



# **50** 50 Solar Estates in North Rhine-Westphalia





# CONTENTS

Foreword	5
Reflections on the project	6
The idea and its implementation	8

## **The Estates**

Aachen-Laurensberg	12
Altenberge	14
Bielefeld-Kupferheide	16
Bochum   Claudius-Höfe	18
Düsseldorf-Garath	20
Düsseldorf-Medienhafen	22
Gelsenkirchen-Bismarck	24
Gelsenkirchen-Lindenhof	26
Gelsenkirchen-Schaffrath	28
Köln   Friedrich-Karl-Höfe	30
Köln-Niehl	32
Köln-Ossendorf	34
Köln-Riehl	36
Köln-Wahn	38
Krefeld	40
Leverkusen	42
Mönchengladbach-Eicken	44
Münster   Wismarweg	46
Schwerte   Märkische Straße	48
Schwerte   Schützenstraße	50
Siegen	52

Imprint	54
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## ■ Dear Readers,

The sun is our enormous inexhaustible source of energy, giving us both light and heat. Natural sunlight promotes our well-being and is also important for our health. So what could be more obvious than to use the sun to supply energy for our buildings? The less we consume resources generating light and heat, the more we lighten the burden on our climate and our environment.

With our 50 Solar Estates campaign, we in North Rhine-Westphalia have pursued precisely this concept with unswerving consistency. Both as new and as existing housing stock, these estates demonstrate the high quality of residential living that can be attained with solar planning and building. Attention has been devoted in these Solar Estates not only to energy concerns, but also to the other aspects of sustainability. One precondition was that the sites, for example, must be integrated into local supply and retailing amenities, and enjoy good links to public transport services.

Our "50 Solar Estates in NRW" project is thus a tangible contribution to climate protection.

The state government of NRW has set itself ambitious targets in its

Climate Protection Act, targets which are to be achieved primarily by enhancing energy-efficiency, by energy-savings and by expanding the use of renewable energy sources.

The examples described in this publication impressively illustrate the climate-protection potentials attainable even now. Impressive to me, personally, are not only the undoubtedly good architecture and successful integration of the solar installations, but also the CO<sub>2</sub> savings of 80 %, and of even 90 % in some cases, achieved in certain projects in existing housing stock.

Most particularly worthy of mention in this context is the commitment of numerous employees working in the residential property sector, and in planning and environmental agencies, and the contributions made by many architectural and engineering consultancies. Experience shows: residents find living on the solar estates pleasant, and are proud of living in an especially energy-efficient environment – in short, they identify with their estate.

The 50 Solar Estates are an innovative impulse in the fields of urban planning, building design and building



automation which we have now evolved even further. Our intention in the "100 Climate Protection Estates in NRW" follow-up project is to accelerate innovation even further, because: there is nothing more motivating than an example standing before you in bricks and mortar.

Johannes Rimmel  
Minister for Climate Protection,  
Environment, Agriculture,  
Nature Conservation and Consumer  
Protection of the German Federal  
State of North Rhine-Westphalia

## ■ Reflections on the project

It was a long road, but one consistently followed, from the visions of Russian Constructivist architect Ivan Leonidov (1902–1959), with his life-long passion for the “Sun City” project, to the maiden flight of the entirely solar-energy propelled aircraft “SOLAR-IMPULSE HB-SIA” in 2010.

A lot of time has elapsed between the visions of the Russian Modern and this high-tech solar achievement. Whether a city or a revolutionary aircraft, these development assign maximum importance to the sun as a regenerative energy power-plant, an importance which has also been fittingly recognised and taken up by the German Federal State of North Rhine-Westphalia.

Among North Rhine-Westphalia’s many successful initiatives, Energy-Agency.NRW also stands for modern environmental awareness in our state.

During its structural transformation from coal and steel to a modern

service and knowledge-based region, NRW put its faith ever more intensively in renewable energy, long before this topic was ever taken up by the many.

North Rhine-Westphalia has successfully reinvented itself in the past few decades, and we in the state can now be justly proud of our great knowledge and comprehension in the discussion on sustainable development.

In parallel to the publication of the Brundtland Report, the IBA-Emscher Park international construction exhibition reacted, in the context of residential estates, with the demand for a net ecological benefit for the environment.

The large residential estates constructed in NRW in the 1960s and 1970s are now, like those of the 1950s – post-war architecture – in some cases in a regrettable state of repair – most especially when one focuses on their energy consumption.

The state of North Rhine-Westphalia reacted to these circumstances and the associated discussions as early as 1997, with the publication of its state-wide appeal to “Building with the sun – 50 Solar Estates in North Rhine-Westphalia”, and thus initiated an innovative project for the promotion of sustainable urban development. Many of the guidelines presented in the project announcement anticipate in an astonishingly prescient manner developments which have only years later become the focus of general urban planning and legislation.

Mandatory requirements, and notes which were to be incorporated into the planning process, were defined for these Solar Estates. Specific consideration was given both to the new or modernised buildings and to the urban-planning framework of each complete estate. Open spaces and the residential environment both play an important role in this context.

The planning guidelines drafted for the project fulfilled a steering function for the construction of the 50 Solar Estates. It is particularly pleasing to note the diversity which has been achieved in the estates and in individual buildings, despite the in some cases extremely detailed stipulations.

Reading the guideline against the background of current urban-planning developments, one scarcely notices that they are already more than ten years old.

Quality of design is specified there as an element in a sustainable development zone of lasting cultural value, and this also achieves an signal effect extending across the intervening time for the estates themselves. In some cases, competitions were also held at urban-planning and architectural level, in order to harmonise these aesthetic criteria with the desired energy, social and ecological standards.

EnergyAgency.NRW set up for the optimisation of the projects and procedures an interdisciplinary commission which selected the eligible projects and provided constructive support for them.

It was often a tightrope walk to find a path for the projects between architectural aspirations and energy/civil-engineering and scientific necessities. If one were asked whether this great effort had been worthwhile, the answer would have to be: Yes, but these processes must be continued, in order to permanently establish effective quality assurance in harmony with the necessary energy-efficiency.

The Solar Estates showcased in this EnergyAgency.NRW publication are therefore an encouraging signal.

Friedrich Wolters



Photo: Private collection

Friedrich Wolters  
Architect and Urban Planner,  
Coesfeld



## ■ 50 Solar Estates in North Rhine-Westphalia

### The idea

In the spring of 1997, the NRW state ministries for construction, urban development, economics and science together enjoined all municipalities in the state to construct 50 Solar Estates. The appeal was also aimed simultaneously at construction project investors, architects and planners, and also at the residential property sector.

The aim of the project was that of applying experience already available in solar construction of individual buildings to entire estates and of combining energy-efficiency with the use of renewable energy sources. The Solar Estates were primarily intended to be distinguished by their



active and passive exploitation of solar energy, and thus to support the market launch of solar construction. A planning guideline explained the energy-optimisation requirements at urban-planning and individual building level, and also the integration of social and ecological aspects. EnergyAgency.NRW co-ordinated this project.

### Requirements

In individual buildings, designed-in thermal insulation, the compactness of the building structure and building air-tightness reduce energy demand, but the Solar Estates project also incorporates the energy-saving potentials achievable via larger-scale urban-planning measures. Enshadownment and the orientation of the individual buildings are also factors which affect heating energy demand. The energy optimisation of new residential estates is a process which extends from the urban-planning draft, via civil-engineering design and planning, up to and including the quality of the ultimate construction work. Buildings' orientation vis-à-vis the sun also assures residential living space which provides a high level of ambient quality thanks to its particularly good natural illumination. Sunlight has an importance not to be underestimated on human well-being, particularly during the winter months.

The following urban-planning and energy criteria are of special significance in the context of the 50 Solar Estates:

- Integration into the existing infrastructure (supply, retailing amenities, local/regional public transport)
- Not less than twenty residential units
- Building orientation: on average, not more than 45 % of all buildings deviating from a south-facing orientation
- Avoidance of enshadowment: not more than 20 % loss of incident solar radiation due to enshadowment and unfavourable orientation
- Compact building structure: The mean SA:V ratio was to be not greater than 0.65 m<sup>-1</sup>

Not less than two of the three energy requirements stated below had to be met in individual new buildings:

1. Passive house or three-litre house: Annual heating-energy requirement must be a maximum of 15 kWh/m<sup>2</sup>a (passive house) or 35 kWh/m<sup>2</sup>a (three-litre house).
2. Hot-water preparation: Not less than 60 % of energy demand for preparation of hot water should be supplied using solar energy.
3. Power supply: Installation of a photovoltaic system of a minimum size of 1 kW<sub>p</sub> per residential unit.

### Selection procedure

An interdisciplinary selection commission evaluated the project proposals submitted and assigned "Solar Estate" status only after detailed consideration. Award of this status was the precondition for the receipt of funding from the state's promotion programme. This commission, consisting, inter alia, of architects and town planners, examined not only the technical aspects, but also topics such as:

- The creation of a visually coherent estate
- Integration of the estates into their surroundings (location and infrastructure)
- Aesthetic integration of active solar installations

### MEMBERS OF THE SELECTION COMMISSION

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Andreas Gries, EnergyAgency.NRW, Düsseldorf

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Prof. Dr. Dietrich Heidt, University of Siegen

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Jochen Kuhn, Architect and Town Planner, Düsseldorf

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Bernd Kuhnert, Projektträger ETN, Jülich Research Centre

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Eva-Maria Küppers-Ullrich, NRW Ministry of Construction, Housing, Urban Development and Transport, Düsseldorf

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Dr. Harry Lehmann, Federal Environmental Agency, Dessau

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Dr. Hartmut Murschall, Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the German Federal State of North Rhine-Westphalia NRW, Düsseldorf

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Martin Rogge, Stadtraum Architektengruppe, Düsseldorf

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Prof. Dr. Hermann-Josef Wagner, Ruhr University Bochum

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Prof. Dr. Wolfgang Wiesner, Cologne University of Applied Sciences

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Friedrich Wolters, Wolters Partner, Coesfeld

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### Project status – Conclusion

A total of forty-seven new or modernised estates incorporating more than 4,300 residential units have now been completed as Solar Estates. This means that more than 10,000 residents of North Rhine-Westphalia already live on Solar Estates. The final three estates are quickly approaching completion.

These Solar Estates apply a large and diverse range of energy and architectural concepts. They include not only completely new estates, but also redeveloped existing housing stock. The latter is especially pleasing in view of the fact that new building permits more flexibility, but greater energy-savings potentials can be realised via the energy redevelopment of existing buildings. Around 55 % of the completed residential units are located on estates constructed in the 1920s, 1950s and 1960s. On some estates, the combination of intensive insulation work and the use of renewable energy sources made it possible to cut CO<sub>2</sub> emissions by 80 to 90 %. The great increases in energy costs in recent years confirm to these residential property companies the rightness of their decision, since they have already significantly reduced subsidiary costs, and enhanced domestic comfort, with such energy-redevelopment projects. A further important

consideration on these estates is the visibility of the solar installations. This positive, future-orientated visual aspect informs the projects in the context of the 50 Solar Estates. It provides for residents a potential for identification found only more rarely in conventional residential areas. Information displays, so-called "Solarpoints", have been designed and installed on the estates, in order to illustrate the special features of these projects on-the-spot on the

individual estates. The "50 Solar Estates" project's interdisciplinary and estate-specific concept makes it unique, and has aroused great interest even beyond the boundaries of North Rhine-Westphalia. The estates have already received visits by numerous international delegations. The project is thus also making its own important contribution to publicising North Rhine-Westphalia as a highly significant energy state.





### Further development of the Solar Estates into the "100 Climate Protection Estates in NRW"

The "50 Solar Estates" project, with the many estates already completed, is on the home straight. The follow-up project, "100 Climate Protection Estates in NRW", has been launched, and started in the autumn of 2009. The aim of this project is that of consistently further reducing heat-induced CO<sub>2</sub> emissions from residential estates. All technologies capable of achieving CO<sub>2</sub> savings can be used for this purpose. Planners and investors are thus free to select from a broad bandwidth of innovative building standards and supply variants. As in the case of the Solar Estates, a wide-ranging planning guideline has been developed and states the requirements and recommendations for the Climate Protection Estates.

Dr. Hartmut Murschall

Andreas Gries



Solarpoint in the Märkische Straße, Schwerte



Photo: Willers



Photo: Willers

Dr. Hartmut Murschall  
Ministry for Climate Protection,  
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[www.50-solarsiedlungen.de](http://www.50-solarsiedlungen.de)  
[www.100-klimaschutzsiedlungen.de](http://www.100-klimaschutzsiedlungen.de)



### Aachen

Population: approx. 250,000

### Address

Schurzelter Winkel

### Project clients

Investors, property developers and private families

## AACHEN-LAURENSBERG

### Location

Forty-three residential units and two office blocks have been constructed on a 2.5 hectare site on the edge of Aachen's Laurensberg district, an attractive location directly linked to a large regional green belt. Important amenities, such as nursery and primary schools, and also shops, are within easy walking distance. A good transport infrastructure means that the city centre can be reached in only a few minutes, either by bicycle or using local public transport.

### Town Planning | Architecture

Varied groups of buildings make up a compact town planning concept, with space-saving traffic arrangements. South-facing rows of terraced houses are bounded by west-facing semi-detacheds. The residential buildings are augmented by two office blocks situated in the northern part of the location, and simultaneously forming the gateway to the estate. The buildings at the southern end of the estate are a special feature, having been built by a private group: here, five families jointly erected a row of terraced houses of hybrid construction with barrel roofs. These houses, constructed to the Passive House standard, have a common heat distribution centre, in which a gas-fired condensing-type heating system is installed, in the basement of the middle house. Also worthy of mention are the two rows of terraced houses at the centre of the estate, which were built by the Aachener Gemeinnützige Wohnungsgesellschaft housing association, and sold





individually. These houses, also constructed to Passive House standard, have solar thermal collectors integrated into their south-facing facades.

### Energy Concept

All residential buildings achieve a high level of integrated thermal insulation. Almost 50 per cent of these buildings have been constructed to the Passive House standard (15 kWh/m<sup>2</sup>a), while the remainder have maximum heating energy demand of 35 kWh/m<sup>2</sup>a (3-litre house). In all cases, not less than 60 per cent of energy requirements for hot-water preparation are covered from solar thermal collectors. Adherence to energy requirements and standards was a condition set down in the site purchase agreements. The planning and construction of this Solar Estate were also underpinned by a quality assurance concept.

The office buildings also have low heating energy demand (25 and 48 kWh/m<sup>2</sup>a, respectively) and use renewable energy obtained from a photovoltaic system and a geothermal-probe heat pump.



### ESTATE DATA

Project type	New construction, owner-occupied housing + two office blocks
Number of residential units	43
Building types – residential	Terraced and semi-detached housing
Total developed site area	2.5 ha
Average plot area	300 m <sup>2</sup>
Average surface area to volume ratio (SA:V)	0.55 m <sup>-1</sup>

### ENERGY CONCEPT – RESIDENTIAL BUILDINGS

Thermal insulation standard	max. heating-energy demand 35 kWh/m <sup>2</sup> a (3-litre house), Passive House standard in some cases
Heating system	Decentralised gas-fired condensing technology, wood pellet heating in some cases
Hot-water preparation	Covered 60 % using solar thermal collectors

### CHRONICLE

Early 2001	Building started
End of 2003	Estate completed







### Altenberge

Population: approx. 10.000

### Address

Brinkstiege

### Property developer

BIB GmbH, Laer

### Town planning concept

Planungsbüro Hahm GmbH, Osnabrück

### Energy concept

BIB GmbH, Laer



## ALTENBERGE

### Location

A new residential district now nestles in the park-like landscape of the Münsterland on the south-western edge of the town of Altenberge. Part of this new residential development, "Lütke Berg", situated very close to the town centre, has been designed as a Solar Estate. The nursery, primary and secondary schools can be reached easily on foot or using the bicycle so beloved of the Münsterland population.

### Town Planning | Architecture

The visuals of this Solar Estate are shaped by four different building types. The building substance, with its brick-based architecture, is informed by traditional Münsterland building styles, while rendered surfaces decorate the stepped storeys of the terraced houses. The steeply sloping pent roofs permit the generation of ample amounts of passive-solar energy. Solar elements also serve to provide shade for the balconies fronting the stepped storeys.

### Energy Concept

These are 3-litre houses, incorporating solar thermal systems for preparation of hot water. Heating is by means of wood pellet or gas-fired condensing heating systems. All houses feature ventilation systems with built-in heat recovery.

## ESTATE DATA

Project type	New construction, owner-occupied housing
Number of residential units	31
Building types	18 residential units in semi-detached houses, 13 residential units in single-family houses, timber-frame construction
Average plot area	400 m <sup>2</sup>
Average living space	140 m <sup>2</sup>
Average surface area to volume ratio (SA:V)	0,62 m <sup>-1</sup>



## ENERGY CONCEPT

Thermal insulation standard	max. heating-energy demand 35 kWh/m <sup>2</sup> a (3-litre house)
Ventilation systems	Regulated apartment ventilation, incorporating heat recovery
Heating system	Decentralised wood pellet furnaces/gas-fired condensing-type systems
Hot-water preparation	Covered 60 % using solar thermal collectors

## CHRONICLE

Summer 2004	Building started
End of 2006	Estate completed







### Bielefeld

Population: approx. 320,000

### Address

Auf dem Hellweg

### Project clients

Property developer and individual families

### Energy concept

Planungsbüro Graw, Osnabrück  
GERTEC GmbH, Essen  
e&u Energiebüro, Bielefeld



## BIELEFELD-KUPFERHEIDE

### Location

A Solar Estate on which single-family, semi-detached and terraced houses are all south-facing has been evolved in the city of Bielefeld. The estate also includes multi-family houses consisting of publicly funded residential units.

### Town Planning | Architecture

This estate, the houses of which were constructed individually using conventional materials, exhibits after its completion a colourful and variegated appearance, with many charming details, and well illustrates the potentials of solar building. In view of the high level of individuality, the city entrusted energy quality assurance to an external consultancy. The estate enjoys a high level of greenery, thanks to the hedges planted. The fact that the project clients joined forces at an early stage by forming an owners' co-operative is apparent in the good results achieved on this Solar Estate.

### Energy Concept

This Solar Estate meets Requirements 2 and 3 of the "50 Solar Estates in NRW" planning guideline. The estate's buildings are equipped with both solar thermal and photovoltaic systems. At a maximum of 52 kWh/m<sup>2</sup>a, heating energy demand is at least 30 per cent lower than the then applicable "WSchVO '95" thermal insulation regulations. Heating energy is provided

via a local-heating system supplied from a natural-gas-fired condensing-type boiler. All individual owners entered into an obligation to comply with the energy requirements in their site purchase agreements; these also specified utilisation of rainwater and gas cooking, for example. Building tightness was mandatorily verified by means of a blower-door test.

#### ESTATE DATA

Project type	New building, owner-occupied and rented housing
Number of residential units	66
Building types	45 residential units in detached single-family, semi-detached and terraced houses, 21 residential units in multi-family houses (2 ½ storeys)
Total developed site area	2.7 ha
Average surface area to volume ratio (SA:V)	0.68 m <sup>-1</sup>

#### ENERGY CONCEPT

Thermal insulation standard	Not less than 30 % below WSchVO '95, 14 residential units of passive-solar type
Heating system	Local-heating network, central natural-gas-fired condensing-type boiler
Hot-water preparation	Covered 60 % using solar thermal collectors
Power generation	Not less than 1/3 from photovoltaics (except in the case of passive-solar buildings)



#### CHRONICLE

Early 2000	Building started
Summer 2004	Estate completed





### Bochum

Population: approx. 350,000

### Address

Mauritiusstraße – Düppelstraße

### Project clients

Matthias-Claudius-Stiftung Bochum

### Architect

Heinle, Wischer und Partner

### Energy concept

Planungsbüro Graw, Osnabrück

## BOCHUM, CLAUDIUS-HÖFE

### Location

The Matthias-Claudius-Sozialwerk social foundation has constructed a new estate with an extremely well thought-out town planning concept and highly convincing architecture on the site of the former municipal vehicle-fleet depot.

The operator has stated three overriding concepts for this Solar Estate:

- “Integrative living – no one must be excluded”
- “Urban living – back to the city”
- “Resources-conserving living – with joint responsibility”

### Town Planning | Architecture

A range of building types, extending from multi-family houses up to terraced houses, distinguish this estate sited centrally in a large city. All public transport services can be reached in just a few minutes. The Claudius-Höfe streets themselves are largely traffic-free, with an underground car park providing some fifty spaces for motoring residents. The central zone of this “multi-generation residential project” features a market square with a guest house, a community centre and a chapel. In addition to the marketplace, further courtyards provide semi-public open space. The project as a whole encompasses around 6,500 m<sup>2</sup> of living space for approximately 200 persons.





Also available are some 1,700 m<sup>2</sup> of space for commercial utilisation and some 350 m<sup>2</sup> of communally used space. Some of the residential units are being constructed as publicly funded accommodation. The estate has forty-six one-floor apartments (48 to 140 m<sup>2</sup>), fifteen town houses (100 to 160 m<sup>2</sup>), two communal residences (sixteen persons) and two students' residences (ten persons). There are also eighteen guest apartments, of which two are wheelchair-accessible. All these apartments are available for rental.



### Energy Concept

The buildings are designed to the 3-litre standard; the local-heating system available within the city is used for heating. Solar thermal installations provide 60 per cent of energy for preparation of hot water. The innovative energy concept is also augmented by generously dimensioned photovoltaic systems.

### CHRONICLE

Early 2010	Building started
Autumn 2012	Estate completed

### ESTATE DATA

Project type	New construction
Number of residential units	65 plus commercial usage
Building types	Multi-family houses, town houses (terraced), apartments for sheltered housing/residential groups
Total living space	approx. 6,500 m <sup>2</sup>
Commercial space	approx. 1,700 m <sup>2</sup>
Communal space	approx. 350 m <sup>2</sup>
Total site area	approx. 10,000 m <sup>2</sup>

### ENERGY CONCEPT

Thermal insulation standard	max. heating energy demand 35 kWh/m <sup>2</sup> a (3-litre house), Passive House standard in some cases
Heating system	Local heating
Hot-water preparation	Covered 60 % using solar thermal collectors (approx. 400 m <sup>2</sup> )
Power generation	Photovoltaics (approx. 1,000 m <sup>2</sup> )





### Düsseldorf

Population: approx. 590,000

### Address

Lüderitzstraße  
Josef-Maria-Olbrich-Straße

### Housing association

Rheinwohnungsbau GmbH, Düsseldorf

### Architects

Druschke & Grosser, Duisburg  
HGMB, Düsseldorf

### Energy concept

Wortmann & Scheerer, Bochum



## DÜSSELDORF-GARATH

### Location

Rheinwohnungsbau GmbH has constructed its second Solar Estate in the state capital in the Garath district. The existing buildings on this site between the Lüderitzstraße and Josef-Maria-Olbrich-Straße consisted of Ruhrgas AG employee accommodation built in the 1950s, and could not be justifiably renovated on the criteria of condition and utilisation (outmoded floor plans).

### Town Planning | Architecture

Two firms of architects were the winners of the project competition. Both were awarded planning contracts, separately for the first and for the second construction phases. The town planning concept allocates eight buildings to each construction phase, each of these enclosing a courtyard featuring a large play area. The ground-floor apartments have gardens for use by the tenants. All flat roofs are planted, and some can be used as roof terraces. The residential zone is kept virtually traffic-free, thanks to the accommodation of resident's vehicles in underground car parks. Generously dimensioned pathways connect the courtyards and the surrounding development. Around a third of buildings take the form of publicly funded housing, with the aim of achieving a mixed population structure. The estate's consistently compact and urban architecture assures a balanced townscape of cubic architectural forms in judiciously selected colours. The attractive open



spaces elegantly compliment the architecture. Clearance and construction work proceeded step-by-step in parallel, making it possible to rehouse the original tenants in the new accommodation.

### Energy Concept

These buildings have been constructed as 3-litre houses with a high standard of integrated thermal insulation. This is achieved, inter alia, by means of an innovative facade insulating material (Thermal Conductivity Group 24). Ventilation systems incorporating heat recovery also assure energy-savings and pleasant room climates. Energy for hot water is supplied 40 per cent from solar thermal systems mounted on legs on the flat roofs. The energy concept is augmented with photovoltaic installations for generation of a total of around 5 kW<sub>p</sub> of electrical power. Each construction phase features a heat distribution centre incorporating a gas-fired condensing heating system. Various supply modes were examined during drafting of the energy concept. The variant selected by Rheinwohnungsbau balances construction costs and anticipated ancillary costs for tenants optimally. The low CO<sub>2</sub> emissions are also a particular benefit of this energy solution.



### CHRONICLE

February 2008	Building started
Mid of 2012	Estate completed

### ESTATE DATA

Project type	New construction, rented housing
Number of residential units	122
Building types	Multi-family houses, 2 ½ to 4 storeys, two construction phases, each featuring eight buildings

### ENERGY CONCEPT

Thermal insulation standard	max. heating-energy demand 35 kWh/m <sup>2</sup> a (3-litre house)
Ventilation systems	Regulated apartment ventilation, with heat recovery
Heating system	Central gas-fired condensing-type heating
Hot-water preparation	Covered 40 % using solar thermal collectors
Power generation	Photovoltaics (5 kW <sub>p</sub> )





### Düsseldorf

Population: approx. 590,000

### Address

Hammer Straße  
Gladbacher Straße  
Gilbachstraße

### Housing association

Rheinwohnungsbau GmbH, Düsseldorf

### Architect

HGMB Architekten, Düsseldorf

### Energy concept

Wortmann & Scheerer, Bochum



## DÜSSELDORF-MEDIENHAFEN

### Location

Rheinwohnungsbau constructed the first Solar Estate in NRW's state capital at the "Medienhafen". Attractive, generously dimensioned apartments for rental and prestigious office space and shops have been created in a widely favoured location in the Unterbilk district of the city. In this future-orientated project, Rheinwohnungsbau meets in a sustainable manner the continuously rising demands for modern, individualised residential and professional life.

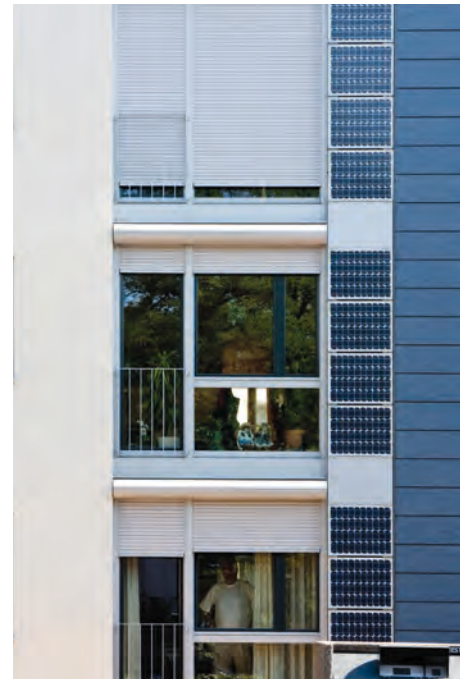
### Town Planning | Architecture

The "Medienhafen" Solar Estate has been constructed in an attractive location and with excellent infrastructure links in the triangle of buildings situated between the Hammer Straße, Gladbacher Straße and Gilbacher Straße. The severe architecture belongs unmistakably to the Modern, while the estate's features can justifiably be described as up-market. The complete ensemble consists of four- and five-storey multi-family houses, and is integrated into the predominant scale of its surroundings. Varied plot layouts, barrier-free access in all ground-floor apartments and a secluded courtyard with a high-quality ambience distinguish the residential block sector. A private underground car park offering 137 parking spaces continues the high standards set by the entire estate. The administrative building, at 1,300 m<sup>2</sup>, provides a well integrated utility area. Local amenities are rounded off by two 120 m<sup>2</sup> shop units.



### Energy Concept

Both the residential buildings and the office and retail units are to the 3-litre standard and are supplied with heating energy and hot water via a cogeneration-plant-based district-heating system. All buildings are equipped with ventilation systems with heat recovery. Incoming air is preheated by means of geothermal probes. Preparation of hot water for the apartments is assisted by a 260 m<sup>2</sup> solar thermal installation. The geothermal probes are also used for cooling of the office and shop buildings. The overall concept is completed by a facade-integrated PV system (3 kW<sub>p</sub>) and optimised use of daylight in the offices.



### ESTATE DATA

Project type	New building, rented housing
Number of residential units	101, plus one shop building
Building types	Multi-family houses, 4 to 5 storeys
surface area to volume ratio (SA:V)	0.38 – 0.47m <sup>-1</sup>

### ENERGY CONCEPT

Thermal insulation standard	max. heating-energy demand 35 kWh/m <sup>2</sup> a (3-litre house)
Ventilation systems	Regulated ventilation, with heat recovery
Heating system	District heating from cogeneration plant
Hot-water preparation	Covered 57 % using solar thermal collectors (260 m <sup>2</sup> )
Power generation	Photovoltaics (3 kW <sub>p</sub> )

### CHRONICLE

March 2005	Building started
End of 2008	Estate completed







### Gelsenkirchen

Population: approx. 260,000

### Address

Sonnenhof-Solarsiedlung

### Property developer

Bau und Grund GmbH, Gelsenkirchen  
(northern and southern area)  
INTERBODEN GmbH & Co KG.,  
Ratingen (southern area)

### Architect

Architekturbüro Heinrich  
+ Dr. Götzen, Ratingen  
Plus+bauplanung GmbH,  
Neckartenzlingen

### Energy concept

Planungsbüro Graw, Osnabrück



## GELSENKIRCHEN-BISMARCK

### Location

The first Solar Estate in the Ruhr area was constructed on an approx. 4 hectare site in the Bramkampstraße in Gelsenkirchen-Bismarck as early as the period 1999 to 2001. Two property developers built a total of seventy-two terraced houses on the boundary of the former Consolidation colliery.

### Town Planning | Architecture

The lenticular arrangement of the buildings in the first construction phase of the southern zone generates a high-quality courtyard area. Non-celled houses with pent roofs, of both conventional and timber-frame construction, have mainly been constructed here. In the northern construction phase east-to-west orientated terraced houses with gabled roofs, the south-facing surfaces of which feature generously dimensioned solar installations, have been built to provide a contrast with the south-facing orientation typical of Solar Estates. The partly colour-accented architecture harmonises well with the three-storey buildings. The now highly verdant Solar Estate directs attention in a diverse range of ways, via its photovoltaic and solar thermal facilities, to the topic which "Solar City Gelsenkirchen" has made its own. The former winding tower of the Consolidation colliery is integrated via open space and serves as a reminder of the city's industrial past.

### Energy Concept

The estate is notable for its high insulating standards and solar-assisted energy supplies. The average heating energy demand of the buildings is 40 to 60 per cent below the requirements of the thermal insulation regulations applicable at the time of construction. In the northern zone, solar energy is generated primarily via the active solar thermal and photovoltaic systems installed on the roofs. These operate on a decentralised basis, individually for each terraced house, and are backed up by separate gas-fired condensing-type systems. In the southern sector, the buildings are south-facing and, in combination with sophisticated zoning of the floor plans, permit both active and passive use of solar energy. The active systems serve simultaneously to provide shade. Unlike the situation in the northern zone, the terraced houses in the south of the estate are supplied with heat via energy distribution centres for each individual row of houses. The solar thermal and photovoltaic systems feed their outputs into a common storage facility and the electricity grid, respectively.



### ESTATE DATA

Project type	New building, owner-occupied housing
Number of residential units	72
Building types	Terraced housing
Total developed site area	approx. 4 ha
Average plot area	approx. 200 m <sup>2</sup>
Average living space	approx. 125 m <sup>2</sup>
Average surface area to volume ratio (SA:V)	0.5 m <sup>-1</sup>

### CHRONICLE

Spring 1999	Building started
End of 2001	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	40 – 60 % below WSchVO '95
Ventilation systems	Regulated ventilation, with or without heat recovery
Heating system	Gas-fired condensing technology, decentralised or supply for groups of houses
Hot-water preparation	Covered 60 – 65 % using solar thermal collectors (total approx. 470 m <sup>2</sup> )
Power generation	Covered 40 % using Photovoltaics (total approx. 80 kW <sub>p</sub> )







### Gelsenkirchen

Population: approx. 260,000

### Address

Lindenhof – Timpenkamp

### Year of original construction

1951–1952

### Property developer

Landesentwicklungsgesellschaft  
(LEG NRW)

### Original architect

Mahs, Mattern und Feger, Bonn/Hamm

### Redevelopment planning

ARCHPLAN, Münster

### Energy concept

KaT-Plan, Ingenieurbüro für Haustechnik,  
Münster

## GELSENKIRCHEN-LINDENHOF, Redevelopment

### Location

Prior to redevelopment, this 1950s former miners' colony consisted of 274 smaller residential units (each of two or three rooms, with average living space of 44 m<sup>2</sup>), with coal stoves for heating. These two- and three-storey residential buildings are grouped around yards, and surrounded by extensive, densely wooded, open spaces. The estate has a tranquil residential ambience, with infrastructural facilities and shops, including a small department store, nearby. The underground station is within walking distance, providing a connection to the city's main station and the centre of the Buer district.

### Town Planning | Architecture

The estate has been comprehensively revamped, with not only new energy arrangements, but also far-reaching redevelopment of the buildings themselves. One hundred of the small apartments have been combined to create fifty larger units (75 to 80 m<sup>2</sup>). Modification of floor plans and the addition of balconies and patios have also significantly enhanced the quality of residential life. Identification with the estate's open spaces has been boosted by extensive conversion to gardens for the tenants. The urban architectural character of the former miners' colony has nonetheless been retained. Many of the south-facing roofs have been fitted with solar collectors.





### Energy Concept

A 16 cm thick exterior insulation and finishing system has been applied to the building facades. Basement ceilings and roofs have also been insulated. New doors and windows have been installed. These provisions, and the installation of regulated apartment ventilation, achieve a significant reduction in heating energy demand. Heat is now supplied via five gas-fired condensing local-heating heat distribution centres. These centres are also assisted by solar thermal collector systems of a surface area totalling 600 m<sup>2</sup>. Solar energy now supplies 60 per cent of needs for hot water and 30 per cent of all heating energy demand (heating + hot water). Monthly heating costs have been cut from 0.80 – 0.90 €/m<sup>2</sup> to 0.30 – 0.40 €/m<sup>2</sup>. Reductions in carbon dioxide emissions of more than 80 per cent, from around 10 tonnes to just some 1.8 tonnes per apartment per year, have been achieved.



### ESTATE DATA

Project type	Redevelopment, rented apartments
Number of residential units	Prior to redevelopment 274; after redevelopment: 220
Building types	Multi-family houses

### CHRONICLE

January 2002	Redevelopment started
May 2003	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Reduction of heating energy demand from around 300 to less than 65 kWh/m <sup>2</sup> a
Heating system	Five local-heating distribution centres featuring gas-fired condensing technology, heating backed up by solar thermal collectors
Hot-water preparation	Covered 60 % using solar thermal collectors (total approx. 600 m <sup>2</sup> )
CO <sub>2</sub> emissions	Reduced by more than 80 %, from 10 to 1.8 tonnes/a per apartment





### Gelsenkirchen

Population: approx. 260,000

### Address

Hegerothsweg – Nottkampstraße –  
Stegemannsweg

### Year of original construction

1959 – 1960

### Housing association

THS Wohnen GmbH, Gelsenkirchen

### Redevelopment planning

THS Wohnen GmbH, Gelsenkirchen

### Energy concept

Planungsbüro Stefan Wolf, Bochum

## GELSENKIRCHEN-SCHAFFRATH, Redevelopment

### Location

The Schaffrath district is situated around 10 km to the north of the centre of Gelsenkirchen, and consists predominantly of single-family and miners' accommodation built in the 1950s and 1960s. The district enjoys good local amenities, and good links to the city centre and the surrounding districts.

### Town Planning | Architecture

A miners' estate was constructed in the 1960s in an area of single-family houses in Schaffrath, Gelsenkirchen. The three-storey plastered-facade buildings with their row structure form a contiguous residential zone. The seventy-one buildings and their well over 400 apartments were redeveloped between 2001 and 2008, and photovoltaic modules fitted to the south-facing rows. The loggias were also renovated, in addition to the necessary technical updating. The traditional mood of this estate, with its plastered-facade buildings, has been retained. The park-like open spaces, with their attractive, long-established trees, have also been spruced up, without losing the essential character of the original period. Demographic factors will most likely result in numerous vacancies in the next few years, and it is intended to attract young families with children as tenants in the future.





### Energy Concept

An exterior insulation and finishing system was applied to the facades as long ago as the late 1980s, at which time the windows were also replaced, the loft floors and the basement ceilings insulated, and the buildings connected to the district-heating supply. The following work was performed in the 2001 to 2004 period, in order to upgrade this estate to Solar Estate status: hot-water preparation was converted from instantaneous electric water heaters to a central hot-water preparation system using district heating from a cogeneration installation, and further insulation work (including balcony slabs, the porches and building expansion joints) was performed. Photovoltaic systems were installed on the south-facing roofs in 2008, in order to complete conversion to a Solar Estate. CO<sub>2</sub> emissions from heating, hot-water preparation and domestic power consumption were 1550 t/a prior to redevelopment to a Solar Estate. The insulation work and conversion of hot-water supplies to district heating have reduced this figure by 390 t/a. The photovoltaic systems contribute further CO<sub>2</sub> savings of 420 t/a.



### ESTATE DATA

Project type	Redevelopment, rented housing
Number of residential units	422
Building types	Multi-family houses, 3 storeys
Total living space	27,420 m <sup>2</sup>
Average living space	approx. 65 m <sup>2</sup>

### CHRONICLE

2001	Redevelopment started
2008	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Reduction of heating energy demand to 70 kWh/m <sup>2</sup> a
Heating system	District heating
Hot-water preparation	Conversion from instantaneous electric water heaters to district heating
CO <sub>2</sub> emissions	Reduced from 1,550 to 740 t/a
Power generation	Photovoltaics 825 kW <sub>p</sub>







### Köln

Population: approx. 1,000,000

### Address

Friedrich-Karl-Straße

### Housing association

Erbbauverein Köln eG

### Architects

Mronz + Schaefer Architekten, Köln

Schmitz-Helbig Architektur, Köln

### Energy concept

Ingenieurbüro Ortjohann, Köln



## KÖLN, FRIEDRICH-KARL-HÖFE

### Location

This Solar Estate is situated to the north of the centre of Köln, in the Niehl district, which is notable for its good infrastructure, with numerous leisure facilities, providing, all-in-all, good quality of residential life. The buildings are consistently orientated toward the northern edge of the Friedrich-Karl-Straße. Transverse elements in each case form courtyards which harmonise with the surrounding development.

### Town Planning | Architecture

The housing association's decision to relinquish 110 residential units from the 1950s was probably a difficult one. The decision to again build apartments on the same site, increase their number by 30 per cent, and involve the tenants of the old residences in the discussion of the new accommodation can, in any case, be regarded as a future-orientated one. The three courtyards newly created blend naturally into the existing urban structure of the surroundings and offer a high-quality ambience and aesthetic conviction. The high design quality achieved is reflected in the new, disciplined but nonetheless diversified architectural style. This is particularly worthy of note when it is remembered that two different architects were commissioned for the solar-construction project, in order to produce for the client and for the tenants, a coherent and harmonious overall result.

### Energy Concept

The buildings have been constructed to a high thermal insulation standard and have an heating energy demand of approx. 50 kWh/m<sup>2</sup>a. Heating is supplied from a central wood-chip boiler and an additional gas-fired low-temperature unit. Around 55 per cent of energy demand for preparation of hot water are covered by solar thermal collectors, the remainder being generated primarily by the wood-chip boiler.



### ESTATE DATA

Project type	New building, rented housing
Number of residential units	143
Building types	Multi-family houses
Total living space	9,490 m <sup>2</sup>

### ENERGY CONCEPT

Heating system	Wood-chip boiler plus gas-fired boiler to cover peak demand Solar-thermal-assisted heating system
Hot-water preparation	Covered 55 % using solar thermal collectors

### CHRONICLE

End of 2007	Building started
September 2009	Estate completed







## Köln

Population: approx. 1,000,000

### Address

Amsterdamer Straße –  
Königsberger Straße –  
Nesselrodestraße – Tilsiter Straße

### Year of original construction

1950 – 1951

### Housing association

LEG Landesentwicklungsgesellschaft NRW

### Original architect

Mahs, Mattern und Feger, Bonn/Hamm

### Redevelopment planning

ARCHPLAN, Münster

### Energy concept

KaTplan, Münster



## KÖLN-NIEHL, Redevelopment

### Location

The Niehl district is situated to the north of central Köln, and boasts excellent public transport links and many green areas. It is around 2 kilometres from Köln city centre. Nurseries, all other types of school and shopping amenities can be found in the immediate vicinity. Here the company LEG NRW has developed its housing stock, which originated in the 1950s, to create a Solar Estate. The buildings stand in a purely residential area with large open spaces and old tree stocks. The nearest large green zones are the Weidenpesch Park to the west and the North Park.

### Town Planning | Architecture

The estate was built for Ford workers in the 1950s and did not meet the basic standards of contemporary living either in terms of energy or in terms of the floor plans. With a surprising freshness, this estate has been rescued from a certain drabness in its design and energy facilities without reshaping its strict basic urban form. New balconies and a bold yet appropriate application of paint to the facades lend the estate new verve, including the extensions. In the course of redevelopment and expansion many different layout variants have been created which satisfy contemporary standards and take account of the demographic change taking place. The open space with its wonderful stock of trees has been given a high-quality make-over with tenant gardens, playing facilities for children and communication areas.

### Energy Concept

Two different building standards have been realised: in the existing stock the energy standard to EnEV (new buildings) has been attained. This means a CO<sub>2</sub> reduction of approx. 200 kg/m<sup>2</sup>a. This is achieved by an exterior insulation finishing system on the outer shell of the buildings, insulation in the cellar and roof areas, and new windows. The storeys added were constructed to KfW-60 or 3-litre standard. All residential units have ventilation systems with heat recovery. Since the buildings have an east-west orientation, the extensions each had a maisonette added on the south gable and were given a pent roof which accommodates the solar thermal installations over its whole surface. These provide about 60 per cent of the hot water demand and are used in addition to support the heating. The rest of the heating and hot water supply comes from three local heating distribution centres which use gas-fired condensing technology.



### ESTATE DATA

Project type	Redevelopment and extension, rented housing
Number of residential units	Prior to redevelopment 300; after redevelopment: 345
Average living space	Prior to redevelopment 47 m <sup>2</sup> ; after redevelopment: approx. 55 m <sup>2</sup>

### CHRONICLE

End of 2007	Redevelopment started
Autumn 2010	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Existing buildings: Reduction of heating energy demand by insulation work and new windows Extension: 3-litre standard
Heating system	Local-heating distribution centres featuring gas-fired condensing technology, heating backed up by solar thermal collectors
Ventilation systems	Regulated ventilation with heat recovery
Hot-water preparation	Covered 60 % using solar thermal collectors







### Köln

Population: approx. 1,000,000

### Address

Westendstraße – Daimlerstraße

### Year of original construction

1961

### Housing association

GAG Immobilien AG, Köln

### Original architect

Planungsabteilung der GWS  
(Gemeinnützige Wohnungsgesellschaft  
Sozialwerk)

### Redevelopment planning

GAG Immobilien AG, Köln

### Energy concept

Wissenschaftspark Gelsenkirchen  
Planungsbüro Graw, Osnabrück



## KÖLN-OSSENDORF, Redevelopment

### Location

The Ossendorf district is situated about 5 kilometres to the north-west of Köln city centre. Transport links and infrastructure are excellent. The nearest tram stop is only 100 metres away and the railway is 2 kilometres away. There is a primary school in the immediate vicinity (300 metres), and there are other schools and sporting facilities within a radius of 500 – 1,500 metres.

### Town Planning | Architecture

The five four-storey residential buildings from 1963 have been fitted out following an interesting and impressive energy strategy. The overall appearance of the estate with the existing stock of trees has been preserved. The character of the plastered buildings has hardly been altered by the exterior insulation finishing system with a heavy paint application. Photovoltaic elements and solar thermal collectors have been mounted on the unconverted, shallow-incline attic roofs. As a whole the estate, with its new balconies and the reworked house entrances – first impressions – have, in conjunction with residential environment measures, been restored to a desirable residential location in Köln-Ossendorf.

## Energy Concept

In order to lower the transmission heat loss to  $0.4 \text{ W/m}^2\text{K}$ , a 14 cm exterior insulation finishing system has been applied to the facades. On the uppermost storey ceiling and in the roof of the stair wells a cellulose insulation has been installed. Insulation has been applied under the cellar ceiling. The new windows have glazing with U values of  $1.1 \text{ W/m}^2\text{K}$ . To avoid thermal bridges the existing loggias have been enclosed and added to residential rooms. As a substitute thermally separated, free-standing balconies have been constructed. As active solar elements solar thermal panels and a photovoltaic system have been integrated into the roof membrane on the roofs facing south. The block-based heat supply with wood pellet boilers and photovoltaic installations have reduced  $\text{CO}_2$  emissions (for heating, hot water and household electricity) to approx.  $20 \text{ kg/m}^2\text{a}$ . All residential units have been equipped with an exhaust air system.



## ESTATE DATA

Project type	Redevelopment, rented housing
Number of residential units	144 WE (8,350 m <sup>2</sup> )
Building types	Multi-family houses, 4 storeys
Average living space	approx. 60 m <sup>2</sup>

## CHRONICLE

June 2006	Redevelopment started
Mid of 2007	Estate completed

## ENERGY CONCEPT

Heating insulation standard	Reduction of the heating energy demand from around $250 \text{ kWh/m}^2\text{a}$ to $50 \text{ kWh/m}^2$ by means of comprehensive structural measures.
Heating system	Before redevelopment mainly electric heating, after redevelopment central wood pellet heating. Cut in monthly heating costs from about $\text{€ } 3/\text{m}^2$ to $\text{€ } 0.21/\text{m}^2$
Ventilation	Decentralised exhaust air system
Hot water treatment	In the two buildings facing south: 60 % coverage by solar-thermal collectors (a total of $150 \text{ m}^2$ collector area), remaining hot water treatment using wood pellet heating
Power generation	Photovoltaics $26 \text{ kW}_p$ (approx. $200 \text{ m}^2$ )
$\text{CO}_2$ emissions	reduction of more than 80 % (incl. household electricity) from $> 100 \text{ kg/m}^2\text{a}$ to $20 \text{ kg/m}^2\text{a}$







### Köln

Population: approx. 1,000,000

### Address

Hildegardisstraße  
 Philipp-Wirtgen-Straße  
 Schachtstraße

### Year of original construction

1926 – 1928

### Housing association

Erbbauverein Köln eG

### Redevelopment planning

Architekten Karsten, Köln

### Energy concept

Ingenieurbüro Ortjohann, Köln

## KÖLN-RIEHL, Redevelopment

### Location

This residential estate erected in the 1920s has the distinguishing feature of a quiet, green interior courtyard. There are bus and tram stops about 500 metres away. Shopping amenities for daily needs, schools and nurseries are located in the immediate vicinity. The residential environment includes local recreation facilities such as Köln Zoo and the Flora Botanical Garden.

### Town Planning | Architecture

The architecture is the modern style of the 1920s. Even though an exterior insulation finishing system had to be applied to the facades, it is possible to sense, even after the redevelopment, that the housing association has made great efforts to re-integrate in the design concept the linking elements of the facades from the time when the building shell was created, thus preserving externally the historical character of the facility. The interior courtyard, which has been greened over throughout, has also been carefully modernised. The ground floor apartments have direct contact with the open space via small staircases. With a newly laid courtyard access road it is possible to leave the interior courtyard with bicycles and prams on a single level. In the interior courtyard a playground and communication area have been created, among other things. In the course of the redevelopment the attic was converted to create single-storey apartments and maisonettes.





### Energy Concept

The facades have been given an exterior insulation finishing system with a coloured finishing coat. The roof areas and cellar ceilings have been insulated in addition. To reduce the thermal bridges the existing balconies have been replaced by free-standing, thermally decoupled structures. Highly insulated windows and door elements complement the standards. About 50 per cent of the hot water demand is dealt with by the solar installation, which has a total collector area of 260 m<sup>2</sup>. A warranty agreement guarantees the solar revenues for Erbbauverein eG and hence low ancillary costs for the tenants. A new central gas-fired condensing installation takes care of the room heating and the residual hot water demand.

### ESTATE DATA

Project type	Redevelopment, rented housing
Number of residential units	Prior to redevelopment 112; after redevelopment: 133
Building types	Multi-family houses
Average living space	approx. 63 m <sup>2</sup>
Average surface area to volume ratio (SA:V)	0.32 m <sup>-1</sup>

### ENERGY CONCEPT

Heating insulation standard	Reduction of the heating energy demand to 47 kWh/m <sup>2</sup>
Hot water demand	55 % coverage by solar-thermal collectors (a total of 260 m <sup>2</sup> collector area)



### CHRONICLE

Summer 2001	Redevelopment started
Summer 2004	Estate completed







### Köln

Population: approx. 1,000,000

### Address

Am Bahnhof

### Project client

IMMO-Projektmanagement GmbH, Köln  
Schürgers Bauträger GmbH, Köln

### Architects

Pässler Sundermann + Partner,  
Leverkusen  
Architekten Schönborn, Köln

### Energy concept

Institut für Bauen und Nachhaltigkeit, Köln

## KÖLN-WAHN

### Location

The Wahn district is situated in the south of Köln on the right bank of the Rhine, around 4 kilometres to the west of Köln/Bonn Airport. With its approximately 6,000 inhabitants the district of Wahn has a good infrastructure. The development area borders to the west on the railway line from Köln to the south along the right bank of the Rhine. At the Eltzhof in the immediate vicinity there are event and catering facilities. In the south of the Solar Estate there is a retail market. In the northern areas it is planned to construct office buildings. The transport link for the existing station and the new development area is being renewed.

### Town Planning | Architecture

In a competition covering both town planning and architecture it was stressed that a building structure configuration should be created which was convincing both strategically (noise insulation) as well as in terms of design and energy. The linear apartment complex oriented to the west "shields" the adjacent single-family house development. On the pent roofs of the stepped storeys the solar-thermal panels have been skilfully integrated into the inclined roof windows. With its plastered surfaces and their new colour system, the estate appears as a self-contained whole emerging logically from the urban structure.



### Energy Concept

All buildings are constructed to Passive House standard. To achieve this standard, triple-glazed windows and ventilation systems with heat recovery are used. 70 per cent of the hot water is provided by solar-thermal installations. The remaining energy demand for heating and hot water is covered by heat pumps. Some of the houses have geothermal storage systems. Here the surplus solar heat is conducted through pipe loops into the earth under the foundation slab of the houses and stored there. From there it can be extracted in the winter using the heat pump.



### Extension

Since spring 2013 the Köln-Wahn Solar Estate has been extended to include 66 new residential units. GAG Immobilien AG is constructing five rented apartment buildings to the 3-litre standard to the south of the Solar Estate that has existed to date. The apartments are being fitted with ventilation systems with heat recovery. On the roofs of the houses photovoltaic systems with a total of approx. 70 kW<sub>p</sub> are being installed.



### ESTATE DATA

Project type	New building, owner-occupied and rented housing
Number of residential units	122 + 66 Extension
Building types	Terraced, semi-detached and multi-family houses

### CHRONICLE

June 2009	Building started
Summer 2013	Estate completed
End of 2014	Extension completed

### ENERGY CONCEPT

Thermal insulation standard	Passive House standard
Ventilation systems	Regulated ventilation with heat recovery
Hot-water preparation	Covered approx. 70 % using solar thermal collectors







### Krefeld

Population: approx. 230,000

### Address

Geschwister-Scholl-Weg

### Property developer

Schotes Bauunternehmung,  
Mönchengladbach

### Architect

Architekturbüro aid, Düsseldorf

## KREFELD

This Solar Estate has been erected on a former sports ground and gives the impression of having been influenced by the “Garden City” philosophy. Along the gently curving residential streets building structures have risen which give a direct impression of a “Solar Estate” because of their greened-over pent roofs with the large window openings to the south and the solar thermal installations.

### Location

The Krefeld Solar Estate is situated in the Oppum district around 2.5 kilometres to the east of the city centre. Krefeld-Oppum is a district with a well-established centre and good infrastructure. The construction area was originally an old sporting facility within loosely scattered residential buildings from the 1930s. The plots of land of the Solar Estate are on small residential streets. In all, a total of 28 residential units have been created here.

### Town Planning | Architecture

On the Solar Estate, terraced, semidetached and single-family houses have been erected with a living space of 105 m<sup>2</sup> to 180 m<sup>2</sup>. Thanks to the modular design individual layouts are possible. Large, south-facing window areas ensure bright rooms. For some of the buildings the ground floor is



shaded by the balconies above it. In the upper storey overhanging green roofs perform this function. The buildings are created in solid design from heat-insulated smooth blocks and mineral scraped rendering in variable colours has been applied. Some parts of the facades have wood cladding.

### Energy Concept

The solar architecture makes it possible to achieve the consistent active and passive use of solar energy. The houses have been erected to the 3-litre standard and equipped with solar thermal installations. In addition ventilation systems with heat recovery and gas-fired condensing boilers are used.



### ESTATE DATA

Project type	New building, owner-occupied housing
Number of residential units	28
Building types	detached single-family, semi-detached and terraced houses, solid construction
Total developed site area	19,027 m <sup>2</sup>
Average plot area	approx. 420 m <sup>2</sup>

### ENERGY CONCEPT

Thermal insulation standard	max. heating-energy demand 35 kWh/m <sup>2</sup> a (3-litre house)
Hot-water preparation	Covered 60 % using solar thermal collectors

### CHRONICLE

November 2003	Building started
Summer 2014	Estate completed







### Leverkusen

Population: approx. 160,000

### Address

Paul-Klee-Straße – Hannah-Höch-Straße

### Property developer

Bayer Real Estate GmbH, Leverkusen

### Architect

tr.architekten, Rössing-Tilicke, Köln/Bad Oeynhausen

### Energy concept

Ingenieurbüro Patrick Jung, Köln



## LEVERKUSEN

### Location

At the start of 2002 the Ministry of Town Planning and Housing, Culture and Sport of the State of NRW joined with the City of Leverkusen, the Gesellschaft für Wohnen und Gebäudemanagement mbH Leverkusen (GeWoGe) housing company and the NRW Chamber of Architects in announcing the state-wide “Passive House Estate Leverkusen” competition. The estate’s design is based on the entry that won first prize in the competition.

### Town Planning | Architecture

The distinguishing feature of the town planning design is the special position of the site as a transitional element between residential development and open countryside. The arrangement of the buildings along the existing developed area establishes a clear urban edge as the boundary of the residential town and opens the planning area to the adjacent green areas. The buildings nestle convincingly up against the landscape modulations. The building development follows the east-west incline and is of a stepped arrangement. The entirely southerly orientation of the large window areas and the extensive freedom from shading ensure high gains in terms of solar exposure. The southern facades are broken up by collector modules and winter gardens.



### Energy Concept

The energy concept provides not only for an extremely low heating energy demand of 14 kWh/m<sup>2</sup>a but also for further regenerative elements: the hot water is heated 60 to 70 per cent by means of solar thermal collectors, while the remaining energy demand for hot water and heating is met by decentralised brine/water heat pumps. Controlled ventilation with heat recovery is a component of the Passive House approach. The feed air is drawn in through an underground duct and preheated. In the summer it is also possible to cool the rooms slightly by this means. The room heating is achieved using standard radiators with low supply temperatures. By this means it is possible to regulate the individual rooms separately.



### ESTATE DATA

Project type	New building, owner-occupied housing
Number of residential units	32
Building types	Terraced houses, timber-frame construction
Average surface area to volume ratio (SA:V)	0.59 m <sup>-1</sup>
Living space	105 – 154 m <sup>2</sup>

### CHRONICLE

Summer 2004	Building started
2009	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Passive House standard (14,2 kWh/m <sup>2</sup> a)
Heating system	Brine/water heat pumps
Hot-water preparation	Covered 60 – 70 % using solar thermal collectors







### Mönchengladbach

Population: approx. 260,000

### Address

Eickener Straße 445 – 459

### Year of original construction

1962

### Housing association

GWSG mbH Mönchengladbach

### Redevelopment planning

Brings Architekten,  
Mönchengladbach

### Energy concept

Ingenieurbüro Rolf Besten,  
Mönchengladbach

## MÖNCHENGLADBACH-EICKEN, Redevelopment

### Location

This estate was built in 1962 by the Mönchengladbach municipal housing association and is situated around 2 kilometres to the north of the main railway station at a former rail junction in Eickener Straße. The supply structure and links to the local public transport system are good.

### Town Planning | Architecture

Over an extended period the estate association has, on the one hand, renewed the estate and, on the other, also erected new buildings to enlarge the district. In architectural terms, traditional design solutions were selected in order to achieve a uniform design language in the future and not to change the character of the quarter. The cautious use of paint ensures that the response to the Solar Estate is perceptibly positive in addition. Before redevelopment the estate consisted of a total of five four-storey building units with 85 apartments and a total living space of 5,725 m<sup>2</sup>. The apartments originally had three to four rooms and were made into 2- to 3-room apartments by changing the floor plan. In addition three two-storey residential buildings were erected, each with four publicly supported dwellings. All the dwellings had barrier-free access. For this purpose access corridors accessible by lift were created in the front in addition to the existing stairwells. All the dwellings were provided with generous balconies or patios.



### Energy Concept

The heating energy demand of the existing buildings was reduced by insulation measures and new windows on the level of new buildings according to EnEV 2007. The new buildings were constructed to the 3-litre standard. Here, and in some cases also in the old buildings, ventilation systems involving heat recovery were also installed. The central energy stations with gas-fired condensing heating and solar support were set up in the attic of each of the buildings redeveloped. The new buildings were supplied with heating energy using air-to-water heat pumps.



### ESTATE DATA

Project type	Redevelopment and new buildings, rented housing
Number of residential units	58 in existing buildings, 12 in new buildings
Building types	3- and 4-storey rows of old buildings, 2-storey new buildings
Average living space	approx. 73 m <sup>2</sup>

### CHRONICLE

October 2008	Redevelopment started
Spring 2012	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Existent buildings: EnEV-new building-standard by insulation measures New buildings: 3-liter standard
Ventilation systems new buildings and stock in some cases	Regulated ventilation, incorporating heat recovery
Heating system	Central gas-fired condensing-type heating, Solar-assisted heating system (10 %) New buildings: air-to-water heat pumps
Hot-water preparation	Covered approx. 50 % using solar thermal collectors (total 50 m <sup>2</sup> )







### Münster

Population: approx. 300,000

### Address

Wismarweg

### Housing association

Wohnungsverein Münster von 1893 eG

### Architect

Architekturbüro Thiel, Münster

### Energy concept

KSK Ingenieurplanung, Münster

## MÜNSTER, WISMARWEG

### Location

On the site of a former garden centre the Wohnungsverein Münster v. 1893 eG has set up a Solar Estate at Wismarweg. The site is situated to the north of the city centre, which can be reached on foot in about 15 minutes. Nurseries, schools and shopping amenities are only a few minutes on foot from the location. Bus routes and cycle tracks complete the infrastructure.

### Town Planning | Architecture

Three two-storey multi-family houses with stepped storeys and a total living space of 3,244 m<sup>2</sup> were erected. The total of 39 dwellings have sizes ranging from 47 to 110 m<sup>2</sup>. This mix is attractive both for senior citizens and for young families. The ground floor flats have barrier-free access. Above these there are family dwellings (maisonettes in some cases) and flats for couples or single people. The buildings' design corresponds to the Passive House standard and tends to be closed to the north and open to the south. The northern sides have each been given a front brick shell. The southern sides are plastered or clad with wood panels. A cellar is only present in ahead-end structure to accommodate the requisite technical systems and facilities. Storage spaces and utility rooms are available in all the apartments. Each apartment has an open area as a garden or roof garden in various forms: the apartments on the ground floor mainly have sheltered patios with a small green zone, while the upper storeys have been assigned not only balconies



and loggias, but also larger, individual garden plots with direct access via a staircase.

The penthouse apartments have a generously dimensioned, screened-off roof gardens. The apartments are accessed using residents' paths which branch off from Wismarweg to the west of the estate. On the northern side of the resident's path there are bicycle boxes. In the north-western zone of the site is a small, tree-covered square which the residents can use for recreation and play.



### Energy Concept

The houses have been constructed to Passive House standard with centralised ventilation system with heat recovery. Solar-thermal installations with a collector area totalling 115 m<sup>2</sup> provide 60 per cent of the hot water treatment. The remaining energy demand for heating and hot water is covered by a centralised wood pellet system.

### CHRONICLE

July 2009	Building started
End of 2010	Estate completed

### ESTATE DATA

Project type	New building, rented housing
Number of residential units	39
Building types	3-storey multi-family houses
Living space	47 – 110 m <sup>2</sup>
Total living space	3,244 m <sup>2</sup>

### ENERGY CONCEPT

Thermal insulation standard	Passive House standard
Hot-water preparation	Covered approx. 60% using solar thermal collectors







### Schwerte

Population: approx. 50,000

### Address

Märkische Straße

### Year of original construction

1962 – 1965

### Housing association

Gemeinnützige Wohnungsbaugenossenschaft Schwerte eG (GWG)

### Original architect

Walter Künkler, Schwerte

### Redevelopment planning

Architekturbüro Wolf-E. Benthaus, Lünen

### Energy concept

Ingenieurbüro Ortjohann, Köln

## SCHWERTE, MÄRKISCHE STRASSE, Redevelopment

### Location

The GWG Schwerte residential estate on Märkische Straße is situated on the northern boundary of Schwerte, around 1.5 kilometres from the city centre. The estate forms a self-enclosed quarter, bounded to the north by a regional rail track, to the south by Märkische Straße and to the east by Kirschbaumsweg. A nursery school, primary schools, secondary schools and retail amenities are all within a short distance. There is a bus stop at a distance of only 100 metres, providing a 20-minute service during busy periods. The next stop of the rail-bound local public transport is 1.5 kilometres away.

### Town Planning | Architecture

This district was constructed in the early 1960s and consisted of five identical, three-storey buildings with a total of 90 residential units. These buildings have been upgraded to a forward-looking building and residential standard adopting a holistic approach. Five additional apartments have been created by converting the lofts. Total living space is 7,560 m<sup>2</sup>. The buildings were redeveloped successively. All measures were carried out in close consultation with the tenants, who were offered the use of substitute accommodation during the construction period. The aim of the redevelopment and modernisation work was to ensure with the investment a future-proof quality which will continue to fulfil the relevant standards for the coming decades. Total



energy costs have been reduced, making it possible to keep the so-called "second rent" low. With the attic conversions and the free-standing balconies the original uniformity of this Solar Estate was given a fresh appearance, which is also reflected in the open space.

### Energy Concept

The redevelopment measures encompassed insulating the outer walls and cellar ceilings, redesigning and insulating the roofs, installing new windows, tearing down existing balcony slabs and replacing them with free-standing structures. The outer walls were insulated using an exterior insulation finishing system with 16 cm mineral fibre insulation. In the area of the attic conversion a wood structure with 21 cm mineral insulation was used. The five heating boilers that existed previously in the terraces were replaced by a heat distribution centre in which a wood-chip-fired boiler supplies the required heat in the base load range. Only local wood waste is used. For each of the five buildings a solar installation is used to provide hot water, covering the hot water demand by as much as around 60 per cent. The collector area totals 280 m<sup>2</sup>. A warranty agreement was concluded with the planner, the installation company and the solar system supplier guaranteeing an annual yield of solar energy.



### ESTATE DATA

Project type	Redevelopment, rented flats
Number of residential units	95
Building types	5 multi-family houses
Total living space	approx. 7,000 m <sup>2</sup>
Average surface area to volume ratio (SA:V)	0.44 m <sup>-1</sup>

### CHRONICLE

Summer 2004	Redevelopment started
End of 2008	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Improvement by extensive insulation measures
Heating system	Local-heating network with wood-chip boiler plus oil-fired boiler to cover peak demand
Hot-water preparation	Covered approx. 60 % using solar thermal collectors
CO <sub>2</sub> emissions	Reduced by 90 %







### Schwerte

Population: approx. 50,000

### Address

Schützenstraße

### Housing association

Gemeinnützige Wohnungsbaugenossenschaft Schwerte eG (GWG)

### Redevelopment planning

Architekturbüro Wolf-E. Benthaus, Lünen

### Energy concept

Ingenieurbüro Ortjohann, Köln



## SCHWERTE, SCHÜTZENSTRASSE

### Location

Hardly 700 metres to the north of Schwerte city centre there is the Schützenstraße residential estate. A nursery, primary schools and secondary schools are only a small distance away. The estate is also integrated into the adjacent landscape to the south, which is framed by the Mühlenstrang stream. There are bus stops located directly on the estate.

### Town Planning | Architecture

The Schützenstraße residential estate, which was developed in the 1960s, was structurally no longer in a marketable condition and so the not-for-profit housing association Wohnungsbaugenossenschaft Schwerte decided in 2003 to abandon the old building stock and replace it with new buildings. Only the western row of buildings has been retained and comprehensively redeveloped. The new buildings have a plastered surface and the stepped storeys are structured in addition by supplementary materials. During the construction phase the residents were accommodated temporarily in other apartments belonging to the GWG. The first construction phase comprised the construction of the new Werner Steinem Centre with 34 apartments and two communal rooms. Some of these flats and one communal room are being used by the Schwerter Beginen (women's community) for a women's housing project. A newly constructed underground car park ensures car-free inner courtyards, which have also been landscaped. The underground

car park is connected with the flats by means of lifts. Tenant gardens provide for a more positive response on the part of the residents in the ground floor flats.

### Energy Concept

All new buildings have been constructed with a high heat insulation standard; average heat transfer coefficient is now  $0.4 \text{ W/m}^2\text{K}$ . The heat is supplied using a local heating system. The heat base load is provided by the wood-chip boiler, which is located together with the chip bunker in the cellar of the Werner Steinem Centre. The fully automatic biomass boiler burns wood waste from the Schwerte town forest. To cover peak loads there is an additional gas-fired boiler. The buildings are linked to one another by a two-line local heating network. The heat is given off by means of a transfer station in each flat and is converted into room heat and hot water. Alongside the renewables-based heat generation, solar power is also generated in the Solar Estate. Photovoltaic systems have been installed on the roofs, with a total capacity of about  $52 \text{ kW}_p$  ( $350 \text{ m}^2$ ).



### ESTATE DATA

Project type	New buildings and redevelopment, rented housing
Number of residential units	137
Building types	Multi-family houses, 3- to 5-storey
Total living space	approx. $10,000 \text{ m}^2$

### CHRONICLE

Spring 2005	Building started
Summer 2009	Estate completed

### ENERGY CONCEPT

Thermal insulation standard	Low energy standard
Heating system	Local-heating network with wood-chip boiler plus gas-fired boiler to cover peak demand
Power generation	Photovoltaics, total approx. $52 \text{ kW}_p$ (approx. $350 \text{ m}^2$ )







### Siegen

Population: approx. 100,000

### Address

Wetzlarer Straße

### Year of original construction

1950s

### Housing association

Wohnstättengenossenschaft Siegen e.G.

### Original architect

Meid und Romeick, Frankfurt

### Energy concept

Ecofys Germany GmbH, Köln

## SIEGEN, Redevelopment

### Location

The Lindenberg district is situated about 2.5 kilometres from Siegen city centre and is linked by a bus route. The railway station in the centre of Siegen is easy to reach. Here the Wohnstättengenossenschaft Siegen has redeveloped 54 apartments from the 1950s to form a Solar Estate. In the past these buildings had already been modernised internally when tenancies had changed. This included electrical systems, bathroom redevelopment, renewal of water and waste-water pipes, doors, windows, and also floor plan modifications in some cases.

### Town Planning | Architecture

The Lindenberg estate with its curving structures takes up the typology of the Garden City concept of the 1950s – the renowned architect and town planner Bernhard Reichow could have been the godfather of this urban form. Between 2006 and 2007 the existing buildings were comprehensively redeveloped and upgraded in terms of energy systems. What is remarkable is that the redevelopment of the estate was carried out with the buildings still occupied. The plastered buildings present a relatively individualised appearance with a differentiated paint system, especially with the free-standing balconies. The roofs are covered over a large area with PV installations and solar thermal equipment, and this therefore also reinforces the architectural impression of a Solar Estate.



**Energy Concept**

The heating energy demand was reduced to the 3-litre standard by means of extensive measures. The existing cantilever balconies were replaced by free-standing structures in order to eliminate thermal bridges. A central ventilation system with heat recovery has been used for each block. Central gas-fired condensing heating systems have also been installed for each block for heating and hot water purposes, and these are supported by solar thermal systems. The solar thermal installations have a total collector area of 142 m<sup>2</sup>. Furthermore PV installations with a total of 66 kW<sub>p</sub> have been installed on the roofs.

- H'ḡ (mean heat transfer loss) = 0.30 W/m<sup>2</sup>K
- Heating energy demand = 34.5 kWh/m<sup>2</sup>a (over 250 kWh/m<sup>2</sup>a before redevelopment)
- CO<sub>2</sub> emissions = 23.9 kg/m<sup>2</sup>a (almost 100 kg/m<sup>2</sup>a before redevelopment)



**ESTATE DATA**

Project type	Redevelopment, rented housing
Number of residential units	54
Building types	9 three-storey multi-family houses
Average living space	66 m <sup>2</sup>

**CHRONICLE**

Autumn 2006	Redevelopment started
End of 2007	Estate completed

**ENERGY CONCEPT**

Thermal insulation standard	Reduction of heating energy demand by insulation from more than 250 kWh/m <sup>2</sup> a to 34,5 kWh/m <sup>2</sup> a (3-litre standard)
Heating system	Heating system per block, central gas-fired condensing-type heating and central ventilation with heat recovery
Hot-water preparation	solar-thermal collectors (a total of 142 m <sup>2</sup> collector area)
Power generation	Photovoltaics, total approx. 66 kW <sub>p</sub>





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**To help the transformation:  
Solar Estates**

[...] A new kind of housing estate is not created on the drawing board – and there is also no “right” architectural and technological answer. A lot of trials are needed – free scope for development in one direction. This is the approach which has been taken and still is being taken in the lead project “50 Solar Estates in NRW”.

The project is intended to “initiate the accelerated use of energy from renewable sources and to highlight approaches to climate protection, the conservation of resources and improvement of social qualities through holistic solutions. The goal is not only demonstration, but the impetus which arises from increased application and which triggers sustainable development.” (Project Guidelines – 2000).

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