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GRATEADVANCE

# GrateAdvance national part – Austrian project

Advanced adjustable grate solutions for future fuel flexible biomass combustion technologies

Central European Biomass Conference Graz, 20.01.2017

ERA-NET Bioenergy

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# Motivation

Energetic exploitation of alternative fuels becomes of interest

Varying fuel properties influence combustion process


| Fuel | C | H | N | Ash | NCV |
|---|---|---|---|---|---|
| Spruce (A1 ISO) | 50.2 | 6.2 | 0.10 | 0.4 | 18.8 |
| Sida hermaphrodita | 47.8 | 6.1 | 0.26 | 2.6 | 17.5 |
| Miscanthus | 47.6 | 5.8 | 0.24 | 3.2 | 17.9 |
| Willow SRC | 49.4 | 6.1 | 0.28 | 1.0 | 18.7 |
| Pure bark pellets | 51.3 | 5.7 | 0.34 | 3.9 | 18.9 |
| Wineyard pruning | 48.6 | 5.9 | 0.39 | 2.7 | 18.1 |
| DDGS | 47.9 | 6.4 | 5.18 | 6.2 | 19.3 |
| Corn cops and hay | 46.9 | 5.9 | 0.55 | 2.9 | 17.2 |

*From BE2020 Fuel database (Projects AshMelT, SIDecA):*



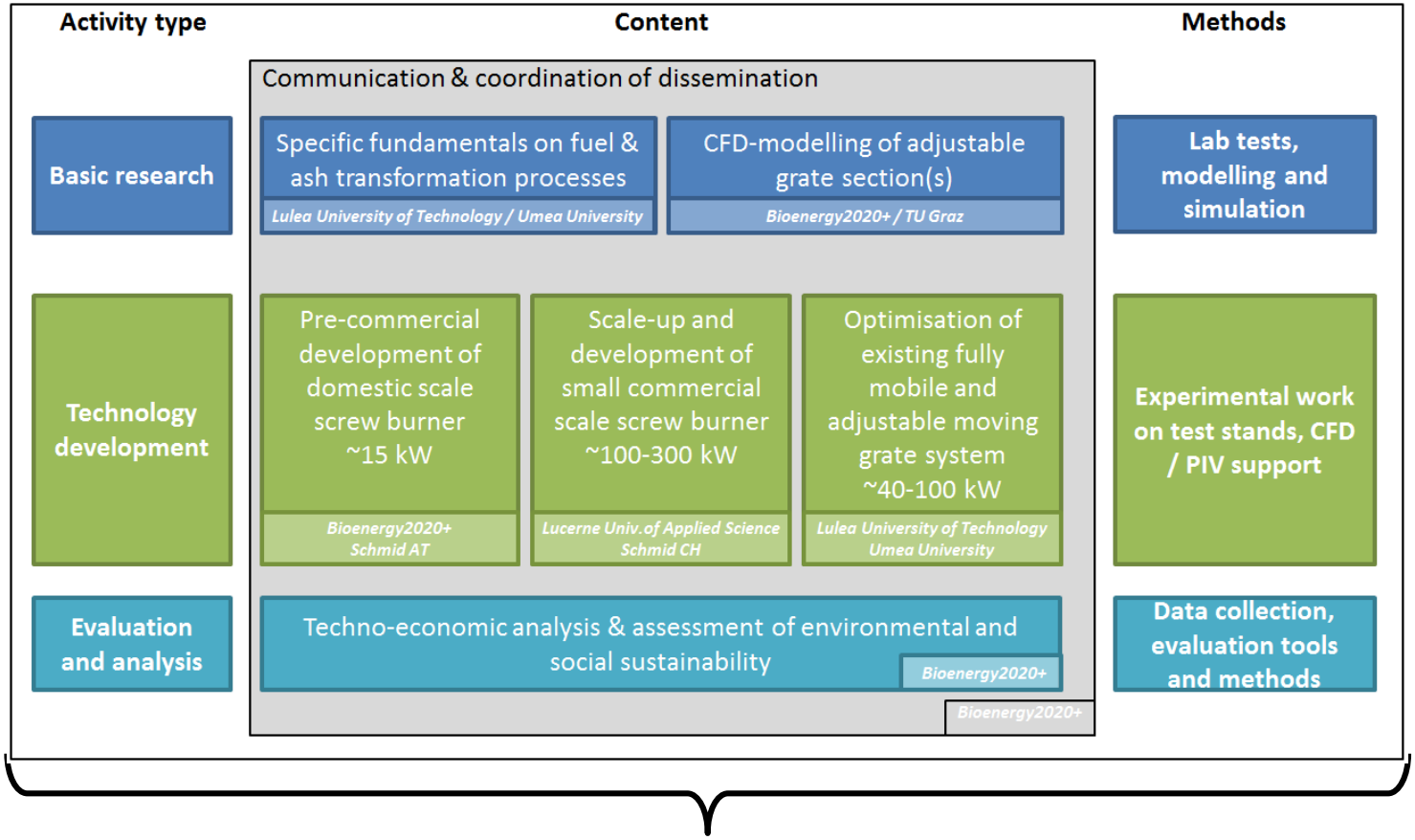
*L.L. Baxter: Ash Deposition during Biomass and Coal Combustion: A Mechanistic Approach. Biomass and Bioenergy 4 (2) (1993) 85 - 102*

# Problem description

- Current situation:
  - Combustion appliances are optimized for A1 class pellets
  - Increased emission release and slag formation
- Required / crucial factors:
  - Low temperatures in the fuel bed
  - Well-directed air supply
- Influencing factors:
  - Residence time of fuel on the grate
  - Structure of the fuel bed


*Agglomerated ash, straw pellet fuel (Foto: BE2020, Project: AshMelT)*

# GrateAdvance project concept




Development of **next generation** small scale biomass burner and boiler systems

# Objectives

**Overall objectives:**

- Improve the understanding and modelling of the solid fuel conversion in the fuel bed, focus on
  - ash-related compounds
  - PM release
- Suitable design and operation parameters for flexible grate technologies

**Objectives of the Austrian part:**

- CFD modelling of grate section
- Further development of patented screw burner technology
- Development and implementation of novel fuel-flexible control concept

# Expected results

**Adaption of conditions in the combustion zone**

Minimize emissions and slagging problems

Basis for a new generation of biomass boilers

**Novel control concept**

Adjust to relevant fuel properties

Optimal combustion conditions

**Technologies will meet emission requirements even for lower fuel qualities**

# Approach

**Lab tests for gaining basic knowledge (ash)**

**Extension of existing CFD model**

Basic operational concept

Optimisation

Validation

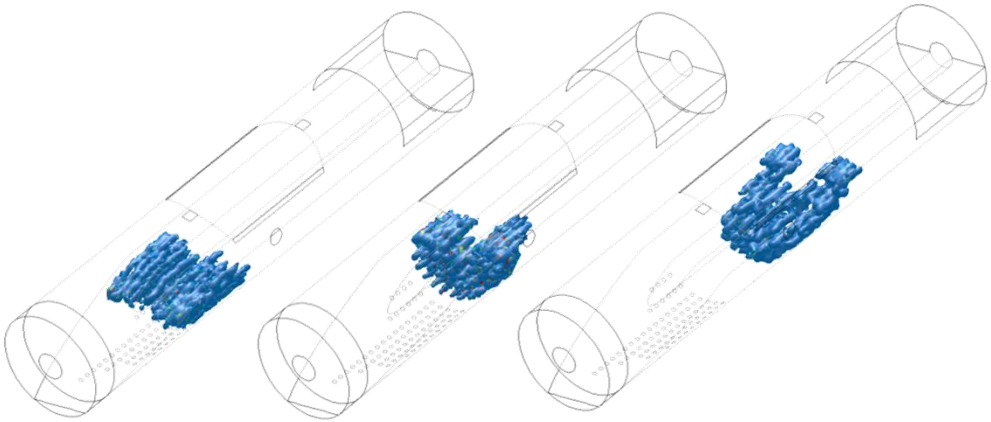
**Further development of technology**

Identification of starting point / Optimisation

**Practical combustion experiments**

# Current state 1: CFD-modelling of adjustable grate section(s)

- In-house 3D CFD packed bed model adapted
- Simulation of the screw burner
- Ongoing: Extension of combustion model regarding
  - $NO_x$ release precursors
  - Ash forming elements

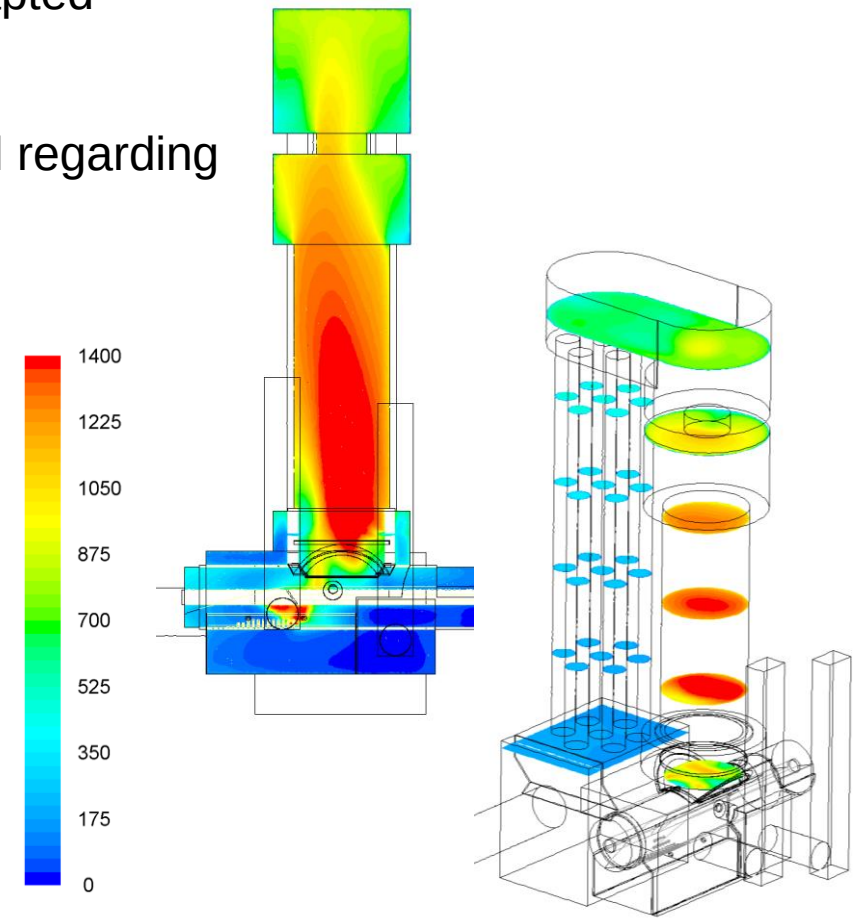


Char oxidation

Pyrolysis

Drying

*Position of thermal conversion sub-processes in the fuel bed*




*Contours of flue gas temperature (°C)*



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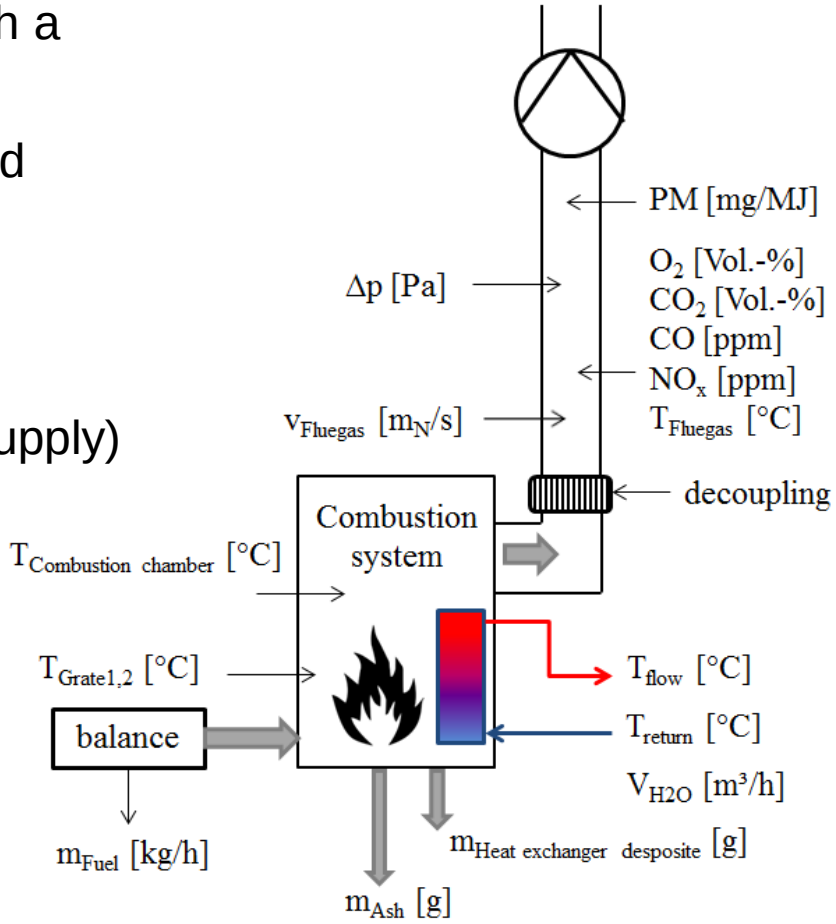
# Current state 2: Combustion tests with prototype

Small scale boiler (30 kW) equipped with a basic control system

- Conduction of tests with different load settings
- Utilization of 10 different test fuels

→ Identification of fuel specific setting requirements (fuel feed, air supply)

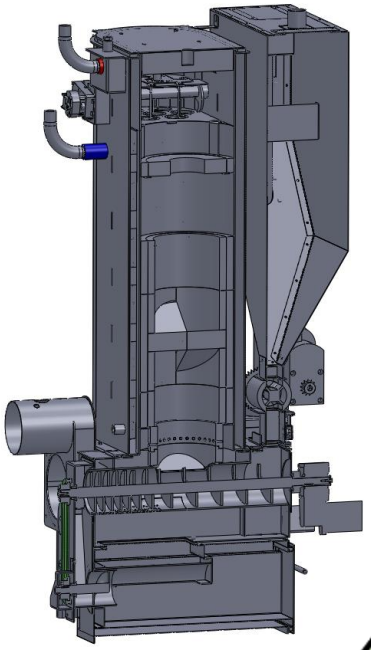



*Experimental setup of combustion appliance (Figure: BE2020)*

## → Callenge:

- Defining control loops
- Implementation of control system

# Outlook – Up-coming project work



Combustion tests with prototype

Data evaluation

Extension
of CFD model

Implementation
of control system

**Up-Scale
300 kW**

# Acknowledgement

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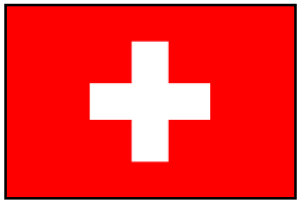
- BIOENERGY2020+ GmbH
- TU Graz Institute of thermal engineering
- Schmid Energy Solutions (Austria)



- Verenum
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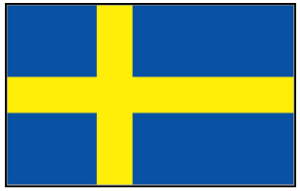

- Lulea University of Technology
- Umea University

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# Thank you for your attention!

Sabine Feldmeier
BIOENERGY 2020+ GmbH
Gewerbepark Haag 3
A 3250 Wieselburg-Land
+43 (0) 7416 52238-68
Sabine.feldmeier@bioenergy2020.eu

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