From Industrial Area to Solar Area - The Redevelopment of Brownfields and Old Building Stock with Clean Energy Solutions (City of Gelsenkirchen, Germany)

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ABSTRACT
A former coal mining and steel production hub, this case study on Gelsenkirchen shows that the concepts of renewable energy and energy efficiency can be attractive, also for a shrinking city with rapid changes in the economic structures as is typical for cities in the former European coalfield regions. The city's urban planning policy is to explore and implement clean energy options in particular for the revitalisation of coal mine brownfields and the renewal of buildings connected to the coal mine industry. Specific projects implemented in Gelsenkirchen that are shared in this article vary from individual industrial buildings with energy efficient architecture to solar housing estates for approximately 2,000 inhabitants. Further to this is the development of a new city district, under construction on the grounds of a former mining area.

Keywords: brownfields, declining population, demonstration projects, district heating, holistic urban planning concept, housing estates, industrial area, joint efforts of the local and state government, life-cycle assessment, Local Agenda 21 (LA21), solar city strategy, urban planning

1. Gelsenkirchen in Context

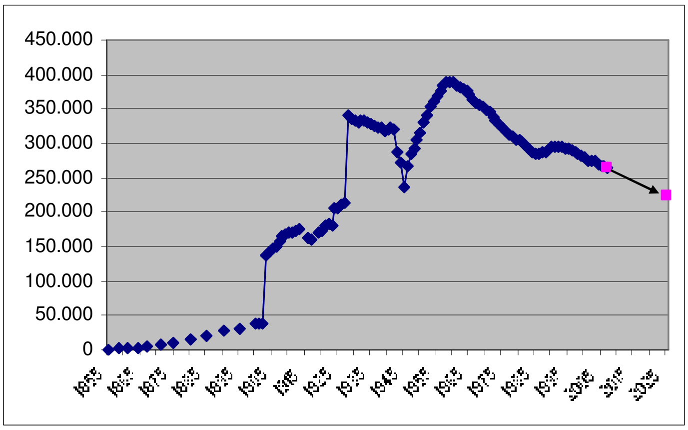
The City of Gelsenkirchen is in the Ruhr region (German: *Ruhrgebiet*), which has 5.3 million inhabitants (2008) and is Germany's largest conurbation and a former centre of coal mining, steel production and electricity generation[1]. The region lies in the centre of the State of North-Rhine Westphalia, Germany's largest and most densely populated state with an overall population of 18 million inhabitants. The vast hard coal resources along the Ruhr river were the basis for rapid growth of the region - an industrial area stretching from Duisburg in the west to Dortmund in the east.

In 1840, when coal resources were first discovered within the current local government boundary of Gelsenkirchen, the population was only 7,000. Coal mining started in the 1850s, followed by steel production in the 1870s, and the population grew rapidly to 340,000 by the 1920s. With the rise of oil production after World War II and the emergence of new overseas competitors, the region's coal, iron and steel sectors came heavily under pressure during the 1950s and 1960s. Overall employment in these fields fell dramatically from 650,000 (65% of all industry and 28% of overall employment) around 1960 to

[1] Administratively, the region is characterized by the Regional Association Ruhr (Regionalverband Ruhr, RVR). Founded under different name in 1920, the RVR is the oldest and with 53 members one of the largest associations of local governments in Germany.

73,000 by 2006 (3.5% of overall employment). Today 20,000 people are employment in the mining sector. In 2007, the Federal Government together with the State Governments of North-Rhine Westphalia and Saarland agreed to phase out coal subsidies (currently 3.5 billion Euro per year) by the year 2018. The remaining eight mines (seven in the Ruhr region and one in the Saarland) will then be closed.

Since 1960, employment in the service sector rose from 900,000 to 1.5 million, at a rate well below the state average and insufficient to compensate for the job losses in industry. As a consequence, the unemployment rate increased to 13% in 2007. Serious secondary effects are a continued decline in population and an aging trend above the state and national average.



Graph 1: City of Gelsenkirchen's population between 1855 and 2007 with a projection for 2025 (Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen and City of Gelsenkirchen)

With a high dependence on the traditional industry sectors, the crisis hit Gelsenkirchen and the neighbouring communities exceptionally hard. Since 1960, Gelsenkirchen has lost more than 30% of its population. This trend will continue at least for the next two decades: projections carried out by the State of North-Rhine Westphalia expect a further 16% decrease between 2005 and 2025 - the highest in the Ruhr region (average decline of 9.3%). The unemployment rate (15% in August 2008) is approximately double the national average (7.6% in August 2008). The home ownership rate in Gelsenkirchen is extremely low – only 15.6% of the population are owners of the housing they live in, compared to a state average of 39% (according to the Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen) and an EU-average of 63% (Norris and Shiels 2004).

Gelsenkirchen municipal profile

Population:	265,700 inhabitants (2008)
Land Area:	105 km^2
Municipal budget:	€ 750 million (2008)
CO_2 reduction targets:	currently in preparation on the basis of the targets of the climate alliance: Halving per capita emissions (baseline year 1990) by 2030

Environmental degradation became a public issue as early as late 1950s when lung cancer rates doubled due to significant declines in air quality. During the early 1960s, dust emissions from coking plants, steel mills and coal fired power plants led to permanent grey skies and frequent smog situations. The goal of restoring "the blue sky above the Ruhr" (a phrase coined by Chancellor Willy Brandt during the election campaign in 1961), initiated the start of environmental policy in Germany. Almost three decades later, in the late 1980s, after numerous legislative efforts on both national and local level and billions of Euro invested in filter technologies, the air quality in the Ruhr region finally reached acceptable levels. Today's problems with air quality such as photochemical smog (high near-surface ozone concentrations) and fine particulate matter are largely caused by traffic and industrial pollution, and is comparable to other metropolitan areas.

2. Goals

When considering that the built environment accounts for approximately 40% of Europe's total energy consumption this is an important area for climate protection (EC DG TREN 2003). To reduce greenhouse gas emissions (GHGs) in communities, strategies should be developed for housing estates, districts and the whole city level. Clean energy solutions can be designed for residential buildings, office and industrial buildings, also considering integration with local transport and waste strategies into holistic concepts.

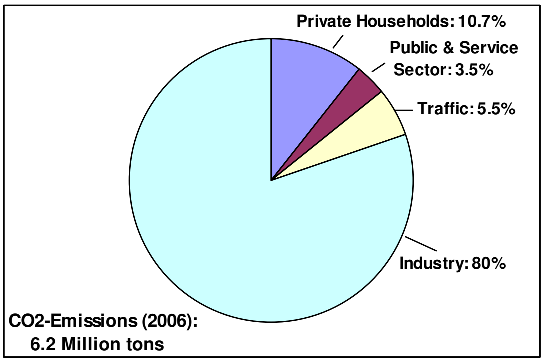
Previously a coal mining and steel production hub, with more than half the workforce employed in these sectors until the 1960s, the City of Gelsenkirchen is now on a track towards a clean energy future. This future is based on utilising renewable energy sources (RES) and improving energy efficiency (EE). A key element of the city's urban planning policy is to explore and implement clean energy options in particular for the revitalisation of coal mine brownfields and the renewal of buildings connected to the coal mine industry. Opportunities for such concepts tend to be considered in communities with rapid population and economic growth, for example where new housing estates and business/industry parks are being developed. Yet, these concepts can be equally attractive for shrinking cities with rapid changes in the structures of the economy – as is the case of European cities in former coalfield regions. Local governments of these cities face particular challenges. They have to support the development of new industry sectors and employment opportunities and, at the same time, improve the quality of urban life to mitigate further losses in population. Developing clean energy concepts for both the redevelopment of industrial brownfields and for the renovation of old building stock is thus a key element of climate-friendly urban planning policies in such cities.

In 2008 the City Council of Gelsenkirchen decided to develop a coherent climate protection strategy and also joined ICLEI's Cities for Climate Protection (CCP) Campaign. The City of Gelsenkirchen addresses climate protection and improves the share of renewable energy, by considering changes in urban planning and industry development, with a particular focus on the redevelopment of brownfields and old building stock with clean energy.

3. Results from the Greenhouse Gas Inventory

The GHG inventory of both the City of Gelsenkirchen and the Ruhr region are dominated by CO_2 emissions from the power sector and other big industries. The region remains a major centre for power production from coal. Within the borders of the Ruhr Regional Association (RVR), 19 coal-fired power plants each with an installed capacity larger than 50 megawatt (MW) are operated today, causing 55 million tons of CO_2 emissions, corresponding to 17 % of emissions from Germany's power sector. Yet, this area accounts for only 6.4% of Germany's total population (EPER 2004). The climate impact of these plants is reduced by using the considerable excess heat produced for space heating and as process energy in industry. Two regional and seven local utilities operate a district heating network stretched throughout the region and serving several hundred thousands of households.

Gelsenkirchen is home to one of the largest coal-fired power plants in Europe. The Scholven power plant (Kraftwerk Scholven) has an installed capacity of 2,200 MW and annual CO_2 emissions of 12.9 million tons (EPER 2004). This figure is not reflected in the city's CO_2 inventory, which calculates emissions based on energy consumption in industry, traffic, private households, public and service sector. According to this method, CO_2 emissions in Gelsenkirchen amounted to 6.2 million tons in 2006, a 22% decrease against 1990 levels, which is the base year of the Kyoto Protocol, and is used by the city.



Graph 2: Sectoral CO_2 emissions in Gelsenkirchen in 2006 (Energy consumption data from the City of Gelsenkirchen)

With 23 tons per capita per year, emissions in 2006 were well above the German average of 10.6 tons. This high value is dominated by emissions from industry. Two large oil refineries alone account for more than 4 million tons of CO_2 per year[2], i.e. almost two thirds of the city's total emissions. When excluding these two plants from the calculations the per capita emissions are 8.2 tons. As a consequence, climate protection policy in Gelsenkirchen is not focused on cleaning up existing big industries, but rather on issues in which the core competency lies with the local government and issues accessible to public private partnership models with local reach.

4. A New Paradigm for the Energy City

During the late 1980s, when industrial decline was at its peak and unemployment rates rose to 17%, the local government together with the State Government of North-Rhine Westphalia conceived the idea to steer the structural change into a new, positive direction while also addressing the roots of economic development in the region, namely energy. Thus Gelsenkirchen, the *energy city*, the *city of a thousand fires* should instead become the *city of a thousand suns* - a *solar city*. The main goal was to create new business and employment in a modern industry sector and to improve the image of the whole region in order to attract investment capital and skilled labour, not only in the energy sector.

Starting point: Science Park Gelsenkirchen

The starting point for the new programme was an idea to build a modern technology park - Science Park *(Wissenschaftspark)* Gelsenkirchen - on the land of a former steel foundry close to the city centre. The idea was first conceived in 1989, and linked to the development of the Internationale Bauaustellung (IBA) Emscher Park – a 10 year multi-billion Euro investment programme for the regeneration of the whole Ruhr region, with individual projects co-funded largely by the state of North-Rhine Westphalia and the European Union.[3]

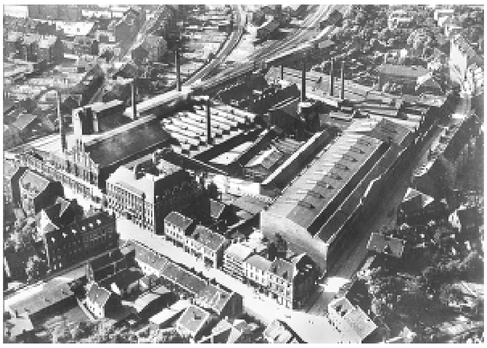
Science Park Gelsenkirchen was inaugurated in 1995 and became a flagship project of both the IBA Emscher Park and Gelsenkirchen's solar city strategy. In the centre of the 45 hectare park area, a 300 meter long technology centre was built, offering 12,500 m^2 space for offices and laboratories. The building has won several awards for its industrial architecture and was rated as ´one of Europe's best

[2] The volume of production and CO_2 emissions from these plants are largely depend on international fuel markets. There is significant temporal variation for example from 2001 to 2004 emissions increased by more than 600,000 tons (+18%), i.e. about the size of total emissions from private households in Gelsenkirchen. Emissions from the two refineries are regulated through national and European law (EU Emissions Trading Directive) and hardly responsive to local activities.

[3] For a brief overview of the programme see: Ingrid Helsing Almaans (1999): Regenerating the Ruhr – IBA Emscher Park project for the regeneration of Germany's Ruhr region. In Architectural Review, February 1999.

business centres´ at MIPIM, the international real estate fair in Cannes in 1995(MIPIM, 1995). The state-owned LEG Landesentwicklungsgesellschaft Nordrhein-Westfalen (LEG NRW) and the City of Gelsenkirchen were co-builders and initially co-owners of the project (In 2007 Science Park Gelsenkirchen GmbH became a 100% subsidiary of the City of Gelsenkirchen). An extensive part of the overall investment of 50 million Euro came from the European Union (EU) through its Regional Development Fund, the State of North-Rhine Westphalia and federal level funding.

In 1996, a 210 kilowatt (kW) photovoltaic power plant was built on the roof of the technology centre, the largest of its type in the world at this time. The three million Euro investment for this was co-funded by the State of North-Rhine Westphalia, the EU and the local utility. The spectacular architecture and the high profile of the building supported targeted recruiting of research institutions and businesses as tenants of the technology centre. As one of the first tenants, the Institute for Applied Photovoltaics (INAP) was founded in 1996. INAP carried out research on a new generation of dye-based solar cells, an activity later taken over by Freiburg-based Fraunhofer Institute for Solar Energy Systems (FhG ISE). Research, development and marketing of renewable energy technologies have become one of several activities in the Science Park. Today, eight of the 45 companies and institutions based in the technology centre and the start-up centre, work in the field of clean energies.




Images 1 and 2: 1 (left) Gelsenkirchener Gußstahl- und Eisenwerke AG (1929) and 2 (right) Wissenschaftspark Gelsenkirchen with its 210 kW PV plant (1996)

The inauguration of Science Park Gelsenkirchen, together with the large scale application of locally produced solar technology, defined the common starting point for two major pathways for implementing the solar city strategy, namely:

- joint efforts of the local and state government to support the growth of a clean energy industry cluster, and
- a series of spectacular demonstration projects in order to substantiate the cluster strategy and to create local identity and support for the strategy.

PV-Industry: Nucleus of a Clean Energy Cluster

An obvious step to strengthen the city's nascent PV industry was to use the PV value-chain and attract investment for a solar cell factory. This goal was achieved in 1999, when Shell Solar opened a facility with advanced production technology and an annual capacity of 25 MW solar cells near the existing solar module factory. The investment of 30 million Euro was supported with funds from the state government and the EU. Today both factories (cell and module production) are owned by Scheuten Solar and projected for growth in line with the upward trend of global PV markets: in 2008 the cell factory has grown to 50 MW production capacity and has 100 employees, and the module factory relocated to the city. Production capacity in the new plant is expected to grow to 100 MW, with a growing number of employees projected to be at 420 by 2010.

To support innovation and optimisation in solar cell production technologies, the FhG ISE opened up a PV laboratory and service centre in Gelsenkirchen close to the solar cell factory in 2000.

The combination of modern production facilities and spectacular demonstration projects began to raise interest in the Gelsenkirchen example. Science Park Gelsenkirchen, Shell's solar cell factory and Academy Mt. Cenis in the neighbouring city of Herne, formed the so-called *Solar Triangle Emscher-Park*, a project presented at the World Expo 2000 in Hannover. Spurred on by the emergence of a local PV industry and improved support schemes for PV from the state and federal levels in the late 1990s, a growing number of companies in the region engaged in the planning, installation, maintenance and marketing of solar technologies, assisting the development of a ´solar service sector´. To support this, regular training programmes were set up for architects, project developers, workmen and unemployed people - many initiated and hosted by the Science Park (Schmitz-Borchert and Jung 2002). Today, the portfolio of companies in the clean energy cluster goes far beyond the PV sector and includes production facilities for solar thermal collectors, ground-based heat pumps and components of wind power stations, as well as engineering companies focusing on biogas and wind parks[4].

5. Getting Ctizens Involved - Solar Housing Estates

Parallel to these cluster management activities, the city administration worked on the second pathway of the solar city strategy, namely through the development of further demonstration projects. The above mentioned projects (Science Park, etc..) highlight the economic potential of solar technology and its suitability for modern industry architecture. This message was easily spread to politicians, entrepreneurs and architects - but was not exactly suitable for involving the general public.

Gelsenkirchen-Bismarck Solar Housing Estate

Public involvement was achieved through the Gelsenkirchen-Bismarck solar housing estate, a project demonstrating that clean energy technologies – as part of integrated housing concepts – have great potential to improve the urban living environment. This project was the first of its kind in the Ruhr region and part of the state programme 50 Solarsiedlungen NRW (50 solar housing estates NRW[5]), launched in 1997 as a unique effort to stimulate innovation in solar and low energy architecture. The projects included are not only characterised by innovative concepts for energy use, but also by excellent social, environmental and urban parameters. A follow-up programme with a broader technology focus is currently under preparation by the state Ministry for Economic Affairs and Energy (working title: 100 climate protection estates').

The solar housing estate was developed at the edge of the former mining site, at the heart of the Gelsenkirchen-Bismarck district, two kilometres from the city centre. Planning for the greater area commenced in 1993 with an urban planning competition leading to two projects - an integrated school with eco-friendly architecture and progressive teaching methods; and a housing estate partly comprised of self-constructed houses with intentionally simple architecture. The construction of the solar housing began in 1999 and was completed in 2001. On an area covering about four hectares, two property developers constructed 72 terraced houses which sold in a short period mostly to young middle-class families (costs ranging between € 170,000 and € 240,000). With its central location, distances to key service and supply facilities, including the above mentioned school and a subway station connecting the area to the city centre, are short.

The buildings' average space heat requirement of 20 to 8 kilowatt hour (kWh) per square meter (m^2) was 40 – 60% lower than the German standard at that time. For urban planning purposes (west-east-facing facades) the use of passive solar energy in the northern part of the estate was limited. Solar energy is utilised primarily through active solar thermal and photovoltaic systems installed on the roofs. These

[4] For a comprehensive overview see www.solarstadt-gelsenkirchen.de > Company Guide

[5] www.50-solarsiedlungen.de

systems operate in a decentralized stand-alone mode, i.e. separately for each house, and are supported by separate gas-fired condensing boilers. In the southern part of the estate buildings face southwards, which, in conjunction with good zoning and internal layout of the buildings, allows the use of both active and passive solar energy. The active systems also serve as shading elements to prevent summer time overheating. Houses in the southern part are supplied with heat from central energy units, used for each group of buildings to save costs. The solar thermal systems are linked and feed their output into a joint storage system supported by an efficient gas-fired burner with condensing technology.

72 single-family terraced houses (solid and timber-framed)		
Living space per house	110-140	m²
Calculated annual heat requirement	20-38	kWh/m²
Collector area	440	m²
Solar contribution to hot water requirement	65	%
Installed photovoltaic (PV) capacity	88	kW_p
PV contribution to electricity requirement	40	%
Some houses have green roofs		
Rainwater infiltration through open depressions in the soil		

Table 1: Details on the 72 single-family terraced houses (solid and timber-framed)

As part of the project evaluation, a life-cycle assessment was conducted to calculate the total energy required to construct the entire housing estate. In this a remarkably high proportion for infrastructure – 15% - was identified, mainly due to complicated preparation of the site involving clean-up of contaminated land and buildings. For the individual houses the overall energy requirement is dominated by the building envelope (i.e. the walls, foundations, roofs, ceilings and floors). Technical systems were found to play a subordinate role. The energy input required to produce the buildings totals around 1400 kWh/m², which is in the order of the total space heat requirement over 35 years (Energie-Cités 2002; Petersdorff et all 2000;   and NRW 2008).

Awareness about the project goals among the residents of the estate was achieved through information meetings and brochures. The residents of the estate founded a local environmental advocacy group SOL - Förderverein für solare Energie und Lebensqualität der Sonnensieldung Gelsenkirchen-Bismarck e. V. (Association for solar energy and quality of life). The group offers information events and guided tours through the estate.

The positive ramifications of the project were many and went far beyond environmental issues. Most importantly, the project offered an attractive living environment for many young families who otherwise might have chosen to move out of the city. Further, it helped to stabilise the social mix and raise the profile of a city district in urgent need of regeneration. It set the stage for the systematic integration of clean energy solutions in housing projects in the city and beyond. Last but not least, it helped to engage the public in the implementation of a solar city strategy, which was initially conceived in top-down direction.
The positive social effects of solar housing projects were underlined in a second project within the state programme 50 Solar Housing Estates. The Gelsenkirchen-Lindenhof solar housing estate of the housing company LEG NRW, is an example of a successful integration of solar technology in the modernisation of old buildings. The Lindenhof housing estate was originally built for miners and their families in 1952. The renovation measures aimed to significantly raise environmental standards and, at the same time keep rental costs at a socially acceptable level. Planning of the project started in 2000, with modernisation measures commencing in 2002 and completed in 2003.

Improved heat insulation of the building envelope and a ventilation system with heat recovery reduced the heating energy demand of the 224 apartments by 80% (from more than 300 kWh/m² to 60-65 kWh/m² per year). Energy for space heating and warm water is supplied through a local heating system with five heat stations fed by 600 m^2 of solar collectors and very efficient gas-fired burners with condensing technology. Through these measures, overall CO_2 emissions were reduced by more than 85% and energy costs per square metre were reduced by almost 60% (EnergieAgentur NRW 2008). More importantly, the solar modernisation helped to raise the lease possibility of the apartments. Almost all of the former inhabitants moved back to the estate and vacancies existing before the renovation were easily filled. Overall demand for the new apartments soared during the construction phase and could not be met.

To facilitate the replication of such solar housing projects, the city administration launched a programme in 2003 to support smaller housing companies and cooperatives to analyse their building stock and set investment priorities. This initiative resulted in solar renovation projects of the city-owned housing company (block of houses, renovation completed in 2006) and a housing cooperative (solar housing estate, currently in the planning stage).

Social Activities

Public participation in the implementation of the solar city strategy was further increased by numerous activities conceived and organised within the Local Agenda 21 network with core funding coming from the City of Gelsenkirchen and the Protestant church. The most prominent project example is the charity race SOLIDAR 21, annually organized since 2000. In these races, between 3,000 and 5,000 school pupils, run some 10,000 km altogether, and are sponsored by approximately 10,000 individuals. The budget raised (between 30,000 and 45,000 Euro per year) is partly spent for photovoltaic installations on public buildings and for solar energy projects in developing countries[6].

6. Second Wave - Strategy Development and Institutionalisation

The successful implementation of the above mentioned large-scale projects had positive repercussions on the strategy level. Within the city administration, processes and budgets were optimised to facilitate further investment and application of solar energy, and also to live up to rising expectations generated by the solar city strategy. In 1999, the City Council set up an annual budget of 50,000 Euro for the general "promotion of solar energy", which was renewed every year since then, although the volume amount has been reduced to 45,000 Euro since 2004 and in 2008 again raised to 65,000 Euro. The budget is managed by the city's Environment Office and used on projects to raise awareness, offer consultancy for private investors and studies to support the development of additional policies and instruments. As one of the first projects funded through this budget, the website www.solarstadt-gelsenkirchen.de was launched in 2000 to disseminate information about clean energy activities within the city.

Resolutions and Studies

In a resolution passed in 2000, the Council charged the administration to set up an inventory of public buildings suitable for installation of PV or solar thermal systems, and to install such systems 'whenever it makes sense'. In the same year, the Council's construction board set up a 100,000 Euro budget to equip five schools with PV systems. This budget was renewed annually and led to the installation of 17 PV systems and more than 29 solar thermal systems. the latter mainly on school gyms.

Between 2001 and 2006, several studies were conducted to support both the development and implementation of the city's clean energy strategy. The study *Solar City Gelsenkirchen*, commissioned by the State Ministry for Urban Planning tried to set targets and major fields of action. Through public hearings and workshops, major stakeholders participated in defining the solar city paradigm and implementation scenarios. Solar urban planning was identified as a particularly attractive field of action (Wachten et al 2002). A CO_2 inventory for the city and detailed sectoral climate action plans were

[6] http://agenda21.gelsenkirchen.de

developed within a follow up-study commissioned by the City of Gelsenkirchen, compiled with support of the three local energy utilities (masterplan on energy) (Gajewski et al 2005). The third study focused on the potential of the building stock and new development areas for application of solar technologies. The first of these studies clearly identified that moving from single projects to sectoral action plans would afford new institutional structures: firstly within the city administration, because energy issues cut across traditional lines of responsibility and secondly to get other stakeholders systematically involved. Regarding, internal structures, an energy team with members from various departments of the city administration was formed in the aftermath of the masterplan study in 2003. The energy team developed a set of measures for more ambitious energy efficiency measures in public buildings and steered the implementation thereof. This procedure was managed by a consultancy firm and the results were certified within the European Energy Award project in 2008.[7] Coordination within the administration will further benefit from the appointment of a climate protection and solar officer, mandated by a city council resolution in 2008. Through the same resolution, the city joined Climate Alliance[8] and ICLEI's Cities for Climate Protection (CCP) Campaign[9].

Solar City Gelsenkirchen

In 2004, to improve participation of major stakeholders, the city administration and Science Park Gelsenkirchen initiated the foundation of *Solarstadt Gelsenkirchen e.V.* (Solar City Gelsenkirchen), a non-profit registered association[10]. Among the founding members were the (privatised) local utility, the University of Applied Sciences, the Chamber of Crafts, a large housing company and the solar industry. Together with the two local financing institutions joining the association in 2007, the member portfolio covers all major players along the chain from research, development and production to installation and maintenance of clean energy technologies. From the beginning, the association served as a forum for communication and the development of Public Private Partnership (PPP) project qualities.

As one of its first activities the association helped to raise funding for an innovative project at a Gelsenkirchen school completed in 2005. The *Solar&Spar Projekt* (Solar & Save Project) introduces a new approach in energy performance contracting. The construction of a 30 kW PV power plant was combined with measures to modernise lighting and the heat supply system, leading to a total emissions reduction of 750 tons CO_2 per year. Due to saved energy costs, the overall investment of € 600,000 is highly profitable, allowing the capital to be increased by selling shares to citizens and other private investors. During this process, the solar city association served as a trustee and managed the fund up to its closure (The project was initiated by the Wuppertal Institute for Climate, Environment & Energy and co-funded through the state programme „Energy School 2000+).[11]

Support for the clean energy movement was substantially broadened in 2008, when some of the biggest companies in the city joined and provided financial support for a three-year campaign targeted at further raising the profile of Gelsenkirchen as a clean energy city. The solar city association was asked to conduct the campaign. With broadly joining this so called *Zukunftsinitiative Gelsenkirchen* 2020 (Future Initiative Gelsenkirchen 2020), the private sector acknowledged the potential of the solar city & clean energy paradigm to improve the overall image of the Gelsenkirchen.

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[7] http://www.european-energy-award.org/

[8] Climate Alliance of European Cities with the Indigenous Rainforest Peoples / Alianza del Clima e. V. http://www.klimabuendnis.org/

[9] http://www.iclei.org/ccp

[10] www.solarstadt-gelsenkirchen.de

[11] http://www.wupperinst.org/solarundspar/PDF/project_description.pdf

7. Second Wave of Large-Scale Projects

The recognition of clean energy as a marketable paradigm for Gelsenkirchen was helpful for the launch of other large scale projects. In 2007/2008, four remarkable projects have been completed, partly initiated by actors new to the local solar scene.

Roof Space for Large PV project

Gelsendienste, a city-owned company responsible for the management of waste and green spaces, made available one of its depot roofs for an investor to install a 185 kW photovoltaic plant. The roof space is rented out to the investor, thereby also generating an income for the roof-space owner. The project is the first of its kind in the city. Earlier attempts often failed because potential roof providers perceived the risks involved with long-term leasing contracts as too high.

Private Sector Investment

The 360 kWp PV installation on the depot of logistic company LOXX showed that large-scale PV projects can be attractive to private sector companies in many respects, as an economically viable investment and as a credible "green statement". One of the most spectacular projects so far is the 355 kWp PV system on a leftover concrete colossus of the steel era. The PV-engineering company Abakus Solar together with other private investors installed the plant on the ore- and coal bunker of the former steel works Schalker Verein, creating another landmark and strong symbol for the city's transition from coal to solar energy.

Housing Company Using PV

The solar housing estate Gelsenkirchen-Schaffrath provides another superlative action for the solar city project portfolio. By the end of 2008, the housing company THS installed almost 800 kWp of solar modules on south-oriented roofs of the modernised former miners' estate, creating the largest PV community in Germany and the second-largest in the world[12]. The project is the city's third contribution to the state programme 50 solar housing estates. As part of the modernisation, the heat requirement of the buildings was reduced to an average of 60 kWh per m^2 annually, and heat supply was switched to district heating.

From Solar Housing Estates to Solar City Districts

The positive experience with solar housing projects encouraged the city administration to further develop and upscale the concept by applying solar urban planning methods on the level of a city district.
The Stadtquartier Graf Bismarck[13] (City Quarter Graf Bismarck) has been developed on the largest industrial brownfield of the city, which was the power plant location of the former coal mine Graf Bismarck. It is planned that the 80 ha quarter would include 5,000 working places and 700 dwellings, also with office buildings, trade, commerce and recreation all with high energy efficiency requirements, solar urban planning and applications of solar systems. The development of infrastructure commenced in 2008, with completion of the whole project expected after 2012. The energy concept for the site does not prescribe the implementation of certain technologies but ensures a high standard for overall energy efficiency. The tender for the heat energy supply stipulates a maximum value of 0.7 for the primary energy factor - a measure for total primary energy requirement of buildings set under new federal legislation. This requirement can only be met with a heat energy supply system based on cogeneration and/or a significant share of renewable energies.

[12] http://www.pvdatabase.org/

[13] http://grafbismarck.gelsenkirchen.de/Projekt/default.asp

 

Left: Former coal mine, cokery and power plant Graf Bismarck in the 1950s. Right: Urban design concept for the new city quarter Graf Bismarck. (Source: City of Gelsenkirchen)

In an innovative approach, the city is imposing solar requirements in the contracts of land purchases. This approach is possible because the State Development Corporation (LEG) is the owner of the land. An investor manual has been prepared with commitments to the energy concept. Residential buildings must include a minimum of 1 kWp per unit and non-residential buildings must include PV on surfaces visible to the public.

An overall urban plan has also been developed, which includes a simulation of shading and solar irradiation on building surfaces. To avoid major shading of building surfaces (solar access) an advisory committee will assist individual investors.

8. Conclusions

To be successful local strategies for climate protection and renewable energies have to be linked to major development trends of the respective city or community. In cities impacted by industrial decline, high unemployment rates and loss of population, clean energy strategies can offer solutions that also address these socio-economic problems. In the case of Gelsenkirchen it was achieved by implementing innovative clean energy concepts for the redevelopment of industrial brownfields and the renovation of old building stock. Creating new jobs through the development of a clean energy industry cluster and improving the urban living environment through solar housing projects have become core elements of a comprehensive strategy paving the way towards a new energy future.

Many elements of the Gelsenkirchen case – ranging from agenda setting, strategy development and institutional design to the implementation of individual projects – should be relevant particular to cities in economic transition like such as those in former European coalfield regions.

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