TECHNICAL ISSUES

FEEDSTOCK AND STANDARDS

WP2C – Feedstock and Standards

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INTRODUCTION

This Work Package WP2C identifies the characteristics of feed stocks that will allow the technologies to develop. Biomass fuels tend to be unrefined products with inconsistent quality and poor quality control. Production methods vary according to crop type, location and climatic variations. Erratic fuels have compounded the difficulties associated with technological innovation in the fields of pyrolysis, gasification and combustion. There is a need to rationalise fuel production in an endeavour to produce more consistent higher quality fuels described by standards.

Less homogeneous and low quality fuels need more sophisticated conversion systems. Larger scale systems tend to be suitable for lower quality cheaper fuels. Smaller plants tend to require higher fuel quality and better fuel homogeneity. We need to understand this relationship and the specific tolerances that each technology can accommodate.

This book is a compilation of information that can be helpful to compare feed stocks, technology and learn about different countries.

The report included
- Biomass feedstock currently and future
- Identification of standards
- Feed stocks and technology

Due to standards and research improve every day, maybe not all the information is up date.

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YEAR ONE REPORT

Identification of standards

Abbreviations and definitions

CEN European Committee for Standardisation (www.cenorm.be)
DIN German Standardisation Institute
DS Danish Standards Association
ISO International Organisation for Standardisation
NEN Netherlands Standardisation Institute
ON Austrian Standards Institute
SFS Finnish Standards Association
SIS Swedish Standards Institute
TC Technical Committee
TS Technical specification so called prestandard, which is in force three years after publishing.

1. Introduction

This report gives an overview of standardisation of solid biofuels and of equipment for biofuel utilisation as well as ideas and proposals for development of additional standards related to the bioenergy field.
Existing standards have been analysed for their suitability in biofuel trade and usage. During this analysis and in contacts with numerous biofuel professionals, needs and ideas for further standards were identified and collected, see Chapter 3.
In the Chapter 4 there is a summary of the project.
In the Appendices A – D there are short summaries of both published standards and standards under development in Europe. The European organisation for standardisation, CEN, is in the process of developing a whole series of standards for solid biofuels. There are also CEN equipment standards and guidelines, both published and under development. Beside CEN standards there are national standards in most countries. A short description of each standard is presented including contact information for enquires. These contacts are from the project partners´organisations. In Appendix E a draft guideline for peat is summarised. In the Appendix F the standardisation bodies are listed, where already published standards can be purchased.
Countries considered in the national standards section (Appendix C) are Denmark, Estonia, Latvia, Lithuania, Finland, Germany, Norway, Poland Russia and Sweden as well as Austria and the UK. A Nordic ecolabelling standard for pellets, which is under development, is also included.

2. Current standardisation

This chapter presents CEN standards and national standards on solid biofuel and equipment for their usage. Both published standards and standards under development are summarized. National standards related to the bioenergy field in Denmark, Estonia, Latvia, Lithuanina Finland, Germany, Norway, Russia, Sweden as well as Austria and the UK are summarized.

2.1 CEN standards

2.1.1 CEN standards for solid biofuels

One of the most important tools for a strong common biofuel market around the Baltic Sea is the standards for solid biofuels currently under development in CEN. Summaries can be found below. The standards can be used as tools to enable both efficient trading of biofuels and good understanding between seller and buyer, as well as in communication with equipment manufacturers.

The Commission has given the CEN a mandate to develop standards for solid biofuels in order to facilitate the trading of biofuels. The scope has been defined by the Commission and is the same as the exclusions from the Waste Incineration Directive (*Directive 2000/76/EC*).

The CEN technical committee for solid biofuels, TC 335, started in year 2000 and decided to start by making prestandards so called Technical Specifications, TSs, in order to serve the market as fast as possible. The main part of this work is now finished and most TSs will be published no later than in 2006. The upgrading of the TSs to full standards will start in 2006.

A Technical Specification, TS, has to be upgraded (or deleted) after three years. When it is upgraded to a full CEN standard and all conflicting national standards in Europe have to be withdrawn.

For summaries of each CEN Technical Specification see Appendix A.

2.1.2 CEN equipment standards

For summaries of CEN standards on equipment for biofuel usage see Appendix B.

2.2 National standards and guidelines

Both new and old EU member countries are obliged to establish a national standardisation institute seeking to enforce the use of the common European standards developed in CEN. National standards in conflict with CEN standards are not allowed. A national standard can however exist in parallel with a CEN prestandard, CEN/TS. National standards on subjects not covered by the CEN are of course no problem.

In the Appendix C national standards related to the bioenergy field are summarized.The review covers Denmark, Estonia, Latvia, Lithuania, Finland, Germany, Norway, Poland, Russia, Sweden and also Austria and the UK.

A Nordic standard for ecolabelling of biofuel pellets is currently under development. This development is summarized in Appendix C as C.11.

3. Future prospects

3.1 General

During the review of existing standards and in the contacts with numerous biofuel professionals, needs and ideas for further standards were identified and collected. They are listed and explained in this chapter.

The CEN-standards and technical specifications can meet the major requirements of the standardisation needs for solid biofuels and small-scale equipment. The CEN technical specifications for solid biofuels are currently being finalised and more experience from their implementation is needed. The need for a special information and training project for the Baltic countries and Russia has been identified. The reason is that the Baltic States have not participated actively in the CEN work and Russia is not even a CEN member.

Many participants in the Tallinn workshop expressed that it is difficult to find a specific standard, because websites include only the title of a standard, and no description of the scope and other content is available. The summaries in this report could be of help in this resopect. The Russian experts complained that for them it is difficult to purchase international standards.They should be able to contact national standards organisations listed in Appendix F.

The following additional standards were found to be urgently needed:

• Standard for storage and handling of solid biofuels, see 3.2
• Standard for requirements and measurements for field testing of 300 kW – 4 MW biomass boilers, see 3.3
• Standard for classification of ash from biofuels, see 3.4.
• Guidelines for peat classification, sampling and and analysis of properties, see 3.5

3.2 Storage and handling standard

The growth in the use of biofuels that Europe has experienced during the past 10 – 15 years has implied a significant increase in the amount of biofuel handled. The size of the storages and transports as well as the number of locations where biofuel is handled and/or stored has risen markedly. The personnel operating these large amounts of biofuels work in a business with a very short history of experience.

This assumption is confirmed by the fact that the market has seen a lot of fires in biofuel storages that could easily have been avoided by following simple rules for handling and storing. For this reason it is argued that a short standard or guideline for correct handling and storing of biofuels, based on existing (although rather limited) research, would prevent accidents and loss of biofuels through fires and can furthermore prevent unnessecary deterioration of biofuel in store.

Health issues are very important and could be either included or handled in a separate standard.

3.3 Field testing of 300 kW – 4 MW biofuel boilers

Equipment standards include currently only small-scale combustion equipments (CEN/TC 295) and the scope of the standards include measurements of heat out, emissions and efficiency and requirements of safety issues.

The works of TC 295 is connected closely to the Construction Products Directive (CPD), Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products. All published standards will be modified to hEN-standards, which ensure that the standardised products meeting the requirements of the standard meet also the essential requirements of the CP Directive. This is a way (not the only one) for manufacturers to get CE marks for their products.

It is difficult to make any common standards for larger combustion equipment (few megawatts). Usually boilers and handling equipment are taylorised for each plant based

on the locally available biomass fuels.
Currently there are several combustion equipment standards for stoves and boilers up to 300 kW, because boilers of this size can be measured in laboratory conditions.

In the Tallinn workshop it was pointed out the need for a simplified method for field measurements for boilers of few megawatts. The earlier mentioned standards cover quite well the needs of quality assurance of small biomass fuel fired appliances. There is a need for simple standard for larger than 300 kW biomass systems, which has to be tested on field. For large power plants exists a well established standard (DIN 1942). It is originally developed for power plants using fossil fuels. It may need updating so that it is better suited also for biomass fuel fired plants.

3.4 Ash classification and ash melting behaviour

Ash from combustion of biofuels can be used to contribute to sustainable forest management. To facilitate such ash usage a classification system for ash from biofuels is needed, including methods for analysis and limit values for heavy metals (usage in the building industry will not be covered).
During the discussion during the workshop held in Tallinn the need of a standard simplified mehod for ash melting behaviour was identified. This is especially needed to evaluate the suitability of different biomass raw materials for pellet production. It is uncertain if the CEN method for ash melting behaviour, which is under development could fullfill this need.
In Denmark a method of a rapid slagging analyser has been developed by Danish Technical Institute. In this method 2 kg of biofuel is ignited with gas on a virgin grate under standard conditions and the ash is valuated visually or by empirical measurements. A slagging analyser described in a standard can be build by any laboratory, and provide information about properties of a biofuel to biofuel purchasers or biofuel producers considering new raw material sources.
Tallinn Technical University has also tested ash melting by so-called “yes or no”-method. In this method biomass is kept in certain temperature (e.g. 1300 $_{o}$C) for certain time to evaluate if biomass is melt or not.
The different ideas for testing of ash melting behaviour were discussed at the workshop in Tallinn. The conclusion was to gather more experience of the CEN method before proposing any other method for standardisation.

3.5 Peat guidelines

In the Baltic Sea Region peat is commonly used together with biofuels in order to improve the biofuel combustion properties and thereby increase boiler efficiency. There is also a significant international trade with peat in the region. Peat reduces slagging problems, fouling and corrosion. Especially when using wood fuel from logging residues, the use of peat is important to avoid combustion problems and down-time. The percentage of peat is dependant on the type of biofuel. Typically 15–20% peat is used. When large amounts of particularly difficult biofuels (e.g. logging residues and used wood) are to be combusted, blends with up to 35% peat are used. Guidelines on classification, handling, storage and testing of peat is needed to facilitate optimizing of biofuel combustion.The classification system and test methods for peat should be

similar to the CEN standards for solid biofuels.
A guideline for fuel peat has been drafted with the help of users of biofuels and peat producers in Finland, Sweden, Estonia, Latvia and Russia and national peat associations. The role of peat industry and utilities has been crucial in developing these guidelines. They have been activily participating in the meetings and collecting statistical information of peat. The intention is to publish the guideline as a Nordtest report by the end of year 2005. National peat associations in Finland and Russia will translate the guidelines into local languages. For a summary of the draft guideline see Appendix E.

4. Summary

The aim of the project is to establish contacts between relevant national organizations in the Baltic Sea Region and Technical Committees within CEN to prepare possible contributions to ongoing activities on solid biofuel standards and further to investigate the needs and possibilities for common test methods and rules regarding biofuels and biofuel machinery and systems in the area.
The work was concentrated on the analysis of existing standards and their suitability in the trade of solid biofuels. Also information on equipment standards for small-scale boilers and stoves were collected.
European standardisation organisation, CEN, is currently preparing 30 different technical specifications for solid biofuels, which are presented in this report. These technical specifications have been drafted in co-operation with the leading bioenergy experts in Europe. They provide a good basis in the future in production, trading and use of solid biofuels. There are also CEN standards on equipment for the usage of biofuel. From the Baltic Sea Area only Denmark, Finland, Germany and Sweden have participated actively in the CEN work. It is essential that the knowledge of CEN standardisation work is transferred to also to the other Baltic Sea countries. This has been one of the major tasks in this project. Members of the project team have a good knowledge of the CEN standardisation as they are participating in the CEN standardisation work.
There are also national standards related to the bioenergy field in most countries. A survey, supported by interviews, was carried out to find information about existing standards and future needs in the Baltic Sea Region. A web based questionnaire (available at http://www.biomasse.teknologisk.dk/survey.htm) was elaborated and has been sent to experts in the countries around the Baltic Sea. Needs of future standards have also been discussed in meetings with experts from industry and in the workshop: *Standardisation of Solid biofuels – Tools for trading* organised in Tallinn on 12 May 2005.
A second, half-day workshop was organised in Riga on 22 August 2005 with 17Latvian participants. Riga workshop was organised together with Riga Technical University.

Participants of the CEN/TC 335 standardisation workshop in Riga on 22 August 2005.

Project results:

The CEN-standards and technical specifications can meet the major requirements of the standardisation needs for solid biofuels and small-scale equipment. The CEN technical

specifications for solid biofuels are currently being finalised and more experience from their implementation is needed. The need for a special information and training project for the Baltic countries and Russia has been identified.
The reason is that the Baltic states have not participated actively in the CEN work and Russia is not even a CEN member.
The following additional standards were found to be urgently needed:
• Standard for storage and handling of solid biofuels.
• Standard for requirements and measurements for field testing of 300 kW – 4 MW biomass boilers
• Standard for classification of ash from biofuels for the use in sustainable forestry.
• Guideline for fuel peat classification, sampling and analysis of properties.
Such standards could preferrably be developed by the Action 2 project team with the help of experts from industry.

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Appendix A. CEN solid biofuel standards

A.1 Terminology

CEN/TS 14588: Solid Biofuels – Terminology, definitions and description
Status: published
Short description: This TS defines the terms within the scope of CEN/TC 335

"Solid Biofuels". Beside the international standards, also national standards and manuals have provided the basis of the TS. Some terms important within specific nations have been added to the terminology: e.g. "black liquor" and "animal husbandry residues" are out of the scope of the mandate, yet included in the TS for information only. Numerically 147 terms and definitions are categorised in a logical structure based on the assumptions that there are different types of solid biofuels, which are produced from different sources and the purpose of which is the conversion into bioenergy.
Additional information: Eija Alakangas, VTT Processes (eija.alakangas@vtt.fi)

A.2 Fuel specification and classes, fuel quality assurance

CEN/TS 14961: Solid Biofuels - Fuel specifications and classes

Status: published
Short description: This TS determines the fuel quality classes and specifications for solid biofuels. The classification principle of the solid biofuels is based on origin and source, major traded forms (briquettes, pellets, fuel powder, sawdust, wood chips, hog fuel, logs, whole wood, straw bales, bundles, bark, chopped straw, grain or seed, shells and fruit stones, fibre cakes) and properties of solid biofuels. It enables classification from first to fourth level. Hierarchical classification system includes four types: woody biomass, herbaceous biomass, fruit biomass and biomass blends and mixtures. This TS involves special recuirements for chemically treated biomass.
Additional information: Eija Alakangas, VTT Processes (eija.alakangas@vtt.fi)

CEN/TS 15234 Solid Biofuels - Fuel quality assurance

Status: under preparation
Short description: This draft TS defines the procedures to guarantee solid biofuel quality through the whole supply chain from the biofuel origin to the delivery to the end-user, and describes measures to provide adequate confidence that specified quality requirements are fulfilled. It covers the fuel quality assurance of the supply chain and the information to be used in the quality control of the product, which ensures traceability and gives confidence by demonstrating that all processes along the supply chain up to the point of the delivery to the end-user are under control.
Additional information: Eija Alakangas, VTT Processes (eija.alakangas@vtt.fi)

Solid Biofuels – A guide for a Fuel Quality Assurance System

Status: under preparation
Short description: This draft guide is to assist all operators within the solid biofuel supply chains to compose a quality assurance manual according to TS "Solid Biofuels - Fuel quality assurance". This document can be considered as a bridging element over the gap between the ISO 9001:2000 quality management principles and the specific needs of operators in the solid biofuel market. Methodology of this guideline can be applied without having a full quality management system already in place.
Additional information: Eija Alakangas, VTT Processes (eija.alakangas@vtt.fi)

A.3 Sampling and sample reduction

The TSs for sampling and sample preparation are intended for all user groups, i.e.

producers, traders and buyers as well as regulators, controllers and laboratories. There are four TSs related to sampling and sample reduction of solid biofuels:
A3
- CEN/TS 14778-1, Solid biofuels Sampling – Part 1: Methods for sampling;
- CEN/TS 14778-2, Solid Biofuels Sampling – Part 2: Methods for sampling particulate material transported in lorries;
- CEN/TS 14779, Solid biofuels – Sampling – Methods for preparing sampling plans and sampling certificates;
- CEN/TS 14780, Solid biofuels Methods for sample preparation.

These TSs can be used, for example, when the samples are to be tested for mechanical, physical or chemical properties. It should be noted that they are not intended for obtaining very large samples that are required for the testing of bridging properties. The principle of each sampling method is that every particle in the lot or sub-lot to be represented by the sample should have an equal probability of being included in the sample. The applicability of the TSs related to sampling and sample reduction is based on the categories of solid biofuels given in Table 1.

Table 1. Categories of solid biofuels to be sampled

Number	**Definition**
1	fine and regularly-shaped particulate materials, particle sizes up to about 10 mm that can be sampled by using a scoop or pipe, e.g. sawdust, olive stones and wood pellets
2	coarse or irregularly-shaped particulate materials with particle sizes up to about 200 mm that can be sampled by using a fork or shovel, e.g. wood chips and nut shells, forest residue chips, and loose straw
3	baled materials that require a special sampling tool to be used if the bales are not to be broken open for sampling, e.g. baled straw or grass
4	large pieces (particles sizes above 200 mm) which are to be picked manually
5	fibrous and vegetable waste dewatered in belt press

CEN/TS 14778-1: Solid Biofuels – Sampling – Part 1: Methods for sampling

Status: under preparation

Short description: This TS is applicable to solid biofuels belonging to categories 1, 2, 3, 4 and 5 presented in Table 1. It describes both manual and mechanical methods for sampling of solid biofuels from both stationary and moving material: the apparatus for sampling is presented and the size and number of the increments needed to provide a representative sample are defined.

Additional information: Antero Moilanen, VTT Processes (antero.moilanen@vtt.fi)

CEN/TS 14778-2: Solid Biofuels – Sampling – Part 2: Methods for sampling particulate material transported in lorries

Status: under preparation

Short description: This TS describes methods for sampling of solid biofuels transported in lorries and is applicable to solid biofuels belonging to categories 1 and 2 presented in Table 1. It defines the minimum of five increments to be taken from every

lorry-load and instructs to take into account single lorry loads and continuous delivery of one source in the sampling plan.
Additional information: Antero Moilanen, VTT Processes (antero.moilanen@vtt.fi)

CEN/TS 14779: Solid Biofuels - Methods for preparing sampling plans and sampling certificates
Status: under preparation
Short description: This TS is applicable to solid biofuels belonging to categories 1, 2, 3, 4 and 5 presented in Table 1. It defines the calculation of the volume required for the combined sample and the preparation of both full and brief sampling plans, as well as sampling certificates.
Additional information: Antero Moilanen, VTT Processes (antero.moilanen@vtt.fi)

CEN/TS 14780: Solid Biofuels - Methods for sample preparation
Status: under preparation
Short description: This TS is applicable to solid biofuels belonging to categories 1, 2, and 4 presented in Table 1. It describes methods for reducing combined samples to laboratory samples and further, laboratory samples to sub-samples and general analysis samples by means of following basic sample preparation processes: mass-reduction of the sample by division and particle size-reduction of the sample.
Additional information: Antero Moilanen, VTT Processes (antero.moilanen@vtt.fi)

A.4 Mechanical and physical properties

CEN/TS 14918: Solid Biofuels - Methods for the determination of calorific value
Status: published in May 2005
Short description: This TS defines a method for the determination of the gross calorific value of a solid biofuel at constant volume and at reference temperature of 25 °C in a bomb calorimeter calibrated by combusting certified benzoic acid. It is applicable to all solid biofuels. In the TS, the reagents, apparatus, test sample preparation, calorimetric procedure and calibration related to the determination process, and the calculation of net calorific value are presented.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15103: Solid Biofuels - Methods for the determination of bulk density
Status: under preparation
Short description: This draft TS describes a method for determining bulk density of solid biofuels by using a standard measuring container and is applicable to all solid biofuels with a nominal top size of maximum 100 mm. The test portion is filled in a standardised way into a standard container of a given size and shape. Bulk density is calculated from the net weight per standard volume and reported for the measured moisture content. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 14774-1: Solid Biofuels – Methods for the determination of moisture content – Oven dry method – Part 1: Total moisture – Reference method

Status: published

Short description: This TS is applicable to all solid biofuels and describes the reference method for determining the total moisture content of a sample by drying in an oven. It should be used when high precision of the determination of moisture content is necessary. A sample with the minimum mass of 300g (preferably more than 500g) is dried at a temperature of (105 ± 2°C) and in which the air atmosphere changes between 3 and 5 times per hour, until constant mass is achieved. Moisture percentage is calculated from the loss in sample mass. Procedure for the correction of buoyancy effects is included in the method.The dried sample has to be weighed while still hot, which gives a buoyancy effect which has to be compensated for when the highest precision is required. The apparatus, sample preparation, procedure and calculation are described.

Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 14774-2: Solid Biofuels – Methods for the determination of moisture content – Oven dry method – Part 2: Total moisture – Simplified method

Status: published

Short description: The principle of this TS is similar to CEN/TS 14774-1, and it may be used when the highest precision is not needed e.g. for routine production control on site i.e.most analysis. The only difference compared to Part 1 is that there is no buoyancy compensation in Part 2. The sample with the minimum mass of 300g (preferably more than 500g) is dried at a temperature of (105 ± 2°C) in air atmosphere until constant mass is achieved and moisture percentage is calculated from the loss in sample mass. The apparatus, sample preparation, procedure and calculation are described.

Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 14774-3: Solid Biofuels – Methods for the determination of moisture content – Oven dry method – Part 3: Moisture in general analysis sample

Status: published

Short description: This TS is applicable to all solid biofuels and it describes the method for determining the moisture in the analysis sample by drying the sample in an oven. It is to be used for general analysis samples described in CEN/TS 14780 Mthods for Sample Preparation. General analysis sample is defined as sub-sample of a laboratory sample having a nominal top size of 1 mm or less and used for a number of chemical and physical analysis. The analysis sample is dried either in air atmosphere or in nitrogen atmosphere at a temperature of (105 ± 2) °C and the moisture percentage is calculated from the loss in the test sample mass. The apparatus, sample preparation, procedure and calculation are described.

Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com

CEN/TS 15148: Solid Biofuels – Methods for the determination of the content of volatile matter
Status: under preparation
Short description: This draft TS is applicable to all solid biofuels and defines the method used for the determination of volatile matters of solid biofuels. This means determination of the loss in mass, less that due to moisture, when solid biofuel is heated out of contact with air under standardised conditions. A test portion of the general analysis sample is heated out of contact with air at (900 ± 10) °C for 7 min, and the percentage of volatile matter is calculated from the loss in mass of the test portion after deducting the loss in mass due to moisture. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 14775: Solid Biofuels – Method for the determination of ash content
Status: published
Short description: This TS specifies the method for the determination of ash content of all solid biofuels. Ash content is defined as the mass of inorganic residue remaining after ignition of a fuel under specified conditions, expressed as a percentage of the mass of the dry matter in the fuel. The ash content of the sample is calculated from the mass of the residue remaining after the sample is heated in air under rigidly controlled conditions of time, sample weight and equipment specifications to a controlled temperature of (550 ± 10) °C. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15370-1: Solid Biofuels – Method for the determination of ash melting behaviour
Status: under preparation
Short description: This draft TS specifies a method for the determination of the ash melting behaviour of all solid biofuels. Ash from the solid biofuel sample is prepared according to the method specified in CEN TS 14775 Solid Biofuels- method for the determination of ash content. A test piece made from the ash is heated and continuously observed. The temperatures at which characteristic changes of shape occur are recorded. The temperatures to be recored are the “shrinkage starting temperature”, the “deformation temperature”, the “hemisphere temperature” and the “flow temperature”. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15149-1: Solid Biofuels – Methods for the determination of particle size distribution. Part 1: Oscillating screen method using screen apertures of 3,15 mm and above
Status: under preparation

Short description: This draft TS specifies a method for the determination of the size distribution of particulate biofuels by the oscillating screen method. The method is intended for particulate biofuels only, i.e. materials having been reduced in size (such as most wood fuels) or materials already in a particulate form (such as grains and nut shells) It is applicable also to particular compressed fuels. To determine the particle size distribution a sample is subjected to sieving through horizontally oscillating sieves, sorting the particles in decreasing size classes by either manual or mechanical means. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15149-2: Solid Biofuels – Methods for the determination of particle size distribution. Part 2: Vibrating screen method for small particles using screen apertures of 3,15 mm and below
Status: under preparation
Short description: This draft TS specifies a method for the determination of the size distribution of particulate biofuels by the vibrating screen method. It is applicable to particulate fuels with a nominal top size less than 3,15 mm (e.g. sawdust). A sample is subjected to sieving through horizontal vibrating sieves, sorting the particles in decreasing size classes by mechanical means. Manual sieving is excluded due to the risk of clogging of the sieve holes. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15149-3: Solid Biofuels – Methods for the determination of particle size distribution. Part 3: Rotary screen method
Status: under preparation
Short description: This draft TS specifies a method for the determination of the size distribution of particulate biofuels by the rotary screen method. It is applicable to all particulate uncompressed fuels with a nominal top size of 3,15 mm and over, e.g. wood chips, hog fuel and olive stones. A sample is subjected to sieving through sieves in a rotary sieving machine sorting the particles by increasing size. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15150: Solid Biofuels – Methods for the determination of the particle density (of pellets and briquettes)
Status: under preparation
Short description: This draft TS describes the method for determining the particle density of irregularly shaped pieces of compressed fuels such as pellets or briquettes. Both mass and volume of an individual particle or a group of particles are determined. The volume is determined by measuring the buoyancy in a liquid. Buoyancy of a body is equal to the weight of the displaced volume of a liquid. The apparent loss in weight between a measurement in air and a subsequent measurement in liquid marks its buoyancy. The volume of the sample is calculated via the density of the applied liquid. For regularly shaped briquettes the volume could also be estimated by stereometric means. This is described in an informative Appendix in the TS. The apparatus, sample

preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/TS 15210-1: Solid Biofuels – Methods for the determination of the mechanical durability for pellets
Status: under preparation
Short description: This draft TS defines the requirements and methods for testing the mechanical durability of pellets. The durability is the measure of the resistance of densified fuels towards shocks and/or abrasion in consequence of transport and handling processes. The test sample is subjected to controlled shocks by collision of fuel particles against each others and against the walls of a defined rotating test chamber. The durability is then calculated from the mass of sample remaining after separation of abraded and fine broken particles. The test chamber according to the TS is a box made of rigid material. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

CEN/15210-2: Methods for the determination of the mechanical durability of briquettes
Status: under preparation
Short description: This draft TS defines the requirements and methods for testing the mechanical durability of briquettes. The durability is the measure of the resistance of densified fuels towards shocks and/or abrasion in consequence of transport and handling processes. The test sample is subjected to controlled shocks by collision of fuel particles against each others and against the walls of a defined rotating test chamber. The durability is then calculated from the mass of sample remaining after separation of abraded and fine broken particles. The test chamber according to the TS is a cylindrical steel drum. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

Solid Biofuels – Methods for the determination of bridging properties of particulate fuels
Status: under preparation
Short description: This draft technical report describes a method for determining the bridging properties of particulate biofuels that either have been reduced in size (most wood fuels or cut straw) or are physically in a particulate form (olive stones, nut shells and grain). A sample is subjected to bridging by placing it over an expandable slot opening facilitating the building of a bridge. The opening width of the slot when the bridge collapses is taken as a measure for the bridge building properties of the sample. The apparatus, sample preparation, procedure and calculation are described. It should be recognised that bridging is not an absolute value. It is influnced by fuel related properties (such as moisture content and proportion of long particles) as well as handling related parameters (such as friction against surfaces and angle of repose).
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

Solid biofuels – Method for determination of the particle size distribution of disintegrated particles
Status: under preparation
Short description: This draft TS defines the method for determinating the size distribution of particles compressed to pellets. The size distribution is determined after the pellets sample has been disintegrated in deinonised water and dried in a drying cabinet in two steps. The dry material is divided into two parts and each part is sieved separately in accordance with TS "Solid Biofuels – Methods for the determination of particle size distribution – Part 2". The average of the results from the two sievings is reported. The apparatus, sample preparation, procedure and calculation are described.
Additional information: Nina Haglund, NAH Consulting (nina.haglund@telia.com)

A.5 Chemical properties

CEN/TS 15104: Solid Biofuels – Determination of total content of carbon (C), hydrogen (H) and nitrogen (N) content – Instrumental methods
Status: under preparation
Short description: This draft TS describes following method for the determination of total carbon, hydrogen and nitrogen contents in solid biofuels: a known mass of the sample is burnt under such conditions that sample is converted into ash and gaseous combustion products, i.e. carbon dioxide, water vapour, elemental nitrogen and/or oxides of nitrogen, oxides and oxyacids of sulfur and hydrogen halides, which are treated to ensure that any hydrogen associated with sulfur or halides is liberated as water vapour. Oxides of nitrogen are reduced to elemental nitrogen, and combustion products likely to interfere with the subsequent gas-analysis procedures are removed. The carbon dioxide, water vapour and nitrogen mass fractions of the gas stream are then determined quantitatively by appropriate instrumental gas-analysis procedures.
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

CEN/TS 15289: Solid Biofuels - Determination of total content of sulphur (S) and chlorine (Cl) content
Status: under preparation
Short description: This draft TS describes a method for simultaneous determination of the total sulphur and total chlorine content in solid biofuels: procedures for the digestion and different analytical techniques for the quantification of the elements in the digestion solution are described. The method is applicable for all biofuel samples containing more than 50 mg/kg of chlorine and/or sulphur.
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

CEN/TS 15105: Solid Biofuels – Methods for the determination of water soluble chloride (Cl) content, sodium (Na) and potassium (K)
Status: under preparation
Short description: This draft TS describes a method for defining the water soluble content of chloride, sodium and potassium in solid biofuels. The method is applicable for all solid biofuels with water soluble contents more than 50 mg/kg for chloride and

more than 10 mg/kg for sodium and potassium. The principle of the method is following: the sample is heated with water in a closed container at temperature of 120°C for one hour, then digestion volume is adjusted and the contents of chloride, sodium and potassium are determined via different analytical techniques.
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

CEN/TS 15290: Solid Biofuels – Determination of major elements (Al, Si, K, Na, Ca, Mg, Fe, P and Ti)
Status: under preparation
Short description: This draft TS describes methods for determinating the content of major elements of solid biofuels, i.e. Al, Si, K, Na, Ca, Mg, Fe, P and Ti, also Ba and Mn can be determined through the methods. Part A of the TS describes the direct determination on the fuel, and part B presents the determination on a prepared 550°C ash. The principle of the procedure is following: the digestion of the sample is carried out in a closed vessel and through method presented either in part A or part B. The detection of the elements is done by Inductively Coupled Plasma Optical Emission Spectrometry (ICP/OES), Inductively Coupled Plasma Mass Spectrometry (ICP/MS) or Flame Atomic Absorption Spectrometry (FAAS).
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

CEN/TS 15297: Solid Biofuels – Determination of minor elements (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mo, Mn, Ni, Pb, Se, Te, V and Zn)
Status: under preparation
Short description: This draft TS defines the methods for determinating the content of the minor elements in all solid biofules, i.e. As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, V and Zn. The principle of the procedure is following: the analysis sample is prepared according to CEN/TS 14780 and digested in a closed vessel made from fluoro plastic using nitric acid, hydrogen peroxide and in some cases hydrofluoric acid in a thermally heated oven or a microwave oven.
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

CEN/TS 15296: Solid biofuels – Calculation of different bases
Status: under preparation
Short description: This draft TS gives formulae, which allow analytical data relating to solid biofuels to be expressed on the various different bases in common use. Consideration is given to corrections that may be applied to certain determined values for solid biofuels prior to their calculation to other bases. The principle of the calculation is that in order to convert an analytical result expressed on one basis to another basis, it is multiplied by the appropriate formula after insertion of the requisite numerical values.
Additional information: Raili Vesterinen, VTT Processes (raili.vesterinen@vtt.fi)

Appendix B. CEN equipment standards

B.1 Boiler and burner standards

EN 303-5: Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300 kW – Terminology, requirements, testing and marketing
Status: published in 1999
Short description: This standard covers the following solid fuels: splitted and chopped wood (billets), chipped wood (chips), wood pellets and briquettes containing natural binding materials only, sawdust, bituminous coal, lignite, coke and anthrasite. The standard determines the flue gas emissions as well as particle content in flue gas, and efficiencies at nominal and maximum output, and classifies the boilers into three classes on the basis of capacity (< 50 kW, 50-150 kW and 150-300 kW).
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 12953-12: Shell boilers – Part 12: Requirements for grate firing systems for solid fuels for the boiler
Status: published in 2003
Short description: This part of EN 12953-12 specifies the requirements for internal or external grate firing systems commencing at the fuel bunkers and ending at the ash extraction plant. For combination of various firing systems, the individual requirements of each system also apply. If several fuels are burnt simultaneously or if a fuel quality varies considerably, additional safety measures can be necessary, especially with respect to limitation of the fuel flow into the firing system and ensuring proper air supply to the individual fuels. This standard covers the following solid fuels: all coal qualities, other fossil solid fuels, biomass solid fuels, municipal waste solid fuels and industrial waste solid fuels.
Available National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

Pellet burners for small heating boilers – Definitions, requirements, testing, marking (CEN/TC 57)
Status: under preparation
Short description: This European standard relates to pellet burners with a nominal rating of not more than 70 kW, intended for fitting with appropriate boilers for hot water according to EN 303-2 and EN 303–5 *(page 1)*, and intended for high quality pellets according to CEN/TS 14961 (*page 1*). It covers all external equipment which influences the safety systems. It contains requirements and test methods for safety, combustion quality, operating characteristics and maintenance.
Available when published: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

B.2 Space heating standards

EN 13240: Roomheaters fired by solid fuel – Requirements and test methods

Status: published in 2001
Short description: This standard is applicable to non-mechanically fired appliances that burn solid mineral fuels and/or wood, in accordance with the appliance manufacturer's instructions. This standard specifies requirements relating to the design, manufacture, construction, performance (efficiency and emission), safety, instructions and marking, together with associated test methods and test fuels for the type testing of appliances, the main function of which is to produce heat by convection and/or radiation and which may also produce hot water.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 13240/A2: Roomheaters fired by solid fuel – Requirements and test methods
Status: published in 2004, candidate for harmonised
Short description: This amendment is applicable to non-mechanically solid fuel-fired roomheaters, the primary function of which is to provide heat into the space of installation and which are listed under categories 1a and 2a of table 1 of *EN 13240*. Additionally, where fitted with a boiler, roomheaters within this amendment provide also central heating.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 12809: Residential independent boilers fired by solid fuel – Nominal heat output up to 50 kW – Requirements and test methods
Status: published in 2001
Short description: This standard is applicable to hand and automatically fired appliances, the nominal heat output of which range up to 50 kW and which are designed to be used only with open vented systems at a working pressure not exceeding 2 bar. These appliances' function is primarily to provide hot water for central heating and secondary to provide space heating to the place of installation. The standard specifies requirements relating to the design, manufacture, construction, performance (efficiency and emission), safety, instructions and marking together with associated test methods and test fuels for type testing residential independent heating and hot water boilers fired by solid fuel, i.e. naturally occuring or manufactured solid mineral fuels, peat briquettes, natural or manufactured wood logs and biomass based products in an identifiable and consistent form.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 12809/A1: Residential independent boilers fired by solid fuel – Nominal heat output up to 50 kW – Requirements and test methods
Status: published in 2004, candidate for harmonised
Short description: The draft amendment is applicable to hand and automatically fired

appliances, the nominal heat output of which range up to 50 kW and which are designed to be used only with open vented systems at a working pressure not exceeding 2 bar.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 12815: Residential cookers fired by solid fuel – Requirements and test methods
Status: published in 2001
Short description: This standard is applicable to appliances, the primary function of which is to cook and the secondary function of which is to provide heat into the space where they are installed. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating. The standard specifies requirements relating to the design, manufacture, construction, safety and performance (efficiency and emission), instructions and marking together with associated test methods for type testing, residential cooking appliances fired by solid fuel. These appliances may burn solid mineral fuels, peat briquettes, wood or be multi-fuel in accordance with the appliance manufacturer's instructions.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 12815/A1: Residential cookers fired by solid fuel – Requirements and test methods
Status: published in 2004, candidate for harmonised
Short description: This amendment is applicable to solid fuel-fired residential independent boilers used primarily for cooking and secondary for space heating in residential buildings with supply of hot water. This amendment is not applicable to hopper fed or mechanically fired appliances or appliances having fan assisted combustion air.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 13229: Inset appliances including open fires fired by solid fuels – Requirements and test methods
Status: published in 2001
Short description: This standard is applicable to residential open fires and inset appliances fired by solid fuels, the intended use of which is space heating in residential buildings with possible supply of hot water. It specifies requirements relating to the design, manufacture, construction, safety and performance (efficiency and emission), instructions and marking together with associated test methods for type testing.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)
EN 13229/A2: Inset appliances including open fires fired by solid fuels – Requirements and test methods
Status: published in 2004, candidate for harmonised
Short description: This amendment is applicable to solid fuel-fired inset appliances

including open fires, the intended use of which is space heating in residential buildings with possible supply of hot water. This amendment covers definitions, requirements and test methods for mechanically fed inset appliances including open fires.
Available: National standardisation body
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 14785: Residential space heating appliances fired by wood pellets - Requirements and test methods
Status: under preparation
Short description: This standard specifies requirements relating to the design, manufacture, construction, safety and performance (efficiency and emissions), instructions and marking together with associated test methods and test fuels for typetesting
residential space heaters fired by pellets, and mechanically fed up to 50 kW nominal heat output. The appliances provide heat into the space of installation and may be operated with either natural draught or fan-assisted combustion air. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating.
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

EN 15250: Slow heat release appliances fired by solid fuel – Requirements and test methods
Status: under preparation
Short description: This European Standard specifies requirements relating to the design, manufacture, construction, safety and performance (efficiency and emission) instructions and marking together with associated test methods and test fuels for type testing residential slow heat release appliances fired by solid fuel. This standard is applicable to hand fuelled intermittent burning slow heat release appliances having thermal storage capacity such that they can provide heat for a period of time after the fire has gone out. These appliances provide heat into the space where they are installed.These slow heat release appliances may be supplied either as assembled appliance or as pre-fabricated sections designed to be built on site in accordance with the manufacturer's specified construction design. One off installations are not included. These appliances may burn either solid mineral fuels, peat briquettes, natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions. This standard is not applicable to appliances with fan assisted combustion air.
Additional information: Heikki Oravainen, VTT Processes (heikki.oravainen@vtt.fi)

B.3 Agricultural and forestry machinery

EN 609-1:1999: Agricultural and forestry machinery - Safety of log splitters - Part 1: Wedge splitters
EN 609-2, 2000: Agricultural and forestry machinery - Log splitters - Safety - Part 2: Screw splitters

Appendix C. National standards for solid biofuel and peat

C.1 Denmark

DK – Wood pellets of "HP" quality
Status: published
Short description: The norm describes requirements for a high quality pellet for the Danish and other markets.
Available: HP briketter, Industrivej 6, 4800 Vildbjerg, Denmark
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

DK – Quality classes for fuel wood chips
Status: published
Short description: The norm describes four different types of wood chips that suits different combustion units.
Available: The National Forest and Nature Agency, Denmark (www.sns.dk)
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

C.2 Estonia, Latvia and Lithuania

Estonia and Latvia

The survey found no Estonian or Latvian standards for solid biofuels. It is likely that there exist standards for wood chips classification. Estonian and Latvian producers of wood pellets for export use the standards of the import countries.

Lithuania

The survey found no Lithuanian standards for solid biofuels. However, there may exist a Lithuanian standard for wood chip classification.

C. 3 Finland

FI – Quality guidelines for fuel peat 1989
Status: published in 1989
Short description: These quality guidelines have been adopted for milled fuel peat in 1989 and are still in use in milled fuel peat trade. The purpose of this manual is to define the procedure, by which the quality of fuel peat can be given and defined unambiguously and appropriately. It provides recommendations for using terms and definitions, sampling and sample handling and specifying characteristics and quality definitions related to fuel peat.
Available: Association of Finnish Peat Industries (http://www.turveliitto.fi)
Additional information: Assiosiation of Finnish Peat Industries

FI – Quality guidelines for fuel peat 1991
Status: published in 1991
Short description: These quality guidelines have been adopted for sod peat in 1991. The purpose of this manual is to define the procedure, by which the quality of fuel peat can be given and defined unambiguously and appropriately. It provides recommendations for using terms and definitions, sampling and sample handling and specifying characteristics and quality definitions related to fuel peat. The long-term aim has been to combine and revise the manuals 1989 and 1991 in order to prepare a

manual that comprises both milled fuel peat and sod peat.
Available: Association of Finnish Peat Industry (http://www.turveliitto.fi)
Additional information: Association of Finnish Peat Industry

FI – Quality guidelines for solid wood fuels in Finland
Status: published in 1998, translated from Impola, R., Puupolttoaineiden laatuohje, FINBIO Julkaisuja/Publications 6. ISSN 1239-4874, ISBN 952-5135-06-3, 29 p.
Short description: This document defines the methods, by which the quality and energy amount of wood fuels - fuel chips, sawdust and bark - can be reported and stated unambiguously and appropriately. It provides directions for definitions, quality classes and determination, sampling and sample treatment and determination of properties related to solid wood fuels. Only clean wood fuels are covered in this manual, not wood that has been chemically treated or coated or painted.
Available: Finnish Bioenergy Association, FINBIO (http://www.finbio.fi)
Additional information: Risto Impola (risto.impola@vtt.fi)

SFS 5875: Solid recovered fuel. Quality control system
Status: published in 2000
Short description: This standard defines the procedure and requirements, by which the quality of recovered fuel, produced for the purpose of energy production from sourceseparated
waste, can be controlled and reported unambiguously. The standard covers
the whole chain of supply from the source-separation of wastes to the delivery of recovered fuel, but does not concern untreated wood wastes, like bark, sawdust and forestry residues.
Available: Finnish Standards Association, SFS (http://www.sfs.fi/)
Additional information: Finnish Standards Association, SFS (sfs@sfs.fi)

C.4 Germany

DIN 51731: Standard of wood pellets
Status: published in 2000
Short description: This standard defines the requirements of the wood pellet quality. Dimensions of pellets are classified in five different classes. Requirements for particle density is 1 000–1 400 kg/m^3, moisture content, <12%, ash content <1.5% and net calorific value as received 4,8–5,4 kWh/kg. Standard also gives requirements for heavy methals and some other chemical composition of pellets.
Available: German Standardisation institute (DIN) and national standardisation body
Additional information: German Standardisation institute, DIN (www.din.de)
Analysis of chemical or physical properties:
- **DIN 22022,** Solid fuels – Determination of contents of trace elements
- **DIN 51701,** Testing of solid fuels; sampling and sample preparation
- **DIN 51900**, The net calorific value of solid fuels for dry matter
- **DIN 51 718**; The determination method of moisture content
- **DIN 51705**; Determination of bulk density of solid fuels
- **DIN 51719**; The determination of ash content

- **DIN 51730**; Ash melting behaviour
- **DIN 51724**; Sulphur
- **DIN 51721** Carbon and hydrogen
- **DIN 51722** Nitrogen,
- **DIN 51725** Phosphorus
- **DIN 51727** Chlorine
- **DIN 51720**;Volatiles
- **ISO/DIN 15238** Heavy metals (Cd), ISO/DIN 15237 (Hg), ISO/DIS 8983 (Cr, Cu, Mn, Ni, Pb, V and Zn)
- **DIN 51723**; Other chemical analyses
- **DIN 51729-8,** Determination of soda and potash (Na_2O, K_2O) contents – fuel ash
- **DIN 51729 – 10 and 11**, Determination of chemical composition of fuel ash.

C.5 Norway

Norwegian standards relating to biofuels and firewood:
- **NS 3165, 1999**: Biofuel - Cylindrical pellets of pure wood - Classification and requirements
- **NS 3166, 1999**: Biofuel - Determination of mechanical strength of pellets
- **NS 3167, 1999**: Biofuel - Determination of moisture content in laboratory samples
- **NS 3168, 2000**: Biofuel - Fuelbriquettes - Classification and requirements
- **NS 4414, 1997**: Firewood for domestic use

C.6 Poland

The survey found a Polish standard for classification of wood chips. Beside this the survey found that a coal laboratory working also with biofuels have developed several standards for determination of chemical properties of solid biofuels, as can be seen below.

Size classes for wood chips (only in Polish)
Status: Published
Short description: The norm classifies types of traded wood chips.
Available: Polish Forest Agency
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
Sample preparation, Q/ZK/P/15/04/A
Status: published
Short description: The norm describes the right way to prepare a sample for analysis in a laboratory.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

Total and analytical moisture, Q/ZK/P/15/05/A
Status: published
Short description: The norm describes suitable methods to determine total and analytical moisture in biomass.

Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
Ash content, Q/ZK/P/15/06/A
Status: published
Short description: The norm describes suitable methods to determine ash content in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
Volatile matter content, Q/ZK/P/15/07/A
Status: Published
Short description: The norm describes suitable methods to determine volatile matter content in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

Total sulphur content, Q/ZK/P/15/08/A
Status: published
Short description: The norm describes suitable methods to determine total sulphur content in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
Ash sulphur content, Q/ZK/P/15/10/A
Status: published
Short description: The norm describes suitable methods to determine ash sulpkur content in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
C, H, N content, Q/ZK/P/15/09/A
Status: published
Short description: The norm describes suitable methods to determine C, H and N content in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

Net and gross calorific value, Q/ZK/P/15/03/B
Status: published
Short description: The norm describes suitable methods to determine net and gross calorific value in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)
Ash fusion temperatures, Q/ZK/P/15/11/A
Status: published
Short description: The norm describes suitable methods to determine ash fusion temperatures in biomass.
Available: Institute for Chemical Processing of Coal, Zabrze, Poland
Additional information: Max Nitschke, Elsam Engineering (man@elsam-eng.com)

C.7 Russia

The most widely applied system of standards in Russia is the GOST ("gosudartsvennye standarty"), i.e. the State Standards of the Russian Federation. Compared to other standard systems and indeed the European CEN, the GOST standards are much more mandatory.

The Russian producers of solid biofuels for export (mostly wood pellets) use the standards of the import countries. There exist Russian standards for solid fuels including peat and standards for fuel peat only, as well as standards specifying wood chips, crushed wood and firewood. Standards listed in this report can be found from both the GOST-website (*http://www.gost.ru*) and website of the East View Information Services (*http://www.eastview.com*)

Russian wood fuel specification standards:
- **GOST 15815-83**: Technological chips. Specifications (published 1985)
- **GOST 23246-78**: Crushed wood. Terms and definitions (published 1979)
- **GOST 3243-88**: Firewood. Specifications (published 1990)

Russian peat standards:
- **GOST 21123-85**: Peat. Terms and definitions (published 1986)
- **GOST 13674-78**: Peat. Acceptance rules (published 1979)
- **GOST 11303-75**: Peat and products of its processing. Method of preparation of analysis sample (published 1977)
- **GOST 10538-87**: Solid fuel. Methods for determination of chemical composition of ash (published 1988)
- **GOST 18132-72**: Peat briquetts and semibriquetts. Method for determination of mechanical strength (published 1974)
- **GOST 10650-72**: Peat. Determination of the disintegration degree (published 1974)
- **GOST 26801-86**: Peat. Method for determination of ash content in deposit (published 1987)
- **GOST 9963-84**: Peat bricks for heating purposes. Technical requirements (published 1986)
- **GOST 50902-96**: Fuel peat for pulverised burning. Specifications (published 1997)
- **GOST 51062-97**: Sod fuel peat for heating purposes. Specifications (published 1998)

C.8 Sweden

Sweden has taken a very active part in the CEN standardisation of solid biofuels, and the CEN TSs are gradually replacing the Swedish standards in Swedish laboratories. Unfortunately the CEN TSs for solid biofuels do not cover peat, which is frequently used together with biofuels in Sweden, and so there is a need for guidelines providing information on how to apply the CEN TSs for analysis of peat samples. Current Swedish standards for solid biofuels and peat are all listed below.

Physical and mechanical test methods:
- **SS 18 71 06**: Solid biofuels and peat – Terminology (2000)
- **SS 18 71 13**: Solid biofuels and peat – Sampling (1998)
- **SS 18 71 14**: Solid biofuels and peat – Sample preparation (1992)

- **SS 18 71 20**: Solid biofuels and peat – Pellets – Classification (1998)
- **SS 18 71 23**: Solid biofuels and peat – Briquettes - Classification (1998)-12-02
- **SS 18 71 70**: Solid biofuels and peat – Determination of total moisture (1997)
- **SS 18 71 84**: Biofuel and peat – Determination of moisture in general analysis sample (1990)
- **SS 18 71 71**: Solid biofuels – Determination of ash content (1984)
- **SS 18 71 73**: Solid biofuels – Calculation to different basis (1986)
- **SS 18 71 74**: Solid biofuels and peat – Determination of size distribution (1990)
- **SS 18 71 78**: Biofuels and peat – Determination of bulk density in bushel (1990)
- **SS 18 71 80**: Biofuel and peat – Determination of mechanical durability of pellets and briquettes (1999)
- **SS 18 71 75**: Peat – Determination of durability of sod peat (1990)
- **SS 18 71 79**: Peat – Determination of bulk density (1990)

Chemical test methods:

- **SS 18 71 76**: Solid biofuels – Determination of total sulphur content with eschka and bomb (1991)
- **SS 18 71 77**: Solid biofuels – Determination of total sulphur content at combustion in high temperature oven - IR-detector (1991)
- **SS 18 71 85**: Solid biofuels – Determination of total chlorine content with bomb method (1995)

C12

- **SS 18 71 86**: Solid biofuels – Determination of total sulphur content with high temperature oven and IR.detector (1995)

C.9 Austria

ÖNORM M 7132: Energy-economical utilisation of wood and bark as fuel – Definitions and properties

Status: published in 1998

Short description: This ÖNORM Standard specifies terms assisting the commercial and legal transactions between the producers, dealers and consumers of fuels. It provides a technological assessment of wood and bark as fuel. This ÖNORM Standard deals with the raw material wood, with or without bark content, and with the wooden parts derived from wood working and processing, but it should not be applied to salvaged materials, chemically treated wood or wood derived from timber products containing binding agents and/or coating materials. Specifications with regard to environmental impact are not concerned in this ÖNORM Standard.

Available: Austrian Standards Institute, ON (http://www.on-norm.at)

Additional information: Austrian Standards Institute, ON (http://www.on-norm.at)

ÖNORM M 7133: Chipped wood for energetic purposes – Requirements and test specifications

Status: published in 1998

Short description: This ÖNORM Standard classifies wood chips with and without bark into different categories, defines testing requirements and methods, and can be used to assess the value of wood chips. It is addressed to persons and organisations manufacturing, selling, erecting or using machinery, equipment, tools and entire plants

having a connection with wood chips, and to all persons and organisations involved in purchasing, selling and utilising wood chips.
Available: Austrian Standards Institute, ON (http://www.on-norm.at)
Additional information: Austrian Standards Institute, ON (http://www.on-norm.at)

ÖNORM M 7135: Compressed wood and compressed bark in natural state – Pellets and briquettes – Requirements and test specifications
Status: published in 2000
Short description: This ÖNORM Standard defines the requirements and methods for the testing of wood/bark pressings. It is addressed to persons and organisations manufacturing, selling, erecting or using machinery, equipment, tools and entire plants having a connection with wood chips, and to all persons and organisations involved in purchasing, selling and utilising pressings.
Available: Austrian Standards Institute, ON (http://www.on-norm.at)
Additional information: Austrian Standards Institute, ON (http://www.on-norm.at)

ÖNORM M 7136: Compressed wood in natural state – Wood pellets – Quality assurance in the field of logistics of transport and storage
Status: published in 2002
Short description: This ÖNORM standard is applicable only to pellets specified in the standard *ÖNORM M 7135*. It determines the quality assurance of pellets during transportation and storing. It is addressed to persons and organisations manufacturing, selling or keeping (intermediate) storages, and to all persons involved in the transportation of wood pellets.
Available: Austrian Standards Institute, ON (http://www.on-norm.at)
Additional information: Austrian Standards Institute, ON (http://www.on-norm.at)

ÖNORM M 9466: Emission limits for air contaminants of wood incineration plants of a nominal fuel heat output from 50 kW onwards –

ÖNORM M 9466 – Requirements and testing on the site
Status: published in 1998
Short description: This ÖNORM Standard classifies wood chips with and without bark into different categories, defines testing requirements and methods, and can be used to assess the value of wood chips. It is addressed to persons and organisations manufacturing, selling, erecting or using machinery, equipment, tools and entire plants having a connection with wood chips, and to all persons and organisations involved in purchasing, selling and utilising wood chips.
Available: Austrian Standards Institute, ON (http://www.on-norm.at)
Additional information: Austrian Standards Institute, ON (http://www.on-norm.at)

C.10 The United Kingdom

British Biogen, The Trade Association to the UK Bioenergy Industry, has developed a system of describing wood fuels, which aims to balance the need to have a good enough description to cover the requirements of the user’s equipment, whilst recognising the practicalities of producing wood fuels. In addition to system of describing wood fuels, BioGen have also produced codes of good practice for biofuel pellets and pellet burning roomheaters with nominal heating capacity less than 15 kW. (*British Biogen website*).

UK- Describing retail wood fuels
Status: published in 2000
Short description: This fact sheet defines a system of describing wood fuels. It divides wood fuels into three main types: log wood, wood chips and other wood fuels, i.e. pellets, compressed logs, faggots and kindlings, and describes methods for calculating moisture content and determining the size or quality (super, fine or coarse) of the wood fuels.
Available: British Biogen (http://www. britishbiogen.co.uk)
Additional information: British Biogen (http://www. britishbiogen.co.uk)

UK- The British BioGen code of good practice for biofuel pellets (Version 2.3)
Status: published in 2001
Short description: This code specifies issues related to pellets' raw materials, physical and chemical attributes, and quality assurance and miscellaneous. The code is voluntary but all members of the industry are strongly encouraged to comply with it. The code is an interim measure, whilst no other standards exist in the UK, and will be superseded by the European Standards for solid biofuels, once it is published.
Available: British Biogen (http://www. britishbiogen.co.uk)
Additional information: British Biogen (http://www. britishbiogen.co.uk)

C.11 Nordic ecolabelling of biofuel pellets

Nordic Ecolabelling: Swan labelling of biofuel pellets
Status: under preparation
Short description: To Swan label biofuel pellets is to take an overall approach to environmental measures. Requirements are set of manufacturing methods, transportation and storage. The aim is to identify the top-grade alternative from an environmental perspective. It is possible to Swan label biofuel pellets intended for private use in small to medium-scale burners. These boilers and stoves are often used in built-up areas. The majority of requirements aim to reduce emissions resulting from combustion due to the likely event of individuals being present in the surroundings and open to exposure from the fumes.
Additional information: Ecolabelling organisations (Finland; www.sfs.fi/ymparist/, Denmark www,ecolabelling.dk, Iceland; www.svanurinn.is, Norway; www.ecolabel.no and Sweden; www.svanen.nu)

Appendix D. National equipment standards

D.1 Norway

Norwegian standards relating to enclosed wood heaters:

- **NS 3058-1, 1994**: Enclosed wood heaters - Smoke emission - Part 1: Test facility and heating pattern
- **NS 3058-2, 1994**: Enclosed wood heaters - Smoke emission - Part 2: Determination of particulate emission
- **NS 3058-3, 1994**: Enclosed wood heaters - Smoke emission - Part 3: Determination of organic micro contaminations (PAH)
- **NS 3058-4, 1994**: Enclosed wood heaters - Smoke emission - Part 4: Determination of the content of carbon monoxide (CO) and carbon dioxide (CO2) in the flue gas
- **NS 3059, 1994**: Enclosed wood heaters - Smoke emission – Requirements

D.2 The United Kingdom

UK- The British BioGen code of good practice for biofuel pellet burning roomheaters < 15 kW (Version 2.3)
Status: published in 2001
Short description: This code concerns biofuel pellet burning appliances' integrity, safety, emissions, efficiency, noise effect and quality assurance. The code is voluntary but all members of the industry are strongly encouraged to comply with it. It is an interim measure, whilst no other standards exist in the UK, and will be superseded by the European Standards for solid biofuels, once it is published.
Available: British Biogen (http://www. britishbiogen.co.uk)
Additional information: British Biogen (http://www. britishbiogen.co.uk)

Appendix E. Guidelines for fuel peat

Nordtest-method: Guidelines for fuel peat classification, sampling and analysis of properties
Status: under preparation will be published for test use in end of year 2005
Short description: This guideline is applied for fuel peat. In case the fuel is composed of both peat and solid biomass fuel fractions, this guideline and CEN/TS 14961 are to be used together. The purpose of this quality guideline is to define the procedure, according to which the quality of fuel peat can be given and defined unambiguously and appropriately. The guideline provides recommendations for using terms and definitions, sampling and sample handling and specifying characteristics and quality definitions related to fuel peat. The Guideline is based on the existing Finnish guidelines and CEN/TC 335 standards. Quality tables are presented in a similar form as in CEN/TS 14961 and the same symbols are used.
Available when published: Nordtest (http://www.nordicinnovation.net)
Additional information: Eija Alakangas, VTT Processes (eija.alakangas@vtt.fi)

Appendix F. National standardisation organisations in Baltic Sea Region

DENMARK Dansk Standard (DS)
Kollegievej 6, DK-2920 Charlottenlund
Tel. + 45 39 966 101, fax. + 45 39 966 102
URL: http://www.ds.dk

ESTONIA Estonian Centre for Standardisation (EVS)
Aru Street 10, EE-10317 Tallinn
Tel. + 372 60 55 050, fax. + 372 60 55 070
URL: http://www.evs.ee

FINLAND Suomen standardisoimisliitto r.y. (SFS)
PO Box 116, FI-00241 Helsinki
Tel. + 358 9 149 93 31, fax. + 358 9 146 49 25
URL: http://www.sfs.fi

GERMANY Deutsches Institut für Normung e.V. (DIN)
Postfach, D-10722 Berlin
Tel. + 49 30 26 010, fax. + 49 30 26 01 12 31
URL: http://www.din.de

ICELAND Icelandic Standards (IST)
Laugavegur 178, IS-105 Reykjavik
Tel. + 354 52 07 150, fax. + 354 52 07 171
URL: http://www.stadiar.is

LATVIA Latvian Standards Ltd (LVS)
K. Valdemãra Street 157, LV-1013 Riga
Tel. + 371 7 371 308, fax. + 371 7 371 324
URL: http://www.lvs.lv

LITHUANIA Lithuanian Standards Board (LST)
T. Kosciuškos g. 30, LT-2600 Vilnius
Tel. + 370 5 212 62 52
URL: http://www.lsd.lt

NORWAY Standard Norge (SN)
PO Box 242, NO-1326 Lysaker (visitors: Strandveien 18)
Tel. + 47 67 83 86 00, fax. + 47 67 83 86 01
URL: http://www.standard.no

RUSSIA Federal agency on technical regulating and metrology (GOST)
Leninsky prospekt, 9, Moscow, B-49, Russian Federation
Tel. + 7 95 236 03 00, fax. + 7 95 236 62 31
URL: http://www.gost.ru

SWEDEN Swedish Standards Institute (SIS)
Sankt Paulsgatan 6, S-11880 Stockholm
Tel. + 46 8 555 520 00, fax. + 46 8 555 520 01
URL: http://www.sis.se

References;
Review of the present status and future prospects of standards and regulations in the bioenergy field. Action 2. 2003-2005
Eija Alakangas

Quantification of biomass feed stocks

Quantification of biomass feed stocks currently being used in Europe on a national basis has been a hard task. This research has been done in seventeen countries of the EU.
We will check that most of the biomass energy is used to produce heat and electricity but in more quantity for heat.

In the future, biomass has the potential to provide a cost-effective and sustainable supply of energy, while at the same time aiding countries to meet their greenhouse gas reduction targets under international agreements. By the year 2050, it is estimated that 90% of the world population will live in developing countries (Ramage & Scurlock 1996). It is critical therefore that the biomass processes used in these countries are sustainable. The modernisation of biomass technologies, leading to more efficient biomass production and conversion, is one possible direction for biomass use in these countries.

In industrialised countries, the main biomass processes utilised in the future are expected to be the direct combustion of residues and wastes for electricity generation, bio-ethanol and biodiesel as liquid fuels, and combined heat and power production from energy crops. In the short to medium term, biomass waste and residues are expected to dominate biomass supply, to be substituted by energy crops in the longer term. The future of biomass electricity generation lies in biomass integrated gasification/gas turbine technology, which offers high-energy conversion efficiencies and will be further developed to run on biomass produced fuel

Austria

In 2000, slightly under 25% of primary energy is produced from renewable sources, with hydropower dominating.

Biomass

The following data is for 2000, although the differences in heat and electricity production was unavailable

Firewood	66.94 PJ
Biogenic	13.35 PJ
Other biogenic	48.99 PJ

A heat/electricity breakdown was available for 2001

Electricity	1,750 GWh
Heat	2372ktoe

References:

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

-Salchenegger, S. 2004 Biofuels in the Transport Sector in Austria: 2005 Federal Environment Agency

-Rathbaur, J. 2002 Biomass Survey in Europe: Country Report of Austria

Belgium

Biomass

As with France, Belgiums' energy market is heavily dominated by nuclear power. Solid biomass (with no distinction drawn between types) was used to generate 189 GWh of electrical energy in 2002. Heat generated from solid biomass in 2002 amounted to 384ktoe.

Biowaste

Biowaste generated 413 GWh in 2002.

Liquid biofuels

Very limited use of biofuels. Currently (2004) no fuels used for transport purposes. Biogas, generated for use purposes other than transportation, amounted to over 800GWh in 2004, an increase from 140 GWh in 2002.

References;

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

Government of Belgium 2005 Progess Report on the Promotion of Biofuels in Belgium in 2005

-Marchal, D. 2005 Biomass Survey in Europe: Country Report of Belgium Regional Biomass Energy Agency

Czech Republic

Biomass

In 1999, approximately 1.6 million tonnes of dry biomass were used for energy production. In 2001, 432Mtoe of heat energy was produced from biomass and in 2002, 514GWh of electrical energy was produced.

Biogas

133GWh of electricity was produced in 2002 from biogas.

Biowaste

In 2002, biowaste is not used for electricity generation.

Liquid biofuels

In 2001, biofuels contributed 1.3% (61ktoe)to the transportation fuel usage.

Biodiesel

In 2004, 46,628 tonnes of rapeseed oil methyl ester was produced, representing 1.37% of the market.

Bioethanol

Use at present is limited to experimental purposes, with expansion planned by 2007.

References;

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Government of the Czech Republic 2004 Report for the European Commission on the implementation of Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003

Denmark

Biomass provided almost 11% of the total energy consumed in 2003, although no figures are yet available for 2004. This is an increase from the 10.6% renewable energy share in 2000. In 2002, 875GWh of electricity was produced using biofuels

Biomass

In 2003, the following fuels were used to generate energy. No electricity/heat energy breakdown was given

Wood chips	7.0 PJ
Wood pellets	10.4 PJ
Wood waste	7.0 PJ
Firewood	11.5 PJ
Straw	16.7 PJ
Municipal solid waste	36.2 PJ
Biogas	3.6 PJ

Data from 2002 shows the following breakdown of biomass usage

Electricity 876 GWh ; Heat 891ktoe

Biogas

Biogas was used to generate 233GWh of electricity in 2002

Biowaste

1,017GWh of electricity produced from biowaste in 2002

Liquid biofuels

Denmark produces 40,000 - 45,000 tonnes of biodiesel, which is exported. Danish consumption of biofuels for transport is very low.

References;

- Eurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

- Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

- Frandsen, S. 2002 Biomass Survey in Europe: Country Report of Denmark

- Office of the Danish Permanent Representative to the European Union 2005 Annual report under the Biofuels Directive (Directive 2003/30/EC)

Finland

In 2004, 312PJ of bioenergy was used, representing approximately 21% of primary energy consumption (Nat), largely in CHP initialisations (OV). This is an increase from 20% of bioenergy in 2000, with a total of 25% from renewable sources.

Biomass

In 2000, the following fuels were used to produce energy, though it was unspecified whether it was as heat or electrical energy.

Wood fuels		271.00 PJ
Black liquor	143.54 PJ	
Industrial wood residues	82.16 PJ	
Domestic firewood	45.30 PJ	
Straw and SRC		0.00 PJ
Municipal solid waste		2.00 PJ
Biogas		0.75 PJ

The 20% of bioenergy usage can be subdivided into a number of different fuel types:

Black liquor	53%	143,541 TJ
Other woods	30.3%	
Tree bark		45,882 TJ
Sawdust		17,914 TJ
Forest Chips		5,451 TJ
Industrial wood residues		4,511 TJ
Demolition wood		1,080 TJ
Pellets and briquettes		353 TJ
Other, not specified		6,959 TJ
Firewood	16.7%	45,300 TJ

Data from 2002, does divide the energy usage:

Electrical energy – 9,762 GWh
Heat energy – 4,818 ktoe

Biogas

In 2002, 26 GWh of electrical was produced from biogas

Biowaste

In 2002, 109 GWh of electrical energy was produced from biowaste

Liquid biofuels

Liquid biofuels for transportation is not widespread, with 0.186PJ used in 2004, representing 0.1% of total transportation energy consumption. This is based on two experimental projects, using 5% (volume) ethanol-petrol mix. There is also small scale experimental production of biodiesel and biogas. Only one noteworthy producer of transport biofuels in Finland, with a capacity of 100,000 tonnes of Bio-ETBE (ethyl-tertio-butyl-ether) per annum, the ethanol for which is imported from Brazil, with a large amount exported.

References;

-Ministry of Trade and Industry 2005 Report as Provided for in Directive 2003/30/EC on the Promotion of the Use of Biofuels or Other Renewable Fuels for Transport in Finland

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Country report of Finland European BIOENERGY Networks

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

France

Electrical energy production in France (in 2000) is dominated by nuclear energy (77.9%), with biofuels representing about 0.5% of the market.

Biomass

Electrical production in 2000

Nuclear	415.200 TWh
Agricultural residues (Straw; SRC)	0.378 TWh
Municipal solid waste	1.520 TWh
Biogas	0.346 TWh

In 2002, solid biomass (its unclear if this included MSW) generated 1,405 GWh of electricity.

Thermal production in 2002 was 9.2Mtoe of heat production from biomass. This sector is dominated by the use of logs in domestic wood-firing systems, with 8.5Mtoe being generated.

Biogas

406 GWh of electrical energy generated from biogas in 2002. 0.3 Mtoe of thermal energy from biogas.

Biowaste

1,714 GWh of electricity was produced from biowaste in 2002

Liquid biofuels

In 2003 the French consumption of bio-ETBE was 164,000 tonnes from 77,190 tonnes of bioethanol. The consumption of biodiesel, used as blend of 5% in diesel, was 321,000 tonnes in 2003. Combined, this amounts to approximately 0.7% (based on energy content) of total diesel and petrol use. In 2002, 466ktoe of liquid biofuels were produced.

References;

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

- Barel, C. 2002 Biomass Survey in Europe: Country Report of France Agriculture and Bioenergy Division

Germany

Renewable energy, in 2000, accounted for 2.6% of the market, with wood fuels accounting for 72.5% of the renewable energy share.

biomass

Firewood and waste wood was used in the generation of 240 PJ of energy in 2000. Biogas was the only other fuel that was used (0.02 PJ), with no energy coming from straw, SRC or municipal sources.

In 2002, biomass was used in the production of 700 GWh of electricity and 5480ktoe of heat energy.

Biogas

2,913 GWh of electricity was produced in 2002

Biowaste

Biowaste was used to produce 2,035 GWh in 2002

Liquid biofuels

Biofuels represent 1.9% of the transportation fuels market. Biodiesel is by far the most dominant fuel, with 1,200,000 litres (1.76% of market) sold in 2004. Recently introduced to the market, 82,380 litres (0.12% of market) of bio-ethanol was also used in 2004, as was a small experimental amount of pure rape oil 5660 litres (0.01% of market). No biogas was used in 2004 for transportation.

Total liquid biofuel production in 2002 amounted to 520 ktoe.

References;

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005

-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks

-Government of Germany 2004 Second National Report on the Implementation of Directive 2003/30/EC of 8 May 2003 on the Promotion of the use of Biofuels or other Renewable Fuels for Transport

- Lack, N. 2002 Biomass Survey in Europe: Country Report of Germany

Holland

With the exception of a number of small-scale demonstration projects, involving in the region of 4 million litres of biodiesel and pure vegetable oil, no biofuels are available on the Dutch market. Indeed the production potential of Holland is practically nil as the Netherlands lacks the production facilities needed to manufacture biofuels.

The use of solid biomass (including co-firing) generate 1,260 GWh of electrical energy in 2002, via the use of approximately 0.4 million tonnes of clean biomass (no distinction was drawn as to types of biomass).
Heat production from biomass sources totalled 324ktoe in 2001.
Biogas
Biogas generated 304 GWh of electricity in 2002

Biowaste

Biowaste generated 971 GWh of electricity in 2002

References;

-Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005
-Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks
-Government of The Netherlands 2003 Report to the European Commission on Directive 2003/30/EC (covering the year 2003)
- Kwant, I.K.W. 2002 Biomass Survey in Europe: Country Report of Netherlands Kovem

Italy

In 2003 the electric power and the heat produced in Italy were:

Electric power from:

Urban solid waste	1812GWh
Wood	1648GWh
Biogas	1033GWh

Heat from:

Remote heating systems using wood, located mainly in Lombardy, Piedmont and Trentino Sud Tirol 1200TJ (28.7 ktoe)
Industrial Wood residues 39600TJ (946 ktoe)
Heat from solid urban waste in heat treatment plants 5700TJ (136,1 ktoe)

The production of bio fuels 177 ktoe

References:

ENEA – Agency for Sustainable Development Advisor
Executive Summary of the Report Energy and the Environment 2004
www.enea.it

Norway

After hydropower, which accounts for nearly 99% of the electricity production in Norway, bioenergy is the most significant contributor to current renewable energy supply.
A figure for electricity generation showed that in 1999 Norway produced 14.7 TWh from biomass. Of this figure 7.2 TWh comes from the combustion of wood. From projections calculated in 1999 theoretically, the potential for bioenergy in Norway is over 100 TWh. In 1995, heat energy produced in Norway was 912ktoe. However, an estimated figure for 2010 showed zero increase (remained at 912ktoe) for heat energy produced (ATLAS project, 1996)

In 1999, no electricity energy was produced from either biogas or biowaste.
No data could be found for Liquid biofuel usage in Norway
Biodiesel contributes an insignificant percentage to biofuels in Norway as there is no fuel distribution network(1999).

References;

- EnR Renewable Energy Working Group 2000 Renewable Energy in the European Union and Norway. Norway

Poland

Electricity production from renewable sources is dominated by large-scale hydropower.
Biomass
Generation of electrical energy from biomass is quite limited, with a mere 31GWh being generated in 2001. Substantially more heat energy from biomass was produced in 2001 (2539ktoe), and indeed biomass is considered the most promising renewable energy within the country

Biogas / Biowaste
In 2002, no electrical energy was produced from either biogas or biowaste.

Liquid biofuels
The 38,270 tonnes (48.5million litres) of bioethanol on Polish market in 2004 represented 0.30% of transport market. In 2001, 25.89ktoe of liquid biofuel was produced.

First biodiesel production plant came online in December 2004, with a planned annual production of 100,000 tonnes of rapeseed oil methyl esters.

References:

- Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005
- Ministry for Agriculture and Rural Development 2005 Second report to the European Commission for 2004 under Article 4(1) of Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport

Portugal

In 2004 the biomass from wood was in million tonnes per year

Bush	0.6
Biomass from burned areas	0.4
Branches and peck	1.0
Industrial wood residues	0.2
Total	2.2

Biogas only represented the 3% of national consume. It has not got information about it.

Liquid bio fuels neither have data because doesn't exist project current.

Electricity generated in 2001 from:

Municipal solid waste renew	511 GWh
Solid biomass	1086 GWh
Gas from biomass	3 GWh

References

International Energy Agency Statistics www.igm.ineti.pt/edicoes_online/diversos/energias_renov/texto2.htm
www.energiasrenovaveis.com

Slovakia

Biomass

In 2002, solid biomass was not used for the production of electrical energy.
In 2001, 103ktoe of heat energy was generated from biomass.

Biogas

No electrical energy generated from biogas.

Biowaste

No electrical energy generated from biowaste.

Liquid biofuels

Despite an annual capacity of 62,000 tonnes (biodiesel), production of biodiesel dropped from over 30,000 tonnes in 2002 to slightly over 3500 tonnes in 2003. This drop in

production is largely due to the abolition of state subsidies. Of this 3500 tonnes, 500 tonnes was exported, the remained being utilised in the domestic market.
Data on the production of bioethanol was unavailable.

References;

- Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005
- Ministry of Economy of Slovak Republic 2003 A Proposal on the Implementation Directive 2003/30/EC on the Promotion of the Use of Biofuels for Transport in Condition of Slovak Republic

Slovenia

Slovenia is the third woodiest country in Europe with the 55% of land area covered by forest. The function of forests as producers of wood is not yet used enough.

The potential of wood biomass in Slovenia was estimated al 600,000 tons:
-Potential of wood biomass in shrubbery and area grown over with forest trees is estimated at 120, 000 ton/year
-Potential of wood biomass in forest is estimated al 2000,000 ton/year
-Potential of wood biomass in wood manufacturing industry is 280,000 ton/year.

In 2004:
Electricity generated from:

Wood/wood waste/other solid wasted	69GWh
Landfill gas	28GWh
Sewage sludge gas	3GWh

Heat generated was:

Wood/wood waste/ other solid	112 TJ (2.7 ktoe)

About bio fuels there is no information.

References:

- Statistical office of the republic of slovenia
Rapid reports 30September 2005. No 266
-Energy Efficiency Centre (EEC). OPET CHP/DHC WP3
-Statistical yearbook of energy economy of Slovenia 2002 Ministry of environment, spatial planning and energy

Spain

Biomass

In 2004 were consumed 4,167,035 toe of biomass.

Separated into sectors:

Domestic	2,056,508 toe
Paste and paper	734,851 toe
Wood, furniture and cork	487,539 toe
Feeding, drink and tobacco	337,998 toe
Power station	254,876 toe
Ceramic, cement and gypsum	129,013 toe
Others industrial activities	57,135 toe
Hotel business	30,408 toe
Agricultural and Stock	21,407 toe
Service	19,634 toe
Chemical products	16,772 toe
Catchments depuration and Water distribution	15,642 toe
Textile and leather	5,252 toe

Also data from 2004 does divide the energy usage as follows:

Electricity energy	680 ktoe (7908.4 GWh)
Heat energy	3,487 ktoe

The heat energy obtained from biomass in the period from 1999-2004:

Wood residues	3,898 toe
Agriculture wood residues	0 toe
Agriculture herbaceous residues	3,303 toe
Industrial wood residues	40,368 toe
Industrial agriculture residues	21,877 toe
Energetic cultivation	0 toe
TOTAL	69,446 toe

The electrical energy obtained from biomass in the period from 1999-2004:

Wood residues	5,773 toe
Agriculture wood residues	0 toe
Agriculture herbaceous residues	55,500 toe
Industrial wood residues	1666,578 toe
Industrial agriculture residues	241,005 toe
Energetic cultivation	0 toe
TOTAL	468,856 toe

Biogas

Biogas has produce de 80% of primary energy of the projects working in the period of time 1999-2004

Treatment of sewage	3,222 toe
Stock residues	7,643 toe
Industrial residues	26,539 toe
Gas from garbage dumping sites	55,986 toe
TOTAL	150.000 toe

Bio fuels

In 2004 228.2 ktep of bio fuels were consumed.
The primay energy gotten from bio fuel from 1999-2004 was from:

Bioethanol	115,700 toe
Biodiesel	112,500 toe
TOTAL	228,200 toe

References:
www.idae.es

Sweden

In 2000, Sweden had the largest dependence on renewable energy, with 30% of its national usage being renewable – just under half of which (46.7%) coming from woody biomass.

Biomass
In 2000, the following fuels were used to produce energy, although no data subdivided this energy into electrical or heat.

Wood fuels		304.92 PJ
Black liquor	146.52 PJ	
Industrial wood residues	120.60 PJ	
Domestic firewood	37.80 PJ	
Straw and SRC		5.47 PJ
Municipal solid waste		19.08 PJ
Biogas		5.04 PJ

Data from 2002 subdivides the energy production as follows:
3,775 GWh of electrical energy was produced from solid biomass.
The use of biomass in heat production has grown significantly and in 2002, 4995ktoe of thermal energy was generated, largely through CHP and district heating systems.

Biowaste
208 GWh of electrical energy produced from biowaste.
Biogas

17 GWh of electricity generated from biogas.

Liquid biofuels
In 2003 the amounts of biofuels used were 0.2PJ of biodiesel, 3.1PJ of bioethanol (largely imported from Norway, Spain, Italy, France and Brazil) and 0.4PJ of biogas, representing 1.3% of fuel usage. Other biofuels, e.g., synthetic diesel and heavier alcohols, are used in very small quantities. The majority of ethanol (85% is used in low-level (5%) blends, i.e., petrol containing 5% bioethanol. The other 15% is used in pure or almost pure (85%) blends.
Energy Crops
Limited to straw and energy grass (*miscanthus*) – 14,300 ha grow in 2000.

References;

- Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005
- Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks
- Ministry of Environment and Social Structure 2005 Report pursuant to Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport
- Risberg, S. 2003 Biomass Survey in Europe: Country report of Sweden Swedish Energy Agency

United Kingdom

The United Kingdom is one of the lowest users of renewable energy sources in Europe, with only 1.3% of its energy coming from renewable sources, the most of which comes from biofuels and waste (85%).

Biomass
In 2000, the following fuels were used to produce energy, although no data subdivided this energy into electrical or heat.

Wood fuels	21.05 PJ
Straw and SRC	3.02 PJ
Municipal solid waste	16.47 PJ
Biogas (landfill gas and sewage sludge digestion)	37.68 PJ

Data from 2002 does divide the energy usage as follows:
870 GWh of electricity energy
700ktoe of heat energy produced
Biogas generated 3,076 GWh of electrical energy in 2002.

Biowaste
Biowaste was utilised in the generation of 958GWh of electricity.
Liquid Biofuels

The latest provisional figures indicate that biofuels sales (for transportation purposes) are currently (May 2005) running at some 10.7 million litres a month. In 2003,19.5 million litres of biofuels were sold for transportation purposes – approximately 0.04% of fuel sales. Biodiesel is the dominant fuel, with the majority of blends at 5% or less. Bioethanol usage is very limited

Feedstocks

Feedstocks for UK biofuel production include re-cycled cooking oils, agricultural by-products (e.g., tallow and possibly straw) and mainstream agricultural crops (e.g. cereals and root crops for bioethanol and oilseed crops for biodiesel). Imports could include straight bioethanol and biodiesel as well as biodiesel feedstocks including tropical products such as palm oil.

References:

- Deurwaarder, E.P. 2005 Overview and Analysis of National Reports of the EU Biofuel Directive Prospects and barriers for 2005
- Alakangas, E. & Vesterinen 2003 Biomass Survey in Europe: Summary report European BIOENERGY Networks
- UK Government UK Report to the Commision on Biofuels 2005
- Wycombe District Council & TV Energy Ltd. 2002 Biomass Survey in Europe: UK Country Report

	Biomasss		Biogas and Biowaste		
	Heat	Electricity	Heat	Electricity	Liquid fuels
Austria *	2372ktoe	1,750GWh		◊ 32 GWh	>100,000ton/y
Belgium ○	384 ktoe	189 GWh	—	413 GWh	—
Czech Republic	* 432 Mtoes	○ 514 GWh	—	○133 GWh	* 61 ktoe ◘ 46,628 tonnes
Denmark ○	891 ktoe	876 GWh	—	1250 GWh	45,000 tonnes (biodiesel)
Finland ○	4,818 ktoe	9,762GWh	—	135 GWh	0.186PJ
France ○	9.2 Mtoe	1,405 GWh	0.3 Mtoe	2,120 GWh	466 ktoe

Germany ○	5480 ktoe	700 GWh	—	4,948 GWh	520 ktoe
Holland ○	* 324 ktoe	1,260 GWh	—	1,275 GWh	—
Italy ▼	946 ktoe	1,648 GWh	164.8ktoe	2,845 GWh	177 ktoe
Norway #	912 ktoe (1995)	14.7 TWh	—	—	—
Poland *	2539 ktoe	31 GWh	—	—	25.89 ktoe (38,270 tonnes ◘)
Portugal *	—	1,086 GWh	—	514 GWh	—
Slovakia*	103ktoe	—	—	—	▼3500tonn
Slovenia *	2.7ktoe	69 GWh	—	31 GWh	—
Spain ◘	3487 ktoe	7,908 GWh	—	1,744 GWh (1999-04)	228.2 ktoe (1999-04)
Sweden ○	4995ktoe	3,775 GWh	—	225 GWh	▼3.3PJ
United Kingdom ○	700ktoe	870 GWh	—	4,034 GWh	▼19.5mill litr

#1999 ◊ 2000 *2001 ○2002 ▼2003 ◘2004

Future feed stocks

An assessment of the potential in quantitative terms of feed stocks that could be used for energy production

Introduction

In industrialised countries, the main biomass processes utilised in the future are expected to be the direct combustion of residues and wastes for electricity generation, bio-ethanol and biodiesel as liquid fuels, and combined heat and power production from energy crops. In the short to medium term, biomass waste and residues are expected to dominate biomass supply, to be substituted by energy crops in the longer term. The future of biomass electricity generation lies in biomass integrated gasification/gas turbine technology, which offers high-energy conversion efficiencies and will be further developed to run on biomass produced fuels.

Future feed stocks in Europe
Finland

In Finland the objective is to utilize reed canary grass and straw on energy production together with peat and wood fuels, on filtration of peat production run-off waters and as a raw material of chemical pulp. The production potential of reed canary grass (Phalaris arundinacea) and straw on mineral soil is estimated to be 7.9 TWh (28 PJ), which means cultivation of reed canary grass on 170 000 hectares and harvesting of straw on 230 000 hectares. Currently 4 000 hectares of reed canary grass is cultivated for energy purpose by Vapo Oy and Pohjolan Voima Oy. A typical amount of harvested crop was 5 500 kg dry matter per hectare, which equals to 25 MWh/hectare.

FINBIO´s and national targets for agrobiomass

Energy crops	Current use	2005	2006	2010
Agrobiomass in Action Plan	0.0 TJ	900 TJ		2 100 TJ
FINBIO, reed canary grass, TJ total area	40 TJ 500 ha	1 470 TJ 15 000 ha	2 450 TJ 25 000 ha	7 300 75 000 ha
FINBIO, straw, TJ total area	70 TJ (6000 tons)	430 TJ 15 000 ha	720 TJ 25 000 ha	1 760 TJ 60 000 ha

Reference;

http://www.finbioenergy.fi

Sweden

The main energy crop of lignocellulose perennial type under development in Sweden is willow. Salix sp for south of Sweden and reed canary grass for middle and north part of Sweden Both are under commercial introduction.

Sweden have use of about 110TWh bioenergy. Of this around 40TWh is black liquor in the forest industry, around 50 TWh is different kinds of forest fuels, like wood chips from forest residues, saw dust, bark, tall oil, etc. We also use peat and municipal waste. Among agricultural products it have 15000 hectares of salix (short rotation willow). Also is use some canary grass and straw, as well as some manure for biogas. Grain is used for ethanol production, rape seed for RME, and oats for small scale heating.

Sweden have a growth rate in the bioenergy sector of around 4-5 TWh per year.

Reference:
Svebio

Denmark

There are no news about new energy crops in Denmark. They use the traditional crops: Straw, grain, willow and miscanthus for energy purposes. Maybe sugar beets will be of interest for ethanol production in the future.

Reference:

Centre for Renewable Energy and Transport
Danish Technological Institute

The Netherlands

Actually in The Netherlands energy crops are not present. The cost of energy crops is very high that any kind of crop is developing.

Reference:
Platform Bioenergy

United Kingdom

The feed stocks that will be examining, and starting to use over the next five years include short-rotation willow, miscanthus, hemp, rape, oilseed rape, cereal and straw. They expect the areas of willow and miscanthus to increase and more rape straw will be available as the biodiesel industry expands.

Hemp still at an early stage of evaluation, and only the 10% of the production is used to get heat and electricity.

Wheat and oats are the news cereals that have just started being develop.

Reference:
Department of Agriculture and Rural Development .Northern Ireland Government
www.dardni.gov.uk

Austria

Liquid biofuels will have importance in the transport sector. Solid biofuels are good fuels for heat production and for combined heat and power production. Austria needs energy crops to reach the renewable targets that are set by the government. Targets like blending diesel with up to 2 % with biodiesel are set by the government for energy from biomass. There are new incentives for energy crops like experimental gasifier tests. Land is available for growing energy crops. The production of energy crops will increase. Rape, triticale and Miscanthus are possibly the favorites. Optimistic experts see a potential of 100,000 ha/yr of rape seeds, 70,000 ha/yr of triticale energy grain and of 30,000 ha/yr of Miscanthus

The change in energy prices and the intention to use non-fossil energy carriers makes biomass (in Austria mostly wood) very competitive and boosts the wood prices, so other Austrian industries as the pulp and chipboard industry have to face substantial losses in competitiveness on international markets.

In some areas maize is now widely used as feedstock for biogas plants.

The use of cereals as a fuel for small heating boilers is also of big interest to some people. A legal regulation on this is expected to be issued soon.

Growing rapeseed for producing RME diesel is quite popular, but with restricted potential by agro technical and biological reasons.

Producing wood chips from forestry residues and thinning is expected to become competitive in the next year or so, as the prices for wood chips from industry are going up rapidly (last year form 6 to 14 €/m³) . They are expected to reach even 18 €/m³ at the end of next year. This level makes the mass production of forestry wood chips very interesting to farmers and offering a really big future potential of biomass as energy feedstock (ca. 16 PJ).

Reference:
Joanneum Research Institute of Energy Research

Preliminary assessment on the influence of feed stocks with regards to gasification

Biomass Feedstocks

Biomass is the organic material from recently living things, including plant matter from trees, grasses, and agricultural crops. The chemical composition of biomass varies among species, but basically consists of high, but variable moisture content, a fibrous structure consisting of lignin, carbohydrates or sugars, and ash. Biomass is very non homogeneous in its natural state and possesses a heating value lower than that of coal. The non-homogeneous character of most biomass resources (e.g., cornhusks, switchgrass, straw) pose difficulties in maintaining constant feed rates to gasification units. The high oxygen and moisture content results in a low heating value for the product syngas, typically <2.5 MJ/m3 (67 Btu/ft3). This poses problems for downstream combustors that are typically designed for a consistent medium-to-high heating value fuel.
Table 2 compares the proximate and ultimate analyses of several potential biomass gasifier feedstocks. Wood is the most commonly used biomass fuel. The most economic sources of wood for fuel are usually wood residues from manufacturers, discarded wood products diverted from landfills, and non-hazardous wood debris from construction and demolition activities. Fast-growing energy crops (e.g., short rotation hardwoods) show promise for the future, since they have the potential to be genetically tailored to grow

Table 2. Potential Biomass Gasifier Feedstocks

	Ultimate Analysis (wt% dry basis)						Proximate Analysis (wt% dry basis)			
	C	H	N	O	S	Ash	Moisture	Volatiles	Fixed Carbon	Heating Value HHV (MJ/kg)
Agricultural Residues										
Sawdust	50	6.3	0.8	43	0.03	0.03	7.8	74	25.5	19.3
Bagasse	48	6.0	-	42	-	4	1	80	15	17
Corn Cob	49	5.4	0.4	44.6	-	1	5.8	76.5	15	17
Short Rotation Woody Crops										
Beech Wood	50.4	7.2	0.3	41	0	1.0	19	85	14	18.4
Herbaceous Energy Crops										
Switchgrass	43	5.6	0.5	46	0.1	4.5	8.4	73	13.5	15.4
Straw	43.5	4.2	0.6	40.3	0.2	10.1	7.6	68.8	13.5	17
Miscanthus	49	4.6	0.4	46	0.1	1.9	7.9	79	11.5	12
Municipal Solid Waste										
Dry Sewage	20.5	3.2	2.3	17.5	0.6	56	4.7	41.6	2.3	8
Coals										
Subbituminous	67.8	4.7	0.9	17.2	0.6	8.7	31.0	43.6	47.7	24.6
Bituminous	61.5	4.2	1.2	6.0	5.1	21.9	8.7	36.1	42.0	27.0

Compositions are approximate and may not sum exactly to 100.0%.
Biomass moisture contents reported are for dried feedstocks.

Reference:
http://www.netl.doe.gov

Commercial gasification plants working in Europe:

Harboore, Denmark

-System characteristic;

Gasifier type Updraft counter-current fixed bed. The gasification agent is Air. The gas treatment are Cooler, Cyclone, Wet electrostatical precipitator and a Wet Scrubber. The prime mover is a gas engine with CHP application.

-Fuel characteristics;

”Harboore” with a capacity of 4 MWth is fuelled by wood chips. The quality of the wood chips is not crucial and some bark, leaves, branches, soil etc. can be accepted. There are none specific problems and the gasifier has been in operation almost 100 000 hours producing gas for two gas engines in 40 000 hours combined.

The emissions of the plant are:
An ash with a TOC less than 1 % of dry ash mass and an amount and composition depending on the quality of the wood chips eg. High content of soil/dirt from the forest “floor” then the amount of ash is higher.

An exhaust from the gas engines. The emissions from the engines are mainly depending on the gas composition and the use of catalysts. Hence, the main component of interest is CO.
A wastewater from cleaning of the product gas after it has been cleaned in the plants wastewater treatment system. It is going in the sewage system and has a COD less than 50 mg/l. Part of the water is reused in the system.
A flue gas from the wastewater treatment system.

Several fuels could be used in the future in this gasifier. Numerous pilot scale or bench scale gasifier concepts focus a lot on different types of fuels but fail to document their ability to provide a stabile operation e.g. 8000 hours/year on any fuel. We are focusing on wood chips as fuel and to implement the gasification technology in the CHP market.

References:
www.gasifiers.org
www.volund.dk

Energia Natural de Mora. SL, Spain

-System characteristic;

Gasifier type Atmospheric bubbling fluidized bed. Use air as gasification agent. The gas treatment is done with ceramic filter. . The prime mover is a gas engine with electricity application.
Electrical output 750 KW.
Thermal output 3500 KW.
One 250 KW engine generator dual fuel gas-diesel running on diesel.
Three 250 KW engine-generator running on Otto Cycle, lean gas fuel.

-Fuel characteristics;

The plant has been running for more than 22.000 hours, and has produced more than 13.000.000 KWh of electricity; using several types of biomass like almond shells, wood chips, olive pits, etc. EQTEC IBERIA and ENERGIA NATURAL DE MORA have jointly designed different types of gasification power plant, output ranging from 250 KW to 2500 KW and 30 % electrical efficiency. Higher outputs can be achieved by means of two or more gasification lines.

There has been used many different feedstock, some of them are wood chips, waste wood, dry fruit shell, wheat, maize and other cereals. Pellet alfalfa, bark, marc from olive and grape, etc. There are not problems working with this type of biomass. The ash that they generate is used as fertilizer. There isn't waste water and the emissions under control using gas engines and catalysts, being all the time under TA-luft levels.

Future feeds stocks that they are planning to use are mud from depuration, tyres, and plastics.

References;
www.gasifiers.org
EQTEC Iberia
www.energiaverde.com

Güssing, Austria

-System characteristic;

The equipment, 1 x GE Jenbacher JMS 620 GS-S.L, rated at 1964kW electric, 2490kW thermal.

The new plant constructed in Güssing uses a fluidised bed gasification reactor, which produces a low-tar product gas with a high calorific value. The average composition of the gas is 40% H_2, 24% CO, 23% CO_2, 10% CH_4, 3% N_2 and the calorific value (Hu) is 3.0 kWh/Nm³. The gas is cooled and the dust it contains is removed by means of a fabric filter. A scrubber then reduces the concentrations of tar, ammonia and acid components.

The GE Jenbacher gas engine converts the chemical energy in the product gas into electrical energy, while waste heat produced by the engine is used for district heating. This allows for efficiency levels that were previously impossible with biomass energy generation. The electrical efficiency of the plant as a whole is between 25% and 28% and overall efficiency (electrical and thermal) even reaches values of over 85%.

The power plant not only uses wood to generate energy - an ecologically sustainable fuel - but also meets the standards for emissions and operates without producing effluent. Using biomass means that it is possible to prevent thousands of tonnes of environmentally harmful carbon dioxide being released each year - and that is just in Güssing.

- **Fuels characteristic;**

It has been in operation since 2002, with low quality wood chips as feedstock. Steam gasification produce a gas with medium heating value of 12MJ/Nm³. Tar content in the producer gas can be reduced by combined action of steam and bed material olivine.

Wood (special gas)

Currently the biomass CHP Güssing use only wood chips as fuel. This is, mainly because of legal restrictions. If they would use other biomasses, they would not get the feed in rate for the electricity.

At the small gasifier in the Research Institute they have tested different feedstocks
The main criteria for them is the ash melting behaviour. If the ash melts above 1000°C they have no problem and the feedstock can be used. For feedstocks with an ash melting below 1000°C they have to add additives and the research in this area is going on at the moment.
As feedstock for the next 5 years they would prefer one with an ash melting above 1000°C. All other criteria (ash content, etc.) of the feedstock are no problem.

References;

-European Center for Renewable Energy Güssing
-www.gastechnology.org
-www.ficfb.at

Lahti, Findland

-System characteristic

The technology used is this gasifier is an atmospheric pressure CFB gasifier, no gas cleaning and gas co-fired in PC boiler.
The capacity of the gasifier is 60MWth (40-90 MWth depending on fuel)

The Kymijarvi CHP plant produce electric power and district heat to Lahti city. The maximum power capacity is 167 MWe and the maximum district heat production is 240MW. The annual operating time of the boiler is about 7000h/a. The biomass/SRF gasifier was connected to the boiler at the end of 1997. The product gas for combustion is led directly from the gasifier through the air preheater to two burners, which are located below the coal burners in the boiler. The gas is combusted in the main boiler and it replaces part of the coal.

Concerning the gasification process itself, the results have met the expectations. The operation conditions as regards temperatures, pressures and flow rates have been as designed and the process measurements as regards the product gas, bottom ash and fly ash composition have been very close to the calculated value. Due to the high moisture content (up to 58%) of the gasifier fuels, the heating value of the product gas has been low, typically only 1.6-3.2MJ/m³n. The operating experience of the gasifier during the years 1998-2003 was excellent. The stability of the main boiler steam cycle was also excellent.
The main boiler emissions were perhaps under the greatest interest as regards the measurement program of the monitoring phase. In summary, it can be states that the changes in the emissions were very small.

-Fuel characteristics;

Wood chips, wood waste, saw dust, shavings, demolition wood, SRF (Solid Recovered Fuel), plastic waste.

References;
http://www.gastechnology.org

Värnamo, Sweden

A pressurized CFB gasifier

Feed systems: lock-hoppers, piston feeders, etc
Gas cleaning/particulate: candle filter materials, other HT filters, cleaning systems of filters, etc
Advanced gas cleaning (bed in-situ, or post gasification): desulfurisation, dechlorination, alkali removal
Gas upgrading: catalysts, reformer burners, etc
Gas turbine/IGCC testing
End product testing areas:
Vehicle fuels: DME, Methanol, FT diesel; Fuel cells; etc
VVBGC also offers opportunities for education and training.
Auxiliary facilities such as laboratories, offices, conference rooms, a visitors' centre etc will be available too.

The plant has been successful in operation with gas turbine running on the producer gas over 3,600 hr by 1999.
It used variety of biomass fuels including wood wastes and RDF as feedstocks.
It achieved an electricity to heat ratio of 1. However, it is not economically feasible. The project is now used for research in syngas. Attention needs to be paid to gasifier bed

material for preventing deposits in the gas cooler, and the hot gas filter for preventing its damage in long term operation.

-Fuel characteristics;

Current feed stocks are differen**t** woody materials, bark, RDF, straw, agricultural products, etc

Reference;
http://www.caenz.com
http://www.vvbgc.com