vehicle kilomentres completed	kWh/100km	#	non-available
Planet	City transportation status	Mobility city profile	Fuel mix	Percentage of the market share of transport fuel for each type of fuel used in given period	%	#	non-available
Planet	City transportation status	Mobility city profile	Average occupancy	Average of number of passengers per vehicle per trip	number of passengers per vehicle	#	non-available
Planet	City transportation status	Mobility city profile	Average vehicle speed	Average network speed by vehicle (peak/off-peak)	0	#	non-available
Planet	City transportation status	Charging points	Total kWh recharged in the public EV charging stations.	#	kWh	Number of kWh recharged during a year in the public charging stations. It will be required to infrastructure operator and vehicle owners in order to compare this indicator with energy consumption and distance travelled.	non-available
Planet	City transportation status	Charging points	Charging points per eVehicle	Total charging points/# eVehicles	%	This indicator measures the number of public charging points related to the total amount of electric vehicles in the city.	non-available

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Planet	City transportation status	Charging points	Total charging points	#	#	Total number of public charging points	600
Planet	City transportation status	Charging points	Recharges per year	Number of charges/year	#/year	Usage of the recharging points	5,000.00
Planet	City transportation status	Charging points	infrastructure growth e-car	number of e-car charging points available	[number of e-car charging]	Total number of public charging points in the city for e-cars	non-available
Planet	City transportation status	Charging points	infrastructure growth e-bike	number of e-bike charging points available	[number of e-bike charging]	Total number of public charging points in the city for e-bikes	non-available
People	Urban infrastructures	Lighting management	Lighting system connected	-	YES/NO	Is there an automated lighting management system in the city?	non-available
People	Urban infrastructures	Waste management	Waste management system	-	YES/NO	Is there an automated waste management system in the city?	non-available
People	Urban infrastructures	Traffic management	Traffic management system	-	YES/NO	Is there an automated traffic management system in the city?	non-available
People	Urban infrastructures	Traffic management	Parking management system	-	YES/NO	Is there an automated parking management system in the city?	non-available
People	Urban infrastructures	Traffic management	Public bicycles management system	-	YES/NO	Is there an automated public bicycles management system in the city?	non-available
People	Urban infrastructures	Traffic management	Public transport management system	-	YES/NO	Is there an automated public transport management system in the city?	non-available
People	Urban infrastructures	Traffic management	Number of public transport stops with real time info	-	%	Number of public transport stops with real time information regarding the total number of public transport stops. ICT applied to public transport needs accuracy and territorial coverage	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Planet	City characterization	Land consumption	Compactness	Relation between the usable space of the buildings (volume) and the urban space (area)	inhabitants or workplaces / m2	Relation between the usable space of the buildings (volume) and the urban space (area)	non-available
People	Urban infrastructures	Liveability of neighbourhoods	Use of groundfloors	(ground floor space used commercially/publically (in m2)/total ground floor space (in m2) *100%.	m2	Liveability of neighbourhoods Percentage of ground floor surface of buildings that is used for commercial or public purposes as percentage of total ground floor surface.	non-available
People	Urban infrastructures	Green spaces	Green and blue space	{ [(Water area) + (Green space area)] / (Total land area) } * 100%.	m2	Nature and recreation possibilities The surface that correspond with green space and water spaces in the city in relation to the total surface of the city	non-available
People	Urban infrastructures	Communication infrastructure	Access to public free WiFi	(sum of wifi node coverage)/total city urban surface)*100%.	%	Attractiveness, accessibility of online services This indicator measures the percentage of a city's public space which is covered by a public Wi-Fi network	non-available
People	Urban infrastructures	Communication infrastructure	Access to high speed internet	(Number of Fixed (wired)-broadband subscriptions /inhabitants) *100000	%	Ensure good city connectivity and the provision of efficient digital infrastructures	non-available
People	Urban infrastructures	Communication infrastructure	Number of phone connections per 100,000 inh	(Number of cell phone connections /inhabitants) *100000	Connections/100.000 hab.	Total number of cell phone connections in the city in relation to the population of the city	non-available
People	Urban infrastructures	Communication infrastructure	Number of Internet connections per 100,000 inh	(Number of internet connections /inhabitants) *100000	Connections/100.000 hab.	Total number of internet connections in the city in relation to the population of the city	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Existence of plans/programs to promote energy efficient buildings	-	Number of plans	Is there any specific plan for promoting energy efficient buildings in the city?	Difficult to count. Depending on the level of detail there are plenty of plans taking these aspects into account. For a general overview and qualitative description see above.
Governance	Governance	Urban planning	Existence of plans/programs to promote sustainable mobility	-	Number of plans	Is there any specific plan for promoting sustainable mobility in the city?	There is one overarching mobility concept.
Governance	Governance	Urban planning	Existence of regulations for development of energy efficient districts	-	Number of regulations	Is there any specific regulation for developing energy efficient districts in the city?	+10?
Governance	Governance	Urban planning	Existence of regulations for development of sustainable mobility	-	Number of regulations	Is there any specific regulation for developing sustainable mobility in the city?	+10?
Governance	Governance	Urban planning	Existence of local/national Energy Performance Certificate (EPC)	-	YES/NO	Is there any specific EPC for buildings in the city?	YES
Governance	Governance	Urban planning	Share of Green Public Procurement	-	%	Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration	non-available
Governance	Governance	Level of correspondence between local energy codes	Level of correspondence between local energy codes	-	YES/NO	Is there any discrepancy between different local energy codes for buildings?	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Level of correspondence among regulations	Level of correspondence with national regulation	-	YES/NO	Is there any discrepancy between local codes and national regulation?	non-available
Governance	Governance	Level of correspondence among regulations	Level of correspondence with European legislation	-	YES/NO	Is there any discrepancy between local codes and European legislation?	non-available
Governance	Governance	Level of correspondence among regulations	Level of correspondence with international construction standards	-	YES/NO	Is there any discrepancy between local codes and international construction standards?	non-available
Governance	Governance	Online governance data	Availability of government data	-	Qualitative Likert scale	The extent to which government information is published Likert scale Not at all – 1 – 2 – 3 – 4 – 5 – Excellent 1. Not at all: most of the information is not available to the public or only upon appointment with an expert 2. Poorly: most of the information is available to the public, but available in the form of a hard copy which cannot leave city hall 3. Somewhat: most of the information is available to the public, some in the form of a hard copy, some online. 4. Good: most of the information is available online, but structure is lacking 5. Excellent: all government information is available online and neatly structured.	Not available
People	Urban infrastructures	Quantity of open data	Quantity of open data	(# of open government datasets/ Inhabitants)*100,000	#/100.000	Quantity of open data sets provided by city's open data portal	Not available

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Governance	Governance	Governance collaboration	Cross-departmental integration	-	Qualitative Likert scale (1 to 5)	The extent to which administrative departments contribute to“Smart City” initiatives and management. The level of cross-departmental integration will be estimated by analyzing the number of departments involved in smart city initiatives, whether by contributing financial, data sources or human resources 1. There is a silo-ed smart city governance structure, only one department actively contributes to smart city initiatives and decides on the strategy. 2. The local authority is poorly oriented towards crossdepartmental “smart city” management: officially there is no “mainstreaming approach”, some civil servants from a few departments work on this portfolio on the side or provide data for the initiatives, but there is no real strategy and commitment. 3. The local authority is somewhat oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and several departments contribute in human, data or financial resources. 4. The local authority is clearly oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and almost all departments provide financial, data and human resources for the smart city themes. 5. The local authority is committed towards crossdepartmental “smart city” management: there is a wellanchored mainstreaming approach” with shared performance targets and all departments are actively contributing to the smart city themes in financial, data and human resources.	Not available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Smart city policy	-	Qualitative Likert scale	The extent to which the city has a supportive smart city policy Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very supportive 1. Not at all: the complete absence of a long-term smart city vision (including and absence of long-term targets & goals) from the side of the government or an opposing vision create a difficult environment for starting smart city initiatives. 2. Poor: The long-term vision of the government does, to some extent, hamper the environment for smart city initiatives. 3. Neutral: The long-term vision of the government has had no significant, positive or negative, impact on the environment for smart city initiatives. 4. Somewhat supportive: The long-term vision of the government has to some extent benefitted the environment for smart city initiatives. The city has created roadmaps and actions to support vision implementation 5. Very supportive: The comprehensive long-term vision on the future of the city stimulates the environment for smart city initiatives to a great extent.	Not available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Citizen participation	Voter participation	(number of people who voted in last municipal elections/total population eligible to vote)*100%	%	The percentage of people that voted in the last municipal election as share of total population eligible to vote	56.5
Governance	Governance	Governance collaboration	Multilevel government	-	Qualitative Likert scale	The extent to which the city cooperates with other authorities from different levels Likert scale: Not at all – 1 – 2 – 3 – 4 – 5 - Very much 1. Not at all: there is no cooperation or coordination with other municipalities and/or other levels of government whatsoever. 2. Poorly: there is little cooperation with other authorities, but this is irregularand very dependent of the people involved. 3. Somewhat: there is some cooperation or coordination with other municipalities and/or other levels of government, which is formalized in a partnership policy. 4. Good: there is good cooperation or coordination with other municipalities and/or other levels of government, which is formalized in partnership policies and in process through regular participation in meetings. 5. Excellent: the city is a driving force in the cooperation or coordination with other municipalities and/or other levels of government, which is formalized in policy and in process through regular meetings initiated by the city.	Not available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Climate resilience strategy	-	Likert scale	The extent to which the city has developed and implemented a climate resilient strategy Qualitative Likert scale (1 to 7) 1.No action has been taken yet 2. The ground for adaptation has been prepared (the basis for a successful adaptation process) 3. Risks and vulnerabilities have been assessed 4. Adaptation options have been identified 5. Adaptation options have been selected 6. Adaptation options are being implemented 7. Monitoring and evaluation is being carried out.	Not available
Governance	Governance	Urban planning	Existence of local sustainability plans	-	YES/NO	Is there any specific sustainability plan in the city?	YES
Governance	Governance	Urban planning	Existence of Smart Cities strategies	-	YES/NO	Is there any specific Smart Cities strategy in the city?	YES
Governance	Governance	Urban planning	Existence of an Agenda 21	-	YES/NO	Has the city elaborated an Agenda 21?	NO
Governance	Governance	Urban planning	Signature and compliance of the Covenant of Mayors	-	YES/NO	Has the city signed the Covenant of Mayors. And Is the city complying with it? (both questions need to be aswered)	YES
People	Citizens	Channels of communication	Number of local associations per capita	Number of associations / Total city population	Number of consultations / inhab.	Total number of civic associations registered with the local authority related to total city population	Not available
People	Citizens	Channels of communication	Number of information contact points for citizens	-	Number of information points	Total number of contact points established in the city by the municipality to share information from the city to the citizens (tourism, events, mobility, environment, etc)	Not available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Citizens	Channels of communication	Number of municipal websites for citizens	-	Number of municipal websites	Total number of municipal websites which belong to the municipality for sharing information of the city to the citizens (citizen participation portal, open data, transparency, etc.)	non-available
People	Citizens	Channels of communication	Number of interactive social media initiatives	-	Number of social media links	Number of accounts in social media created by the municipality for sharing information about the city (e.g. news, cultural agenda, etc).	non-available
People	Citizens	Channels of communication	Number of discussion forums	-	Number of forums	Total number of discussion forums organized by the municipality dedicated to discuss with citizens about the needs, opportunities and solutions to be implemented the city	non-available
People	Citizens	Accesibility of services	Access to public amenities	-	%	Basic services available close to home Share of population with access to at least one type of public amenity within 500m. Examples of the types of public amenities considered here are social welfare points, social meeting centers, theatres and libraries. (note: other public amenities such as green spaces, public recreation and healthcare facilities are already covered in separate indicators).	non-available
People	Citizens	Accesibility of services	Access to commercial amenities	-	%	Basic services available close to home Share of population with access to at least six types of commercial amenities providing goods for daily use within 500m. Commercial amenities are services/goods for daily use provided by private actors. Typical commercial amenities include shops for bread, fish, meat, fruits and vegetables, general food shops (i.e. supermarkets), press, and pharmaceutical products	non-available
Prosperity	City characterization	Equity	Diversity of housing	-	%	Diversity Percentage of social dwellings as share of total housing stock in the city	non-available

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
Governance	Governance	Urban planning	Preservation of cultural heritage	-	Qualitative Likert scale	Identity of place based on its history The extent to which preservation of cultural heritage of cultural heritage of the city is considered in urban planning The indicator provides a qualitative measure and is rated on a fivepoint Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very much 1. Not at all: no attention has been paid to existing cultural heritage in urban planning. 2. Fair: heritage places have received some attention in urban planning, but not as an important element. 3. Moderate: some attention has been given to the conservation of heritage places. 4. Much: heritage places are reflected in urban planning 5. Very much: preservation of cultural heritage and connections to existing heritage places are a key element of urban planning.	non-available
People	City characterization	Education level	Number of high edu degrees per 100,000 population	(Number of high edu degrees /inhabitants) *100000	n/100,000 inh	It is an indicator of well being and development. Number of city inhabitants with high education degrees per 100000 inhabitants. Tertiary education broadly refers to all post-secondary education, including but not limited to universities	1,883.32

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Theme	Category	Application field	Indicator	Formula	Units	Objectives of the indicator	Value
People	Urban infrastructures	Urban platform	Cybersecurity	-	Qualitative Likert scale	Data protection, security of ICT systems Low level of cybersecurity — 1 — 2 — 3 — 4 — 5 — High level of cybersecurity 1. Maximum one of the following conditions is met. 2. Two of the following conditions are met 3. Three of the following conditions are met. 4. Four of the following conditions are met. 5. All the five following conditions are met. 1. There has been no serious information leakage or cyberattack with ignificant negative impact on the organisation, its employees or citizens during the past two years. Serious means that it results in disclosure of information (e.g. confidential or sensitive personally identifiable information) or financial lost, due to illegal system access, unauthorized data storage or transmission, unauthorized hardware and software modifications or personnel's lack of compliance with security procedures. 2. The city makes annually a risk assessment on risks of cybersecurity and has a contingency plan against the identified risks. 3. All city personnel receive basic security training when they are employed to conduct adequately to security incidents. 4. The city has recruited personnel dedicated to cybersecurity and they have signed a security pledge. 5. Employees' devices deploy an antivirus program for mitigating malware including viruses residing in them and remote access protected, i.e. controlled with security function for intrusion prevention or intrusion detection.	non-available

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People	Urban infrastructures	Urban platform	Data privacy	-	Qualitative Likert scale	The level of cybersecurity of the cities' systems Likert scale Not at all — 1 — 2 — 3 — 4 — 5 — Very high 1. City doesn't follow national regulations/laws on protection of personal data. 2. City follows national regulations/laws on protection of personal data. 3. City follows relevant national regulations on protection of personal data and the EU Directive on the Protection of Personal Data (95/46/EG). 4. City follows all the relevant national and European regulations/laws related to data privacy and protection. If personal/private data is collected from citizens, proper authorisations with written agreements are made. 5. Relevant national and European regulations on data protection and privacy are followed and written agreements are made for use of citizens' private/personal data. All the collected personal/private data, especially sensitive personal data, is accessed only by agreed persons and is heavily protected from others (e.g. locked or database on internal server with firewalls and restricted access).	non-available
People	Urban infrastructures	Urban platform	Number of data publishers	-	#	Number of data publishers that publish data into the existing urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of sensors/devices connected**	-	#	Number of IoT sensors/devices from any field that are connected in the current urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of services deployed	-	#	Number of available services in the current urban platform (e.g. website)	non-available

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People	Urban infrastructures	Urban platform	Number of available Open APIs	-	#	Number of available APIs in the current urban platform (e.g. website)	non-available
People	Urban infrastructures	Urban platform	Number of available Open Data sources	-	#	Number of available Open Data sources in the current urban platform (e.g. website). Open means anyone can freely access, use, modify, and share for any purpose (subject, at most, to requirements that preserve provenance and openness)."	non-available
People	Urban infrastructures	Urban platform	Number of accesses to the urban platform APIs	-	#	Number of accesses that have been made into the APIs of the urban platforms (e.g. website)	non-available
Prosperity	City characterization	Employment	Unemployment rate	% people not working among those available for work	%	Unemployment	7.40%
Prosperity	City characterization	Employment	Youth unemployment rate	% youth (<24y) labour force unemployed	%	Youth unemployment	5.40%
Prosperity	City characterization	Equity	Fuel poverty	-	% of households	Equity The percentage of households unable to afford the most basic levels of energy	non-available
Prosperity	City characterization	Economic performance	Costs of housing	% gross household income spent on housing	% in €	Equity	non-available
Prosperity	City characterization	Green economy	Green public procurement	-	%	Stimulating eco-innovation Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration	non-available
Prosperity	City characterization	Economic performance	GDP	GDP per capita	€/cap	Economic performance	61.729

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Prosperity	City characterization	Economic performance	Median disposable income	Median disposable annual household income	€/household	Economic wealth	23.596
Prosperity	City characterization	Economic performance	New businesses registered	(Number of new business registered /inhabitants) *100000	#/100.000	Economic activity, attractiveness Number of new businesses registered (including start-up) in a year per 100,000 population. An average of the last 5 years with available data	1096.758
Prosperity	City characterization	Innovation	New startups	(Number of startups registered /inhabitants) *100000	#/100.000	New business Number of new businesses registered (including start-up) in the last year per 100,000 population. An average of the last 5 years with available data It shows how attractive is the city for starting new economic activities	6508.541
Prosperity	City characterization	Innovation	Research intensity	R&D expenditure as percentage of city's GDP	% in euros	Innovation	2.6
Prosperity	City characterization	Equity	Population Dependency Ratio	0	#/100	Economic development Number of economically dependent persons (net consumers) per 100 economically active persons (net producers)	44.21

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