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ADAPTING CITIES. Global Climatic change,
natural disaster and urban resilience

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Climate Protection and Green City Policies in Frankfurt am Main, Germany

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ABSTRACT: The city of Frankfurt, 710,000 inhabitants, represents today a business and financial centre, transportation and logistics hub, research and technology location in a national and international context. As a result, the city is experiencing a constant and for European settings considerable population growth. Such increase implicates a high demand for housing, infrastructure and open space development. Urban extensions would be needed, but within the municipal boundary there are no development areas left. Further growth demands will have to be met within the already built-up city. On the one hand, inner city development, re-use of brownfields and densification can reduce the consumption of green fields and suburbanization. On the other hand, it involves an increasing conflict between the demand for new developments and the preservation of open and green spaces and quality of life within the city, leading to risks for climate and environment.

Suitable policies and adaptive strategies have to be prepared to cope with these changes and their impact. In Frankfurt, these include: the Energy and Climate Protection Concept, containing over 50 actions and guidelines, with a particular focus on the construction of “passive houses”; the Master Plan 100% Climate Protection, with milestones that focus on how the city can achieve 100% renewable energy supply by 2050; the Frankfurt Green City municipal platform, which coordinates information on city policies and programmes regarding urban and environmental development; and the Integrated Urban Development Concept Frankfurt 2030 as a vision for environment, housing, economy, mobility and social coherence until that year.

Recently, Frankfurt has been ranked as “the most sustainable city” worldwide by the ARCADIS Sustainable Cities Index. In both the environmental and the economic aspects, Frankfurt was evaluated first, whereas with regards to social issues, it was rated only 9th. This result makes clear that successful urban management in the environment and economy fields alone cannot solve (and may eventually even increase) social disparities, making this a major issue in all future integrated urban development efforts.

KEYWORDS: Integrated urban development; climate change adaptation; green city policies; case studies urban planning; Frankfurt am Main.

Introduction

The city of Frankfurt am Main (Fig. 1 and 2), 710,000 inhabitants in 2014, is located in the middle of the Metropolitan Region of Rhine-Main in central Germany, one of eleven

metropolitan regions in the country, counting about 5.6 millions inhabitants (Regionalverband FrankfurtRheinMain, 2015). It is the fifth-largest city in Germany, and contrary to other cities and regions in the country and on the continent, where the population is experiencing a shrinking process, in the last ten years Frankfurt has continuously attracted new residents. The city has grown with an average increase of 15,000 inhabitants per year since 2011, and it is estimated that in a short delay the population will exceed the number of 800,000 (Dobroschke & Gebhardt, 2015). Additionally, more than 325,000 people commute to Frankfurt for work every day.

Fig. 1: New housing along the river (Peterek, 2015)

Fig. 2: Urban fabric from above (Peterek, 2015)

Nowadays, Frankfurt is considered to be one the most attractive cities in Germany and Europe, thanks to a wide range of job offers, its relative affordability (compared to many other metropolitan cities worldwide), the provision of attractive residential facilities, the efficient services and infrastructure, leisure and environmental amenities and its central geographic location. Almost one third of its population has a non-German passport and about 50% an international background, creating a multinational and multicultural environment that deeply affects the city and its social and cultural dynamics.

Due to its central location, the city has since long established as a central traffic hub in the national and international context, with one of the largest international airports, two high-speed train stations, and a north-south east-west highway intersection passed by 150,000 vehicles every day. Therefore, logistics, transport, and trade are among the strongest sectors in the city, but the city also hosts the global financial economy, including the seat of the European Central Bank, the German National Bank and the German Stock Exchange, as well as the headquarters of a large number of other national and international banks and insurance companies. Besides the financial economy, the trade and the transportation,

Frankfurt is nowadays shaped by the telecommunications and informatics sector, chemistry and pharmaceutical industries, the “creative” and cultural economy, as well as an extensive number of research and higher education institutions (Stadtplanungsamt, 2012).

Urban Challenges

The increasing population together with the high functional and economic attractiveness of the city lead to a growing demand for housing, infrastructure provision and open space development. Further urban extension would be needed, but within the limited municipal boundary there are almost no development areas left. Surrounding cities and municipalities within the Metropolitan Region define clear restrictions for any additional physical growth. The Riedberg area, a new district of about 200 hectares currently under development for 15,000 inhabitants plus university extension, has been the last larger land reserve (Fig. 3).

Therefore in Frankfurt, further growth demands will have to be met within the existing and already built-up city, as brownfield developments or in the form of densification of the existing fabric. Former industrial areas, military precincts, derelict harbours or freight terminals are potentials of such kind, but a large part of them has also already been developed in Frankfurt in the last 20 years. The redevelopment of the former Western Harbour (Fig. 4) to a mixed-use inner-city district for housing, leisure and office is an important example of this type (Stadtplanungsamt, 2012).

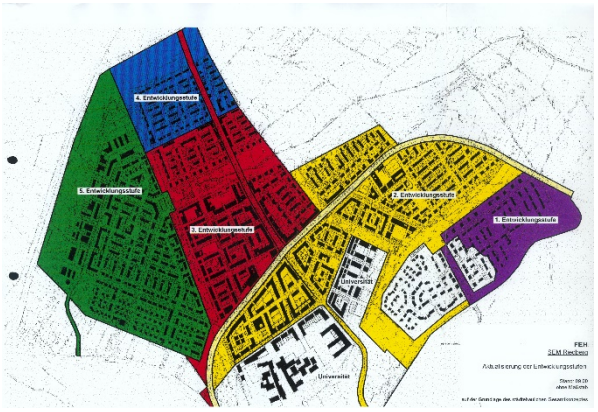

Fig. 3: Riedberg urban extension (Stadt Frankfurt)

Fig. 4 Western Harbour development (Peterek, 2015)

On the one hand and in a sustainability perspective, inner city development, re-use of brownfields and urban densification can help to reduce the consumption of greenfield sites, sprawl and suburbanization. On the other hand, also in Frankfurt this involves an increasing conflict between the demand for new developments, due to the population growth, and the preservation of open and green spaces and quality of life within the existing city, what leads

to considerable risks and consequences for urban climate conditions and the urban environment, too.

So far, Frankfurt has been a comparatively “green” city in comparison with many other cities of similar size around the world (Fig. 5). About 52% of the total area of the city comprises green and open spaces, including more than 40 parks, a continuous Green Belt of 8,000 hectares surrounding the city, and an extended city forest in the south (Stadtplanungsamt, 2008; Dezernat Umwelt und Gesundheit, 2010).

The city’s status as an international business location as well as an attractive residential city will also depend on maintaining its environmental assets while coping with the challenges of urban growth and effects of climate change. So the city’s Environment Department has already stated that the urban quality can only be strengthened if the natural resources are preserved in the long term, the environmental and housing quality is improved, and the natural resources are used as efficiently as possible (Dezernat Umwelt und Gesundheit, 2010).

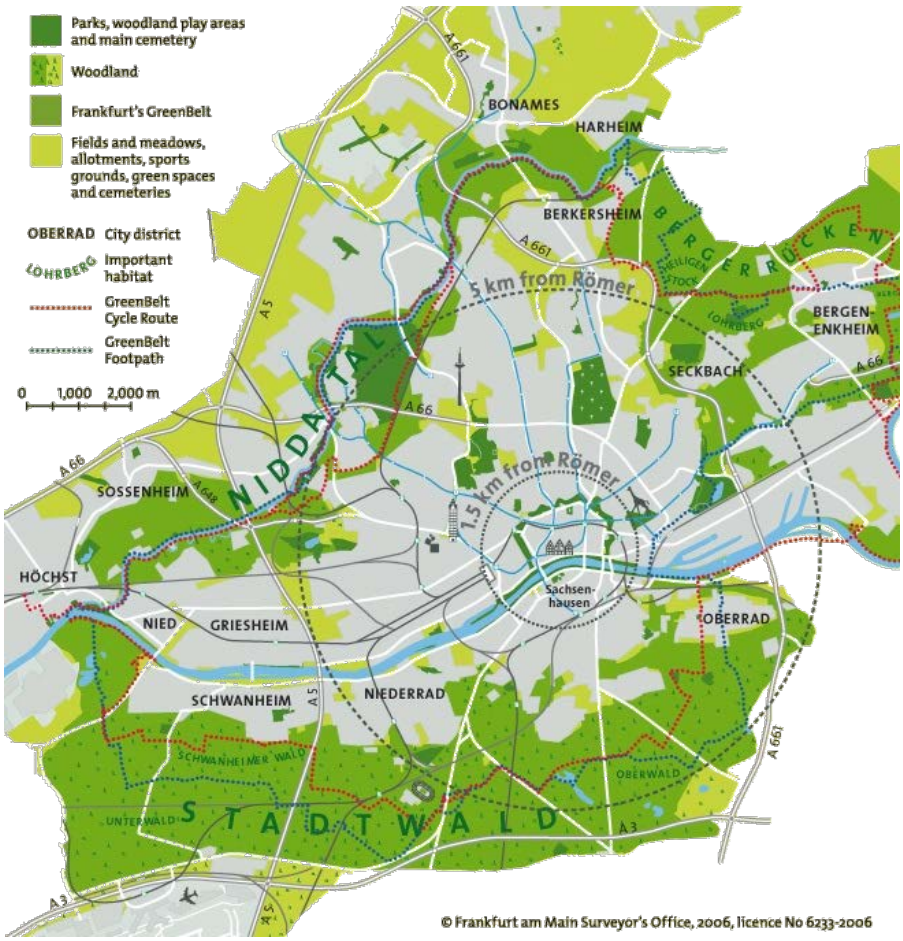

Fig. 5: Map of green and open spaces in Frankfurt (Dezernat Umwelt und Gesundheit, 2010)

Climate Change and Climate Risks

The ecological, economic, and social consequences of worldwide climate change will have an increasing impact on the urban living conditions of the coming decades in Frankfurt am Main, too. For instance, climate change in Frankfurt will lead to a further increase in the annual mean temperature. There will be a rise of summer heat waves, bringing more warm summer days, with a maximum temperature over 25° C, and more hot days, with a maximum temperature over 30° C, as well as an increase of periods of dryness. At the same time, rainfall patterns will also change, as drier summers will be followed by wetter winters. Stronger rains will then result in a higher frequency of water floods (Frankfurt Green City, 2015).

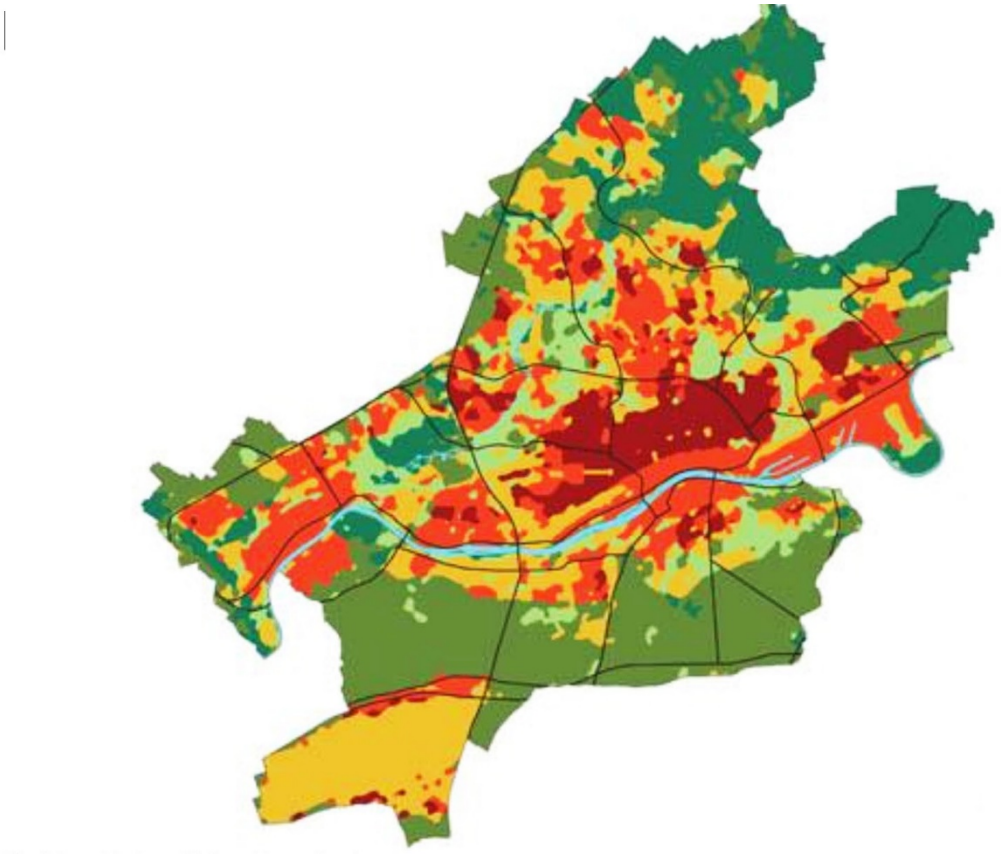

Fig. 6: Climate Change Atlas Frankfurt am Main (Klimaplanatlas für Frankfurt am Main, 2015)

The Climate Change Atlas (Fig. 6), compiled by scientists of the university of Kassel, provides a forecast on the future impacts of climate change on the city of Frankfurt and directly relates these impacts to the different typologies of urban structures and open space. It indicates the urban areas, specifically in the inner city, with the risk of overheating and the risk of critical housing and living situations. The Climate Change Atlas also give suggestions what should be done in city planning to maintain and to improve the urban climate, e.g. to let cooling air masses penetrate the city during the night. Areas in which cool and cold air is

produced and which constitute “air channels”, i.e. woodland areas, farmland and meadows (green and dark green in Fig. 6), must be preserved and protected. More densely built-up areas (red) and the tightly packed inner city areas (dark red) are zones where substantial improvements concerning open space and city greening are needed (Klimaplanatlas für Frankfurt am Main, 2015).

Therefore, suitable policies, measures and adaptive strategies have to be prepared to cope with these risks and their expected impact. Since the creation of the municipal Energy Agency in 1990, as part of the Environment Department, and the co-founding of the Climate Alliance of European Cities in the same year, the city of Frankfurt has developed a diversity of policies and programmes related to climate protection and adaptation strategies as well as Green City policies. The most important of them will briefly be presented in the following.

Energy and Climate Protection Concept

Since 2008, the city’s Energy and Climate Protection Concept has started to develop measures to show where and how it would be possible to save considerable amounts of CO_2 emissions in the coming years. Thereby, the city’s objective is to reduce its CO_2 emissions by 10% every five years.

The concept, responsibly headed by the municipal Energy Agency, involves a wide number of partners and stakeholders – from municipal administrations, such us Environment Department, City Planning Department, Building Department, and others, to city-shared companies providing essential urban infrastructure services with regards to energy and heat, water, waste water, waste, as well as other public and private organisations and associations and, last not least, the general public and citizens. The program contains more than 50 direct and indirect actions and guidelines for reducing CO_2 emissions by 2030, which focus around the following four main action fields (Energiereferat, 2009):

- reducing the demand for heat and electricity: by energy-saving new buildings as well as modernization and energy renovation of the existing building stock; consulting of owners and developers; promotional programs;
- expanding district heating nets and systems: for instance, by municipal law, the already mentioned Riedberg extension project, is completely connected to a central district heating system, which is based on cogeneration of combined heat and power and includes all private households, public buildings as well as the campus of the Goethe university; the only possible exemption is to build in a passive house standard, what means consuming no heating or cooling energy at all;
- promoting of decentralized cogeneration and home power stations for housing blocks and neighbourhoods as well as office parks and companies;

- using more renewable energies: in the urban context, for instance, by supporting and massively increasing the use of photovoltaic systems, with no restrictions on their size; by creating a web access to the site “SolarDachFrankfurt”, an online solar register developed by Frankfurt University of Applied Sciences (SolarDachFrankfurt, 2015), where every homeowner of the city can check on the internet whether his house is suitable for a photovoltaic system and how much the gain would be (Fig. 7); as well as by public participation schemes, managed by Frankfurt’s housing association, ABG Frankfurt Holding GmbH, where tenants can purchase shares in the photovoltaic plants and thereby also earn money.

In most cases, energy efficiency and climate protection can be combined with economic development and job creation.

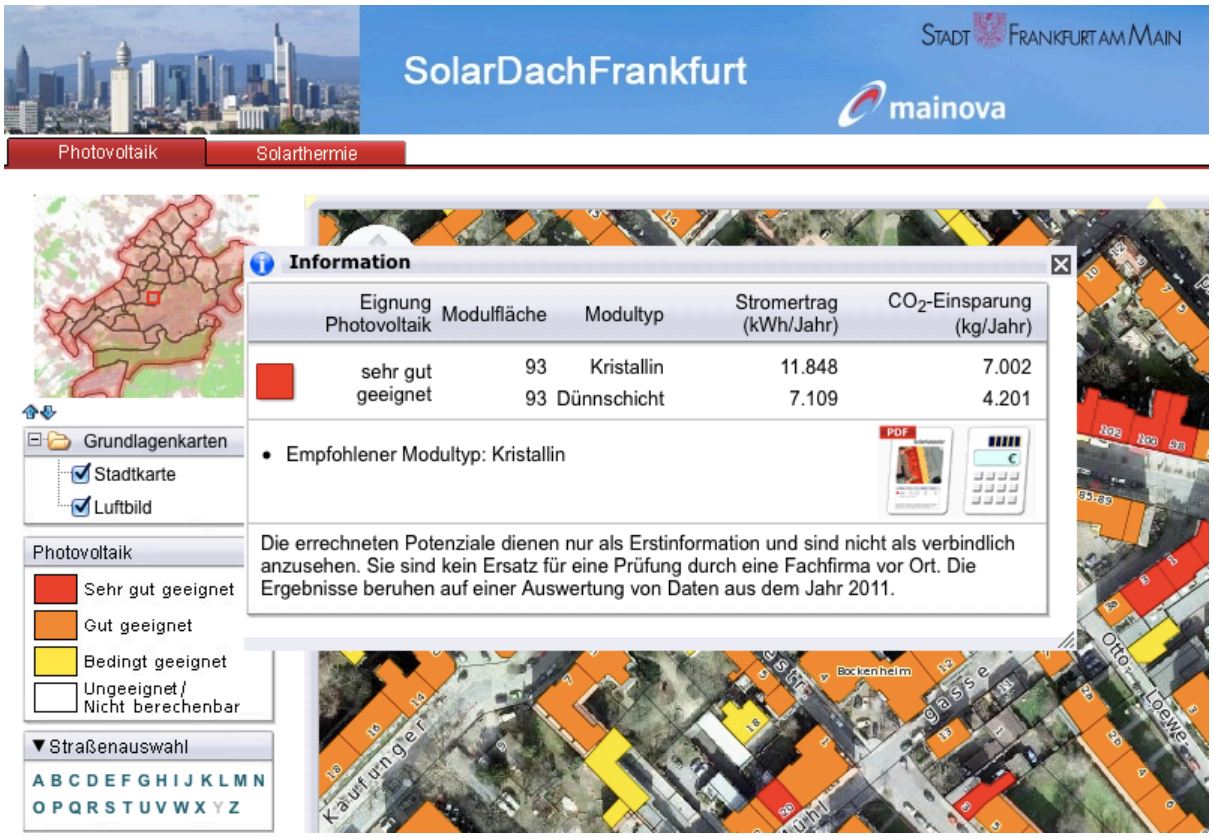

Fig. 7: Online Solar Register of Frankfurt (SolarDachFrankfurt, 2015)

Within the Energy and Climate Protection Concept, a particular importance is given to the construction of “passive houses”. Passive houses are particularly energy efficient buildings that need around 90% less energy than regular houses. Based on a decision of the municipal council, all city-owned buildings and any other projects on municipal land must be constructed according to passive house standards, and passive house components must also be included in eventual refurbishment works. Until 2014, this already includes over 1,500 homes (many of them developed by the municipal housing organisation ABG Frankfurt Holding, which builds only in accordance with passive house standards), but also schools, day nurseries, sports halls and office buildings (Fig. 8). Therefore, Frankfurt is today regarded as the “capital of passive houses” in Europe (Stadt Frankfurt, 2013).

Fig. 8 Primary school in passive house construction Fig. 9 EfficiencyPlus House (ABG Frankfurt Holding) (Photokontor Gerd Kittel, Frankfurt)

But the city tries to do even better, by supporting the construction of “energy+ houses”., which are houses that produce more energy than they need themselves. One of the most recent projects of this type is the “EfficiencyPlus House” (Fig. 9), so far the biggest project of such type worldwide, on a narrow plot 160 metres long and 9 metres wide, including 74 apartments, office space and shops on 12,000 square metres total floor area. Hot water, heating and electricity are included in the monthly rent as well as a certain number of kilometres with electric car sharing vehicles parked on the ground floor. The energy surplus produced by the house in an average year amounts to 46,000 kilowatt hours, which corresponds to a driving performance of 250,000 kilometres of a medium-sized passenger car (Aktivstadthaus Frankfurt am Main, 2015).

Master Plan 100% Climate Protection

Since 2013, the municipal Energy Agency is charged with developing the Master Plan 100% Climate Protection. It is a project funded by the Federal Ministry for the Environment and a relevant part of the National Climate Protection Initiative.

The Master Plan 100% Climate Protection represents a concept with timeline and milestones that focuses on how the city and the region can achieve 100% renewable energy supply by 2050 through a mix of climate-friendly, highly efficient energy production and energy savings, and within a close cooperation of adminstrations, urban planners, architects, house owners, companies and citizens (Energiereferat, 2015).

The objectives are two-fold: reduction of the energy consumption by fifty per cent until the year 2050, and use of 100% renewable energy (half of them produced locally) for the remaining energy needs (Fig. 10). CO_2 emissions will at the same time be reduced by 95% compared to the year 1995. As one of the first German cities, Frankfurt will thereby provide and establish a detailed schedule for its “decarbonisation”.

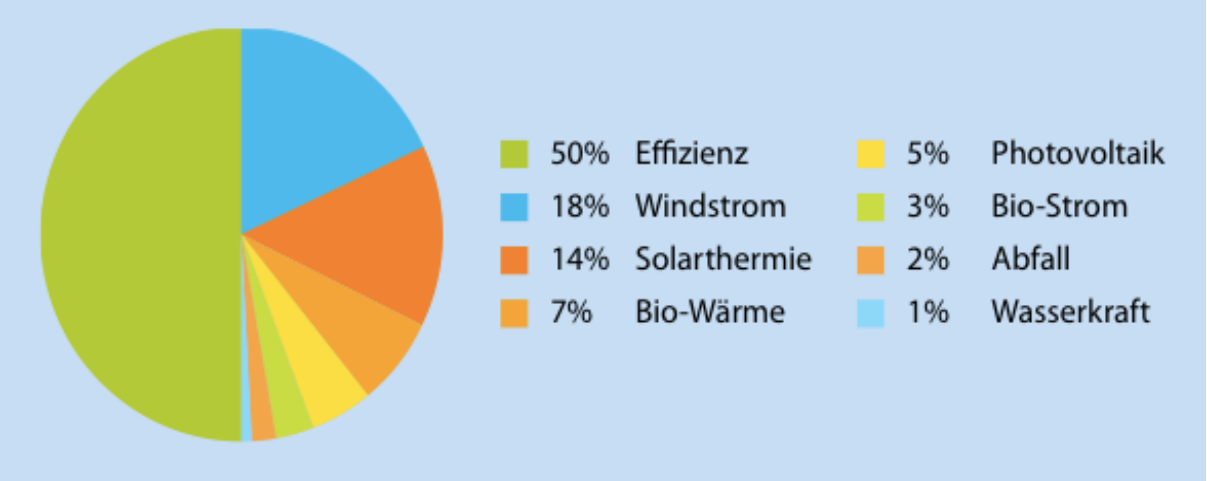

Fig. 10 Scenario of energy provision and sources of Frankfurt in the year 2050 (Energiereferat, 2015)

A first feasibility study has been voted by the city councillors in July 2015, and will now be followed by a detailed programme of short, medium and long-term measures, including a wide range of components, from technical aspects concerning heat and power production, distribution and consumption, to urban planning issues, concepts for a more sustainable mobility (with regards to cycling, walking, e-bikes and e-cars, car-sharing, as 20% of total energy consumption is today related to the needs of urban transport), and – last not least – a specific importance is given to the related educational programmes, addressing the general public, but also specific groups such a children, schools, companies, home owners, associations, administrations and many other.

In this context of sensitization and involvement of the public, for instance, the continuously extended “Climate Protection City Map”, managed by the Energy Agency, shows climate protection projects in the city of Frankfurt, providing a full description of buildings and facilities as well as detailed further information. And the “Climate Tours”, conceived by the city together with the communication platform AiD presents an opportunity for professional and general audiences to visit energy-efficient buildings and to look “behind the scenes”, observing how cogeneration plants operate, how passive houses work or how low-energy office cooling systems function.

Frankfurt Green City Approach

“Frankfurt Green City” is a municipal platform, managed by the Environment Department, which coordinates and provides extensive information on city policies, programmes, campaigns and projects related to a wide range of aspects regarding urban and environmental “green city” developments: including climate protection, energy supply, air and noise pollution, waste, drinking water, waste and surface water, green spaces and urban gardening, urban development, transport and mobility and others (Fig. 11; Frankfurt Green City, 2015).

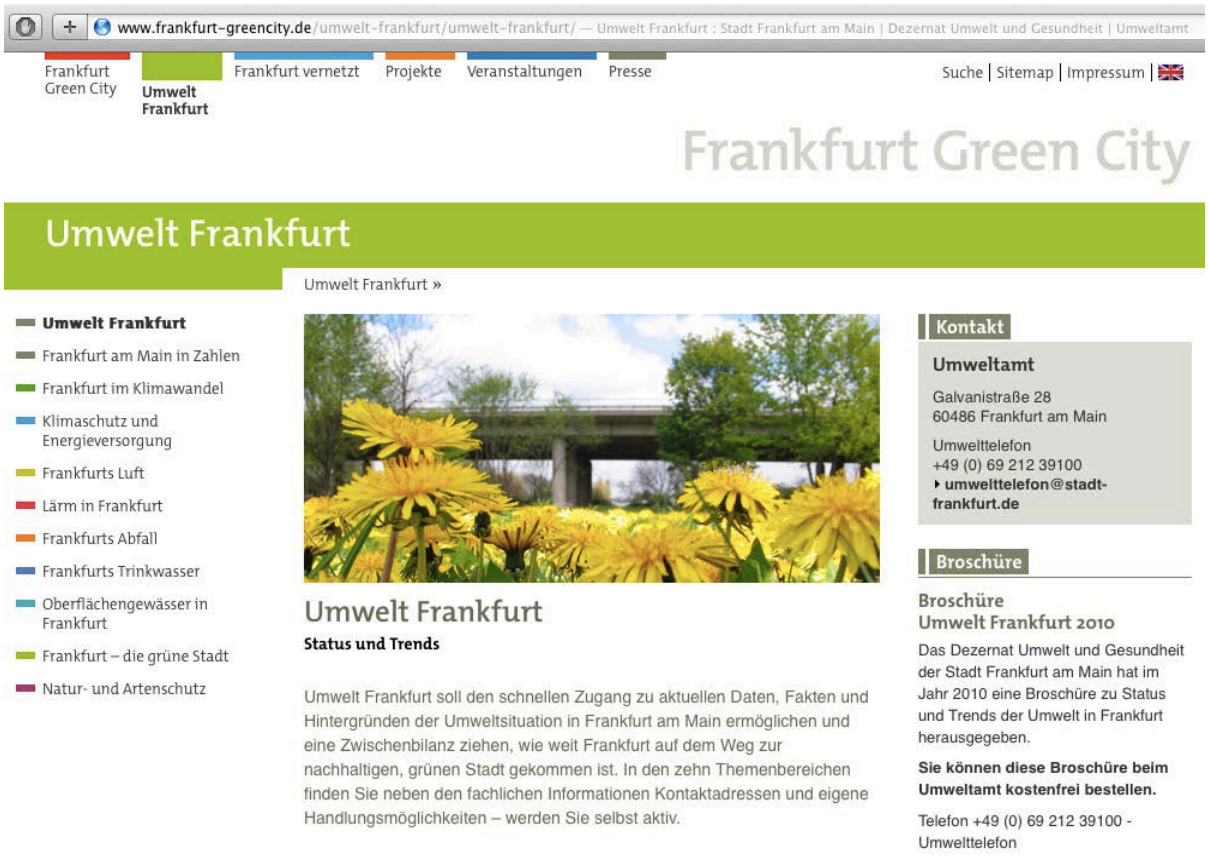

Fig. 11 Homepage of the platform Frankfurt Green City (Frankfurt Green City, 2015)

Starting point has been an application for the European Green City Capital Award 2014, when the city of Frankfurt became one of the three finalist cities, the two others being Copenhagen and Bristol. Created by the European Commission, the title of European Green City Capital is awarded each year to a city, which is an environmental model to other municipalities, by having followed a consistent environmental policy, implemented a more sustainable mobility, expanded green and park areas, introduced innovative infrastructure and resource management and generally improved urban living quality and conditions (European Commission, 2015).

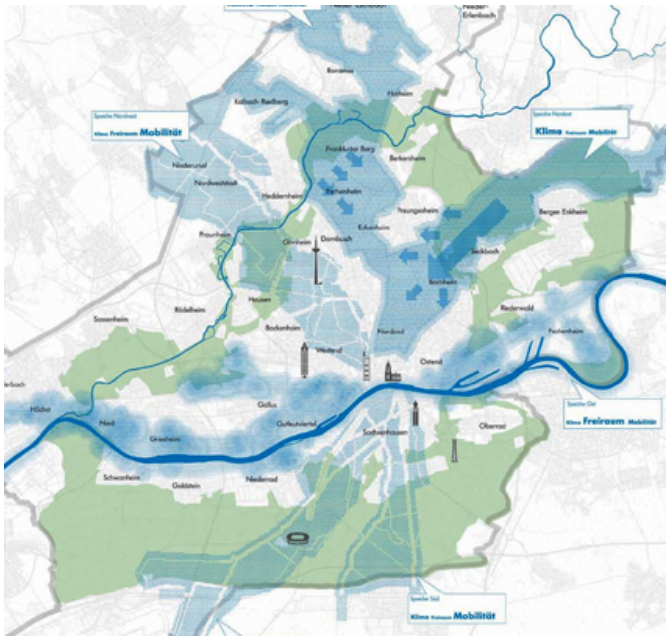

Fig. 12 Strategic open space plan of "rays & spokes" (Stadt Frankfurt, 2012)

Fig. 13 Frankfurt eMobile initiative (Frankfurt Green City, 2015)

Even if Frankfurt did not take the first place in 2014, this initiated and supported an on-going process and a broad social discourse about objectives, potentials and further steps towards a city balancing its economic and social, ecological and cultural needs in the future. Today, the Green City Approach integrates many different planning concepts, projects and sectors, including among others in the urban development and climate protection field:

- the development and qualification of open and green spaces, linking the inner city with the existing Green belt and the surrounding region by a strategic system of radiant "rays and spokes", allowing for better city ventilation as well as providing attractive spaces for recreation, walking and cycling. (Fig. 12; Frankfurt Green City 2015 / projects; Stadt Frankfurt, 2012);

- a flood prevention concept, not only for the river Main, but also the side streams from the Taunus mountains, often reaching the city after strong rains with almost no forewarning (Frankfurt Green City, 2015 / flood prevention);
- the “Frankfurt e-mobile” initiative, aiming to promote the use of electric vehicles in Frankfurt am Main by making people aware of the wide variety of types of vehicles available, including electric bicycles, e-scooters, electric cars, delivery vans and buses (Frankfurt Green City, 2015 / electromobility);
- the decentralization, development of mix-use districts and neighbourhoods, including the re-qualification of the inner city, with the aim to integrate basis recommendations of the Climate Change Atlas concerning heat islands, city ventilation and green spaces (Frankfurt Green City 2015 / projects).

Integrated Urban Development Concept Frankfurt 2030

In the past, the concepts and projects developed for the city’s future were for the most part developed solely for specific sectors, like for instance, residential developments, industrials zones, the green belt, mobility, and others. Already with the application for the European Green City Capital Award, the city of Frankfurt publicly committed to a more integrated approach to its future urban development.

On these premises, in late 2014 the city parliament and the magistrate decided to start the process of a comprehensive and integrated vision for environment, housing, economy, mobility and urban life in Frankfurt until the year 2030 with an “Integrated Urban Development Concept”. The aim of such concept is to deal with the expected growth, and at the same time maintain the city’s high quality of living and environment. Hereby, already existing planning processes, goals, strategies and initiatives should no longer stand separate from each other, but rather be regarded together, illustrating conflicting aims and seeking possible solutions, to formulate a total picture and framework for future development. (Stadtplanungsamt Frankfurt am Main, 2015).

The envisaged process, which has just begun and is conceived over a period of two years until the end of 2016, will thereby be subdivided into the following four steps, the first two examining Frankfurt as it currently is, and the latter two asking how the city should evolve in the future (Fig. 14):

- an analysis of the status quo by different sectors, outlining today’s main trends, challenges and development factors, strength and weaknesses, threats and opportunities in each field;

- an integrated and holistic assessment of the status quo, looking at cross-cutting issues with regard to the social, economic, ecological and cultural dimensions of sustainable urban development;
- the formulation of development goals and discussion of different development options and scenarios;
- the formulation of a vision for the city of Frankfurt in 2030, of strategies and of a set of actions and "lighthouse" projects to reach the objectives.

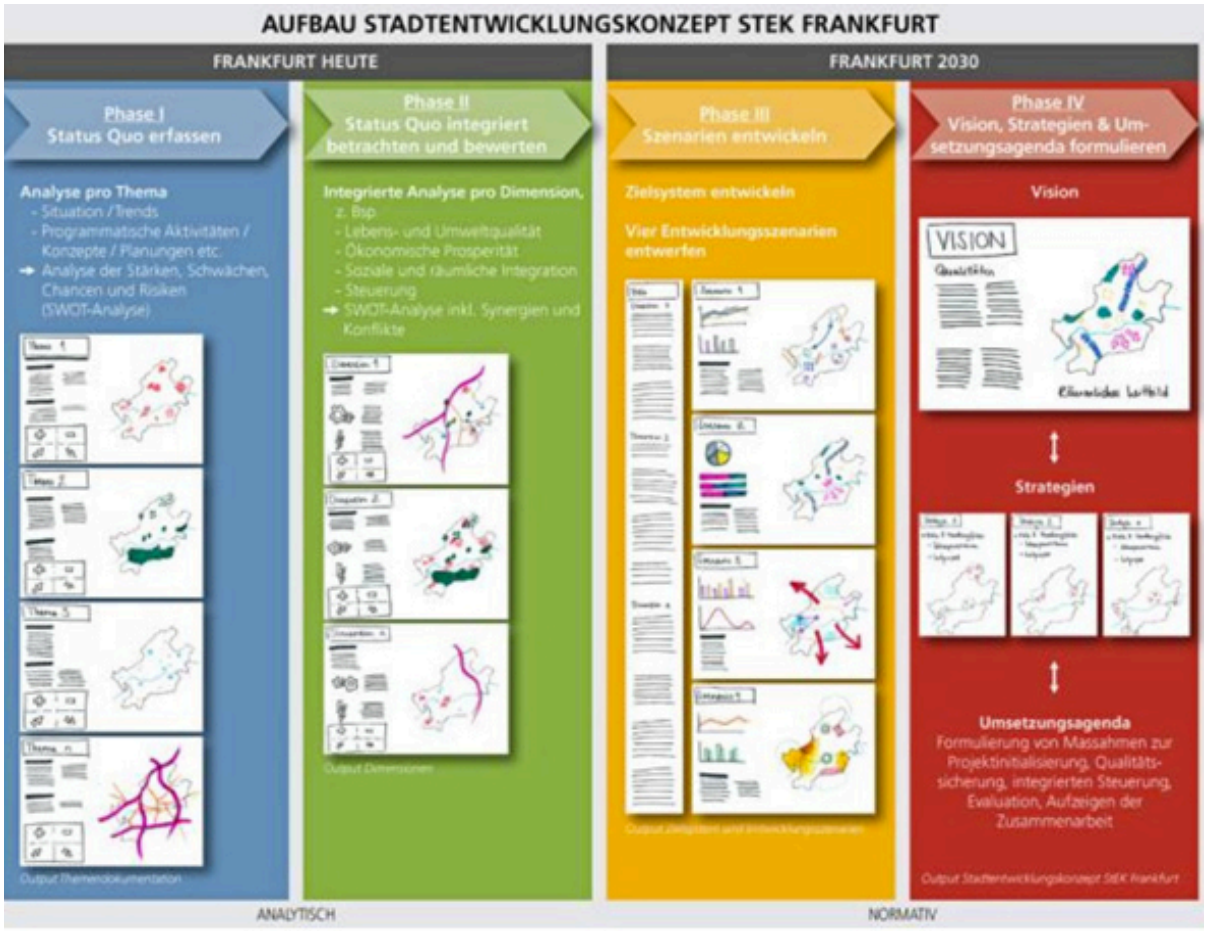

Fig. 14 Phasing of Integrated Urban Development Concept (Stadtplanungsamt Frankfurt am Main, 2015)

During the whole process a wide range of public participation is seen as a major asset for its success within the community. Therefore, besides the involvement of the different city departments and divisions, and the support by the external planning firm Ernst Basler + Partner AG from Zürich in Switzerland, a broad debate and involvement of citizens, experts and interest groups shall make such integrated urban development approach as transparent and comprehensible as possible. The overall concept is supposed to be finally presented to the city council for discussion and voting in 2017.

Conclusion

In the year 2015, Frankfurt am Main has been rated as the “most sustainable city” in a ranking of 50 leading cities worldwide by the ARCADIS Sustainable Cities Index 2015, followed by London and Copenhagen, and based on a study of the London Centre for Economics and Business Research, CEBR (Fig. 15; Arcadis Sustainable Cities Index, 2015). Such distinction is proof of the considerable results and performance the city of Frankfurt has achieved in the last twenty-five years, since the creation of the municipal Energy Agency in 1990, in the fields of green city policies, climate protection and sustainable urban development.

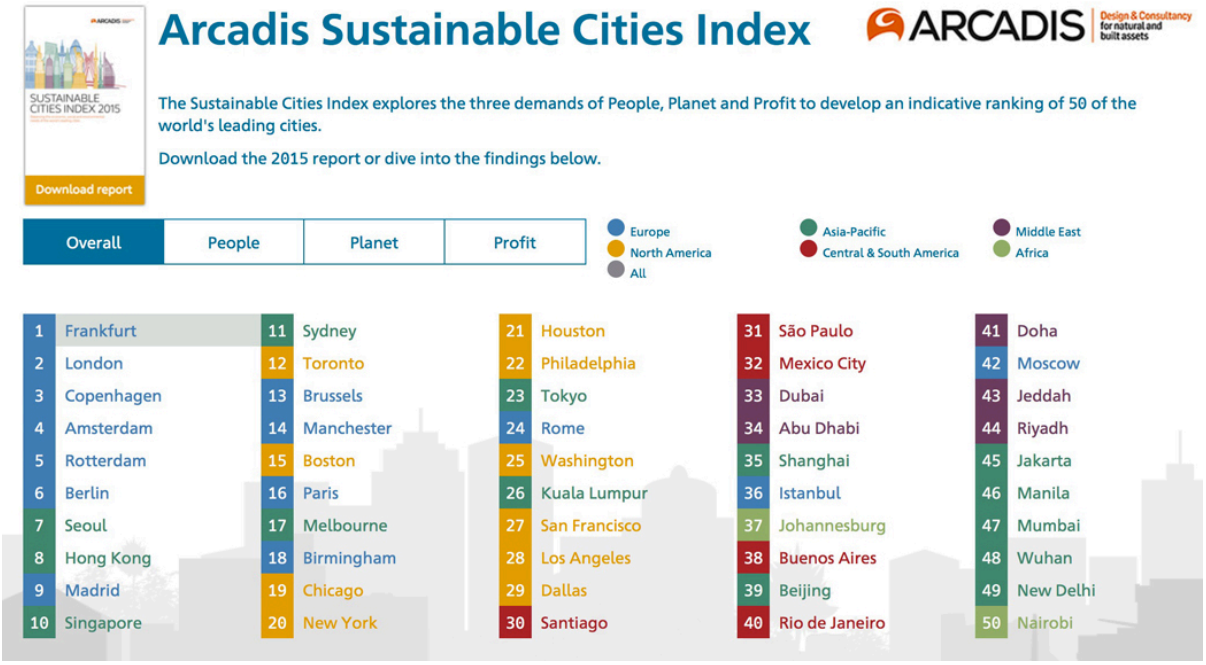

Fig. 15 Frankfurt leads the ARCADIS Sustainable Cities Index (Arcadis Sustainable Cities Index, 2015)

Looking at the results in detail, in both the categories of “planet” (environment) and of “profit” (economy), Frankfurt is been rated first in the worldwide context (Berlin being the second in the environment, and London the second in the economy related field). This demonstrates that a consistent effort to at least partially cope with today’s global challenges of climate, energy, open space and environment in general does not necessarily need to contrast or stand in opposition to successful economic development. Despite its constantly growing population in the last years (within a city boundary where there are almost no extension areas any more) and a high functional and economic pressure on the urban areas, too, Frankfurt has achieved to develop reliable steps and manageable concepts to preserve open spaces and the quality of urban living, adapt and mitigate the impacts of climate

change, make a move towards 100% renewable energies, develop forms of a more sustainable mobility, and sensitize and integrate its citizens along this way.

Nevertheless, in the category "people" (social issues), Frankfurt is rated only 9th in the worldwide comparison, Rotterdam taken the lead in this field. This result highlights the primary importance, which in the future will have to be attached to the social issues in the urban sustainability and climate adaptation discourse. Also in Frankfurt, despite all positive developments, the gap between high and low-income groups has increased in the last decades. Successful urban management in the environment and economy fields alone will not solve and could possibly even increase such disparities, excluding parts of the population who are not able any longer to afford the rising rents in a highly contested market, mobility and general living costs, as well as the transition towards renewable energies. Therefore, the social dimension will necessarily become a central issue in the Integrated Urban Development Concept Frankfurt 2030.

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