



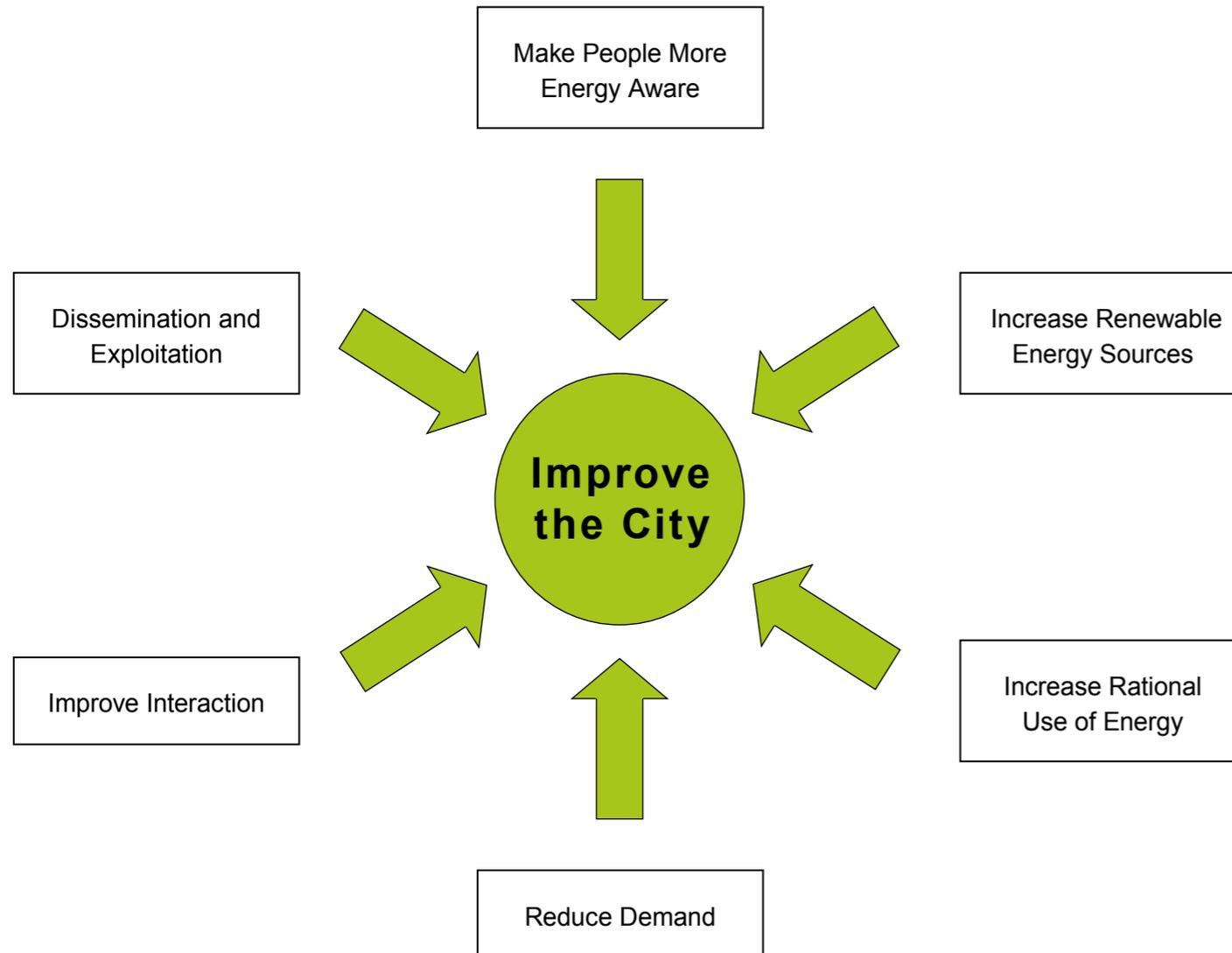
# THE ENERGY EFFICIENT CITY



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an EU project shows effect



## Goal

The project Energy in Minds aims to reduce the use of fossil energy and CO<sub>2</sub>-emissions in the building sector by 20 to 30 percent in 4 European communities within a 5 year period. To reach this goal a wide range of measures are being taken to reduce the energy consumption and increase the use of renewable energy.

## Work Programme

There are many possible ways to reduce energy. However, only the combination of many single measures and the active participation of both private individuals and public organisations within the community can ensure goals are realized successfully. To achieve the objectives Energy in Minds is carried out by focusing on six key actions shown in the lefthand chart.

## Benefit of International Cooperation

The close cooperation of different cities, with similar approaches, improves the quality of measures significantly. Intensive exchange of experience and training within the consortium is one key aspect to integrate the numerous single measures undertaken within the Concerto programme. In doing so the knowledge already existing and the experience gained during the implementation of Energy in Minds is effectively used by all partners.

## Acting as exemplar for other cities

The goal of this brochure is to show good examples of Energy in Minds in order to inspire other cities to use similar approaches.

Goal	20-30% reduction of CO <sub>2</sub> -emissions in 4 European cities
Duration	5 years (2005 – 2010)
Budget	22,3 million Euro
EU-support	9,1 million Euro
Coordinator	Steinbeis-Transferzentrum Energie-, Gebäude- und Solartechnik in Stuttgart, Germany

Energy in Minds is a project of the Concerto initiative co-funded by the European Commission within the Sixth Framework Programme.



## Project Coordinator:

Steinbeis-Transferzentrum Energie-, Gebäude und Solartechnik, Germany

## Active Communities:

- Falkenberg, Sweden
- Neckarsulm, Germany
- Weiz-Gleisdorf, Austria
- Zlin, Czech Republic

Four cities were chosen for optimizing their overall energy situation within Energy in Minds. All of them are very advanced in comparison to the average of their countries and have special experience in different parts of the energy chain.

## Observer Communities:

- Gornji Grad, Slovenia
- Province of Torino, Italy
- Wieselburg, Austria
- Värnamo, Sweden
- Comunita Montan Val Pellice, Italy
- Provincia di Biella, Italy
- Trier, Germany

Within the 5-year period of Energy in Minds Gornji Grad and the Region Torino locally undertake preparative measures in order to be ready for a full implementation of the Concerto approach in a few years.

The other observer communities take part in dissemination activities in order to profit from the experience of Energy in Minds.



## Falkenberg, Sweden

- 40.000 inhabitants
- Pioneer in comprehensive, carefully planned use of wind power on a large scale
- One of the leading and most ambitious municipalities regarding regenerative energy systems
- Large scale biogas plant delivering biogas for vehicles

Partners: Municipality of Falkenberg, Falkenberg Energi AB, Falkenberg Bostads AB, Halmstad University



## Neckarsulm, Germany

- 27.000 inhabitants
- One of the premier cities with the highest density of solar thermal and PV systems in Germany
- One of the leading cities in Germany in the area of solar energy
- Support programme in the area of climate protection and ecological energy supply for over 10 years
- The worlds largest solar system with seasonal storage

Partners: City of Neckarsulm, Stadtwerke Neckarsulm, Solar & Energie Initiative Heilbronn e. V.



## Energy Region Weiz – Gleisdorf, Austria

- 38.000 inhabitants
- Cooperation of 15 villages and the cities Weiz and Gleisdorf
- Highest density of solar thermal and photovoltaic systems in Austria
- European Solar Energy Award (2 times)
- More than 25% renewable energy from biomass, solar energy, hydropower

Partners: Management of Energy Region Weiz-Gleisdorf (W.E.I.Z.), AEE INTEC, Feistritzwerke Steweag GmbH

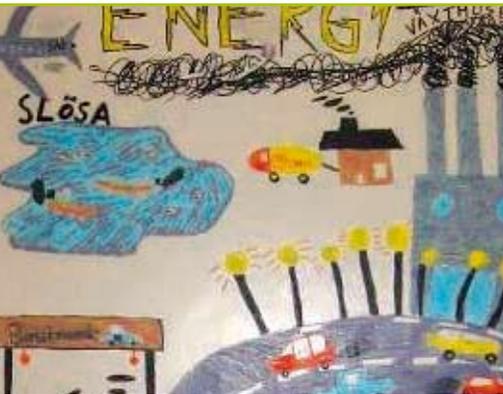


## Zlin, Czech Republic

- 76.800 inhabitants
- „Green“ & healthy lifestyle city
- Industrial city
- Regional energy conception supporting the utilization of renewable energy sources
- Eco-village of low-energy houses „Jizni Chlum“

Partners: City of Zlin, Green Housing Association, Teplo Zlin, Ekosolaris, a. s.

# INFORMATION CAMPAIGNS

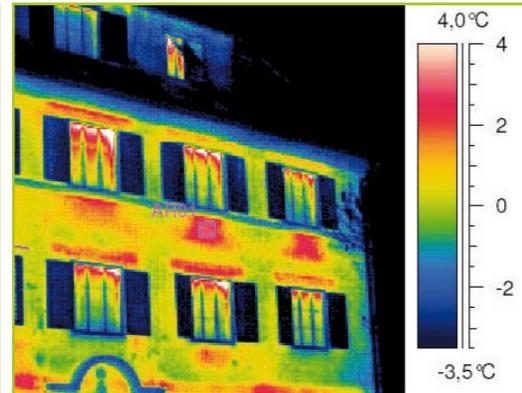


The active cooperation of the population is very important for the successful implementation of Energy in Minds. Several activities are carried out in order to inform people about energy questions thus increasing the “energy thinking” of the whole population. As a result of better understanding, people are more active in realising measures to reduce the energy consumption.

## The following activities are carried out:

- Establishment of energy agencies
- Information campaigns
- Workshops / lectures
- Energy Days (public events)
- University summer courses
- Energy platform [www.energy-in-minds.de](http://www.energy-in-minds.de)
- Information brochures
- Press conferences
- Guided tours to demonstration plants
- Regular information about energy topics

# RESIDENTIAL BUILDINGS



## Energy standard 30 percent better than national standard.

Due to an increasing awareness through information campaigns the residents are becoming increasingly active in saving energy. The number of retrofits, new low energy buildings, installation of solar thermal systems, etc. has grown significantly since the start of Energy in Minds.

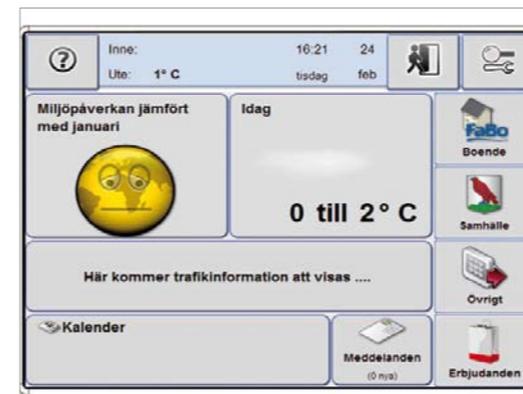
The good publicity and financial support of Energy in Minds encourages inhabitants to invest in a better energy standard.

## Acknowledge of our energy consumption is the first step in saving energy.

In order to identify buildings with a good potential for energy savings several thousand energy checks were carried out. In Weiz-Gleisdorf the energy checks resulted in an average reduction of the energy consumption of all retrofitted single-family buildings by more than 50 percent. This contributes to CO<sub>2</sub> savings of about 475 tons per year.



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The two low energy multi-storey houses with 54 apartments are the first in Falkenberg designed according to passive building principles. 45 kWh/m<sup>2</sup>a is the goal including the energy consumption for heat and hot water. The energy requirements are less than half the standard of new build houses in Sweden.

A perforated solar-air panel is installed on the south-west facade in order to preheat the ventilation air.

A smart box (touch screen display) is installed in each apartment visualizing the current energy consumption thus helping tenants to save energy.

### Advantages:

- Good indoor climate
- Pleased tenants
- Low noise disturbance in the flats
- Low environmental impact
- Low energy costs
- The project has paved way for low energy buildings to be the standard in the future buildings of the company

Year of construction	2008
Gross floor area	2.552 m <sup>2</sup> /building
Measured energy consumption	37 kWh/m <sup>2</sup> a (heat and hot water)
Investment costs	9,2 million Euro
Heating system	District heating
Heat distribution	Floor heating Ventilation system with heat recovery

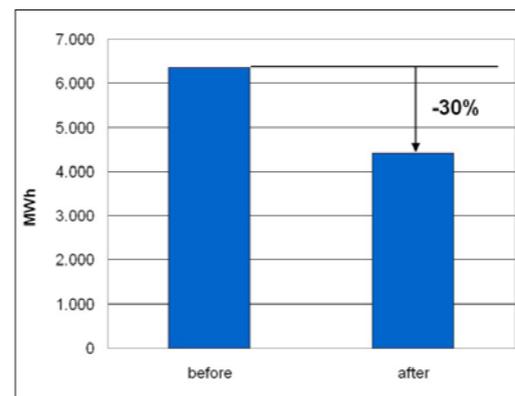


The position of an energy manager was established in 2006 in Zlin. He is responsible for the energy consumption of all public buildings owned or operated by the city of Zlin. He proposes and ensures the implementation of non- and low-costs measures for the reduction of the energy consumption.

In summer 2006, individual room control systems were installed in 5 elementary and 10 nursery schools. The temperature is reduced from 21°C to 15°C during the night and during weekends. This results in 30% less energy consumption. Savings of about 2 GWh per year correspond to yearly CO<sub>2</sub> reductions of about 850 tons.

### Advantages:

- Reduced energy demand for space heating
- Possibility to set up the space heating in individual rooms depending on the current activity
- Heat comfort in individual rooms
- Low investment cost



Year of construction	1962-1985
Year of optimization	2006
Total heated net floor area	34.304 m <sup>2</sup> (5 elementary, 10 nursery schools)
Energy consumption before	6.4 GWh/a
Energy consumption after	4.4 GWh/a



The eco-village Jizni Chlum near Zlin consists of earth-sheltered houses. Their energy consumption is close to those of passive houses. 60 - 90% of the heat is provided from renewable sources.

The building is covered with earth. Only the front façade is visible. The rear is built into the slope of a hill. This, together with good insulation, results in low heat losses through the building envelope.

Solar spots direct light into the back rooms.



### Advantages:

- Reduced energy for space heating
- Good compatibility with nature and landscape
- Renewing of the original green by planting the roof
- Possibility of utilization of slopes and other lands not suitable for traditional housing or agriculture
- Maximum security from fire, storms, hailstorms, earthquakes and other natural disasters
- Noise insulation provided by earth
- Less expenses and time needed for maintenance



Year of construction	2002-2008
Heated net floor area	1.055 m <sup>2</sup> (5 houses with 105 - 330 m <sup>2</sup> each)
Measured energy consumption	about 15 KWh/m <sup>2</sup> a

# RETROFIT OF THE “NEUBERGSCHULE”

Neckarsulm (Germany)



In June 2007, the high efficient retrofit of the “Neubergschule” was finished. Besides retrofitting the building envelope a new heating system was installed consisting of two pellet boilers and a prototype Stirling engine.

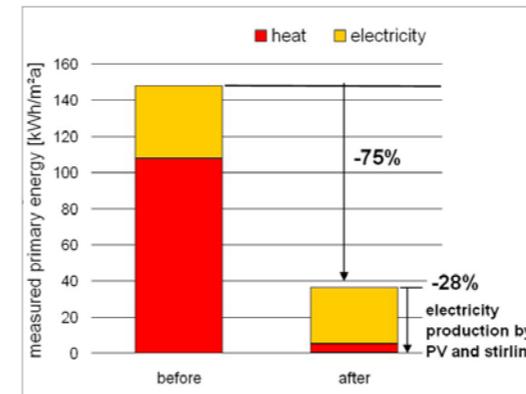
The primary energy is reduced by 75%. When taking the electricity production of the PV system and Stirling into consideration the school becomes a primary energy supplier (rather than consumer).

The Neubergschule is a positive example showing that the combination of good insulation of the building envelope and an energy efficient heating system contributes to the successful implementation of a retrofit.



## Results:

- Better comfort in the classrooms
- Reduces energy consumption
- Replacement of natural gas by wood pellets
- Zero primary energy building
- First running wood pellet Stirling engine in Germany



Year of construction	1970
Retrofit due to PCB pollution	July 2006 - June 2007
Gross floor area	ca. 3.000 m <sup>2</sup>
Investment costs retrofit	2,5 million Euro
Heating system	2 pellet boilers with 69 kW each prototype Stirling engine with 1 kW <sub>e</sub> /3 kW <sub>th</sub>



A new technology was installed at Zlin's central waste depot enabling the re-processing of biodegradable wastes into a certified combustible ("energetic") compost.

This technology, together with the large-scale PV system of approximately 200 kWp located at the communal waste depot, will be used as a "demo-park" presenting utilization of various kinds of renewable energies.

### Approach:

- Collection of biodegradable wastes at home composters and pick up with a special mixing car
- Transport of grass, leaves and woods from the city parks and forests
- Collection of wastes from school & public building dining rooms
- Running of the aerobic fermentation of bio-wastes for about 100 hours
- Production of energetic compost with a heating value of ca. 3,2 kWh/kg
- Combustion of the energetic compost in the central heating plant

### Results:

- Replacing of brown coal by "energetic compost"
- CO<sub>2</sub> savings of more than 1.000 tons per year

Year of construction	2007
Capacity of plant	1.500 tons biodegradable waste per year
Annual production	900 tons of energetic compost a year i.e. approx. 2,88 GWh/a

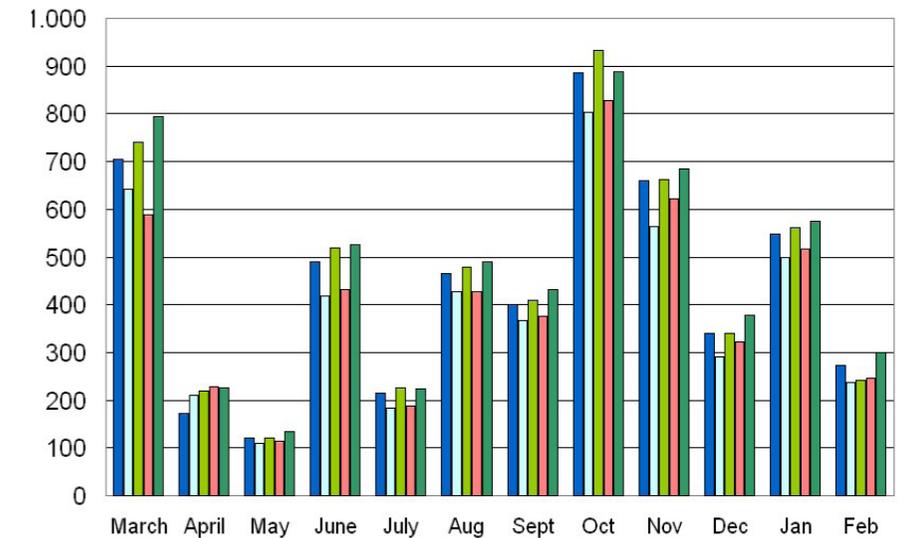


### An important step towards 100 % renewable electricity

Since March 2007, five new wind turbines near the sea shore of Falkenberg generate almost 30 GWh renewable electricity per year. This is equal to the annual requirement of 7.000 households.

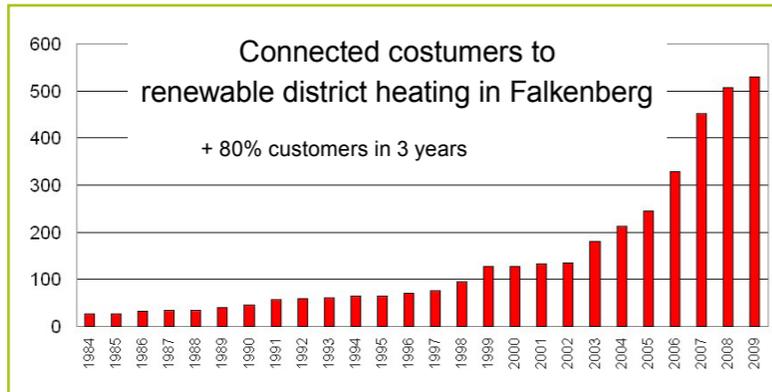
The turbines provide valuable planning input for a large offshore park with 30 turbines, about 8 km out to sea. Once the plan will be realised, electricity generated by wind power in Falkenberg will correspond to the annual power demand of the municipality.

### Monthly production of the 5 turbines (2008/2009) in MWh



Year of construction	2007
Rated power	2,3 MW each
Annual production	~30 GWh (5% of electricity demand Falk)
Production so far (2 years)	55 GWh

# BIOMASS



## Pellet boiler:

- In total about 5.000 kW pellet boiler were installed in private households and public buildings.
- In Falkenberg, 292 m<sup>3</sup>/a of fossil oil were replaced by wood pellets in 100 private homes resulting in CO<sub>2</sub> savings of about 780 tons per year.

## District heating systems:

- During the last 4 years, the use of biomass was more than doubled by the enlargement of the district heating net in the town of Falkenberg producing heat from wood chips.
- In Weiz-Gleisdorf, the installation of district heating systems (between 50 and 1.000 kW) is very successful.
- A wood fired co-generation plant at the central heating station in Neckarsulm increases efficiency by the enlargement of the district heating net. Raising the heat load by 200% results in CO<sub>2</sub> savings of 3.000 tons per year.



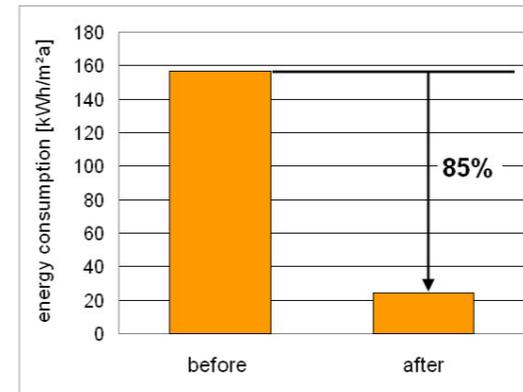
The retrofit of the “hostel for pensioners” is a showcase in the Energy Region Weiz-Gleisdorf. It provides a good example for a successful retrofit of a multi-family house.

### Approach:

- New glass façade in front of the old façade turning the open balconies into additional living space
- Good insulation
- Modern control engineering
- Controlled ventilation system with 70% heat recovery
- District heat generated from biomass
- 160 m<sup>2</sup> solar thermal system

### Advantages:

- Energy savings / lower energy costs
- High indoor air quality
- Improvement of living quality by enlargement of floor areas
- Higher thermal comfort due to higher surface temperatures of the inner walls
- No heat bridges through the facade
- Less noise



Year of construction	1973
Retrofit	2006
Gross floor area before (after)	4.600 m <sup>2</sup> (5.490 m <sup>2</sup> )
Energy consumption before (after)	157 kWh/m <sup>2</sup> a (24,3 kWh/m <sup>2</sup> a)
Energy costs before(after)	ca. 30,5 T€/a (4 T€/a)
Investment costs retrofit (additional costs for better standart)	800 T€

# SOLAR SLUDGE DRYING PLANT

Neckarsulm (Germany)



When it became clear that the existing central sewage treatment plant in Neckarsulm had to be retrofitted, an innovative concept was worked out by the "Abwasserzweckverband Unteres Sulmtal".

### Approach:

Solar energy and a floor heating system are used to dry out the sludge in a solar greenhouse to a water content of less than 35%. In doing so volume and weight of the sludge reduces by up to 70%. This dry „sludge“ can be easily disposed of or can be used as a bio-fuel in a nearby wood-chip central heating station.



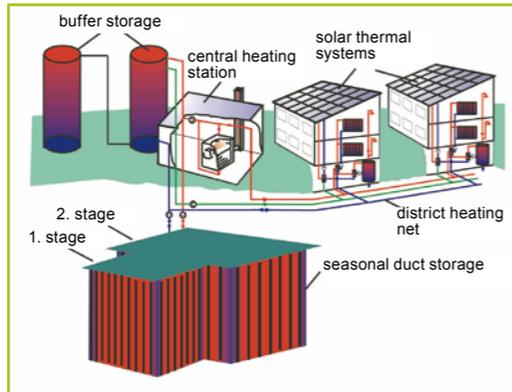
### Advantages:

- Reduction of CO<sub>2</sub> emissions by 7.000 t/a
- Reduction of transport and disposal costs
- Maintaining low charges for the population
- Ensuring the safe development of the city
- Economic running of the plant due to clear-sighted planning and modern technology
- Self-sufficient plant to a large extent (regarding electricity and heat demand) due to intelligent recycling of "waste energy" such as the waste heat of the co-generation plant, digester gas.



Construction time	July 2008 - September 2009
Total reduction of CO <sub>2</sub> emissions	ca. 7.000 t/a 28 kg CO <sub>2</sub> /a inhabitant
Total investment costs	27 - 28 million Euro
Investment costs solar sludge drying plant	5,2 million Euro

# SOLAR THERMAL AND PV SYSTEMS



## Solar thermal systems:

- Installation of about 5.000 m<sup>2</sup> collector area
- Besides small and large-scale combi-systems other innovative solar technologies like the combination of solar thermal systems and district heating, solar air systems and solar systems with seasonal storage are tested and demonstrated within the project.

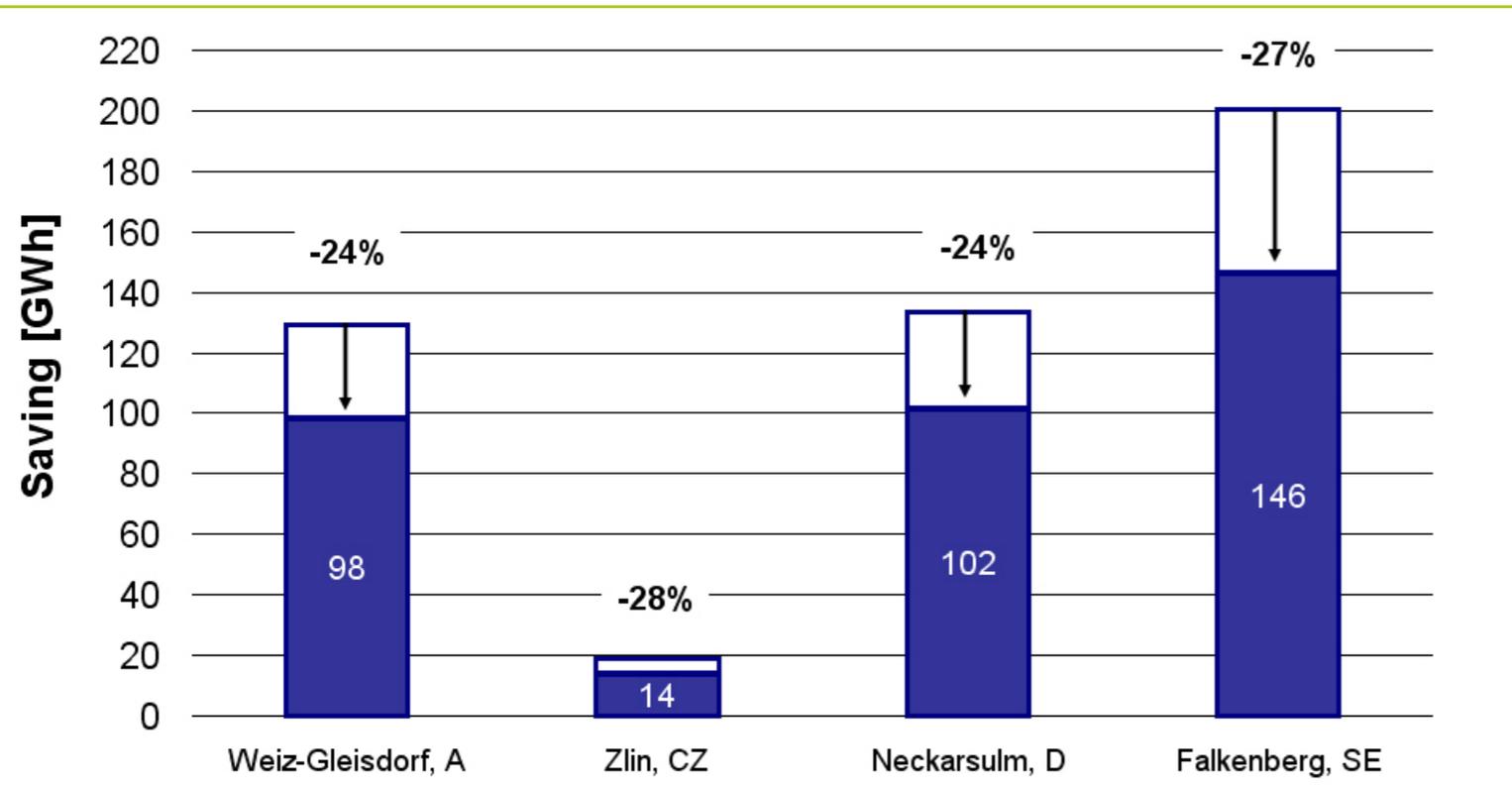


## PV systems:

- Installation of about 1.700 kWp
- The expectations of Concerto were surpassed by more than double concerning the installation of PV systems. In Neckarsulm the reason for the high number of PV installations are interesting economic boundaries.
- In Zlin the number of investors rises now that people have the opportunity to see the systems in reality.
- Renting the roofs to other people or investing in parts of larger systems belonging to the community enables people who do not have suitable roofs to invest in PV systems.

# RESULTS AND CONCLUSION

Fossil Energy Consumption - Savings from 2005 until 2010



During the last years Energy in Minds demonstrated that it is in fact possible, even in energy-advanced cities, to realise the ambitious goal of saving up to 30% of fossil energy in 5 years.

By combining many different measures und the Concerto programme, the 4 communities within Energy in Minds have reduced their CO<sub>2</sub> emissions by 50.000 tons per year. This corresponds to the CO<sub>2</sub> emissions of 10.400 cars driving once around the world every year.

Are you interested in making your city even more energy efficient?  
Use the chance to benefit from the experience from Energy in Minds!  
Ask us!

Steinbeis-Transferzentrum Energie-, Gebäude- und Solartechnik  
[www.stz-egs.de](http://www.stz-egs.de)

[www.energy-in-minds.de](http://www.energy-in-minds.de)

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