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INSTITUTE

# Heating with wood, obstacles and drivers

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# Danish Technological Institute

- Founded in 1906 by Gunnar Gregersen
- Mission in 1906: *To support Danish industry, mainly small enterprises, by providing technical assistance in the form of teaching, advice, testing and technological research,* said Gunnar Gregersen





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## STATUS

- An independent, not-for-profit institution
- Approved as a technological service institute by the Danish Ministry of Science, Technology and Innovation.



Building and construction



Business and industrial development



Chemistry and biotechnology



Energy and climate



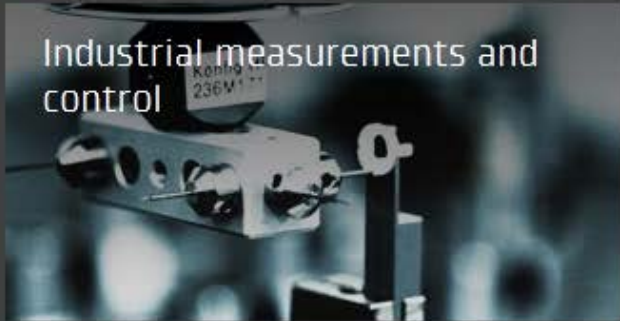
Environment, working environment and health



Food and packaging



Industrial measurements and control



Industrial production and development



Meat industry solutions



Productivity and management



Surfaces and microtechnology



Transport and logistics





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## ENERGY & CLIMATE

- 185 specialists in the fields of improvement of energy efficiency in building, industry and transport, solar energy, biomass, district heating, Smart Grid, measuring technology and handling of torrential rain and rainwater.



# Centre for biomass and biorefinery

- Centre was established in 2013 (previously a section in Renewable Energy and Transport)
- The centre has 31 employees
- Commercial work and research projects nationally and internationally





# Sections within Centre for Biomass and Biorefinery



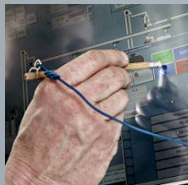
## Biomass and combustion technology

- DANAK accredited biomass and energy laboratory
- Testing of burning stoves, biomass boilers and wood pellets



## Marine biomass

- Research within cultivation and utilization of algae for feed, food and energy



## Pilotproduction for feed and biomass

- Test of additives, new recipes and processes before upscaling to full commercial size



## Bioenergy and Biorefinery

- Research within biomass and biowaste for energy and feed purposes
- Enzym laboratory

# Biomass laboratory

- Testing of wood pellets, straw and wood chips
- DANAK accredited in accordance with ISO 17025
  - Impartial testing of product quality
- Test of properties regarding grinding, pelletizing with and without additives from 100 grams
- Quality analysis of wood and bio pellets
- Own developed slag analyser and method to perform slag test, expected to be an accredited standard







# Marine Biomass

- Research projects aiming at utilizing marine biomass as a new resource for feed, food, high value products and sustainable energy
  - Biowalk4Biofuels: Production of second-generation biofuel which can be upgraded to biogas quality
  - MAB3: Development of new technologies that will lead to sustainable growth and subsequent conversion of two brown algae (*Saccharina latissima* and *Laminaria digitata*) into three energy carriers -bioethanol, biobutanol and biogas - and a high-protein fish feed
  - Partner in AlgeCenter Denmark: Research plant in Grenaa for cultivating algae
  - Manage a nordic network with industry, SMV and universities





# Pilotproduction for feed and biomass

- Pilot scale tests for feed, food and biomass
- Facilities include grinding, mixing, extrusion, vacuum coating and pelletizing
- Trials performed under controlled conditions
  - Ecologically approved production facilities
- Data acquisition systems and laboratory facilities for verification and documentation
- Test results can be directly transferred to a standard production







# Pilotproduction for feed and biomass

- Newest technology in pretreatment, refining and processing ingredients
- Torrefaction demo plant






# Bioenergy and biorefinery

- Optimization of biomass and storage
  - Research and experiments regarding storage of pellets made out of straw
  - Experiments regarding pelletizing and torrefaction of wood pellets



## Large scale Utilization of Biopellets for energy Applications (LUBA)

The demand for renewable energy is increasing in Denmark and one of the largest expanding areas in the near future is the use of biomass in power plants. The current use of biopellets comprises about 500 000 tons/year but is expected to increase to around 2 mil tons/year within the coming couple of years.



SafePellets

About project Pellet transport & storage News Events Contact Press releases & publications

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**Welcome**

**Latest News**

*SafePellets Contribution to 21st European Biomass Conference*  
May 13, 2013


*Pellet safety workshop in Fügen, Austria*  
March 18, 2013

*Pellet standards workshop in Leipzig, Germany*  
June 4, 2012

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SafePellets

**SafePellets**

Welcome to the SafePellets website

This website provides public information about the SafePellets project. The SafePellets project aims at providing information about safety and quality assurance measures along the biomass pellets supply chain. The project was initiated by the coordinator BIOENERGY2020+ – an Austrian K1 centre – and is funded within the 7th Framework Programme "Research for SME Associations" by the EU.







# Bioenergy and biorefinery

- Projects regarding transformation of biomass waste to sustainable products as bioethanol, biogas, fertilizer, protein etc.



- Biorefinery of algae for energy and protein
- Enzym laboratory
  - Mapping analysis of biomass composition, estimation of biofuel potentials (bioethanol, biogas) and technology consultancy



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# Power Plant conversion

## Drax steams ahead with £700m biomass conversion

*“Yorkshire power plant's green transformation continues as new systems to support first biomass unit are opened”*



Klimaminister  
foreslår forbud mod  
kul om 10 år



Source: [www.businessgreen.com](http://www.businessgreen.com) and  
[www.dr.dk](http://www.dr.dk)



# Heating with wood – on a domestic scale



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- Wood burning stoves or pellets stoves
- Automatic pellets boilers and log wood boilers



# Wood burning – pros and cons

Carbon  
footprint



Air  
Quality

Logistics & availability - user behavior - cost – legislation - appliances



# The Air Quality Issue



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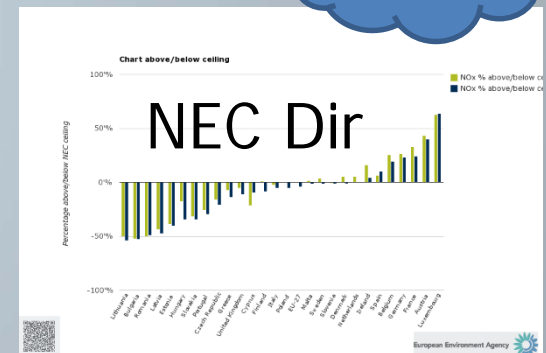
Clean Air Act



DIR 2008/50/EC  
25 µg/m<sup>3</sup> of PM 2.5

**Supreme court finds UK in breach of European air pollution rules** - ClientEarth said it welcomed the ruling and added that air pollution causes 29,000 early deaths a year in the UK as well as heart attacks, strokes and respiratory disease.

NO<sub>x</sub>



**World Health Organization**

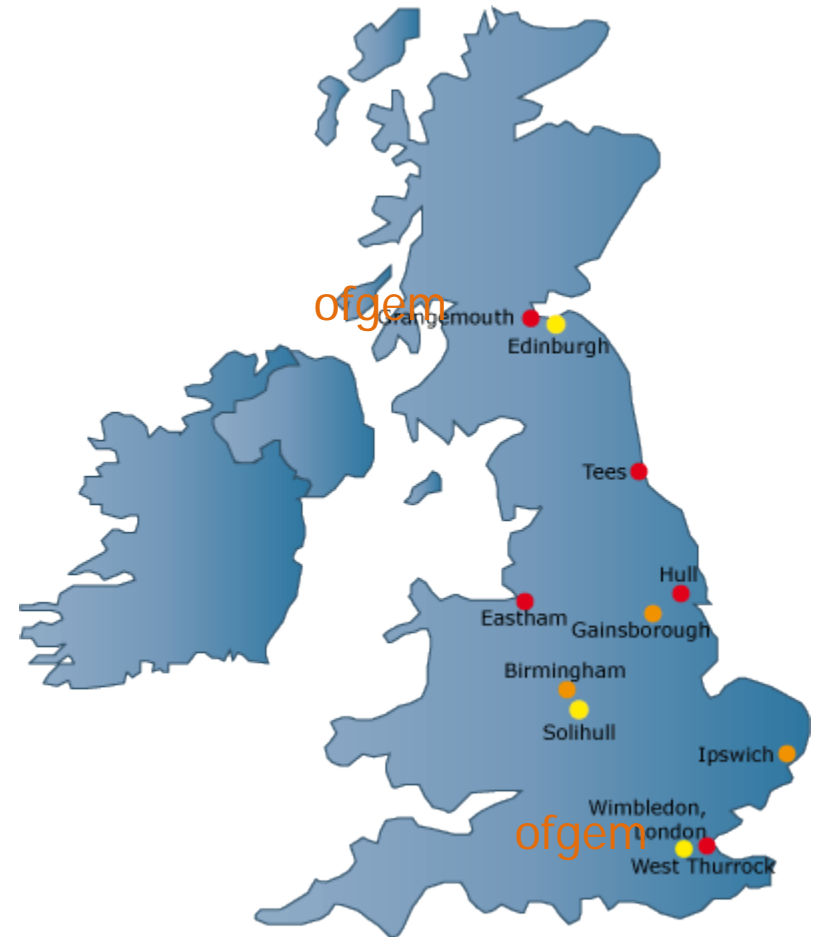
Some 40 million people in the 115 largest cities in the European Union (EU) are exposed to air exceeding WHO air quality guideline values for at least one pollutant. Children living near roads with heavy-duty vehicle traffic have twice the risk of respiratory problems as those living near less congested streets.

# UK Carbon saving potential

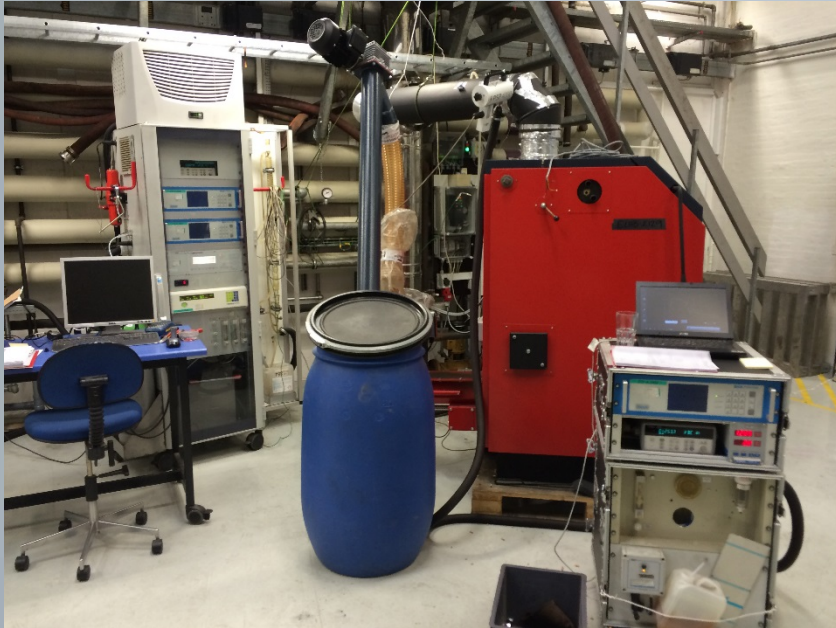


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- Apprx 7 mill fireplaces in the UK having 60% Gross efficiency
- 10 % displacement of oil&gas
- Annual heat demand 25-38 MW pr dwelling
- Saving potential 4.2 -6.2 MT CO<sub>2</sub> per year
- EU annual LRH+SFB 16 MT CO<sub>2</sub>
- RHI domestic grant scheme £122 per MW - £3000 annually (biomass)



# Energy laboratory – testing of biomass boilers



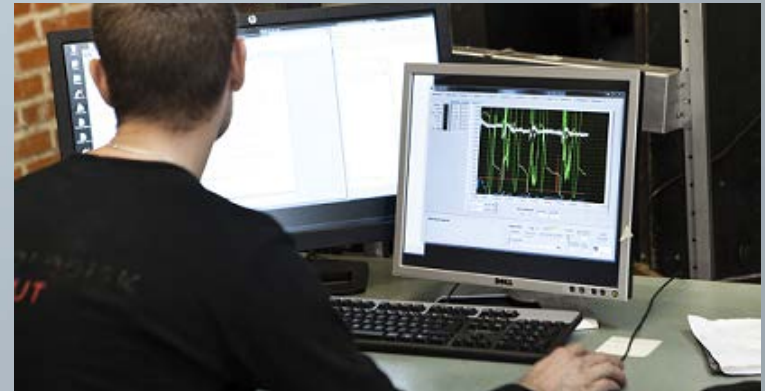
- Testing to EN303-5
  - Lab test capacity 10-300 kW
  - Field test capacity 100-600 kW
  - CO, CO<sub>2</sub>, OGC and NO<sub>x</sub>
  - Particle measurements by SMPS or Dusttrack
  - MCS Certification
  - RHI attestation
  - Open '*SEDBUK*' kind of list at <http://www.biomasse.teknologisk.dk/kedler/index.htm>





# Energy laboratory – testing of stoves and inset appliances

- Testing to
  - EN13240, etc
  - NS3058-59
  - DEFRA Smoke Control
  - DIN plus dust measurements
- Measurements
  - CO
  - OGC
  - NOX
  - CO2
  - Particle measurements with SMPS or Dusttrack

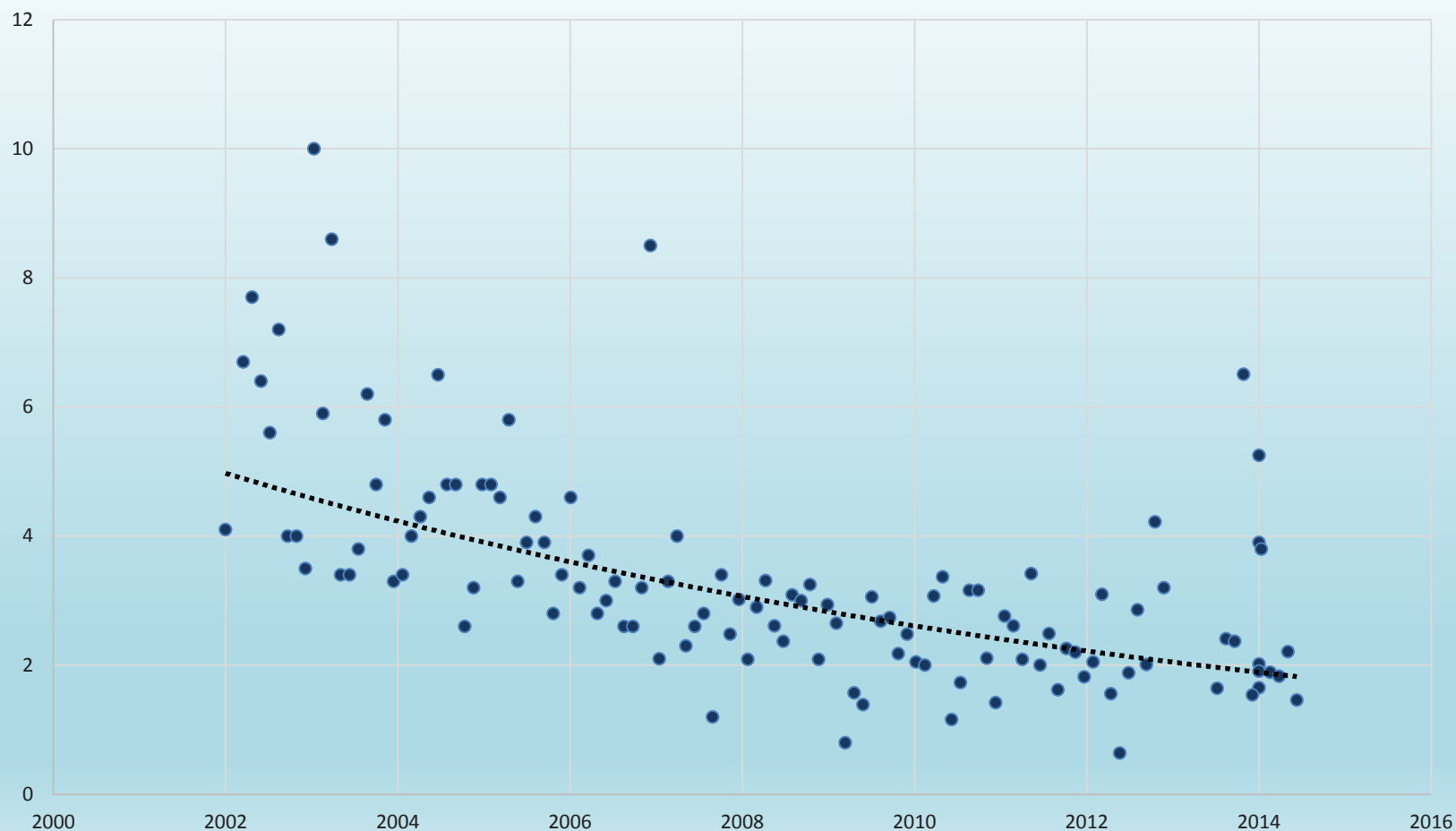


# PM emission DK stove tests to NS3058



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Particle emission, g/kg dry matter



# Ecodesign regulations on the stoves, from 2024



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(seasonal)	PM (HF) mg/m <sup>3</sup>	PM (DT) g/kg	PM (UK) g/kg	OGC mg/m <sup>3</sup>	CO mg/m <sup>3</sup>	NOx mg/m <sup>3</sup>	Engy Eff %
<b>Open fronted</b>	50	6	2.9	120	1800	200	30
<b>Closed fronted</b>	40	5	2.4	120	1250	200 fossil 300	65
<b>Pellets</b>	20	2.5	1.2	60	250	200	79
<b>Cookers</b>	40	40	2.4	120	1500	200 fossil 300	65



# Ecodesign regulation on the solid fuel boilers, from 2020

EN303-5 Class 5 level of requirements



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(seasonal)	PM (HF) dust mg/m3	OGC mg/m3	CO mg/m3	NOx mg/m3	Energy Efficiency %
<b>Automatic stoked boilers</b>	40	20	500	200 fossil 350	77  <20kW: 75
<b>Manually stoked boilers</b>	60	30	700	200 fossil 350	77  <20kW: 75

# The Challenge of using wood pellets and wood chip



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## Crow Edge recycling fire

Firefighters have finally extinguished a blaze at a wood recycling site near Penistone after almost two weeks.



# SafePellets – Measurements in large scale storage facilities (powerplants)



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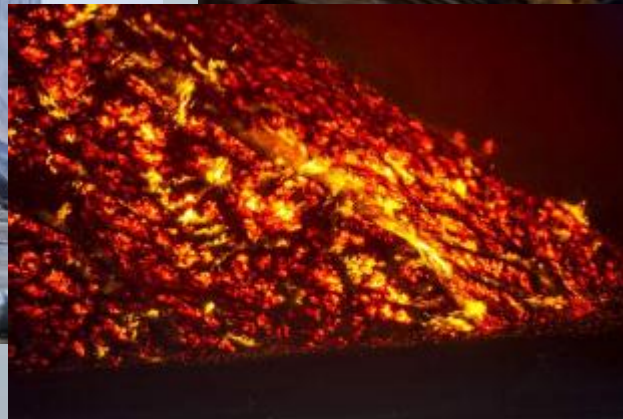


# Selfheating in pellet storages

- Recent (Dec. 2013) fire in Ljusne, Sweden
- Assumed cause of fire: Selfheating



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# Accidents



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## Suffocation & CO poisoning due to off-gassing

- Between 2002 and 2011, 9 fatalities reported in connection with storage of pellets
- 4 on ships; 5 in smaller closed pellet storage
- Also in spaces nearby



En död och flera skadade efter olycka i hamnen

En filippinsk besättningsman på fartyget *Saga Spray* omkom efter en arbetsplatsolycka i Västhamnen i Helsingborg på torsdagsg morgonen. Även en av Helsingborgs hamns stuvare skadades allvarligt och ytterligare personer har förts till lasarettet för observation. Polisen har förklarat olyckan som ett misstänkt brott mot arbetsmiljölagen.

**HELINGSBORG.** Olyckan inträffade vid 7.55-tiden på torsdagsg morgonen i samband med att de båda männen

Senaste nytt i Helsingborg | 16 november 2006 kl 14:48 uppdaterad 14:59

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Tagesnytt WISSEN

### Ärzte warnen: Holzpellets können toxisch wirken

Ärzte des Schweizerischen Toxikologischen Informationszentrums (Tox-Zentrum) warnen vor der Vergiftungsgefahr durch Holzpellets.

Holzpellet-Köle sollen demnach nicht ohne vorheriges Lüften betreten werden, wie das Tox-Zentrum am Montag angibt. In grossen, nicht gut gelüfteten Versandbehältern könne sich das giftige Gas Kohlenmonoxid ansammeln, kann es. Daraus entsteht nicht nur bei defekten Heizanlagen, sondern auch durch die Pellets selbst. Das giftige Gas könne tödliche Vergiftungen hervorrufen. Für die Menge des entstehenden Kohlenmonoxids spiele das Volumen der gelagerten Pellets und die Lagerungsdauer eine entscheidende Rolle.

Wird umhüllter Holzpellet-Köle mit Kohlen- oder Holzpellets gefüllt, so besteht Gefahr von Kohlenmonoxid. (Bild: Tox-Zentrum)

# Off-gassing and self-heating



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○ O<sub>2</sub> depletion & Toxic offgases (CO, CO<sub>2</sub>, aldehydes,...)

○ Fire

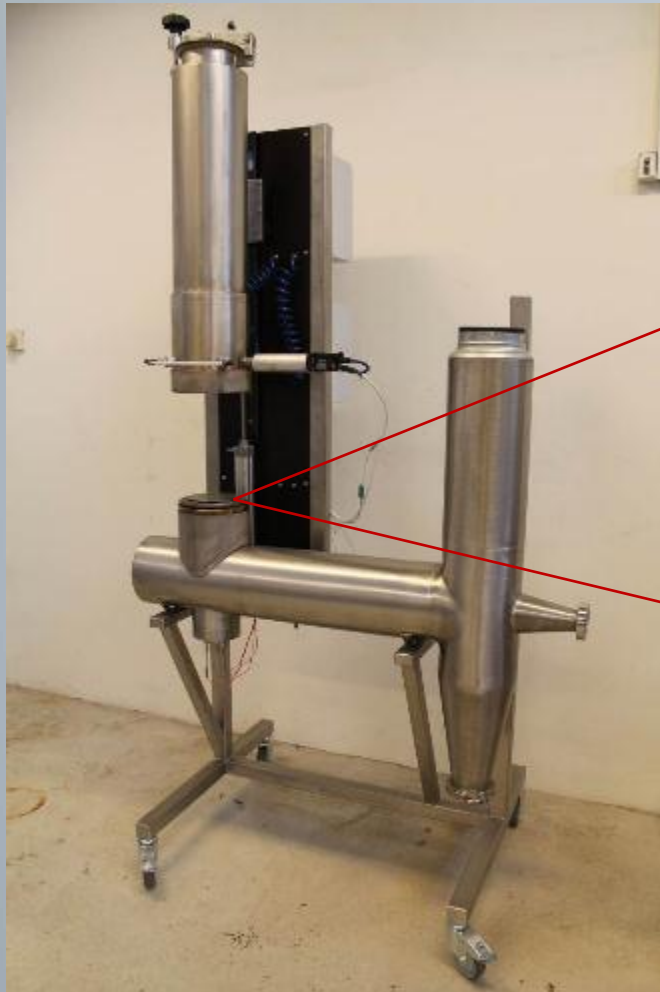




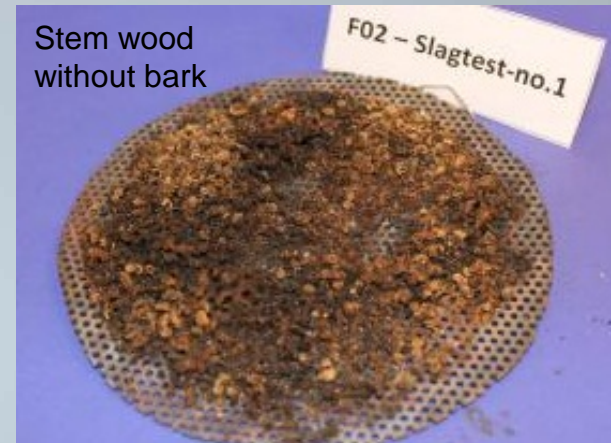


# The slag analyser

the ash / slagg after test



Stem wood  
without bark



Wheat straw



# EU FP7 – Projects at DTI

## Bioenergy & Biorefinery

- SafePellets – Investigations of mechanisms and development of methods for detecting self-heating and off-gassing in pellets storage - [www.SafePellets.eu](http://www.SafePellets.eu)
- AshMelt – Investigation of mechanisms and development of a new method for characterising slagging in small scale pellet boilers - [www.AshMelt.eu](http://www.AshMelt.eu)

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