Austrian Bio Energy Centre

Development of test methods for non wood small-scale combustion plants

Project overview

Lara Carvalho
Gottfried Eder
Walter Haslinger

non-K plus Innovationskompetenz

Project overview: Key data

Austrian Bio Energy Centre

- Title:
  Development of test methods for non wood small-scale combustion plants
- Project duration:
  15 months
- Project start:
  01/2007
  Kick-off meeting: 14th of February 2007
- Total costs:
  333.121 €
- National fundings:
  235.742 €

Project overview: Scientific partners

- Austrian Bioenergy Centre GmbH (ABC): Project co-ordination WP1
- Institute for Energy and Environment (IE): Leader of WP2
- SP Technical Research Institute of Sweden (SP): Leader of WP3
- Technologie- und Förderzentrum Nach-wachsende Rohstoffe (TFZ): Leader of WP 4
- HBLFA – Francisco Josephinum, Biomass Logistics Technology (FJ BLT): Leader of WP5
- VTT Technical Research Centre of Finland (VTT): Leader of WP6

Project overview: Company partners

- Committed partners
  - in Austria
    - Guntamatic
    - KWB
    - ÖkoFEN
  - in Finland
    - Ala-Talkkari Oy
- Potentially interesting or interested partners
  - in Austria
    - Hargassner
    - Calimax

Project overview: Scope

- Draft proposal for EU-wide best practice guideline for small-scale non wood biomass boilers and
- Preparation of EU-wide round robin test
- Identification of further R&D required
- Based on
  - Identification of driving forces and barriers
  - National legal regulations
  - Identification of the state-of-the-art boiler technology
  - Determination of appropriate measurement methods
  - Requirements and specifications of test fuels
  - Determination of appropriate test procedures

Project overview Working Packages

- WP1 – Project co-ordination and project management
- WP2 – General conditions, analysis, advice for measurement techniques and standardization
- WP3 – State of the technology
- WP4 – Measurement methods
- WP5 – Development of tests procedures
- WP6 – Identification of further R&D required and preparatory work for a round robin test

WP1 – Project co-ordination and project management

- WP leader: Austrian Bioenergy Centre
- Persons involved:
  - Lara Carvalho (project co-ordination)
  - Walter Haslinger (project leader)
  - Jürgen Mitterlehner (homepage)
- Duration: 15 Months (from Jan. 07 to M
- Objectives: Project co-ordination
  management, project controlli unication
  set-up and information di on, project
  representation and re

Main issues:
Communication & Reporting

Description – WP1

- Task 1.1: Co-ordination, organization, presentation of project, reporting
- Task 1.2: Project controlling
- Task 1.3: Set-up and maintenance of project homepage, organization of data exchange and communication via homepage

Institut für Energetik und Umwelt

Institute for Energy and Environment

Research, Development, Services for
- Energy
- Environment

Development of test methods for non wood small-scale combustion plants

Work package 2

General conditions, analysis, advice on measurement techniques and standardization

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Aims of work package 2

- Analysis of regional availability and existing national and international regulations
- Evaluation of requirements of non wood biomass types for a more intensive use as fuels

↓

Assistance of the development of a broad measurement guideline
(„Best practice guideline“)

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Tasks of work package 2

- Work package 2 is divided into 5 tasks:

2.1	Basic conditions for the use of non wood biomass fuels in small scale combustion systems
2.2	Combustion characteristics and derivation of relevant recommendations for measurement techniques
2.3	Analysis of the regional availability and potential reserves of non wood biomass fuels
2.4	Economical framework conditions
2.5	Derivation of relevant recommendations for measurement technology and standardization

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Task 2.1
Basic conditions

Contents:

- Identification of available non wood biomass fuels in the partner countries
- Allocation of the political, administrative and social framework conditions in the respective states

Target results:

- Basic conditions of each non wood fuel in the individual European country
- Complexity of measurements
- Integration of new measurement methods in existing methods

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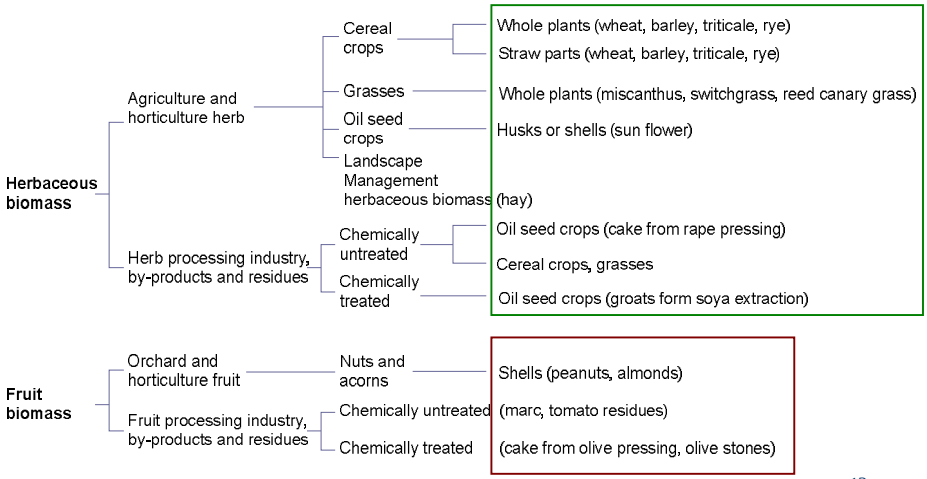
Available non wood biomass, according to CEN/TS 14961



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Task 2.2
Combustion characteristics

Contents:

- Compilation of chemical composition, calorific value, water content and particle size according to the CEN TS 14961:2005
- Literature researches and experts interviews concerning combustion in small-scale boilers
- Single combustion tests

Target results:

- Identification of typical problems in each class of fuel à special measurement problems
- Evaluation of problems and imperfections related to the use of test methods applied for wood fuels

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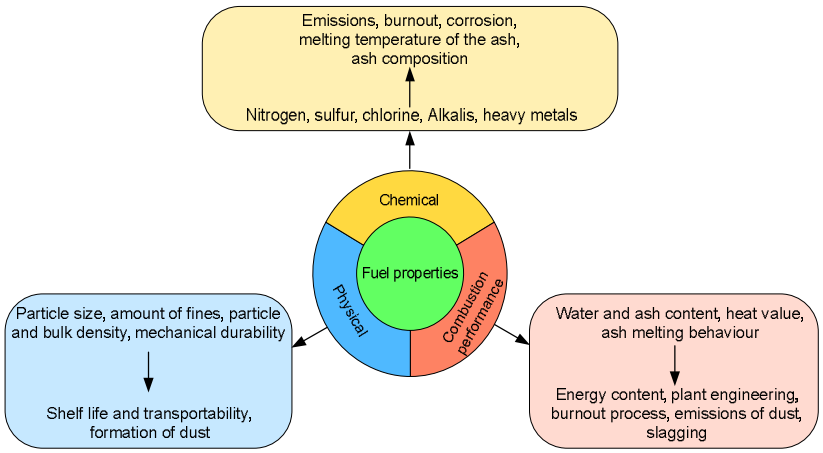
Compilation of fuel properties



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Task 2.3
Regional availability, potential reserves

Contents:

- Allocation of current and future use in the partner countries of each individual fuel
- Organization of an international workshop with the most important stakeholders (see below for details)

Target results:

- Definition of relevant fuels in the partner countries, for which the test methods have to be applicable
- Provision of an overview of national expectations and minimum necessary standards concerning the combustion of non wood fuels

Processing task 2.3: Regional availability, potential reserves

- For gaining an overview about national potentials of each fuel, a questionnaire was prepared and sent to the partners:

Fuel	Potential amount of fuel		Used amount of fuel				Alternative material ways of utilization	References (as known)
	Currently (2007)	Perspectively (ca. 2015)	Currently (2007)		Perspectively (ca. 2015)			
			Total	In small-scale combustion plants	total	In small-scale combustion plants		
…	…							
…								…

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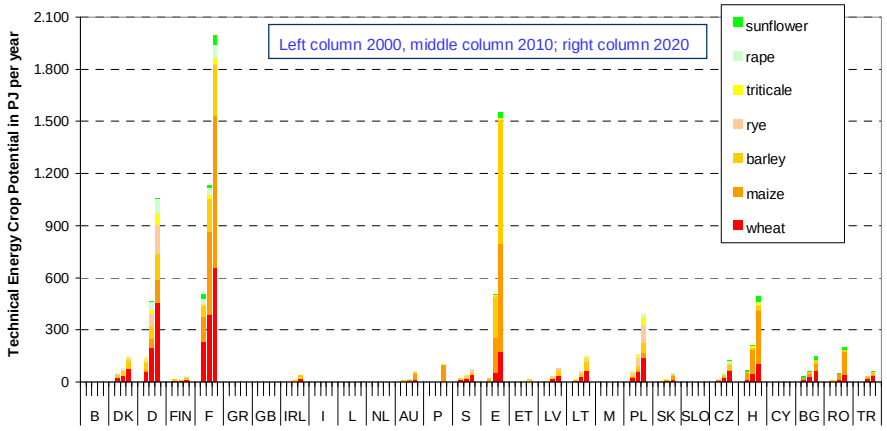
European availability of biomass



- Technical thermo-chemical fuel potential of energy crops in the EU 28-countries will grow significantly (2000: 983 PJ; 2020: 6 782 PJ)

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Task 2.4
Economical framework conditions

Contents:

- Determination of fuel costs for different raw materials and regions
- Development of possible scenarios for the future trend of costs

Target results:

- Estimation which non wood fuels will achieve higher market relevance under certain economic conditions

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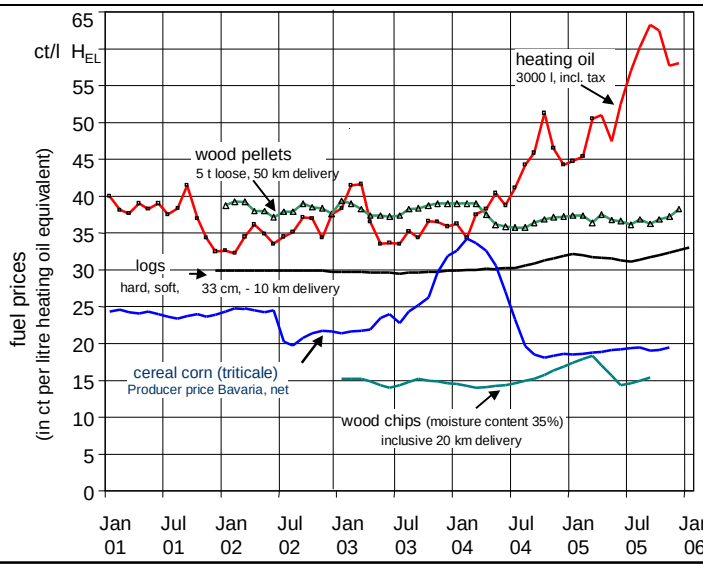
Fuel prices of biomass and fossil fuels in Germany



source:
C.A.R.M.E.N. e.V.,
Tecson,
Bayer. Bauernverband,
TFZ

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Task 2.5
Recommendations for measurement technology and standardization

Contents:

- Summarization of the results 2.1 – 2.4 in a matrix, including
  - Plants licensing
  - Adaptability of legal regulations
  - Fuel characteristics
  - Emission profiles
  - Security of supply
  - Social acceptance
  - Specific fuel costs
  - Cost trends

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Timetable

- International Workshop (milestone M 2.1): **03**/2007
- First overview of tasks 2.1 – 2.3 (D 2.1): 04/2007
- Final report incl. work packages 4 and 5 (D 2.2): 12/2007

		Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07
WP2	**General conditions, analysis, advice for measurement techniques and standardization**		M 2.1		D 2.1								D 2.2
Task 2.1	Basic conditions for the use of non wood biomass fuels in small-scale combustion systems				x								x
Task 2.2	Combustion characteristics and derivation of relevant recommendations for measurement techniques				x								x
Task 2.3	Analysis of the regional availability and potential reserves of non wood biomass		x		x								x
Task 2.4	Economic basic conditions												x
Task 2.5	Derivation of relevant recommendations for measurement techniques and standardization												x

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Processing task 2.3: International workshop

- **03**/2007 an international workshop will be organized by IE
- The most important stakeholders of the partner countries will be invited:
  - Political decision makers
  - jurists, experts administration
  - Representatives of the churches
  - Environmental associations
  - Agricultural organizations
- It should be provided an overview of national expectations related to the combustion of non wood fuels

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WP 3 State of the technology

Objective:

Compilation of current state of technology for small scale non wood biofuel appliances – Focus (Austria, Germany, Finland and Sweden)

Personnel:

Marie Rönnbäck

David Eskilsson

Started to gather some information to Task 3.1-3.3 in December.

Literature survey

Identify products and manufacturers

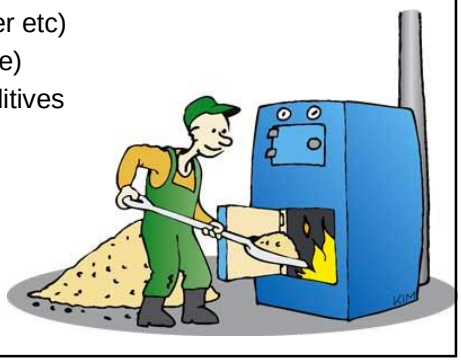
Database experiences of different combustion appliances and fuels

SP Technical Research Institute of Sweden

Task 3.1 Manufacturers and products

Manufacturers and products will be compiled from each participating country (Sweden, Finland, Germany and Austria).

Manufacturer, address, Web address
Products
Fuels
Load
Combustion technique (grate, stoker etc)
Automatic ash removal (boiler, grate)
Secondary flue gas cleaning or additives
Combustion and load control
References on public tests



SP Technical Research Institute of Sweden

Task 3.2 Available scientific results on the operation of non wood biomass boilers

The results are compiled in a data base. Which include following:
References
Combustion application (grate, burner, stoker)
Manufacturer and product
Fuel
Type of ignition
Automatic ash removal (grate or boiler)
Control menu for different fuel
Combustion control (Fuel, air)
Combustion temperature control
Load control (Modulating, on-off)
Emission results

SP Technical Research Institute of Sweden

Emission results:

Maximum and tested load:

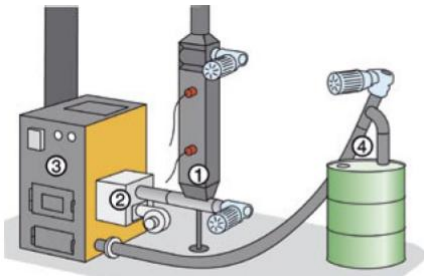
Load control during test: Nominal, Thermostat, Modulating

Total efficiency

Emissions (ppm): CO2 (%), O2 (%), CO, THC, VOC, OGC, SO2, HCl and particle emissions

Normalised emissions at a certain oxygen concentration (mg/nm3):

CO2 (%), O2 (%), CO, THC, VOC, OGC, SO2, HCl, particle emissions, PM2.5, PM1



SP Technical Research Institute of Sweden

Tests in data base – at the moment

About 70 tests in the database now

15 different products

Tested fuels: Oat Grain, Ray grain, Wheat grain, Barley grain, Rape seed, Straw Pellets, Wheat Straw, Reed canary grass, Miscanthus pellets and Miscanthus straw

Flue gas cleaning: flue gas well, additives, cyclones

We need more data so all available reports are welcome !

User experiences: Recently made telephone interviews with energy grains users will form the base – complemented if necessary

SP Technical Research Institute of Sweden

Task 3.3 Systematic characterization of boiler technologies

A Workshop is going to be held in Sweden.
Manufacturers
Fuel producers
Distributors
Users
Authorities

Suitable time – August-September ?

Gathered information will be systematically characterized

Task 3.5 Preparation of a summary report on state of the art non wood biomass combustion technologies

Summary report on state of the art non wood biomass combustion technologies.

Compiled databases will be distributed to partners in June

Summary report ready after workshop

Contribution from other partners

Reports of non wood biomass combustion (German is okay)

Information about products and manufacturers the participating countries

Work Package 4: “Measurement Methods“ – Objectives

– Identify possible measuring incertainties associated with small-scale grain or straw combustion

– evaluate selected measuring procedures and equipment for possible measuring error (quantitative and qualitative)

– Identify suitable methods for evaluation of flue gas from grain and straw
combustion (manly particles but also gaseous parameters)

– Provide input data for best practise guidelines, based on experimental data
and general experience

Work Package 4: Task structure

– Task 4.1:
Inventory of measuring hazards and elaboration of detailed testing plan

– Task 4.2:
Measurement equipment and measurement techniques testing

– Task 4.3:
Evaluation and quantification of influences

Work Package 4: Open questions (examples)

Ø required minimum sampling time

Ø required number of replications

Ø identification of suitable filter material for gravimetrical dust determination

Ø role of dust depositions in dust probe (out-stack measurement)

Ø required flue gas pre-treatment (e.g. dilution)

Ø required sample gas filtration media (e.g. stuffed filtering cartridge or ceramic filter, absorption of components?)

Ø useful test fuel characteristics and tolerable bandwidth of parameters

Ø test methods for part load and zero load operation (blaze sustaining mode?)

Work Package 4: Input from partners

State of the art in measuring practise (inventory)
(questionnaire, to be drafted by TFZ):

- Ø basic measuring section (geometry, inlet and outlet sections, etc.)
- Ø position of sampling probe
- Ø equipment for determination of gaseous parameters
- Ø calibration gases
- Ø flue gas velocity and volumetric flow rate
- Ø gas pretreatment (dilution tunnel, filtration for sample gas)
- Ø dust determination equipment (devices, filter types, sampling rate, filter treatment, balance partition etc.)
- Ø fuel mass flow determination (devices, accuracy, calcultion)
- Ø others

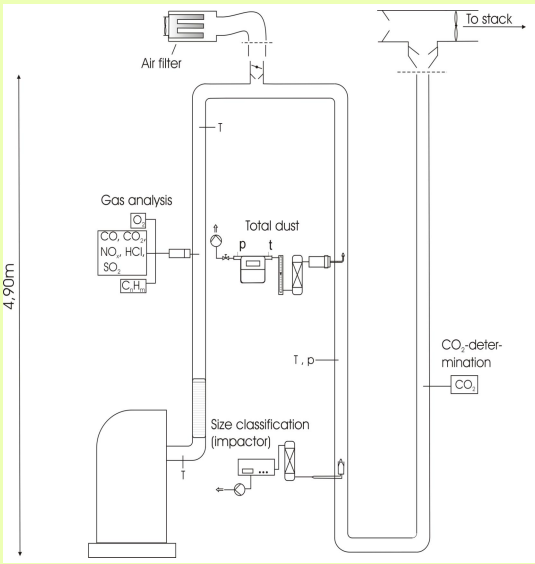
Work Package 4: Input from partners (2)

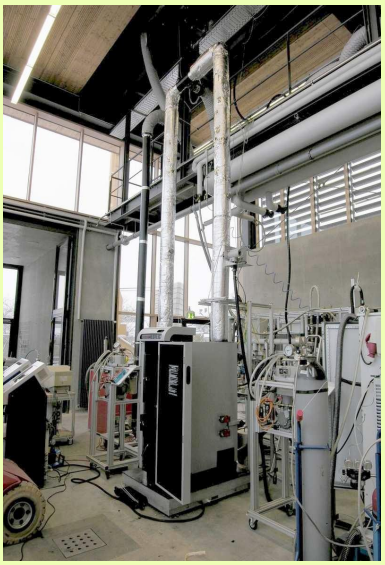
Previous experiences and problems with straw and grain fired boiler testing
(focused on measuring equipment and procedure)

Short report by partners on:

- Ø previously made comparative testings (if applicable)
- Ø measurement failures or complications with grain/straw fuels (if applicable)
- Ø deviation from usual practise with wood fuels
- Ø general measuring experience with grain/straw fuels
- Ø open questions concerning relevant influences on results

Work Package 4: Scheme of gas sampling: dilution tunnel



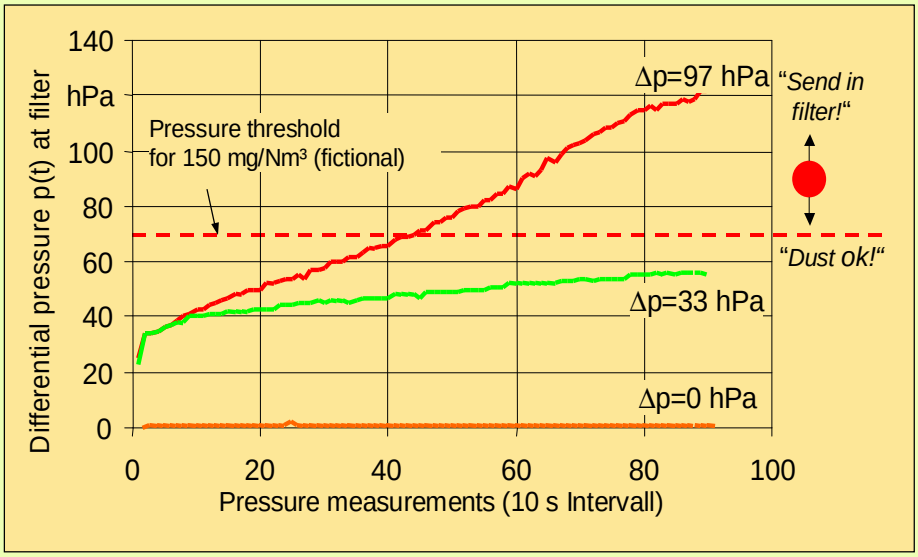


"Delta-P" rapid method for dust

Chimney sweep test instrument DPS 2002

Pressure meter connection to dust probe:

“Delta-p“ rapid test method for dust emissions: Applicable for grain and straw?



Suggestion for first tests in TFZ-work plan

Dilution tunnel test:

a) undiluted flue gas: VDI-2066 filter head with stuffed quartz wool & plane filter

b) undiluted, chimney sweep instrument combined with “Delta-p“

c) diluted, VDI-2066 filter head with stuffed quartz wool & plane filter

Procedure:
- isokinetic and “over-kinetic“ sampling (chimney sweep equipment)
- time: 15 min.
- 2 to 3 replications per measuring day

- Additional evaluation: difference quartz wool and plane filter

Suggestion for first tests in TFZ-work plan (2)

Comparison of filter media:

a) stuffed quartz wool & plane filter

versus

b) chimney sweep filter cartridge (glass fibre)

Procedure:
– both isokinetic
– time: 15 min.
– parallel measurement, undiluted
– 2 to 3 replications per measuring day

WP5- Development of test procedures

- **WP leader:**
  FJ BLT (Francisco Josephinum Biomass Logistics Technology)

- **People involved:**
  - Leo Lasselsberger (FJ BLT)
  - Harald Baumgartner (FJ BLT)
  - Wolfgang Reiner (FJ BLT)
  - Gottfried Eder (ABC)
  - Lara Carvalho (ABC)
  - Elisabeth Wopienka (ABC)

WP5- Development of test procedures

- **Duration:**
  11 months (from Feb. 07 to Dec. 07)

- **Objective:**
  Development of a **best practice guideline** for a uniform and comparable European testing procedure for testing non wood biomass fuels in small-scale combustion systems

WP5- Development of test procedures

- **WP leader:**
  FJ BLT (Francisco Josephinum Biomass Logistics Technology)

- **Objective:**
  Development of a **best practice guideline** for a uniform and comparable European testing procedure for testing non wood biomass fuels in small-scale combustion systems

Description of WP5 (1)

- **Task 1: Identification of state of the art of national and international testing procedures**
- **Task 2: Selection and adaptation of the most appropriate testing standards for non wood fuels**
  - Require contributions from WP2 and WP4
  - Milestones:
    - Selection of the most feasible testing procedures (March 2007)
    - Selection of the test fuels (April 2007)

Description of WP5 (2)

- **Task 3: Selection of appropriate boilers and conduction of boiler tests**
  - 4 different boilers from co-operating companies will be used (3 in FJ BLT and 1 in VVT)
    - Milestones:
      - Selection of testing boilers (April 2007)
- **Task 4: Requirements for testing procedures**
  - Description of the legal, technological and methodological requirements for a draft proposal of a European standard

Description of WP5 (3)

- **Task 5:** **Preparation of a draft proposal for a best practice guideline for a testing procedure of non-wood small-scale biomass boilers, including measurement technologies and state of the art**

  - Deliverables:
    - Draft proposal (December 2007)

Assisted by: Austrian Bio Energy Centre

WP 6 – Identification of further R&D required and preparatory work for a round robin test

OBJECTIVES of WP 6

- *Preparatory work for a round robin test*
- *Identification of further R&D requirements*

Tasks

Task 6.1: Elaboration of a work plan for a round robin test

Task 6.2: Identification of interested laboratories

- All relevant laboratories in EU-area will be contacted.

Task 6.3: Cost budget for the round-robin tests

- Based on individual costs in different laboratories, a cost budget to carry out a round-robin test will be done.

Task 6.4: Identification of further R&D required

- In the framework of the final meeting a workshop will be performed within the partner consortium of this project and eventually also involving stakeholders from industry and the administration.

Persons involved at VTT

- Project manager Heikki Oravainen
- Experts in measurements: several candidates
- Help in contacting laboratories in EU and making cost budget: several candidates

Timetable

		WP Leader	Jan. 07	Feb. 07	Mar. 07	Apr. 07	May 07	Jun. 07	Jul. 07	Aug. 07	Sep. 07	Okt. 07	Nov. 07	Dez. 07	Jan. 08	Feb. 08	Mar. 08
WP 1	Project co-ordination and project management	ABC															
WP 2	General conditions, analysis, advice for measurement techniques and standardization	IE															
WP 3	State of technology	SP															
WP 4	Measurement methods	TFZ															
WP 5	Development of tests procedures	FJ BLT															
WP 6	Identification of further R&D required and preparatory work for a round robin test	VTT															

- Exchanging information
  - SP questionnaire
  - IE questionnaire
  - ABC/FJBLT questionnaire
- Boiler for combustion testes are installed – ready to start in June

THANK YOU!

Contact

Austrian Bioenergy Centre

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