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D3.3 Report on retrofitted actions and implemented actions new buildings including RES and storages in Hamburg

WP3, Task 3.2

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.

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Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30st November 2021 (60 Months)
Deliverable	D3.3 Report on retrofitted actions and implemented actions new buildings including RES and storages in Hamburg
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Abbreviations and Acronyms

Acronym	Description
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
BUE	Behörde für Umwelt und Energie (in English: Hamburg Ministry for Environment and Energy)
CC4E	Centre for Energy Efficiency and Renewable Energies (Laboratory Building for new Energy Systems in Hamburg-Bergedorf)
CHP	Combined Heat and Power – Power Plant
ENER	enercity Contracting Nord GmbH (Beneficiary of the Project)
ENH	EnergieNetz Hamburg eG (beneficiary of the project)
GDP	Gross Domestic Product
GFA	Gross-floor-area
GNH	Gasnetz Hamburg (third linked party from HAM)
HAM	City of Hamburg (beneficiary of the project)
HAW	Hamburg University of Applied Sciences (beneficiary of the project)
HU	Housing Units (in German: “Wohneinheiten“)
IFB	Hamburgische Investitions- und Förderbank (in Englisch: Hamburg Bank for Investments and Founding)
KFW70	German Energy Standard. This means that the buildings must undercut the energy requirements of the German Energy Saving Ordinance (EnEV) by 30%.
NSH	Night Storage Heaters
PV	Photovoltaik
RES	Renewable energy sources
SNH	Stromnetz Hamburg (third linked party from HAM)

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Executive summary

The main objective of the mySMARTLife project is the definition of an innovative Urban Transformation Strategy to present best examples to the follower cities to support them in developing their own approach towards a smart city, to increase the quality of life for the citizens and to decrease the CO2 Emissions which are connected to modern urban lifestyle.

In addition to the field of urban mobility, the area of housing is of here particular importance. In 2016, about 44% of CO2 emissions in Hamburg are produced by households and small commercial consumers (BUE, n.d.). In this field, the mySMARTLife project in Hamburg tried to identify solutions in both - in the new construction of energy-efficient apartments and in the renovation of old buildings. This has taken place in a realistic setting (real life laboratory), so that many actions of the project had to face the challenges of the conditions of Hamburg administration system and the applicable regulations, as well as the actual requirements of the real estate market and the tenants and citizens. Many positive, but also challenging insights were gained from this practical test, which will be integrated into politics and administrative regulations in the coming project years.

It has been shown during the implementation phase that the approach chosen by the Hamburg consortium, to encourage house owners and real estate companies to obtain a more CO2 neutral heat and energy supply, by means of advice and activation, was only partly successful. This was evident in both: in the larger new construction projects along the "Schleusengraben", as well as in the small-scale owner activation in the redevelopment area "Bergedorf Süd".

The reasons for this are manifold and will be explained in the following chapters. Decisive success factors in this approach, however, are that owners and investors are approached at the right moment. In the best case, before the planning a construction area has become too concrete, i.e. before the final building layout in the planning area has already been determined, so that it still can be modified to a certain extent on the basis of the energy infrastructure. Furthermore, the legal and economic framework conditions in Germany must be improved. At the moment, the incentive to save CO2 is still very low; there are hardly any financial advantages for owners. This can be seen in particular in the renovation projects in “Bergedorf Süd”, but also in the difficult integration of renewable energy source (RES) plants in new buildings, where conventional gas supply is still the most economically profitable supply.

In the mySMARTLife project, the Hamburg project team dealt intensively with these challenges and also discussed them with the Hamburg Ministry of Environment. So that in 2019, with the compulsory sectoral plan for energy (german: “Energiefachplan”) for construction areas with more than 150 housing units, a new planning tool could be introduced at the municipal level by the BUE for the first time, which attempts to solve these problems. The aim is to integrate scenarios for the energy supply of new residential areas

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in the planning process as early as possible to lower the barriers for more innovative and ambitious energy concepts (see Chapter 2.4).

Furthermore, the project mySMARTLife dealt with the conventional gas network and assigned a new role for it as a new storage system for the Smart City by using the network as storage for hydrogen. Within the high-performance area, the injunction of hydrogen with content up to 30% will be tested in the CHPs in the residential area “Am Schilfpark”. If the used hydrogen is produced with renewable energies, this could be representing a major contribution to the German energy transition (Chapter 3).

During the project two new hydrogen ready CHPs could be implemented in the area “Am Schilfpark”, a monitoring system is installed and the hydrogen injection unit is planned and in implementation. In the retrofitting area “Bergedorf Süd” 61 energy consultations, several stakeholder and public events to activate the house owners for retrofitting have been done. About 20 different retrofitting projects with 15,000m² in total were carried out and one heating island could improve with a new CHP.

Overall, the project has gained a great deal of experience over the last three years with regard to the challenges of citizen activation and the technical implementation of heat networks. Even though not all planned interventions could yet been completed in the project duration, the mySMARTLife has been able, to gather important experience and lay the foundations for a future integrated and linked energy supply and for future development areas in the Borough of Hamburg-Bergedorf and in the City of Hamburg.

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1. Introduction

1.1 Purpose and target group

This deliverable explains the approach to create a so called “high-performance district”, with the implementation of new buildings and it describes a method to use hydrogen for heating in a district heating network in one focus housing area. Furthermore, it describes an approach for retrofitting in a highly diverse town quarter, by activating house owners to retrofit their buildings or to take part at so called heating islands.

With that in mind, the deliverable is divided into the following chapters:

Chapter 2 provides an overview over the “high-performance district” consisting of several new housing areas at the “Schleusengraben” in the Borough of Hamburg-Bergedorf. It showed a short description about the planning methods and it introduced the “sectoral plan for energy” (German: “Energiefachplan”) a new planning tool on state level.

Chapter 3 shows the technical description of the district heating with hydrogen in the area “Am Schilfpark”, one of the housing areas at the “Schleusengraben area”.

Chapter 4 explains the approach and the methods of the activation of house owners for energetic retrofitting in “Bergedorf Süd” and gives an overview about the achieved results.

Chapter 5 completes this deliverable with the conclusions, a review of the main challenges and an outlook on future approaches to establish a sustainable energy supply with less CO2 emissions in the smart city.

The deliverable is targeted at planning institutions, energy providers and stakeholders responsible for planning and constructing new energy systems and new housing areas or for the retrofitting of old town areas. The information and findings reported in this deliverable should be relevant for German players, but other cities and countries can find some gripping surface on the results and hence this could also benefit other international stakeholders as well.

1.2 Contribution of partners

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

Table 1: Contribution of partners

Participant short name	Contributions
HAM	Chapter 1, 2, overall conclusion, overall correction and layout

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HAW	Chapter 3
KON	Chapter 4
ENER	Contribution Chapter 3
GNH	Contribution Chapter 3

1.3 Relation to other activities in the project

This deliverable is allocated in Task 3.2 “Building/District Renovation and Smart Homes Deployment” and describes the results of subtask 3.2.1 “Retrofitted/new high-performance district design and deployment”, 3.2.5 “Integrated renewable energy generation on district level” and subtask 3.3.1: “District heating and cooling improvements”, which after an amendment in 2019, are now focussing on the integration of hydrogen in a new housing area. Since the smart home solutions will after the amendment not directly implemented in the project area but in the Borough, they will be described in the Deliverable D3.4: "Smart energy Supply and demands. Integration of RES and storages management and control”, which gives an overview about further energy actions, not always connected to the retrofitting or high-performance district.

The delivery provides an overview of the evolution of the interventions and the technical description of smart energy interventions in the core project area of Hamburg-Bergedorf, especially in the high-performance district “Am Schleusengraben” and the retrofitting area “Bergedorf Süd”. Therefor this deliverable is connected to D3.1, the baseline information of the demonstrator area and to D3.2, the simulation models as well as to some parts of D3.3, smart energy supply and demand, as the “energy pillar” of the Project mySMARTLife in Hamburg. Furthermore some mobility interventions described in D 3.8 (e-busses, e-fleet, charging stations) and the adaptive lighting concept (D3.10) at a planned bicycle way at the channel “Schleusengraben”, are also elements of the new created high-performance district in the Borough of Bergedorf.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D3.1	Baseline report of Hamburg demonstrator area - This deliverable provides the baseline information of Hamburg demonstrator area.
D3.13	Simulation models of the building stock, energy system, transportation, urban infrastructure - This deliverable provides the description of the baseline report of interventions at the project start
D3.4	Smart energy Supply and demands. Integration of RES and storages management and control - This deliverable provides smart

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	energy supply and demand solutions, as also control systems and smart appliances in the project area and beyond.
D3.8	Development of new mobility services and intermodality strategies - This deliverable provides the description of mobility interventions like e-busses, e-fleets and charging stations which are also located in the project area and beyond
D3.10	Adaptive lighting concept – describes the development of smart lighting at a planned bicycle way at the channel “Schleusengraben”,

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2. Development of new Buildings in the High-Performance district “am Schleusengraben”

This chapter provides an overview over the “high-performance district”, which is consisting of several new housing areas at the watercourse “Schleusengraben” in the Borough of Hamburg-Bergedorf. This massive new construction area is the topic of Action 1 in Hamburg (“Schleusengraben” new construction programme). The chapter shows a short description about the planning methods, the status of the different new construction areas and their energy supply. It introduces in addition the “sectoral plan for energy”, a new planning tool on state level, as a first improvement of local policy, as result of the experiences in mySMARTLife.

2.1 Overview about the area

The project area in Hamburg is located in the Borough of Hamburg-Bergedorf, on the eastern edge of the town area. As the borough has the lowest number of inhabitants on the one hand and at the same time it is the borough with the largest area on the other, it has moved more and more into the focus of Hamburg's urban development in recent years.

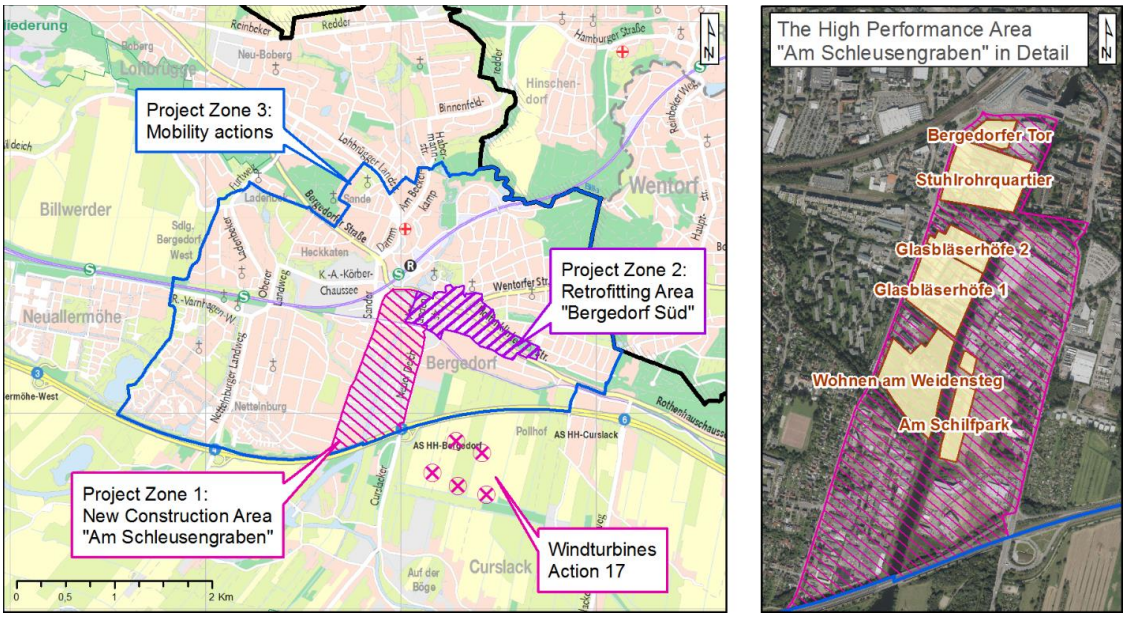

Figure 1: Hamburg area of interventions (Borough of Bergedorf, 2019, own source)

The high-performance area of the project consists of a collection of separate new development areas, lined up along the shores of an old industrial canal, the so-called "Schleusengraben". These areas are mostly vacant commercial areas, which are conveniently located near the inner-city parts of the borough and are now to be transformed into residential areas. In addition, there are several commercial and crafts

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enterprises in the southern area, as well as research facilities and laboratories. A research and innovation park will be developed in the future, which will all together give this entire part of the town the character of an innovation area in the future.

2.2 Description of the approach in mySMARTLife

Before the start of the project, the administration of the borough already had a good contact with all local investors in the area. The first construction phases had already been completed for the area "Glasbläser Höfe", while the other areas were already in the preliminary planning stage. At first the focus of the implementation of the interventions of the mySMARTLife have been on the area “Am Schilfpark”, where the planning for the buildings and streets had already been completed and the investor was up to plan the future energy supply.

At that time, the goal was the construction of a local low-exergy heating network (low-ex) by the partner Energienetz Hamburg eG (ENH), to connect the residential development area “Am Schilfpark” with the waste heat of the surrounding laboratory and commercial buildings. Several meetings with the investor, who initially expressed interest, took place, but these could not be successfully concluded. Since the implementation of such an innovative and carbon-free heating solution instead of standard is much more expensive and more complicated in maintenance (for further information see Deliverable 3.4 “Smart energy supply and demand”).

After this first approach had finally failed, the borough was, nevertheless, able to make use of the established contacts and developed a new innovative idea for heat supply with Hamburg University of Applied Sciences (HAW). Together with the energy contractor of this area, the company “enercity” (ENER) and the gas network operator “Gasnetz Hamburg” (GNH), will for the first time in Hamburg, the feed-in and combustion of hydrogen in a gas grid and heating system in a real residential area (as real life laboratory) be implemented. By this, the innovative character of the area could be preserved and another element for the energy turnaround could be developed. This new approach and the new partners could be officially integrated into the mySMARTLife project with the approval of a purposed amendment in 2019 (see Chapter 3 for the technical description).

At the same time, the Borough of Bergedorf contacted all other investors at the area, together with the related partners of the project. These investors were, in general, interested in innovative energy supplies for their construction areas and the ideas of the project, but various developments outside of the project delayed the realisation of further new development areas in the implementation phase of the project.

In the northern part, the "Bergedorfer Tor", the borough has provided the necessary federal land use plan and also granted a building permit, but for internal reasons the investors have not started the construction since 2018.

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In the largest construction area, the so-called "Stuhlrohrquartier", intensive consultation and coordination with the project took place. This included joint workshops between the investors and several authorities and experts about the mobility concept of the area. Unfortunately, however, in 2017 a citizens' movement formed against the, in their view, too dense and high development of the area, which led to a substantial re-planning, including a new time intensive urban planning competition. So that, until today, no start of construction could take place.

Also, in the new development area "Am Weidensteg" were initially very good contacts to the investor, who was not only interested in an independent energy supply, but also in new mobility solutions and integrated mobility concepts. Unfortunately, however, a serious legal dispute with the City of Hamburg, due to a new development area elsewhere in the city, led to a complete planning stop in the area at the “Schleusengraben”. This also caused a delay in the realisation of the cycle path and the smart street lights along the channel (see Deliverable D3.10 and D3.11 “Adaptive Lighting Concept” and “Humble Lampposts Concept”), as important and necessary spaces are still owned by this investor.

Parallel to these direct approaches to the well-known investors and real estate companies, another attempt was made, to connect the different stakeholders, which are active in the project area. To achieve synergy effects for the actions of mySMARTLife a new stakeholder network, the so-called "Innovation Network Bergedorf" has been established. The meetings of the network were organised by the project partner konsalt (KON) and consisted mostly of a casual gathering as well as workshops in the fields of innovative energy production and new mobility services for residential areas.

All active real estate companies in the area, local research institutions, energy companies which are currently active in the area as well as representatives of the Bergedorf economy and the urban planning department were invited. The aim of this network is, to permanently establish the topic of innovative buildings and heat and energy networks in the development of the “Schleusengraben area”, “Bergedorf Süd” and the further southern Bergedorf urban area. This network has proved, to be an important instrument, to advertise the innovations of the project and it was also very helpful in the development of the new action for the supply of hydrogen, to get in contact with the new players at the area “Am Schilfpark”.

Furthermore, the Borough of Bergedorf has constantly exchanged the experiences about the progress and the challenges with the other related authorities and discussed how innovative energy supplies could be better integrated into the planning and approval process, without at the same time disproportionately increasing the bureaucratic workload for investors by imposing too strict requirements. This led to the development of the “sectoral plan for energy” (German: “Energiefachplan”) as an obligatory part of an urban planning contract by the Hamburg Ministry for Environment (BUE). This new innovative planning instrument, based on the experience of the project, is explained in Chapter 2.4.

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2.3 Status of the development subareas at the new construction program “am Schleusengraben”

The following chapter describes the actual development status and the planned or realised energy supply for the different development areas at the “Schleusengraben area”.

2.3.1 Area “Am Schilfpark”

The new construction area “Am Schilfpark” is the focus area for the project at the high-performance zone of the project. Here is the construction, with about 273 housing units (HU) and appr. 33,000m² gross floor area in 9 buildings and is almost finished and the move in of the tenants has already started. One last residential building in the northern part of the area with about 96 HU and 10,530m² gross floor area will be finished in 2021.

The buildings are constructed in accordance to the national energy standard KfW 70 (EneV 2016), which means that the energy consumption of these building is 70% compared to a reference building of these sizes.

The heat supply is based on a central heat production with a local district heating network. The heat supply consists of two CHPs with a capacity of 50 kWel / 100 kWth and two gas boilers with a capacity of 500 KWth. The cogeneration units form a sector coupling to the electricity grid, cover the basic heat load and are therefore operated heat-controlled. The peak load boilers cover any load peaks that may occur in the heat demand. The energy source for both types of plant is natural gas. Thermal storage units are used so that the CHP units can run down their rated output even at low heat demand and can feed in electricity accordingly. Each of the three storage tanks holds 4,000 litres of water, which together corresponds to a storable heat quantity of around 400 kWh. A single CHP unit can therefore continue to operate for four hours without any heat requirement if the storage tanks were discharged at the start.

The local district heating network, which is mainly laid in the basement and underground car park, is over 460m long and distribute the heat to residential buildings in the development area. Here in this area, the injection of hydrogen in the gas grid and the uptake of up to 30% hydrogen will be tested (see Chapter 3).

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Figure 2: Visualization of the new buildings at the Schilfpark, view from west (BGZ, 2017)

Figure 3: Picture of the new houses at the Schilfpark area, view from the east (Borough of Bergedorf, 2019, own source)

2.3.2 Area “Bergedorfer Tor”

At the project “Bergedorfer Tor” a mixed-use housing block, consisting of five buildings, with different forms of living (95 flats in a multi-storey residential building as well as senior citizens' home), office areas and a health centre on a former area of the German post in the central urban area of Bergedorf is planned. The gross floor area (GFA) is about 38,000 m². The tear down process of the old buildings is completed and the construction of the new buildings has started in 2019.

The heart of the energy supply is a CHP with a gas boiler with a capacity of 1,400 kW. The two CHP modules consist of a capacity of each 50 KWe/100kWth. The two modules run seasonally depending on heat or electricity. They supply a high-temperature heating network with a supply temperature of more than 60 °C. The two gas engines are used to generate electricity. From this, the residential building and the care facility receive the heat for heating and hot water.

A low-temperature heating network with a flow temperature of around 45 °C supplies the office buildings and the medical centre. This low temperature level makes it possible to use otherwise unusable waste heat from refrigeration to supply heat to non-residential buildings. This not only significantly improves the efficiency of the refrigeration machines, but also reduces fuel consumption for heat supply. In this case, the cooling machines that provide the medium for the cooling network for air conditioning in buildings work according to the principle of heat/cool coupling. In addition, the refrigeration machines are primarily driven by electricity generated locally by the CHP modules (enercity 2018a).

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Figure 4: Visualization of the “Bergedorfer Tor” (enercity, 2018b)

Figure 5: Visualization of the Bergedorfer Tor (enercity, 2018b)

2.3.3 Area “Stuhlrohrquartier”

Right in the south of the project “Bergedorfer-Tor”, the so-called "Stuhlrohrquartier" is currently being planned as a densely populated urban quarter with about 1,100 housing units.

The area is within a walking distance to the Bergedorf railway station and directly adjoins the “Schleusengraben”. It covers an area of approx. 55,000 m2 in an attractive water location.

Initially, the district developed a dense residential and business quarter here together with the investors, which also included several high-rise buildings, the highest of which was to have up to 20 storeys. The mySMARTLife project was always involved here, as a consultant on questions of neighbourhood mobility and energy supply. In February 2018, however, a citizen's petition formed itself against these plans.

The main objective of the citizens' initiative was to reduce the height and density of the planned buildings. The citizens' initiative and the political factions of the district, mediated and moderated by the head of the district office, subsequently held intensive discussions with the aim of developing an agreeable solution for the neighbourhood.

The result of these negotiations is a future residential quarter with an average height of 4-6 storeys (incl. staggered and attic floors). This still makes a residential quarter with an inner-city character possible.

Furthermore, the parties involved agree on the permanent preservation of the listed monuments, the “Stuhlrohrhallen”, and the assurance of a high living quality through the use of the inner courtyards as green and recreational areas. In addition, 0.5 car parking spaces per residential unit and 0.1 parking spaces for visitors per residential unit as well as roofed bicycle parking spaces of at least 2.5 per residential unit were agreed (Bezirk Bergedorf, 2018).

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Due to this massive replanning due to the citizens' initiative, the "Stuhlrohrquartier" project has been significantly delayed. The district is currently drawing up a binding land use plan, which is to be drawn up in 2019. It is not yet possible to foresee the start of construction.

Figure 6: Plan of the winning desing according to the new planning 2018 (Bezirk Bergedorf, 2018)

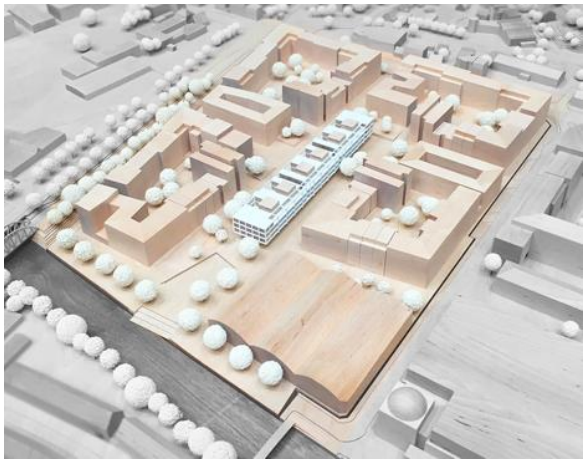

Figure 7: Model of the winning design according to the new planning 2018 (BUWOG, 2018)

2.3.4 Area “Glasbläserhöfe I+II”

The area of “Glasbläserhöfe”, named after a former Glass factory, is a mixed-use area with a total of about 490 residential units. It was built in two construction phases with different forms of living, a school, kindergarten, craft and other commercial uses and has been is completed in 2019.

The energy supply consists of a heating network with two connected heating centrals. One heating central is built in the area with one CHP powered with 100% biomethan with a capacity of 420 kWth and 286 kWel. In addition there is gas boiler powered with conventional gas with a capacity 2750 kWth.

This energy Central has been connected in 2018 with an existing energy supply from a close residential area which offers a surplus of capacity of a CHP also powered with 100% biomethan with a capacity of 432 kWth and 331 kWel. Here is also a gas boiler, powered with conventional gas, with 2760 kWth in addition (BUE, n.d.).

In the area, there are about 38 new buildings completed, constructed in block structures, owned by several real estate companies.

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Figure 8: Picture of the new construction area "Glasbläserhöfe" (konsalt, 2017, own source)

Figure 9: Picture of the new construction area "Glasbläserhöfe"(konsalt, 2017, own source)

2.3.5 Area "Am Weidensteg"

A few meters in the south and, thus, in a central location on the west side of the "Schleusengraben axis", is the quarter "Am Weidensteg" in which in the next few years approx. 740 housing units with about 80,000 m² GFA will be built, which will lead to high density of buildings. 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".

Furthermore, a continuous path connection and a bridge over the "Schleusengraben" will link the new quarters together in the future. The planned path along the water, which is to be developed into an attractive recreational area at the level of the neighbourhood, will create the first continuous footpath and cycle path connection between the inner city of Bergedorf and the rural areas in the south of the borough.

Unfortunately, after very good initial contacts and discussions of the mySMARTLife project with the investor, about the future energy supply and mobility concepts for this very densely built-up area, the talks broke off in spring 2018. Another construction project, in another borough of Hamburg, was the subject of a legal dispute between the investor and the city, which led to a complete planning stop also in this area. This also has a negative impact on the planning of the cycle path along the water, foreseen for the test of smart street lights, as the necessary areas are still in the hands of the investor.

Nevertheless, the project was able to achieve for this area as a requirement in the urban planning contract, that a local heating network with a 50% renewable energy share had to be implemented or that the area had to be connected to one of the existing local heating networks ("Glasbläserhöfe" or am "Am Schilfpark").

Currently the borough is working on the binding land use plan, which is planned to be drawn up in 2020, but it is in the moment not yet possible to foresee the start of construction of the buildings.

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Figure 10: Plan of the new housings in the area “Am Weidensteg” (Bezirk Bergedorf, n.d.)

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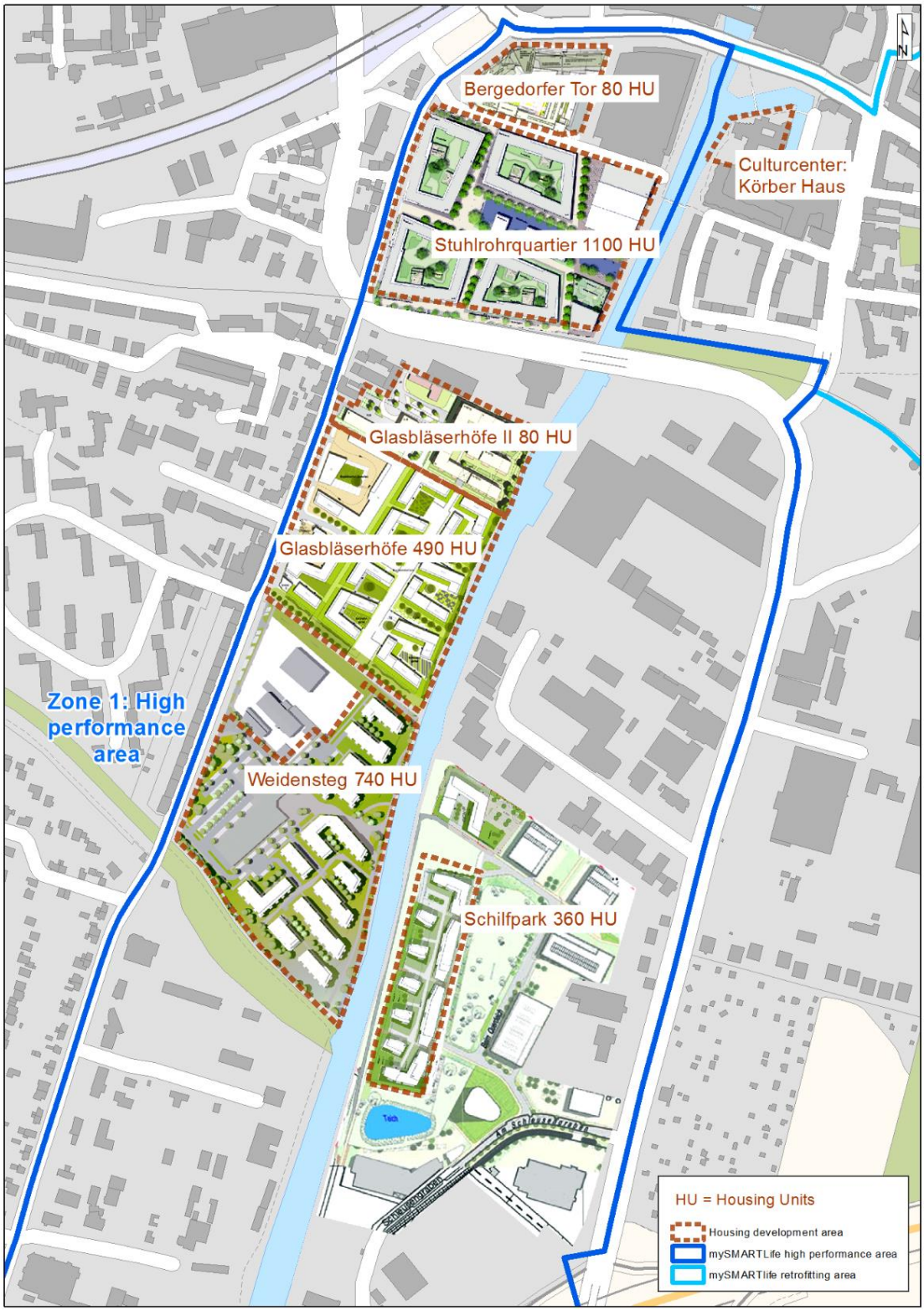

Figure 11: The high-performance area of the project along the “Schleusengraben-axis” with a figure of the planned buildings of the actual development areas, taken from several plans (Borough of Bergedorf, 2018, own source)

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2.4 The “Energiefachplan” (sectoral planning for energy on state level) as a new planning instrument in the City of Hamburg

Very early on in the project it became apparent, that a more CO2 neutral heat and energy supply will be an important issue for future urban development, but that there are still no sufficient planning instruments for this in the City of Hamburg. Therefore, the Hamburg project team intensively dealt with these framework conditions and discussed them with the Hamburg Ministry for Energy and Environment (BUE), which developed in 2019 with the “Energiefachplan” (sectoral planning for energy) a new planning tool, which targeting these problems. In the following chapter, a brief overview of the anchoring of the topic of "innovative energy supply" in Hamburg's planning system is presented, followed by the presentation of the “Energiefachplan” as a new planning instrument.

2.4.1 Obligations regarding energy supply in the German planning system

As mentioned above, the general development of the “Schleusengraben area” is divided in six several areas - each area with its own investor and own architectural and energy supply concept. This is a typical setting in which urban development takes place in Hamburg and it has shown that the legal framework has an important impact on the realisation and energy quality of the new buildings.

On the basis of the Federal Building Code, local authorities could undertake development planning in the form of urban land-use planning on their own responsibility (here the Borough of Bergedorf). The function of urban land-use planning is to prepare and organise the use of plots within the municipal territory for building and other purposes in accordance with the Federal Building Code. It may also lie down defined restrictions (e.g., maximum lot coverage, maximum number of storeys, etc.), obligations (e.g., housing for specific categories of person), and requirements with respect to the implementation of the use in question (e.g., noise control, greenery) (see Commin, 2019a).

Although the possibility exists, it has been very rare so far, to establish energy supply regulations for construction sites. A GIS analysis has shown that only 98 (3.3 %) of the 2915 existing binding land use plans in Hamburg have any energy determinations at all (see Table 3). The most frequent obligation here is the mandatory connection of new buildings to an already existing local heating network. About 41 binding land use-plans obligate for an energy supply with a certain proportion of renewable energy; and only 4 binding land-use plans (0.14%) enact between 2014 and 2017, obligate PV systems on the roofs. The reasons for this can certainly be found in history; the majority of Hamburg's development plans were already drawn up in the last century. The topic of energy supply is therefore still a very new one for urban land-use planning; it is only in recent years that CO2 reduction has become a task for the municipal administration.

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Table 3: Percentage of binding landuse plans in Hamburg with obligations regarding the energy supply (source: GIS analysis based on: “WFS Wärmekataster Hamburg – B-Pläne mit energetischen Vorgaben (BUE, n.d.,a)” and “WFS Bebauungspläne (BSW, n.d.)”, Borough of Bergedorf)

Obligations regarding energy supply in binding land use plans in Hamburg		Total Number of binding land use plans in Hamburg: 2915
Obligation	Total Number	Percent
Obligations regarding energy in total	**98**	**3.36%**
New buildings must connected to local heating networks	53	1.82%
New buildings must connected to local heating networks, networks have to use > 50% RES	30	1.03%
New buildings must connected to local heating networks, networks have to use > 30% RES at warm water production	11	0.38%
Roofs have to be used for PV	4	0.14%

2.4.2 Urban development contract

The term urban development contract is applied to a range of contractual agreements under urban development or planning law. The subject of an urban development contract can, for example, be the preparation and implementation of urban development measures by, and at the expense of, the private party to the contract. Measures of this type might include land reallocation or soil decontamination. The municipality and a private partner may also enter into an urban development contract, to settle the assumption of costs or other liabilities which the municipality has incurred or expects to incur in respect of urban development measures, which are prerequisites or direct consequences of the planned development project (e.g. providing the site).

In recent years, urban-development contracts have become an important supplementary tool in urban land-use planning, and have to some extent superseded classical governmental measures like bye-laws (or municipal statutes). Urban development contracts are regulated by the Federal Building Code (Sections 11, 124) (see Commin, 2019b).

The urban development contract is, therefore, a very flexible tool that makes it possible, to determine the energy supply. However, these possibilities are rarely used. On the one hand the urban development contracts in Hamburg are fixed at the district level and CO2 savings had not been a fixed planning objective for the districts until today, on the other hand the administrations of the Boroughs would like to prevent investors from being deterred and try to cause unnecessary bureaucracy by too strong conditions. In addition, the employees in the boroughs, which develop these contracts, usually do not have the

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necessary expertise when it comes to energy systems. This requires more support and specifications from the relevant authorities.

2.4.3 A new approach: Sectoral planning for energy as a regular part for urban development contracts

Since the project has shown that there are currently too few financial incentives for investors and the Hamburg administration is finding it difficult, against the background of the high development pressure for new residential construction areas, to make too strong compulsory specifications in the preparation of binding land use plans, the Hamburg Ministry of Environment and Energy (BUE) developed the so-called "Energiefachplan" as a new planning tool. The aim is to increase the use of renewable energy sources and to reduce CO2 emissions and to anchor this in the planning of residential areas on a regular basis, without setting too excessively tight specifications which could hold back the creation of housings.

The so called “Energiefachplan” (sectoral planning for energy) is a new expert report about energy management, that has to be create regularly for new constructions with more than 150 HU (or an equivalent heating demand) and a GFZ (floor-space index or floor area) of more than 0.8, which is the premise for an economic heat supply on district level. The “Energiefachplan” examines three variants of German heat insulation standards in combination with at least three variants of the renewable energy supply, which are based on local conditions. The “Energiefachplan” determines the variant combination with the lowest CO2 emissions with economic acceptability for the new development area.

Table 4: “Energiefachplan” – Matrix of possible variants (BUE, personal node)

Energy Production / Insulation standard	Variant 1 (e.g. Heatpump + Ice storage)	Variant 2 (e.g. Solarthermal)	Variant 3 (e.g. industrial waste heat)
Variant 1 (EneV)	CO_2 - €/MWh	CO_2 - €/MWh	CO_2 - €/MWh
Variant 2 (KfW 55)	CO_2 - €/MWh	CO_2 - €/MWh	CO_2 - €/MWh
Variant 3 (KfW 40)	CO_2 - €/MWh	CO_2 - €/MWh	CO_2 - €/MWh

The determined variant is to be secured via energetic stipulations in binding land use plans or regulations in town planning contracts. In the case of grid-based solutions, a public tender can be used to find an energy service provider that implements the defined CO2 savings with the lowest heat costs.

The expected advantages of these new approach are:

- Consideration and "visualization" of climate protection as an essential task of urban land use planning according to the Federal Building Code (§1 Abs. 5 BauGB).

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- Identification of CO2 savings potential and linked heat costs as a basis for the weighing of interests as part of the planning process.
- An independent development of energy concepts outside of the economic interests of energy service providers.
- Ensuring that the specifications developed in the energy plan correspond to the state of the art and the specific local conditions.

The future requirement to provide an “Energiefachplan” should be communicated to the developers or investors as early as possible. The urban planning department of the boroughs should assign the energy department of the BUE already at the first investor negotiations or during the preparation of the tender of competitions, to coordinate the content with each other. At the latest in the first drawings or in the scoping of the binding land use plan, the energy department of the BUE as public agency will demand this expert opinion if it is technically necessary.

The results of the “Energiefachplan” should be included as early as possible in the draft of the binding land use plan, the energy department of the BUE as public agency will demand at the latest in working group one in the Hamburg planning procedure (see table 5) the inclusion of the results of the energy plan in the development plan.

Table 5: Scheme of a binding land use plan procedure with a sectoral plan for energy (BUE, personal note)

Scheme of a Binding Land Use Plan planning procedure with a “Energiefachplan” (sectoral plan for energy)	
1.	Planning occasion
2.	First coordination round / Scoping →is a sectoral energy plan necessary
3.	Formal decision for plan preparation
4.	Early public participation
5.	Working group 1 → has a sectoral energy plan been developed?
6.	Public display
7.	Working group 2
8.	Approval of the plan

The "Energiefachplan" was officially presented by the Hamburg Ministry of Environment and Energy in 2019 and will be a regular part of the planning in the city of Hamburg in the future. Based on the experience to date, it is the aim to strengthen the energy topic in the planning process from the start and to increase the number of development plans with energetic determinations. Another goal is the

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improvement of the number and quality of local heating networks and the use of renewable energy sources in the city.

2.5 Conclusions for the development of new buildings in the high-performance district

During the three-year implementation phase of the mySMARTLife project, a variety of experiences were gained, particularly among the actors at the urban planning level. So far, the topic of innovative and CO2-saving energy supply has only been a marginal topic in Hamburg's urban planning. In mySMARTLife, this real laboratory situation was used, to test the extent, to which a Hamburg borough can control this aspect with its existing planning instruments. It has been shown, that there is a general conflict of objectives here. On the one hand, to enable inexpensive and fast housing construction with few bureaucratic requirements and, on the other hand, to persuade investors to a sustainable and CO2 reduced energy supply. Conventional energy and heating concepts are still considerably cheaper, while advanced concepts usually require subsidies. Here, the City of Hamburg is trying to learn from the experience gained in mySMARTLife, among other things, and has developed the new sectoral plan for energy ("Energiefachplan") as a flexible planning tool. By that the topic of energy supply is to be regularly anchored in the urban development plans of the City of Hamburg for new development areas.

The implementation of the new development areas along the "Schleusengraben" has shown that the three-year project phase represents a relatively short period of time. Thanks to its good contacts with investors and the development of the innovation network, the Borough of Hamburg-Bergedorf has been able to act as an advisor here and to initiate many processes for a smarter energy supply in the residential areas. Here the two subareas "Glasbläserhöfe" and "Am Schilfpark", with about 45 buildings above national standard (KFW70), could be finished.

However, individual external influencing factors very quickly led to considerable delays in the implementation of the individual areas. The planning phase is often more expanded than the construction phase of new buildings. Nevertheless, during the project phase individual construction areas could be completed and the character of an innovation area could be secured, through the implementation of project interventions, such as hydrogen injection, W-Lan at street lights or the installation of charging stations in the area "am Schleusengraben". Future projects of the Borough of Hamburg-Bergedorf, such as the addition of a research and development park to this area, will secure this character even after the end of mySMARTLife.

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3. Heating with Hydrogen at the area “Am Schilfpark”

With the approach of using hydrogen as an energy carrier for heating, "heating with hydrogen at Schilfpark" fits well into the so called: “Northern Germany Hydrogen Strategy”. It is defined by a working group on minister level of the northern German federal states in 2019 (Ministerielle Arbeitsgruppe B-HH-MV-NI-SH, 2019), to further expand hydrogen in the sectors. The following chapter gives an overview of the use of hydrogen as an energy carrier and its role as a storable medium. Subsequently, the implementation, obstacles and findings of the concrete project "Heating with hydrogen at Schilfpark", as well as the planned procedure in the following two years are described (Action 18: “Local district heating island supplied with hydrogen”).

3.1 Introduction and general Description

On the east side of the water body in the so-called area “Am Schilfpark”, 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.

3.2 Why heating with hydrogen?

Two of the greatest challenges of the energy system transformation are the transport and storage of energy. Electricity is to be transported from the offshore wind farms in the North Sea and Baltic Sea to the major cities and industrial centres in Central Europe. Electricity from PV systems is also required to supply traffic lights, cold stores and hospitals at night. All this can only work if the energy can be transported over many kilometers and stored for many hours. One approach that is becoming increasingly important is the generation of hydrogen from renewable electricity. This has the advantage that hydrogen can be transported in the natural gas infrastructure available throughout Europe. If the hydrogen is then burned again, the heat can be used to heat buildings. Although energy was transported in this way, neither the transport nor the storage of electricity took place. To do this, the hydrogen has to be converted back into electricity. The conversion of a fuel into heat and electrical energy has been carried out with combined heat and power (CHP) plants for years. A cogeneration plant operated with hydrogen can re-convert hydrogen into electricity and consequently make electricity generated elsewhere and at other times usable as electricity again.

Electrolysers and CHP plants are suitable for re-electricity generation. Electrolysers have higher electrical efficiencies - i.e. produce more electricity with the same waste heat - than cogeneration units, but also require high purity of the hydrogen. A CHP unit, on the other hand, consisting of a combustion engine and

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a generator, is capable of converting fuel gases to which hydrogen has been added into electricity and heat.

So far, there have been no experiments with hydrogen contents above 10 % in natural gas. Together with the gas network operator Gasnetz Hamburg (GNH) and the energy supplier with own facilities enercity (ENER), these tests are now being carried out at the area "Am Schilfpark". Up to 30 % hydrogen is added to the natural gas directly before the house connection by GNH. ENC's plants will then be examined for their behaviour. During the monitoring phase it will be tested if an operation with hydrogen content up to 30 % is possible. The findings will be used by the operators of the existing plant parks in Europe to prepare for higher hydrogen content in natural gas.

3.3 Overview about the intervention and task description

The development area “Am Schilfpark” is a crucial area for the high-performance district in Hamburg. Since the former planed “Low-ex” heating network will be not performed by the Partner ENH, because of a lost tender, it was necessary to include the new developer of the energy infrastructure, the energy provider enercity Contracting Nord GmbH, in the project consortium. Enercity introduced an innovative energy concept to mySMARTLife and was willing to supervise the monitoring after the heating system has been taken into operation.

The heat supply concept is based on a central heat production with a local heating network. The heat supply consists of two CHPs and two condensing boilers. It has been clarified, together with the manufactures, that the used boilers and CHP can be operated with hydrogen content up to 30 %. The local heating network is mainly laid in the basement and underground car park and distributes the heat to the residential buildings in the development area. The energy supply via a local heating network creates a modern and efficient energy infrastructure with attractive primary energy factors.

In the scope of the energy transition, it is expected that hydrogen will play an important role in the decarbonisation of heating systems, as well as for mobile applications. Currently, in a number of initiatives electrolysers powered by renewable energies are planned to be installed and to feed the produced hydrogen in the gas grid. Therefore, the new system is ready for the future with the expected rising hydrogen content in the gas grid.

Within the mySMARTLife project, a test series is planned to prove the suitability of the system. This will be done in form of a temporary set-up. This includes hydrogen storage near to the development area “Am Schilfpark”, and a special mixing system that charges the natural gas from the grid with hydrogen, up to a level of 30 %. Furthermore, a test program will be developed to test different mixing ratios and to gain experiences with the used technical systems. The two boilers and CHPs are already in operation. The conventional heat supply (gas only) should be compared to the innovative heat supply (gas + 30 % hydrogen content). In real operation, the CO2 saving potentials should be determined. The measurement

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concept and the scientific support are accompanied by the HAW Hamburg. Additionally, the municipal gas grid operator Gasnetz Hamburg (GNH) is involved in this action to give technical advice and support regarding the supply of the natural gas and the hydrogen. Enercity will provide the power generation equipment for the hydrogen demonstration and will adapt the CHPs and boilers to the corresponding hydrogen concentrations. Among other things, this requires permanent monitoring of the plant, adjustments to the compression ratio of the engines and the injection nozzles of the boilers.

3.4 Procedure and Implementation

After Gasnetz Hamburg (GNH) and enercity (ENER) joined the project as new partners, ENER replaced the originally planned conventional plants with hydrogen-compatible plants. The two CHP units and two peak-load gas boilers have now been installed together with the necessary measurement technology. The two boilers and CHPs unit have been in operation since March 2018. The two CHP units will be operated redundantly until the neighborhood is fully occupied and the CHP units are thus fully utilized.

At the same time GNH is working constructing and putting into operation a hydrogen injection system near the central heating plant. In addition to applying for use of the site, the plant and instrumentation and control technology have also been designed. Construction will start in spring 2020. Hydrogen will then be supplied in cylinder bundles and injected in the natural gas via the gas mixer. First, the basic behaviour of the plants in interaction with the control system of the injection system will be tested for varying hydrogen contents. As soon as all plants can be operated fail-safe, 30 vol.% hydrogen will be run for as long as possible.

Faced with the project to really operate hydrogen-compatible plants with hydrogen, the manufacturers expressed their concerns and want to be closely involved in the tests. Due to a similar structure at the nearby “Energy Campus” of the HAW, but with considerably smaller plants, basic plant parameters can first be determined at a non-critical plant at the campus, which can then be transferred to the larger plants.

In addition, the procurement of renewable hydrogen represents a financial challenge. At present, hydrogen from renewable energies is far from being an economically viable alternative to natural gas.

3.5 The development area “Am Schilfpark“

On the east side of the water body in the so-called area “Am Schilfpark”, the construction of about 360 residential units and a not inconsiderable share of commercial uses has started directly in the high-performance area. 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. The nine buildings are connected by the aforementioned local heating network. A total of 33,000 m² of living space were built according to the energy standard KFW70. This means that the buildings must undercut the energy requirements of the German Energy Saving Ordinance (EnEV) by 30 %.

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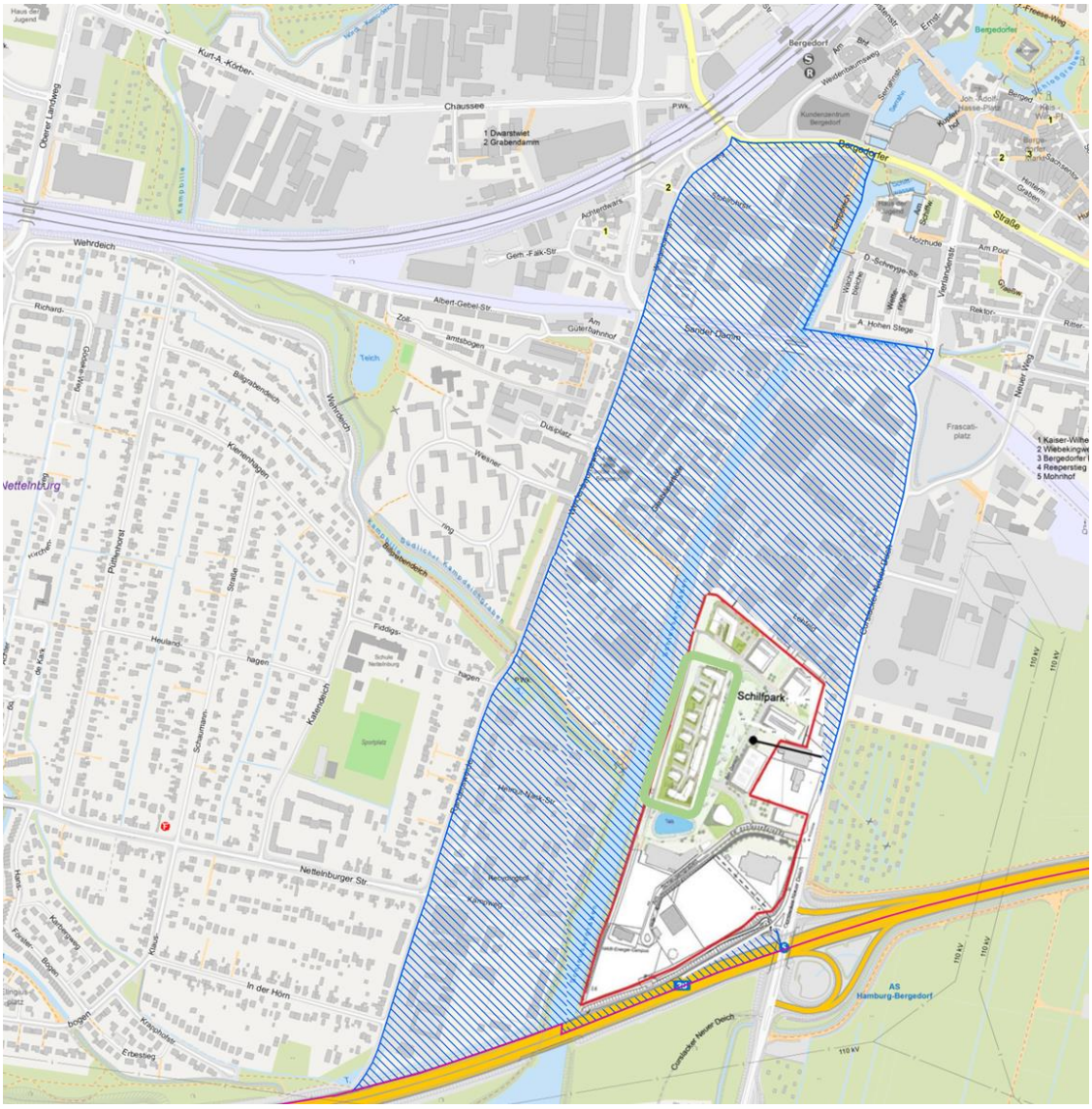

Figure 12: Schilfpark district in the high-performance area (HAW 2019, own source)

3.6 Heating System

The components consisting in the heating system in the development area “Am Schilfpark” are shown in Table 6. The central elements for heat supply are the two CHP units and the peak-load boilers. The cogeneration units form a sector coupling to the electricity grid, cover the basic heat load and are therefore operated heat-controlled. The peak-load boilers cover any load peaks that may occur in the heat demand and put in operation during scheduled and unscheduled shutdowns of the CHPs. The energy source for both types of plant is natural gas. Three thermal storage tanks with a total volume of 12,000 litres are used for a high utilization of the CHPs. The CHPs can thus be operated at their rated output

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even at low heat demand and feed in electricity accordingly. This corresponds a storable heat quantity of around 418 kWh. A CHP unit alone can therefore continue to operate for four hours without any heat requirement if the storage tanks were discharged at the start.

Within the framework of mySMARTLife, the hydrogen energy carrier has been added to this system. Up to 30 vol.% hydrogen is added to the fuel gas. Due to the lower energy content of hydrogen (approx. factor 3), the volume flow increases with the same energy content. In order to react to the changed properties due to the addition of hydrogen, Enercity has installed both hydrogen-capable CHP units and peak-load boilers. In order to add hydrogen to natural gas, Gasnetz Hamburg is installing a hydrogen injection system directly in front of the central heating plant building on the supply line on the gas network side. A schematic representation of the entire structure can be found in Figure 14. The black dotted line marks the plant park created as part of mySMARTLife. The gas flows are depicted as coloured arrows, in orange the natural gas, in blue the hydrogen and in green the mixture of both gases. Grey arrows describe the heat flow and black arrows the electricity from the CHP units. In addition, measuring points are drawn at the individual flows at which characteristic data such as volume flow or energy quantity are measured.

Figure 13: Picture of the used CHP (enercity, 2019, own source)

The gas mixer enables volume fractions between 0 % and 30 % to be added. The reaction of the plants to higher hydrogen admixture can first be tested by the gradation. In particular, the interaction of the injection system and heating plant with varying hydrogen contents will be tested. Subsequently, long-term tests with 30 % hydrogen are carried out and measured. These will take place in the second half of 2020.

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Table 6: components of the heating system (enercity, 2019, own source)

Component	
2 Combined heat and power units	Each: 50 kWel / 100 kWth
2 Condensing Boiler	Each: 500 kWth
3 Thermal Storages	Each 4,000 l
Local heating network	over 460 m long
Temperatures flow/return	70°C/35°C
Hydrogen storage	10x 12 gas cylinders with 8.9 Nm³ H2 each
1-3 Gas mixing units	Ratio/flow rate/???
Annual heat demand	1,970,000 kWh/a
Annual natural gas demand for CHP (without H2)	3,050,000 kWh/a
Annual hydrogen demand	Estimated 201,000 m³ / 703,500 kWh
Annual CO2 savings	Up to 140 t

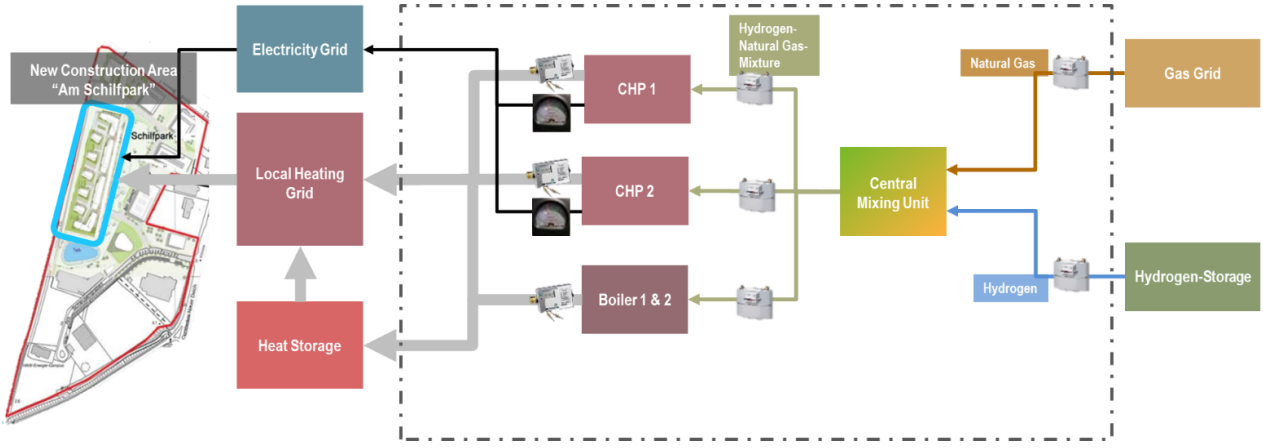

Figure 14: schematic representation of the heat supply (HAW, 2019, own source)

3.7 Hydrogen supply

The hydrogen that is used within the duration of the mySMARTLife project will be stored at hydrogen cylinder bundles. There will be two times six bundles between which you can switch when six bundles are empty. The other six bundles can be replaced by new ones while the hydrogen supply is still ensured. There will be a pressure reduction before the storage is connected with the hydrogen injection plant. The hydrogen will be counted and fed in by a quantity control system which works on basis of the set hydrogen content and the natural gas volume flow. A Gas mixer is located after the injection to ensure sufficient mixing of the gases.

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The Injection can be interrupted in case of emergency. In that case the heating plant will be fed with pure natural gas to ensure security of supply.

The heating plant and the injection system will be coupled with each other to enable data exchange. This guarantees a safe operation of the plants and ensures that hydrogen can only be fed in the system if the units in the heating plant operate failure-free.

3.8 Testing and monitoring schedule

The Hamburg University of Applied Sciences (HAW) has a research facility in close vicinity to the new development area. With its Centre for Energy Efficiency and Renewable Energies (CC4E), the Energy-Campus is well known for practice-oriented research in the eponymous fields of this centre. For this reason, a similar setting of heat producers as in the area “Am Schilfpark” can be found at the CC4E. Even the used CHP is from the same manufacturer as in the development area. Yet, in opposite to the development area, the hydrogen being used at the CC4E is produced with an electrolyser on-site and also the other gas in the mixture, here methane the main component of natural gas, is produced directly at the centre. Nevertheless, because of the similar technical setting a pre-test schedule has been developed at the CC4E where the involved project partners (HAW, ENER, GNH) are able to gain practical experiences with the mixing of hydrogen with another gas and the use of that mixture, as well as with the operation of the CHPs and boilers with different mixing ratios.

The outcome of the pre-test at the CC4E is very valuable for the practical operation of the heating system in the development area. Yet, it will be necessary to have another test period at the actual setting at “Am Schilfpark”, whereas the CHPs and the boilers need to be calibrated to be able to run with the gas mixture before the regular operation can start.

During the first heating period in winter 2019/2020. the pre-tests at CC4E will be carried out. Based on this, hydrogen will be fed into the plants at Schilfpark in spring 2020. This will start with a hydrogen content of 5 % and then be increased to 30 % over several days. Initially, it is planned to maintain each step for 14 days. After 26 weeks, an ascending and a descending ramp have been driven. Based on the findings from the 14-day tests, faster changes in the hydrogen content will then be tested. It is conceivable to increase the hydrogen content from 0 % to 30 % in a few minutes and to reduce it again. This places special challenges not only on the engine control system but also on the control technology of the gas mixer. Once it has been established that the systems are functioning without problems and the behaviour when the hydrogen content changes have been investigated, operation is set to 30 % hydrogen.

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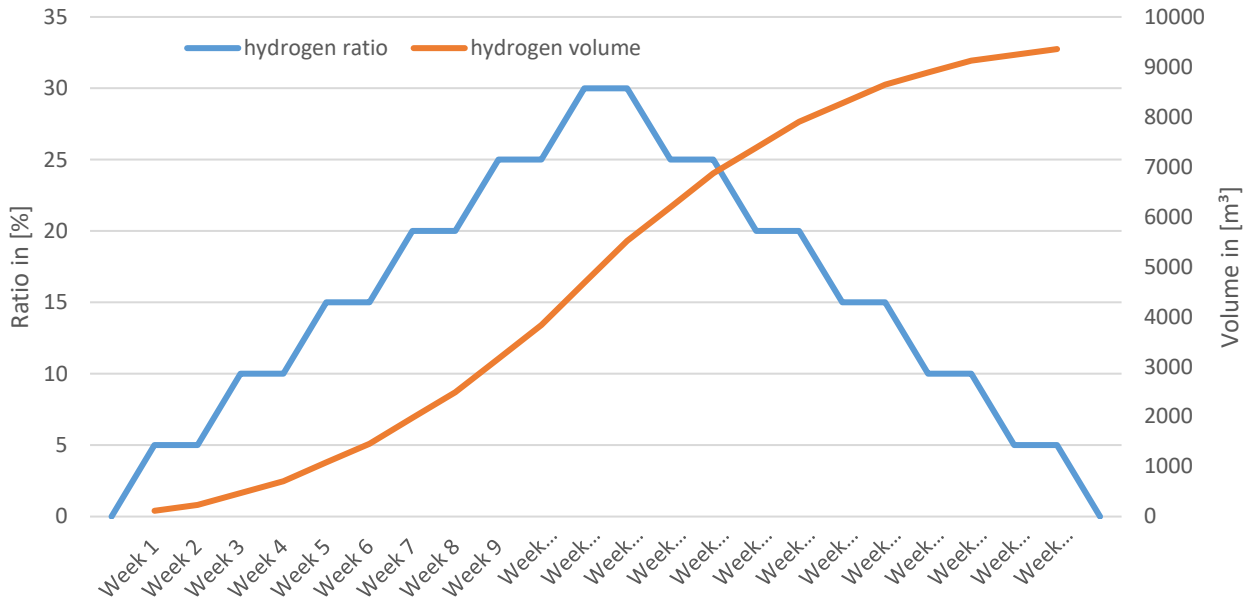

Figure 15: scheduled hydrogen ratio over time and estimated hydrogen demand (HAW, 2019, own source)

The CHP plant, which has already been commissioned, has been monitored since March 2019. As a result, energy data from the "Am Schilfpark" heating centee are available even before the monitoring phase. Figure 16 shows the thematic and electrical energy as well as the electrical output of one CHP from March to November 2019. In these nine months it has generated about 400 MWh of thermal and 240 MWh of electrical energy. During this time the CHP burned about 720 MWh of natural gas[1].

[1] With a calorific value-related efficiency of 104 %

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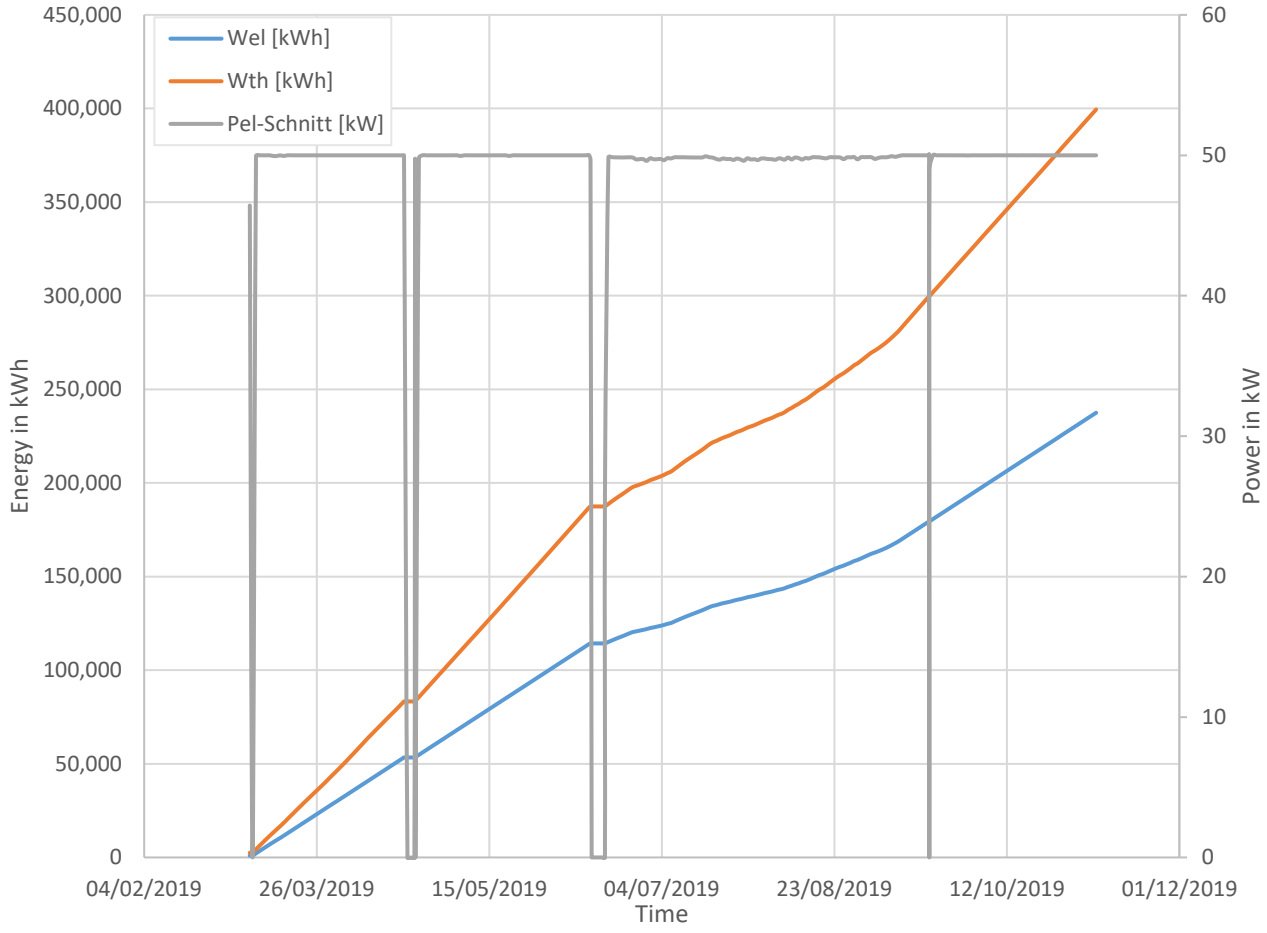

Figure 16: Power and electricity production of one CHP (HAW, 2019, own source)

3.9 Expected outcome and next steps

One of the most important experiences gained in the course of the project is the interaction between the CHPs and the hydrogen injection system. In particular, with regard to varying hydrogen contents. The project provides information on what is needed in terms of the hydrogen injection system to supply customers with hydrogen.

Gasnetz Hamburg gains experience regarding the planning, construction and operation of hydrogen storages and hydrogen injection plants. This applies to the technical aspects as well as to the organisational and regulatory aspects. This is particularly important for Gasnetz Hamburg, as the gas network operator has to increasingly assume the task of operating a hydrogen infrastructure in the future.

With regards to the expected outcome, a distinction must be made between outcome that will be observed on the one hand on the hydrogen mixing plant and the natural gas pipeline and on the other hand on the energy supply plant (condensing boiler and CHP).

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On the side of the energy supply plant, an expected outcome will be to determine at what level of hydrogen in the combustion gas mixture changes will occur in the operation of the CHP units and the condensing boiler. In particular, the technical management expects the occurrence of unintentional ignitions at the CHP and a supposed flame break at the boiler. Corresponding settings at the compression ratio or ignition time of the CHP and settings at the air and gas throttle valve for fuel metering at the boiler must be made then. Based on the different proportions, standardized setting parameters can be determined from this. Thus, the sensitivity of the energy supply system to changes in the hydrogen content in the natural gas and the effects on the operation of the systems can be recorded here as an expected result.

A further result will be the CO2 emissions savings resulting from the addition of hydrogen to the natural gas. With a maximum hydrogen content of 30 % by volume in the fuel mixture, the example shown above can save approx. 11.8 % of natural gas in the period from March to November 2019. Assuming a CO2 emission factor for natural gas of 244 kgCO2/MWh, this corresponds to a saving of approx. 20 t CO2 emissions.

The next step is to generate hydrogen locally from renewable energies. With a power-2-gas plant (electrolyzer), which causes a chemical reaction in the form of a material conversion with renewably generated electricity. As a result, water is broken down into its chemical components hydrogen and oxygen. With a view to using the public gas network as storage for renewably produced hydrogen, the experience gained in this demonstration project can point to a wide range of possibilities. Yet, it can also illustrate the limits of technical feasibility.

Enercity contracting operates and manages heating and power stations throughout Germany. One of our largest district heating projects is the development of “HafenCity East”, Europe’s largest waterfront re-development. Currently enercity contracting supplies this area with industrial waste heat. The heating, cooling and other energy products are individually tailored to the customers' needs. In the scope of the energy transition, it is expected that hydrogen will play an important role in the decarbonization of heating systems as well as mobile applications. Currently multiple initiatives are planned to install electrolyzers powered by renewable energies and mix hydrogen in the gas grid. Therefore, the new system is ready for the future and the expected rising hydrogen content in the gas grid. Furthermore, this project allows to gain a lot of experience which will offer an efficient, economical and environmentally friendly energy supply in the future.

3.10 Conclusion for the use of hydrogen in the heating network “Am Schilfpark”

In the residential area "Am Schilfpark" in the middle of the high-performance area of mySMARTLife, the foundation stone was laid to use hydrogen for heat generation. Hydrogen-capable instead of conventional components were used for the heating technology. However, the use of hydrogen also requires additional

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components. For this purpose, a gas mixer for the admixture of hydrogen and additional measurement technology were installed near the residential area. The hydrogen, which was procured later, is stored in cylinder bundles next to the gas mixer.

In summary, the following devices were implemented at Schilfpark:

- Two hydrogen-capable CHP plants
- Two hydrogen-capable peak load boilers
- Three hydrogen-capable gas quantity meters
- Building for gas mixing device
- Gas mixing device
- ICT for remote control and remote maintenace
- Hydrogen cylinder bundle storage area
- Procurement of hydrogen
- Measurement technology:
    - Gas quantity meters NG and H2
    - Volume flow meter NG und H2
    - Heatmeter

During the test phase, the aforementioned components and their interaction, as well as the cooperation between gas network operator, heat supplier and university, will provide well-founded insights into the operation of such systems.

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4. Retrofitting and smart Heating Island in “Bergedorf-Süd”

The following chapter describes the results of the approach in mySMARTLife, to activate house owners to retrofit their buildings in the project area zone 2 “Bergedorf-Süd” (Action 2: “Bergedorf-Süd retrofitting Project”). The chosen approach, carried out by konsalt (KON) and the activities regarding the participation and activation of the citizens is described in detail in the following (Action 48:”Citizens’ participation to promote investments of private property owners” and Action 49:”Stakeholder participation”). Afterwards an overview about the concepts of “smart heating islands” and the achieved results are shown (Action 14: “Smart heating islands in retrofitted area of Bergedorf-Süd”).

4.1 Introduction

The current climate policy objectives in Hamburg for the years 2020, 2030 and 2050, as well in this context guiding principle of a "Climate Smart City" and complementary strategies and measures to achieve the ambitious goals, based on the Hamburg Climate Plan of December 2015 (BSU, 2011). The climate plan integrates climate protection and adaptation to climate change. Already by 2030, the city wants to halve CO2 emissions compared to 1990. Currently, the Hamburg climate plan is being updated (Lindner S., John A., Hermelink A. et al., 2019).

In addition to the share caused by traffic, a large proportion of urban emissions are accounted by residential and non-residential buildings. In Hamburg, this amounts to approx. 4.23 million tonnes of CO2 for heat supply (excluding process heat) and 16.2 TWh of final energy (Energy Balance 2015). That is about 34 % of the final energy consumption of Hamburg. The goal of the city of Hamburg - in line with the federal goal - is to achieve a nearly climate-neutral building stock by 2050 (Lindner S., John A., Hermelink A. et al., 2019).

Focusing one of the topics of mySMARTLife on retrofitting and on heating islands with the integration of renewable energies is a main strategy to achieve this goal. Challenges and results of these topics can be very helpful for other cities.

In total, about 71 million m² of heated space in Hamburg can be allocated to the residential buildings and approx. 56 million m² to the non-residential buildings (Lindner S., John A., Hermelink A. et al., 2019 based on Ecofys, 2012).

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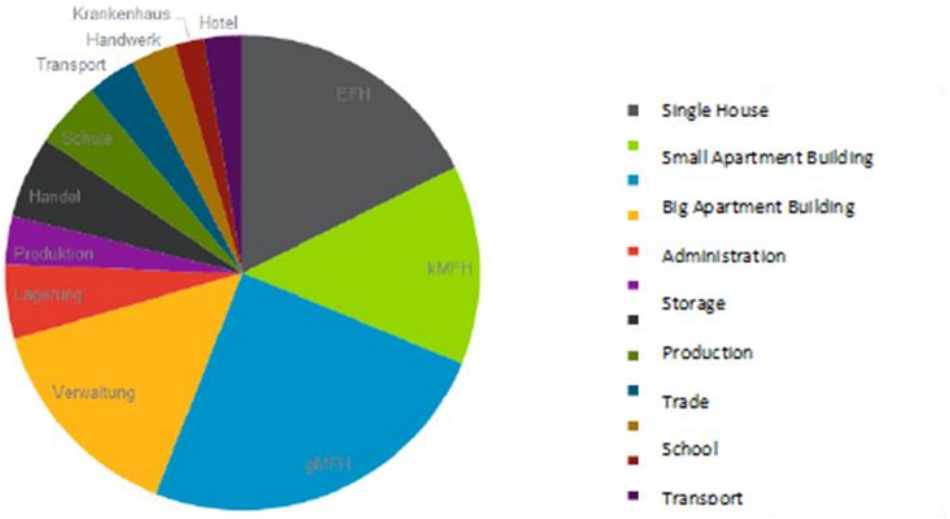

Figure 17: Housing stock in Hamburg differentiated to the usages (Lindner S., John A., Hermelink A. et al., 2019)

The allocation of the building age classes of residential buildings in Hamburg shows the particular relevance of buildings from the post-war period since 1945 to the end of the 70s.

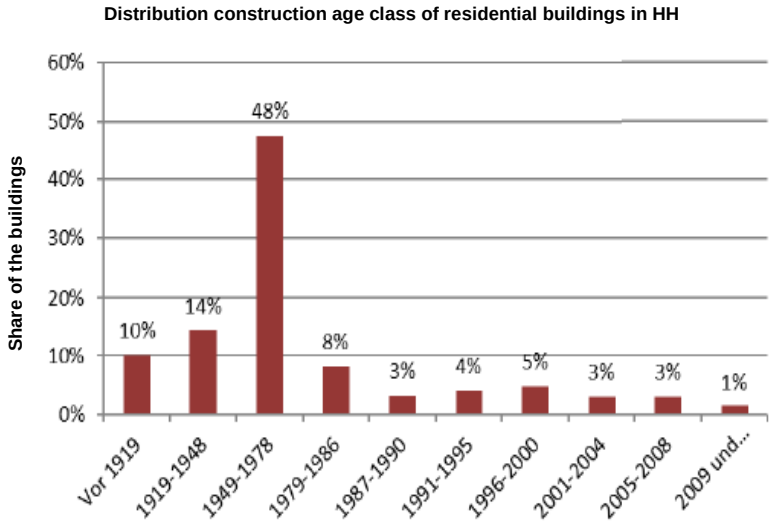

Figure 18: Distribution construction age class of residential buildings in Hamburg (Lindner S., John A., Hermelink A. et al., 2019)

The actual retrofitting rate in Hamburg is 1.1 % for the residential buildings and 0.8 % for non-residential buildings (Lindner S., John A., Hermelink A. et al., 2019). According to the goal of achieving a nearly climate-neutral building stock by 2050, this rate has to be raised significantly.

Figure 19 shows that residential buildings in Hamburg are mostly owned by private owners (69%).

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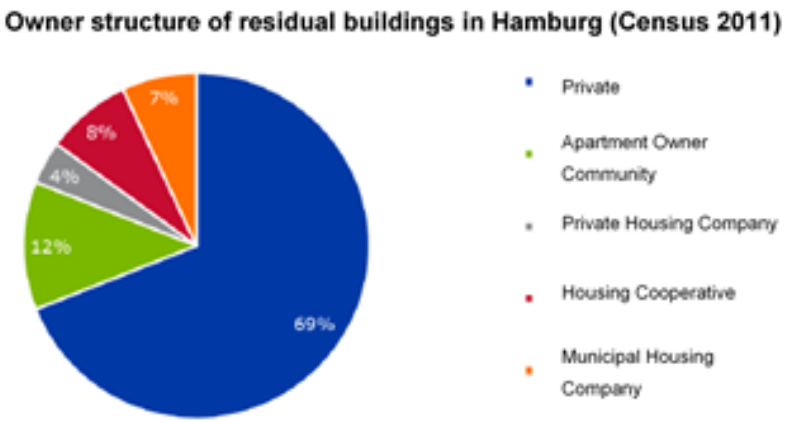

Figure 19: Owner structure of residential buildings in Hamburg (Lindner S., John A., Hermelink A. et al., 2019 based on Census, 2011)

In 2015, more than half of the energy for space heating and hot water was provided by natural gas and mineral oil. In Hamburg, district heating plays an important role – almost one quarter of the provided energy is distributed through a large grid in the city. Recently, the City of Hamburg repurchased this grid from Vattenfall, a Swedish private company due to a referendum of the citizens. Renewable energies in the City of Hamburg concerning space heating and hot water play up to now a subordinate role.

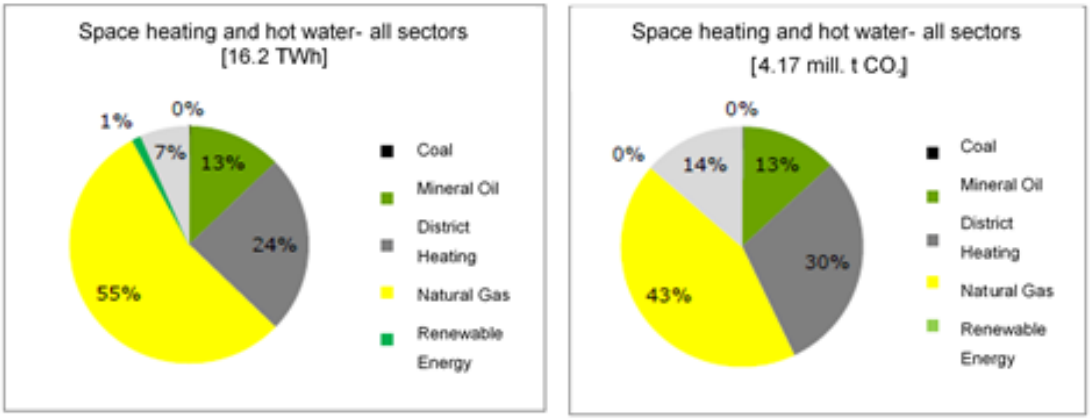

Figure 20: Proportions of energy sources for space heating and hot water and CO2 emissions in Hamburg (Lindner S., John A., Hermelink A. et al., 2019)

This means that for the whole City of Hamburg there is a large potential for retrofitting and the transformation of the heating systems to a higher share of renewable energies.

Nevertheless, the high potentials are also strong challenges especially for a fast-growing city like Hamburg. The present target of 10,000 permits for new apartments per year is one of the challenges. Associated with it is a discussion about rising construction prizes and difficulties of finding construction companies. As in other growing cities, prizes for condominiums and for rents as well have increased drastically and affordable housing is a very actual topic in local politics as well as in the public.

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The funding offers of the Hamburgische Investitions- und Förderbank (IFB) for energy saving measures or implementation of renewable energy are quite good and differentiated. Nevertheless, private investors often do not take advantage of the funding because of the current low interest rates.

4.2 Overview about "Bergedorf Süd"

The retrofitting area "Bergedorf-Süd" was chosen as a demonstration side for the mySMARTLife project, because of the complexity of a wide mixture of old buildings (approximately 500 buildings with 330,000 m2 in total) and a highly diversified property owners' structure.

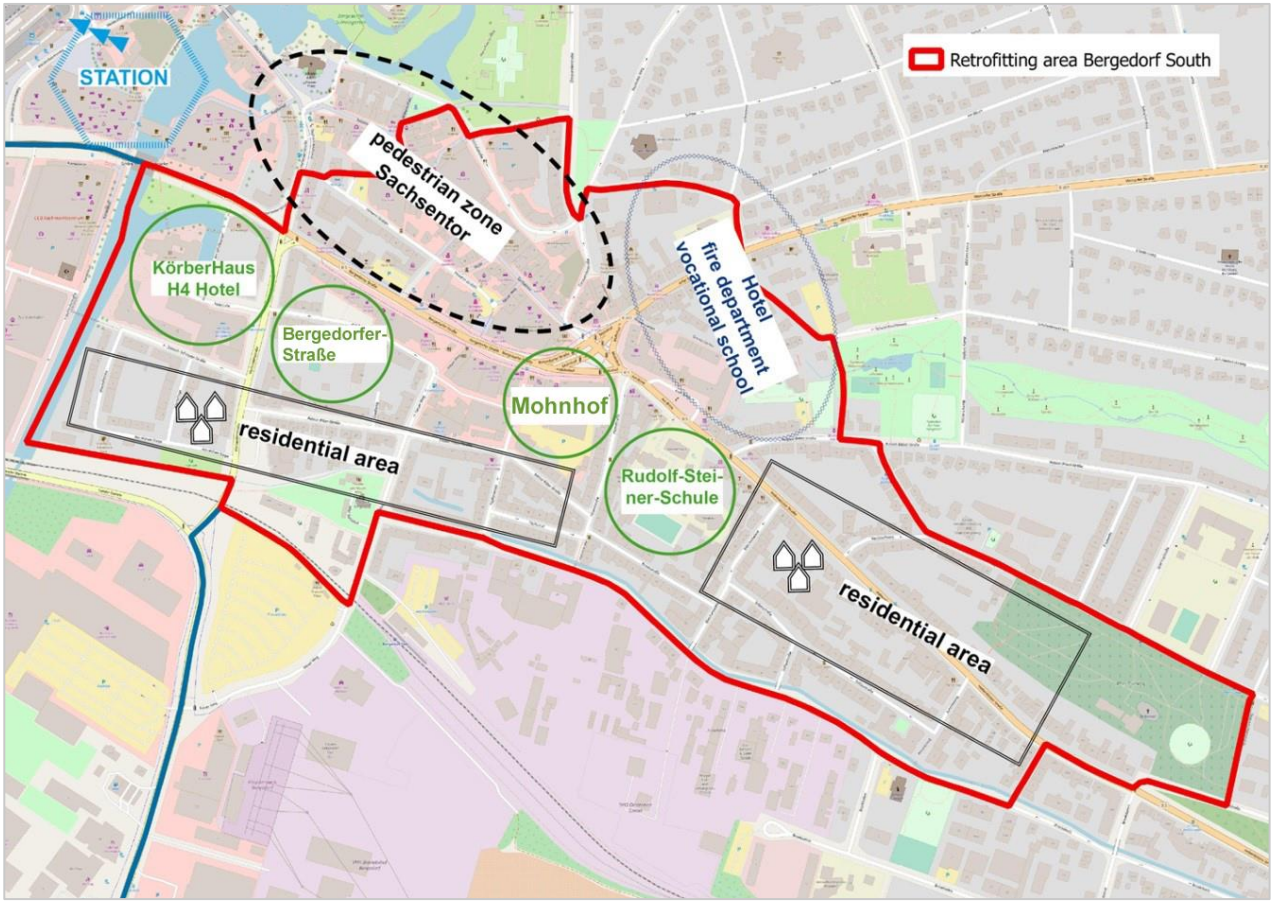

Figure 21: Project area "Bergedorf-Süd" (konsalt, own source, background map: www.openstreetmap.org)

Due to its heterogeneous development, user and ownership structure, the quarter can serve as an example location in order to transfer approaches developed there to other quarters.

Here, the project mySMARTLife followed an activation approach for the house owners and aimed at motivating and advising them for using retrofitting measures and to sensitize for concepts of smart heating islands, mainly based on renewables. Also, raising public awareness for energy subjects in general was one of the main goals.

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4.2.1 Urban status quo

The area includes a large variety of architectural styles with a large fraction as multi storey buildings with the Hamburg typical brick facades.

Figure 22: Buildings at “Sachsentor”, “Soltaustraße”, “Bergedorfer Straße” (konsalt based on pictures of Metropol Grund, 2016)

Furthermore, about 12 % of the area is under protection, because of the historical value of the buildings, which are preserved and listed as monuments. As for the other buildings, although they have not been identified as monuments, they nonetheless convey significant historical importance from the 1920s until today. Because of this, the area is a much-demanded urban residential quarter and rents have risen significantly in recent years.

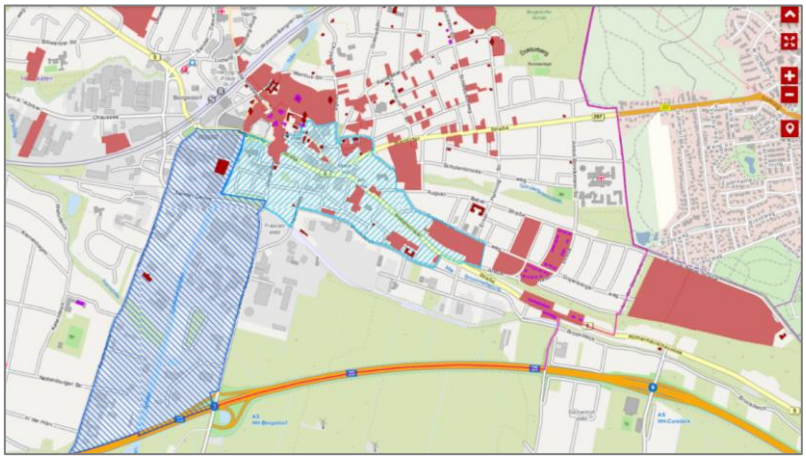

Figure 23: Map of preserved (red) and listed (dark red) monuments and important red brick building (pink) (source: Konsalt, based of https://geoportal-hamburg.de/geoportal/geo-online/)

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Almost half of the buildings in the project area were built before 1950s and almost half of the buildings are used as multi-dwelling apartment houses.

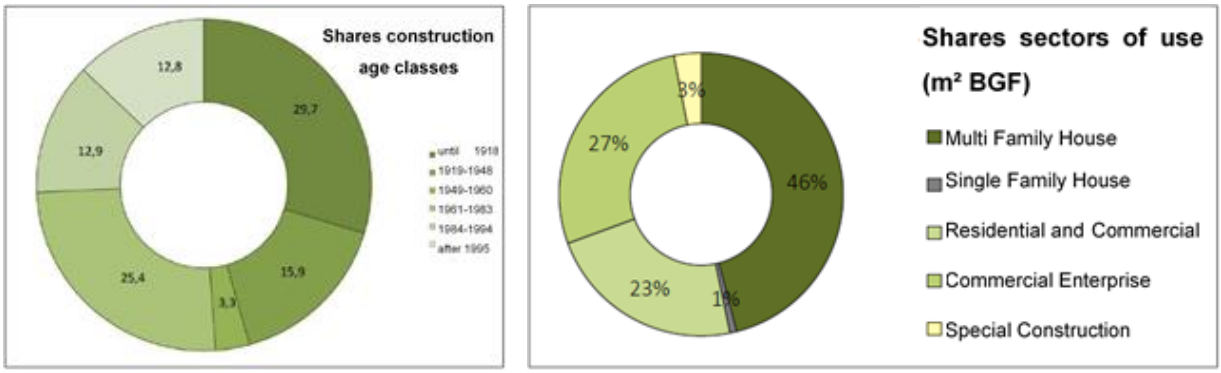

Figure 24: Shares construction age classes and shares sectors of use (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

The gross floor area of the total building stock in the area was at the starting point of mySMARTLife about 323,000 m².

4.2.2 Energy demand in Bergedorf-Süd

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

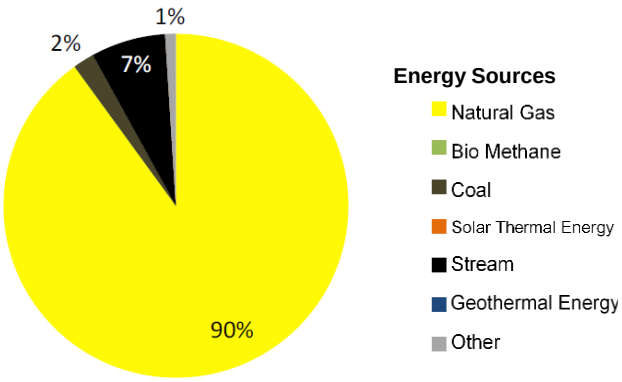

Figure 25: Heat supply 2010 in Bergedorf-Süd (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

The area is fully developed with gas mains along the roads. The connection density was rated as high with 81 % of all buildings.

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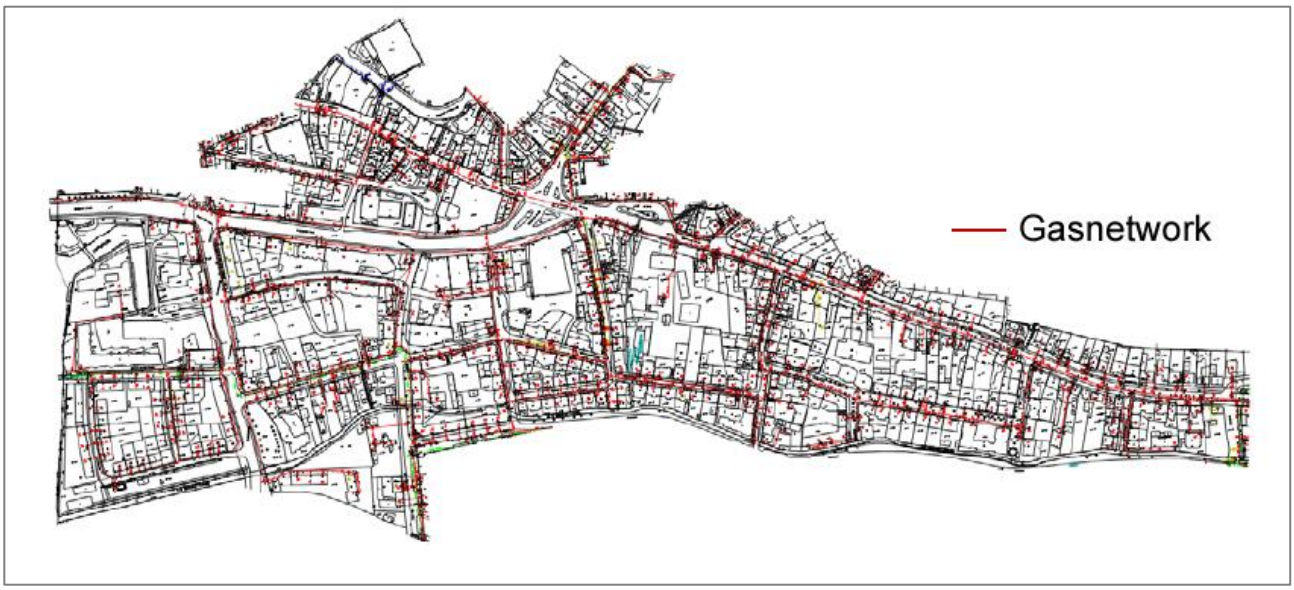

Figure 26: Gas network and distribution in Bergedorf-Süd (Gasnetz Hamburg own source, 2017)

The analysis of the energy consumption of the Bergedorf-Süd area showed the following energy consumption for heat and electricity:

- According to the information provided by Hamburg Netz, natural gas consumption in the total area amounted to 34.28 GWh/a in 2011.
- Electricity consumption for replenishment heaters (NSH) was 2.20 GWh/a in the total area.
- The sum of the weather-adjusted gas and NSH electricity consumptions including boiler losses and auxiliary power for generating plants as well as the current in instantaneous water heaters amounted to 43.40 GWh/a, including boiler losses and auxiliary power.
- Electricity consumption for households and commercial uses less electricity consumption for instantaneous water heaters for domestic hot water production was 12.63 GWh/a.

Heat consumption in 2013 was on average 120 kWh/m²a, about 20 % below the statistical average for residential buildings in Germany. Household electricity consumption, at 41 kWh/ (m²a), was about 30 % above the German average.

Including the type of heat generator, the primary energy requirement was 56.57 GWh/a. This corresponded to a specific primary energy requirement of approx. 175 kWh/m²a (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2014).

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4.2.3 Energetic potentials

Concerning the energetic potentials, it has to be differentiated between theoretical maximum possible solutions, probably technical realisable projects, economic feasible potentials and by the end of the real implemented projects.

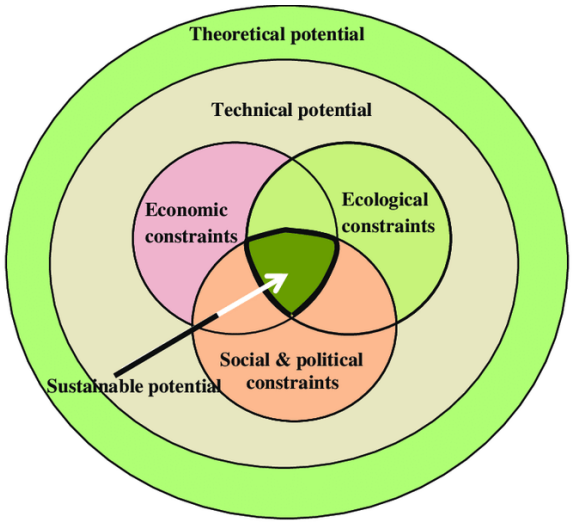

Figure 27: Schematic illustration of the technical potential (source: researchgate, 2019 adapted from Steubing et al. 2010)

At the starting point of mySMARTLife the theoretical potentials where in focus:

Potentials by retrofitting

Through various analyses and assumptions on the development of the building stock in “Bergedorf-Süd” (increase of retrofitting rates and depths) annual savings potentials were simulated and extrapolated. This results in a theoretically possible reduction in CO2 emissions from building retrofitting by almost 45 % in 2050 (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017).

Potentials by replacement building

It was stand out at the beginning of the mySMARTLife project that some of the old buildings would not be retrofitted, but that it would be cheaper and more energy efficient to build new replacement buildings. For some buildings, not only energy savings but also modern floor plans could be implemented.

Potentials by successive conversion of energy supply to RES and implementation of heating island

In addition to energy-efficient retrofitting and energy-efficient new buildings, one of the most important levers is the gradual conversion of the energy supply to a high share of RES and low CO2-intensity.

With regard to heat generation, theoretically about one third of the heat demand could be covered on the basis of solar thermal collectors if all suitable areas could be used.

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By increasing the technical potential in the field of electricity generation by using all the appropriate PV areas in the area, electricity consumption could be covered by up to 20 %.

In order to implement more RES or more efficient energy sources in neighbourhoods, so-called "Heating Island" concepts were deepened.

4.3 Specific approach in mySMARTlife

In the framework of the project, a specific approach for the activation, information, citizen and institutional engagement, tailored to interest of the different stakeholders, was developed - the mySMARTLife-Tool-Box (see Figure 28).

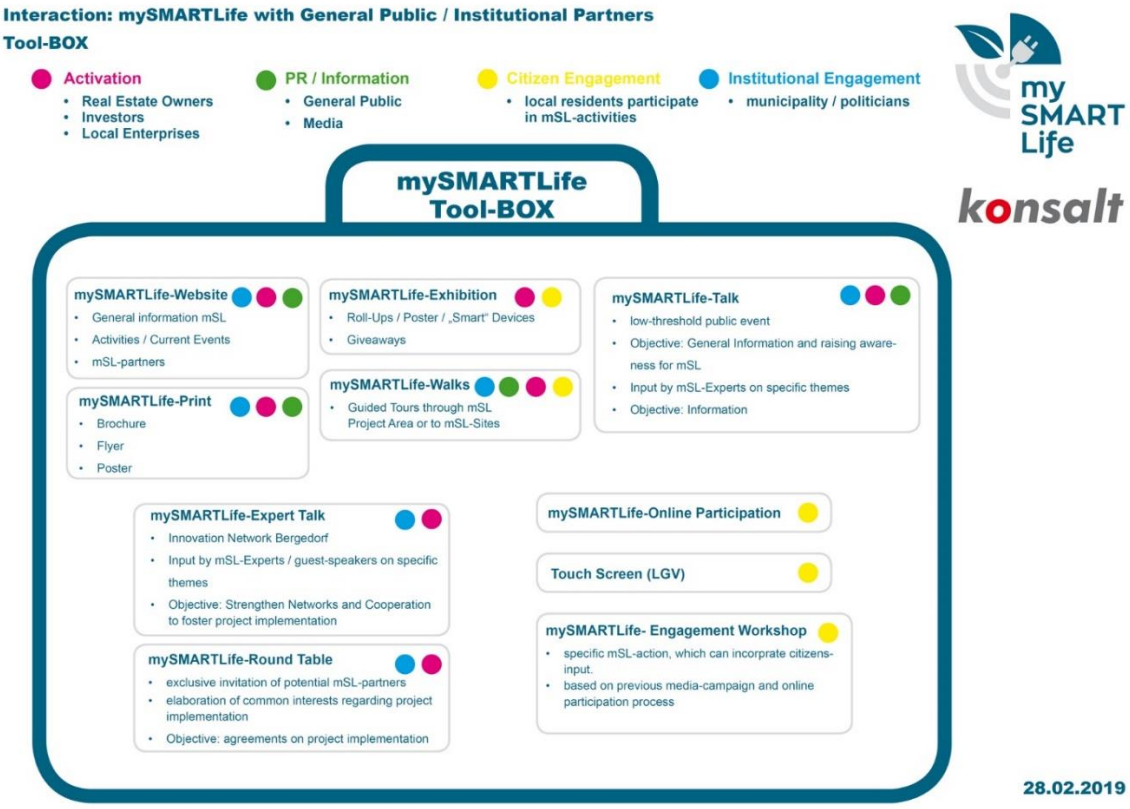

Figure 28: The mySMARTLife Tool-Box, developed by konsalt, gives an overview about all the activation measurements and the addressed stakeholders in the project (konsalt, own source)

One aim of the mySMARTLife Tool-Box is to constantly increase the number of retrofitting activities in the area via different measures:

1 Attention

2 Addressing

3 Supporting

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

4 Evaluation

4.3.1 Creating attention!

mySMARTLife Website

In order to keep the public up to date with mySMARTLife, the hamburg.de/mysmartlife website was implemented. Information about project partners, projects and current events and activities have been continuously published.

mySMARTLife Print

To inform the public about mySMARTLife different print media were used. An Information Booklet, a mySMARTLife Rollup and three other leaflets were realized.

Figure 29: mySMARTLife information material (source konsalt, own source left, Steinbeis middle and right)

mySMARTLife events, presentations, workshops

With the public kick-off-event during the European Week on 12th of May 2017, the mySMARTLife project and the project partners presented their activities to the public.

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Figure 30: mySMARTLife public kick-off event (konsalt, own source, 2017)

There were also mySMARTLife Study Tours through the project area – with the focus on the Bergedorf-Süd project area and the retrofitting projects.

Figure 31: mySMARTLife Study Tour through Bergedorf-Süd (konsalt, own source, 2016-2018)

In order to inform the public about the project and to discuss various topics, there were different participation formats.

The mySMARTLife-Talks lecture series included 4 different topics:

- Talk 1: Opportunities of the new Tenant Electricity Act for the urban energy transition
- Talk 2: Package delivery on the last mile | CEP services in the district and lodging
- Talk 3: Smart Points | Smart starlight lanterns
- Talk 4: The role of smart cities in the energy transition and smart metering

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Figure 32: mySMARTLife-Talks (konsalt, own source, 2016-2018)

During the European Week 2019, mySMARTLife participated with lectures on the topic "Urban Development of Tomorrow". The mySMARTLife VR-Walk was presented to a specialist audience as well as to the public.

Figure 33: Announcement for the event during the European Week 2019 in Hamburg “Smart City – life and design virtual urban development” (konsalt, own source, 2019)

Figure 34: State Councillor Dr. Tabbara is testing the Virtual Reality Walk through Bergedorf (Senate Chancellery of Hamburg, 2019)

In March 2017 the mySMARTLife-Round-Table started with the focus on heating solutions with solar thermal energy. Besides funding possibilities and technical option, especially the topic “economic aspects of renewable energies in the heating sector” was tackled.

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Figure 35: mySMARTLife Round-Table on solar thermal use – technical options and case studies in the Bergedorf-Süd area (konsalt, 2017)

Two mySMARTLife exhibitions presented the topics of retrofitting and innovative systems of energy supply in the City Hall of Bergedorf and a local Shopping Centre. From a total of 156 visitors, 97 consultations were held.

Figure 36: mySMARTLife exhibitions on retrofitting and energy supply at local public spaces with the offer of personal consultations for individual house owners (konsalt, own source, 2016-2018)

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A total of four mySMARTLife Expert Talks – so called Innovation Network Bergedorf were organized. The topics of these Innovation Network meetings were design innovation, sustainable mobility and sustainable energy. The 5th Innovation Network Bergedorf will take place in December 2019.

Figure 37: mySMARTLife Expert Talks – Innovation Network Bergedorf (konsalt, own source, 2017-2019)

One of the major aims of these Innovation Network meetings is to create a community among the innovative stakeholder in Bergedorf which will last over the period of mySMARTLife project and will continue as a driver for the Smart City of tomorrow in Bergedorf.

4.3.2 Addressing directly!

Letter to house owners

At the end of 2018, all owners of existing houses or flats in the “Bergedorf-Süd” area were contacted (see picture of the Letter in Annex 1). In total, these were 350 people or housing companies. In this letter, attention was drawn to the established consultation offer for energetic retrofitting. In addition, information on current funding programs was added.

The response to this action was quite low. With seven private owners or companies this initiative led to further contacts and consultations.

On-site-consultations with the Hamburg Consumer Association

In order to create a broader range of consulting options, a cooperation agreement was concluded with the Hamburg Consumer Association (“Verbraucherzentrale Hamburg e.V.”). The Hamburg Consumer Association can draw on a broad pool of energy consultants for the various fields from retrofitting to renewable energy and efficiency measures.

In addition to the regular consultation services in the borough of Bergedorf, an additional service was provided in the local district office in “Bergedorf-Süd” in order to raise consumer awareness of environmentally friendly usage behaviour and to promote concrete advice to house owners.

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Figure 38: Consultant offer on retrofitting, renewable energies and efficiency measures for house owners in the local district office Bergedorf-Süd (konsalt, based on steg, 2018)

In total, 61 consultations where held – main topics: insulation, heating systems, renewable energies, sustainable construction materials, economic aspects and funding possibilities.

Department for Construction approval in the Borough of Bergedorf

In order to gain early knowledge of retrofitting or replacement projects, contact was established with the department responsible for the approval of building projects. In addition, this department advises investors at an early stage on the possibilities of construction, (use) change and construction facilities, and could therefore point out parallel to the consulting services within the mySMARTLife project.

4.3.3 Supporting and consulting!

Throughout the mySMARTLife -process, there were several retrofitting projects which were very promising in respect to their size and effects (see map in Figure 40). This was firstly the H4-Hotel with 50 apartments to be delivered with thermal energy, secondly the development “Bergedorfer Straße” aiming at restructuring the whole complex to build 200 apartments and replace the existing commercial uses and thirdly, the project “Mohnhof”, where four property owners plan to build apartments and establish a local heating island. This heating island is planned to integrate the retrofitting area. Because of their complexity and size, these projects and also other private house owners were intensively consulted and supported by all Hamburg partners and mySMARTLife e.g. the City of Hamburg, the Borough of Bergedorf, Energienetz Hamburg (ENH) and konsalt. Many of the consultations were about technical solutions, finances and funding and planning prerequisites.

Whereas the H4-Hotel has been successfully completed, the “Mohnhof” project will started and will be completed probably in the next 2-3 years, the development “Bergedorfer Straße” has come to a stop because the owners did not agree among each other about their financial commitment.

4.3.4 Periodically evaluation!

In order to be informed about ongoing construction projects, periodical site inspections and a photographic documentation of the retrofitting or construction measures in the area were carried out.

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Figure 39: Example for retrofitting projects in Bergedorf-Süd (konsalt, own source, 2016-2019)

4.4 Current status and challenge for the implementation of retrofitting

4.4.1 Current status

With the information out of the constantly site expectations, direct contacts to some of the house owners and the data from the department of construction approval of the Borough, it is possible to have an overview of the ongoing retrofitting process in the area of “Bergedorf-Süd”.

In mySMARTLife, so far, over 20 projects with approx. 15,000 m2 (approx. 14 retrofitting and 6 replacements) are estimated to have been realised. A detailed validation still is necessary with the house owners – according to the data protection law. The Borough of Hamburg-Bergedorf is supporting with a letter to all these house owners to get detailed information about their realised measures, the energy results and the authorisation to evaluate and monitor the energy data.

Considering that the actual yearly retrofitting rate in Hamburg is 1.1 % for the residential buildings and in Germany even less (0.8 %), it is a success of the mySMARTLife project to have in “Bergedorf-Süd” a retrofitting rate of more than 1.5 % (Lindner S., John A., Hermelink A. et al., 2019).

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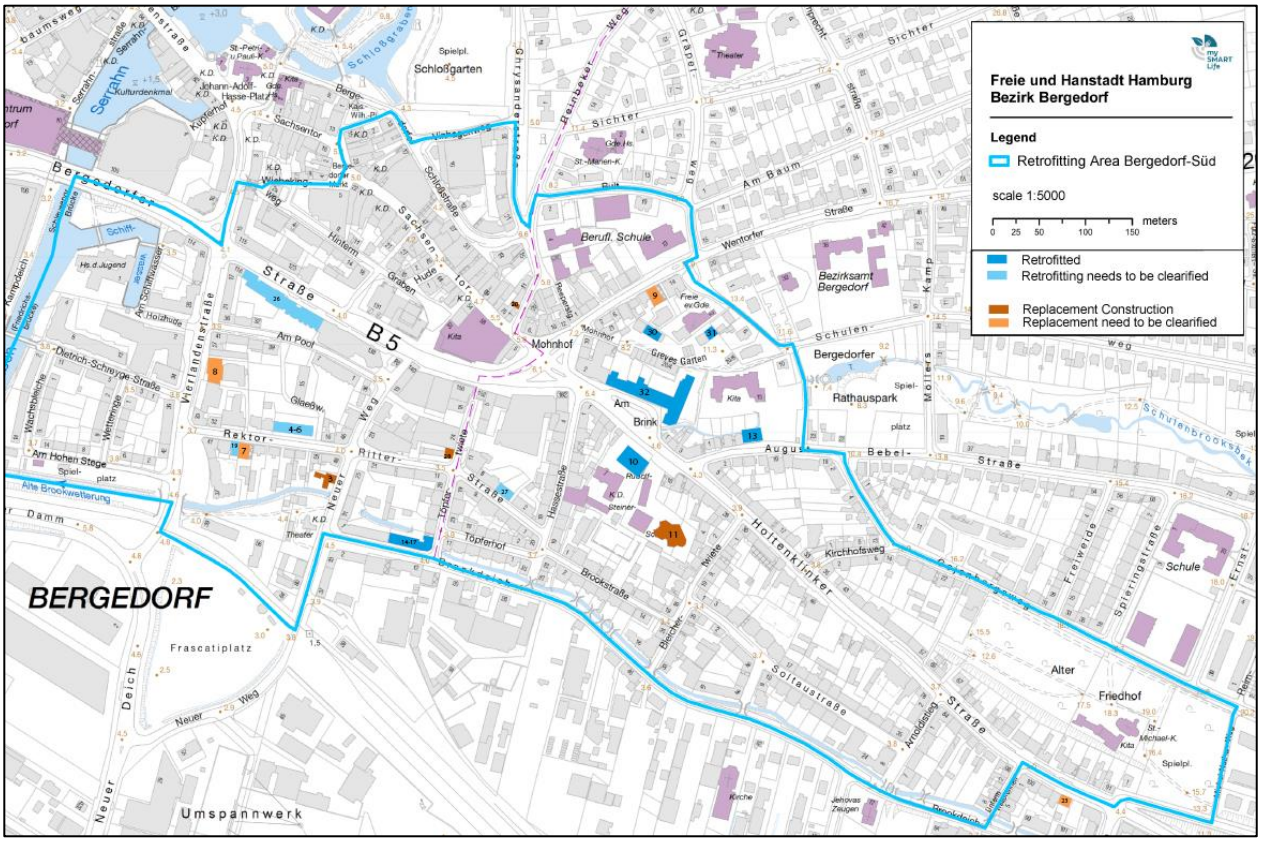

Figure 40: Map overview of the current mySMARTLife projects (konsalt own source, 2019)

Table 7: List overview of the current mySMARTLife projects (konsalt, own source, 2019)

	Destination	Retrofitting/ Replacement	Square Meter	Specification of Measures
	Am Brink	Retrofitting	876	Insulation of the inner walls according to the historical monuments
	August-Bebel Straße	Retrofitting	700	Insulation of the back façade, new windows
	Brookdeich	Retrofitting	408	Insulation of the façade; new clinker coverage
	Brookdeich	Retrofitting	408	Insulation of the façade; new clinker coverage
	Brookdeich	Retrofitting	408	Insulation of the façade; new clinker coverage
	Rektor-Ritter Straße	Retrofitting	393	to be clarified
	Rektor-Ritter Straße	Retrofitting	558	to be clarified

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	Rektor-Ritter Straße	Retrofitting	590	to be clarified
	Rektor-Ritter Straße	Retrofitting	590	to be clarified
	Rektor-Ritter Straße	Retrofitting	590	to be clarified
	Greves Garten	Retrofitting	400	wood chip pellet supply
	Greves Garten	Retrofitting	160	wood chip pellet supply
	Töpfertwiete	Retrofitting	408	Insulation of the façade; new clinker coverage
	Am Brink	Replacement	966	KfW-55-Standard with heat pump supply
	Chrysanderstarße	Replacement	1,165	to be clarified
	Holtenklinker Straße	Replacement	730	to be clarified
	Neuer Weg	Replacement	1,340	to be clarified
	Rektor-Ritter Straße	Replacement	420	to be clarified
	Rektor-Ritter Straße	Replacement	1,054	EnEV -30%, solar thermal supply
	Vierlandenstraße	Replacement	3,051	to be clarified
	Wentorfer Straße	Replacement	1,550	to be clarified
	total	**approx.**	**15,000**	

For collecting detailed data from the house owners a special factsheet was prepared (see Annex 2). All house owners with retrofitting or replacement actions are asked to support the mySMARTLife project and provide their data. In some cases there is already a close contact to the owners and the factsheets can be filed, also with the support from experts.

The Hamburg Investment and Funding Bank (Hamburgische Investitions- und Förderbank) analysed their funding programmes (retrofitting, green roofs and renewable energies) in Bergedorf during the last years:

Programme “Hamburger Energiepass” (expert report on the current situation and possible energy savings through retrofitting):

Table 8: Programme “Hamburger Energiepass” (konsalt on basis of data IFB Hamburg, 2019)

Bergedorf district year	Grant approval multi dwellings	Grant approval single houses
2014	4	0
2015	1	0
2016	1	10
2017	1	8
2018	0	6

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Since the mySMARTLife project the grant approval of this program has increased significantly.

Programme "Wärmeschutz im Gebäudebestand" (funding for retrofitting measures):

Table 9: Programme "Wärmeschutz im Gebäudebestand" (konsalt on basis of data IFB Hamburg, 2019)

Bergedorf district year	Number approved requests	number approved apartments
2014	45	63
2015	23	90
2016	60	116
2017	33	78
2018	25	37

Since the mySMARTLife project there were in total approx. 120 approved requests for this programme with more than 230 apartments. The table shows also a decrease of funding in the last years which could not be exactly explained by the funding bank.

Programme "Erneuerbare Wärme" (funding for renewable heating systems):

Table 10: Programme "Erneuerbare Wärme" (konsalt on basis of data IFB Hamburg, 2019)

Bergedorf district year	Number approved requests	Savings CO2 (t)
2014	7	47,498
2015	3	22,49
2016	5	28,352
2017	4	8,474
2018	5	44,819

There is a continuously request for the funding of renewable energy systems in the area.

Programme "Gründach" (funding for green roofs):

Table 11: Programme "Gründach" (konsalt on basis of data IFB Hamburg, 2019)

Bergedorf district year	Number approved requests	Savings CO2 (t)
2014	0	0,0
2015	0	0,0
2016	0	0,0
2017	2	76,2
2018	3	677,9

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This programme started in 2017 and especially in 2018 a large project in Bergedorf could be realised. With a green roof, profound energy savings and also cooling effects in summer are positive effects.

4.5 Exemplary description of two realised mySMARTLife projects:

Retrofitting:

Figure 41: mySMARTLife retrofitting project August-Bebel-Straße before (left) and after (right) (google maps street view, 2009; konsalt, own source, 2019)

This retrofitting project shows an appropriate handling of historical facades and buildings that characterize the area. Both were combined: the renewal of the inner structure as well as the energetic upgrading of the building. The street façade was repaired and beautifully coloured, the windows on both sides were replaced and the back was insulated with a thermal insulation composite system (ETICS). Furthermore, new balconies were built for all apartments on the garden side. The building was raised by an attic with two additional apartments.

Replacement:

Figure 42: mySMARTLife replacement project Rektor-Ritter-Straße, before (google maps street view, 2009)

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

Figure 43: mySMARTLife replacement project Rektor-Ritter-Straße, after (konsalt, own source, 2019)

The investors of this block decided not to retrofit the existing old building with approx. 420 m². They built a new apartment block with 12 units in an energetic 30 % better standard as the legal standard.

Raised was an attractively built multiple dwelling with only 12 residential units - three full storeys plus staggered storey. The facade is insulated with thermal insulation composite system with 3-fold glazed windows. The heat supply takes place with a gas condensing boiler with central hot water preparation - the hot water is supported by a solar system on the roof. The property has a comfortable ventilation system.

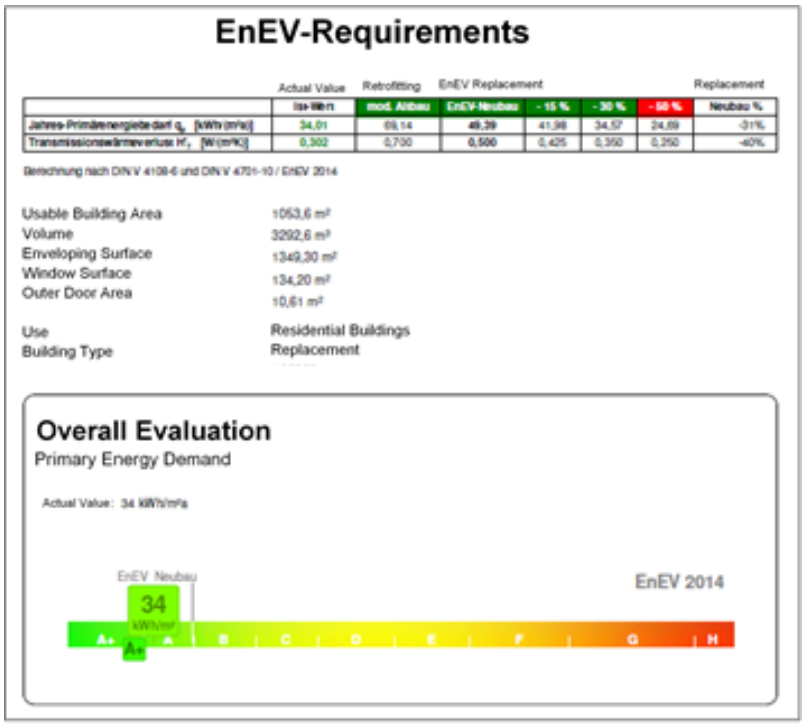

Figure 44: Energy Saving Certificate Rektor-Ritter Straße (konsalt based on report of the energy advisor, 2017)

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

4.6 Current status and challenges for the implementation of the smart heat islands

In context of the mySMARTLife project a heat island approach was conceptualized to tackle primary heating energy demands and the CO2 emissions of the area.

The path of convincing and consulting private house owners to retrofit their houses is very slow and tedious. It takes a long time and often – as well in the mySMARTLife project seen again – especially for private house owner it is a complicated, expensive and complex decision. In the future, a generation change is expected among house owners. It might be expected that the younger ones among them will be more willing to invest in renewable energy.

For the Bergedorf-Süd area, the mySMARTLife project team decided to bring forward two aspects: never stopping in consulting about retrofitting and efficiency measures but on the other hand promoting the use of low CO2-heating concepts – especially as heat island solutions.

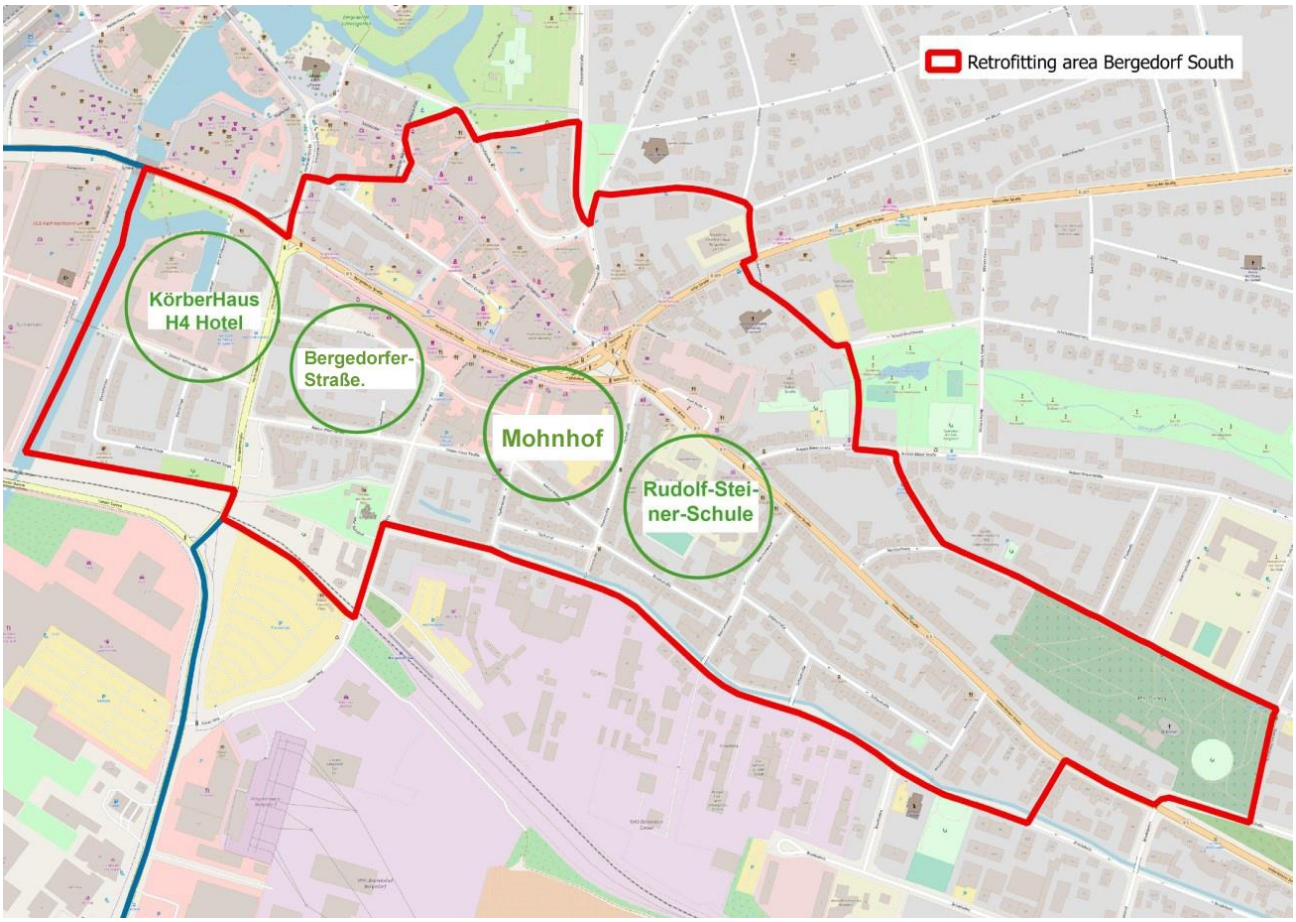

Figure 45: Developed concepts of heat island solutions in Bergedorf-Süd (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

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An evaluation of major public and commercial buildings was conducted in order to establish possible small district heating networks – so called heat islands.

Four projects started with the mySMARTLife project:

1. H4 Hotel / Körber Haus
2. Rudolf-Steiner-Schule Bergedorf
3. Development area “Mohnhof”
4. Local housing cooperative at the “Bergedorfer Straße”

4.6.1 H4 Hotel / Körber Haus

The existing heating system of the H4 Hotel was due to the age on anchor point of another heat island. A modernization of the heat supply was required.

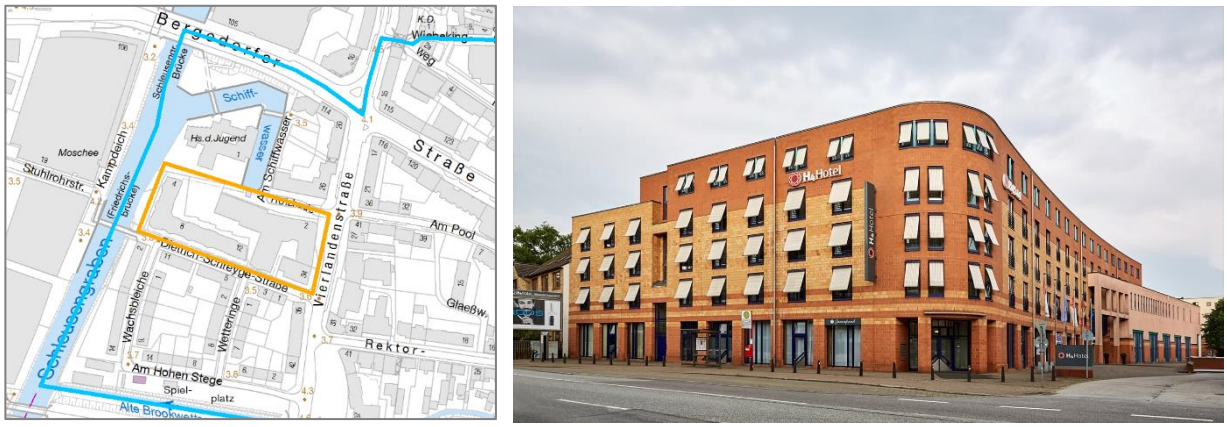

Figure 46: Site plan H4 Hotel, existing building H4 Hotel (map left: Borough of Bergedorf, own source; picture right: konsalt own source, 2019)

In coordination with the responsible technical manager of the property, an energy timetable has been set up, which the commissioning of the existing power plant provided planned. Through the first conversations different potentials for an energetic optimization were identified. The necessary replacement of the energy supply could provide a sustainable solution, e.g. based on CHP with a district heating network, in which surrounding buildings and residential areas could be included. Especially the cultural centre “Körber Haus” was interested in a cooperation in the heat island.

During an on-site inspection of the entire building, various structural measures were identified on the envelope surface which could reduce the energy requirements of the building.

The director of the H4 Hotel showed a keen interest in a district heating solution and the implementation of energetic refurbishment measures, so that further consulting sessions were held with him and the technical manager of the property.

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Beginning of 2019 a CHP for the H4 Hotel and the surrounding housing block with 50 apartments came on stream.

Figure 47: The new CHP plant in the H4 Hotel which supply heat to additional 50 apartments in the neighbour block (konsalt, own source, 2019)

Table 12: Performance data of the new CHP heat island (konsalt based on data of DIE - Deutsches Institut für Energieeffizienz eG, 2019)

Performance data of the new CHP heat island	
Electricity demand	1,212,100 kWh/a
Heat demand	2,080,400 kWh/a
CHP:	
Type	YADO EG 70
Commissioning	05.06.2019
Electrical power	70 kW
Thermal power	113 kW
Overall efficiency	90.7 %
Fuel	Natural gas
Average operating hours	7,700 oh/a
Average CO_2 avoidance	155,160 kg/a
Electricity:	
Average electricity generation CHP	512,800 kWh/a
Average owner use CHP electricity	512,380 kWh/a
Average grid feed-in CHP electricity	420 kWh/a
Average electricity coverage share	42 %

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Heat:	
Average heat generation CHP	842,500 kWh/a
Average owner use CHP heat	842,380 kWh/a
Average heat coverage share	40 %
twin boiler plant:	
Type	Reneha Gas 610 ECO Pro 610-1300
Commissioning	20.05.2019
Nominal heat output (80/60)	1,200 kW
Overall efficiency	98.5 %
Fuel	Natural gas

4.6.2 Rudolf-Steiner-Schule Bergedorf

The property of the private Rudolf Steiner School comprises several school buildings, including three listed buildings, of which the front building on the street “Brink” is the oldest school building still in operation in Hamburg. The heat supply system no longer met today's requirements.

Figure 48: Front facade Rudolf-Steiner-Schule, site plan Rudolf-Steiner-Schule (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

In the course of the discussions with the managing director, possible optimization potentials in the field of energy renovation and replacement of the heating system were discussed and the option of creating a district heating network with integration of the surrounding properties was presented. The managing director showed great interest in these measures and also saw the possibilities of integrating regenerative energies into the supply and further strengthening the positive image of the school in the neighbourhood.

After completion of the planning, the retrofitting work on the listed front building was completed in the summer of 2017.

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Figure 49: Retrofitting of the brick facade with calcium silicate interior insulation (konsalt, based on pictures of Metropol Grund, 2017)

With regard to the planning of the canteen extension, the school was supported in the investigation of various energy standards, the analysis of energy supply options and the integration of subsidies. As a result, the school management decided to build the building in accordance with the KfW-55 standard and to realize the heat supply via a heat pump with activation of the foundation piles as a heat source. The laying of the cornerstone for the new building took place on 24.04.2017 and the completion was in 2018.

Figure 50: New building for the school canteen (konsalt own source, 2019)

With regard to the heat supply of the school and the neighbourhood, the school's energy demand scenarios were first determined as the basis for the further energy supply concept. On this basis, various options of local heating supply with the involvement of surrounding properties were examined and calculated in their respective economic and ecological effects. The relevant potentials were presented to the management and then held initial discussions with a potential contractor. In addition, owners of surrounding buildings were informed in an information session about the possibilities of a district heating network in order to determine their prospects to participate. On the basis of the higher heat prices determined by the contractor, by the end the low interest of the owners in an investment and the high

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planning effort, the idea of a heat island extending beyond the school area with other properties could not be realized.

4.6.3 Development area “Mohnhof”

The site of the development area of a private company is located on the place “Am Mohnhof” to which at the beginning a vacant department store, several adjacent commercial flat roofs, an administrative tower and four apartment buildings from different eras, and a larger open space in the block interior belonged. The owner had been planning to demolish the department store and the low-rise buildings, and to build three new apartment houses here and on the open space in the block yard. For this purpose, a construction development plan (B-Plan) process on the area had already been initiated by the local planning authorities before the start of the project and an architectural competition had been executed.

Figure 51: Concept for the new buildings at the “Mohnhof” (konsalt, based on pictures of DFZ Architekten, 2016)

After discussions with the participating planners and the Borough of Hamburg-Bergedorf, the owners were informed about the potential for energetic optimization of the planning and a central local heating supply for the new buildings and possibly surrounding properties. The owners at the beginning were open-minded and interested in innovative solutions.

The discussion on the details of the construction project between the owner and the district was then more protracted than initially planned, so that the decision to start a project was postponed. The already started request to the owners of the surrounding properties with regard to the interest in a common energy supply was subsequently interrupted. Initial results showed, however, that an interest in participation was to be expected, with contracting solutions being favoured.

Energy and economic calculations were made and several planner meetings were held with the owner, the architects and the city planning department of the district on the energy concept for new and old buildings. Following this, a comparison of different enveloping area standards and retrofitting options were presented to the owners, on the basis of which they decided to set at least the KfW-55 standard for the

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new buildings and to check the central heating of her buildings within the framework of the ongoing development plan procedure.

The owners then decided to plan the project in several construction phases and initially to build only two instead of three multi-family houses. This represented a decisive change both for the ongoing B-planning process and for the topic of the district heating network. After further clarification and detailing of the changed concept, the calculations were adapted to the energy standard and different variants of the heat supply were calculated. Again, the results were presented to the owners. As a result, they decided to provide the KfW-55 standard and also to provide local heating for the new buildings as well as to check the connection of its existing properties to the district heating network. The energetic retrofitting of the old buildings was to be examined in detail at a later date.

The energy supply calculations also looked at several options where the location premises could serve as a location for a heat island. Specifically, the connection to local housing cooperative properties in the northwest and the Rudolf Steiner School in the southeast was examined and the effects assessed. In 2017, several discussions and coordination rounds on this topic took place together with the Borough of Hamburg-Bergedorf and the Hamburg Ministry of the Environment and Energy, where concepts with comprehensive support and planning assistance were developed and proposed to the owners. Despite these offers, however, the investors then decided against a heat island solution, because the associated coordination effort seemed too large and they did not want to get into a dependence on other project developments.

4.6.4 Local housing cooperative at the “Bergedorfer Straße”

The area at the „Bergedorfer Straße“ and „Am Pool“ belongs to the property of a local housing cooperative and is mainly used for apartments. At the beginning, there were already plans for a new construction project at the “Bergedorfer Straße 122” with the approach to realize a high energy standard. In addition, the boiler plant with a thermal output of 117 kW in the house "Am Pool" proved to need of modernization. The boiler was installed in 1989, so that the normal life of a boiler had already been exceeded. There was thus a need for action. This provided the opportunity to conceptually combine the modernization of the existing heat supply "Am Pool", the planned heat supply of the new buildings in the “Bergedorfer Straße 122” and the existing heat supply of the remaining existing buildings of “Bergedorfer Straße”.

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Figure 52: Excising buildings „Bergedorfer Straße“, site plan (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

The cooperative expressed great interest in being advised in the project for the modernization of the existing energy supply of their properties in “Bergedorfer Straße” and “Am Pool” as well as for the possible energy supply of the planned new buildings in “Bergedorfer Straße 122”.

Baselines of energy consumption and future energy requirements were determined and a concept for heat island, which could be fed with heat from CHP plant, was worked out. In addition, potential roof areas of the properties suitable for solar thermal energy were investigated.

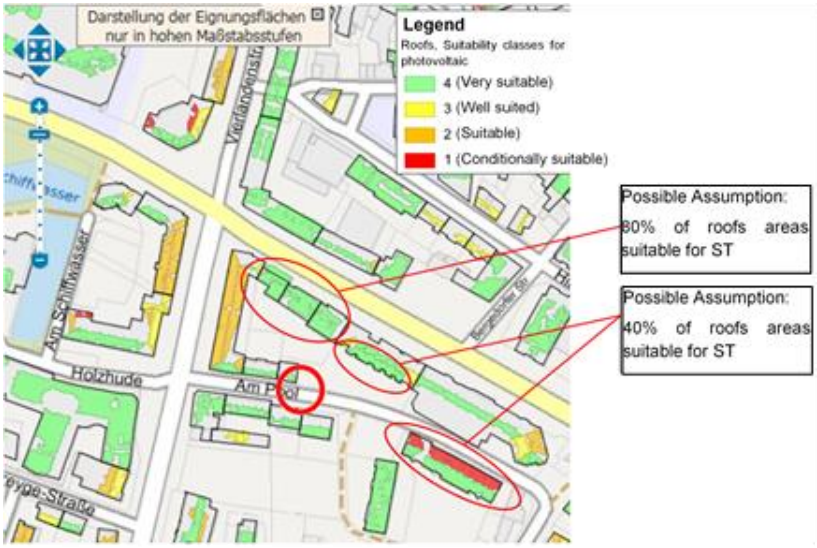

Figure 53: Existing buildings “Bergedorfer Straße” (Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017 based on map: Ministry of Environment and Energy Hamburg)

Large efforts were made to mobilize potential partners, investors and contractors as well as potential heat consumers and in coordination with the local cooperative. This led to the idea of a "great solution", in which further properties such as the development area on Bergedorfer Straße or new construction projects such as "Wohnen an der Vierlandenstraße" should be integrated into the planned district heating

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network. A consultation regarding the economic and ecological effects of this hat island including surrounding properties as well as funding opportunities took place. In spite of the intensive consultations, until now the project has not been realised.

New construction "Wohnen an der Vierlandenstraße"

On the property "Vierlandenstraße 29", a residential complex with 50 senior service apartments was to be built. The aim of the new building project was the establishment of a heat network for the supply of heat possibly with power supply and a high energy standard in terms of construction technology. This resulted in the possibility of various consultations aimed at integrating the energy supply into the planned heat island of the neighbouring properties of the cooperative and the inclusion of other neighbouring buildings as a "great solution".

Figure 54: Site plan Vierlandenstraße, new construction (map: Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017; picture: konsalt own source, 2018)

Potential contractors were involved, so that the tasks did not only consist in the support of the technical interests for the creation of an energy concept but also in the activation work. The latter measures also included addressing and activating neighbouring owners in order to integrate their properties into a local heating network and to inform and advise on this. In this context, the variant to integrate "Am Pool 1 to 7" into the heat island was also considered.

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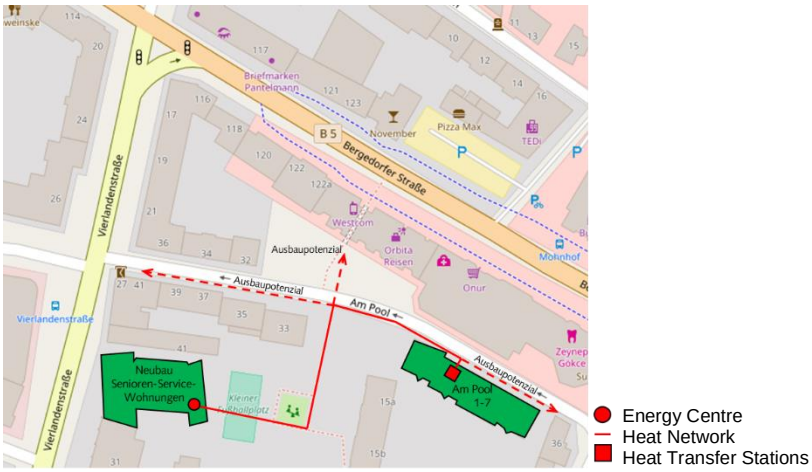

Figure 55: Supply variant „Additional supply of the cooperative“ (map: Arbeitsgemeinschaft konsalt GmbH, MegaWATT GmbH und Metropol Grund GmbH, 2017)

In the energy concept, various possibilities of energy supply and a possible construction / connection to a district heating network were examined. After several discussions with the investor of the building about the possibility of a supply through contractors, the legal uncertainties could be clarified and negotiations with selected heat providers took place. The investor was very interested in efficient combined heat and power generation, either as a standalone solution or in cooperation with the local cooperative. Due to uncertainties regarding the realization of a large common heating network, the investor decided in mid-2017 an own local supply variant, consisting of a CHP (customer plant in the building block). The CHP was with a capacity of 40 kWth and 20 kWel dimensioned so that a primary energy factor of 0.50 and low CO2 emissions could be achieved.

4.7 Lessons learned: smart heating islands and retrofitting

In mySMARTLife, so far, over 20 projects with approx. 15,000 m2 (approx. 14 retrofitting and 6 replacements) are estimated to have been realised. A detailed validation still is problematic and difficult because of the European data protection law regarding energy data on house level, only voluntary information is possible. Nevertheless, the Borough of Hamburg-Bergedorf supports a request for voluntary participation with a letter to all these house owners, to get detailed information about their realised measures, the energy results and the authorisation to evaluate and monitor the energy data.

Considering that that the actual yearly retrofitting rate in Hamburg is 1.1 % for the residential buildings and in Germany even less (0.8 %) it is a success of the mySMARTLife project to have in Bergedorf-Süd a retrofitting rate of more than 1.5 %.

In mySMARTLife four heat island concepts were analysed – one heat island is realised by 2019.

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After the experience of several years of activating and consulting and building up a network of private and public stakeholders as well, the following conclusions can be drawn:

- The low energy prices have made many of the proposed energy retrofitting projects uneconomic.
- Currently the low energy prices mean that larger investments in cross-project supply are economically not feasible. Therefore, the planned smart heating networks were more difficult to implement.
- In particular, gas and heating oil prices are so low in Germany that renewable energies often do not appear to be economically viable, because taxes and levies are distributed very unevenly among the various energy sources, from which fossil fuels have hitherto benefited.
- Another important factor is the question of reimbursement of infrastructure for smart heating networks. In particular, the construction of infrastructure (canals, etc.) that run below roads cause greater problems and really high costs in the realization.
- When advising and accompanying retrofitting or replacement projects on efficiency standards or supply solutions, it has also been shown that the mySMARTLife team can only act in an advisory and supportive capacity. The implementation of projects or measures depends ultimately on the decision of the house owners and their economic and private expectations as well as on the given planning framework of the community.
- Another lesson is that private individuals are less motivated than expected to undertake energy retrofitting of their buildings. Despite an intensive activation strategy and public relations, such as the direct approach of the individual owners, the offers of mySMARTLife are accepted significantly lesser than expected.
- According to the tenancy law reform with the heat supply regulation, the costs of a new supply must not exceed the previous operating costs for the previous heat supply, which makes it very difficult to realize a heat supply, especially in the case of integrated solutions with contractors in the inventory.
- The framework conditions for the implementation of local heating networks are currently difficult (legal requirements, energy prices, individual timetables of the individual actors). Bringing private owners and housing companies together requires along consulting and supporting process and infrastructural upfront services.
- During the implementation phase of the mySMARTLife project it became apparent that private individual owners are rather deterred by the current (in principle very good) funding opportunities and do not take advantage of them because of their perceived complexity.

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- Another lesson is that the new European data protection law makes it very difficult for evaluation projects to get the needed data for the monitoring.
- In the cities the prices for construction have raised dramatically and due to a high construction activity in the urban agglomerations, it is a challenge to find good educated planners and craftsmen.
- The social impact of the ricing construction prices is more and more in the public debate, so every action has to be seen under this aspect – even if energetic retrofitting or ambitious replacement projects are not significant more expensive. Affordable rents are one of the main topics these days in the cities.
- The very heterogeneous of individual house owner structure in Bergdedorf-Süd impeded quick and comprehensive realised projects. It has to be kept in mind the very high expenditure in the mySMARTLife project to activate this group.
- And one of the most difficult lessons maybe is, that the offer of comprehensive consulting free of charge, for some investors has no binding character in the realisation. (“What costs nothing isn't worth anything either.")

4.8 Conclusions for the retrofitting actions in “Bergedorf Süd”

After the experience of three years of activating and consulting and building up a network of private and public stakeholders as well, the following recommendations can be drawn:

In particular, gas and heating oil prices are so low in Germany that renewable energies often do not appear to be economically viable, because taxes and levies are distributed very unevenly among the various energy sources, from which fossil fuels have hitherto benefited.

However, the economic costs incurred in the long term due to climate change have to be considered, either with the instrument of a CO2 tax or emission trading. The partial lack of interest in the topic of energy retrofitting shows that the incentive for owners to act has to be increased. This cannot be achieved after the project experience by an intensification of the general counselling offer.

Here measures such as a simplification of funding conditions could better support. During the project period, it became apparent that some owners are rather deterred by the current conditions. One possibility here would be to offer simplified measures. Although high energy requirements could continue to be met, individual component-related measures could be supported by easily understandable and easy-to-apply funding. This would remove the hurdle of having to implement complex packages of measures in order to be able to participate in any funding at all and thus also facilitate subsidized retrofitting in partial steps.

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The framework conditions for the implementation of local heating networks are currently difficult (legal requirements, energy prices, individual timetables of the individual actors). Bringing private owners and housing companies together requires infrastructural upfront services, which should be created by the city itself or the energy supplier. Here is the consideration of energy supply on the district level a very promising base.

Continuing to motivate house by house every private house owner in retrofitting measures should continue but transforming the heat supply with renewable district heating solutions can gain better CO2-results in shorter time and in many cases for fewer investments, therefore a compulsory connection to use existing district heating grids should be applied in binding land use plans.

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5. General Conclusions

During the implementation of the building-related interventions in the project it became evident, that a major hurdle for the execution of the project interventions was, that the players in the Hamburg project consortium all had no direct access to the buildings in the new and old building areas. As a result, the implementation of the project actions depended largely on external factors and was often slowed down or made impossible by external influences and decisions of third parties.

Also the City of Hamburg, which was represented in these interventions by the Borough of Bergedorf, has only a limited influence on the privately owned buildings. The role of the City of Hamburg is essentially to establish planning law and to issue building permits at the end of the planning process. If building rights exist and a building permit has already been granted, the city has only limited influence.

Against this background, the project has accordingly taken the approach of activating investors and owners, by reducing concerns about innovative energy systems through examples and giving advice during the implementation of new construction projects.

Moreover, it also became apparent, that the reality in the actual urban development beyond subsidised pilot projects is still essentially determined by the factor of economic efficiency. Climate-friendly construction that allows to reduce CO2 emissions has not yet become a decisive factor for most of the project developers. Germany has so far no powerful financial incentive to avoid or reduce CO2 emissions. A number of approaches to lower the climate effect of the new developments were developed by the mySMARTLife consortium in Hamburg. But, since the project does not offer direct subsidies and due to the reasons mentioned above, many of those could not be implemented. The best example for this is the planned low-ex local heating network that failed, because of the high investment and operating costs that could not compete with a conventional energy supply.

After three years of project duration, mySMARTLife was nevertheless able to achieve several successes. The project was intensively involved in the planning of the new development areas along the Schleusengraben channel and was able to advise both the investors and the planning actors. A total of about 45 new buildings were erected with a higher energy standard (KFW70).

An important development in mySMARTLife that can serve as lighthouse project for the German energy transition and heat transition, respectively, was implemented in the focus area "Am Schilfpark". In a very short time, after the redirection of the action, from a low-ex district heating network towards the hydrogen injection in the gas grid, a hydrogen-ready heating system based on CHP plants was implemented. Here it was even possible to upgrade the technology level of the conventional energy supply through the introduction of the hydrogen by the project. Additionally, until spring 2020 a gas mixing device and a hydrogen storage will be installed and an ICT system for remote control and remote maintenance will be

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set up. To complete the system, the necessary measurement technology (Gas quantity meters NG and H2, Volume flow meter NG und H2 and Heatmeter) will be installed.

In combination with the installation of smart street lamps and the planned cycle path along the Schleusengraben the character of an innovative and sustainable residential area is guaranteed.

In the retrofitting area, the project faced high challenges due to the small decentralized ownership structure in the old building quarter. Theoretically, the "Bergedorf Süd" quarter has high energy saving potentials, yet, in such an area the potentials are much more difficult to exploit than in new development areas. Despite the large number of events held to activate and advise house owners, the positive feedback was less than expected. Here also the problem occurred, that conventional fossil-based energy and heating concepts are still considerably cheaper, while advanced concepts usually require subsidies. The very heterogeneous ownership structure also makes access to energy data more difficult, this has direct negative effects on the arrangement of a sufficient monitoring of the energy-related implementations in this area. In addition, the technical implementation of refurbishments showed, that the current construction boom in Germany makes it difficult to find well-trained planners and reliable craftsmen for smaller projects. Furthermore, it became apparent in the discussion at citizen information events, that private owners are rather averse from making use of the current funding opportunities because of the perceived complexity.

Nevertheless in mySMARTLife so far over 20 retrofitting projects with approx. 15,000 m2 (approx. 14 retrofittings and 6 replacements) were estimated to have been realised. A detailed validation still is problematic and difficult because due to the conducted approach, additional retrofittings could have been realized without the knowledge of the project, when activated house owners started a retrofitting but did not maintain the contact to the project. Further, also the European data protection law regarding energy data on house level does not allow an observation of building-specific energy demands which could help to identify retrofitting projects retrospectively.

It has been shown that the framework conditions for the implementation of local heating networks or heating islands among several local players are currently difficult (legal requirements, energy prices, individual timetables of the individual actors). It is a high effort to bring private owners and housing companies together because it requires a long consulting and supporting process and a lot of infrastructural upfront services.

Despite these high hurdles, the promotion of district heating solutions should be continued. The past efforts showed that the focus on projects with one main player, best a professional a financial strong housing company or investor, as an anchor for other smaller house owners could be a beneficial solution for the success of such a project. This would also help to reduce the high activation efforts in the early pre-design phase.

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At the level of the city as a whole, currently a conflict of objectives can be identified. On the one hand inexpensive and fast housing construction with little bureaucratic requirements are fostered and on the other hand, a sustainable and CO2 reduced energy supply for buildings should be implemented at new developments. The City of Hamburg tries here to learn from the experience gained in mySMARTLife. Among other things, the city has developed and introduced the new “Energiefachplan” (sectoral plan for energy) as new binding but flexible planning tool. With that plan, the topic of energy supply should be regularly consolidated in the urban development plans of the City of Hamburg for new development areas. This is a considerable result by the project and a first step of policy implementation towards sustainable development and smart city strategies.

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7. Annex

7.1 Annex 1: Letter to house owners in Bergedorf Süd:

Gemeinsam bringen wir die Energiewende in Bergedorf mit dem europäischen Projekt mySMARTLife voran. Nutzen Sie die damit verbundenen Chancen für Ihre Immobilien!

Sehr geehrter Herr Ahrndt,

Ihr Gebäude liegt im Projektgebiet des EU-Projektes mySMARTLife! Das Projekt wird durch das Bezirksamt Bergedorf koordiniert und entwickelt innovative Energielösungen im Bezirk Bergedorf. Im Rahmen des Projektes mySMARTLife bieten wir daher den Eigentümerinnen und Eigentümern im Stadtteil Bergedorf-Süd eine Beratung bei einer energetischen Sanierung oder Erneuerung ihrer Energiesysteme an.

Für Ihr Gebäude können Sie kostenlose Informationen zu folgenden Themen erhalten:

- Photovoltaik für Eigenverbrauch und Einspeisung ins Stromnetz - Sauberer und günstiger Strom
- Photovoltaik-Mieterstromprojekte für Direktverbrauch in Wohnungen und Gewerbebetrieben
- Energetische Gebäudesanierungen
- Effiziente Wärmeversorgung mit modernen Heizanlagen und Erneuerbaren Energien
- Fördermöglichkeiten der Hamburger Investitions- und Förderbank

Rufen Sie uns gerne direkt an, senden Sie uns das beigefügte Kontaktformular oder schicken Sie eine E-Mail bis zum 15. Juli 2018. Wir setzen uns dann unmittelbar mit Ihnen in Verbindung. Die ersten zehn Rückmeldungen erhalten für ihr Interesse eine digitale Klimastation.

Für Rückfragen stehen wir Ihnen gerne zur Verfügung. Nähere Informationen erhalten Sie auch über unsere Webseite der Solaroffensive www.solaroffensive-hamburg.de und die EU-Projektseite: www.hamburg.de/mysmartlife. Ihr direkter Ansprechpartner ist Klaas Wulff (konsalt GmbH). Tel.: 040 35 75 27 0, E-Mail: energie@konsalt.de.

Wir freuen uns, Sie als Eigentümerin und Eigentümer im Auftrag des Bezirksamtes Bergedorf herzlich zu einer Beratung begrüßen zu dürfen.

Christoph Lindemann, Matthias Ederhof — Projektleiter mySMARTLife
Margit Bonacker — Geschäftsführerin konsalt GmbH
Energienetz Hamburg eG

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 731297
Topic: SCC-1-2016-2017: Smart Cities and Communities lighthouse projects

Hintergrund:

Im Rahmen des EU-Projektes mySMARTLife werden mit den Partnerstädten Nantes in Frankreich und Helsinki in Finnland bis 2019 vielfältige Modellprojekte für eine energie- und ressourceneffiziente Stadt entwickelt und praktisch umgesetzt. Die Themenschwerpunkte des Projektes bilden die Arbeitsfelder Energie, Mobilität und digitale Kommunikation und Interaktion mit den Bürgerinnen und Bürgern.

Das Projekt mySMARTLife wird von der Europäischen Kommission durch das Förderprogramm für Forschung und Innovation Horizon2020 gefördert.

Das Projektgebiet in der Stadt Hamburg befindet sich im Zentrum des Bezirks Bergedorf. Hier befindet sich mit der Entwicklung der neuen attraktiven Wohngebiete entlang des Schleusengrabens bereits eines der wichtigsten innerstädtischen Hamburger Wachstumsgebiete. Das mySMARTLife Partnernetzwerk, in dem sich verschiedene Institutionen aus Verwaltung, Wissenschaft und Forschung sowie lokal und international agierende Unternehmen zusammengeschlossen haben, ist im Zentrum Bergedorf bereits an vielen Stellen aktiv.

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Topic: SCC-1-2016-2017: Smart Cities and Communities lighthouse projects

Figure 56: Information letter to all house owerns in Bergedorf-Süd to promote mySMARTLife, offering consultation for retrofitting possibilities and promote special funding programs (konsalt, Borough of Bergedorf, ENH)

7.2 Annex 2: mySMARTLife factsheet on retrofitting of buildings

mySMARTLife Retrofitting project – WP3
Hamburg – Bergedorf-Süd

13. August-Bebel-Straße 13

Basic info	
Owner	Busch Grundstückverwaltung Tarpenring 16 22419 Hamburg
Construction year	
Use	Dwell
Floors	3 + 1 Rooftop
GFA	
Activities: retrofitting, replacement construction	Retrofitting
Completion: retrofitting, replacement	2017

Description initial situation

Description of the measures [renovation, replacement construction]

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mySMARTLife Retrofitting project – WP3
Hamburg – Bergedorf-Süd

Building Energy Specification Table – August-Bebel-Straße 13

Building structure

Component	Before U [W/m²K]	After U [W/m²K]	Reduction [%]
Facade/ wall			
Roof			
Ground Floor			
Glazing/ window			
Average U-value			
Glazing [g]			

Building Energy Performance

Heating

Measure	Consumption Before [kWh/m²a]	Consumption After [kWh/m²a]	Reduction of consumption [%]

Ventilation

Measure	Consumption Before [kWh/m²a]	Consumption After [kWh/m²a]	Reduction of consumption [%]

Lighting

Measure	Consumption Before [kWh/m²a]	Consumption After [kWh/m²a]	Reduction of consumption [%]

Domestic Hot Water (DHW)

Measure	Consumption Before [kWh/m²a]	Consumption After [kWh/m²a]	Reduction of consumption [%]

Integration of renewable energy

Energy form	Measures	Installed m²	Total production [kWh/a]	Share in total consumption [%]
Heat				
Electricity				

Overall comparison	Before [kWh/m²a]	After [kWh/m²a]	Reduction [%]
Primary Energy Consumption			
Final energy demand			

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Figure 57: mySMARTLife Factsheet on retrofitting or replacement measures (konsalt)