

## Geothermal Technology



### Geothermics

1.

#### Groß Schönebeck

##### ► Initial Position

Research

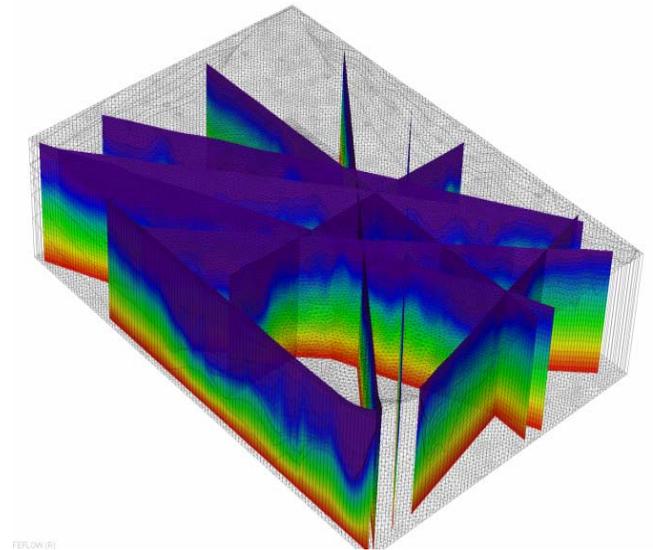
Results

### Initial Position

Geothermal technology is still in an early stage of development. The technology offers a huge potential for innovation and optimization and pose high challenges on Research & Development.

Demonstration projects and case studies are needed to show the general feasibility of geothermal power generation under different geological settings.

The North German Basin e.g. provides water bearing sedimentary reservoirs with a high potential for base load supply of heat and electricity. The geological conditions are representative for many parts of Western and Central Europe.



PERLOW (R)

Coupled fluid flow and heat transfer modelling in regional scale for the North German Basin



## In situ geothermal laboratory Groß Schönebeck – A reference site in the North German Basin

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### Research

Geothermal research at GFZ combines geosciences and engineering along the whole chain of geothermal energy supply .

*Reservoir exploration* >> *Reservoir engineering* >> *Thermal water production* >> *Power generation*



### Key challenges

New geophysical methods and techniques for a sustainable and economic exploitation

Development of advanced drilling technology and safe bore-hole completion systems

Enhancement of the reservoir productivity (EGS: Engineered Geothermal Systems )

Material qualification considering specific site conditions

Optimisation of power conversion cycles for a reliable energy supply



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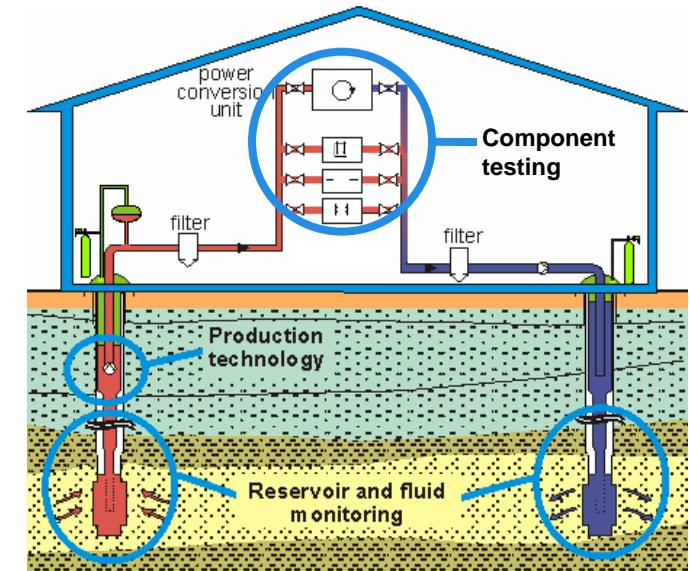
## In situ geothermal laboratory Groß Schönebeck – Test facilities for a reliable use of Geothermal Energy

### Results

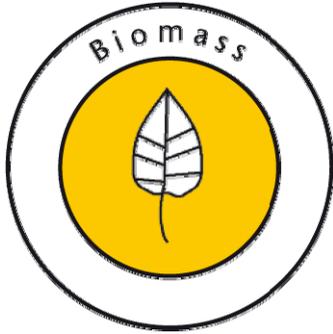
The case study Groß Schönebeck represents a lighthouse project for geothermal technology development in Europe. New geothermal methods can be developed and components can be tested in a world-wide unique natural laboratory.

The longterm goal is the development of technological capable concepts for the use of deep reservoirs in sedimentary basins, independent of the location.

The successful learning curve of Groß Schönebeck allows the transfer of technologies to other regions of similar geology worldwide.



Sketch of **INGE**: **IN** situ test facilities at Groß Schönebeck to support the development of system components for a reliable use of **Geothermal Energy**



## Biogas Plants for Decentralised Power Supply



### Biomass

2.

#### Biogas Plants

#### ► Initial Position

Research

Results

### Initial Position

Biogas plants offer a multitude of opportunities for a decentral power supply. They can be used for a very efficient power production as base load as well as for demand oriented application.

Biogas can also be upgraded to natural gas quality to feed it into the natural gas grid or to use it as vehicle fuel. Raw gas pipelines and micro gas grids are additional ways to use biogas.

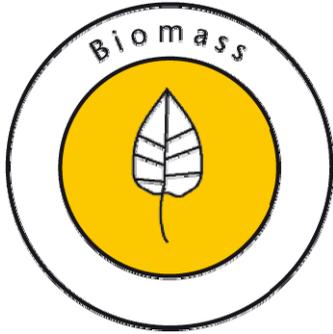
Since the usable biomass for this process is characterized by a high water content, the maximum plant size is restricted to some MW due to transportation costs.

Thus plant size and type has to be fitted to the specific task in the energy supply system and the local boundary conditions.

The decentral character as well as the availability of biomass from waste predetermine biogas as an ideal technology for countries with a developing energy supply structure.



Typical biogas plant in Germany



## Biogas Plants for Decentralised Power Supply



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### Research

Fraunhofer IWES concentrates on the integration of bio energy in (future) energy supply systems. The main focus lies on biogas applications.

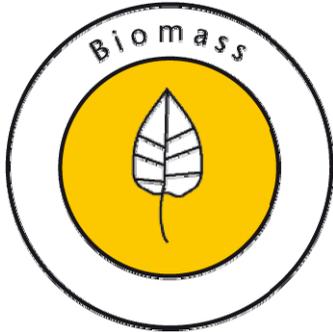
The projects cover the whole range from biogas derived electricity to biogas upgrading, grid injection and fuel production.

- Demand oriented supply of power from biogas plants
- Dynamic biogas production
- Measurement and control systems for biogas plants
- Simulation of the biogas process and the integration in the supply systems
- Biogas upgrading technologies an applications

The research work concentrates on finding the best technical solutions and business models to maximize the overall efficiency of a renewable energy supply by optimizing the interaction of all renewable energy sources.



Agricultural test site for grid integration of biogas derived energy (power, heat, gas)



## Biogas Plants for Decentralised Power Supply



### Biomass

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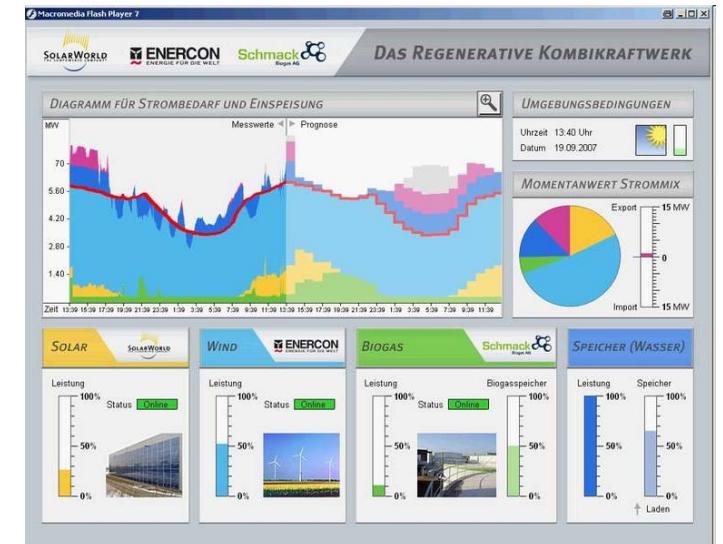
## Results

Energy from biogas is identified to play an important role in future energy supply systems by providing balancing power in grids with a high or even 100% share of renewable energy.

Biogas upgrading and grid injection will facilitate the transition of a fossil dominated supply structure to a renewable one by providing a 100% compatible energy carrier.

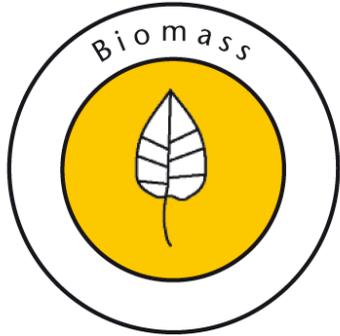
To fulfil the needs of a sustainable future energy supply conversion paths and business models are being developed with respect to the specific characteristics of biomass as well as the local grid structure.

Biogas plants in the electrical sector will have the best efficiency in decentral applications thus the structure of stakeholders and the business models for power trading have to be adopted to disburden this important pathway of sustainable energy supply.



The combined power plant

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## Effect of small scale biomass combustion on local concentration and composition of ambient PM10



### Biomass

3.

#### Biomass Power Plant

##### ► Initial Position

Research

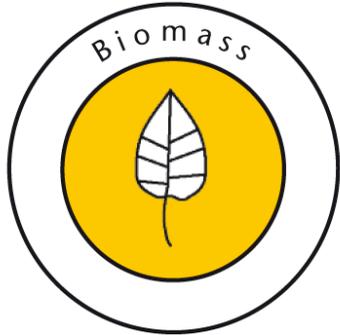
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### Initial Position

During 2008 selected German conurbations were defined as green zones (traffic low emission zones) actually to reduce the ambient particulate matter (PM) concentration. Beside traffic, private house heating causes about one third of the PM immission. Biomass combustion is significantly involved here although it is designated as climate friendly because of its CO<sub>2</sub>-neutrality.



Waste gas plume of a biomass combustion



## Effect of small scale biomass combustion on local concentration and composition of ambient PM10



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### Research

The importance of small scale biomass combustions on the PM immissions was investigated by ZAE Bayern with the Augsburg area used as the test case.

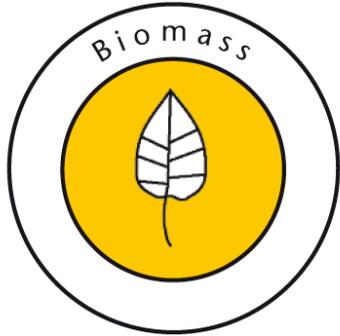
First an update of the emission cadastre for domestic heating in the Augsburg area was done together with the chimney sweeper guild Swabia to determine the significance of biomass combustion.

During the heating periode air quality monitoring was performed at several stations in Augsburg by the project partners Bavarian state office of environment and bifa GmbH, the analysis were done by the university of Augsburg (chair of solid substance chemistry).

By ZAE Bayern reference measurements of PM 10, Levoglucosan and Potassium were taken using test site set-ups with typical single-stoves. On dispersion calculations for the whole urban area of Augsburg (about 18.000 raster sources, grid width 128 m, 24 chimney sweeper areas) the immission distribution for PM from wood firings was calculated.



Emission measurements on typical wood log fired single stoves.



## Effect of small scale biomass combustion on local concentration and composition of ambient PM10



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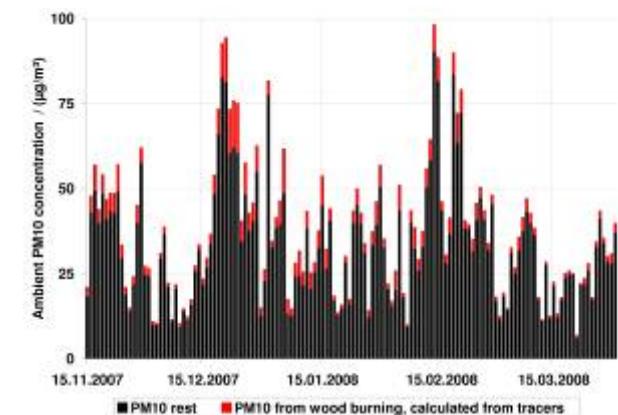
Research

► Results

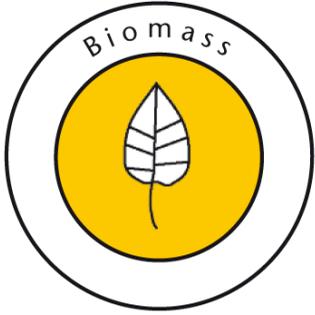
### Results

A number of about 18.000 stoves for solid fuel installed at Augsburg was determined. This equates to approx. 51 % of all private house heating. However the wood consumption of about 60.000 stacked cubic meter per year equated to only 2 % of the heat supply requirements.

The air quality monitoring shows values of 23 – 500 ng/m<sup>3</sup> for Levoglucosan, a tracer for biomass burning. The concentration of potassium (anorganic tracer for biomass burning) was between 50 – 514 ng/m<sup>3</sup>. Based on the identified emission factors the level of primary particles caused by wood combustion on measured PM10 immissions was calculated. In the winter 2006/07 between 0.2 and 11 µg/m<sup>3</sup> (2 – 20 %) of ambient PM resulted from wood burning. The results of the dispersion calculations show the effect of the emission time series and the location of the emission as well as the significant effect of the meteorological-caused dispersion terms and conditions. With stationary temperature inversions both measured and calculated immission concentrations rose significantly. When such weather situations exist high emission firings should be stopped as their emissions lead to high local immissions.



Ambient PM time series in the city centre of Augsburg



# Renewable Energy Research for Global Markets



## Enerbiom – Sustainable production of energy biomass



### Biomass

4.

### Enerbiom

#### ► Initial Position

Research

Results

### Initial Position

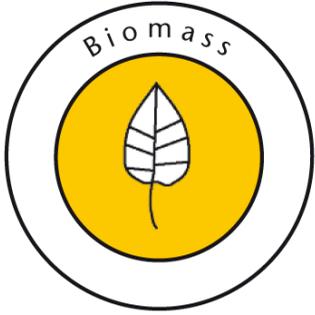
The project is investigating possibilities for a sustainable and economic interesting biomass production in the border region of Saarland, Rhineland-Palatinate (Germany), Lorraine (France), Wallonia (Belgium) and the German speaking community of Belgium.

A main focus within the project lies on the preparation and publication of guidelines for sustainable cultivation of energy plants with respect to existing agricultural and ecological framework conditions. Field tests will be effected in Belgium, Germany and France which might help to identify environmental friendly production processes also easy going on resources.



Dieses Projekt wird von der EU über den EFRE-Fonds im Rahmen des Programms INTERREG IV A kofinanziert

**Die Europäische Union investiert in Ihre Zukunft.**



## Enerbiom – Sustainable production of energy biomass



### Biomass

4.

### Enerbiom

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Results

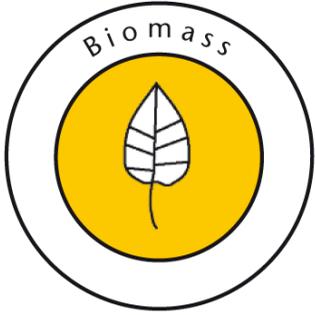
### Research

One research focus is the elaboration of reference cases for cultivation of energy plants in a transnational network. A number of promising plants like miscanthus, switchgrass, hemp and some sorts of grain will be selected and planted under different pedoclimatic conditions in the border region.

Then the potential of development and ecological impact of the different cultures as well as their practical value following the planned usage will be analysed. The plants should be used to produce biogas and bioethanol, or they should be incinerated for heat supply.



The project region



## Enerbiom – Sustainable production of energy biomass



### Biomass

4.

### Enerbiom

Initial Position

Research

### ► Results

### Results

As the project just started and will run until 2011 there are not yet results available. As first interim steps the cultivation tests at the partners areas are implemented and the sampling and planning of analysis are finished.

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Miscanthus plantation