Hochschule für Technik Stuttgart

Politechnika Śląska

ITC

APOS

Biop-GmbH

ARP

proen gliwice

IntBioCHP

System integration of biomass fired cogeneration plants

Project under

POLISH - GERMAN SUSTAINABILITY RESEARCH PROGRAMME

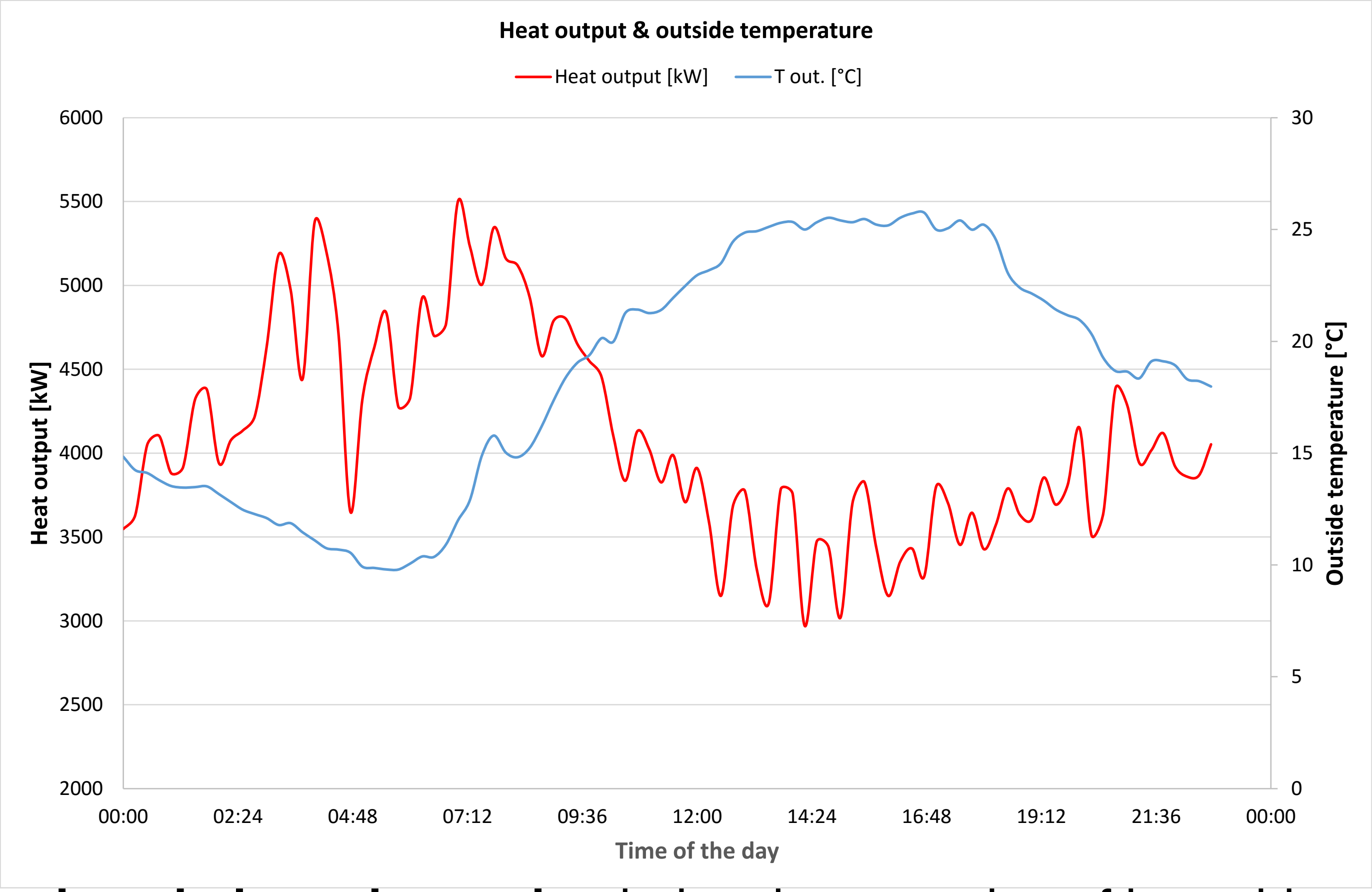
STAIR

IntBioCHP

Agenda

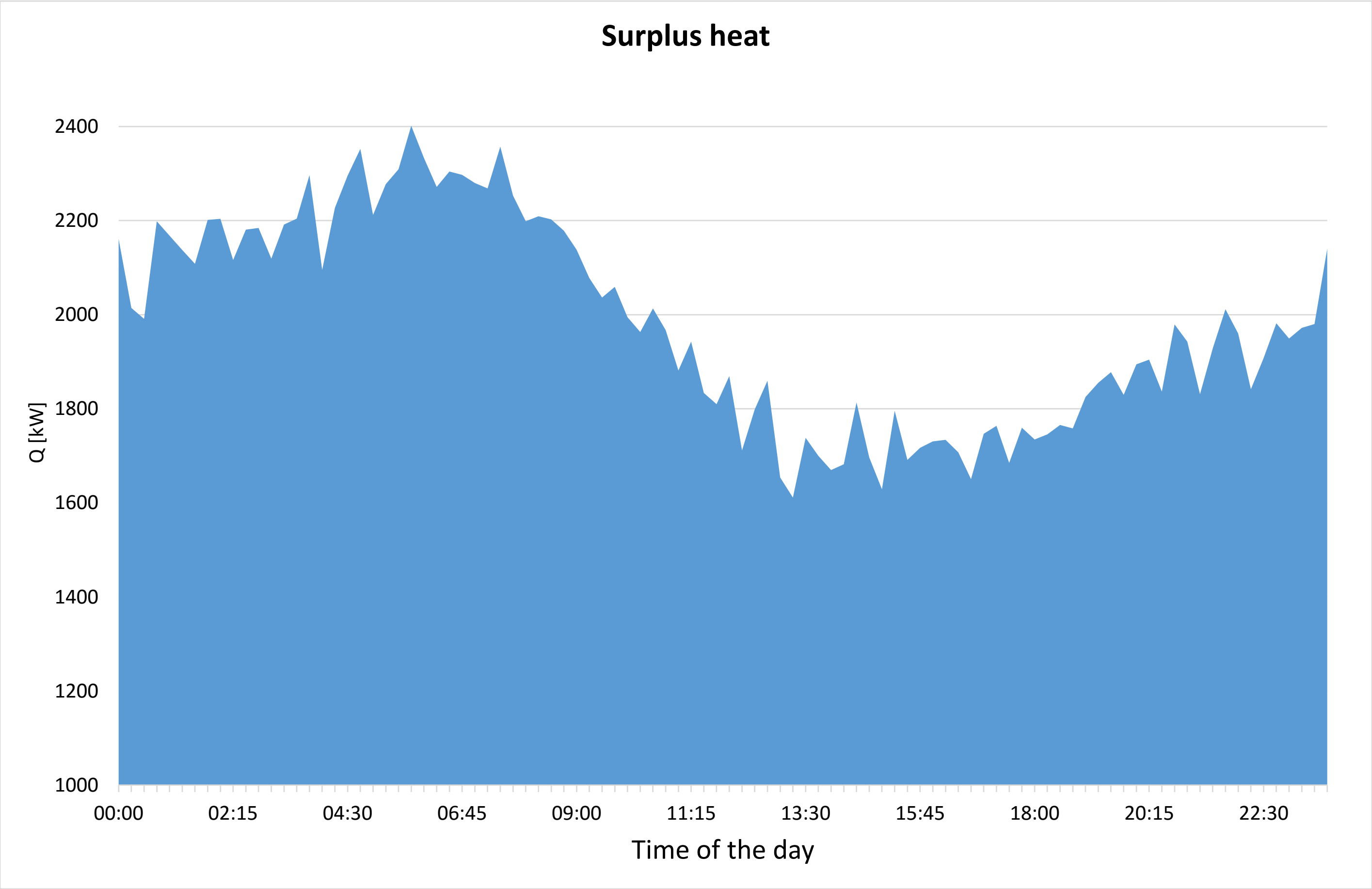
- Problem definition
- Project objectives
- Proposed solution
- Work plan and implementation concepts
- German-Polish co-operation

Problem definition



- **Fluctuations in heat demand –** during the operation of heat driven plants fluctuations in heat demand can lead to inefficient and unstable energy generation
- **Indirect plant control –** the energy input at the plant can be defined only indirectly which makes achieving of stable process conditions difficult

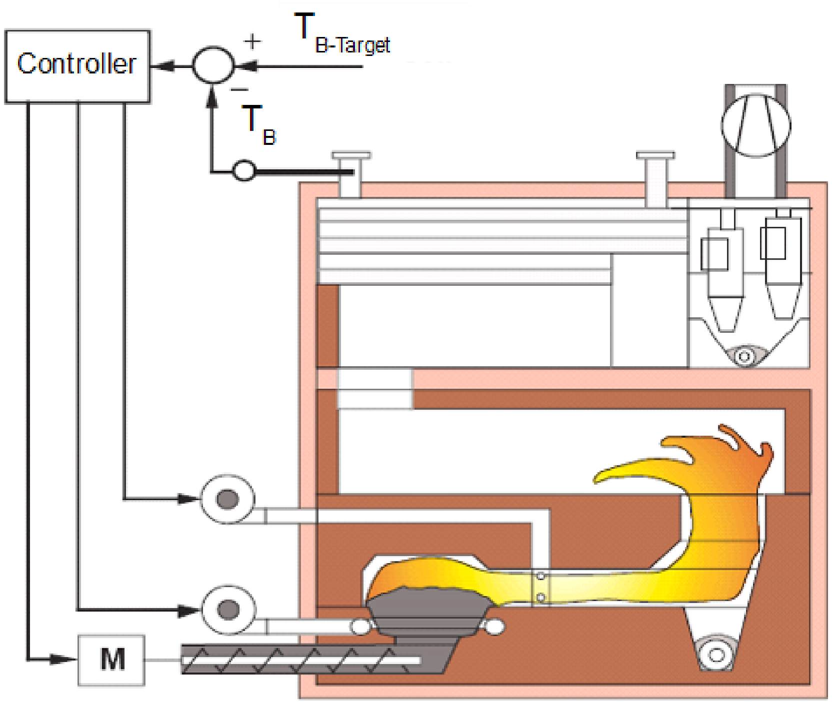
Problem definition



- Efficiency loss due to part-load operation – significant efficiency deficits occur when the plants are operated with power output below 70% of the nominal load
- Heating energy losses – often the plant produces too much heat and the surplus heat has to be released to the environment

Problem definition

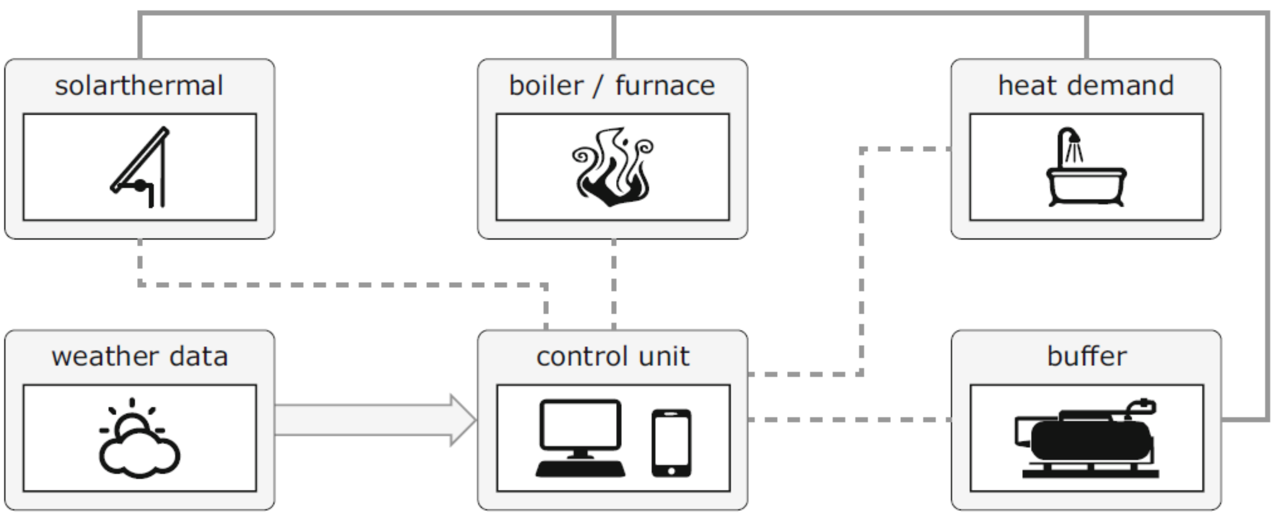
- The operation of medium and small-scale decentralised biomass CHP-plants is often controlled by equipment which only allows achieving of suboptimal working conditions
- Varying fuel properties lead to problems related to unstable plant operation and reduction of the durability of system components



[Kaltschmitt 2016]

Project objectives

- In course of the project activities the system efficiency of decentralised biomass CHP plants should be improved by:
  - Direct control of the fuel parameters
  - Improvement of the plant control system
  - Optimisation of the heat supply system



[D. Thrän 2015]

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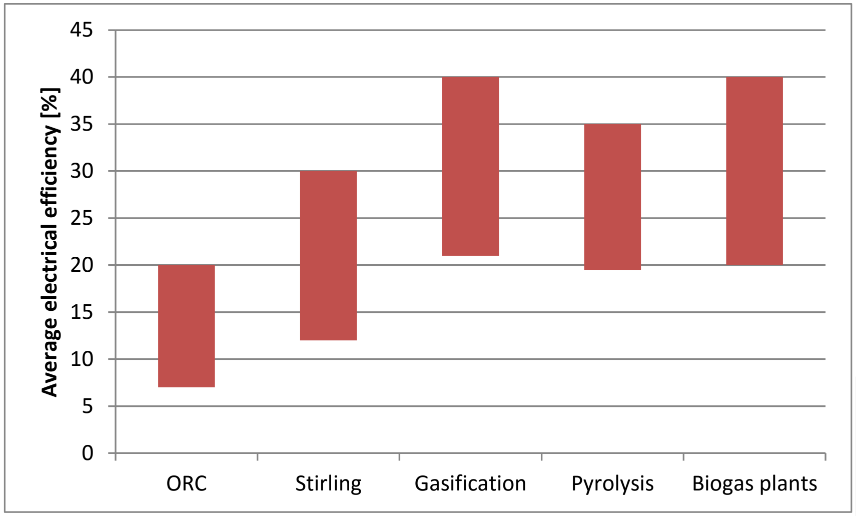
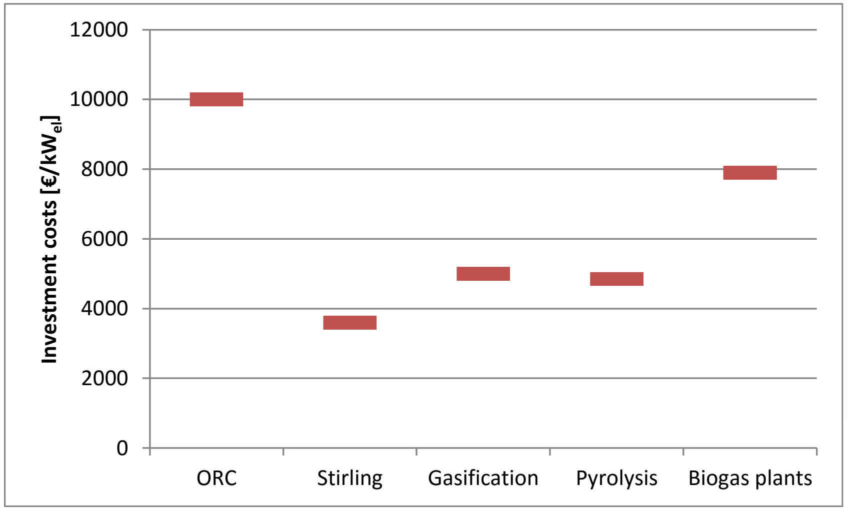
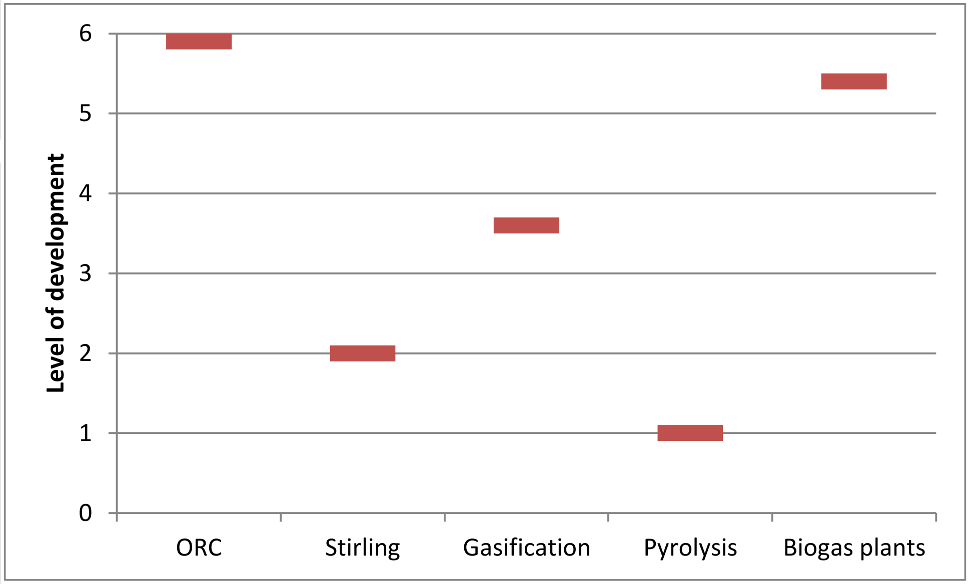
Project objectives



The main target of the project is to improve technological, environmental and economic performance of the existing and newly planned cogeneration plants based on Organic Rankine Cycle (ORC) technology.





*Level of development: 0 – concept, paper to 6 – commercial stage of development

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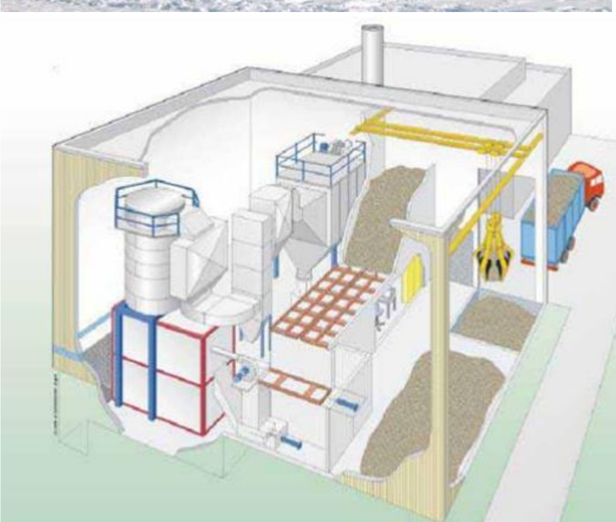
Project objectives

Two existing CHP plants in ORC technology

Holzheizkraftwerk Scharnhauser Park (DE) – district heating

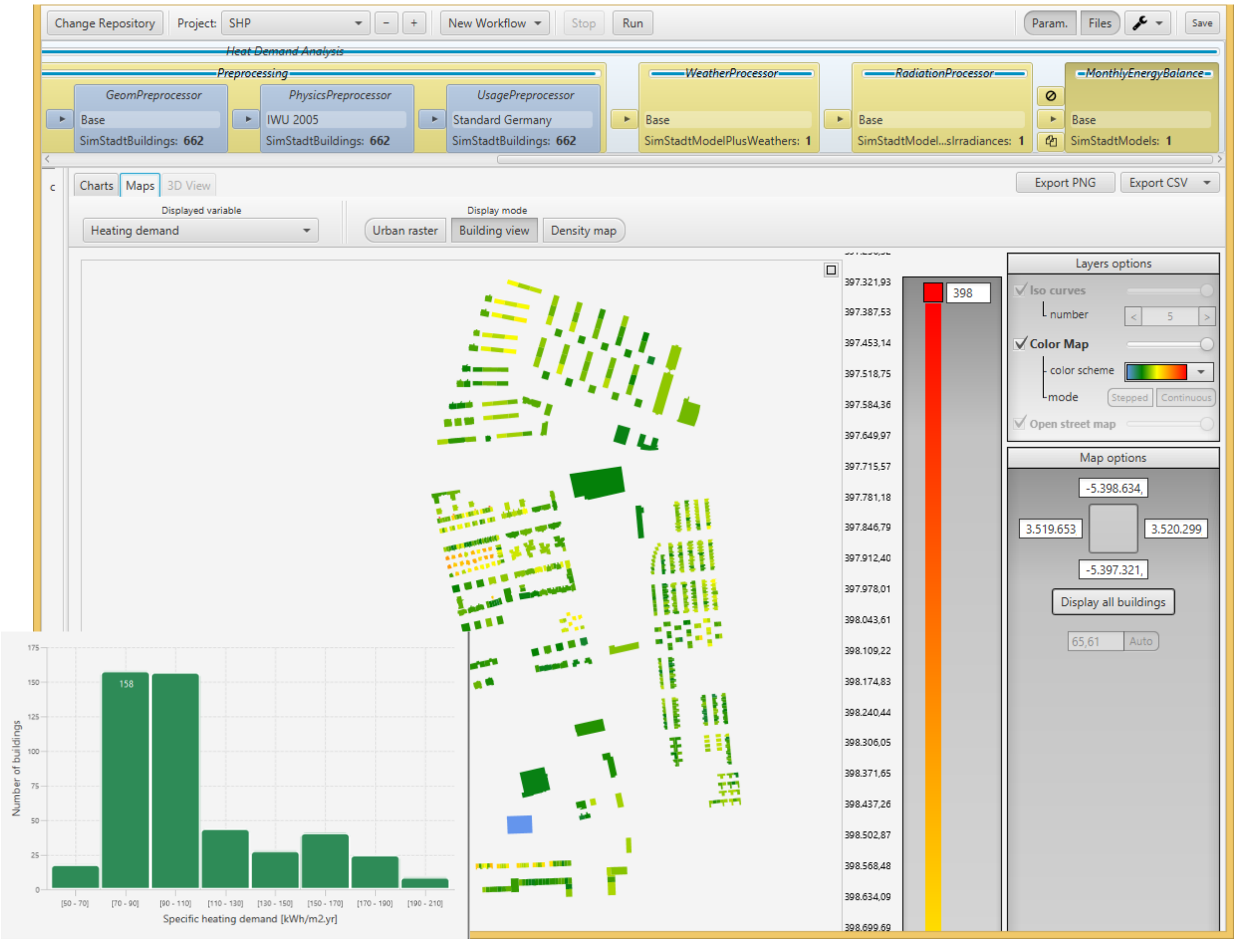


Polish Wood Cluster at Żory (PL) – industrial plant

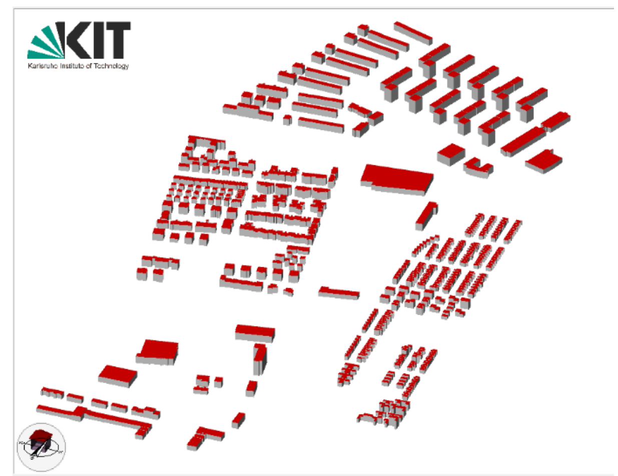
POLISH WOOD CLUSTER

Proposed solution

Urban Energy Simulation Platform Simstadt for heat demand simulation



Automatic heat demand simulation of each building of a district/city based on 3D CityGML city models



3D CityGML model of Scharnhauser Park

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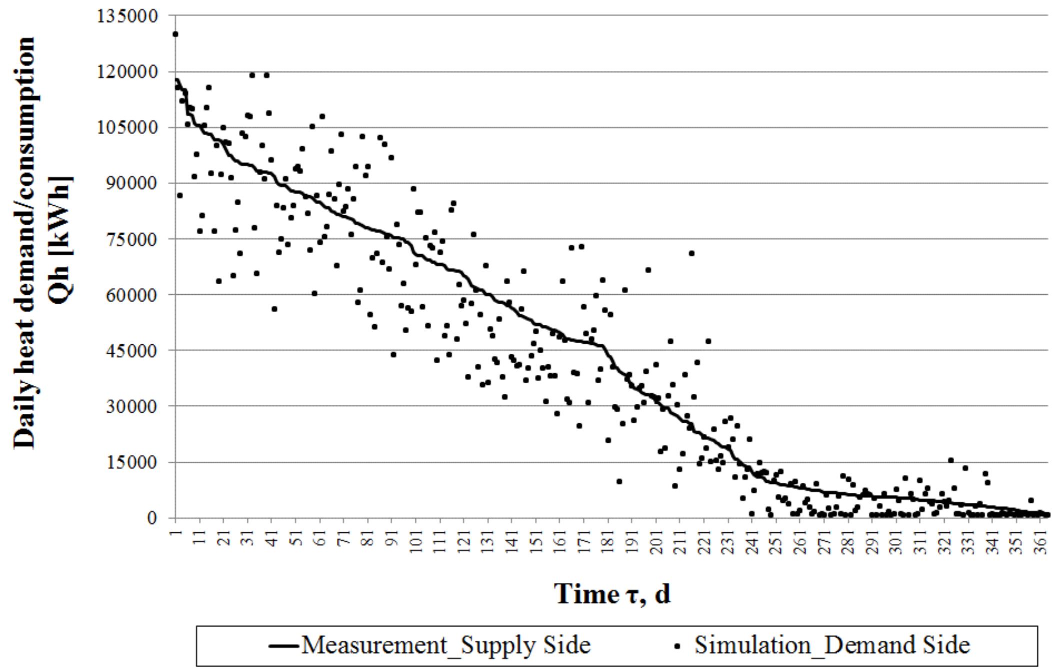
Proposed solution

Load management prediction

SUPPLY SIDE:
ORC biomass plant



DEMAND SIDE:
District heating network (multi-family houses, row houses, etc.)

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Proposed solution

Development of software, models and simulation tools

Development of hardware

COLLABORATIVE, SYNERGETIC APPROACH

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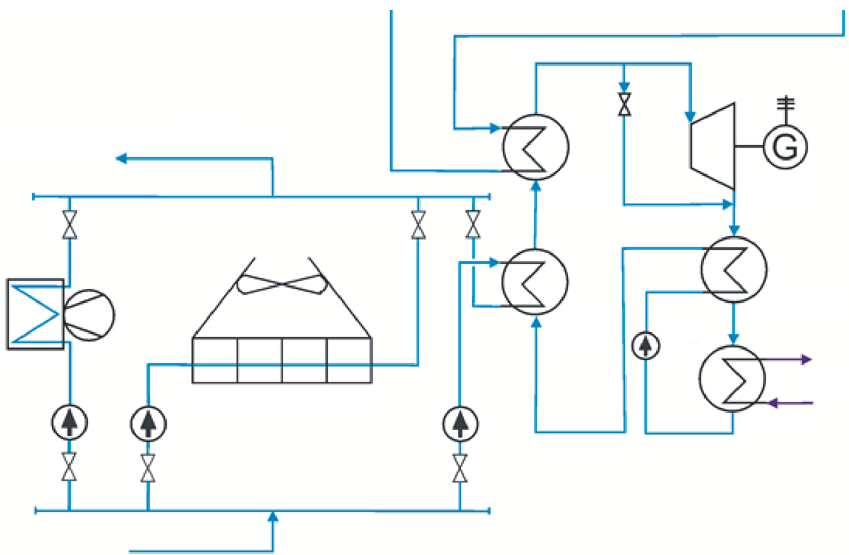
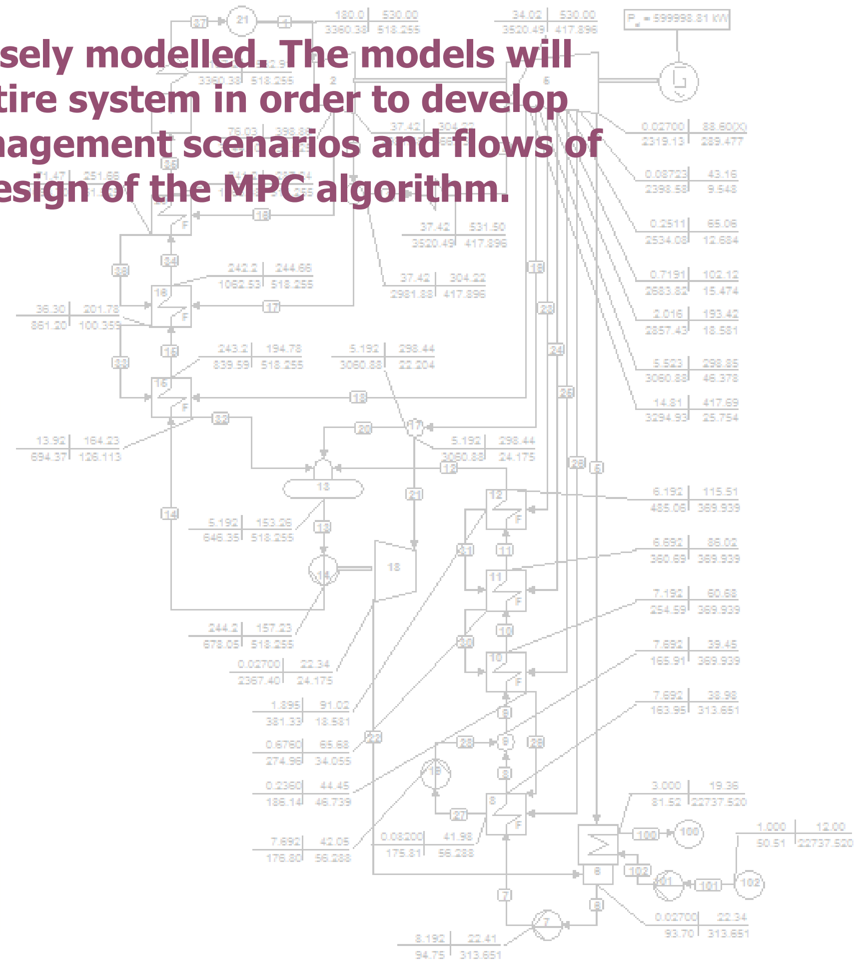
Proposed solution

Development of software, models and simulation tools

- ✓ **Each component of the process will be precisely modelled. The models will be used to examine the behaviour of the entire system in order to develop proper production programmes, energy management scenarios and flows of fluids. The model will be also used for the design of the MPC algorithm.**





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Proposed solution

Development of hardware

- ✓ **An innovative sensor system for continuous control of fuel parameters will be developed. In order to test and verify the performance of the hardware components will be installed at the cogeneration plant Scharnhauser Park.**

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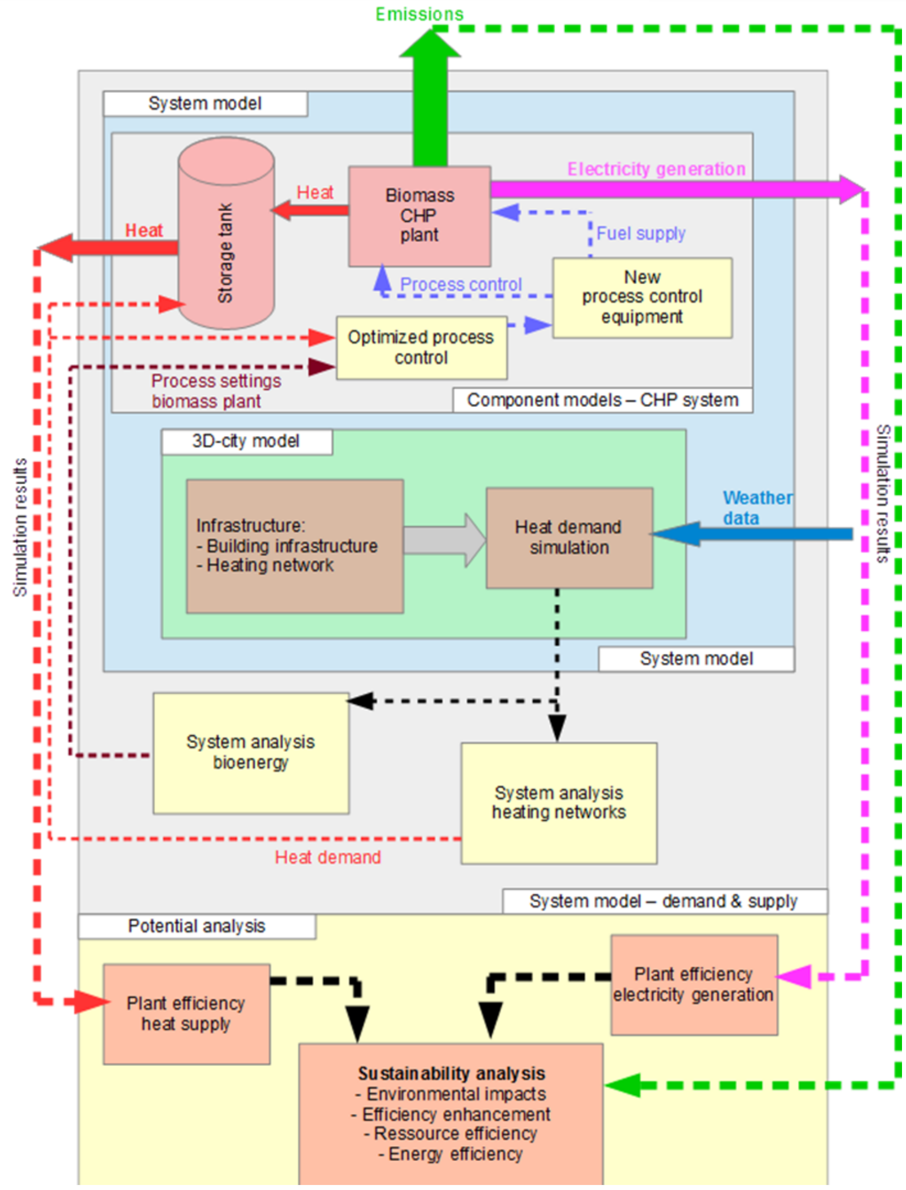
Proposed solution



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Work plan and implementation concepts

WP 1 – Data acquisition and analysis
(Partners: HFT, SUT, ARP, Proen)

WP 2 – System inventory and development of assumptions
(Partners SUT, APOS, Proen, ARP, HFT)

WP 3 – Process identification – Biomass CHP
(Partners: Biop, SUT, HFT, ARP)

WP 4 – Load modelling and management
(Partners: HFT, ARP, APOS, SUT, Proen)

WP 5 – Development of predictive control concept
(Partners: APOS, BIOP, SUT, HFT, ARP, Proen)

WP 6 – Preparation for product implementation
(Partners: APOS, Proen, BIOP, ARP, SUT, HFT)

WP 7 – Sustainability and market potential analysis
(Partners: HFT, SUT, APOS, BIOP, ARP)

Work plan and implementation concepts

WORKPACKAGES		2015 Jahr 1 Q1	2015 Jahr 1 Q2	2015 Jahr 1 Q3	2015 Jahr 1 Q4	2016 Jahr 2 Q1	2016 Jahr 2 Q2	2016 Jahr 2 Q3	2016 Jahr 2 Q4	2017 Jahr 3 Q1	2017 Jahr 3 Q2	2017 Jahr 3 Q3	2017 Jahr 3 Q4	Total working time [pm]
WP 1	Data analysis	4,5	3,5	3,5	2,5	-	-	-	-	-	-	-	-	14,00
WP 2	System inventory	2,5	2,5	4,0	1,5	-	-	-	-	-	-	-	-	10,50
WP 3	Process identification	-	-	-	3,0	4,5	3,5	3,0	3,0	3,0	-	-	-	20,00
WP 4	Load management	-	-	5,0	6,0	5,0	5,0	1,0	1,0	3,0	2,0	-		28,00
WP 5	Predicitive control concept	-	-	-	-	-	-	-	-	6,0	5,0	4,0	-	15,00
WP 6	Product implementation	-	-	0,5	1,5	-	2,0	3,0	1,0	-	3,0	3,0	3,0	17,00
WP 7	Sustainability and market potential	-	-	-	-	2,0	2,0	2,0	2,0	2,0	6,5	6,5	6,0	29,00
														133,50

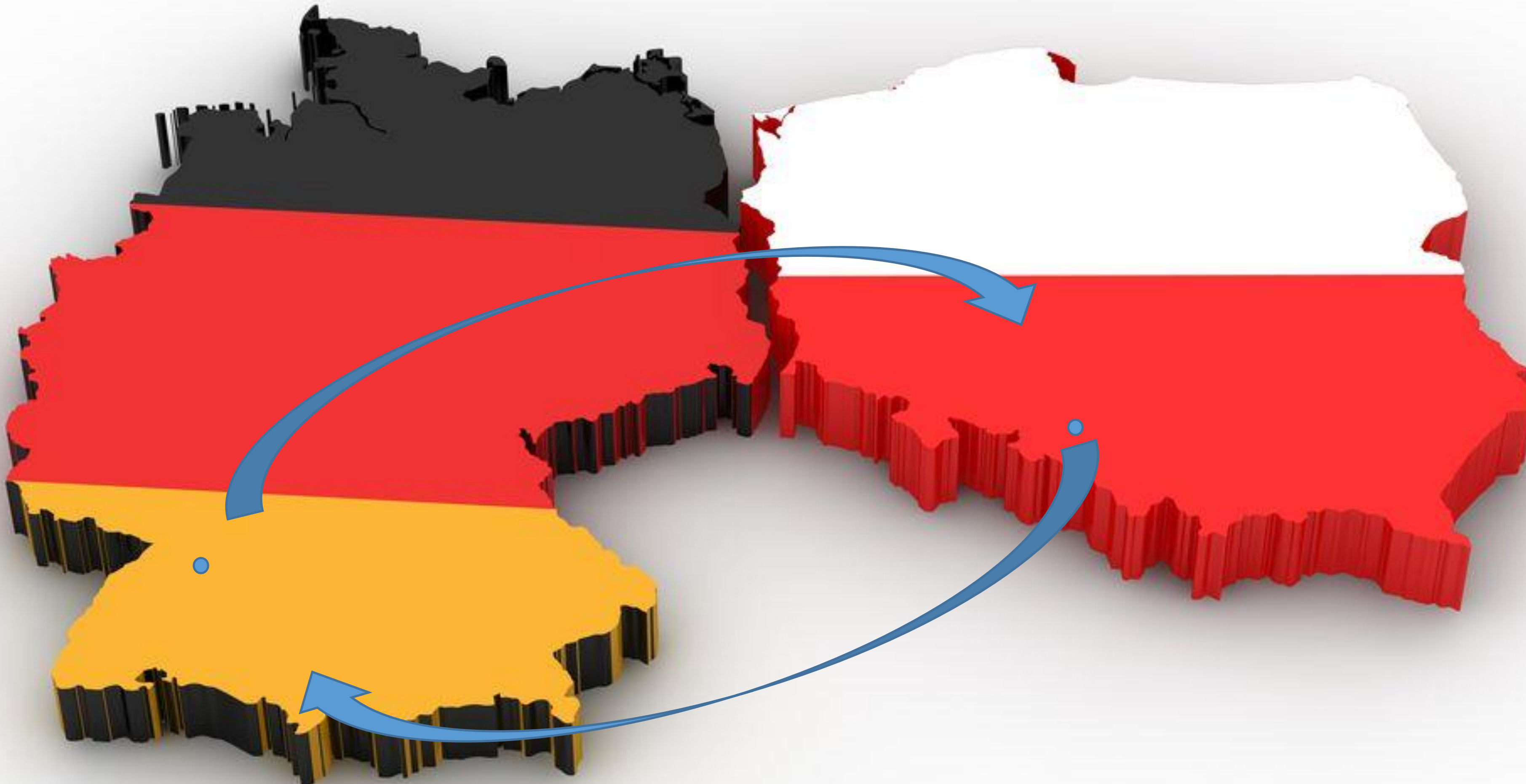
MILESTONES

- Milestone I: Data analysis accomplished
- Milestone II: System described
- Milestone III: Mathematical modeling finished
- Milestone IV: Load management scenarios analysed
- Milestone V: Predictive control system developed
- Milestone VI: Product implementation prepared
- Milestone VII: Market potential and sustainability analysis accomplished

* The yellow marked numbers are corresponding to quarters

IntBioCHP

German-Polish co-operation



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German-Polish co-operation

Complementary consortium

Hochschule für Technik Stuttgart – Co-ordinator

Institute of Thermal Technology, Silesian University of Technology

APOS GmbH (Industrial partner)

Biop GmbH Biomass optimisation (Industrial partner)

Agencja Rozwoju Przedsiebiorczosci Sp. z o.o. Żory (Industrial partner)

„Proen“ Gliwice Sp. z o.o. – Project Office (Industrial partner)

IntBioCHP

German-Polish co-operation

Budget : 828,303 EUR; DE: 496,234 EUR; PL: 332,069 EUR

Hochschule für Technik Stuttgart	263,714 €
APOS	125,220 €
Biop-GmbH	107,300 €
Politechnika Śląska; ITC www.itc.polsl.pl	120,691 €
Polish Wood Cluster; ARP Agencja Rozwoju Przedsiębiorczości Sp. z o.o.	113,638 €
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Thank you for your attention

Hochschule für Technik Stuttgart

www.itc.polsl.pl

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