FRAUNHOFER IFF MAGDEBURG

APPLIED RESEARCH FOR ENERGY CONVERSION 2.0

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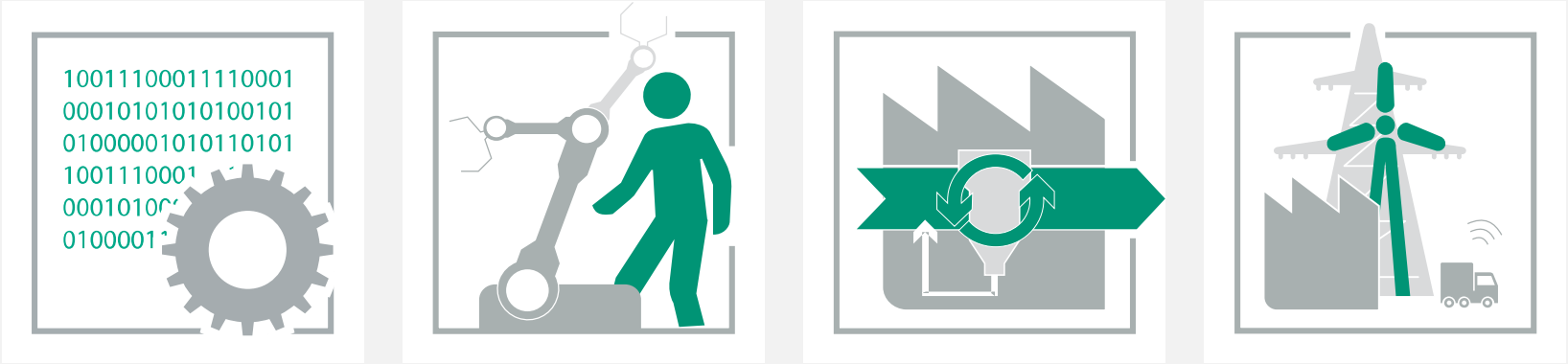
Magdeburg, June 22, 2017



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Efficient Processes and Plants
Our Activities Related to Efficiency and Sustainability

1. **Efficient Energy Conversion**
   - New conversion processes with higher efficiency (gasification, fuel cells)
   - New biomass energy sources (straw, agricultural waste)

2. **Process Optimization with Waste Recovery**
   - Industrial waste recovery (technology development)
   - Waste heat recovery

3. **Efficient Production Processes and Sustainable Energy Supply Systems**
   - Renewable energy use (solar and wind power)
   - Energy source substitution (biogas, syngas)

4. **Efficient Energy Distribution**
   - Combined energy management (electricity, heat, gas, etc.)
   - Integration of energy storages

Efficient Processes and Plants
Process and Plant Component Development

Challenges for the energy industry:
1. Decentralization
2. Efficiency and cost effectiveness
3. Sustainability and environmental protection

Our contribution:
1. Developing technology for distributed, thermochemical energy conversion (broad range of fuel, waste utilization)
2. Implementing distributed conversion processes with high efficiencies (gas production, CHP with ORC, gas engines and turbines, fuel cells)
3. Reducing carbon emissions by using biomass, low-emission combustion processes (compact FBC)


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Efficient Energy Conversion
Distributed Biomass Power Plants

Energy Supply for Industry and Municipalities

? Development and engineering of sustainable energy supply solutions

☑ Fully automated units that recover heat from biological renewables to supply heat variably and to produce electricity efficiently
(e.g. Organic Rankine Cycle)

CO_2 emissions are reduced ↓ as much as 85%	Energy delivery costs are reduced ↓ as much as 50%

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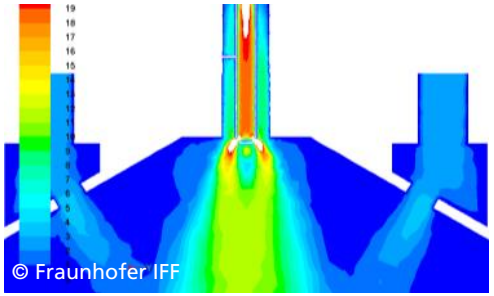
Efficient Production Processes

Plants that Recover Heat from Manufacturing Waste



Companies in the metal coating industry

?

Resource efficient manufacturing chains

☑

Plant that recovers heat from non-recyclable, fine-grained production waste, e.g. coating powder, to supply heat to heat treatment kilns or to produce electricity

Waste disposal costs ↓ 100%	Energy supply costs ↓ 25%

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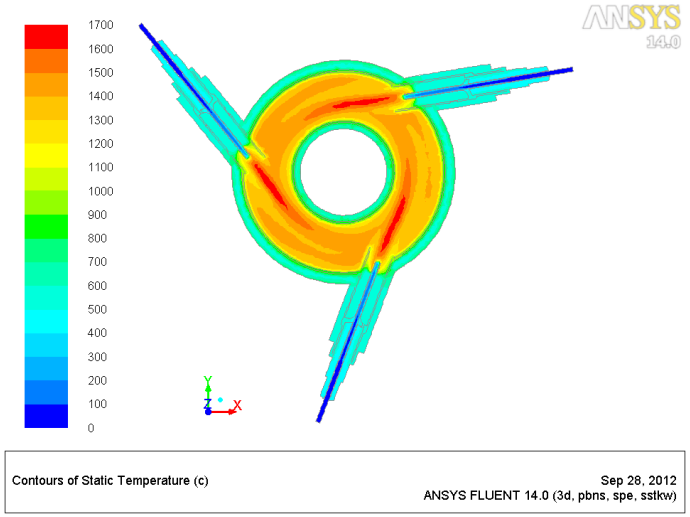
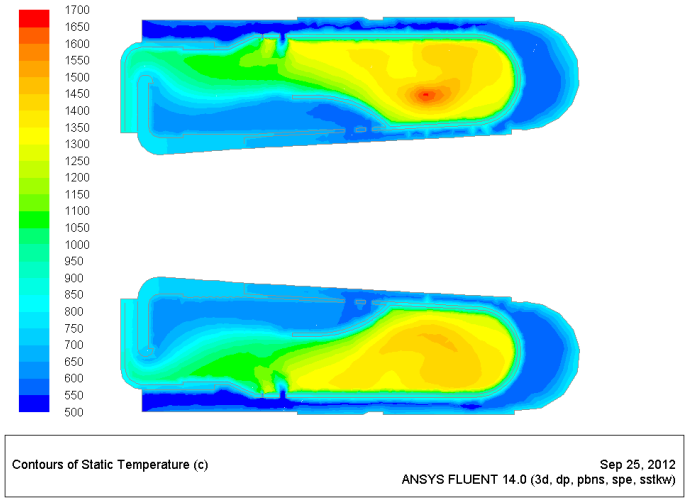
Efficient Energy Conversion
Gas Microturbines for Biofuels

- Gas microturbines with electrical efficiencies > 30%
- Utilization of syngas from biomass and waste
- Ceramic components
  - resist fouling (syngas fuel)
  - increase combustion temperatures (higher efficiency)
- The combustion chamber and turbine rotor were optimized with CFD simulations





Waste Recovery
Distributed Waste Power Plants

Manufacturing Processes that Produce Waste with High Heating Values

? Resource efficient manufacturing chains with closed-loop energy and resource cycles

☑ Low emission units that recover heat from manufacturing waste (e.g. scrap from automotive panels, wind turbine parts) to supply heat and electricity

Waste disposal costs are reduced
↓ as much as 100%

Energy delivery costs are reduced
↓ as much as 100%

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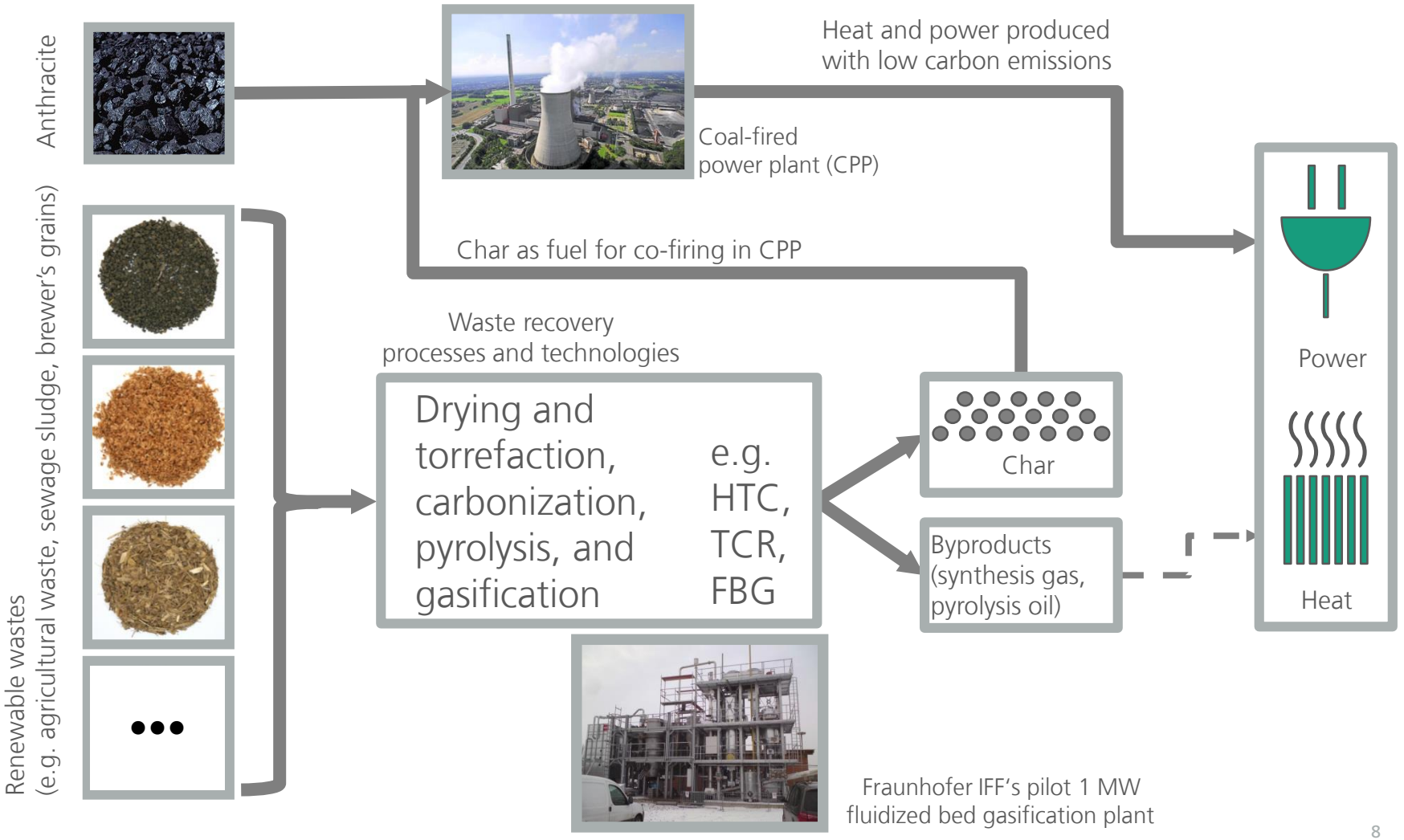
Sustainable Energy Supply and Waste Recovery

LCPP Low-Carbon Power Production



Efficient Processes and Plants

Systems Integration of New Processes and Plants

Challenges for the energy industry:
1. Responsiveness
2. Digitization
3. New business models

Our contribution:
1. Developing new production and supply structures, simulating the operation of complex systems and plants, integrating energy storage systems
2. Analyzing and managing operating data, developing soft sensors
3. Managing energy dynamically, knowledge management, creating new infrastructure services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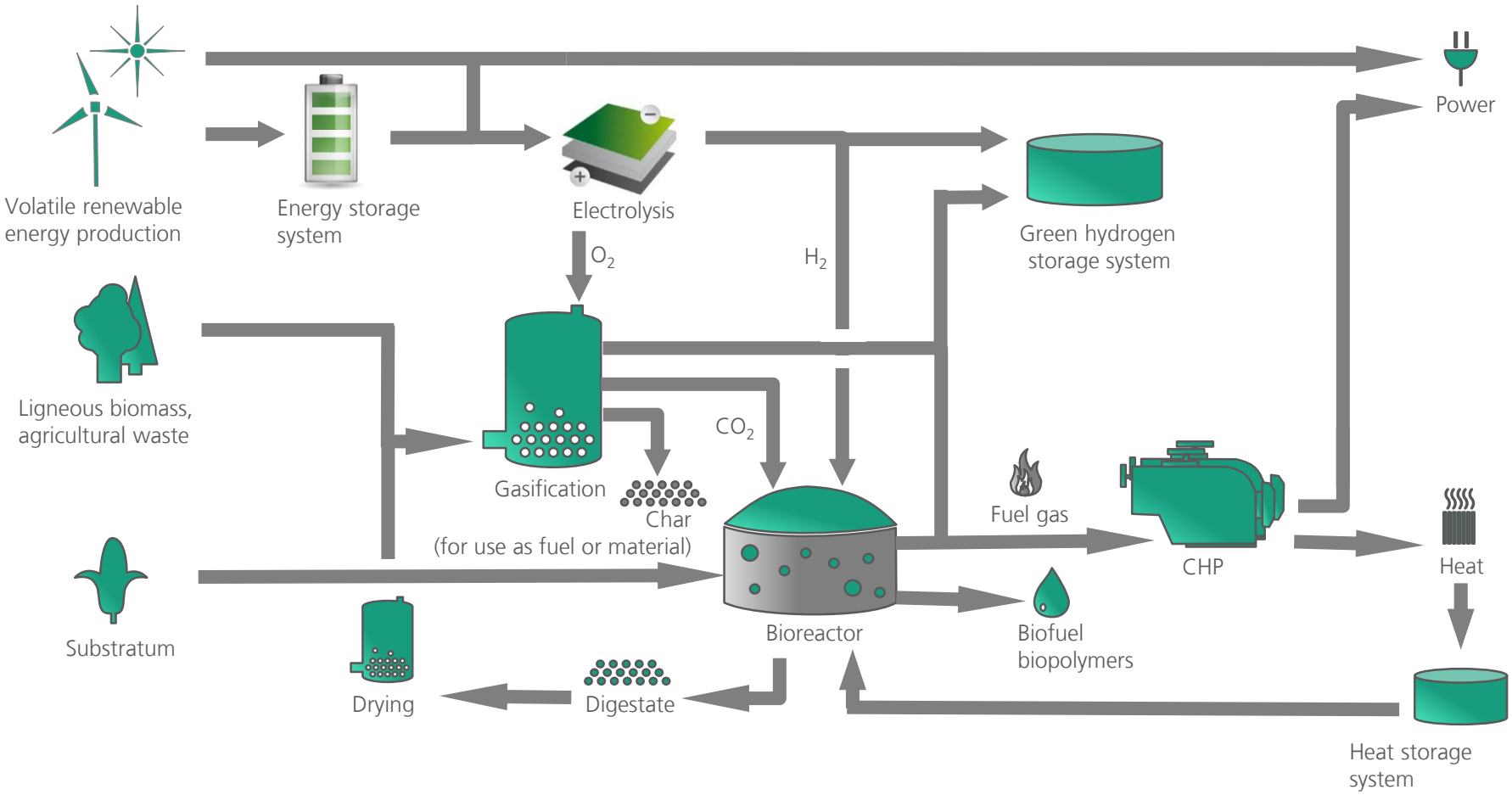
Energy Supply and Production Systems
Sustainable Structures in Rural Regions



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Efficient Production Processes

Plants that Recover CO_2 from Flue Gas

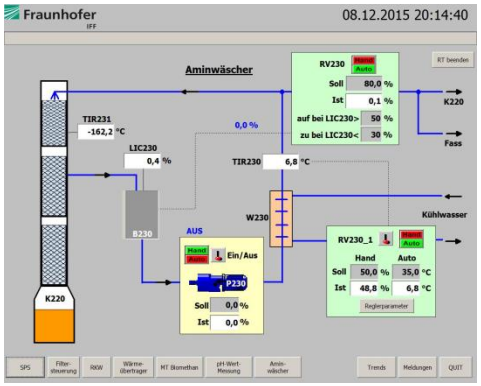
Food Industry with Greenhouse Production

Energy supply with a closed-loop CO_2 cycle

Engineered solutions for biomass-fired CHP and CO_2 separation

CO_2 emissions are reduced
↓ 30% (secondary cycle)

CO_2 supply costs are cut
↓ 25% (without storage losses)



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