

BIOENERGY INNOVATION CENTRE

CenBio

www.cenbio.no

Renewable Energy Research Conference,
Trondheim, 2010-06-07

Lars Sørum
Centre Coordinator

Bioenergy – The biggest contributor of renewable energy in the world today!

► The world:

- More than $\frac{3}{4}$ of all renewable energy is bioenergy
- The second largest renewable power producer (after hydropower)
- 25-33% of the primary energy supply can come from sustainable bioenergy in 2050



► The European Union

- Contributes with 2/3 of today's renewable energy production
- Bioenergy in the 20-20-20 target: 70%



► Norway

- 14 TWh bioenergy today (mainly heat)
- Potential: 45 TWh
- Target 2020: Doubling to 28 TWh!



Why is R&D on bioenergy important?

- ▶ Inefficient heat production is dominating bioenergy today
- ▶ Need for "new" bioenergy
 - Efficient power production
 - Biofuels
 - Biogas
 - Clean heat production
 - Sustainable forestry

BioPower



Biogas



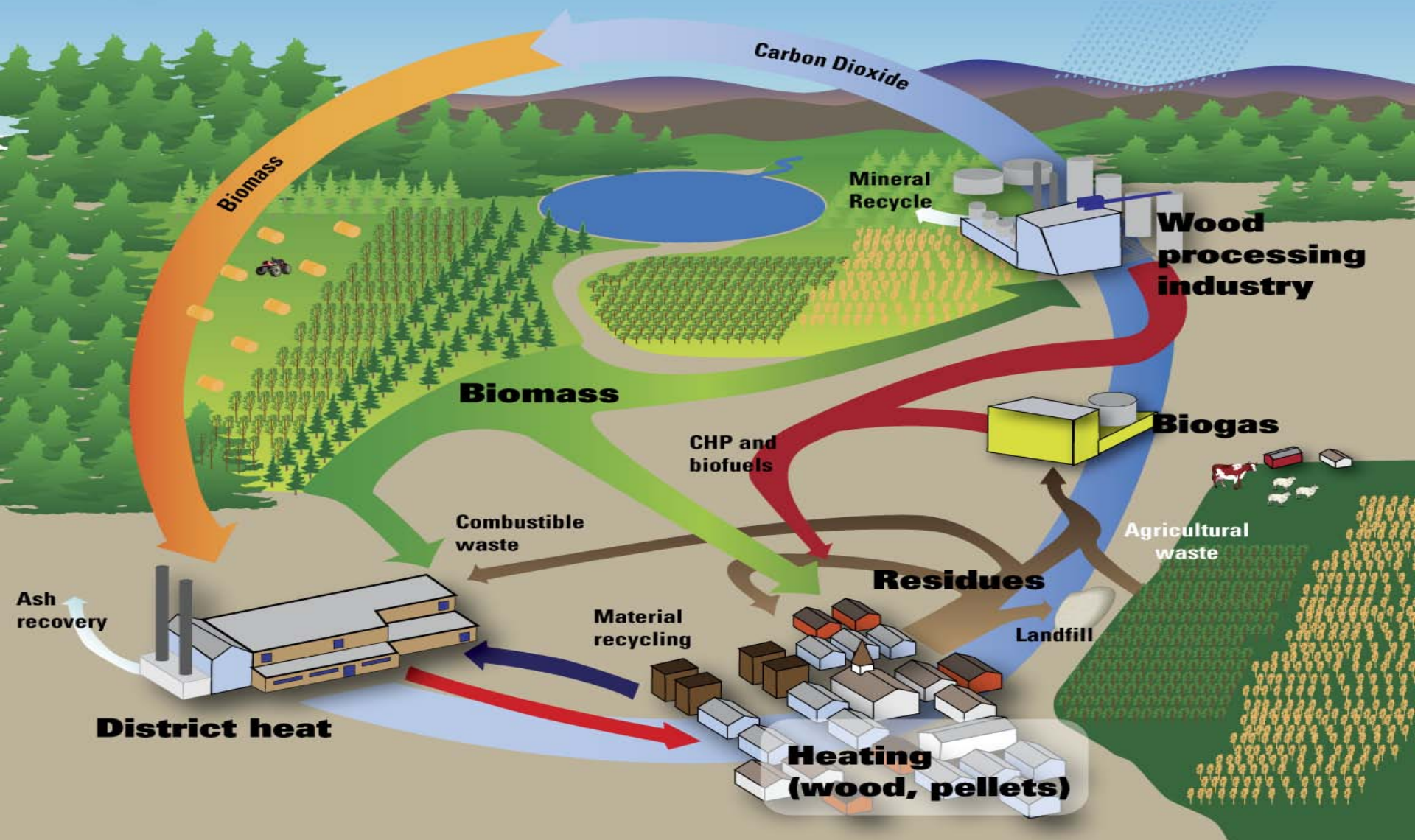
Biofuels



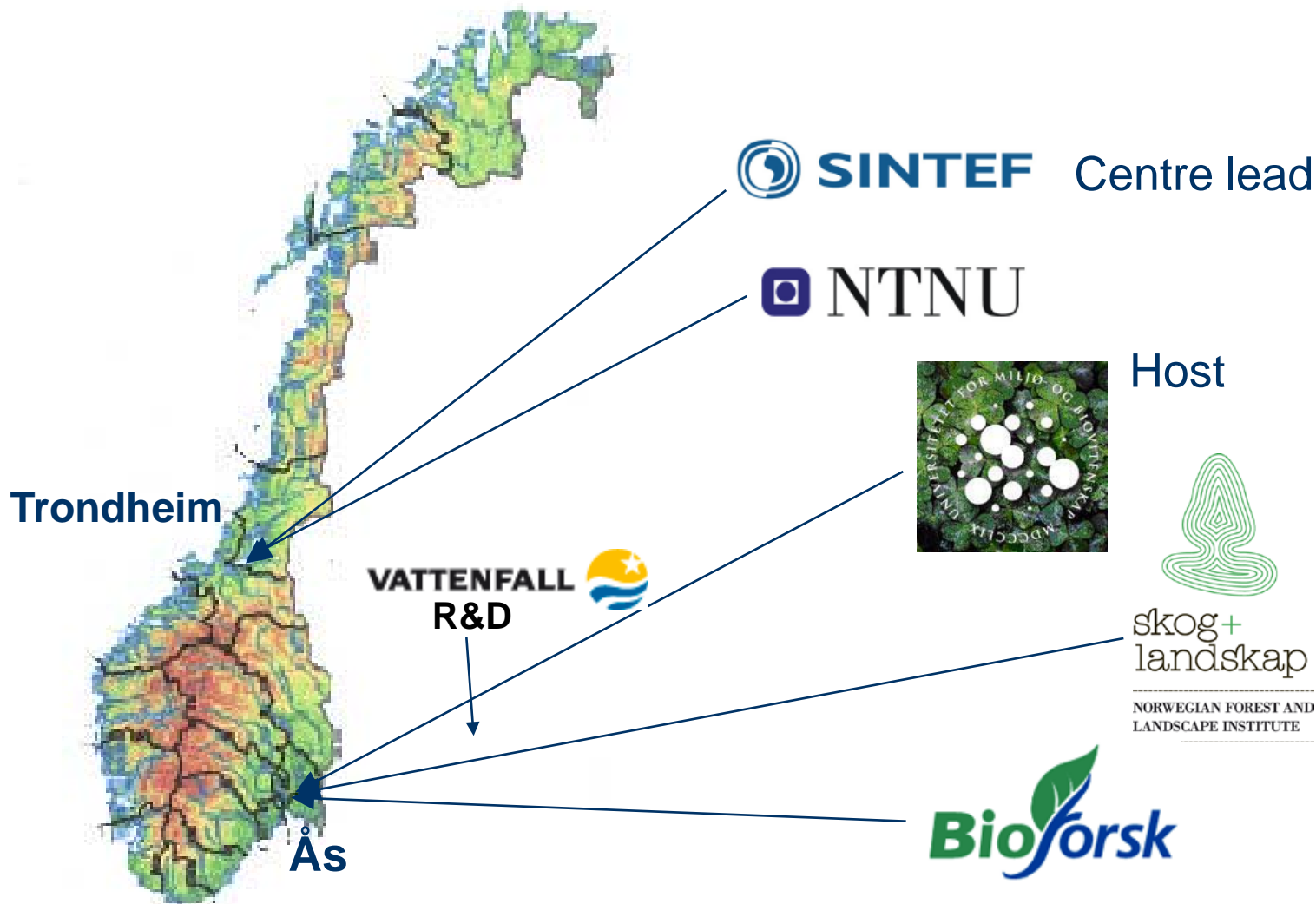
Point heat sources



CenBio



R&D partners in CenBio



Industry partners

Bioresources

Avfall Norge
Norges skogeierforbund
Norges bondelag

Technology

Cambi
Energos
Jøtul
BioNordic
Granit Kleber

Other

Norsk protein

Energy

Afval Energie Bedrijf
Agder Energi
Akershus Energi
EGE Oslo
Hafslund
Trondheim Energi/Statkraft
Nord-Trøndelag Energi
Norske Skog
Xynergo
Vattenfall Nordic Heat

International cooperation

- ▶ University of Minnesota (USA)
- ▶ Stanford University (USA)
- ▶ US Forest Service (USA)
- ▶ Finnish Forest Research Institute (FIN)
- ▶ Chalmers University of Technology (S)
- ▶ Åbo Akademi University (FIN)
- ▶ Technical University of Denmark (DK)
- ▶ University of Copenhagen (DK)
- ▶ Vienna University of Technology (A)
- ▶ Technical University Bergakademie Freiberg (D)

Overall objectives

*To develop the basis for a sustainable, cost-effective bioenergy industry in Norway in order to **double the bioenergy use by 2020***

► CenBio focus on **stationary bioenergy** (Heat and Power)

► Action 1. Production and accessibility of **biomass** for energy purposes will have to be increased substantially.

► Action 2. Great improvements must be made in the **efficiency** of biomass production, energy conversion and applications of bioenergy.

► Requirement 1. **By-products** need to be upgraded in order to be ecologically recycled.

► Requirement 2. **Sustainability** must be documented for complete bioenergy value chains to **enable sustainable and cost-efficient bioenergy**

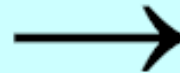
CenBio Vision

The Norwegian Government Bioenergy Strategy

CenBio Vision 2020

TWh - Today:

	Input	Efficiency	Output
Wood / pellet stoves	7	0,6	4,2
District heat	2,7	0,85	2,3
Wood industry	4,4	0,85	3,7
CHP - heat	~ 0	0,6	~ 0
CHP - power	~ 0	0,2	~ 0
Power	~ 0	0,4	~ 0
Biogas	~ 0	0,5	~ 0
SUM	14,1		10,2



Documented overall sustainability

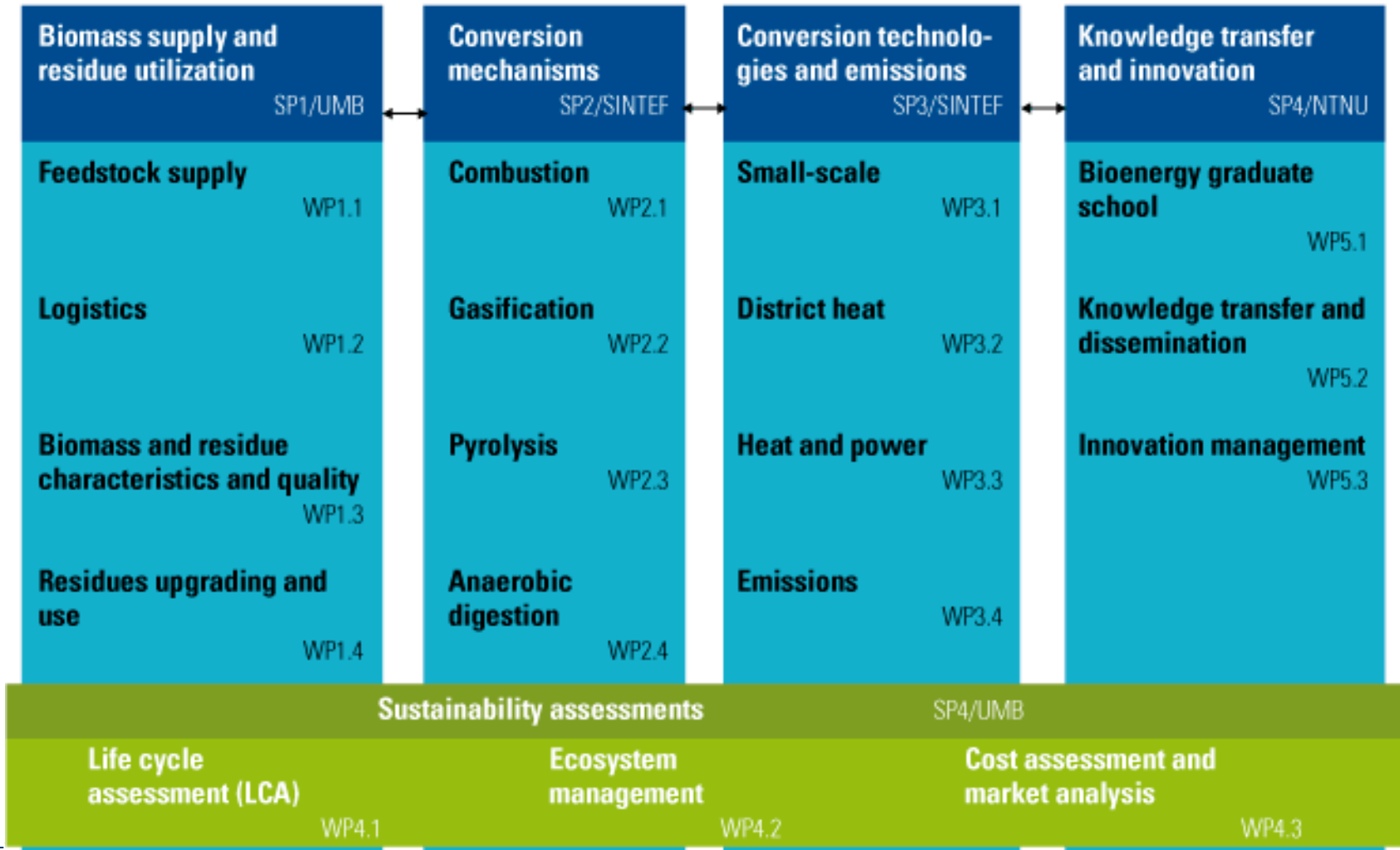
TWh - 2020:

	Input	Efficiency	Output
Wood / pellet stoves	12	0,85	10,2
District heat	6	0,9	5,4
Wood industry	5	0,9	4,5
CHP - heat	4	0,65	2,6
CHP - power	1	0,3	1,2
Power	1	0,5	0,5
Biogas	2	0,7	1,4
SUM	30		25,8

Wood / pellet stoves
District heat
Wood industry
CHP - heat
CHP - power
Power
Biogas
SUM

Work breakdown structure in CenBio

CenBio management and co-ordination - Lead: SINTEF

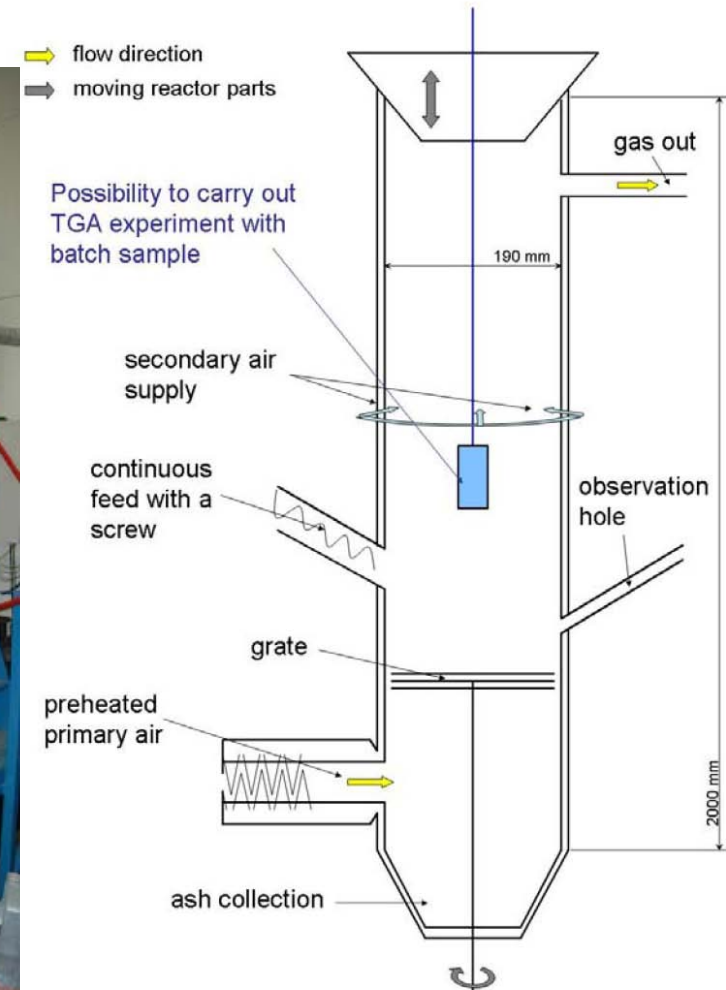


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10

Laboratory reactors for thermochemical conversion studies

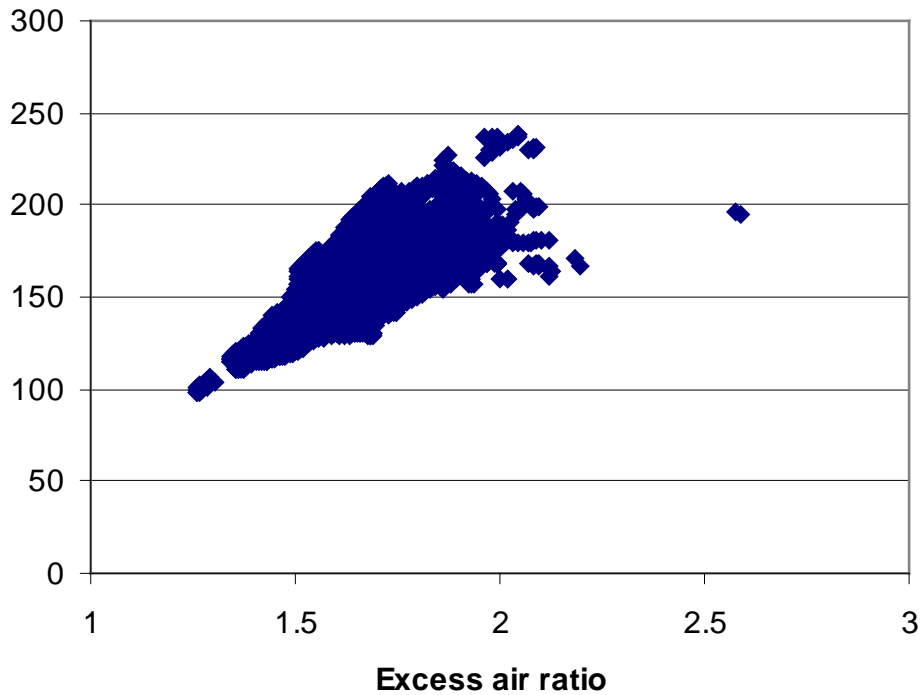
- ▶ Heating rate
- ▶ Temperature
- ▶ Reaction gas
- ▶ Fuels and fuel mixtures



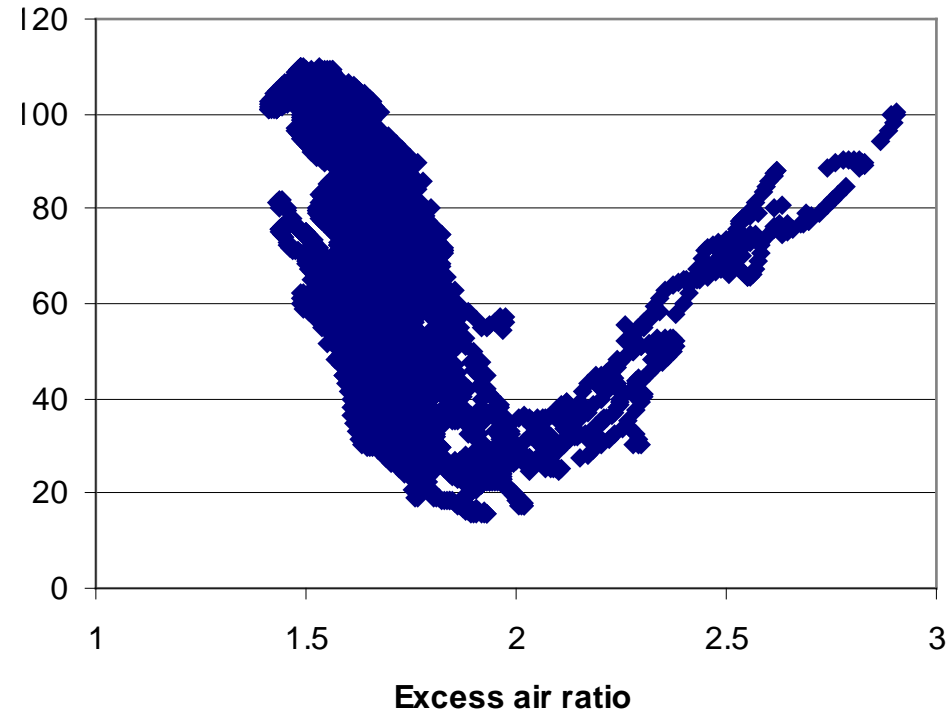
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Results

Non-staged combustion

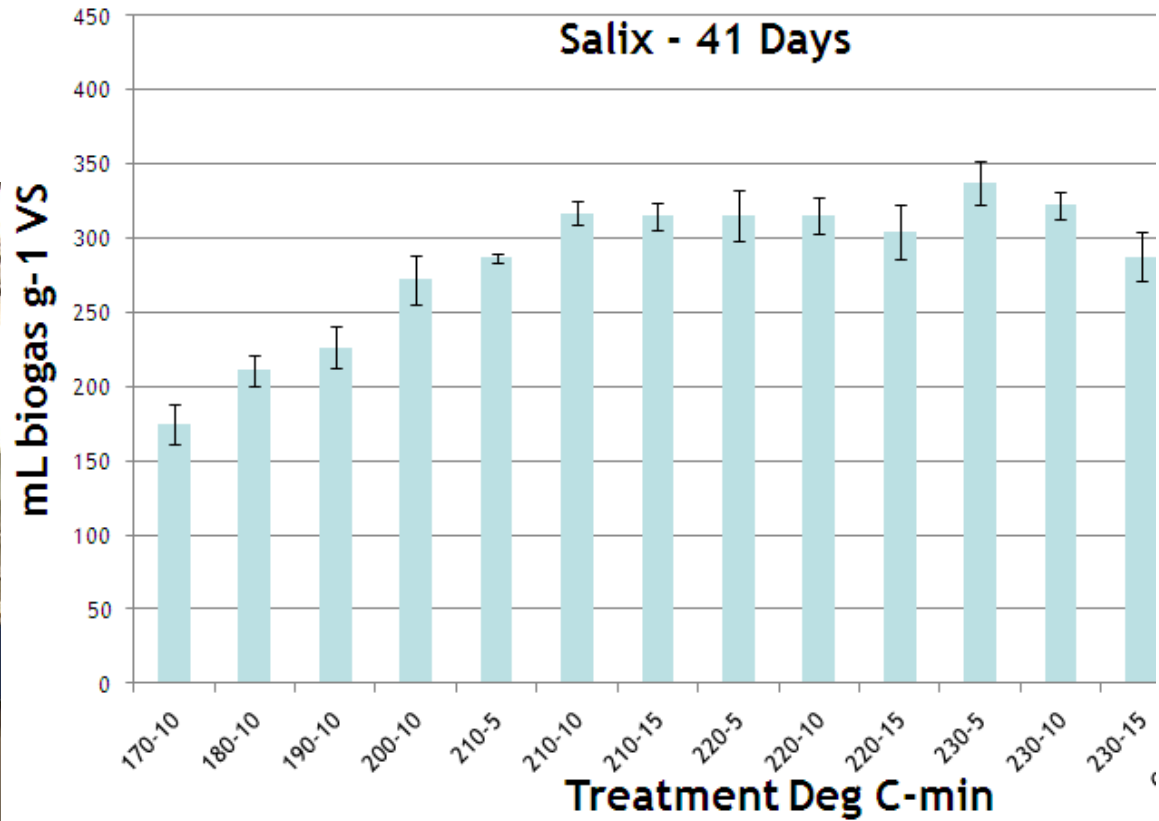


Staged combustion



Anaerobic digestion

Biomass



Steam

Explosion





Forskningsrådet

Thank you for your attention!

Acc.V Spot Magn
5.00 kV 3.0 350x

Det WD
SE 9.9

100 μ m