

# SOLAR ENERGY

## Solar Housing Estate

# GELSENKIRCHEN

## (DE)

Neither solar thermal energy applications nor photovoltaics have yet succeeded in capturing appreciable market shares in Europe. However, thanks to political engagement on site, there are a number of good examples at local level. As a former mining and steel industry location (the 'city of a thousand furnaces'), the German city of Gelsenkirchen has set itself the aim of playing an active role in shaping the transition from the coal age to the solar age, and becoming a 'city of a thousand suns'.

## THE CITY

Over many decades, the history of the city of Gelsenkirchen was linked closely to the coal and steel industry. Thus a major industrial city emerged, which, with almost 400,000 inhabitants, was for a period the most important coal city of Europe. The coal crisis in the late 1950s triggered a process of structural change, away from coal and steel and towards new technologies such as solar energy and towards the service society. This process is still by no means concluded. Today, Gelsenkirchen has just under 300,000 inhabitants.

### Climatic data:

Sunshine hours: 1,450 h/a

Annual solar irradiation: 1,024 kWh/(m<sup>2</sup>a)



## CONTEXT

The city of Gelsenkirchen is well on course to proving that renewable energy technologies strengthen the economy at the national level while at the same time creating new, sustainable employment at the local level. Research, development and the application of solar technologies are being promoted vigorously through joint projects with partners in industry, crafts, science, solar associations and other groups in society.

Strong signals for the application of this forward-looking technology have already been given through the photovoltaic facility installed on the roof of the 'science park' (*Wissenschaftspark*) with a capacity of more than 210 kW<sub>p</sub>, and through the construction of the first solar housing estate in the Ruhrgebiet region, in the Gelsenkirchen-Bismarck district (the street address is *Sonnenhof* – 'solar court'). The production facilities for photovoltaic modules set up by the Flabeg Solar International company (formerly Pilkington) and the city's success in being chosen as the site for the construction of a factory for solar cell production by the Shell Solar company, which, at full capacity utilization, will be able to produce almost 13 million cells annually with a total capacity of 25 megawatts, are further clear signs of the efforts made by this city to promote the various levels of solar facility production, distribution and installation. Today, a good dozen companies and institutes focussing on solar energy already work in Gelsenkirchen – and more will follow.

# EXPERIENCE OF GELSENKIRCHEN

## 50 solar housing estates in North-Rhine/Westphalia

The state-wide initiative for forward-looking energy sources launched by the government of the German regional state of North-Rhine/Westphalia supports the implementation of innovative projects in the fields of energy conservation, efficient energy use and the exploitation of inexhaustible energy sources.

In 1997, the project 'Building with the sun – 50 solar housing estates in North-Rhine/Westphalia' was initiated with the aim of achieving resource conservation in urban planning and building design while giving consideration to urban development and social aspects. This pioneering project seeks not only to demonstrate the opportunities for utilizing solar energy to deliver heat and power to buildings at housing estate level, but also aims to give solar building design a further impulse and thus to facilitate its broad market penetration.



### Location of the housing estate

The first solar housing estate in the Ruhrgebiet region has been created in Gelsenkirchen-Bismarck. As early as 1993, the city administration of Gelsenkirchen developed the planning concept for the site with an urban planning competition. On an area covering about four hectares, two property developers have now constructed 72 terraced houses close to the former Consolidation hard coal mine. The one property developer – Bau+Grund Immobilien GmbH based in Gelsenkirchen – has built 29 gable-fronted solid-construction houses with cellars and saddle roofs in the northern part of the estate and 5 solid-construction houses with single-pitch roofs in the southern part. The other property developer – Interboden GmbH & Co. KG based in Ratingen – has built houses with single-pitch roofs in the southern part of the estate, of which 16 have solid construction and 22 are timber-framed (of these, 12 have rooms in front of the house as a substitute for cellars).

The estate is located close to the centre of the district, so that distances to all necessary service and supply facilities are short. Connections to local public transport are good, which contributes to preventing car traffic.

### Energy concept

The estate is characterized by high thermal insulation standards and solar-supported energy supply systems. The average space heat requirement of the buildings is 40–60% lower than the standard mandated by the present German Thermal Insulation Ordinance (*Wärmeschutzverordnung*).

For urban planning reasons, the use of passive solar energy in the **northern part of the estate** is limited (because of west-east-facing facades). Solar energy is utilized here primarily through active solar thermal and photovoltaic systems installed on the roofs. These 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 zonation of the layout within the buildings, allows both active and passive solar energy use. The active systems serve at the same time as shading elements in order to prevent summer-time overheating. In contrast to the buildings in the northern part of the estate, the terraced houses in the southern part are supplied with power and heat from central energy units for each terrace (i.e. group of buildings). This saves costs. The solar thermal and photovoltaic systems are linked, and feed their output into a joint storage system or into the electric grid.



In the 2nd phase of construction, six buildings have been built in passive solar design, thus achieving a space heat requirement 60% lower than the standard set by the 1995 German Thermal Insulation Ordinance. Moreover, they have ventilation systems with heat recovery.

### Housing estate data

72 single-family terraced houses (solid and timber-framed)		
Living space per house	110-140	m <sup>2</sup>
Calculated annual heat requirement	20-38	kWh/m <sup>2</sup> a
Collector area	440	m <sup>2</sup>
Solar contribution to hot water requirement	65	%
Installed photovoltaic (PV) capacity	88	kW <sub>p</sub>
PV contribution to electricity requirement	40	%
Some houses have green roofs		
Rainwater infiltration through open depressions in the soil		

### Costs and public grants

The turn-key costs of the houses range between € 170,000 and € 240,000.

Public grant support has been provided in the following areas:

- Urban planning competition
- Development of the energy concept
- Photovoltaic and solar thermal installations: € 353,000
- Passive solar design: € 82,000 Euro
- Evaluation and measurement programme

# EVALUATION AND OUTLOOK

The evaluation of the Gelsenkirchen-Bismarck solar housing estate took place during the construction phase and is being continued in the use phase. The scientific programme supported quality assurance activities during the production of the houses. Through its ongoing measurement activities, the programme is delivering important findings for further solar housing estate projects. The measurement activities are conducted at three levels:

- 10 reference buildings are being analysed intensively.
- In a further 30 houses, the main energy flows are recorded.
- In all the other houses, the utility meters are read manually once a month.

The measurement programme is scheduled to run for 2 years until autumn 2002. The figures for 2001 essentially confirm the data anticipated in the planning phase. However, a realistic assessment of the consumption data will only be purposeful from the 2nd reference year onwards. Detailed documentation of the evaluation is available on the Internet at [www.50solarsiedlungen-tuv.de](http://www.50solarsiedlungen-tuv.de).

The lower the energy requirement for heating, the more attention needs to be given to the proportion of energy consumed to construct the buildings. The Gelsenkirchen project has examined for the first time the energy required to construct an entire housing estate, thus drawing up a **life-cycle assessment**. This includes the energy needed for construction machines, the transport energy requirement and the energy consumed to produce the building materials. From the material values thus identified, specific indexes are used to determine the primary energy requirement of building production. The associated CO<sub>2</sub> emissions can also be calculated.

It was found that the Gelsenkirchen solar housing estate has a remarkably high proportion of 15% for infrastructure, i.e. the development of the site (due to complicated preparation of the site involving clean-up of contaminated land/buildings). For the individual houses it was found – as expected – that the energy requirement for building production is dominated by the building envelope, i.e. the walls, foundations, roofs, ceilings and floors. Technical systems play a subordinate role. The energy input required to produce the buildings totals approx. 1400 kWh/m<sup>2</sup>, which is in the order of the total space heat requirement over 35 years.

## FURTHER INFORMATION

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#### (Gelsenkirchen city administration)

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