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Working report 1

Future Concept Renewable Wilhelmsburg

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Content

Working Report for the Future Concept Renewable Wilhelmsburg

Uli Hellweg, Manfred Hegger, Harry Lehmann

In the 2010 Renewable Wilhelmsburg Climate Protection Concept, the IBA Hamburg set out a strategic concept focused on the energy transformation of a district of central Hamburg 35 square kilometres in size and with more than 55,000 residents. The IBA Hamburg's demonstration area, on the Elbe Islands, is in urban and socio-spatial terms a clearly defined area, by the two arms of the Southern and Northern Elbe and the abandoned course of the Reiherstieg river. Due to the historic flood in 1962, this area was particularly exemplary in showing how and what cities, as the main victims of but also the main contributors to climate change, can do towards protecting the climate. The holistic approach taken by an International Building Exhibition also presented the chance to implement an exemplary, locally based scheme through practical construction projects and campaigns, in the first major stage up until 2013, the final Presentation Year of the IBA Hamburg.

The cornerstones of the Renewable Wilhelmsburg Climate Protection Concept, published in the ENERGY ATLAS,[1] are the improvement of energy efficiency and the use of local energy resources such as wind, sun, biomass, and geothermal energy. The ENERGY ATLAS restricts itself to the energy-related optimisation of the building stock of private households, commerce, trade, and services – i.e. the core area of the built city environment, with an about 41 per cent share of the total energy consumption nationwide.[2] The energy required by industry, transport, and residents' lifestyles are not considered in the concept, and are to be reserved for subsequent work (cf. articles by Hain, Pichl/ Hain, Lehmann). This

Fig. 1: The Elbe-Island Wilhemsburg is the project region of the IBA Hamburg

self-imposed restriction reduces the diagnostic value of the results, as the almost CO_2-neutral self-sufficiency in electricity by the end of the 2020s and in heat by the end of the 2040s, as targeted in the ENERGY ATLAS, clearly does not yet indicate the complete climate neutrality of the Elbe Islands. It permits, however, a methodological examination that incorporates architectural and design aspects (cf. article by Hegger), which are often neglected in energy-related urban redevelopment.

Above all, the opportunities that emerged from the IBA afforded the chance for the strategies and projects to be implemented for the first time. Today the ENERGY ATLAS represents an internationally acclaimed and applied methodological tool for local energy-related urban redevelopment (cf. articles by Kemfert, Droege, Lehmann, Hain, and Gerbitz—"Smart Energy City" research). For Hamburg, it is the Roadmap towards the exemplary energy renovation of Wilhelmsburg and Veddel over the coming decades (cf. article by Gerbitz—"Future Heat Concepts for the Elbe Island" and "On the Path towards a Renewable Wilhelmsburg").

By 2013 the IBA was able to implement most of the projects planned as part of the 2010 Roadmap. 1,420 kWp electricity were installed on the Elbe Islands. In practical terms this means that 35 per cent of households are supplied with locally produced electricity as calculated on annual balance, and 12 per cent of households are supplied with heat from Wilhelmsburg (cf. articles by Sauss, Konig). This makes Wilhelmsburg probably the most climate-friendly district of Hamburg regarding the energy supply of private households and commerce, trade and service businesses.

The preconditions for the implementation of the Renewable Wilhelmsburg Climate Protection Concept against the backdrop of energy policy in Hamburg were special, and not only because of the IBA's exceptional status. Of Hamburg's total heat market, 20 per cent is supplied with district heat from fossil energy sources[3] but Hamburg's Elbe Islands are not part of this system. In 2007 there were plans to connect the Elbe Island of Wilhelmsburg to the district heating grid during the construction of the controversial Moorburg coal power plant. In negotiations with the Hamburg Senate and the energy supplier Vattenfall, the construction of the grid, which had been contractually agreed, was abandoned in order to make space for the IBA's local supply concept.

Thus Hamburg's Elbe Islands offered a unique laboratory for urban redevelopment in relation to energy, whereby many problems typical of current energy policy discussion were given focus, like under a magnifying glass. Today issues of grid integration and the load management of local and district energy producers are relevant beyond Hamburg, both in the heat and in the electricity sectors (cf. articles by Sandrock and Gerbitz—"Smart Energy City" research). While the ENERGY ATLAS in 2010 contrasted the annual energy requirement of Wilhelmsburg, in a greatly simplified version, with the amount of energy produced in one year, the 2013 Island Power Study (cf. article by Lutzenberger) examined the dynamic electricity demand and production across four years with an hourly resolution. The results are clear: on the one hand, the assumptions made by the ENERGY ATLAS are correct, and the objectives set out for the local coverage of the annual energy requirement with renewable energy are achievable. On the other hand, in the dynamic, time-dependent analysis the widely fluctuating production of renewable electricity leads both to high electricity surpluses and to high deficits in provision.

Target-actual comparison of self-sufficiency through renewable energies

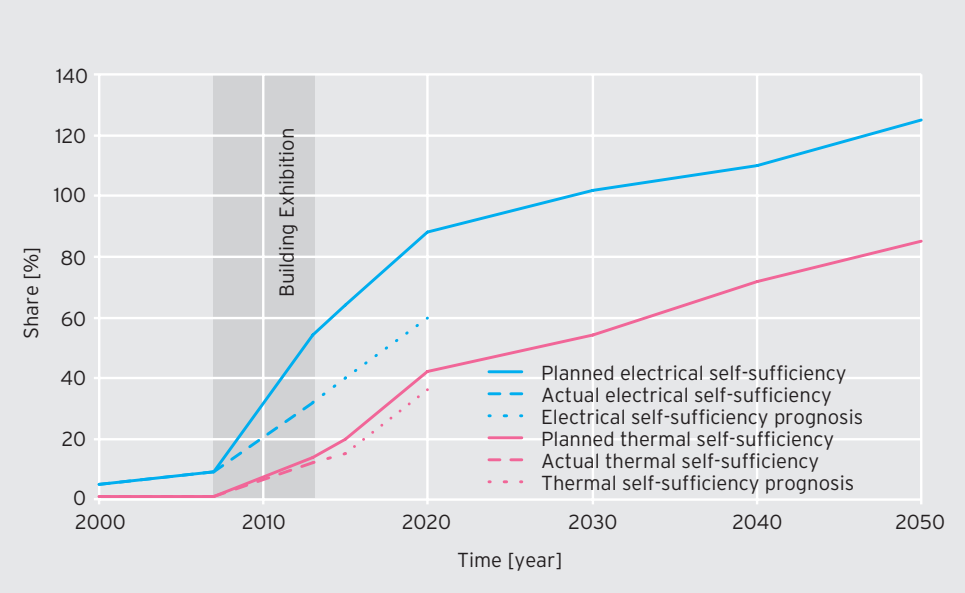


Fig. 2: Forecast for the development of the Future Concept Renewable Wilhelmsburg

Therefore local self-sufficiency cannot be the goal of sustainable energy supply; rather, it should be autonomy—namely, the enhancement of local production through load management, the use of storage facilities, and energy exchange with the other districts and the rest of the region.

Following five years of the Renewable Wilhelmsburg Climate Protection Concept, the learning processes have included not only new technical and economic challenges but also different political framework conditions at federal and state level (cf. article by Hain), as well as the social experience of energy-related urban improvement in a socially disadvantaged district.

The experience of the IBA demonstrates that sustainable development in an urban space is at least a technical problem, but above all a social and political, thereafter a financial, architectural and urban design problem. This is particularly evident in relation to the issue of the annual renewal rate, the decisive factor in improving the energy efficiency of the existing building stock. In its Excellence Scenario, the Renewable Wilhelmsburg Climate Protection Concept starts out from the assumption of almost CO_2 neutrality within the existing building stock, as already mentioned, from a renewal rate of 3 to 5 per cent. However, the energy-related improvement of houses in Wilhelmsburg is thought to be at around 0.8 per cent today, the same as the national average (cf. article by Hartwig). In this context, it must be noted that the Top Climate Plan campaign initiated in 2009, in which private homeowners were to carry out energyrelated modernisation of their houses, has succeeded more qualitatively than quantitatively.

For instance, the Wilhelmsburger Strasse 76–82 project on Veddel showed for the first time how buildings from the 1920s, with their distinctive brick facades, so typical of the city, could be modernised almost to new-build standard, thus upgrading Hamburg's "Red City" without visibly changing the historic facades. Similarly, late nineteenth-century houses in Wilhelmsburg were renovated, and a much acclaimed model project was carried out by VELUX, which with the LightActive House provided an energy template for the modernisation of estate buildings from the 1930s and 1950s, albeit not the only one. A breakthrough in the renewal rate, however, could not be achieved in this way. Despite the rather financially weak social structure on the Elbe Islands the cause of this is not to be found in the cost of the work, but mainly in two other reasons: the demography—many homeowners are of an advanced age; and in the fact that energy-related measures are rarely the sole reason for investment in one's own house. For the most part, there is more extensive modernisation (bathrooms, layouts) and repairs, so that the total package of costs increases and the renewal rate stagnates (cf. article by Jacobs). If the findings from the Top Climate Plan are to be seen as representative, this raises the question of whether the supply side, i.e. the production of renewable energy sources, should be given greater emphasis in strategic and practical terms, as opposed to the efficiency side, i.e. privately funded housing modernisation, without harbouring any illusion that this means dispensing with energy efficiency for buildings and businesses (cf. article by Hartwig). In addition, strengthening the supply side has its own problems: it cannot eliminate the lack of thermal comfort in housing units any more than the moderni-

Fig. 3: Power for the Elbe-Island is produced by sun and wind at the former landfill site Georgswerder

sation backlog that exists throughout Germany, which causes further deterioration of the building stock and ultimately leads to increased reconstruction or replacement costs. Strengthening the supply side would also adversely affect the overall increase in efficiency. This would encourage the use of fossil fuels due to increasing the uncertainty associated with the Renewable Energy Law (EEG), and the EU and the German government's goals of reducing CO_2 would recede into the distance. Major dependence on conventional heat suppliers (coal, natural gas, and crude oil), in particular, would be prolonged. It is therefore hoped that national and, if possible, local incentive programmes can contribute towards increasing the renewal rate in the near future and thus enhance efficiency-related improvement. Further investment and activation processes are required in line with this, in order to make climate protection concepts of concern to everyone in society.

Even though, with respect to the ENERGY ATLAS, it must be noted that the level of targets reached is significantly higher on the supply side than the increase in efficiency through energyrelated modernisation of existing buildings, we must warn against excessive optimism, as those who are the first to criticise "densifiers and insulators" are by no means pioneers in terms of renewable energy sources. One major difficulty in connecting existing districts to heating grids is the mass of institutional, logistical, and legal problems involved: whether when large, or even city-owned, housing associations cannot coordinate their retrofitting concepts with the energy suppliers, or can only do so in part; or when incentives or tax laws make connection to new, environmentally friendly supply grids difficult or impossible (cf. article by Sandrock).

This then raises the question of what the appropriate concepts and the necessary framework conditions might be for supplying districts and cities with renewable forms of energy. In the future, who will be the key stakeholders in the energy transition? What role will residents and decentralised local concepts play? And Cui bono—who ultimately benefits from this?

The Climate Protection Masterplan of the Free and Hanseatic City of Hamburg envisions the continuation of the Renewable Wilhelmsburg Climate Protection Concept as a model. However, the referendum on the repurchase of the district heating grid raises the question of what value decentralised supply structures will be in Hamburg's new heat strategy (cf. articles by Gabanyi/ Dietrich, Sandrock), especially since at present new central investment is under discussion, such as in a combined-cycle power plant in Wedel. No final decisions have been made, but it is now clear that following the decisions surrounding investment in the power plant structure the course will have been set for decentralised, districtfocused concepts. The Senate is expected at the end of the editorial process to present the heat strategy by the end of 2014.

Between 2008 and 2010, when the Renewable Wilhelmsburg Future Concept was being developed by the IBA, in close cooperation with the research group from the University of Applied Technology Nordhausen[4] and an international advisory board[5] (cf. summary of the Climate Protection Concept in the Appendix), the world of renewable energy legislation seemed to be in order. Since then, a whole range of political and legal framework conditions have changed, from the limited extension of the renewable energy producers to the financial burdens placed on small local plants. The Working Report on the Future Concept therefore

Fig. 4: Participation of the citizens during the development of the Georgswerder Vision for the Future

represents not only the earlier results and impacts of the Renewable Wilhelmsburg Future Concept, but also examines the consequences arising from the interim decisions made at federal and state level about the updating of the Roadmap. On the one hand a critical review has looked at what has been achieved and also established that decentralised concepts can make a significant contribution towards energy self-sufficiency and the reduction of CO_2 emissions within a short space of time (cf. article "Path Towards a Renewable Wilhelmsburg"). On the other hand, essential tasks for the future are defined, such as the intelligent linking of local heat and electricity production, as well as the issue of local storage technology (cf. article by Lehmann). At the same time it is also clear that, although the Renewable Wilhelmsburg Future Concept was indeed developed on an island, it is itself far from being an island in the energy policy landscape of today.

An experiment has become a strategic approach that may make a significant contribution to the policy goal of energy transition. It also gives considerable impetus to further refinements of the methods included in local or regional climate protection concepts and energy development plans (cf. articles by Lehmann, Hegger / Schulze). Universities and research institutions in many countries have paid attention to the planning approach that the IBA Hamburg has adopted for the district of Wilhelmsburg— for instance, the Lake Constance / Alpenrhein region (cf. article by Droege). They are using this as a basis for developing solutions that should facilitate the survey of requirements and potentials in the future, as well as locally based, tailored, and economically optimised development of forward-looking energy concepts. The Renewable Wilhelmsburg Climate Protection Concept thus literally acts as a blueprint: using manual methods

and is thus highly reliable and experimental in its results, it nevertheless acts as a model for many other users. On Hamburg's Elbe Islands this approach has been so successful that there are questions being asked, in Hamburg and beyond, as to whether it can at least be transferred to comparable districts. Discussions on this matter are still ongoing. The implementation of such a climate protection concept requires a lot of staying power, both in Hamburg and elsewhere. The medium- to long-term measures often need to be checked and adapted to altered technical, economic, and political realities. In particular, further technical developments and the changes associated with them play a big role in the cost structures. The evolution and marketing of renewable forms of energy are still in their infancy and are thus dynamic. In the same way, the integration of user behaviour analysis will have more emphasis in future planning (cf. article by Peters), as such planning can only be successful if consumers become stakeholders in the energy transition. The Renewable Wilhelmsburg Climate Protection Concept still has its economic and, ultimately, its social sustainability to prove (cf. article by Krummel).

The Climate Protection Concept requires careful control of the individual measures, using a purely technical monitoring system, like that planned for Wilhelmsburg. First and foremost, however, this major project requires engaged and technically competent leadership dedicated to the exemplary implementation of the energy transition, independent from the vicissitudes of political life.

Notes

1. IBA Hamburg (ed.): ENERGY ATLAS. Future Concept Renewable Wilhelmsburg. Berlin 2010.
2. AG Energieverbrauch e.V: Anwendungsbilanzen für die Endenergiesektoren in Deutschland in den Jahren 2011 und 2012 mit Zeitreihen von 2008 bis 2012. Berlin 2013.
3. Hamburg Senate: Printed issue 20/11237. Hamburg 2014.http://www.gruene-fraktion-hamburg.de/sites/gruenefraktion-hamburg.de/files/dokument/11451_ska_jens_kerstan.pdf
4. Dieter D. Genske / Thomas Jödecke / Jana Henning-Jacob / Ariane Ruff: Energetische Optimierung des Modellraumes IBA Hamburg. Hamburg 2011.
5. The members of the IBA Hamburg's Climate and Energy advisory board were: Prof. Peter Droege (Liechtenstein University and representative of the World Council for Renewable Energy, Australia), Prof. Manfred Hegger (Technical University Darmstadt), Dr. Harry Lehmann (team manager at the Environment Agency, Dessau), Prof. Irene Peters (HafenCity University Hamburg), Matthias Schuler (executive director of Transsolar, Stuttgart, and Adjunct Professor for Environmental Technologies at Harvard University, USA), Stefan Schurig (director of Climate and Energy, World Future Council, Hamburg).

On the Path towards a Renewable Wilhelmsburg

Uli Hellweg, Manfred Hegger, Harry Lehmann, Jan Gerbitz, Katharina Jacob, Simona Weisleder, Karsten Wessel

This working report on the ENERGY ATLAS offers a differentiated picture of the implementation and further development of the Renewable Wilhelmsburg Future Concept in 2014. Large parts of the Roadmap 2010 have so far been implemented: the Georgswerder Energy Hill supplies approximately 20 per cent of households in Wilhelmsburg with renewable electricity, and the heating grid around the Energy Bunker and in Wilhelmsburg Central do not yet operate to their full potential, but in the future they will be able to supply many households in Wilhelmsburg with renewable heat. All new buildings and urban regeneration projects realised as part of the IBA Hamburg on the Elbe Islands and in Harburg's Upriver Port have exceeded the legal energy-efficiency performance requirements. However, there have been numerous cases in which unforeseeable factors have emerged, leading to the failure of some projects and delaying others. If we analyse the reasons for the failure of the two unsuccessful projects—the New Hamburg Terraces local heating grid and the Urban Biogas project—and the time delays on completed projects, five key factors can be identified:

1. Legal and business reasons;
2. Institutional obstacles;
3. Problems relating to urban planning constraints and emissions regulations;
4. Socio-demographic barriers; and
5. Altered political framework conditions.

In terms of the legal and business obstacles, the prime concern is the lack of agreement between tenancy, fiscal, and funding law in force in relation to residential construction, and the politically desirable intent of energy-efficient urban redevelopment. Thus, the shutting down of heating units that have not yet been written off in order to provide connection to a heating grid can lead to financial losses and problems in recalculating rental costs in subsidised residential construction—even if the heating grid is running on renewable energy sources and thus benefitting climate protection goals. In addition, tenancy law makes it difficult to connect to a heating grid, since the change in heat supply must not result in higher heating costs for the tenants, in this connection the cost of investing in individual units cannot be taken into account. The price of heat supply via a heating grid is directly compared to supply via "the cheapest gas boiler".

For the Geothermal Energy Wilhelmsburg project it was primarily the high investment costs of almost 30 million euro that delayed the implementation of the project, because the cost-effectiveness had to be checked by means of lengthy investigations, and the results are currently being assessed (see Introduction, Note 1). The institutional difficulties include the divergent economic plans of the respective owners or a lack of interest in energy-efficient urban redevelopment. Among some property owners and future connected parties there is a general scepticism about supply via a decentralised grid instead of supply via one's own boiler in one's own cellar.

Projects may also be delayed or cancelled for reasons related to urban design or emissions regulations. The site for the Urban Biogas project had been identified following a protracted and troublesome search in southeast Wilhelmsburg, but it ultimately fell victim to plans for a new road. An alternative location could not be found.

The socio-demographic barriers to energy-efficient urban redevelopment are particularly important, and this is reflected in the (unacceptably low) renewal rate (cf. articles by Hartwig and Jacobs). The IBA had similar experiences with the Top Climate Plan start-

ed in 2009. It appears that the willingness and ability to renovate one's own property is negligible in places like Wilhelmsburg. Refurbishment work is often carried out without the involvement of energy consultants or architects. In singlefamily homes the residents often do the work themselves ("DIY renovations"), so there is no additional financial support. The integration of renewable forms of energy such as solar thermal energy is insufficient despite the technology that has been introduced, tried and tested over many years.

There are potential political risks in the implementation of long-term climate protection concepts such as the Renewable Wilhelmsburg, due to changing framework conditions at various national and international levels. Thus not only have the EU's legal goals changed (cf. article by Lehmann), but at the national level the EEG 2014, and at the municipal level the work carried out for the Hamburg Heat Strategy (cf. article by Gabányi and Dietrich) have set out framework conditions that necessitate modifications to the Renewable Wilhelmsburg Climate Protection Concept. A linear implementation of the Roadmap, formulated as a "gamble" in the first edition of the ENERGY ATLAS in 2010, is not possible at this point in time. In this respect there is no sure-fire way of achieving the carbon neutrality goals for Wilhelmsburg that were set out in the ENERGY ATLAS in 2010. However, the dynamic of recent years, including geopolitical changes and conflicts, shows how sensitive and variable energy policy can be. Therefore, from the editors' point of view, it not only makes sense to continue the Renewable Wilhelmsburg Climate Protection Concept as a flagship project for energy-efficient urban redevelopment, but it is also warranted, due to what has already been achieved, to have an impact far beyond Hamburg and Germany.

Fig. 5: The Energy Bunker supplies the surrounding neighborhood with renewable heat

Roadmap
Renewable Wilhelmsburg 2050

Energy-Efficient New Development

- Efficiency House 55 for residential buildings or EnEV 2009 minus 30 per cent for non-residential buildings as a minimum standard for all tenders and competitions, Passive House or Efficiency House 40 as target standards
- Integration of photovoltaic into the design as a minimum requirement for tenders and competitions
- Priority given to the use of biogas, biomass, and locally available resources such as solar thermal energy, geothermal energy and waste, or ambient air to drive heat pumps for heating and domestic hot water
- Zero or Plus Energy House as the target standards
- LifeCycle approach and sustainable and renewable construction materials as special criteria for tenders and competitions

Retrofitting the Existing Building Stock

- Execute campaigns to inform and motivate homeowners
- Energy consultants should attend local events for organised homeowners and locally based, offers of individualised advice
- Development of specific model renovation concepts for larger areas of privately owned housing such as in Kirchdorf
- Information and campaigns for local CO_2-neutral heat supply
- Improvement in provision of and advice on funding for homeowners and owners' associations
- Implementation of energy-related urban regeneration projects in districts such as Veddel, the Reiherstieg district, Kirchdorf, and Kirchdorf-Süd

Renewable Heating Grids

- Further development of the spatial energy concepts and legal possibilities for local heat generation on Hamburg's Elbe Islands, including local generators (heating grids)
- Further development and spatial expansion of the Wilhelmsburg Central Integrated Energy Network
- Compulsory referendum on the renovation plans for individual heating units, with a further grid expansion from the Energy Bunker in the northern Reiherstieg district
- Implementation of the Geothermal Energy Wilhelmsburg project
- Anchoring local heating grids in the densely built-up areas of Wilhelmsburg
- Establishment of local heating grids in established districts with the framework of energy-related urban design redevelopment and as an extension of grids in neighbouring development areas
- Consolidation of local heat concepts through the use of innovative measures

Renewable Power Generation

- Exemplary further development of the concept in order to ensure grid integration and the load management of decentralised electricity generators on Hamburg's Elbe Islands
- Exemplary implementation of concepts such as power-to-heat and power-to-gas
- Information and advice on the possibilities of combined heat and power (CHP)
- Supporting operating models for the use of photovoltaic
- Exemplary implementation of Plus Energy Houses and Plus Energy Districts on Hamburg's Elbe Islands
- Technical and organisational expansion of personal electricity use (net accounting)
- Repowering of old wind turbines and exploitation of new sites
- Widened search for wind turbine sites

Thanks to this project— precisely because of its ambivalent experiences—Hamburg is not only internationally at the forefront of novel, energy-efficient urban design concepts, in both new-build projects and regeneration areas within cities, but it is also a test bed for innovative practical solutions. This leading position should be extended and exploited further, not least to help the long-neglected district of Wilhelmsburg to gain a fresh, innovative image as a pioneering part of Hamburg.

Against this backdrop, the following recommendations for the continuation of the Renewable Wilhelmsburg Climate Protection Concept should be seen as cornerstones rather than as a panacea for climate neutrality in Wilhelmsburg by 2050. However, this goal is still the focal point of the work undertaken, as only in this way will it be possible to create a postfossil- fuel, sustainable, and liveable district for over 70,000 people (cf. article "Vision 2050" by Gerbitz, Jacob, Weisleder, and Wessel,). In order for the goal to become a reality rather than just a vision, there needs to be not only a roadmap but also a driver, to maintain the metaphor. So far, this driver has been the IBA Hamburg GmbH, which ended its activities in 2014. If the innovative Renewable Wilhelmsburg project is to be continued successfully, a new driver is required to develop, promote, adapt, implement, and review the strategies, projects, and procedures. The best-case scenario would be for this driver to be the city of Hamburg itself. Such a stakeholder—"driver"—is also necessary in order to stop the emerging trend in Wilhelmsburg for a return of building energy policy to the status quo ante—that is, to the time before the IBA. Against the backdrop of all the construction activity in Hamburg, this is an ambitious undertaking since it also concerns funding.

Renewable Wilhelmsburg Climate Protection Concept: Cornerstones for further development

In order to reach the target of a 'climate-neutral island' by 2050, the IBA Hamburg set out four strategic areas for action in its 2010 Renewable Wilhelmsburg Climate Protection Concept:

- Energy-efficient new development
- Retrofitting the existing building stock
- Renewable heating grids
- Renewable power generation

Since these measures are well established and have proven successful elsewhere, suggestions for further development of the concept should be made within this framework.

Energy-efficient new development
An initial step towards achieving the climate protection goals is a reduction of the energy consumption for space heating and domestic hot water to a minimum. Through the Climate Protection Masterplan, the Senate of the Free and Hanseatic City of Hamburg aims at the reduction of annual final energy requirements for heating and hot water in existing apartment blocks to an average of 40–45 kWh/m2, and to 45–55 kWh/m2 for existing single-family homes. In order to achieve these goals by 2050, buildings and areas being developed now already have to meet the requirements of the future. New buildings have to compensate for the complex situation prevalent in the existing building stock and thus they have to significantly surpass the average targets even though this is not specifically demanded by the current housing policy in Hamburg, as existing heat protection and energy regulations for residential construction are not to be tightened at a state level. The solution may be to stipulate higher

energy-efficiency standards at the point of site allocation.

Back in 2010, the Renewable Wilhelmsburg Climate Protection Concept specified its aim as Passive House standard or a comparable Efficiency House standard. The best possible heat insulation, energy-saving building components such as windows, air tightness, thermal bridging minimisation, controlled ventilation, efficient building services and integrated planning, construction management, and quality assurance are state of the art in today's world.
From 2009 onwards, due to an absence of appropriate Efficiency House standards, the minimum standard for an IBA project equalled the criteria of the Energy Saving Ordinance (EnEV) 2009 minus 30 per cent. This standard is currently being continued by the IBA as a criterion in tenders and competitions, as well as for the development and marketing of sites outside the existing spatial limits of the Building Exhibition, as Efficiency House 55 for residential buildings or EnEV 2009 minus 30 per cent for non-residential buildings. This standard should be maintained, at the very least, for future site allocations, with the aim of gradually increasing it; better standards should already be included in a positive way for the evaluation of tenders and competitions. Experience shows that savvy architects, investors, and developers can comply with and even surpass these minimum standards in a nearly cost-neutral manner. Experience shows that the frequently lamented higher construction costs are often not only explained by higher material and labour costs, but also by shortcomings in planning and construction management, as well as by errors arising from instructing unsuitable, supposedly cheaper, planners and contractors.

Efficiency House 55 for residential buildings or EnEV 2009 minus 30 per cent for non-residential buildings as a minimum standard for all tenders and competitions, Passive House or Efficiency House 40 as target standards

Wherever possible and when they are not connected to renewable heating grids, new buildings should use renewable energy, particularly locally available sources and carriers such as biogas, biomass, or renewable electricity for heating and domestic hot water. Solar thermal energy and environmentally friendly heat sources, such as geothermal energy, and waste or ambient air for driving heat pumps, can reduce the consumption of valuable raw materials. Photovoltaic make the building itself into a power plant and contribute towards the supply of renewable electricity. In the past, therefore, the IBA has implemented numerous different concepts for the use and production of renewable forms of energy and will also promote the integration of these components in the future by taking them into consideration in tenders and competitions. Going forward, every building should reach Energy House Zero or Plus standard.

Integration of photovoltaic into the design as a minimum requirement for tenders and competitions

Priority given to the use of biogas, biomass, and locally available resources such as solar thermal energy, geothermal energy and waste or ambient air to drive heat pumps for heating and domestic hot water

Zero or Plus Energy House as the target standards

Not only the operation, but also the production of building materials and components, the construction, demolition and recycling, or disposal of a building contribute to its energy balance. In energy-efficient buildings, in particular, the proportion of this "grey energy" can amount to more than 50 per cent. Therefore it is especially important to consider the LifeCycle approach and the use of sustainable building materials. The IBA Hamburg was able to highlight timber construction within Hamburg and produce a number of good examples. The experience gained has led to increased skills among planners and contractors in Hamburg and northern Germany. This impetus should be further exploited. As part of European legislation, from 2021 onwards all new buildings must be low-energy buildings (nearly zero emissions), while all new public buildings will have to achieve this standard two years earlier. In this way, the public sector and public investors can provide models and good examples.
Statutory funding for projects with a high level of CO_2 neutrality in the LifeCycle analysis would be useful, not least in order to compensate for deficits in the renewal rate of the building stock.

LifeCycle approach and sustainable and renewable construction materials as special criteria for tenders and competitions

Retrofitting the existing building stock

As is generally the case for energy-efficient urban regeneration, the existing building stock is of central importance in the target-oriented implementation of the Renewable Wilhelmsburg Climate Protection Concept. This publication makes a number of references to the problem of increasing the renewal rate against the backdrop of the actual socio-demographic situation in Wilhelmsburg. The energy-related renovation of the existing building stock therefore represents the biggest challenge in Wilhelmsburg and beyond. The situation on the Elbe Islands is unique, but the measures are often general and transferable. A citywide perspective seems necessary, but it must be implemented at a local level. In order to achieve long-term climate protection goals, all existing buildings must be evaluated and their particular circumstances adapted or tightened up to optimise their energy credentials, as the urban space types of the ENERGY ATLAS demonstrate. In doing so, there are numerous factors to consider, from development status, historical significance, and socio-demographic situation to ownership levels and rental price trends. The different owner groups also have to be taken into account, as they have to be addressed and motivated separately. One major challenge comes in the form of the private owners of apartment buildings and private homeowners. These groups often have limited financial resources for energy-related renovation. The general availability of information about possible renovations and the specific situation of privately owned property are of a lower quality than in larger, organised associations. The experience of the Top Climate Plan has shown that success in terms of the renewal rate cannot be achieved in the short term or through one-off actions. Occasional campaigns have built up knowledge and awareness, but if there is to be a broad spill over effect and concrete investment decisions that flow from this, not only perseverance are needed, but most importantly targeted expert advice. Initiatives such as the Top Climate Plan should therefore be continued in Wilhelmsburg and supported by the provision of practical advice from appropriate energy consultants.

Execute campaigns to inform and motivate homeowners

Energy consultants should attend local events for organised homeowners and locally based offers of individualised advice

Even if every building is considered as an individual object, similar construction and renovation projects occur in many different housing configurations, such as the area of privately owned housing in Kirchdorf. Simple model upgrading concepts may prove useful for such similar projects, to provide information about possible retrofitting and their costs to homeowners in a low-key but practical way, while also supporting or maintaining the urban design context of such areas.

Development of specific model renovation concepts for larger areas of privately owned housing such as in Kirchdorf

The low heat density of areas of single-family houses makes a grid-connected heat supply inefficient, both financially and in terms of energy, or at least difficult to implement. The types of buildings found in Wilhelmsburg for which connection to a local heat grid is not worthwhile will be the focus of appropriate concepts for a local, CO_2-neutral heat supply (e.g. using heat pumps, solar thermal energy or biomass), including planning requirements, funding options, and costs. These should be clearly and purposefully communicated and promoted through local campaigns.

Information and campaigns for local CO_2-neutral heat supply

The implementation of measures to upgrade building envelopes and the integration of renewable forms of energy should be supported through improved funding, especially through the programmes for homeowners and owners' associations.

Improvement in provision of and advice on funding for homeowners and owners' associations

Joint action in a particular area has benefits not only in technical and design terms, but also financially when compared with an approach dealing only with individual buildings. Many cities therefore take a district-based approach to tackling the challenges of energy-related urban regeneration and restructuring. For this reason, the KfW Bank currently supports both the creation of a district concept and the co-ordination of upgrading work involved through a district manager as part of a special programme. Despite promotion, there has been little use of this arrangement so far. In Wilhelmsburg, district concepts and managers could contribute towards the better co-ordination of measures for individual homeowners in Veddel, the Reiherstieg district, Kirchdorf, and Kirchdorf-Süd. This could be a key task for the previously mentioned "stakeholder" or "driver". Their responsibilities should also include the procurement of the necessary additional financing from the appropriate authorities and administrative bodies, as well as interested property owners and energy suppliers.

Implementation of energy-related urban regeneration projects in districts such as Veddel, the Reiherstieg district, Kirchdorf, and Kirchdorf-Süd

Renewable heating grids

Some renewable energy sources can only be used in a grid-connected heat supply or

are much more effective in such a context rather than in individual buildings. Such incompatible sources include industrial waste heat, geothermal energy, cogeneration units, and larger solar thermal plants. Less restrictively, a grid with different producers allows exchange between them and thus increases the utilisation of the systems. For this reason, the Renewable Wilhelmsburg Climate Protection Concept provides different types of local heating grids for the heat supply of all built-up areas by 2050. The first projects or first stages of construction were carried out with the local heating grid around the Energy Bunker and the Wilhelmsburg Central Integrated Energy Network. In the future greater attention should be paid to smart heating grids, in which highly efficient new buildings contribute to the heat supply of the less energy-efficient building stock.

Further development of the spatial energy concepts and legal possibilities for local heat generation on Hamburg's Elbe Islands, including local generators (heating grids)

The Integrated Energy Network, as an open heating grid, represented an innovative concept for local heat supply. Supply via a biogas-powered cogeneration unit enabled an almost completely CO_2-neutral heat supply, which is also attractive to investors, because it makes it possible to achieve higher standards of efficiency without further investment. At the same time, the possibility of feeding in most of the energy in the form of solar thermal for individual projects and into the whole system is made more feasible. However, feeding energy into heating grids at a local level is still at an early stage from an organisational and technical point of view. A profitable operation is possible only with special funding. The important thing here is to continue with the energy monitoring in order to identify vulnerable areas and increase the efficiency of the system as a whole.

Further development and spatial expansion of the Wilhelmsburg Central Integrated Energy Network

As a buffer storage facility for collecting different forms of renewable energy, such as solar thermal energy, biogas-generated combined power and heat, industrial waste heat, and (in the future) biomass, the Energy Bunker in the Reiherstieg district was first connected to the apartments of the Global Neighbourhood and to some public institutions. This system is to be extended to a maximum of 3,000 connected housing units.

Compulsory referendum on the renovation plans for individual heating units, with a further grid expansion from the Energy Bunker in the northern Reiherstieg district

The Geothermal Energy Wilhelmsburg project is a pivotal question in the realization of the Renewable Wilhelmsburg Climate Protection Concept and could be an important contribution to the renewable heat supply of residential buildings in the southern Reiherstieg district, as it is for local commercial enterprises. After clarification of the financial framework, the joint project by the municipal supplier and a local business, can go ahead, in order to not only ensure a long-term, stable energy supply for the connected firms and households, but also act as a pilot project for northern Germany. Should the realization not succeed, in order to achieve the goals of the Climate Protection Concept, a considerable scale of alternative sources for the heat supply is needed.

Implementation of the Geothermal Energy Wilhelmsburg project

For new development areas such as Dratelnstrasse and the North South Axis along the former route of the Wilhelmsburger Reichsstrasse, or in Georgswerder or Haulander Weg, there are connection areas with a sufficient energy density to ensure a cost-effective supply via a local heating grid (according to energy surveys), and which can be stipulated in the land use plan using assessments of connection and use options. A high level of climate neutrality should be built into the preparation of land use plans and urban design agreements, as well as the award of contracts.

Anchoring local heating grids in the densely built-up areas of Wilhelmsburg

For other existing districts such as Veddel or Kirchdorf-Süd a local heat solution should be in place, with the framework of district concepts relating to energy-efficient urban regeneration (see above). Urban design developments such as those in Veddel-Nord result in opportunities and potential as the first crystallisation point of a new grid.

Establishment of local heating grids in established districts with the framework of energy-related urban design redevelopment and as an extension of grids in neighbouring development areas

As part of the development or extension of local heating grids the use of innovative measures, such as power-to-heat or urban production of biogas from biogenous residues, should be continuously monitored.

Consolidation of local heat concepts through the use of innovative measures

Renewable electricity production

The Roadmap 2010, aiming towards decentralised electricity generation on Hamburg's Elbe Islands now has to address altered political and legal framework conditions. The Renewable Wilhelmsburg Climate Protection Concept is essentially based on a future energy supply enhanced by large-scale, central plants as well as offshore and onshore wind parks, plus decentralised supply using cogeneration, photovoltaic systems, and individual wind turbines. This approach is also found in the analysis of the Island Power Study, which examines the possibilities of grid integration and load management for centralised and decentralised supply. In the next stage, the existing potential for decentralised electricity generation under the current conditions should be consolidated and practically harnessed (e.g. by increasing the proportion of photovoltaic). Work that has already begun should be continued over the coming years under the auspices of the "driver" concept.

Exemplary further development of the concept in order to ensure grid integration and the load management of decentralised electricity generators on Hamburg's Elbe Islands

In future, energy storage will play a key role in energy-focused urban redevelopment. The Island Power Study demonstrated the pressing nature of this problem in relation to Wilhelmsburg. In future, therefore, innovative technology for using temporary excess capacity for energy will become increasingly important, alongside the cross-regional networking of decentralised elec-

tricity production. Due to the existing built infrastructure (Energy Bunker, Energy Hill, and the Integrated Energy Network), Wilhelmsburg is in an ideal position to expand on its pioneering role. Power-to-Heat is one option that allows such use within the context of expanding the local heating grids. In addition, Power-to-Gas not only offers the opportunity to use excess electrical capacity, but can also increase the proportion of renewable gas within the natural gas grid, while allowing power to be reconverted in cogeneration units in order to address any gaps in coverage.

Exemplary implementation of concepts such as Power-to-Heat and Power-to-Gas

It is no longer up-to-date to only use the heat from gas boilers. The use of heat offers blanket coverage as far as possible, with the generation of electricity through combined heat and power (CHP) in decentral CHP plants or fuel cells. If the use of gas is extended in not grid connected-areas, the aim for sufficiently large building units should therefore be to use CHP. A campaign with information and planning benchmarks can promote this.

Information and advice on the possibilities of combined heat and power (CHP)

The use of photovoltaic is the easiest and most accessible form of decentralised electricity production. Photovoltaic plants can be implemented by any property owner, but also investors, without own installation possibilities for photovoltaic can organise themselves jointly. As a result, the establishment of energy co-operatives or the involvement of school associations and similar bodies is to be supported. Moreover, decentralised production of electricity can benefit electric transport, while also offering the possibility of electricity storage and of increasing personal electricity usage (net accounting).

Supporting operating models for the use of photovoltaic

In order to increase the profitability of personal electricity production while also relieving the grid infrastructure, the highest possible personal use of electricity is desirable. Personal electricity production is a prerequisite for the development of Plus Energy Houses and Plus Energy Districts. As a result, these concepts need to be further developed and supported, and pilot projects should be carried across into mainstream planning.

Exemplary implementation of Plus Energy Houses and Plus Energy Districts on Hamburg's Elbe Islands

Technical and organisational expansion of personal electricity use (net accounting)

With the repowering of the wind turbines on the Energy Hill, Wilhelmsburg and the IBA have contributed towards the expansion of onshore wind power. The further potential of this repowering process should be exploited. In the search for sites for new wind turbines more use of areas such as the harbour zone should be made, as has been done in recent years.

Repowering of old wind turbines and exploitation of new sites

Widened search for wind turbine sites

Framework Conditions for the Renewable Wilhelmsburg Climate Protection Concept

In addition to the individual technical and administrative measures in the Roadmap for the Renewable Wilhelmsburg Future Concept, it is possible to define framework conditions that should be considered in the further implementation of the concept. These often apply not only to Hamburg's Elbe Islands, but are relevant to the whole city of Hamburg and even the whole of Germany.

Resident participation and involvement

The good foundations of recent IBA projects and the Renewable Wilhelmsburg Climate Protection Concept should serve to turn all the residents into active stakeholders, who are working on their island's climate protection. The residents of the Elbe Islands often find themselves in situations in which issues such as retrofitting are not the main concern. If they only have a low level of income, financial decisions are often made in favour of things other than climate protection. Experience has shown that co-operation works particularly well if it includes associations and groups already working within their districts, with the local buildings, or the surrounding spaces in the widest sense. In order to ensure successful co-operation with district stakeholders in relation to energy and climate protection, it is very important to strengthen local networks and expand networking.

The IBA was able to demonstrate this with many different joint initiatives, such as the collaboration with the Kirchdorf Home Owners' Association and other district organisations and urban regeneration management groups based in the Reiherstieg district. This resulted in a number of good experiences of collaboration with citizens when implementing energy-related ideas and concepts. Numerous events, such as the discussions that took place as part of the Top Climate Plan were only possible and successful due to the close contact between associations, networks, and the local people. In the future other networks and institutions, for example from the Southern Reiherstieg Urban Regeneration Area or the Reiherstieg Community Group, should therefore be approached.
A special collaboration emerged between students from the Hamburg University of Applied Sciences (HAW) and the Kirchdorf Home Owners' Association, within the framework of Hamburg Energy Partnerships. The combination of information, competition, and short-term involvement bore fruit and can be seen as an example for similar partnerships and campaigns.

Although the theme of transport does not form part of the Renewable Wilhelmsburg Climate Protection Concept, the work carried out for the Wilhelmsburg Bicycle City project shows how prolific and successful collaboration between the authorities, the IBA, and local working groups (in this case "Fahrradstadt Wilhelmsburg") can be. Specific requirements can be developed and fed into the political process. Wilhelmsburg is the first model district for cycling in Hamburg. In early 2012 the administration office of the borough Hamburg-Mitte launched the cycling concept.

The PERSPECTIVES citizen participation process run by Wilhelmsburg's municipal authorities, the State Ministry for Urban Development and Environment, and the administration office of the borough Hamburg-Mitte has laid important foundations for further citizen participation, and can draw in other initiatives. Unfortunately,

thus far no theme has dealt directly with the area of climate protection; this theme is only occasionally included. However, it can be assumed that this issue will come into focus when the different themes take on greater importance.

Supporting policies and management

The Renewable Wilhelmsburg Climate Protection Concept is an internationally renowned and highly regarded pilot project carried out as part of the IBA Hamburg that made the city state a pioneer in energy-related urban regeneration and redevelopment. This position, which it has retained even after the end of the official IBA period, has been achieved only due to exceptional efforts. The editors of this working report take the view that due to what it has already achieved, Hamburg is in an ideal position to build upon its ground-breaking role, and also to make an important contribution towards energy transition at a municipal level in the future. In view of this, it is worth welcoming the fact that the concept also formed part of the Climate Protection Masterplan in 2013, even though the measures contained in the Action Plan for 2020 are so far only fully funded until the budget year 2013/2014. In the future, additional funding sources will have to be generated in order to continue the Renewable Wilhelmsburg Climate Protection Concept and carry on with the pilot projects. This is not only in the interest of Hamburg, but also of national climate protection policy.

The Ministry, the management and the municipal companies can and must be part of the realisation of the Climate Protection Concept. Where this is not possible to guarantee by general and binding agreements, there must be individual measures and projects on-site. Again, it seems sensible and necessary to appoint a local driver as part of the continuation of the concept, who can be responsible for the implementation of the proposed measures, in consultation with the Coordination Centre for Climate Issues and the other relevant bodies and authorities. Also, the "driver" should be responsible for the continuation of the concept in detail and within the local area, co-ordinating the work with other affected authorities, administrative bodies, and city-based associations.

Appointing a co-ordinator to continue the Climate Protection Concept

Political and financial support for the continuation of the Climate Protection Concept forms the foundation of the work, but it is just as important to continue to develop the theme of climate protection together with building contractors, housing associations, transport planners, engineers, and the people of Wilhelmsburg, actively involving them in the process. This is the only way in which the residents can identify with abstract themes such as climate protection and climate change, and thus take action on behalf of their district. In order to put climate change processes involving many stakeholders in motion at a district level, Hamburg can draw upon its positive experiences in places such as Dulsberg and Bergedorf-Süd.
For the first few years of the implementation of the concept, during the International Building Exhibition, the IBA Hamburg largely took on all responsibility. It raised funds, co-ordinated activities, brought wide-ranging stakeholders together on difficult points, and attempted to devise solutions that were aimed at objectives rather than individual interests. Together with the policies and administration of the city, the IBA Hamburg worked towards a goal and positioned Hamburg as a pioneer in climate protection matters.

A co-ordinating role is still necessary in order to develop the Renewable Wilhelmsburg Climate Protection Concept further so as to move from the parochialism of individual stakeholders to a common concept and integrated planning. The Elbe Islands are made up of numerous districts; it is useful to look at these individually with a district management and to create tailored implementation measures, for example in Veddel and Georgswerder.

Here it is important that Hamburg develops and applies new forms of binding and project-oriented co-operation between all those involved, based on the experiences of the IBA. In view of this, the possibilities of the KfW programme on energy-related urban regeneration should be used, providing funding for district concepts and managers. The necessary additional funding should be jointly supported by the authorities, the district, housing associations, commercial enterprises, and energy suppliers, thus minimising the costs for all of those involved, while maximising the financial benefits for individual components.

Development of further concept modules

Back in 2010, the ENERGY ATLAS set out the expectation that in the coming years more sectors would be incorporated into the Renewable Wilhelmsburg Climate Protection Concept. In particular, the theme of transport is worth looking at more closely, and customised solutions should be devised for the Elbe Islands. The editors would like to stress this intention that transport is not only one of the main sources of CO_2 pollution, but the correlation between urban development and traffic is more than obvious. Moreover, looking ahead, more sectors such as city infrastructure and industry should be included; on the one hand, industry is one of the largest emitters of greenhouse gases with the highest potential for reduction, while on the other hand it is possible to employ a range of synergies in this sector, as shown with the example of the industrial waste heat used in the Energy Bunker.
The conceptual development of the city lies at the root of the development of all sectors – transport, commerce, trade, services, households, and industry – and thus reflects all of the processes found within urban society. The spectrum of measures to be carried out at a municipal and regional level is thus expanded, while the district-based overall balance of energy and material flows, in particular greenhouse gases, is improved. New decisions on energy transition and energy use can be made by considering this overall balance. Current studies on the neutrality of greenhouse gases in Germany and in municipalities that follow the Masterplan for 100 per cent climate protection, and in the 100 per cent renewable energy regions, can serve as a good guide.

As renewable energy self-sufficiency becomes a new and deciding factor in achieving ambitious goals in the reduction of greenhouse gases, these considerations should also be taken into account when developing the concept. As a result, it will be important to set out new technical systems and reduced needs in a socially acceptable system. Expanding the Renewable Wilhelmsburg Climate Protection Concept in this way would also build a bridge to the Climate Protection Masterplan of the Free and Hanseatic City of Hamburg, and thus go some way towards achieving the "grid integration" of the decentralised IBA approach in an overall strategy for Hamburg.

Vision 2050

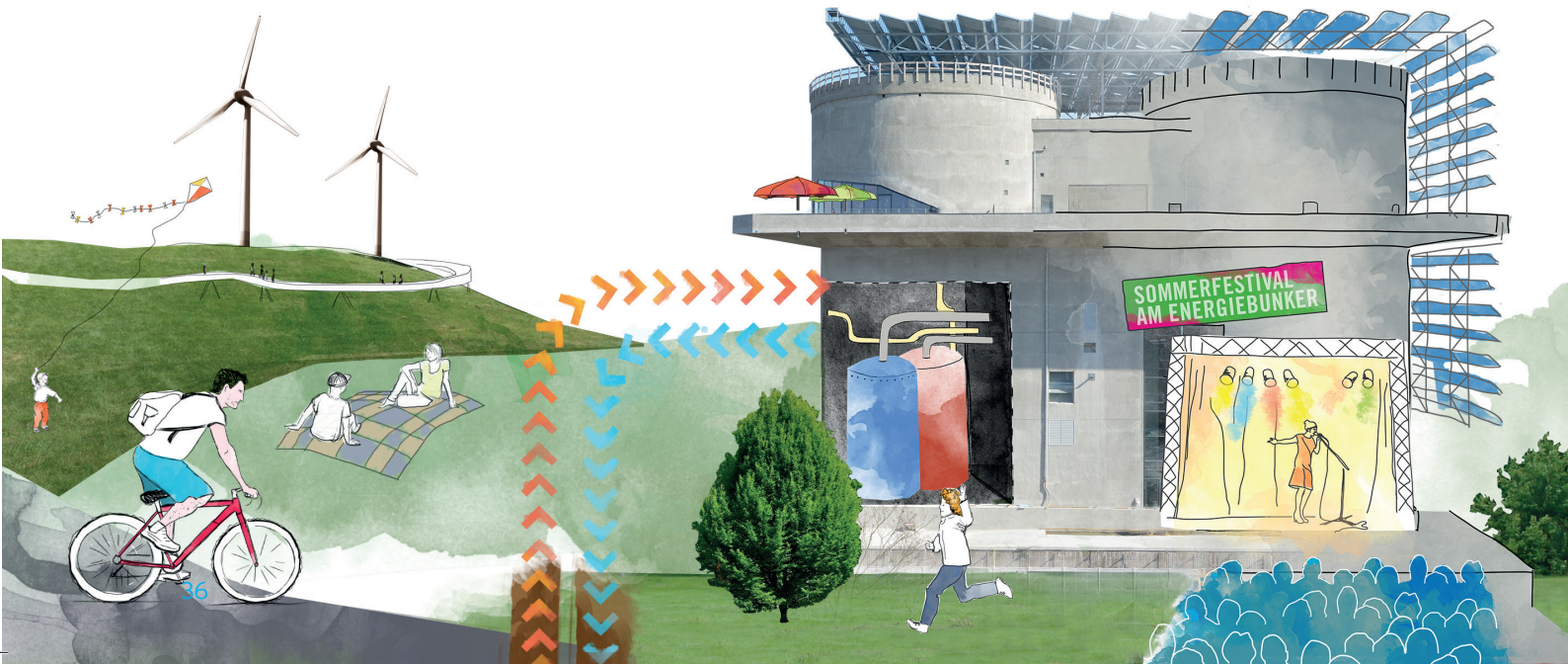
Jan Gerbitz, Katharina Jacob, Simona Weisleder, Karsten Wessel

It is 2050, and 40 years after the publication of the Renewable Wilhelmsburg Climate Protection Concept, the transformation of the Elbe Islands into a climate-friendly district is clearly visible and almost complete. As expected, development has not proceeded along quite the straight line predicted in the graphics in the 2010 ENERGY ATLAS. Many visions were not fulfilled, but they were replaced by surprising new ideas that could not have been foreseen 40 years ago. The way has been marked by national legislation, key decisions by the city, the changes in fossil energy prices, and the investment costs for renewable energy technologies and for technological progress. The increasing involvement of the residents of the Elbe Islands in "their" climate-sensitive islands has become a major driving force for development.

As seen from the 2050 vantage point, these key goals, as set in 2010, have been achieved:

- over 95 per cent CO_2 emissions reduction in the building sector;
- an electricity surplus from wind and solar energy, and combined heat and power, for the building sector, which was achieved even earlier and in the end was larger than had been assumed in 2010;
- self-sufficiency in the building sector with heat derived from heat recovery and heat pumps, geothermal technology, solar heating, biomass, and the conversion of electricity into heat and hydrogen;
- a comprehensive and almost complete refurbishment of buildings to the minimum energy standard, which began slowly at first but really accelerated around 2025;
- a population increase of 30 per cent, with the accompanying new residential building predominantly (and since 2020 entirely) meeting the zero energy standard.

In 2050 the view from the terrace of the Energy Bunker or the Horizon Footpath of the Energy Hill shows how clearly this energy-related development has left its mark on the overall appearance of the district.



Even Greener, and with Local PV Systems

Despite the many new buildings, Wilhelmsburg has become even greener. Many flat roofs and also some of the façades have been covered with vegetation in order to improve the city climate. This was mainly driven by the rise in average summer temperature of almost 2°C, and on hot summer days of an average 8°C. In addition, the dual use of extensive green cultivation and PV systems can often be seen on the flat roofs of commercial buildings, while on residential buildings there may be a mixture of intensive green planting with shading PV panels above. Most of the pitched roofs are equipped with integrated PV systems or solar roof tiles. Falling prices for PV systems and improved yields from diffuse radiation have meant that all roof alignments have become economically viable. This has also considerably alleviated the problem of the midday peak of solar energy production, as the different alignment of the solar energy systems leads to the spreading of production peaks throughout the day.

Wind Power as the Backbone of the Energy Supply on Wilhelmsburg and in Europe

Of course, the large wind farms near and on the Energy Hill and in the Port of Hamburg area, upgraded since to over 10 megawatt, are particularly eye-catching. As expected, they form the backbone of the renewable energy supply in Wilhelmsburg. In addition, an electrolysis plant for the production of hydrogen from wind energy has been built in the harbour area adjacent to and on the site of the Moorburg coal-fired power station, was only rarely being used as back-up, and this can help to match the production of renewable energy to the demand for power. The biomethane is fed directly into the city gas grid, thus replacing fossil natural gas.

Passing the 95 per cent mark for renewable energy in Europe in 2050 signalled the end of coal-fired power stations. The expansion of the European electricity grid, the continent-wide mixture of small, decentralised power producers and larger systems such as onshore and offshore wind energy, hydro-electric power, biomass, and geothermal technology, the Europe-wide system of

electricity stores and current transformers, not to mention load management, make it possible to have a complete back-up system using only the available gas-fired power stations. These operate on a mixture of biomethane, hydrogen, and the remainder of the fossil natural gas. This makes them considerably more climate-stabilising and flexible than the fossil dinosaurs, the last coal-fired power stations from the 2010s that are still in operation.

The Energy Bunker itself has been further expanded during the last 35 years and equipped with additional energy technology. Along with the Energy Hill, it has remained the iconic symbol of the climate-friendly development of Wilhelmsburg. The residents also like to hold events there, because of its special view of the city. They are occasionally asked if they really come from "the district with the first Energy Bunker in Germany".
In the 2020s the Bunker's heat storage capacity was once again doubled and industrial waste heat replaced by the conversion of excess wind power into heat. The three heating grids in the west of Wilhelmsburg were gradually expanded until they were able to supply the whole of this increasingly densely built-up area, including some industrial and commercial businesses in the port area. After the connection of the three heating grids, the Energy Bunker became the switching station and buffer storage unit for the entire system. A fourth heating grid for Georgswerder and Veddel was added, using the waste heat from the waters of the Elbe and from industry, with contributions from the large-scale solar energy systems on flat roofs in the area.

From the 2020s on, it became common to also use the entire façades of new buildings for the generation of solar energy. In combination with the novel, highly efficient, and consequently very thin insulation technologies, there are almost no limits to the possible ways they can combine with the design, and the PV modules are used as integral building materials as a matter of course. Usually all sides of the buildings are equipped with PV modules, as the building costs for façades with integrated PV usage are very little higher than for those without.

After the renewal rate had remained at around 1 per cent for many years, in the 2020s cheap energy generated from façades and roofs in combination with the sharp price rises for fossil-based energy and more extensive tax write-offs radically changed the cost of refurbishing buildings. The high running costs of buildings that had not been retrofitted were no longer compensated for by the lower rent (without heating costs), and occupying such buildings became a luxury. Demographic changes and a construction industry had caused a continued slackening of the housing market, with a wide selection for those interested in renting or buying. Landlords began to compete for efficiently refurbished buildings with their own energy supply and this increasingly counteracted the slowdown in building renovation.

In the business districts, protected brick façades deemed worth preserving now alternate with walls that generate solar energy. Solar panels on some buildings and especially over public spaces provide protection from rain and sun, while also generating electricity, which, at daily peak production times, can be used free of charge at public electricity filling stations.

Detached private houses and small blocks of flats are still "problem children". Despite the fact that refurbishment has become financially worthwhile as a result of higher energy prices and the change to renewable energy, the owners often do not have sufficient means to make the necessary investments. Builders' merchants try to make it easier for people to refurbish their own property by offering cheap, durable building materials and convenient system kits, and there are courses demonstrating how private individuals can use these successfully and still achieve a high degree of quality.

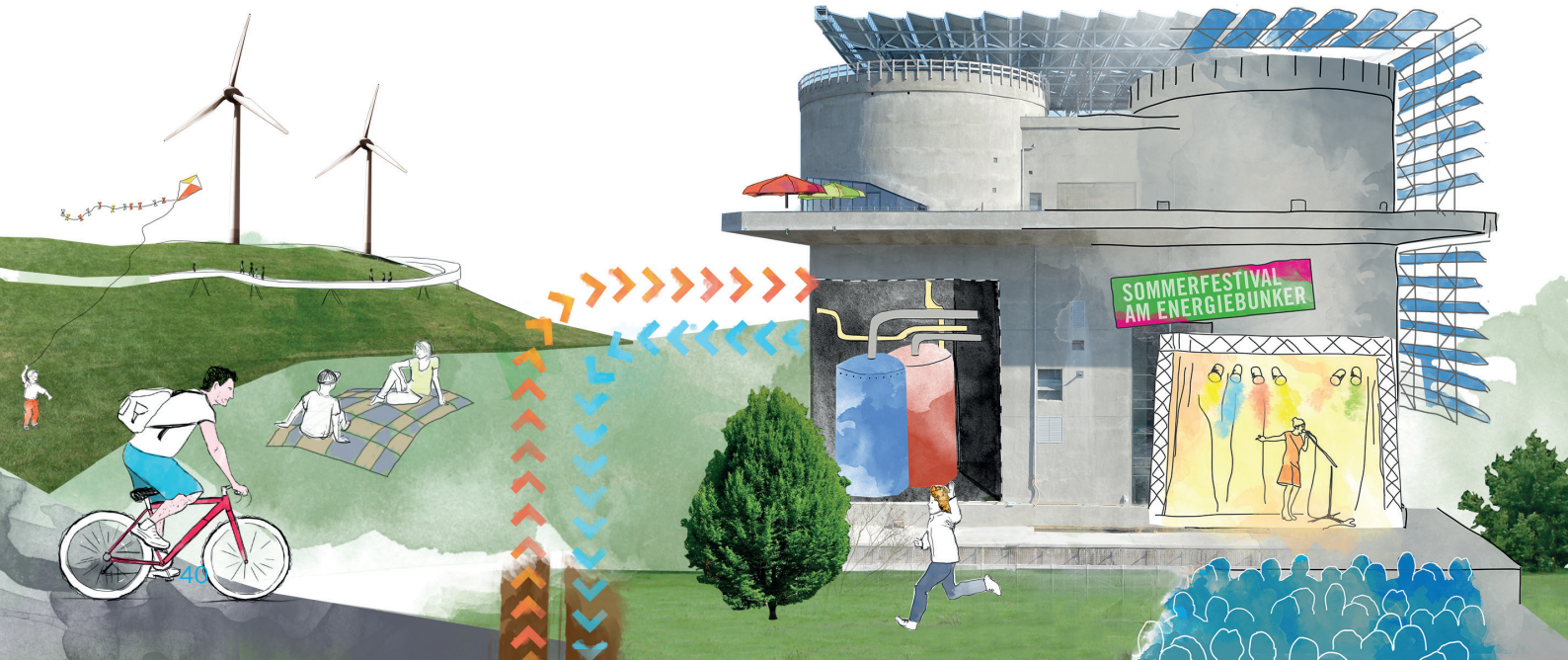
District Management, yet Traffic Still Needs Development

Wilhelmsburg has gradually become quieter, more colourful, and greener. An important step in this direction was the establishment of district management. In the mid-2020s it was finally accepted that district management could be useful not just for the socially deprived areas of the city but for all

districts. In Wilhelmsburg, the increasingly heavy traffic through the harbour soon became the focus of discussion. Concepts and ideas were worked out together with the Hamburg Port Authority, the harbour company, the integrated urban planning authority, and the local residents. There was a great deal of arguing and wrestling with the problems, but a consensus was finally reached and technical solutions were found that resulted in genuine improvements and peace and quiet for the Wilhelmsburg population, without impeding the Port of Hamburg in its role as one of the most important economic elements in the city.

The extension of the Hamburg underground system to the Elbe Islands and the construction of a light railway were already planned in the early 2010s but could not be implemented until the late 2020s, because of the enormous pressure on the inhabitants of the area. As the view of the surrounding streets from the roof of the Energy Bunker shows, this has unfortunately not resulted in private car traffic becoming totally insignificant, but young people especially have converted almost completely to bicycles, e-bikes and the growing opportunities for car sharing. The marked increase in two-wheeled traffic, which began back in the 2010s, meant that the city of Hamburg was obliged to widen streets and even convert whole stretches of road to construct a safe and attractive network of cycle paths. In addition, many changes to laws and tax regulations have led to the use of increasingly smaller vehicles. More and more cars run without fossil fuels and, as a result, air quality has considerably improved and noise has been reduced.

Goods traffic, which is particularly heavy in Hamburg compared to other cities, has been brought under control by skilful logistics, with large distribution centres on the outskirts of the city and smaller distribution centres in the districts. Deliveries are bundled on the urban periphery and then transported over the last "Green Mile" to customers by shared "City Carriers". Transregional goods traffic, especially transport to and from the Port of Hamburg, is now mostly carried by rail and water.



All the same, there is still much to be done here before the volume of traffic is substantially reduced and more areas of the city can be released for other uses. Free public transport will be the next step in this direction.

The Island of Wilhelmsburg – An Attractive Place to Live, Work, and Play

As clearly seen from the viewing point on the Energy Bunker, the green spaces of this area of the city now form a single, large, interconnected green space. They create open-air aisles and act as connecting routes for cycle traffic between the different parts of the city. The Dyke Park, which was created as part of the extension of the flood protection systems around Wilhelmsburg, is now the key component of green space provision. The Elbe has thus once again become a natural element in everyday life and the most important leisure area for the residents. Some of the district's public green space is used for horticulture, thus strengthening communication between neighbours, improving the environment, and encouraging self-sufficient food production.

After reaching a peak in the 2030s, expenditure on household electricity, home heating, and transport is now falling again, thanks to the largely completed investment in building refurbishment and the energy infrastructure. Powerful wind and solar energy companies have been established on the Elbe Islands, and many Wilhelmsburg residents are involved in them. After 40 years, a slow but steady change in leisure and consumer behaviour ("sharing instead of consuming") and the return to the urban design ideal of the "mixed town" gradually began to reveal their effect. Like horticulture and the repairing and sharing of everyday essentials, local energy production has become a natural part of the urban lifestyle and, like the changes in the traffic sector and the extensive renovation of buildings, it has resulted in additional jobs and income for the island.

List of Figures