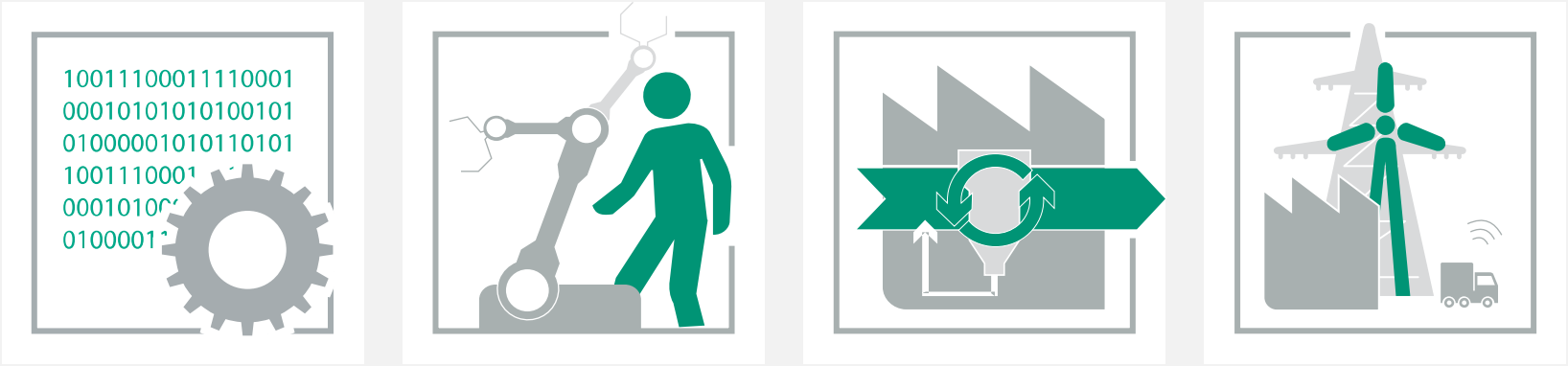
SUBSTITUTION OF NATURAL GAS WITH PRODUCT GAS IN A MICROTURBINE POWER PLANT

Andreas Lehwald

Vienna, June 3, 2015

23rd European Biomass Conference & Exhibition



Process and Plant Engineering Business Unit
Fraunhofer Institute for Factory Operation and Automation IFF
Magdeburg, Germany

OVERVIEW

1. Fraunhofer IFF
2. Introduction
3. Objectives
4. Experimental Setup
5. Results
6. Summary

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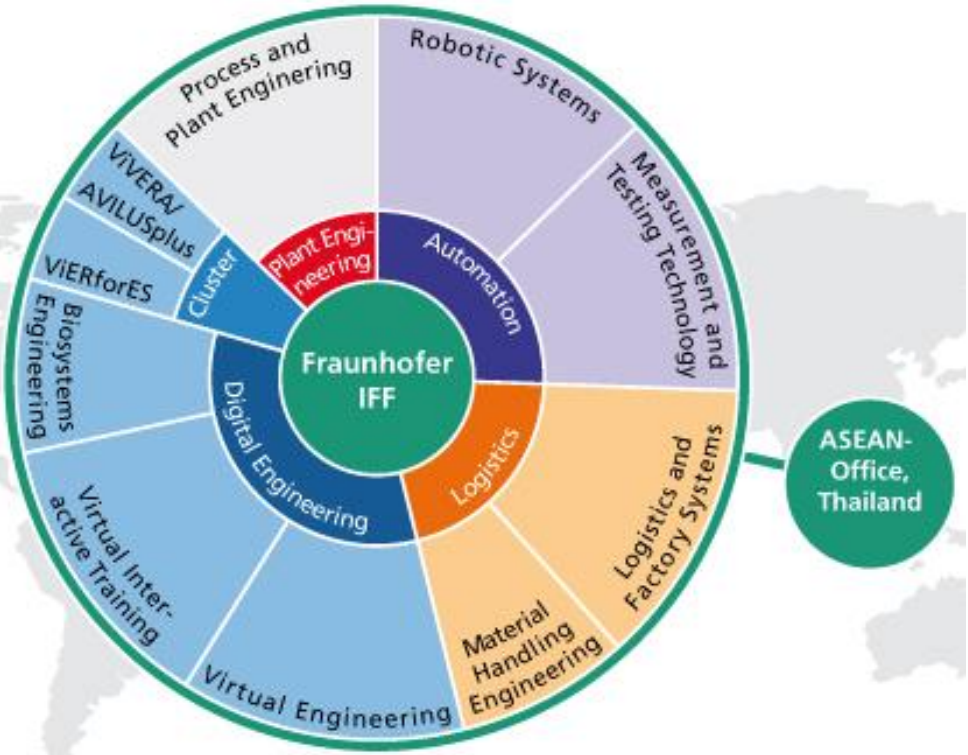

Univ.-Prof. Dr.-Ing. Michael Schenk

Fraunhofer IFF

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Process and Plant Engineering Business Unit

Biomass

Waste recycling

Straw

Digestate

Wood

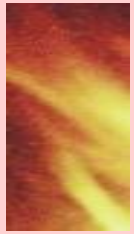
Sewage sludge

Bone meal

Waste

Combustion
Gasification
Gas treatment
Energy conversion

Heat
&
Electricity



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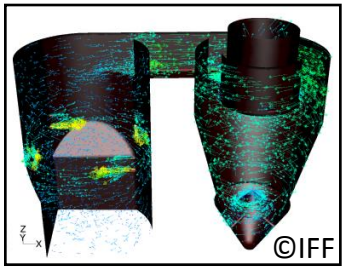
Process and Plant Engineering Business Unit

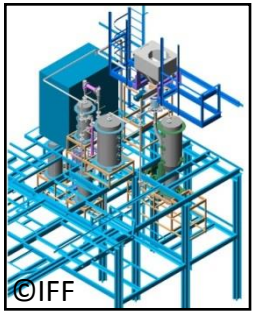
We cover the entire process development chain.

Lab

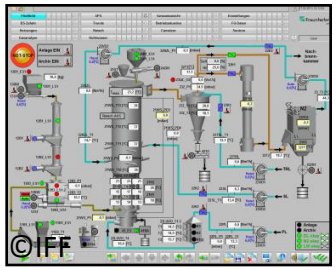
Process Design (Simulation)



Piloting



Process Automation



Commissioning and Training

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Introduction
CHP Plants

- CHP plants are primarily used for distributed supply of heat and power.
- CHP plants are usually powered by natural gas or biogas.
- CHP plants operate with piston engines but microturbines constitute an alternative.

Introduction

Advantages of Microturbines, Especially in High-Temperature Applications

- Simple design
- Good exhaust quality, low pollutant emissions due to continuous combustion
- Low maintenance costs
- Flexibility of fuels
- High tolerances with regard to gas quality, gas composition, and fluctuations in heating value

OVERVIEW

Objectives

- Utilization of microturbines to burn gas with low heating values to produce power and heat
- Production of product gas from biomass or waste, e. g. gasification of wood waste
- Reduction of natural gas and thus fossil fuel consumption

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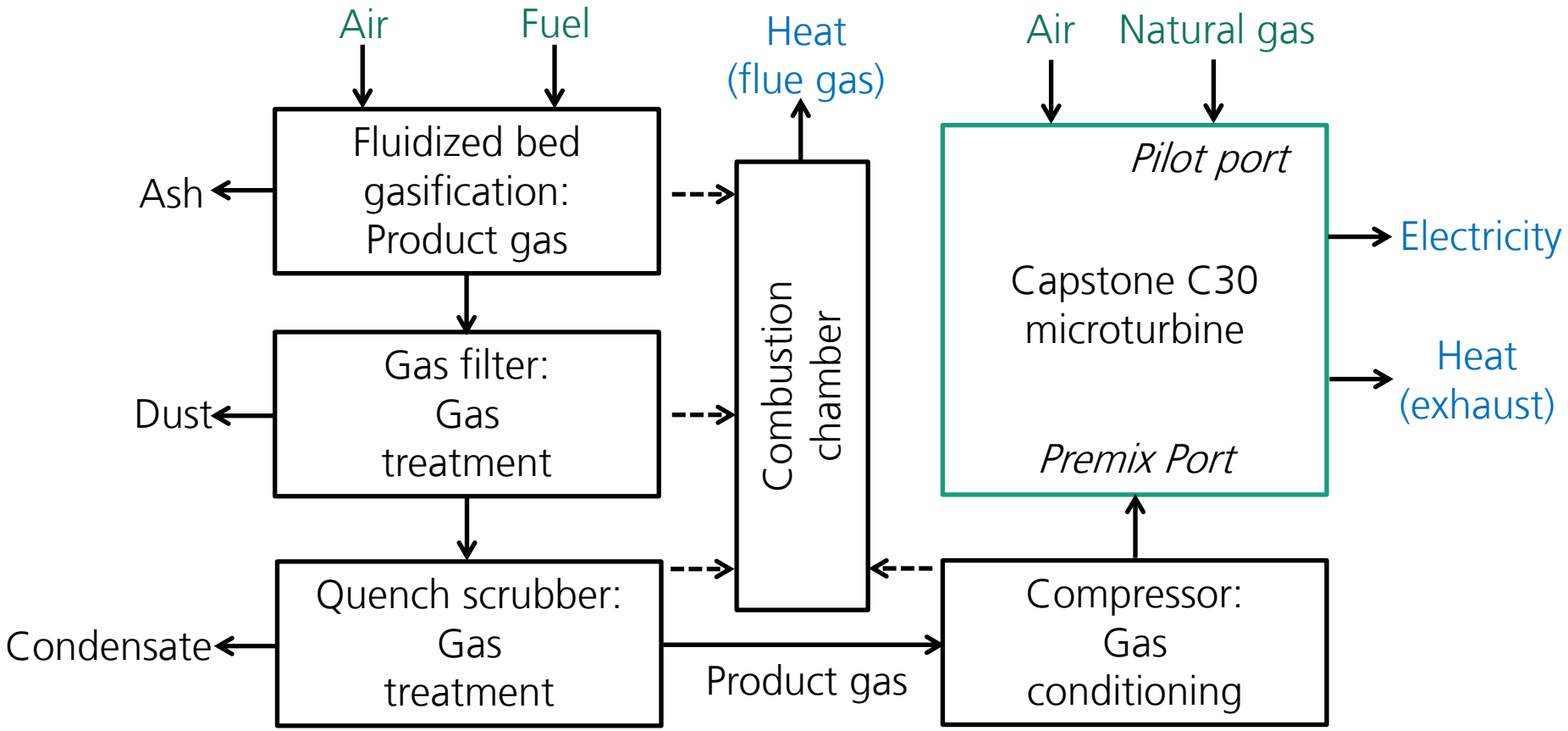
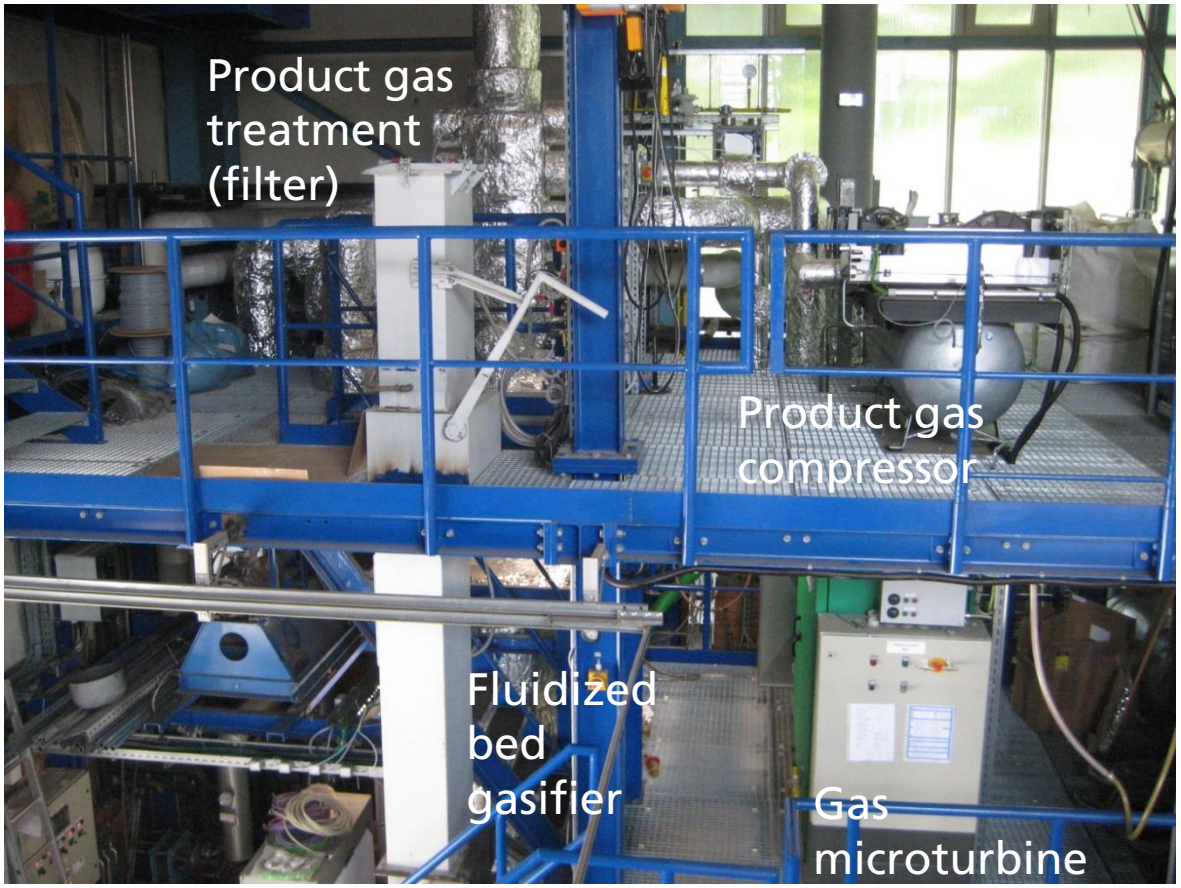
Experimental Setup

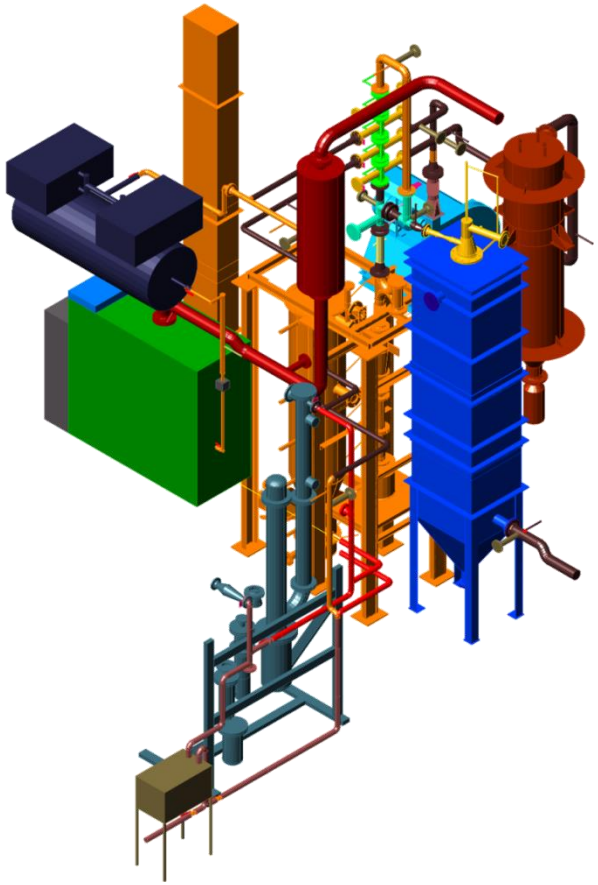
Gas Production, Treatment and Utilization (Schematic)



Experimental Setup

Gas Production, Treatment and Utilization (Test System)





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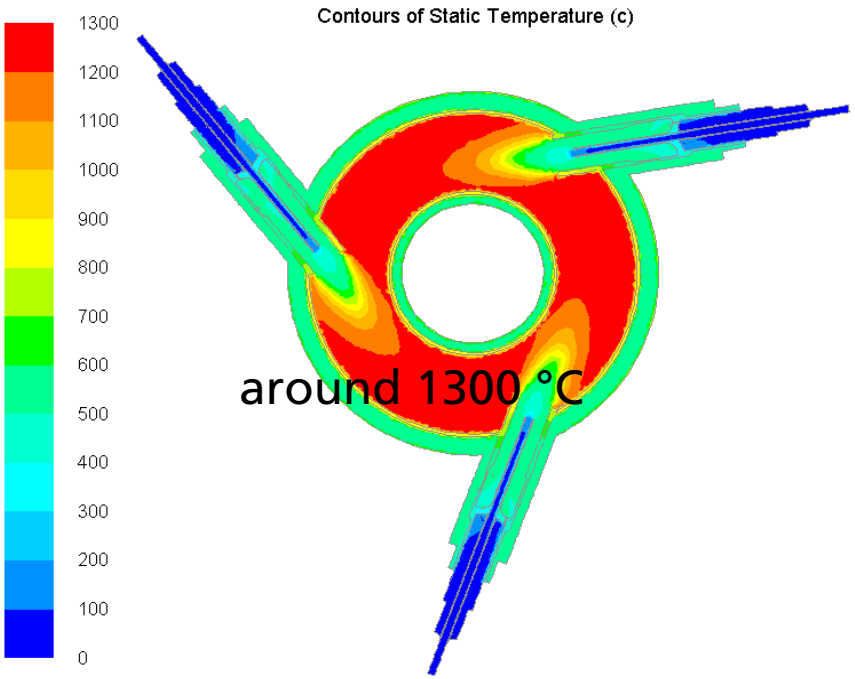
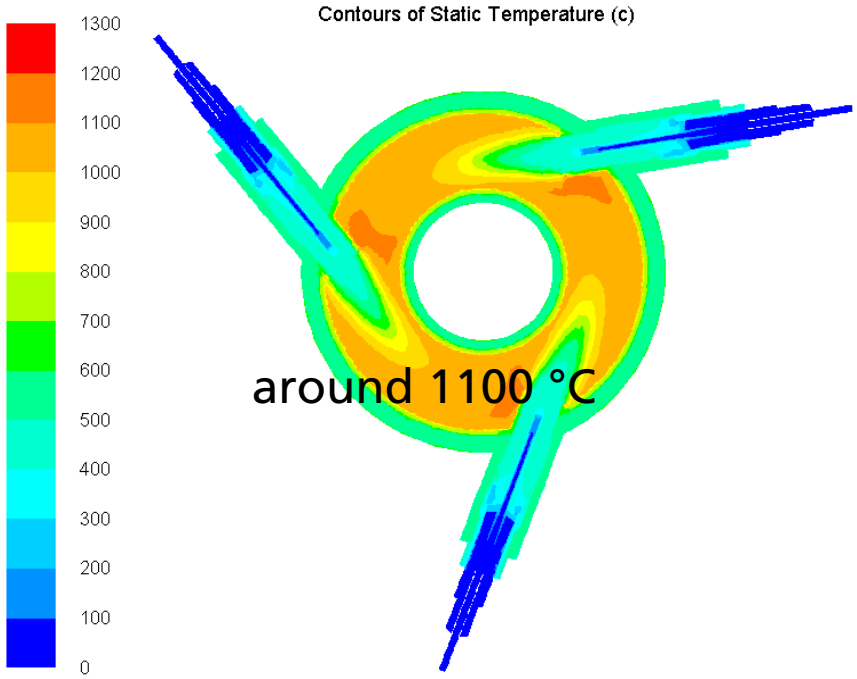
Results
Simulation

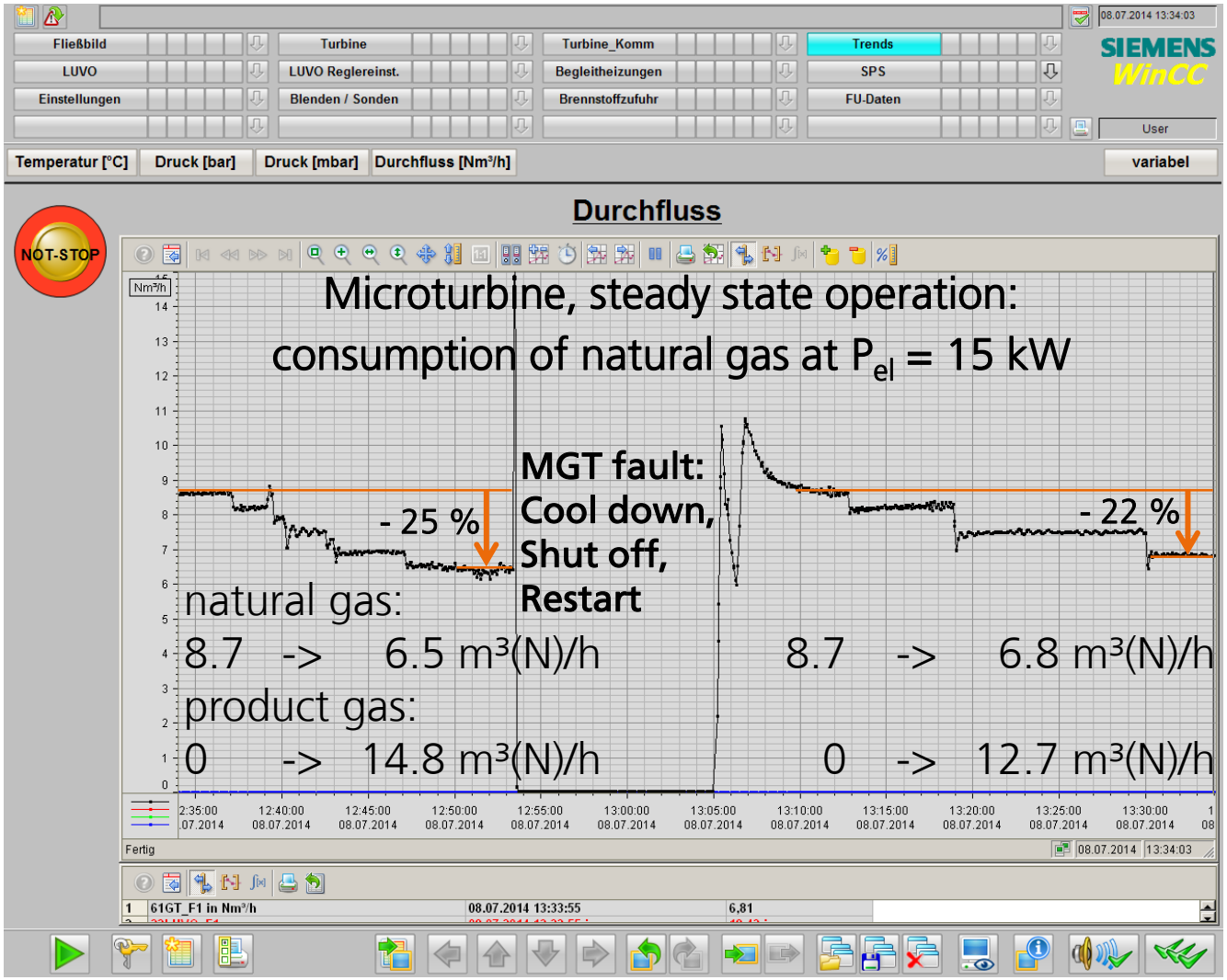




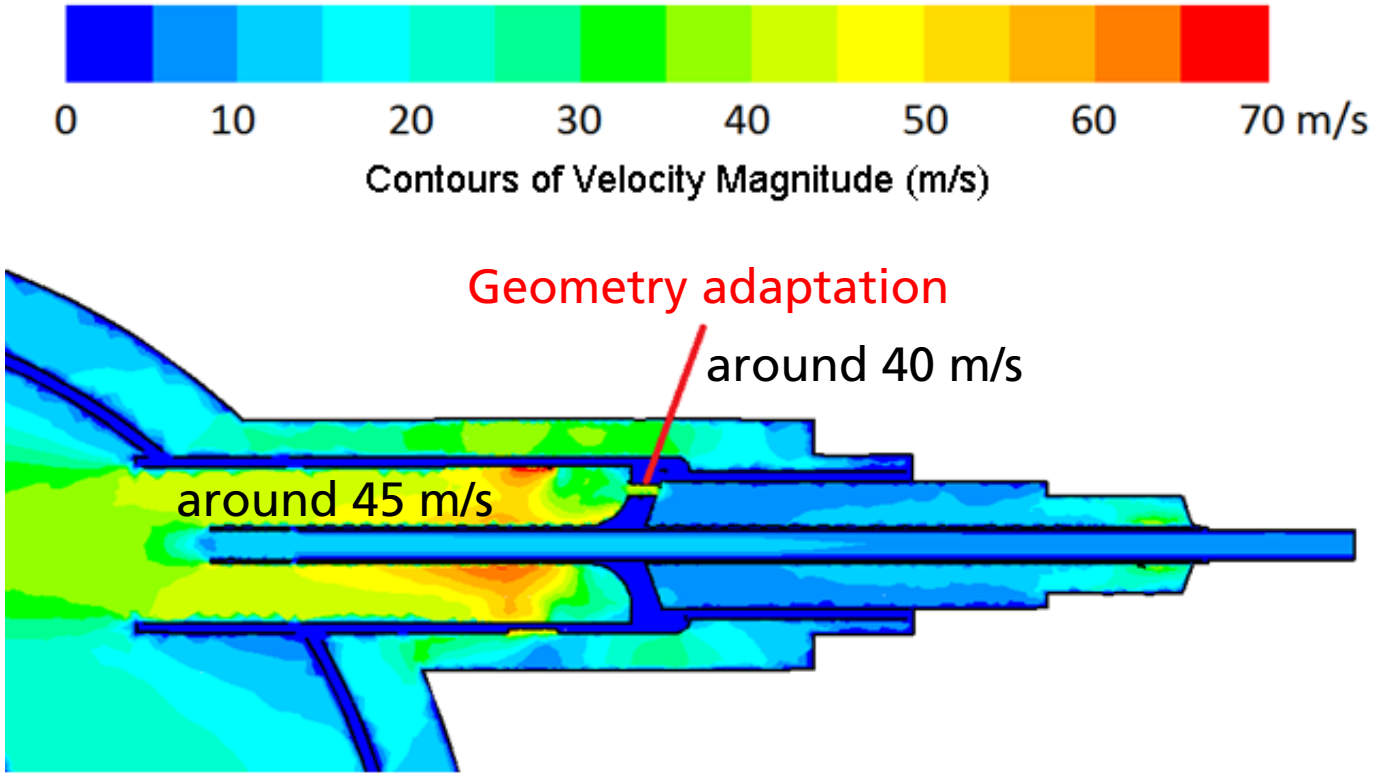
- Temperature distribution in the combustion chamber during the combustion of natural gas (left) and of product gas (right)

Results

Experiment



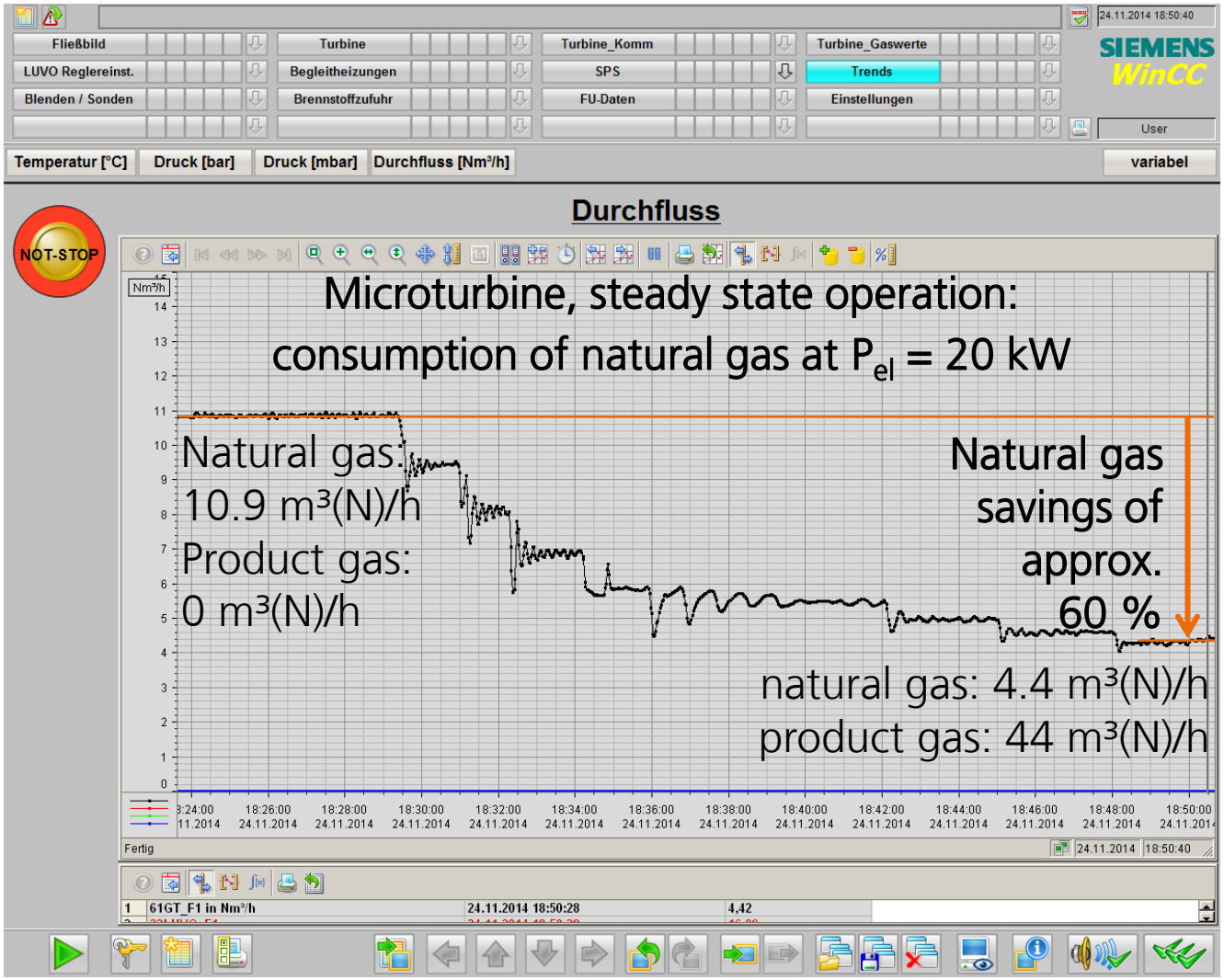
Results
Simulation



- Flow velocity in the injector with modified nozzle holes during the combustion of product gas

Results

Experiment



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Summary / Outlook

- The product gas is suitable for use in the turbine.
- Injector geometry must be modified.
- We are trying to achieve a substitution rate of 100% product gas.
- The current objective of our research is the development and testing of a high-performance ceramic turbine rotor that increases turbine efficiency by increasing the turbine inlet temperature.

Thank you for your attention!

Acknowledgments:
Dr. Matthias Gohla
Dr. Wolfram Heineken

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Fraunhofer IFF
at the 23rd European Biomass Conference & Exhibition

Poster Presentations

"Fluidized-Bed Combustion of Biological Waste: Ash Deformation Temperatures"
Room: LEHAR 2-3-4, yesterday

"Using Fluidized Bed Combustion and Gasification to Recover Energy from Agricultural Waste"
Room: LEHAR 2-3-4, Session: 1CV.3, today at 3:15 p.m.

Exhibit

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