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Technical Specifications for Solid Biofuels

Evaluation of the new Technical Specifications provided by CEN/TC 335 in the Swedish Biofuel Market

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Abstract

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The main objective of this thesis was to determine to which extent the new terminology standard and fuel specification standard provided by the European Committee for Standardization (CEN) have penetrated the Swedish biofuel market and to which extent they fit the need of its users. Two surveys and six interviews were performed. One survey was addressed to large scale producers, suppliers and consumers of solid biofuels, the other survey was addressed to producers and suppliers of equipment for upgrading and combustion of solid biofuels. The interviewees were actors from different stages in the biofuel supply chain: 1) Medium-scale log wood producer; 2) Large scale producer and supplier of solid woodfuels for large scale consumers; 3) Large scale straw firing DH-plant; 4) Actor providing measurement services of larges scale biofuel deliveries; 5) Large scale producer of upgraded solid biofuels.

Results from the surveys indicate that ca two thirds of the biofuel actors and one third of the equipment producers know about the existence of at least one of the mentioned standards. Still only a few of the respondents use any of the standards.
Some nonconformity between information required by the biofuel actors and information provided of the standards was discovered. Net calorific value is highly demanded by both producers and consumers and should be obligatory information for most kinds of solid biofuels. Content of heavy metals and Cesium 137 should be stated if it is high enough to cause risk for restrictions regarding ash recycling in crop land and forest. Ash melting temperature is demanded for many kinds of fuels and ash melting is seen as a problem causing wear and stoppages by 80% of the respondents making combustion equipment. Some of the interviewees were sceptical to the idea of several threshold values on the different fuel properties. Many of the threshold values is suggested to be rejected, except from cases where they are motivated by restrictions regarding contamination of ash, risk for air emissions or where solid biofuels are intended for usage by unskilled people at household level.

Key words: Solid biofuels, standards, fuel quality

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1. Introduction

In 1997 the European Commission released their White Paper which is a strategy and action plan to increase the share of renewable energy in the total energy supply in EU from under 6 % in 1997 to 12 % in 2010. Regarding bioenergy the target was to increase the energy utilisation from biomass sources from ca 3 % (EU15) to 8.5 % of the annual energy supply in EU (EC, 1997). This corresponds to a triple of the annual amount of biomass used for energy purposes from 45 Mtoe in 1997 to 135 Mtoe which equals 1570 TWh or ca 270 Mton dry matter biomass.

One of the major problems for creation of a dynamic and sustainable biofuel market is that the quality of the traded biofuels varies extremely among the various producers, and the users are often reluctant to buy fuels for which quality and composition can not be guaranteed. The same problems are faced by manufacturers of equipment for the conversion of solid biofuels to electricity and heat. The more specific the supplier of biofuels can be on the physical and chemical characteristics, the more likely the manufacturers of conversion technology are willing to guarantee a reliable performance of the different conversion steps and related equipment. The use of renewable energy resources in general and solid biofuel in particular is sometimes not fully accepted by the people living close to a plant using these fuels. Therefore it is seen as important to build up confidence in solid biofuels (CEN, 2002).

In this context, reliable tools are necessary to facilitate communication in the biofiel market and to support reliable trade. Standardization of solid biofuels is a necessary means on the way to fulfil the political goals at EU-level as well as on national level (CEN, 2002). The European Committee for Standardization (CEN) established a Technical Committee, CEN/TC 335 Solid Biofuels, year 2000 to develop common standards for solid biofuels (Okstad, T. personal communication, February 16, 2006). Several standards are released for provisional application and will soon be upgraded to EN – European standard.

The European Bioenergy Network (EUBIONET2) is a network with partners from most EU countries and founded by the European Commission under the Intelligent Energy – Europe programme. One of the targets for EUBIONET2 is to collect feedback on the suitability of CEN/TC 335 solid biofuel standard for trading of biofuels (http://www.eubionet.net/default.asp; 4-February-2006). According to the papers from last meeting in EUBIONET2 the aim of the study is to collect feedback of CEN/TS 14961 – Solid biofuels, Fuel specifications and classes (Hillring B., personally communicated February 2006). The Department of Bioenergy at SLU, Uppsala participates in EUBIONET2. This thesis is done as part of the work to evaluate some of the standards provided by CEN/TC 335 in the Swedish biofuel market. Partners in EUBIONET2 will conduct interviews in their home countries to evaluate the standard. The interviews are prepared by the project coordinator in Finland. A final report from EUBIONET2 will be sent to CEN/TC335.

Project objectives

The scope of this thesis is to evaluate if the standards for Terminology and Fuel Specification fits the needs of its users, and to which extent they have penetrated the Swedish biofuel market. The main focus is the standard for Fuel Specification and Classes, but some attention also will be paid to the Terminology standard and the scope of CEN/TC 335 as this may limit which biomass recourses that might be treated and traded as biofuel.

There are three groups of actors who are of particular interest in this work. On one side it is the biofuel producers and suppliers who have the burden to state the quality of the biofuel. On the other side it is the biofuel consumers who have the daily experience of using solid biofuels and the need for fuel that meets the requirement of their plant. Finally it is the equipment suppliers who have to guarantee the performance of their equipments.

The standards will be examined to clarify if they will provide the information required by consumers and manufacturers of equipment for the conversion of solid biofuels, and if they are adequate for the producers, suppliers and retailers of solid biofuels.

Issues that will be investigated among producers, suppliers, retailers and consumers of solid biofuels:

1. Knowledge and use of the CEN-standards for solid biofuels among the actors in the Swedish biofuel market.
2. Which information about solid biofuels that is demanded for different kinds of biofuels of the different actors. Results will be compared to the suggested standard and make the basis for the evaluation of the standards.
3. Which biomass resources that are accepted as biofuel of the market actors.

Issues that will be investigated among equipment suppliers:

1. Knowledge and usage of the CEN-standards for solid biofuels among the actors in the Swedish biofuel market.
2. Identify which fuel properties that makes the biggest challenge regarding wear and performance for their equipment.
3. To which extent fuel quality causes wear, stoppages and lower performance in their equipment.

Limitations

This work will focus on the bigger actors in the bioenergy sector in Sweden. Actors in the food industry, pulp industry, fishery, waste and recovery industry will not be included, despite they might be affected by the mentioned standards.

Solid biofuels

The term biomass is defined as material of biological origin excluding material embedded in geological formations and transformed to fossil. Biofuels means fuels produced directly or indirectly from biomass and bioenergy denotes energy form biofuels (CEN/TS 14588).

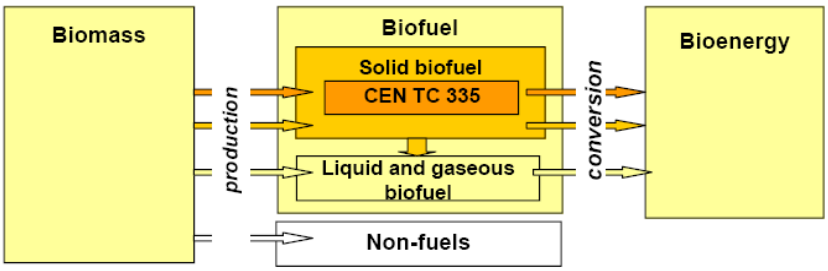


Figure 1. The figure describes the bioenergy utilisation chain from sources of biomass, to biofuel production to final use of bioenergy (CEN/TS 14588).

Several properties of the fuel contribute to the concept called fuel quality – which affects the usability and value of the fuel. Carbon and hydrogen are mainly the components in biomass which react with oxygen in an exothermic reaction and releases heat, and are therefore the valuable part of the fuel.

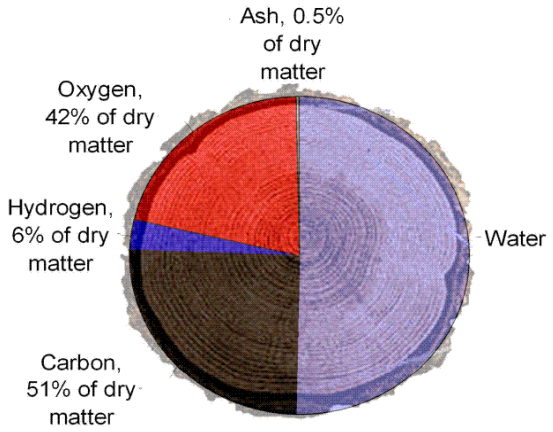


Figure 2. Coarse typical composition of woodfuels. Moisture content can vary between 10 – 65 % of the weigh of the fuel (CEN/TS 14961)

The primary quality requirements governed by the technical limitations of the equipments on *e.g.* a heating plant or small scale boiler are requirements of properties like particle size, moisture content and fine fraction. Other quality parameters are those affecting the performance and maintenance costs of the

equipment, cost of logistics, air pollution, ash pollution, health and safety for people working with the fuel. The properties of the fuel are affected by growth place, type of wood or herb, handling, processing and storage conditions.

Moisture content and ash content are the factors which most of all affects the calorific value of biofuels. The water in the fuel evaporates during the combustion and binds energy in the vapour. This process lowers the combustion temperature as well as increases the flue gas volume which has to go through the boiler.
Ash is defined as the rest product after combustion and consists of un-combustible inorganic components. Pure wood normally has an ash content of ca 0.3 w-% of dry matter, bark ca 4 w-%, straw materials ca 5 w-%. Variations of ash content in the fuel are mainly caused by treatment, storage conditions and production technique (Hogfors, 2005).

Sulphur usually forms SO_2 during combustion if sufficient oxygen is present. Sulphur also readily enters into sulphates with most metals if oxygen is available. SO_2 in the flue gas dissolves in water and forms sulphuric acid (H_2SO_4) which is corrosive for the equipment as well as contributes to acid rain. SO_2 may also be captured by calcium to form $CaSO_4$ which is a stable compound and may be separated from the flue gases by filtering (Zethræus, 2000).

Chlorine in the fuel together with alkali metals is highly corrosive for the boiler and tubes, particularly at high temperatures as these matters undergo chemical reactions into sodium chloride and potassium chloride. Chlorine also may delay the combustion rate and hence increase the concentration of hydrocarbons in the flue gas (Paulrud, 2004; Zetræus, 2000). Typical sources with high chlorine content is biofuels of agricultural origin, timber floated in the sea and chemically treated wood (Zethræus, 2000).

Nitrogen may be oxidized into several oxides during combustion, some of which are NO, NO_2, NO_3, N_2O_3, N_2O_5 and N_2O. The first five ones are normally grouped together into "NO_x", while the latter one, nitrous oxide, is treated separately. The members of the NO_x group all act as acids and thus contribute to corrosion in boiler and tubes as well as the acid-rain problem while the nitrous oxide in the first instance is and ozone depleting gas (Zethræus, 2000).

Ash deformation contributes to retarded heat transfer and decreased capacity and efficiency of boilers, corrosion in hoppers and grates and in worst case it causes mechanical damages and stoppages in boiler and equipment. A melt that is formed in ash from biomass fuels can belong to either salts of alkali and alkaline metals or oxide/silicate systems (Baxter *et al.,* 1998).

Mould is formed during storage of biomass and causes health risk for the workers and dry matter losses. Growth rate of mould is affected by moisture content, access of oxygen and storage time (Jirjis, 2005).

Some of the biofuel actors are recycling the ash back to the forest. According to Swedish regulations this cannot be done if the ash has to high content of ^{137}Cs or to high content of heavy metals (Møre & Lynn, 2005; Samuelsen, 2001). Woodfuels from some regions in Sweden might generate both bottom ash and fly ash with to high content of ^{137}Cs (Møre & Lynn, 2002). The content of ^{137}Cs in wood and bark correlates with the ^{137}Cs content of the soil at the growth place.

There are several paths to control the fuel quality. One is to measure all relevant parameters of the fuel at the end of the production chain or when delivered. One other is to have control over the complete production chain and the fuel's origin. E.g. pine harvested at the same geographical area and treated exactly the same way before each delivery will not have much variation in the fuel's properties. In between these paths there are numerous ways to control the fuel's quality.

Standardization

In the simplest sense, a standard is a well defined agree-upon way of doing something. A standard denotes a uniform set of measures, terms of performance, agreements, conditions, or specifications between parties (Spivak & Brenner, 2001). Standards improve efficiency and help to reduce costs. Further, they stimulate the sharing of experiences, they help to establish benchmarks and create a level playing field for companies to operate (Stigson, 2002).

A standard is created in technical committees or working groups made up of experts from interested companies, organizations and authorities. The stakeholders interested in a standard themselves initiate and fund the project; the committee works under their guidance (CEN 2006b (URL)).

The standardization work that affects the Swedish market is done at three levels, by three standardization bodies.

SIS – Swedish Standards Institute

SIS is the Swedish national standardization body. It is a non-profit association which develops and provides the Swedish society with national and international standards. SIS contributes to the international standardization work by being the Swedish participant in ISO and CEN. In Sweden, all standardization is carried out by three standardization bodies: SIS, for most business areas; ITS (Informationstekniska standardiseringen) for all telecom standardization and SEK (Svenska Elektriska Kommissionen) for all standards regulating electronics and electro-technical applications (SIS, 2006 (URL)). Regarding the suggested standards for solid biofuels, SIS is required to announce the existence of the new technical specifications from CEN promptly after they are released. This is because the standards in most cases will be upgraded to EN-standards after a three year test period, and thus has to be tested in the market before upgrading (CEN/TS 14961).

CEN – Comitè Europèen de Normalisation

CEN was founded in 1961 by the national standard bodies in the European Economic Community and the EFTA countries. Now CEN is contributing to the objectives of the European Union and European Economic Area with voluntary technical standards in most areas. Each field which is to be standardized by CEN gets its Technical Committee (TC). The Technical Committee often involves several Work Groups (WG's), which are responsible for the different sub areas (CEN, 2006 (URL)).

ISO – The International Organization for Standardization

ISO is a non-governmental organization and a federation of the national standards bodies of 149 (year 2004) countries. ISO have members from all regions of the world, including developed, developing and transitional economies. Each ISO member is the principal standards organization in its country. The members propose the new standards, participate in their development and provide support in collaboration with ISO Central Secretariat for the 3000 technical groups that actually develop the standards (ISO in brief, 2005).

The CEN Technical Committee for Solid Biofuels, CEN/TC 335

The European Standardization Organization under the European Commission (EC) mandate created two Technical Committees: "CEN/TC 335 – Solid Biofuels" and "CEN/TC 343 Solid Recovered Fuels" to be in charge of the standardization of solid biofuels and solid recovered fuels. Those committees has been working in parallel within a common scope of elaborating standards, technical specifications and technical reports on solid biofuels and solid recovered fuels to be utilized as energy resources (Okstad, T. personal communication, February 16, 2006).

The scope of CEN/TC 335 includes solid biofuels from the following sources (CEN, 2002)

- Products from agriculture and forestry
- Vegetable waste from agriculture and forestry
- Vegetable waste from food processing industry
- Wood waste, with the exception of wood waste which contains halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating, and which includes in particular such wood waste from construction- and demolition waste
- Cork waste

According to the Terminology standard (CEN/TS 14588) and the Fuel Specification standard (CEN/TS 14961), the scope of CEN/TC 335 also includes:

- Fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and heat generated is recovered.

Since the beginning of the standardization process in the CEN/TC 335 in 2000, work was undertaken in five working groups in order to cover all appropriate issues under the EC-mandate. Working group

WG 1 Terminology, Definitions and description
WG 2 Fuel specifications, classes and quality assurance
WG 3 Sampling and sample reduction
WG 4 Physical and Mechanical Test Methods
WG 5 Chemical Test Methods

CEN/TS 14588 - Solid Biofuels - Terminology, Definitions and Description

This standard is called CEN/TS 14588. The objective of terminology standardization, which is the unification and harmonization of concepts, concept systems, terms and definitions, is to obtain a normative vocabulary in which only one term corresponds to one concept and only one concept corresponds to one term. The aim of standardization in terminology is to avoid the cost that would result from reworking proposed or existing terminologies, and also from producing a terminology that lacks uniformity or fails to meet the requirements of the user (ISO, 2001).

The Technical Specification CEN/TS 14588 was approved by CEN on 28 February 2003, validity limited to three years. Below is an example of a definition from the standard.

4.93 net calorific value (q_{net})
under such conditions that all the water of the reaction products remains as water vapour (at 0.1 MPa), the other products being as for the *gross calorific value,* all at the reference temperature

NOTE 1 The net calorific value can be determined at constant pressure or at constant volume. The net calorific value at constant pressure is however the generally used.

NOTE 2 Old term is lower heating value

NOTE 3 Net calorific value as received ($q_{net,ar}$) is calculated by the net calorific value from dry matter ($q_{net,d}$) and the *total moisture as received*

NOTE 4 Adapted from ISO 1928:1995

Figure 3. Example from CEN/TS 14588, definition on net calorific value. Words and phrases written with *italics* are defined other places in the standard

A common standard of terminology is also of importance when designing laws, directives and support arrangements and when developing statistics to i.e. compare the use of renewable energy sources in different geographical areas.

Principle
Solid biofuels are produced from different sources, which are defined within the Draft Business Plan of CEN/TC 335 Solid Biofuels. Terms and definitions are categorized in a structure based on the fact that solid biofuels are produced from different sources and that the purpose of solid biofuels is the conversion into bioenergy.
Terminology, definitions and descriptions in this standard shall cover (CEN/TS 14588):

1. Sources of biofuels, the initial location of the input material (biomass) in the economic and environmental cycles (like forest wood, landscape management residues, logging residues etc.)
2. The description of the solid biofuel itself as well as their handling, the different forms of biofuels produced (e.g. chipped wood, briquettes, moisture content), the most relevant biofuel properties (e.g. moisture content, ash content), and terms of sampling and testing as well as classification and specification
3. Bioenergy as the result of biofuel conversion

CEN/TS 14961 – Solid Biofuels – Fuel specifications and classes

CEN/TS 14691 was approved by CEN on 9th November 2004, and released in June 2005. The objective of this Technical Specification is to provide unambiguous and clear classification principles for solid biofuels. The standard shall serve as a tool to enable efficient trading of biofuels and to enable good understanding between seller and buyer as well as a tool for communication with equipment manufacturers (CEN/TS 14961). Below is an example from the standard on fuel specification on briquettes.

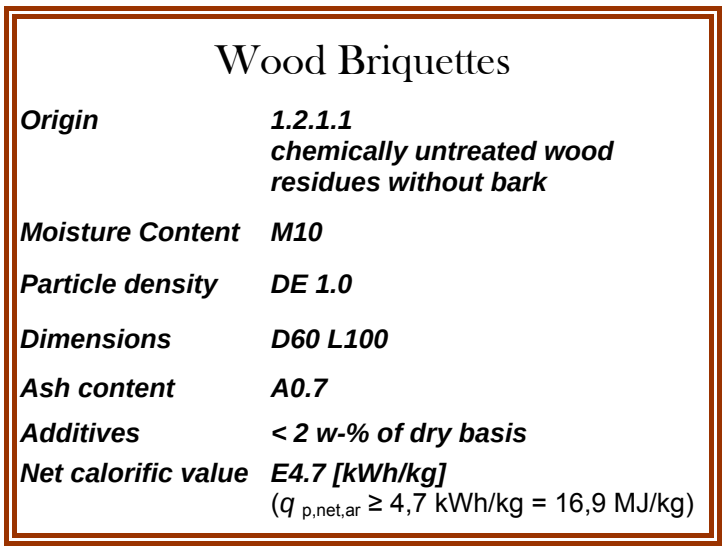


Figure 4. Example of fuel specification of wood briquettes given in CEN/TS 14961.

Principle
Solid biofuels are specified by:

- Origin and source – a description of the biological origin of the fuel. The standard provides a code list of the different origins. E.g. stem wood of coniferous delivered direct from forest will have code 1.1.2.2, or chemically untreated wood residues without bark delivered from wood processing industry will have code 1.2.1.1.
- Traded form – a description of major traded forms of solid biofuels like pellets, briquettes, wood chips etc.
- Normative properties – properties which have to be stated when fuel is traded. The standard specifies which properties that is normative for each traded form. Typically normative properties are moisture content, ash content and dimensions.
- Informative properties, that might be stated if required from buyer or seller of the fuel. The standard specifies which properties that is informative for each traded form. Typically informative properties are energy density, chlorine content etc.

The standard provides a reference list of standards and technical specifications to determine fuel properties. In addition, there are four annexes in the standard. Annex A gives examples of specifications for high quality classes of solid biofuels, designed for household usage. Annex B serves illustrations of typical forms of wood fuels, i.e. pictures of wood powder, sawdust, woodchips etc. Annex C is a table of typical values and properties for different solid biofuels. The table includes ash content, gross and net calorific value, major and minor components. Annex D gives examples of possible causes for deviant levels for different

properties and of consequences of handling and treatments for the properties of woody biomass.

CEN/TS 15234 – Solid biofuels — Fuel quality assurance

CEN/TS 15234 was prepared of WG2 and approved of CEN 335 year 2005, published in April 2006. Thus, this standard is not well known by the market actors yet.

The overall aim of this Technical Specification is to guarantee the solid biofuel quality through the whole supply chain, from the origin to the delivery of the solid biofuel and provide adequate confidence that specified quality requirements are fulfilled. The solid biofuel supply chain usually consists of the main stages described in Figure 5.

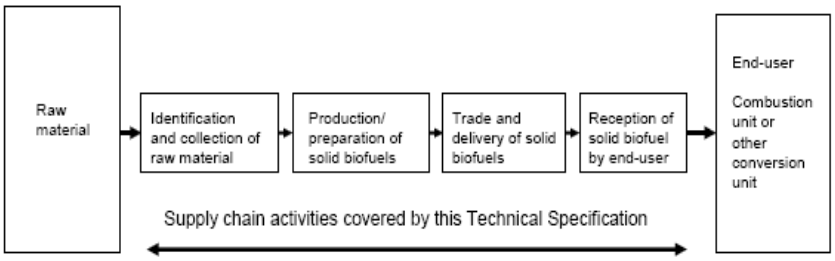


Figure 5. Solid biofuel supply chain as specified in CEN/TS 15234 (CEN, 2005).

Principle

The Technical Specification CEN/TS 15234 covers the Fuel Quality Assurance of the supply chain and the information to be used in the quality control of the biofuel. The methodology described in CEN/TS 15234 facilitates the design of a fuel quality management system for producers and suppliers of solid biofuels. Use of this system will provide traceability back to origin source of the fuel and confidence in the fuel quality.

Procedures to establish confidence in the biofuel quality includes the following requirements:

1. The first operator in the biofuel supply chain shall document the origin and source of the biofuel. Origin and source refers to the kind of biofuel, as listed in Table 1 in the CEN/TS 14961
2. The biofuel shall be traceable through the entire supply chain
3. The biofuel producer shall take quality assurance measures to achieve and secure the fuel quality and the company's performance relating to the production and/or supply of the solid biofuels
4. Transportation, handling and storage of the fuel should be performed with care and shall be documented by the operator

5. The supplier to the end-user or retailer is responsible for the biofuel quality and shall make a Fuel Quality Declaration
6. For specifications in the Fuel Quality Declaration, CEN/TS 14961 shall be used. The Fuel Quality Declaration shall include:

    - Supplier (body or enterprise) including contact information
    - A reference stating compliance to this Technical Specification (CEN/TS 15234)
    - Origin and source according toCEN/TS 14961
    - Country where the biomass is harvested or first traded as biofuel
    - Traded form according to definitions in CEN/TS 14961
    - Normative and if requested informative properties according to CEN/TS 14961.
    - The properties shall be determined in accordance with the standards and technical specifications listed in Table 3, 14961.
    - Chemical treatment if chemically treated biomass is traded;
    - Signature (assigned person), name, date and place.

Other standards for solid biofuels in Sweden

SIS has earlier developed several well established standards for solid biofuels, which probably will be replaced with the new CEN-standards. Current use of these old standards may slow down the introduction of the new CEN-standards. The Swedish standards which will be replaced by the CEN-standards evaluated in this exercise are (translated to English)
SS 18 71 06 Biofuels and peat – Terminology,
SS 18 71 20 Biofuels and peat – Fuel pellets – classification,
SS 18 71 23 Biofuels and peat – Fuel briquettes – classification

The Swedish district heating association has developed a "standard contract for wood and peat-fuels" which is a more comprehensive standard. In addition to fuel quality the contractors shall state a delivery plan for the fuel, measurement of the deliveries, price regulations, environmental issues and clauses on irregularities of the deliveries.

2. Methodology

2.1 Data collection methods

One way to get answers to the questions stated in the introduction is to ask the Swedish biofuel actors. Thus, the chosen method is to conduct surveys in the Swedish biofuel market.
Survey instruments take four forms: Self-administrated questionnaire, interview, structured record review, and structured observation (Fink, 1995).

Self-administrated questionnaires
A self-administrated questionnaire consists of questions that an individual completes by oneself. They can be conducted as a mail-survey or internet survey or other ways. Self-administrated questionnaires provide the opportunity to reach a bigger part of the target population, and therefore get a bigger sample size followed by higher accuracy of the results. At self-administered questionnaires, the respondent personally reads the questions and marks response options; there is nobody to probe, clarify, and motivate the respondent to complete the questionnaire. Another drawback is that only those respondents personally motivated to complete and return the questionnaire will be heard from. The sample may not meet the criterion of representativeness, and the survey results then can not be generalized to the target population (Fink, 1995).

Interviews
An interview survey requires at least two persons, one interviewer and one interviewee. Interviews can take place on telephone, face-to-face, video conferences etc. Although surveys done by interview are usually more expensive compared to other techniques, surveyors will choose them because the role the interviewer can play in enhancing respondent participation, guiding the questioning, answering the respondent's questions, and clarifying the meaning of responses. Another advantage is that the interviewee doesn't have the option to "throw away" the questionnaire, which ensures the representativeness of the interviewees. Interviews take a lot more time than self administrated questionnaires. Human errors might be done by the interviewer, like if the interviewer inadvertently overlooks a question, has snuffling pronounce and cause miss-understandings, or accepts answers that are inconsistent with the range of response alternatives (Fink, 2005).

Structured record reviews (Not considered as a suitable technique for this task). A structured record review is a survey that uses a specially created form to guide the collection of data from financial, medical, school, and other records (Fink, 1995). For example, one could collect delivery data from some biofuel suppliers, and extract data on how they specify their fuel.

Structured observations (Not considered as a suitable technique for this task). A structured observation collects data visually and is designed to guide the observer in focusing on specific actions or characteristics (Fink, 1995). E.g. one could go

out to wood-fuelled power plants to measure several characteristics of their fuel, measure the stoppage frequency caused by the fuel, and investigate the pulmonary health of the workers at the plant.

Reliability
A reliable survey instrument is one that is relatively free from measurement errors and sampling errors. The ideal sample is a miniature version of the target population. The ideal questionnaire is a questionnaire which does not generate any misunderstandings, and which does not affect the respondent's opinion while he/she read the instruction and questions. One major source of error in a sample arises from nonsampling errors. They affect the accuracy of a survey's findings because it mars the sample's representativeness. Nonsampling errors occur because of imprecision in the definition of target population and errors in survey design and measurement. Another source of nonsampling bias is nonresponce. Biases may also be introduced by the measurement or survey process itself. Poorly worded questions and response choices contribute to the possibility of error (Fink, 1995).

The challenge is to make intelligible questions without affecting the respondents answer, and to evaluate if the respondents are a representative mirror of the target population.

Project plan

According to the EUBIONET2 plan for year 2006, 5 actors in the biofuel market will be interviewed in line with the questionnaire proposed by project coordinator. There will be a report from each interview, and there will also be a summary report from all the five interviews. In addition a mail-survey will be sent to actors in Swedish biofuel market. The mail-survey is a practical way to determine which fuel properties that are important for the different actors and for that reason should be stated in a quality declaration. It is also practical to determine to which extent the standards from CEN/TS 335 are known to and used by actors in the Swedish biofuel market. To determine which threshold values that suits for the different biofuel products interviews are chosen to provide the possibility to guide and clarify the meaning of responses. One other option with two different types of surveys is to compare results from the same question, like which properties that should be stated when trading pellets. This is interesting as regards if the responders from the mail-survey have misunderstood some of the questions.

2.2 Target population - the Swedish market of biofuels

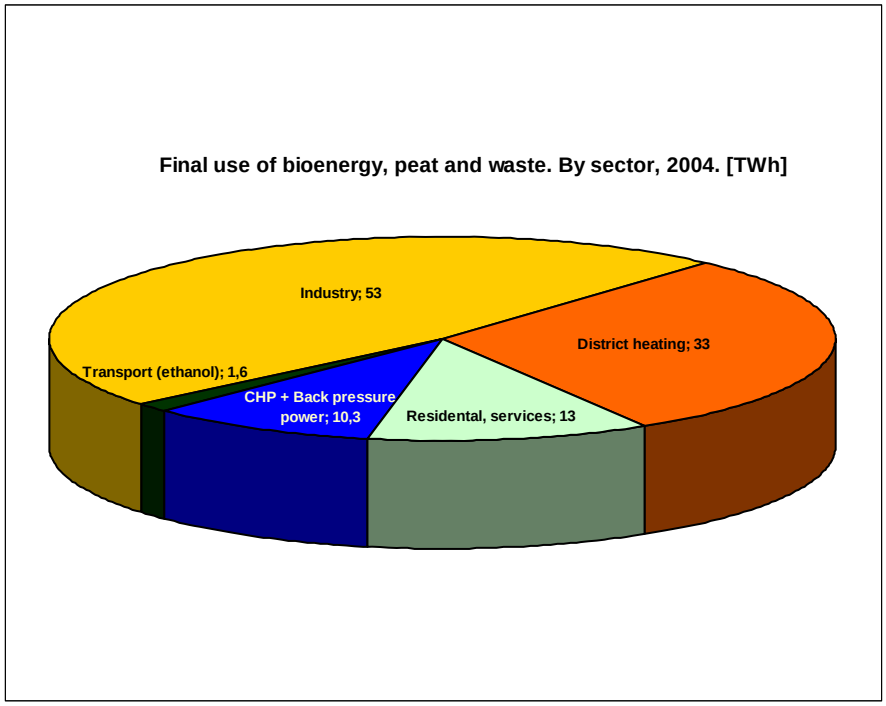


Figure 6. Final use of bioenergy in Sweden 2004 (Andersson, 2005)

The final use of biofuels, peat and waste for energy purposes was ca 110 TWh in 2004. The market actors in the biofuel chain consist of producers, suppliers, retailers and consumers. Many of the Swedish actors cover several of this roles, some only one. One fourth "family" in the biofuel chain is the equipment suppliers.

Producers and suppliers of solid biofuels in Sweden

The Swedish bioenergy association has done a mapping of the biofuel suppliers on the Swedish market year 2005. They found 45 companies, selling biofuels for 7100 mill. SEK. 24 of these companies have 99.1 % of the market share (Ljungblom, 2006).

The total supply of pellets in 2005 was ca 6 TWh, of which one third was used in residential and services, the rest of it mostly in CHP-plants. 90% of the pellet market was covered by the 14 members of PIR (www.pir.se; 15-Mars-2006))
The sixteen biggest producers of pellets, briquettes and powder had a total sale of 8.7 TWh upgraded solid biofuels (Ljungblom, 2006). The total supply of log wood in residential Sweden 2003 was ca 9 TWh (Andersson & Munkhammar, 2005). Much of the logs have never been merchandise, the wood is produced by the end-

user him/herself. Still there are numerous of small-scale wood producers in Sweden who sell their log wood direct to customers.

Consumers of solid biofuels in Sweden

220 district heating plants had a total energy consumption of 60 TWh, of which biofuels had a contribution of 22 TWh. Several of the heating plants are owned by the same company (Andersson, 2005).

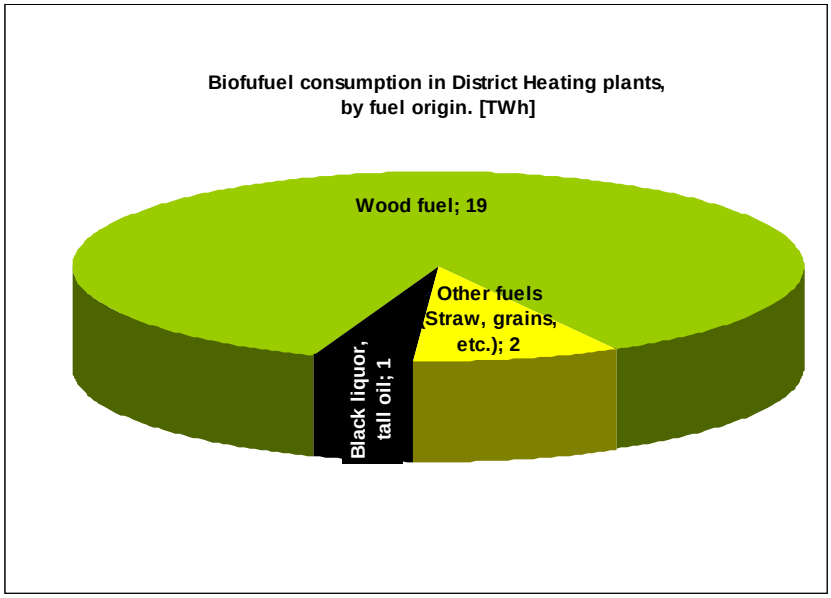


Figure 7. Biofuel used in District Heating Plants, by fuel origin (Andersson, 2005)

The total biofuel consumption in the residential market was 13 TWh, of which 2 TWh was pellets, ca 9 TWh log wood and the rest originates from grains, straw firing, peat firing, woodchips etc (Andersson, 2005).

Producers and suppliers of equipment for production and combustion of solid biofuels

In this work the focus will be on those producing or selling equipment for combustion installations and fuel upgrading. The total market is not quantified. In the last overview in the Swedish periodical of Bioenergy there are listed 41 suppliers of combustion equipment and 15 suppliers of fuel upgrading equipments (Ljungblom, 2006b).

2.3 Data to be collected in the survey and interviews

Two surveys and six interviews will be conducted to investigate the six issues mentioned in the introduction. One survey will be sent to producers, suppliers and consumers of solid biofuels to collect the following data:

- The knowledge of the CEN/TC 335 standards
- The usage of the CEN/TC 335 standards
- The required level of stating the origin of the biofuel
- Which kinds of "traded forms" of biofuel that exists in the biofuel market
- Which fuel properties the market actors demand for different kinds of solid biofuels in their biofuel trade
- Which fuel origins that are accepted to be included in the term "solid biofuels"
- Which unit of measure that is preferred in biofuel trade by the market actors

Six interviews will be conducted on actors at different stages in the solid biofuel supply chain to investigate if the suggested standards will fit to their fuel, and if the suggested standard will provide sufficient information about the fuel.

One survey will be sent to suppliers of equipment to the biofuel market to collect the following data:

- The knowledge of the CEN/TC 335 standards
- The usage of the CEN/TC 335 standards
- Which fuel properties affects their the performance of their products
- Which fuel properties that frequently generate wear and stoppages in their products

The receivers of the questionnaires and the interviewees are identified from advertisements in the periodical of the Swedish biofuel association, their member list, and from the member lists of the Swedish District heating association and web-search for biofuel and equipment suppliers.

3. Results from the survey and the interviews

The survey was sent to 83 different actors in the Swedish biofuel market. 29 of them were producers or suppliers of equipment for biofuel conversion. 54 of them were large scale producers, suppliers or consumers of biofuels. In the following it will not be distinguished between producers and suppliers of biofuels, as most of the Swedish producers also operate as suppliers.

Table 1. *Response rates from producers, large scale consumers and equipment suppliers.*

Kind of respondent	Number of surveys sent	Number of surveys returned	Response rate
Biofuel producer or supplier	32	22	69%
Large scale consumer	22	11	50%
Equipment supplier	29	19	66%

As mentioned before, the biofuel suppliers in Sweden had an approximate turnover of 7.1 billion SEK. Many of them operate both as suppliers and consumers of solid biofuels. A sum up of the respondents shows that they had a total turnover of 8.8 billion SEK, where the *consumers* had a turnover of 4 billion SEK, the pure *suppliers* had an turnover of 2.2 billion SEK and those who both supply and consume biofuel had a turnover of 2.6 billion SEK. The biofuel suppliers that have answered the questionnaire represent a market share of 67% of the traded biofuels in Sweden.

A sum up of heat and power produced by the respondents shows an annual production of 5 TWh heat and 1.5 TWh electric energy. However 6 of the 20 respondents who said they produce heat and power have not quantified their production. As mentioned the annual energy supply from biofuels for DH and CHP is about 22 TWh. A coarse estimate of the respondent's production and market share of the heat and power produced on biofuels is therefore respectively 9 TWh and 40 %.

From the equipment suppliers there were 19 responses out of 30 possible. 17 of them were dealing heating equipments and 4 were dealing equipment for upgrading to wood-powder, pellets and briquettes. The total market for equipments for the biofuel market is not quantified. The 19 responders had an annual sale of 2.7 billion SEK, where the contribution from one of them was 2 billion SEK

3.1 Knowledge and use of the new CEN-standards in the Swedish biofuel market

The respondents were asked if they have been missing a common EU-standard for solid biofuels, if they know about the existence of the different CEN-standards, and if they use the standards. The equipment suppliers were only asked about CEN/TS 14588 and CEN/TS14961.

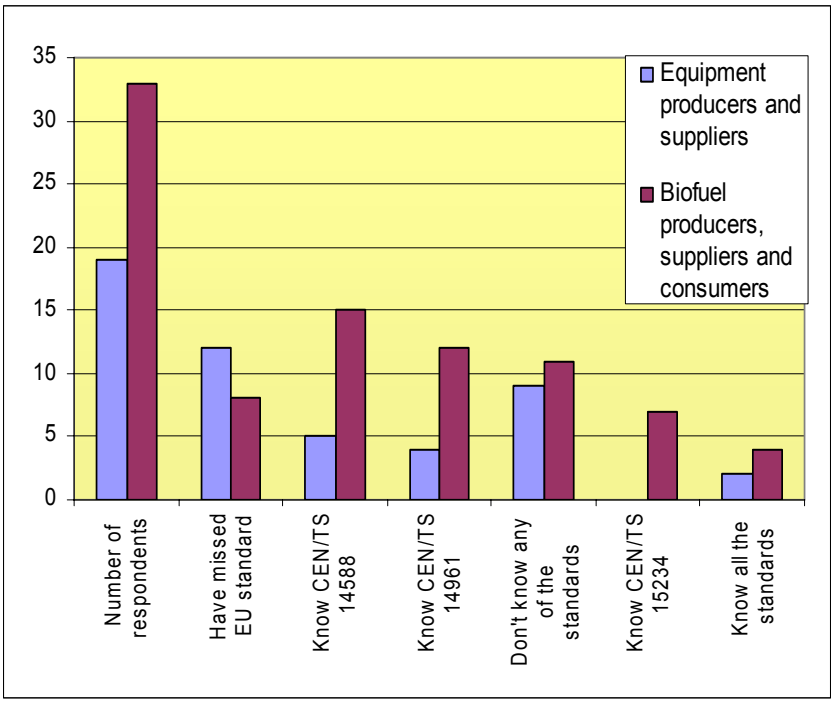


Figure 8. Result from the survey, knowledge of the CEN-standards by the biofuel actors in Sweden.

Two of the respondents answered that they use the standard for fuel specification CEN/TS 14961.

Only one of the interviewees was an active user of the new CEN-standards. The other interviewees either don't use any standard at all, use their own home-made standard formulary, or use the "standard contract for wood and peat-fuels" developed of the Swedish District Heating Association.

3.2 Accepted biofuel resources

The respondents were asked which sources they thought could be accepted as a biofuel resource.

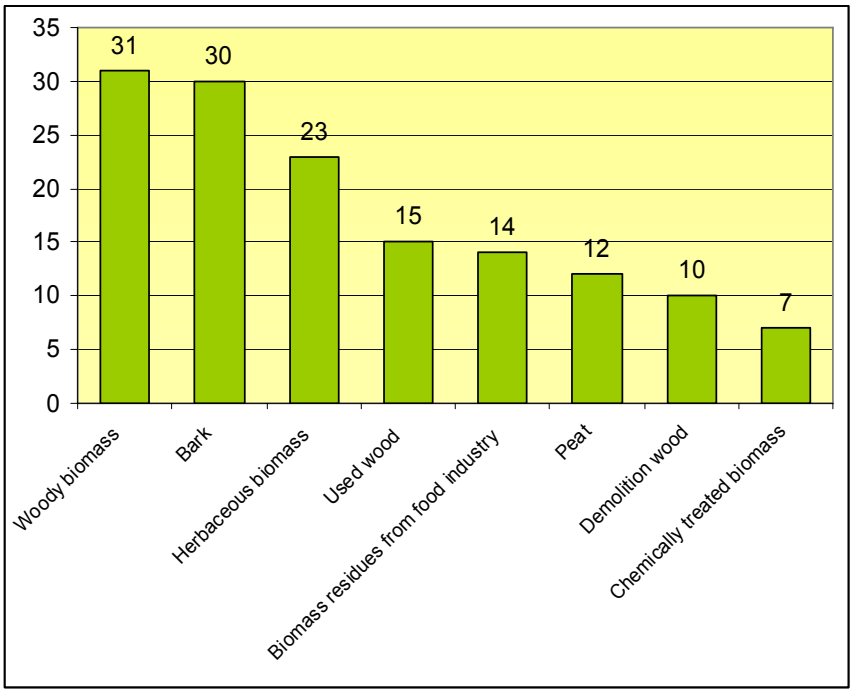


Figure 9: Result from the survey, accepted biofuel sources

32 of the 33 respondents answered the question. It seems like the actors in the Swedish biofuel market are sceptical to include chemically treated biomass, demolition wood, peat, residues from food industry and used wood in the biofuel market.

3.3 Requirements for specification of properties for different types of fuels

The respondents of the survey were asked which properties they want stated when different types of solid biofuels were traded.

Biofuels of agricultural origin

Straw bales

Only two of the respondents of the questionnaire had filled in this part of the questionnaire, so there is no valuable data on this. One of the interviewees was firing straw. The comments was as follows

- Weight pr bale should at least be informative. Important when handling the bales.
- Type of rope that is used to cord together the bale should be informative
- Pesticides used during cultivation, treatment and storage history affects ash content, ash melding and burning characteristics. Some declaration on this should be informative.

Grains
None of the respondents from the survey were firing grains
One of the interviewees was firing grains. No additional specifications of grains were demanded.

Biofuels mixed of biomass from wood, agriculture and other possible sources

Five of the respondents had filled in this question. None of the interviewees were trading blended fuels. Thus there is not enough data to ensure reliability of the response.

Woodfuels

The respondents were asked to fill in which properties they want stated on all types of wood fuels, regardless if it was chips, hog fuel or upgraded to pellets etc.

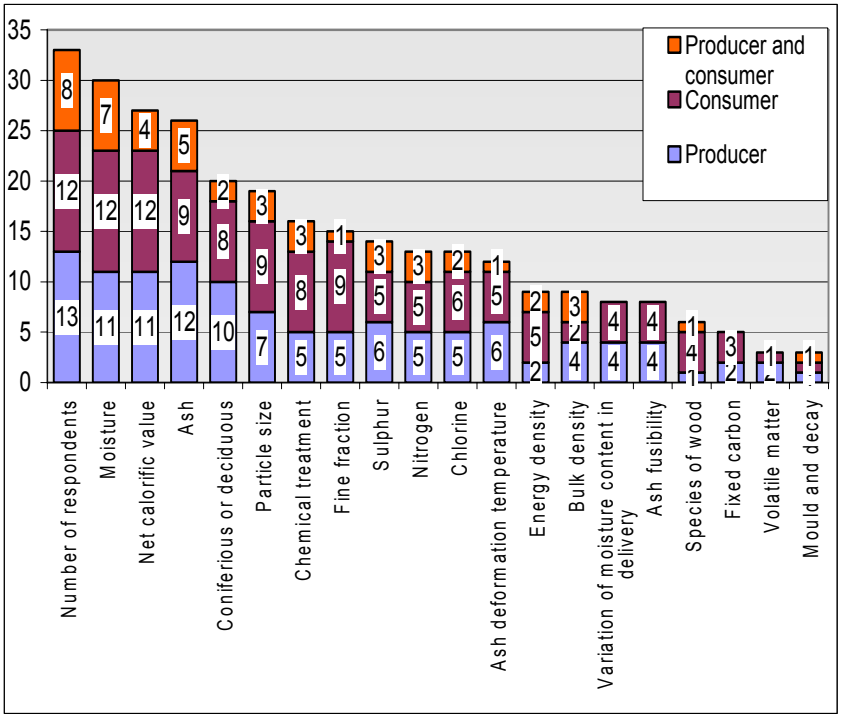


Figure 10. Result from the 33 respondents who have woodfuels in their assortment.

In addition there were some comments from the respondents. Some of those who recycle the ash want to know the content of cesium and heavy metals in the fuel or in an ash analysis of the fuel. Statements of risk of contamination and statement of sustainable forestry were also requested.

Briquettes

The respondents were asked to fill in which properties they want stated on briquettes. 15 of the respondents said they were dealing with briquettes, 16 have answered the question. Only the 15 dealing with briquettes are included in the diagram.

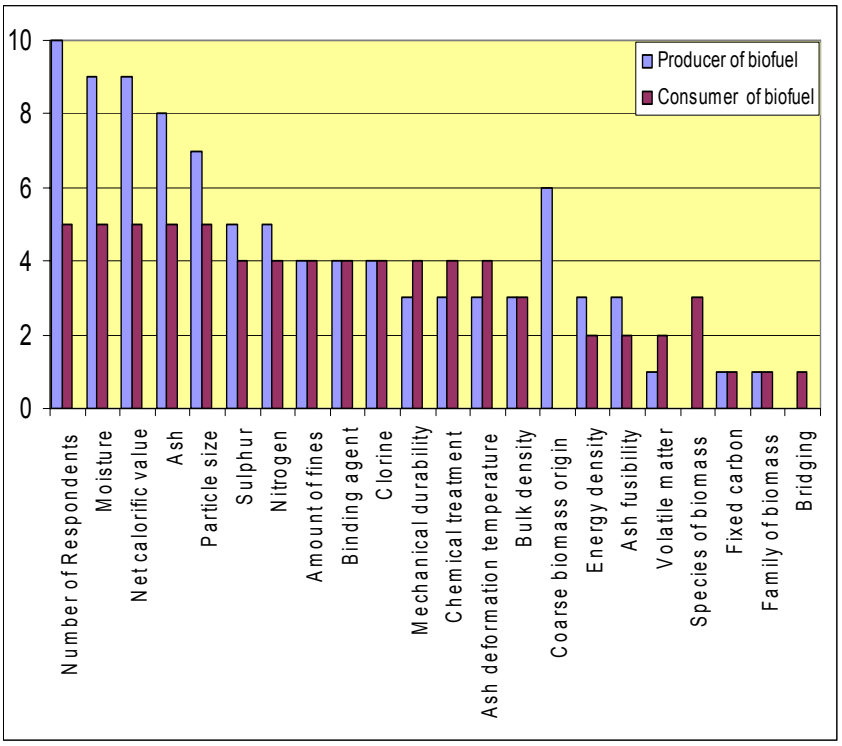


Figure 11. Response from the 15 producers and consumers of briquettes. Actors both producing and consuming solid biofuels are re-categorized to either consumers or producers as they mainly produce and sell or mainly consume briquettes.

Some of the respondents also requested other properties for briquettes noted in Annex 4. The comments were rather similar to the comments for woodfuels in general.

From the interviews ash deformation temperature, Nitrogen, Sulphur, particle density and fine fraction should be among the ***informative*** properties.
Net calorific value ($q_{net,ar}$) is normally stated for briquettes, and could be Normative information. Briquettes produced from used wood and other wood wastes require a higher resolution on the description of origin and source than suggested in Table 1 in CEN/TS 14961.

Pellets

The respondents were asked to fill in which properties they want stated on pellets. 21 of the respondents said they were dealing with pellets, 23 have answered the question. Only the 21 dealing with pellets are included in figure 12

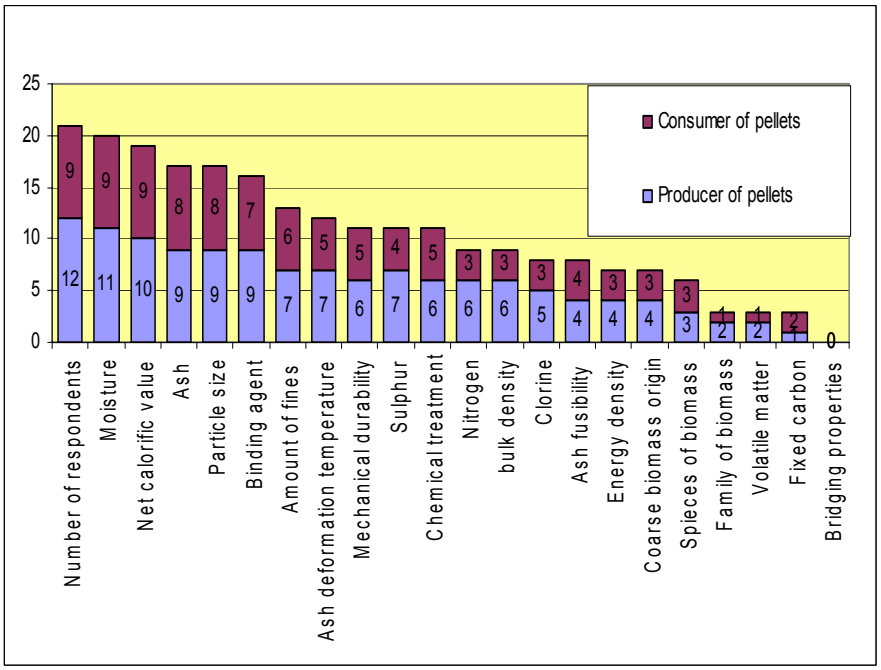


Figure 12. Response from the 21 producers and consumers of pellets. Actors both producing and consuming solid biofuels are re-categorized to either consumers or producers as they mainly produce and sell or mainly consume pellets.

Additional comments were mainly as for woodfuels in general. See annex 4.
From the interviews ash melting behaviour and the content of heavy metals and cesium-137 were demanded. Regarding the suggested threshold values comments are listed in Annex 2.

Chips and hog fuel

The respondents were asked to fill in which properties they want stated on pellets. 23 of the respondents said they were dealing with chips or hog fuel, 24 have answered the question. Only the 23 dealing with chips or hog fuel are included in the table.

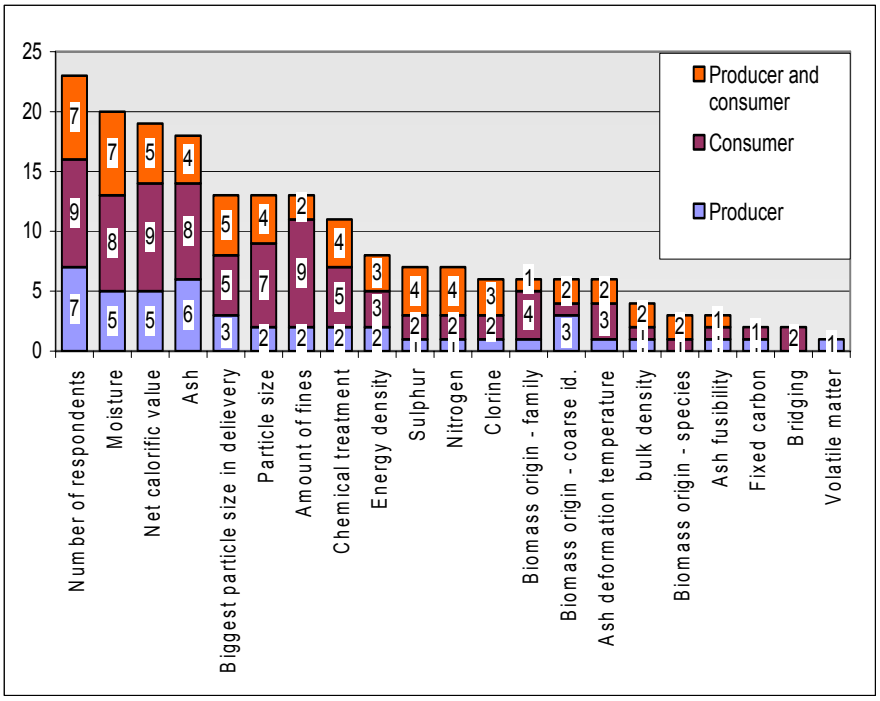


Figure 13. Response from the 23 respondents producing and consuming chips and hog fuel.

Additional comments were mainly as for woodfuels in general. Degree of mould attack was demanded by several of the interviewees. Other properties demanded were content of cesium-137, alkali metals, Sulphur and Chlorine. If the chips originate from short rotary forest specie of wood should be stated. Regarding suggested threshold values in the standard comments are listed in Annex 2.

Log woods
Log woods were not mentioned in the survey. One of the interviewees thought that a statement of traded unit (solid, stacked or loose volume) should be within the normative properties.

Saw dust
Sawdust was not specified in the survey. The feedback from the interviews were that if cutter chips should be included as saw dust the threshold values for ash and moisture content would not suit this product, and that species of wood and content of heavy metals and Cesium-137 should be informative information.

Bark
The respondents were asked to fill in which properties they want stated on bark fuels. 16 of the respondents were dealing with bark, 18 of the respondents have answered the question. Only those dealing with bark fuels are included in the diagram.

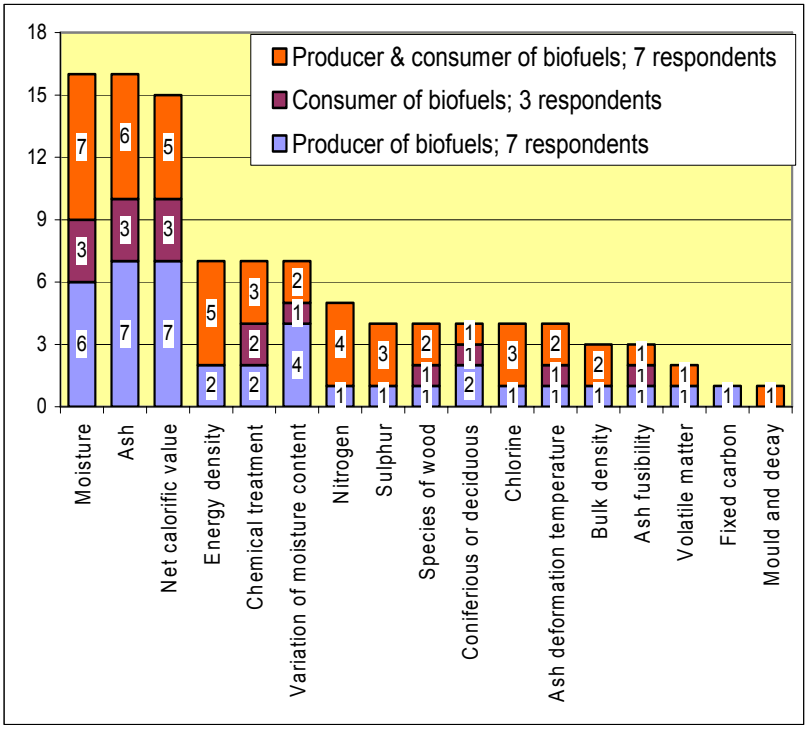


Figure 14. Result from the 16 respondents producing and consuming bark.

Additional comments from the interviews were that there should be an option to state if the bark originates from bark peeled off during handling or if it originates from a de-barking process. The first mentioned bark is often contaminated with sand, stones and other waste.

The content of heavy metals, alkali metals, Cesium, Chlorine and Sulphur is of importance for some of the actors, and should be included within the normative properties for bark due to high variation of the content of these elements in bark.

Table 1 in CEN/TS 14961 distinguish between wood processing residues without bark (1.2.1.1), with bark (1.2.1.2), pure bark residues (1.2..1.3) and blends and mixtures of these (1.2.1.4). The difference of 1.2.1.2 and 1.2.1.4 were demanded.

3.4 Traded unit

The respondents were asked which unit they prefer to use when biofuel is traded. All respondents answered the question, many of them crossed for several units.

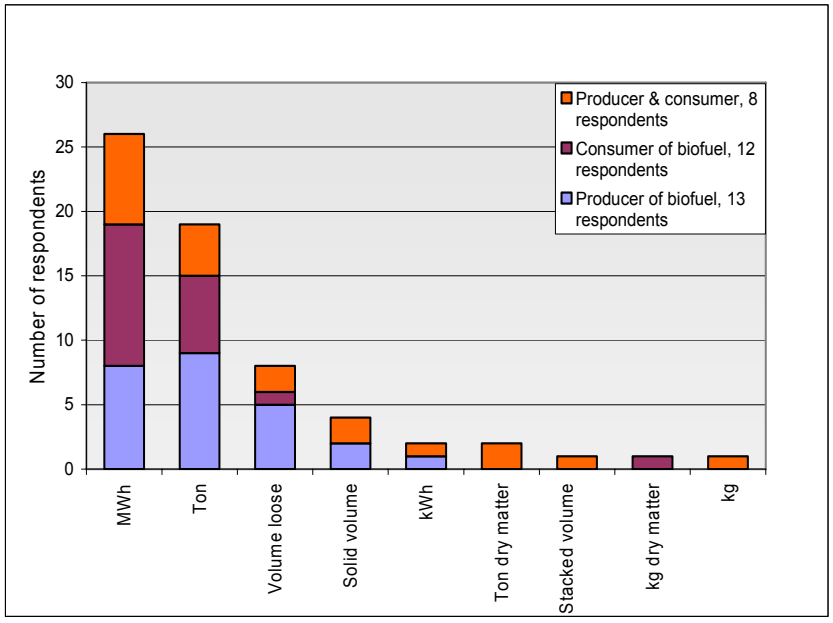


Figure15. Result from the survey on which unit that was preferred when trading biofuel. Among the 33 respondents there were 13 producers, 12 consumers and 8 actors both producing and consuming solid biofuels.

MWh were preferred by 80 % of the respondents, 60 % preferred ton while 40 % of the respondents have crossed both MWh and ton.

3.5 Results form the equipment producers and suppliers

There were 21 respondents of 30 who got the questionnaire. 2 of the respondents answered that the objective of standardization of solid biofuels had no relevance for them. Two of the respondents were making/selling equipments for upgrading to pellets, briquettes and fuel powder.

The respondents were asked which properties that affect wear and tear or that cause lower performance of their equipments. *Figure 16* shows the result of the survey.

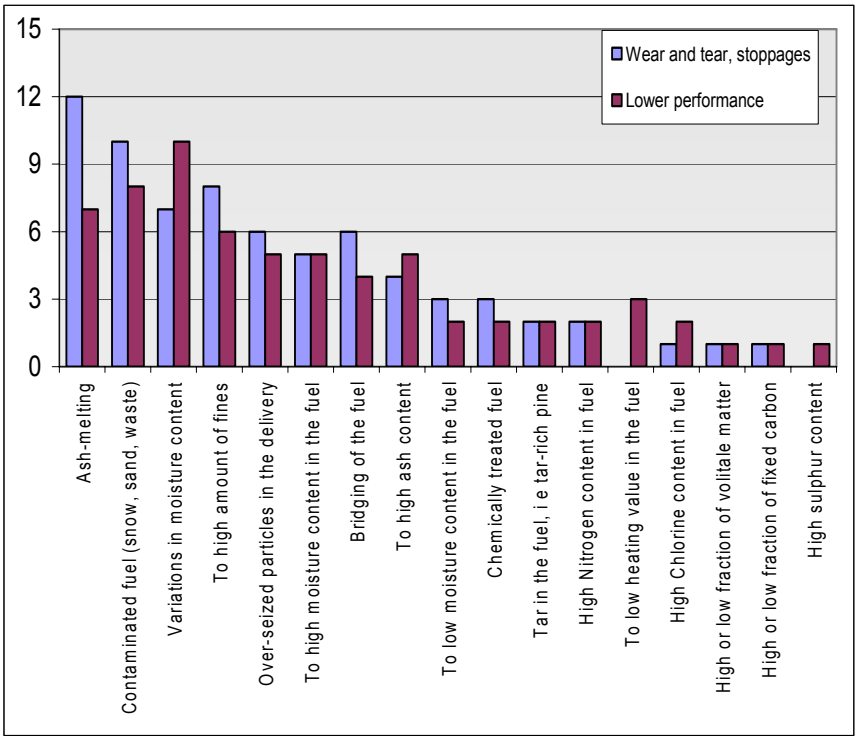


Figure 16. Result from the survey of equipment suppliers.

4. Discussion

4.1 Knowledge of the CEN-standards for solid biofuels

66% of the biofuel actors and 33% of the equipment producers who has answered the questionnaire know about the existence of at least one of the CEN-standards. Most of the biofuel actors have not been missing a common EU-standard on solid biofuels. Probably many of them already have well established agreements on the fuel specifications between buyer and seller or use the previous standards made by SIS or the Swedish district heating association.

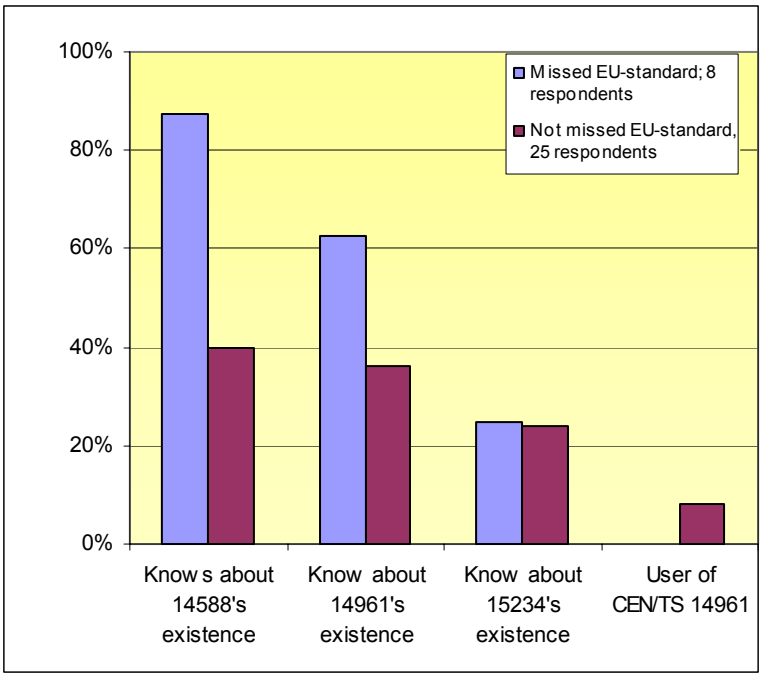


Figure 17: Knowledge about CEN-standards among biofuel producers, retailers and consumers as they have missed a common EU-standard or not. 8 of the respondents have missed an common EU-standard, 25 have not. Unfortunately there is not enough data to approve the result statistically.

Of greater importance is if those who have been missing a common EU-standard have got access to the new standards. Figure 17 shows that ca 87% of those who have been missing a EU standard know about the oldest standard CEN/TS 14588, and ca 60% of them know about CEN/TS 14961 which were released in June last year.

12 of the 19 equipment suppliers answered that they have been missing a common EU-standard for solid biofuels. Still only 33% of those who have missed the EU-standards know about the existence of CEN/TS 14588 and 25% of them know about the existence of CEN/TS 14961.

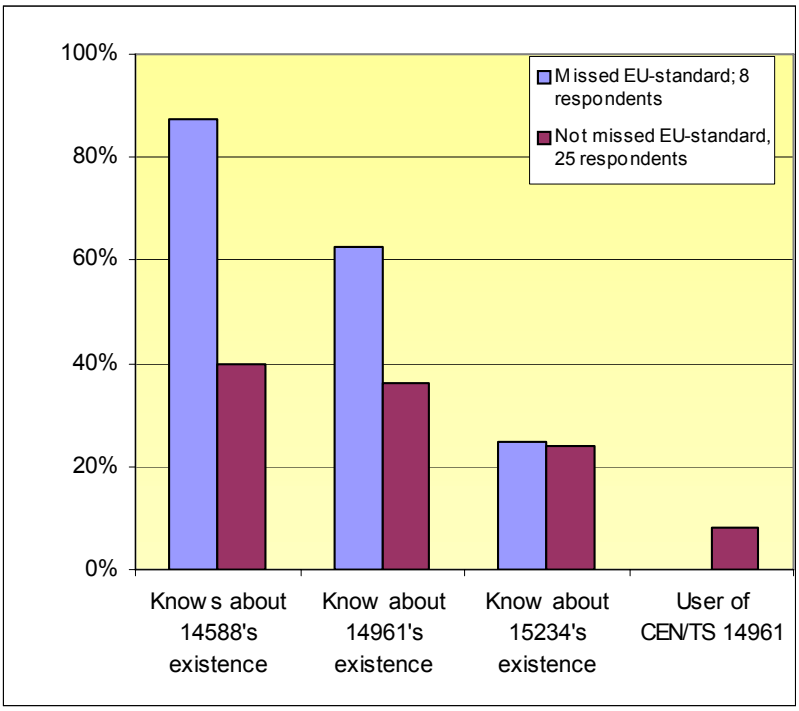


Figure 18: Knowledge and use of CEN-standards among suppliers of equipment to the solid biofuel market.

It seems like biofuel actors better know about the CEN-standards than equipment suppliers, despite that such a standard are more demanded by equipment suppliers. SIS is required to announce the existence of the new standards to the market actors, the result from the survey indicates that this is not done in a sufficient way.

4.2 Evaluation of CEN/TS 14588 – Terminology, definitions and description

The biomass term and the scope of CEN/TC 335

In the survey the respondents were asked which sources they thought should be accepted as a biofuel resource.

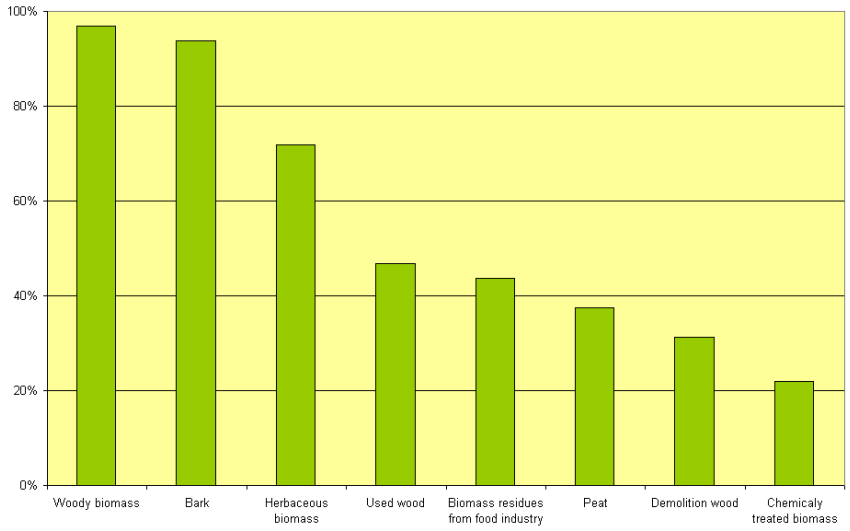


Figure 19. *Accepted biomass resources among the respondents dealing with biofuels.*

The question about which sources that should be included in the term *Biofuel* is maybe a scientific and political issue more than an issue for the actors in the market. None of the actors in the biofuel has an impartial approach to this question; it is reasonable to think that those burning pure biofuels don't want the biofuel term to be "polluted" with contaminated or chemically treated fuels, while those who use such sources want to be included when political support arrangements are made to promote the use of biofuel.

According to section 3 in CEN/TS14588 solid biofuels shall be classified and specified by their origin, traded form and properties. Three sources (wood, herbs and fruit) are mentioned to be possible origins of biofuels, and only these tree sources have got their vocabulary in the standard. Biofuel is defined as fuel produced directly or indirectly from biomass. Biomass is defined as material of biological origin excluding material embedded in geological formations and transformed to fossil (CEN/TS 14588). This definition of biofuel will include peat (dependent on the definition of fossil), paper and cardboard, any type of waste of biological origin, aquatic biomass like algae's and seaweed, meat and fish. None of these biomass sources is mentioned within the scope of CEN/TC 335, or in the list of sources of solid biofuels in CEN/TS 14588. Thus – there are several biomass sources which not can be traded in accordance with the standard.

There are several definitions of biomass in official EU-documents.

Definition of biomass by CEN/TC 355 *Solid Biofuels – Terminology, definitions and descriptions:* "Material of biological origin excluding material embedded in geological formations **and** transformed to fossil."

Preferred definition of biomass by CEN/TC 343 Solid Recovered Fuels' *Report on relative difference between biodegradable and biogenic fractions of SFR:* "Material of biological origin excluding material embedded in geological formation **or** transformed to fossil."

Definition in the directive *2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market (RES-E)*: "Biomass is the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste."

Definition of biomass in the directive *2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants:* "Biomass are products consisting of any whole or part of a vegetable matter from agriculture or forestry which can be used as a fuel for the purpose of recovering its energy content and the following waste used as a fuel:

a) vegetable waste from agriculture
b) vegetable waste from the food processing industry, if the heat generated is recovered
c) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered
d) cork waste
e) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating, and which includes in particular such wood waste originating from construction and demolition waste."

Definition of biomass in the Comission Decision of 29.01.2004, *Establishing guidelines for the moitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/WC of the European Parliament and the of the Council*: "Biomass means non-fossilised and biodegradable organic material originating from plants, animals and micro-organisms. This shall also include products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilised and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gasses and liquids recovered from the decomposition of non-fossilised and biodegradable organic material. When burned for energy purposes biomass is referred to as biomass fuel."

Definition of biomass in Svensk Standard SS 18 71 06: “Biomass: material with biological origin which is not or is negligible chemically converted.”

Biofuel is in most cases denoted as fuel originating from biomass. Is peat a biofuel or not? Is aquatic biomass and card boards a potential biofuel or not? Which fuels are legitimated for green certificates when used in electricity production? Which fuels have to pay tax on GHG-emissions? The definition of biomass is of great economically interest for many of the energy market actors and for the owners of different “biomass” resources.

Solid recovered biofuels

One other much discussed term is solid recovered biofuels. Two important questions are; what is solid recovered biofuels, and if solid recovered biofuels should be traded and treated as a pure biofuel or not. The scope for CEN/TC 335 is a little diffuse on this area.
Draft Business Plan of CEN/TC 335 Solid Biofuels and the Terminology Standard CEN/TS 14588 states that: “Within the scope, in line with the EC mandate is: wood waste, with the exception of wood waste which may contain halogenated organic compounds or heavy metals, and which includes in particular such wood waste originating from construction and demolition waste.”
In the Terminology Standard (CEN/TS 14588) it is noted that: “*The CEN/TC 335 consider that wood waste, including wood waste originating from construction and demolition waste are included in the scope of CEN/TC 335 and of the scope of the mandate M/298 “solid biofuels”, unless they contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings*”.

In the Fuel specification standard CEN/TS 14961 page 5 it is noted that: “*demolition wood is not included in the scope of this Technical Specification*.”

Recovered construction wood is defined as: used wood arising from construction of buildings or from civil engineering works. Demolition wood is defined as: used wood arising from demolition of buildings or civil engineering installations.
Recovered wood and *demolition wood* are terms on biomass that may include both pure biomass, contaminated biomass and biomass containing hazardous components. Woody biomass that is classified as non-pure biomass can not be used as a fuel if the combustion shall take place in a plant not using a cleaning technology according to the incineration Directive 2000/76/EC.

It is not easy, maybe not possible in practice, to identify with certainty whether wood from demolition activities has been treated with halogenated organic compounds or heavy metals. Thus there is a risk that contaminated and hazardous waste wood from demolition activities could occur in a delivery of pure solid biofuels and incinerated in facilities which do not comply with the requirements of the incineration Directive 2000/76/EC (T. Okstad, personal communication, February 16, 2006)..

It is undoubtedly important to clear up in the mentioned definitions to establish confidence on the terms of biofuel and bioenergy.

4.3 Evaluation of CEN/TS 14961 – Fuel Specifications and classes

Structure of the standard

Two of the interviewees had the opinion that the system with threshold values in fuel specification would counteract improvements of handling systems and fuel quality as the different producers will try to meet the threshold values rather than make the best possible quality of their fuel. E.g. straw bales have four different dimension classes. If an innovative actor improves the logistic system with some adjustment of the dimensions which is not in line with the standard, his/hers straw bales cannot be labelled in accordance with the standard. Many pellets producers offer pellets with ash content lower than 0.7 %, moisture content under 10 % and mechanical durability between 95 % and 97.5 %. Still there can be a substantial difference in ash and moisture content and durability in the different offers.
On the other hand, this way of standardizing properties is quite common. The standards set the quality requirement, and the producer of the standardized product has to meet the requirements. Then all market actors know which qualities they can expect to find on the fuel market, and the equipment producers might adapt their products to cope the different standardized fuel qualities.

One other issue is cases where a threshold value is within the confidence interval of a test of the fuel. It should be specified which threshold value that should be stated in these cases.

In the suggested standard the different properties will be designated with a letter code for the property and a number to indicate the value. E.g. an ash content of 1.5 % in the fuel will be denoted as **A1.5**, a bulk density of 600 kg/m^3 will be denoted as **BD600**. The idea might be to simplify communication between biofuel producer, retailer and customers. Anyway, in most of the examples for fuel specifications in line with the CEN-standards, both the letter code is explained and the number orderly denominated. This is maybe necessary to make any person understand the fuel specification, in particular if the person does not know the standard. There might be a risk that a fuel declaration where the different properties are written like codes will be confusing and less pedagogic than if there were fully written phrases and denominations.

For small-scale end users at household level it might be too much to deal with if they have to consider mechanical durability, fine fraction, content of Sulphur, Nitrogen and heavy metals, fuel origin etc. It should be considered to have an own standard for solid biofuel at retail level, so that unskilled people can buy fuel without risk for stoppages in their equipment or contamination of their ash-fertilized vegetables.

Fuel specification

In the following part the results from the survey and interviews will be analysed and discussed. Suggestions regarding which fuel properties that should be included in the normative and informative information in a fuel quality declaration will be based on an approach where 60 % score qualifies for normative and 30 % qualifies for informative.
Feedback from the interviewees will also be considered.

One issue that might affect the answers is the respondent's knowledge of fuel properties and how they affect burning characteristics, air emissions, wear of equipment etc and how they might vary between different types of fuels. The respondent's competence on this has not been investigated. Thus in cases of few responses on the particular question a few unskilled respondents might cause a wrong picture of what information of the fuel that is relevant or not.

One important point of view is the experiences of equipment suppliers about which properties of the fuels that lower the performance of their equipment, and which properties that cause wear and stoppages. In the questionnaire the respondents were asked to cross all the relevant properties, not to rank them. Lower performance was exemplified as lower efficiency and increased air emissions. Wear and stoppages was described as wear and stoppages in the fuel conversion equipment.

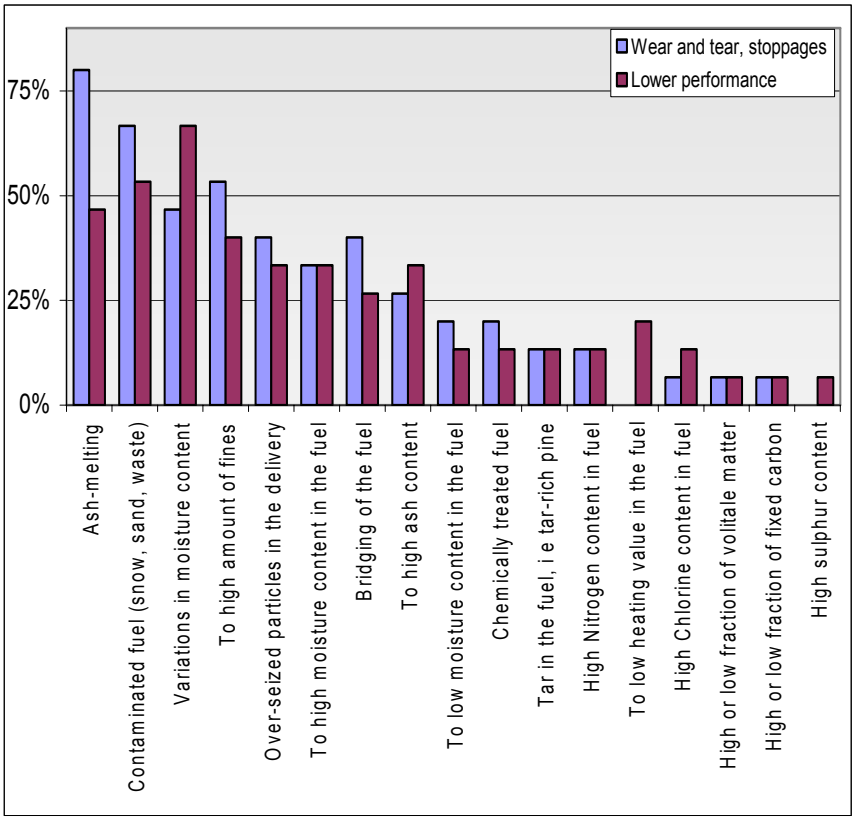


Figure 20. Properties causing wear and stoppages, and properties causing lower performance in equipment for combustion of solid biofuels.

Figure 20 is based on the response of the fifteen respondents making equipment for combustion of solid biofuels. It seems like the most problematic properties for combustion of solid biofuels are ash melting, contaminations of the fuel, variations of moisture content and fine fraction. This was also stressed in the comments from the respondents. Other properties of importance is over-sized particles in the delivery, bridging and to high ash content. High ash content might be a result of contaminations of the fuel – it has not been investigated if the respondents were thinking about high content of natural ash or high content of ash caused by contamination.

Specification of wood fuels

Woodfuels in general

The respondents are classified in three categories; pure woodfuel producers or suppliers, pure woodfuel consumers and those both producing and consuming solid biofuels.

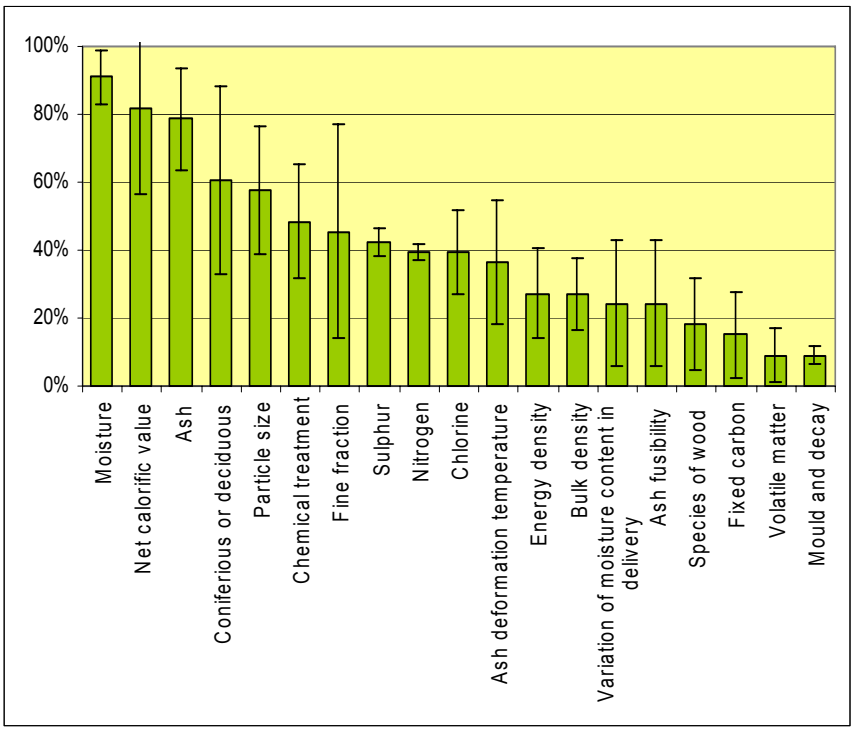


Figure 21. Properties demanded for all kinds of woodfuels. High standard deviation is due to big differences of the response between the three categories mentioned above.

All the 33 respondents have answered this question.

From the interviews it was mentioned that content of heavy metals and cesium-137 is of importance for those who intend to recycle ash back to the forest, and that the content of alkali metals, sulphur and chlorine affects the air emissions and corrosion of the equipment.

Those actors who intend to recycle the ash to the forest need an indication of the content of these components in the fuel. Thus, in case of ^{137}Cs it might be a solution to state if wood fuels originate from areas with higher ^{137}Cs content in the soil than a threshold value stated by some radiation protection authority.

Briquettes

Consumers of briquettes include only five respondents, thus *Figure 22* have to be read with care; the information demanded by the consumers may be much more or less important than it seems to. Suggestions for modifications in the standard for briquettes will be based on Figure 22 (properties demanded for briquettes), Figure 21 (properties demanded for woodfuels in general) and the feedback from the equipment suppliers.

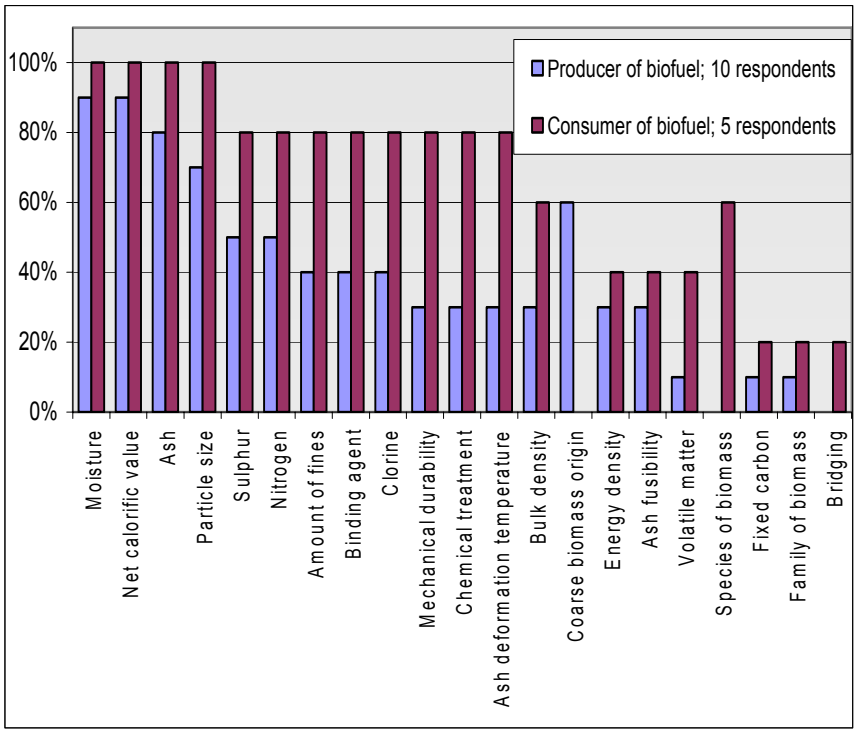


Figure 22. Properties demanded for briquettes.

Feedback from the interviews supports the demand of ash deformation temperature and for lifting the net calorific value from informative to normative information.

Comparing to the suggested standard, it seems like net calorific value ($q_{net,ar}$) should be added to the normative properties. Fine fraction should be considered to be added to the normative properties. Ash deformation temperature should be added to the informative properties, ash fusibility should be considered to be included.

Pellets

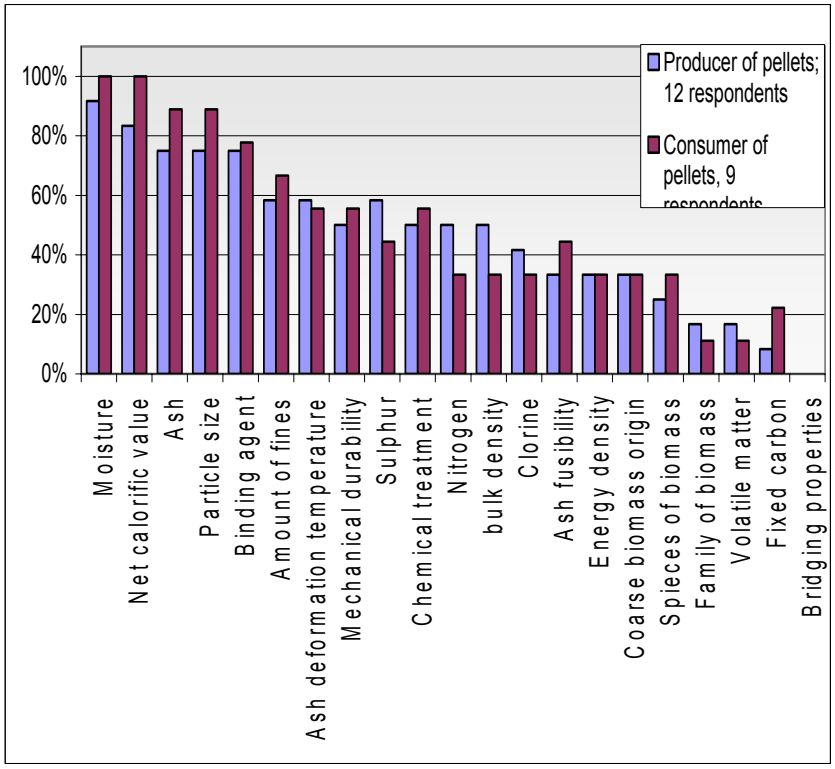


Figure 23. Properties demanded of pellets producers and consumers.

Feedback from the interviews and the feedback from equipment producers support the demand of ash deformation temperature and that net calorific value should be within the normative information.

Compared to the suggested standard it seems like net calorific value ($q_{net,ar}$) should be added to the Normative properties and that ash deformation temperature and ash fusibility should be included within the informative properties for pellets. Maybe also a opportunity to specify species of wood. In addition, content of cesium-137 and heavy metals maybe should be stated in cases where there is a risk that the ash will have higher content of these components than the requirements for ash recycling.

Regarding threshold values it was emphasized by some of the interviewees that pure wood has far lower ash content than 0.7, thus there should be a threshold value below 0.7 %.

Diameter (D) and Length (L)*	
D06	≤ 6 mm ± 0,5 mm and L ≤ 5 × Diameter
D08	≤ 8 mm ± 0,5 mm and L ≤ 4 × Diameter
D10	≤ 10 mm ± 0,5 mm and L ≤ 4 × Diameter
	***** Maximum 20 w-% of the pellets may have a lenght of 7,5 ×Diameter

Figure 24: The suggested way to denote dimensions of pellets in CEN/TS 14961

The suggested way of denoting tolerance limits is not very common. In accordance to the standard a pellet labelled D08 might have any diameter under 8.5 mm. the standard could therefore denote the requirement of a pellet labelled D08 as ≤ 8.5 mm. In addition, according to the standard, 20 w-% of the the pellets may have a length of 7.5 × Diameter. This amount of pellets having a length of exactly 7.5 × Diameter is rather seldom. It is possibly meant that maximum 20 w-% of the pellets may have a length bestween 4 × Diameter and 7.5 × Diameter. If so this should be stated a different way than suggested in standard.
One of the interviewees stressed that pellets having this lenght (7.5 × Diameter) would cause lots of stoppages in the feeding systems of much of his customers and could not be accepted.

Wood chips and hog fuel

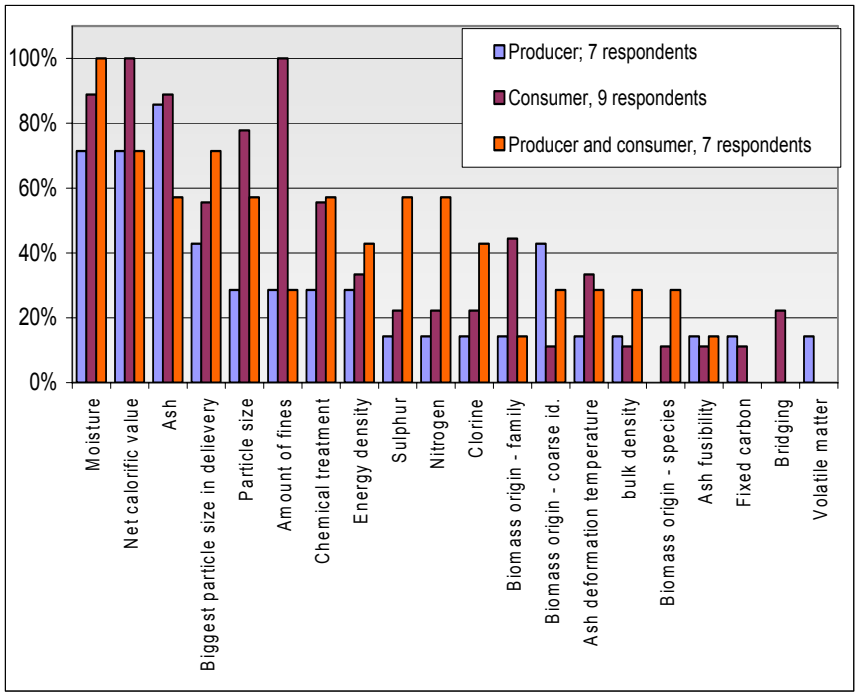


Figure 25. Properties demanded of woodchips and hog fuel producers and consumers.

Mould attack of the delivery was stressed by two of the interviewees. Unfortunately this was not asked for in the questionnaire. There is not established a common way of denoting the amount of mould in a delivery. This might be done by a description of handling history, storage conditions and storage time as this affects the fungi activity in the biomass. Or it could be established some kind of measuring standard for measurement of mould attack.

Regarding other properties than those listed in Figure 25, see the session of woodfuels in general.

Comparing to the suggested standard it seems like net calorific value ($q_{net,ar}$) should be Normative, and Sulphur content could be added within the informative properties. In addition, content of ^{137}Cs and heavy metals maybe should be stated in cases where there is a risk that the ash will have higher content of these components than what is stated in the requirements for ash recycling.

Regarding threshold values one of the interviewees mentioned that it would be an advantage if particle size distribution were done the same way for chips and hogfuels and cellulose chips. According to the current standard for cellulose chips, SCAN-CD 40.01, fine fraction should include all particles < 3 mm. The biggest

particle size measured in SCAN-CD40.01 is 45 mm, which seems to comply with one of the threshold values in CEN/TS 14961.

It was also suggested a higher resolution of threshold values for ash and moisture content in the most common intervals, for ash content this interval is between 1.5 – 5 w-% of dry matter, for moisture it is between 40 – 55 w-%

Log woods

Log woods were not investigated in the survey, but feedback were collected in the interviews.

Type of volume, m^3 solid, loose or stacked was demanded as Normative information. This might be reasonable as the different ways to denote the amount of wood give a difference of the actual amount of wood in a delivery of 30 – 60% (Hohle, 2001).

According to the standard, it should be stated if the wood is coniferous or deciduous. The heating value of deciduous log woods varies from 1520 kWh/m^3 (alder) to 2400 kWh/m^3 (beech). For coniferous the variation is less; spruce have heating value of 1710 kWh/m^3 and pine have heating value of 1900 kWh/m^3. The main reason for this is the high variation of density of the different species (Hohle, 2001). Thus the energy content of a volume of deciduous might vary with 50-60 %. It should therefore be considered if species of wood should be stated, or if it should be distinguished between heavy and a light deciduous.

The suggested standard states that if more than 10 w-% is mould and decay this should be stated. It is not suggested how to decide the fraction of mould. A mould share of 10 w-% of a delivery of log woods is rather much.

Regarding threshold values the tolerances on length were seen unreasonable. When making log woods there will always occur some oversized and undersized pieces. E.g. an assumption that the origin stems has an average length of ca 3 meter and cut length is 30 cm, there will often be one rest piece of irregular length for each stem, thus ca 10 % of the produced log woods will have a irregularity of more than the suggested 2 cm. If the rest pieces are to short it is normally not a problem to make them suit in the stove, but if they are to long this might be a problem. At longer cut lengths a bigger fraction of the wood will have irregular lengths.
One possible solution of this is to set a “normal” length and in addition a maximum length of the pieces in the delivery, and a statement that a maximum share of *e.g.* 10 % of the delivery has abnormal lengths.

Sawdust

Sawdust was not investigated in the survey but feedback was collected in the interviews. Regarding the content of different components the comments were the same here as in the session for wood fuels in general.

Cutter chips does not have its own fuel class in the standard, the intention is maybe that cutter chips can be traded as sawdust or woodchips. If so the suggested threshold values for moisture content is too high as cutter chips often have moisture content between 10 and 20 w-%. It should be considered if cutter chips should have its own table in the standard.
Much of the sawdust has moisture content in the interval 35 – 55 w-%, thus there should be an additional threshold value between these two values, e.g. 45 w-%. The lowest threshold value for ash content should be lower than 0,7 w-%, *e.g.* 0,5 w-%.

Bark

Consumers of bark includes only three respondents, thus Figure 26 have to be read with care; the information demanded by the consumers may be much more or less important than it seems to.

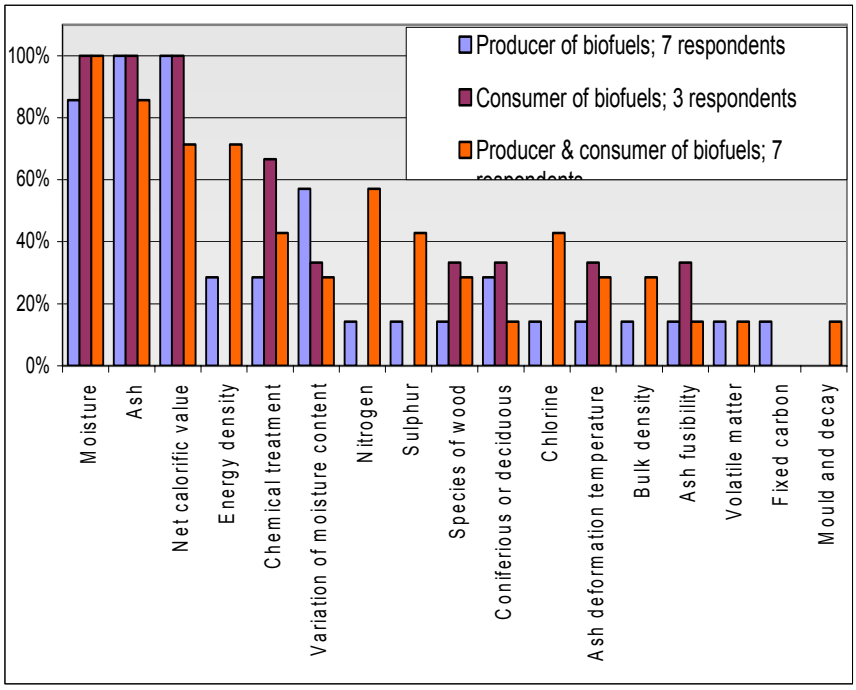


Figure 26: Properties demanded for bark producers, suppliers and consumers. Suppliers and producers is merged to one category.

There should be an option to state if the bark originates from bark peeled off during handling or if it is pure bark from a de-barking process. The first mentioned bark is often contaminated with sand, waste and other residues like plastics, steel bands etc. The content of heavy metals, alkali metals, ^{137}Cs, Chlorine and Sulphur is normally higher and vary more for bark than for pure wood(CEN/TS 14961; Möre & Lynn, 2002). Thus it should be considered if the content of these components should be Normative for bark fuels.

Comparing to the standard, it seems like the calorific value ($q_{net,ar}$) should be Normative, and content of sulphur should be within the Informative properties. If the content of ^{137}Cs and heavy metals should be stated should be further discussed with authorities on the field.

Specification of biofuels of agricultural origin

Straw bales

Straw bales were not directly investigated in the survey. Some comments were collected in the interviews.

Four sizes of cubic bales are listed in the standard, two of them with rigid dimensions, one with flexible height and one with flexible length. Round bales are not included. It was stressed from one of the interviewees that regarding dimensions of the bales the standard should provide more flexibility.

Treatment of fungicides, storage time and condition affect ash content and ash fusibility. Thus, information of treatment history of the bales should be considered. Information of which kind of rope that is used to cord together the bale should also be considered as Normative or Informative information.

General Master Table

General Master Table was not investigated in the survey. Some comments were collected in the interviews. Grains and seeds do not have their own standard, the General Master Table might be used for this purpose which was done in one of the interviews. In the suggested standard the threshold values for moisture content are stated in intervals of 10 w-% from 10 w-% to 60 w-%. As grains normally have a moisture content of ca 12 w-% the resolution of threshold values for moisture content should be higher to fit with grains. Regarding Dimensions there should also be an option to state a minimum size of the fuel pieces.

4.4 Evaluation of CEN/TS 15234 –Fuel quality assurance

Respondents in the survey and interviewees demanded statement of “sustainable and responsible forestry” or statement of certified forestry on woodfuels. This could be considered to be included in the fuel quality assurance standard.

5 Conclusion – suggestions to CEN/TC 335

In the following part there will be some general suggestions for the coming standardization work in CEN/TC 335, and suggestions on new specification tables for the different traded forms of solid biofuels. The suggestions are all based on results from the discussion chapter.

For the avoidance of doubt and to establish confidence on the terms ***Biomass*** and ***Biofuels,*** these terms should be stated the same way in all official documents from EU; in standards, legislations, regulations etc.

There are several other biomass sources than those listed within the scope of CEN/TC 335 which can be utilized for energy purposes, e.g. food waste, cardboards, peat and aquatic biomass. It should be considered to state which sources that can be traded and treated as pure solid biofuels, solid recovered fuels, fossil fuels and other classes, with references to the actual standards and regulations for the different fuels. This could be done in the standard for fuel specification and classes.

Producers of solid biofuels cannot in accordance to the standard state the actual quality of their fuel, and they might be stimulated to meet the requirement for the threshold values rather than making the best fuel quality. Thus it might counteract improvements and competition on fuel quality, handling systems, and logistics.
One possible way to compensate for this is to state the net calorific value of the fuel, as the net calorific value are affected by the purity and moisture content of the fuel, and as it mainly is the energy content of the fuel which is paid for.

To simplify use of solid biofuels for household users there could be stated a maximum content of components causing corrosion, air pollution and ash pollution and minimum requirements on qualities causing risk for wear and stoppages in the combustion equipment. Such requirements should be stated in accordance with regulations and directives for ash recycling and disposal, air pollution and in cooperation with producers of equipments for small scale biofuel utilisation.

The system of denoting different fuel qualities with symbols and numbers in stead of fully written phrases, values and denominations might act more confusing than explanatory, especially for users who do not know the standard. Thus it should be considerate to use fully written phrases and denominations when labelling biofuels.

Under is a clip from table 1 “origin and source” in the fuel specification standard, listing codes for wood residues from wood processing industry.

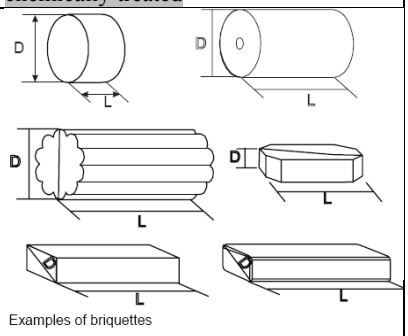
1.2.1 Chemically untreated wood residues	1.2.1.1 Without bark
	1.2.1.2 With bark *
	1.2.1.3 Bark (from industry operations)*
	1.2.1.4 Blends and mixtures
1.2.2 Chemically treated wood residues	1.2.2.1 Without bark
	1.2.2.2 With bark *
	1.2.2.3 Bark (from industry operations) *
	1.2.2.4 Blends and mixtures

Figure 27. Clip from table 1, "Classification of origin and sources of solid biofuels". in CEN/TS 14961

In this table the difference between 1.2.1.2. "Chemically untreated wood residues with bark" and 1.2.1.4 "blends and mixtures" should be explained, or these two categories could be merged to one category. Same is with 1.2.2.2 and 1.2.2.4. Further, Table 1 in CEN/TS 14961 should provide the option to distinguish between bark piled of during handling of the wood (in Sweden this bark is called "städbark") and bark originating from a de-barking process.

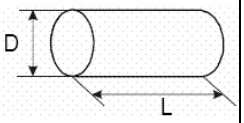
In the following part there will be suggested changes in table 4 – 13 in CEN/TC 14961 in accordance with the results from the surveys and the interviews. The suggestions are based on an assumption that there will be made special requirements for biofuels intended for household and small scale users. Shaded areas denote changes of the suggested standard regarding which properties that are listed as normative or informative. XX denotes that more information is necessary to motivate the actual number. Crossed off text indicated a suggestion to remove the property from the table. Additional comments are currently made as footnotes. The maximum values of heavy metals and ^{137}Cs in ash intended for ash recycling in Sweden are listed in Appendix 5. If the standard for fuel specification shall include instructions regarding ^{137}Cs and heavy metals CEN/TC 335 has to develop standards for this purpose.

Table for specification of Briquettes

	Master Table		Briquettes
Normative	**Origin:** According to 6.1 and Table 1		**Chemical treatment:** To be stated if chemically treated
	Dimensions [mm]		 Examples of briquettes
	Diameter:	25 mm ≤ Diameter ≤ ∞ Average of xx randomly chosen samples	
	Length:	50 mm ≤ Length ≤ ∞ Average of xx randomly chosen samples	
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg][a]		
	Moisture content (w-% as received) [a]		Max. for household standard is XX w-%
	Ash content (w-% of dry basis) [a]		Max. for household standard XX w-%
	Ash deformation temperature		Min. for household standard XX °C
	Additives (w-% of pressing mass) [a]		Type and content of any additives to be stated
	Amount of fines (w-%, < 3.15 mm) [a] at the last possible place in the production site		Max. for household standard XX w-%
Informative	**Nitrogen** (w-% of dry basis) [a]		Normative for chemically treated biomass
	Chlorine (w-% of dry basis) [a]		Normative for chemically treated biomass
	Sulphur (w-% of dry basis) [a]		Normative for chemically treated biomass or if sulphur containing additives have been used
	Heavy metals and ^{137}Cs (w-% of dry basis)		To be stated if the content exceeds XX w-% [1]
	Mechanical durability (w-%) of briquettes after testing [a]		Minimum for household standard is XX w-%
	Ash fusibility		
	Bulk density as received (kg/m^3 loose) [a]		
	Particle density (kg/dm^3) [a]		Minimum for household standard is XX kg/dm^3
	[a] Required number of decimals is stated in Table 3, CEN/TS 14591 [2]		

[1] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.
[2] Required number of decimals should to be stated in Table 3 or another place in the standard

Table for specification of Pellets

	Master table	Pellets
Normative	**Origin:** According to 6.1 and Table 1	**Chemical treatment:** To be stated if chemically treated
	Dimensions [mm] Actual values to be stated. **Diameter (D) and Length (L)** For industrial use: 6 mm ≤ Diameter ≤ 25 mm For household use: 6 mm ≤ Diameter ≤ XX mm Length: max 4 × Diameter Length is average length of XX random samples Maximum 20 w-% of the pellets may have a length in the interval 4 – XX [3] × Diameter	
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg][a]	
	Moisture (w-% as received)	Max for household standard is XX w-%
	Ash (w-% of dry basis)	Max for household standard XX w-%
	Ash deformation temperature	Min for household standard XX °C
	Mechanical durability (w-% of pellets after testing)	Min for household standard is XX w-%
	Amount of fines (w-%, < 3.15 mm) after production at factory gate [a]	Max for household standard XX w-%
	Additives (w-% of pressing mass)	Type and content of any other additives to be stated
Informative	**Nitrogen** (w-% of dry basis) [a]	Normative for chemically treated biomass
	Chlorine (w-% of dry ash free basis) [a]	
	Sulphur (w-% of dry basis) [a]	Normative for chemically treated biomass
	Heavy metals and ^{137}Cs (w-% of dry basis)	To be stated if the content exceeds XX w-% [4]
	Ash fusibility	
	Bulk density as received (kg/m^3 loose)	
	[a] Required number of decimals is stated in Table 3, CEN/TS 14591[5]	

[3] According to the interviews maximum length should be far below the suggested 7.5 × Diameter

[4] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

[5] Required number of decimals should to be stated in Table 3 or another place in the standard

Table for specification of properties for woodchips

	Master table		Woodchips	
Normative	**Origin**: According to 6.1 and Table 1		**Chemical treatment:** To be stated if chemically treated	
	Dimensions (mm) [a]			
		Main fraction > 80 % of weight	Fine fraction [b] < XX w-%	Coarse fraction max length of particle
	P16	3,0 mm ≤ P ≤ 16 mm	< 3,0 mm [b]	max 1 % > 45 mm, all < 85 mm
	P45	3,0 mm ≤ P ≤ 45 mm	< 3,0 mm [b]	max 1 % > 63 mm, all <xx mm
	P63	3,0 mm ≤ P ≤ 63 mm	< 3,0 mm [b]	max 1 % > 100 mm, all <xx mm
	P100	3,0 mm ≤ P ≤ 100 mm	< 3,0 mm [b]	max 1 % > 200 mm, all <xx mm
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg]			
	Moisture (w-% as received)			
	Ash (w-% of dry basis)			
Informative	**Sulphur** (w-% of dry basis)		Normative for chemically treated biomass	
	Nitrogen (w-% of dry basis)		Normative for chemically treated biomass	
	Chlorine (w-% of dry basis)			
	Variation of moisture content in delivery			
	Heavy metals and ^{137}Cs		To be stated if the content exceeds XX w-% [6]	
	Ash deformation temperature			
	Energy density (kWh/ m^3) loose as received			
	Bulk density (kg/m^3) loose as received			
	Mould and decay			

[a] The numerical values for dimension refer to the particle sizes passing through the mentioned round hole sieve size (3,15 mm, 16 mm, 45 mm, 63 mm and 100 mm). Dimensions of actual particles may differ from those values especially the length of the particle.

[b] 3.0 is suggested instead of 3.15, to comply to the established standard SCAN-CD 40.01 for determining size distribution for cellulose chips.

[6] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

Table for specification of properties for hog fuels

	Master table			Woodchips
Normative	**Origin**: According to 6.1 and Table 1			**Chemical treatment:** To be stated if chemically treated
	Dimensions (mm) [a]			
		Main fraction > 80 % of weight	Fine fraction [b] < XX w-%	Coarse fraction max length of particle
	P45 **P63** **P100** **P300**	3,0 mm ≤ P ≤ 45 mm 3,0 mm ≤ P ≤ 63 mm 3,0 mm ≤ P ≤ 100 mm 3,0 mm ≤ P ≤ 300 mm	< 3,0 mm [b] < 3,0 mm [b] < 3,0 mm [b] < 3,0 mm [b]	max 1 % > 63 mm, all < xx mm max 1 % > 100 mm, all <xx mm max 1 % > 200 mm, all <xx mm max 1 % > 400 mm, all <xx mm
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg]			
	Moisture (w-% as received)			
	Ash (w-% of dry basis)			
Informative	**Sulphur** (w-% of dry basis)			Normative for chemically treated biomass
	Nitrogen (w-% of dry basis)			Normative for chemically treated biomass
	Chlorine (weight of dry basis, w-%)			
	Variation of moisture content in delivery			
	Heavy metals and ^{137}Cs (w-% of dry basis)			To be stated if the content exceeds XX w-% [7]
	Ash deformation temperature			
	Energy density (kWh/ m^3 loose)			
	Bulk density as received (kg/m^3 loose)			
	Mould and decay			

[a] The numerical values for dimension refer to the particle sizes passing through the mentioned round hole sieve size (3,15 mm, 16 mm, 45 mm, 63 mm and 100 mm). Dimensions of actual particles may differ from those values especially the length of the particle.

[b] 3.0 is chosen instead of 3.15, to comply to the established standard SCAN-CD 40.01 for determining size distribution for cellulose chips.

[7] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

Table for specification of properties for log woods

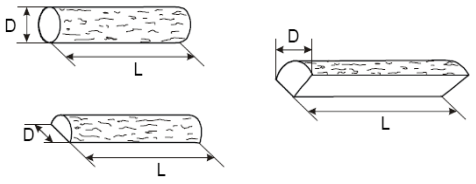
<table>
<tr><td rowspan="8">Normative</td><td colspan="2">Master table</td><td>Log woods</td></tr>
<tr><td colspan="2">Origin: According to 6.1 and Table 1</td><td></td></tr>
<tr><td>Dimensions (mm)
Length and diameter denotes the length and diameter of the main fraction of delivery.
No pieces shall exceed XX % of stated cut lenght or diameter.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="3">Length (L) and thickness (D) (maximum diameter of a single chop)</td></tr>
<tr><td>P 300 mm
P 500 mm
P 1000 mm</td><td colspan="2">L = 300 mm ± 20 mm and 40 mm ≤ D ≤ 160 mm
L = 500 mm ± 40 mm and 60 mm ≤ D ≤ 250 mm
L = 1000 mm ± 50 mm and 60 mm ≤ D ≤ 350 mm</td></tr>
<tr><td colspan="3">Wood
To be stated if coniferous, dense or light deciduous or mixture of these.
Dense deciduous is defined as species with particle density ≥ XX kg/dm^3
Suggestion: birch is set to be the lightest of the dense deciduous. Birch has a basic density of 510 kg / m^{3}solid. Maple, mountain-ash,, oak and beech are heavier. Alder, willow, aspen, and goat willow are lighter (Hohle, 2001).</td></tr>
<tr><td colspan="3">Traded volume m^3 solid, stacked or loose as received</td></tr>
<tr><td colspan="3">Moisture content (w-% as received)</td></tr>
<tr><td rowspan="4">Informative</td><td>Energy density, E_{ar} (kWh/m^3 loose or stacked)</td><td>Recommended to be specified when retailed.</td></tr>
<tr><td>Proportion of split volume</td><td>No split (=mainly round wood)
Split: more than 85 % of volume is split
Mixture: split and round wood as a mixture</td></tr>
<tr><td>The cut-off surface</td><td>To be stated if the cut-off surface of log woods are even a and
smooth a or ends of log woods are uneven</td></tr>
<tr><td>Mould and decay</td><td>If significant amount (more than 10 % of weight) of decay exists it should be stated.
If significant amount (more than XX % of cut-off surface) are moulded it should be stated.
In case of doubt particle density or net calorific value could be used as indicator to decide degree of decay.</td></tr>
<tr><td colspan="3">[a] Use of chainsaw is considered to be smooth and even.</td></tr>
</table>

Table for specification of properties for sawdust

	Master table	Sawdust
Normative	**Origin**: According to 6.1 and Table 1, woody biomass	**Chemical treatment:** To be stated if chemically treated
	Dimensions	< XX mm
	Ciniferous or deciduous or mixture	
	Moisture (w-% as received)	
	Ash (w-% of dry basis)	
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg]	
Informative	**Ash deformation temperature**	
	Energy density (kWh/ m^3 loose)	
	Bulk density as received (kg/m^3 loose)	
	Nitrogen (w-% of dry basis)	Normative for chemically treated biomass
	Sulphur (w-% of dry basis)	Normative for chemically treated biomass
	Heavy metals and ^{137}Cs (w-% of dry basis) **Chlorine** (weight of dry basis, w-%)	To be stated if the content exceeds XX w-% [8]

[8] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

Table for specification of Cutter chips and shavings

	Master table	Sawdust
Normative	**Origin**: According to 6.1 and Table 1, woody biomass	**Chemical treatment:** To be stated if chemically treated
	Dimensions	< XX mm
	Ciniferous or deciduous or mixture	
	Moisture (w-% as received)	
	Ash (w-% of dry basis)	
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg]	
Informative	**Ash deformation temperature**	
	Energy density (kWh/ m^3 loose) **Bulk density as received** (kg/m^3 loose)	
	Nitrogen (w-% of dry basis)	Normative for chemically treated biomass
	Sulphur (w-% of dry basis)	Normative for chemically treated biomass
	Heavy metals and ^{137}Cs (w-% of dry basis) **Chlorine** (weight of dry basis, w-%)	To be stated if the content exceeds XX w-% [9]

[9] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

Table for specification of properties for bark

	Master table	Bark
	Origin: According to Table 1 [10] and 6.1, Woody biomass [a]	**Chemical treatment:** To be stated if chemically treated
Normative		
	Moisture (w-% as received)	
	Ash (w-% of dry basis)	
	Net calorific value $q_{p,net,ar}$ [MJ/kg] or [kWh /kg]	
	Shredding	To be stated if shredded
Informative	**Nitrogen, N** (w-% of dry basis)	Normative for chemically treated biomass
	Sulphur S (w-% of dry basis)	Normative for chemically treated biomass
	Kalimetals (w-% of dry basis)	
	Alkalimetals (w-% of dry basis)	
	Ash deformation temperature	
	Deciduous or Coniferous	
	Species of wood	
	Chlorine, (w-% of dry basis)	
	Heavy metals and ^{137}Cs (w-% of dry basis)	To be stated if the content exceeds XX w-% [11]
	Bulk density as received (kg/m^3 loose)	Recommended to be stated if traded by volume basis in categories BDxxx

[a] Also cork is included.

[10] Table 1 should give the option to distiguish between bark piled of during handling of wood and bark originating from a de-barking process.

[11] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated.

Table for specification of straw bales

	Master table		**Straw bales**	
	Origin:According Table 1 and 6.1 in CEN/TS 14961		**Chemical treatment:** To be stated if chemically treated [12]	
	Traded Form		Big Bale	
Normative	**Dimensions** (mm), Cubic bales: height (L_1), width (L_2) and length (L_3) Round bales Diameter and Depth			
		Height (L_1)	Width (L_2)	Length (L_3)
	Standard Big bale	XX	XX	XX
	Other sizes	To be stated	To be stated	To be
	Round bale	Diameter to be stated	Length to be stated	stated
	Bale weight (kg)			
	Moisture (w-% as received)			
	Ash (w-% of dry basis)			
	Species of biomass			
Informative	**Bale density** (kg/m^3)			
	Net calorific value, $q_{p,net,ar}$ (MJ/kg as received or energy density, E_{ar} (kWh/m^3 loose)		Recommended to be specified.	
	Storage time and conditions		Affects ash content and ash fusibility.	
	Treatment of fungicides		Affects ash content and ash fusibility	
	Type of rope used to cord togeter the bales			
	Particle size distribution or structure		It is recommended to declare production methods that influence the size of the straw particles. That is for instance weather the crop has been thrashed by rotation or oscillation or weather it has been chopped.	

[12] Chemically treatment of ammonia or preservation agents are often used if straw is intended to be animal food.
It should be specified if treatment of fungicides, insecticides etc. during growth should be stated or not.

General Master table for solid biofuels

	General Master Table	
	Origin: According Table 1 and 6.1	**Chemical treatment:** To be stated if chemically treated
	Traded Form	A short description of the form of the fuel (see Table 2 for guidelines)
Normative	**Dimensions** (mm) $D_{max,}$ Maximum diameter $D_{min,}$ Minimum diameter L_{max} Maximum length L_{min} Minimum Length	If dimensions are not suitable to express as diameter and length other formats may be used, but shall then be clearly stated
Normative	**Moisture** (w-% as received)	
Normative	**Ash** (w-% of dry basis)	
Normative	**Additives** (w-% of dry basis)	Type and content of additives to be stated
Informative	**Net calorific value** $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/ m^3 loose)	
Informative	**Bulk density as received** (kg/m^3 loose)	
Informative	**Nitrogen, N** (w-% of dry basis)	Normative for chemically treated biomass
Informative	**Chlorine, Cl** (weight of dry basis, w-%)	
Informative	**Sulphur, S** (weight of dry basis, w-%)	
Informative	**Mechanical durability** (remaining weight after treatment, weight of dry basis, w-%)	
Informative	**Heavy metals and ^{137}Cs** (w-% of dry basis)	To be stated if the content exceeds XX w-% [13]
Informative	Further specification of dimensions	
Informative	Others e.g. major and minor elements	

[13] Should either be stated for all solid bifofuels some place in the standard or for each traded form. Special requirements for residental use should be considerated

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Appendix 1: Abbreviations, units and symbols

Abbreviations used

CEN	Comitè Europèen de Normalisation European Committee for Standardization
CEN/TC 335	Technical Committee for Solid Biofuels
CEN/TS	Technical Specification approved by CEN
CHP	Combined Heat and Power
DH	District Heating
EN	European standard approved by CEN
GHG	Green House Gas
ISO	International Organization for Standardization
SIS	Swedish Standards Institute

Units used

kWh	kilo Watt hour = 3600 kilo Joule
MWh	10^3 kWh
GWh	10^6 kWh
TWh	10^9 kWh

Symbols used

w-%	Percent of weight
$q_{net,d}$	Net calorific value of dry matter
$q_{net,ar}$	Net calorific value as received. Calculated by $q_{net,d}$ and the moisture content

Appendix 2: Results from interviews

Company specific information

A1.2 Type of organisation

Interviewee 1: Producer, retailer and consumer.
Interviewee 2: Producer, supplier
Interviewee 3: Large scale consumer, DH-plant (owned by the fuel suppliers)
Interviewee 4: Producer and Large scale consumer, CHP-plant
Interviewee 5: This Company offer measuring services of deliveries for wood industry and bioenergy industry.
Description of service offered by interviewee 5: *We measure amount in the delivery, moisture content, calorific value and ash content, plus provide traceability of the deliveries. Other parameters are measured by the contractors. Still our system allows the contractors to put other parameters in the delivery description.*
Interviewee 6: Producer, supplier

A1.3 Traded forms and annual production, sale and/or consumption
Interviewee 1: *Log woods. Annual production 500 m^3 loose, annual consumption 10 m^3 loose.*
Interviewee 2: *Wood chips; 2 TWh, Sawdust; 0,5 TWh, Bark; 0,7 TWh*
Interviewee 3: *Straw bales; 4500 ton, Grains; 1000 ton*
Interviewee 4: *Production: Salix; 60 GWh, Consumption: Salix chips; 60 GWh, Woodchips; 200 GWh, bark; 80 GWh, Saw dust; 60 GWh, Pellets; 30 GWh.*
Interviewee 5: *Annual measured amounts is ca 140000 deliveries, or ca 5.3 mill. ton.*
Measure all assortments.
Interviewee 6: Briquettes, Pellets, Woodchips, Sawdust, bark

A1.4 Current standard used
Interviewee 1: No standard used.
Interviewee 2: Swedish standards for decision of fuel properties, no standard for trade. The customer states what he/she want.
Interviewee 3: No standard used currently
Interviewee 4: Standard-form contract provided by the Swedish District Heating Association
Interviewee 5: We use our own standard to describe quantity of delivery, moisture content and ash content.
Interviewee 6: We use Swedish and CEN-standards

For the rest of the result summary, interviewee 1 is denoted as I1, interviewee 2 is denoted as I2 etc.

B. Feedback from the CEN technical specifications - Briquettes

B1. Specification of traded/produced or used fuels

I5: *Required specifications are stated between the contractors. We measure amount in the delivery, moisture content, calorific value and ash content, plus provide traceability of the deliveries. Other parameters may be measured and added to the delivery description by the contractors.*

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I5: Amount of fines should be within the informative properties for briquettes.
Much of the briquettes are produced from used wood and other wood waste. These products require a higher resolution on the description of origin and treatment than suggested in Table 1, or they have to be used in waste incineration plants.
Net calorific value is usually stated. This could be normative information

I6: Ash deformation temperature

B2.2 Are there enough normative properties or should some other properties be normative?

I5: It should be up to buyer and seller to state which fuel properties that should be stated at the delivery and also which threshold values that is required.
Particle density should be informative
Nitrogen and Sulphur should be Informative

I6: Net calorific value should be Normative

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.

I5: We usually measure moisture content and weight. Other properties is measured by buyer and seller. Suggested values suits pretty well.

I6: Lowest suggested threshold value for ash content is too high and not reasonable. Pure wood has 0.3 % ash. Our suggestion: 0.5 %

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.

I5: We have developed our own standards for this purpose, based on the demand of our customers. If the new CEN-standards is better than our own, or if our our customers ask for it we will use them.

I6: We do not use CEN-standard for specification of briquettes, we will use it if our customers requires it.

B2.5 How do you control of the fuel properties?

I5: We only measure quality, amount and provide traceability on the deliveries, and have nothing to do with the fuel before or after.

I5: Periodical analysis of the fuel, visual control of deliveries.

B. Feedback from the CEN technical specifications – Pellets

B1. Specification of traded/produced or used fuels

	Master table		
	Origin: According Table 1 in CEN/TS 14961		Select from Table 1 **I4:** ***1211***
	Traded Form		Pellets
Normative	**Dimensions** (mm)		
	Diameter (D) and Length (L)*		
	I4: ***D08*** **I6:** ***D06*** **I6:** ***D08***	***≤ 8 mm*** ***≤ 6 mm*** ***≤ 8 mm***	
	Moisture (w-% as received)		
	I4: ***M10*** **I6:** ***M10***	***≤10 %*** ***≤10 %***	
	Ash (w-% of dry basis)		
	I4: ***A0.7*** **I6: A0.7**	***≤ 0.7 %***	**I4:** ***Typical value 0.5% Ash*** **I6:** ***Typical value 0.3% Ash***
	Sulphur (w-% of dry basis)		
	S	**I4, I6:** ***Not specified, we do not burn pellets of chemically treated biomass***	
	Mechanical durability (w-% of pellets after testing)		
	DU **I6: DU 95,0 %**	**I4:** ***not specified, and doesn't matter for our plant. Pellets s milled before firing.*** ***≥ 95,0***	**I6:** ***Typical value 96.5***
	Amount of fines (w-%, < 3.15 mm) after production at factory gate [a]		
	F	**I4:** ***not specified, and doesn't matter for our plant. Pellets is milled before firing*** **I6:** ***Not specified***	[a] At the last possible place in the production site
	Additives (w-% of pressing mass)		
	I4: ***No additives in the pellets we buy*** **I6:** ***No additives added***		
	Nitrogen	**I4:** ***not specified, but affects the performance and wear of our plant.***	**I4:** ***Will might be of interest if pellets from other origins is to be considered as a fuel at our plant***
Informative	Net calorific value, qp,net,ar (MJ/kg as received) or energy density, Ear (kWh/m^3 loose)		Specified by retailer
	Bulk density as received (kg/m^3 loose)		**I4:** ***Normally not specified***
	Chlorine, Cl (weight of dry basis, w-%)		**I4:** ***Might be of interest if pellets from other origins is to be considered as a fuel at our plant***
	*NOTE: Maximum 20 w-% of the pellets may have a length of 7,5 x Diameter.		

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I4: The content of heavy metals, Cesium, Clorine and Svovel is of importance for us, and should be included within the informative properties.

I5: The listed specifications seem sufficient.

I6: Ash deformation temperature should be included

B2.2 Are there enough normative properties or should some other properties be normative?

I4: Net calorific value is allways stated by the supplier, this value should be normative.

I5: Same comments as for briquettes.

I6: Ash deformation temperature should be Normative

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.

I4: The threshold values seems to fit our products.

I5: The lowest threshold value for ash content should be lower, or there should be other ways to state the purity of the fuel. Pure wood has lower ash content, often 0.3 %.

I6: Why is the standard based on threshold values? We think it would be much better with a standard where the actual value were stated.

Not reasonable tolerance limits. Stating the limit as e.g. ≤ 6 mm ± 0.5 mm is the same as statin the limit as ≤ 6.5 mm. If there are going to be tolerance limits, diameter should be stated = threshold value, and the tolerance limit should be wider than 0.5 mm.

Lenght of pellets of 7.5 times diameter cannot be accepted, this would cause numerous stoppages in most of household the equipment in Sweden. Maximum length should be 4 times diameter, longer pellets should not be accepted. In view of burning characteristics, the length of pellets should be under 20 mm.

Moisture content: Our pellets never exceed 9 % moisture content, normally it is in the intervall 6 – 9 %. Threshold values should be 9 and 12 %. We have never seen pellets containing 20 % moisture, this value seems not reasonable.

Ash content: 0.7 is to high ash content. Such high ash content would not be accepted for our customers. Ash content in our pellets is normally 0.3 %, lowest threshold value should be 0.5 %. Ash content says a lot about the purity of the pellets. In our point of view, it would be the best to state the ***actual*** value of ash content.

Mechanical durability: The resolution in values for stating mechanical durability is not sufficient. DU97,5 is a very good pellets, DU95,0 is a very bad pellets, our pellets is a quite good pellets but not good enough to be classified as DU97,5.

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.

I4:

I5: Same comment as for briquettes.

I6: Yes, we try.

B2.5 How do you control of the fuel properties?

I4: We measure the moisture content in every load
We keep the fuel on dry ground

I5: Same comment as for briquettes.

I6: We monitor several measure points during the process. We measure weight and moister content of deliveries of raw material. All parameters of our product are annually measured 3 times, most important parameters (moisture, ash content, ash deformation temperature, Nitrogen, Hydrogen, Oxygen, Sulphur, fixed Carbon) every second month. Measurements are done on a common sample from the two last months. Our products are traceable back to date of production.

B. Feedback from the CEN technical specifications – Woodchips
B1. Specification of traded/produced or used fuels

	Master table			
	Origin: According Table 1 in CEN/TS 14961		**I2:** ***Woody biomass (1),*** 1115, 1113, 1122, 1123, 1131, 1132, 1133, 1212, 121 **I4:** 1131, 1132, 1122, 1123, **I6:** 1212, 1131, 1132	
	Traded Form		Wood chips (see Figure 3 in CEN article)	
Normative	**Dimensions** (mm) [a]			
		Main fraction > 80 % of weight	Fine fraction < 5 %	Coarse fraction max. length of particle,
	P100 **P45**	**I2:** 3,15 mm ≤ P ≤ ***100*** mm **I4:** 3,15 mm ≤ P ≤ *45* mm	< 1 mm	**I2:** *all < 200 mm* **I4:** *all < 100 mm (we reject all over sized particles to the supplier)*
	Moisture (w-% as received)			
	M65 ***M55***	**I2:** ≤ ***65*** % **I4:** ***Daily average ≤ 53 %, but the individual load can be untill 65 %***	**I2:** ***Usually an average of 60 %*** **I4:**	
	Ash (w-% of dry basis)			
	A3,0	**I2:** ≤ ***3,0*** % **I4:** daily average ≤ *3,0* %	**I2:** ***Usually an average of 1.5 – 2 %*** **I4:**	
	Nitrogen, N (w-% of dry basis)			
	Nx.x	**I2:** ***Usually not stated*** **I4:**	Nitrogen is normative only for chemically treated biomass	
Informative	Net calorific value $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/m^3 loose)		Recommended to be specified when retailed. **I4:** *ok*	
	Bulk density as received (kg/m^3 loose)		BDxx **I4:** ***No requirement for threshold values, but an indication is of importance when we plan our fuel-mix.***	

	Chlorine, Cl (weight of dry basis, w-%)	Recommended to be stated as a category Cl 0.0x (if Cl > 0,1 % the actual value to be stated) **I4:** *ok*
[a] The numerical values for dimension refer to the particle sizes passing through the mentioned round hole sieve size (3,15 mm, 16 mm, 45 mm, 63 mm and 100 mm). Dimensions of actual particles may differ from those values especially the length of the particle.		

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I2: *Our costumers (mostly District Heating plants) are primary interested in daily-average properties of our deliveries. I.e. if we have a delivery of 30 trucks a day, it is the average of all the loads which is of interest and is measured. There are enough listed properties in the tables.*

I4: *One other property that should be stated for wood chips are the level or degree of mould and fungi activity in the delivery. This is of importance in particular to safeguard the health for us and our workers, and affects other fuel qualities as well.*

The content of heavy metals, alkali metals, Cesium, Chlorine and Sulphur is of importance for us, and should at least be included within the informative properties. This is for all fuels.

I5:*Mould in the delivery is of importance for the workers health and the storability of the fuel. The mould content or the degree of mould attack in the delivery should therefore be informative, but unfortunately we have no suggestion how this should be measured.*

Type of wood (pine, spruce, birch) should be informative. There is substantial difference of the fuel characteristics of different types of wood, and it is not always sufficient to know if it is coniferous or deciduous. E.g. birch and alder are both deciduous but still are quite different fuels, pine has a lot higher tar content than other coniferous, etc.

It should be normative to state the species of wood if the chips originate from short rotation coppice.

I6: *Sulphur should be included as informative.*

B2.2 Are there enough normative properties or should some other properties be normative?

I2: *Ok*

I4: *The list of normative properties seems sufficient.*

I5: *Nitrogen content should be informative*

I6: *Ok*

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I2: *The threshold values suits pretty well.*
I4: *The threshold values seems to fit our products.*
I5: The standard should allow the buyer and seller to adjust the dimension requirements of the chips and limits for fine fraction and coarse fraction in the delivery. Standardized limits of this will counteract flexibility in the biofuel market.
SCAN-CD 40:01 screening of cellulose chips is the dominating method for determining the particle distribution of woodchips. It would be a huge advantage to use the same method in both bioenergy and pulp industry. Then it would not be necessary with a new measure if a load is rejected from one purpose to be used for another. Fine fraction should include all particles < 3 mm. This is defined as fine fraction in SCAN-CD 40.01. The moisture content in the deliveries will some times exceed M65.
Most of the deliveries have moisture content between 40 and 55 %. We suggest a higher resolution of the threshold values in this interval, e.g. M40, M45, M50, M55, M60, M65 and M70.
Most of the wood chips have ash content in the interval 1.5 – 5 %. We suggest a higher resolution of the threshold values in this interval, e.g. A1.5, A2, A2.5, A3, A4, A5, and A6.
I6: *Ok*

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.
I2: *If our costumers require labelling and specification in line with this standard we will use it. Delivery reliability is one of the most important factors for our costumers.*
I4: *We do not use this standard currently, but maybe we will start using it in the future. We already have a well defined standard contract with our fuel suppliers.*
I5: *Same answer as briquettes*
I6: *Maybe in the future*

B2.5 How do you control of the fuel properties?
I2: *Selection of raw materials, traceability back to origin of our deliveries, good storage conditions, feedback from costumers.*
I4: *We measure the moisture content in every load*
We keep the fuel on dry ground
I5: *Same answer as briquettes*
I6: *Measurement of moisture content and visual inspection at deliveries*

B. Feedback from the CEN technical specifications – Hog fuels
None of the respondents were dealing hog fuels.

B. Feedback from the CEN technical specifications – Log woods

B1. Specification of traded/produced or used fuels

	Master table		
	Origin:		**I1:** ***1.1.2.1 Deciduous (Birch), stated when retailed*** **I1:** ***1.1.2.3 Mixture and blends*** **I1:** ***1.1.2.2 Coniferous, stated when retailed***
	Traded Form		Log woods
Normative	**Dimensions** (mm)		
	Length (L) and thickness (D) (maximum diameter of a single chop)		
	P300	**I1:** ***L = 300 mm ± 30 mm and 40 mm ≤ D ≤ 160 mm***	
	P 500	**I1:** ***L = 500 mm ± 30 mm and 40 mm ≤ D ≤ 160 mm***	
	Moisture content (w-% as received)		
	Mx0	**I1:** ***≤ 30 %***	**I1:** ***Seasoned in the storage, never measured, only assumed value. Assumed value stated when retailed***
	Wood		
Informative	Energy density, E_{ar} (kWh/m^3 loose or stacked)		**I1:** ***Not specified when retailed***.
	Volume, m^3 solid, stacked or loose as received		**I1:** ***Volume m^3 loose stated when retailed***
	Proportion of split volume		**I1:** ***Not measured or stated when retailed. Assumes that more than 90% is split***
	The cut-off surface		**I1:** ***Smooth and even, not stated when retailed.***
	Mould and decay		**I1:** ***Not measured or stated when retailed, assumes an average of ca 10% is decayed.***

[a] Use of chainsaw is considered to be smooth and even.

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I1: Yes.

I5: Deciduous or coniferous is to coarse resolution when stating type of wood. It should be distinguished between heavy or light deciduous or species of wood and this information should be normative.

B2.2 Are there enough normative properties or should some other properties be normative?
I1: Yes
I5: If the volume is given stacked or loose should be normative information.

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I1: Normal cut length is 300 mm.
I5:
Dimensions: do not understand the narrow requirements of the dimentions. When making log fuel there will allways occure over-sized and under-sized pieces. Particle size should be stated as the length L +/- an percent of the length, plus an limited amount of over-sized and under-sized particles.

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.

I1: No, does not need any standard, both the costumers and I can see and feel what is in the load of log wood, and come to an agreement about the value of the wood.

I5: Same answer as for briquettes

B2.5 How do you control of the fuel properties?

I1: Keep it under roof or plastic to avoid high moisture content and fungi.

I5: Same answer as for briquettes

C. Other general comments and proposals

I1: No comments. Interviewee worried if the standards will be followed by lot of paper-work or new documentation requirements for the log-wood producers.

B. Feedback from the CEN technical specifications – Sawdust
B1. Specification of traded/produced or used fuels

	Master table	
	Origin: According Table 1 in CEN/TS 14961	Woody biomass (1), specify more detailed from Table 1 **I2:** ***1122*** **I4:** ***1122***
	Traded Form	Sawdust
Normative	**Moisture** (w-% as received)	
	M55 **I2:** ≤ ***55*** % **I4:** ≤ *55* %	**I4:** average of 52.4 %
	Ash (w-% of dry basis)	
	A0.7 **I2:** ≤ ***0.7 %*** **I4:** ≤ *0.7 %*	
	Nitrogen, N (w-% of dry basis)	
		Nitrogen is normative only for chemically treated biomass
Informative	Net calorific value $q_{p,net,ar}$ (MJ/kg as received or energy density, E_{ar} (kWh/m^3 loose)	Recommended to be specified.
	Bulk density as received (kg/m^3 loose)	Recommended to be stated if traded by volume basis in categories xBDxxx
	Chlorine, Cl (weight of dry basis, w-%)	Recommended to be stated as a category Cl 0.xx, + (if Cl > 0,10 % the actual value to be stated)

Comment if particle size is needed or do we need information on wood species.
I2: *Declaration of particle size is normally not necessary.*
I4: *Not nessecary*
I5: *Species of wood should be an option.*

Note that sawdust can also be raw material for pellet production. Can this be suitable for specification also for pellet producer, what is needed?
I2: *We only sell shavings to the pellet industry*
I4:

I5:
I6: Cutter Chips should be an assortment.

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I2: Same comments as under chips
I4: The content of heavy metals, alkali metals, Cesium, Chlorine and Sulphur is of importance for us, and should at least be included within the informative properties.
I5: It should be an option to state the spices of wood. This should be informative.
Cutter chips should be one option in addition to sawdust in this table, or have its own table.

B2.2 Are there enough normative properties or should some other properties be normative?

I2: Same comments as under chips
I4: *Same comment as under chips*
I5: Nitrogen content should be informative on fuels originating from pure wood.
Net calorific value and bulk density is normally shown. This could be normative information.

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.

I2: Same comments as under chips
I4: *Same comment as under chips*
I5: If sawdust or cutter chips originate from i.e. furniture or flooring board industry, the moisture content might be far below 20 %. Thus, there should be one or two lower threshold values between 12 and 20 % moisture. Our suggestion is M15.
Much of the sawdust has moisture content in the interval M35 to M55. Thus M45 should be an option.
Pure wood has lower ash content than 0.7. We suggest an lowest threshold value of A0,5.

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.

I2: Same comments as under chips
I4: *Same comment as under chips*
I5: Same answer as briquettes

B2.5 How you control of the fuel properties?

I2: Same comments as under chips
I4: *Same comment as under chips*
I5: Same answer as briquettes

B. Feedback from the CEN technical specifications – Bark
B1. Specification of traded/produced or used fuels

	Master table		
	Origin: According Table 1 in CEN/TS 14961		Woody biomass **I2:** ***1122, 1213 (utmost coniferous bark from wood industry)*** **I4:** 1213
	Traded Form:		Bark
Normative	**Moisture** (w-% as received)		
	M70	**I2:** ≤ 70 % **I4:** Average of 50 %, have all categories	
	Ash (w-% of dry basis)		
	A6.0	**I2:** ≤ 6,0 % **I4:** ≤ 6,0 %	
	Nitrogen, N (w-% of dry basis)		
	Nx.x	> 3,0 % (actual value to be stated)	Nitrogen is normative only for chemically treated biomass
	Shredding **I2:** Always stated **I4:** *Indeed, maximum length for us is 100 mm*		
Informative	Net calorific value, $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/m^3 loose)		Recommended to be specified.
	Bulk density as received (kg/m^3 loose)		Recommended to be stated if traded by volume basis in categories BDxxx
	Chlorine, Cl (w-% of dry basis)		Recommended to be stated as a category Cl 0.xx, (if Cl > 0,10 % the actual value to be stated)
[a] Also cork is included.			

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.
I2: *Same comments as under chips*
I4: *The content of heavy metals, alkali metals, Cesium, Chlorine and Sulphur is of importance for us, and should at least be included within the normative properties for bark.*
I5: There should be an option to state if the bark originates from bark peeled off during handling or if it is pure bark from a de-barking process. The first mentioned bark is often contaminated with sand, waste and other wood residues. In our system we distinguish between pure bark, bark blended with other wood residues and the so-called "städbark" which normally is more contaminated.

It is common to make blends of bark and other fuels with bark as the dominating component. Annex 8 should include this type of blends or there should be another table for specification of such blends.

What is the difference between 1.2.1.2 and 1.2.1.4?

B2.2 Are there enough normative properties or should some other properties be normative?
I2: *Same comments as under chips*
I4: *See B2.1 for bark*
I5: Seems ok

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I2: *Same comments as under chips*
I4: *The threshold values seems to fit our products.*
I5: Lowest threshold value for moisture content is too high; M20 and M30 should be possible options

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.
I2: *Same comments as under chips*
I4: *Same as under chips*
I5: Same answer as briquettes

B2.5 How you control of the fuel properties?
I2: *Same comments as under chips*
I4: *We measure the moisture content in every load*
We keep the fuel on dry ground
I5: Same answer as briquettes

B. Feedback from the CEN technical specifications – Straw bales
B1. Specification of traded/produced or used fuels

	Master table			
	Origin: According Table 1 in CEN/TS 14961		Select one of these **I3:** ***2.1.1.2 Cereal crop straw, except straw from oat*** ***2.1.3.2 Oil seed crops stalks and leaves***	
	Traded Form		Big Bale	
Normative	**Dimensions** (mm), height (L_1), width (L_2) and length (L_3)			
		Height (L_1)	Width (L_2)	Length (L_3)
	I3: ***P3***	**I3:** ***900***	**I3:** ***1200***	**I3:** ***2500***
	Bale density (kg/m^3)			
	BD165+	**I3:** ***> 165***		
	Moisture (w-% as received)			
	M16+	**I3:** ***≤16 %***		
	Ash (w-% of dry basis)			
	A10	**I3:** ***≤10 %***		
	Species of biomass			
	Has to be stated **I3:** ***Indeed***			
Informative	Net calorific value, $q_{p,net,ar}$ (MJ/kg as received or energy density, E_{ar} (kWh/m^3 loose)		Recommended to be specified.	
	Particle size distribution or structure		It is recommended to declare production methods that influence the size of the straw particles. That is for instance weather the crop has been thrashed by rotation or oscillation or weather it has been chopped.	

Comment especially if the Chlorine content should be normative and what will then the property classes.

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.

I3: We normally not consider bale density, only weight of the bales.
We do not accept straw from oat.
One thing that affects the fuel's quality and ash melting is how long and in which conditions the straw has been stored. This could maybe be stated, but is not required of us.
What also that affects the fuel quality of straw is if and how the crops are treated with fungicides etc. Such treatment has a preservative effect on the straw. This could maybe be stated, but is not required of us.

We do not require any information on Chlorine content.

I5: Dimensions of the bales should be an agreement between each buyer and seller. The suggested standard, with static dimension requirements, will counteract a development of improved handling systems if this improvement requires other bale dimensions.
Weight pr bale is of interest, should be informative
What kind of rope that is used to cord together the bale is of interest, and should at least be informative.

B2.2 Are there enough normative properties or should some other properties be normative?
I3: Seems sufficient.
I5: Seems to be sufficient.

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I3: Threshold value of moisture content of 20% would be more suitable for us.
I5: Seems ok.

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.
I3: Maybe in the future.
I5: Same answer as briquettes

B2.5 How you control of the fuel properties?
I3: We measure the moister content of the deliveries, stores the bales under roof and on ventilated "groundsheet", to keep them dry.
We return deliveries with average moisture content higher than 20%.
I5: Same answer as briquettes

B. Feedback from the CEN technical specifications – General Master Table

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.
I5: Dimensions: Maximum ***and minimum*** length and/or diameter should be stated.

- While trading GROT it is of particular interest to know the history of handling of the GROT. It should be stated if it is green or dry, if it is bundled while it was green or dry, and if it has been covered or not during storage.
- Dry is not a good definition; in Sweden we denote it as "avbarrat", which is better.

B2.2 Are there enough normative properties or should some other properties be normative?
I5: No comment

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I5: No comment

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.
I5: Same answer as briquettes

B2.5 How you control of the fuel properties?
I5: Same answer as briquettes

B. Feedback from the CEN technical specifications – Grain

B1. Specification of traded/produced or used fuels (general master table adjusted to grain)

	General Master Table	
	Origin:	**I3:** ***2.1.1.2 Cereal crop, rejected from mill***
	Traded Form	**I3:** ***Grains***
Normative	**Dimensions** (mm) D_x x = Maximum diameter L_y y = Maximum length	**I3:** ***Not specified***
	Moisture (w-% as received)	
	M12 **I3: ≤ 12 %**	
	Ash (w-% of dry basis)	
	A0.5 **I3: ≤ 5,5 %**	
	Additives (w-% of dry basis)	
Informative	Net calorific value $q_{p,net,ar}$ (MJ/kg as received) or energy density, E_{ar} (kWh/ m^3 loose)	
	Bulk density as received (kg/m^3 loose)	***Weight is stated***
	Chlorine, Cl (weight of dry basis, w-%)	
	Sulphur, S (weight of dry basis, w-%)	
	Mechanical durability (remaining weight after treatment, weight of dry basis, w-%)	
	Further specification of dimensions	
	Others e.g. major and minor elements	

B2. Feedback on CEN standards

B2.1 Did you find enough property classes in the classification tables? If not please indicate what other properties is needed to specify the fuel.
I3: We normally consider only weight and moisture content of the delivery,
We do not require any information on Chlorine content.

B2.2 Are there enough normative properties or should some other properties be normative?
I3: Seems sufficient.

B2.3 Are the threshold values suitable for your products? If not please explain why and make a proposal for other threshold values.
I3: Threshold value of moisture content of i.e. 15% would be more suitable for us.

B2.4 Are you using or going to use CEN classification to specify your products? If not please explain why.
I3: We measure the moister content of the deliveries, stores the grains under roof and on ventilated "groundsheet", to keep it dry.

B2.5 How you control of the fuel properties?

C. Other general comments and proposals
I2:

- Now and then our costumers ask for documentation of that the fuel originates from sustainable forest exploitation. We normally check if the logging has been done in accordance with regulations.
- The list of properties will never be sufficient for a delivery contract. A more detailed description of the fuel, delivery method, delivery conditions etc. is normally necessary.
- Currently we have a situation where the delivery quantity and quality is measured by one of the parts, either the supplier or the costumer. It would be better with an impartial measure body.
- Now and then costumers asks for Sulphur, Chlorine, Calcium, Caesium and some other components
- If oak is represented in the delivery, some of our customers want specified the ratio of oak, due to higher content of chlorine
- The contamination level is normally stated in our deliveries.

I3: *No comments*

I4:

- Our plant need to control the content of heavy metals and caesium in our ash. This is because we intend to recycle our ash, and if the content of these components is too high, we have to deposit the ash. For this reason

the content of heavy metals and caesium should be on the list of informative parameters.

- The content of alkali metals, sulphur and chlorine should both be on the list of informative properties for the fuel. For bark it should be normative.
- The level of mould attack is important for health care. This should be informative, at least for chips.
- The accepted level of contamination is normally stated in the contract with our suppliers. This should be informative, at least for chips and bark.
- The District heating association[14] has made a contract template for woodfuels and peat. This template is the basis when we enter into contract with our fuel suppliers.

I5:

- It is important to not make a standard which counteracts developement of improved systems for biofuels. I. e. it might be suitable with other dimensions of straw bales than those listed in Annex 9. If the standard has to be followed it counteracts an improvement of the handling system. If it is a guidance for the biofuel actors it might be useless for their purpose.
- We wonder about table 1, biofuel origin, what is the different between 1.2.1.2 and 1.2.1.4?
- Content of Cesium and heavy metals is of interrest if the ash shall be recyckeled. Such information should be informative for all biofuels.
- History of handling and quality of the original biomass affects the fuel quality to a great extent, and is shown in our system. I.e. for whole wood we distinguish between decayed wood, dry wood, small pulpwood, pulp wood, rejected timber, etc. For logging residues we distinguish between fresh, dried. fresh bundled, dry bundled, forwarded dry and stored under cover, forwarded dry and stored without cover, forwarded green and stored under cover, forwarded green and stored without cover. This system will be continued, and it would be an advantage if such possibilities exist in the new CEN-standards.

I6:

We do not understand the reason to state threshold values. These way to state quality on biofuels will so some extent counteract improvement of fuel quality, e.g. if our pellets meets the best threshold value for mechanical durability or moisture content there is no reason for further improvement of the quality. It would be more temting to try to meet the threshold values, i.e. to not dry the pellets lower than 10 %. because drying is expensive, wood material is expensive and water is very cheap. No threshold values would to a greater extent stimulate competition on fuel quality.

[14] Svensk Fjärrvärme – www.svenskfjarrvarme.se

Appendix 3: Questionnaire sent to the biofuel actors

Om företagets verksamheter

- Vad är företagets huvudverksamheter? Kryssa i alla som passar.

☐ Vi säljer biobränsle till energibolag, fjärrvärmebolag, osv.
☐ Vi säljer biobränsle till konsumenter
☐ Vi tillverkar pellets eller briketter
☐ Vi säljer el och/eller varme baserat på biobränsle
☐ Vi erbjuder utbildning inom bioenergi
☐ Vi utför forskning inom bioenergi
☐ Vi utför konsultuppdrag inom bioenergisektorn
☐ Annat_____

- Ungefärliga nyckeltal om Ert företag år 2004. Om företaget arbetar med flera energikällor eller flera affärsområden, ange ett ungefärligt värde för verksamhet tillhörande bioenergi. Fyll bara i det som passar.
    - Omsättning ..... SEK
    - Värmeproduktion ..... GWh / TJ[15]
    - El produktion ..... GWh / TJ[1]
    - Försäljning av biobränsle ..... GWh / Ton[1]
    - Antal anställda ..... h.t.e[16]

[15] Var snäll stryk ut den måttenhet som inte passar
[16] Heltids ekvivalenter, till exempel en heltids anställd ger 1, en del tids anställd i 40 % arbete ger 0.4.

1. Har du/Ni saknat en gemensam Europeisk standard inom biobränslen?

    - Ja
    - Nej
    - Vet inte/det har jag aldrig tänkt på

2. 2004 kom en gemensam Europeisk standard för terminologi inom fasta biobränsle; *SIS-CEN/TS 14588:2003 Fasta biobränslen – Terminologi*. Känner du till denna standard? Kryssa i alla som passar

    - Den känner jag inte till
    - Ja, jag har hört talas om den eller sett den
    - Ja, vi använder termerna från den i vår verksamhet
    - Vi använder termene från Svensk Standard – SS 18 71 06
    - Vi har ingen policy för vilka termer vi använder

3. För att kunna kommunicera mellan aktörer i bioenergi branschen är det viktig att ha en tillräckligt bra gemensam terminologistandard. Om ni känner till terminologistandarden *SIS-CEN/TS 14588:2003 Fasta biobränslen – Terminologi*, har Ni någon kommentar till den?

    - Jag vet inte, vi känner inte till denna standard
    - Den är bra
    - Följgjande är fel eller saknas: (Använd gärna baksidan om platsen inte räcker till)

_____

4. 2005 kom en gemensam europeisk standard för specifikationer och klassificering inom fasta biobränslen; *SIS-CEN/TS 14961 Fasta biobränslen – Specifikationer och klassificering*. Känner du till denna standard?

    - ☐ Nej
    - ☐ Ja, jag har hört talas om den eller sett den
    - ☐ Ja, vi använder den i vår verksamhet

5. Standarden för specifikationer och klassificering anger ett sätt att märka bränslet. Man skall ange vilket land det kommer från, vilket biologiskt material bränslet består av (om det är träd, gräs, halm etc.), vilken bränsletyp det är (om det är pellets, briketter, ved etc.), och några av bränslets kvaliteter och egenskaper (fukthalt, askhalt etc.)

Målet är att köpare och säljare skall få tillräcklig information om bränslet för att veta om det kan användas i köparens installation och utrustning. Om Ni känner till standarden för specifikationer och klassificering *SIS-CEN/TS 14961:2005 Fasta biobränslen – Specifikationer och klassificering*, tycker du/Ni biobränsle som är specificerad enligt denna standard är tillräckligt specificerad?

- ☐ Jag vet inte, vi känner inte till denna standard
- ☐ Den är bra
- ☐ Följande är fel eller saknas: (Använd gärna baksidan om platsen inte räcker till)

_____

6. Har du hört talas om eller sett standarden CEN/TS 15234 ”Solid biofuels – Fuel quality assurance”?

    - ☐ Ja
    - ☐ Nej

7. Använder Ni något fast system för kvalitetssäkring av biobränslen inom Ert företag?

    - ☐ Ja
    - ☐ Nej
    - ☐ Vet inte

8. Vilka bränsleslag omsätts inom Ert företag?

- ☐ Briketter
- ☐ Pellets
- ☐ Bränslepulver
- ☐ Sågspån
- ☐ Trädbränsleflis
- ☐ Bränslekross
- ☐ Ved, kluven ved, längd mellan 0.1 och 1 meter.
- ☐ Stamved, längd över 0.5 meter.
- ☐ Balat halm och strå
- ☐ Buntat biobränsle, grot och liknande
- ☐ Bark
- ☐ Hackad halm
- ☐ Spannmål
- ☐ Skal eller fruktstenar
- ☐ Fiber kaka

- ☐ Annat: _____

Olika biobränslen har olika kvaliteter och egenskaper som påverkar lagringsegenskaper, bränslets energiinnehåll, krav på eldstaden, transportegenskaper osv. Standarden för specifikationer och klassificering anger ett sätt att märka bränslet, där målet är att bränsleköparen och bränslesäljaren skal få reda på tillräcklig information om bränslet.

Vikgtigt: Läs igenom fråga 9 till 15 innan du börjar kryssa i.

Vikgtigt: Läs igenom fråga 9 till 15 innan du börjar kryssa i.

9. Vilka bränsleegenskaper tycker du man borde specificera vid handel med alla slags **<u>åkerbränslen,</u>** oberoende av om det är spannmål, halm, energigräs, pellets från halm etc.? Kryssa i alla som passar.

    - ☐ Vet inte, vi har ingen erfarenhet av åkerbränslen

    - ☐ Askhalt
    - ☐ Fukthalt
    - ☐ Fuktvariation inom leveransen
    - ☐ Värmevärdet (kWh/kg)
    - ☐ Energidensitet (kWh/kubikmeter)
    - ☐ Partikelstorlek (längd på strå, diameter på pellets, dimensioner på balar etc.)
    - ☐ Andel finmaterial
    - ☐ Om materialet är kemiskt behandlat
    - ☐ Svavelhalt (S)
    - ☐ Kvävhalt (N)
    - ☐ Klorhalt (Cl)
    - ☐ Skrymdensitet
    - ☐ Askans smältningstemperatur
    - ☐ Askans smältningsforlopp
    - ☐ Andel flyktiga ämnen
    - ☐ Andel bundet kol
    - ☐ Andel röta

Bränslens biologiska ursprung skall också anges. Hur noggrant behöver man ange åkerbränslens biologiska ursprung? *kryssa i ett av dessa två alternativ*

    - ☐ man borde ange vilket spannmålsslag spannmålen är, vilket spannmålsslag eller gräs-slag balen kommer från etc.
    - ☐ det räcker att ange om det är gräs, spannmål, rotväxt, eller oljaväxt etc.

    - ☐ Andra bränsleegenskaper man borde uppge vid handel med åkerbränslen:

_____

10. Vilka bränsleegenskaper tycker du man borde specificera vid handel med alla slags **trädränslen,** oberoende av om det är trädpellets, ved, flis, spån, logs etc.? Kryssa i alla som passar.

    - ☐ Vet inte, vi har ingen erfarenhet av trädbränsler

    - ☐ Askhalt
    - ☐ Fukthalt
    - ☐ Fuktvariation inom leveransen
    - ☐ Värmevärdet (kWh/kg)
    - ☐ Energidensitet (kWh/kubikmeter)
    - ☐ Partikelstorlek (längd på ved, diameter på pellets, dimensioner på flis, dimensioner på buntar etc.)
    - ☐ andel finmaterial
    - ☐ Om materialet är kemiskt behandlat
    - ☐ Svavelhalt (S)
    - ☐ Kvävhalt (N)
    - ☐ Klorhalt (Cl)
    - ☐ Skrymdensitet
    - ☐ Askans smältningstemperatur
    - ☐ Askans smältningsförlöp
    - ☐ Andel flyktiga ämnen
    - ☐ Andel bundet kol
    - ☐ Andel röta

Bränslens biologiska ursprung skall också anges. Hur noggrant behöver man ange trädbränslens biologiska ursprung? *Kryssa i ett av dessa två alternativ*

- ☐ man borde ange vilken trädtyp bränslet kommer från, dvs om det är gran, tall, björk, al eller alm etc.
- ☐ det räcker att ange om det lövträd eller barrträd.

- ☐ Andra bränsleegenskaper man borde uppge vid handel med trädbränslen:

_____

11. Vilka bränsleegenskaper tycker du att man borde specificera när man handlar med biobränslen baserat på **bark?** *Kryssa i alla som passar*.

- ☐ Vet inte, vi har ingen erfarenhet av barkbiobränsler

- ☐ Askhalt
- ☐ Fukthalt
- ☐ Fuktvariation inom leveransen
- ☐ Värmevärdet (kWh/kg)
- ☐ Energidensitet (kWh/kubikmeter)
- ☐ Om materialet är kemiskt behandlat
- ☐ Svavelhalt (S)
- ☐ Kvävhalt (N)
- ☐ Klorhalt (Cl)
- ☐ Skrymdensitet
- ☐ Askans smältningstemperatur
- ☐ Askans smältningsförlöp
- ☐ Andel flyktiga ämnen
- ☐ Andel bundet kol
- ☐ Andel röta
- ☐ Valvbildnings eller bryggbildningsegenskaper på flis och kross

Bränslens biologiska ursprung skall också anges. Hur noggrant behöver man ange barkens biologiska ursprung? *Kryssa i ett av dessa två alternativ*

- ☐ man borde ange vilken trädtyp bränslet kommer från, dvs om det är gran, tall, björk, al eller alm etc.
- ☐ det räcker att ange om det lövträd eller barrträd.

- ☐ Andra bränsleegenskaper man borde uppge vid handel med barkbränslen:

_____

12. Vilka bränsleegenskaper tycker du att man borde specificera när man handlar med **Blandat biobränsle, som kan innehålla biomassa både från träd, åkerbränslen eller frukt?** Kryssa i alla som passar.

- ☐ Vet inte, vi har ingen erfarenhet av blandat biobränsle

- ☐ Askhalt
- ☐ Fukthalt
- ☐ Fuktvariation inom leveransen
- ☐ Om materialet är kemiskt behandlat
- ☐ Svavelhalt (S)
- ☐ Kvävhalt (N)
- ☐ Klorhalt (Cl)
- ☐ Skrymdensitet
- ☐ Askans smältningstemperatur
- ☐ Askans smältningsförlöp
- ☐ Andel flyktiga ämnen
- ☐ Andel bundet kol
- ☐ Andel röta
- ☐ Valvbildnings eller bryggbildningsegenskaper

Bränslens biologiska ursprung skall också anges. Blandat biobränsle kan komma från många biologiske material. Hur noggrant behöver man ange bränslens biologiska ursprung? *Kryssa i ett av dessa tre alternativ*

- ☐ man borde ange om det är ved från gran, tall, björk, al eller alm etc, halm från korn eller vete etc.
- ☐ det räcker att ange om det är lövträd eller barrträd, halm eller gräs etc.
- ☐ det räcker att ange om det är från ved, åkergrödor, kärnor etc.

- ☐ Andra bränsleegenskaper man borde uppge vid handel med blandat biobränsle:

_____

13. Vilka bränsleegenskaper tycker du borde specificeras vid handel med **bränslepellets**? Kryssa i alla som passar.

    - ☐ Vet inte, vi har ingen erfarenhet av pellets

    - ☐ Askhalt
    - ☐ Fukthalt
    - ☐ Värmevärdet (kWh/kg)
    - ☐ Energidensitet (kWh/kubikmeter)
    - ☐ dimensioner (diameter och längd)
    - ☐ andel finmaterial
    - ☐ mekanisk hållfasthet
    - ☐ Om materialet är kemiskt behandlat
    - ☐ Om bindmedel har användts i tillverkningen
    - ☐ Svavelhalt (S)
    - ☐ Kvävhalt (N)
    - ☐ Klorhalt (Cl)
    - ☐ Skrymdensitet
    - ☐ Askans smältningstemperatur
    - ☐ Askans smältningsförlöp
    - ☐ Andel flyktiga ämnen
    - ☐ Andel bundet kol
    - ☐ Valvbildnings eller bryggbildningsegenskaper

Bränslens biologiska ursprung skall också anges. Bränslepellet kan tillverkas från många biologiska material. Hur noggrant behöver man ange pelletsens biologiska ursprung? *Kryssa i ett av dessa tre alternativ*

- ☐ man borde ange om det är ved eller bark från gran, tall, björk, al eller alm etc., halm från korn eller vete etc.
- ☐ det räcker att ange om det är ved eller bark från lövträd eller barrträd, strån från halm eller gräs etc.
- ☐ det räcker att ange om det är från ved, bark eller från åkergrödor

- ☐ Andra bränsleegenskaper man borde uppge vid handel med pellets:

_____

14. Vilka bränsleegenskaper tycker du borde specificeras vid handel med **Briketter?** Kryssa i alla som passar.

    - ☐ Vet inte, vi har ingen erfarenhet av briketter

    - ☐ Askhalt
    - ☐ Fukthalt
    - ☐ Värmevärdet (kWh/kg)
    - ☐ Energidensitet (kWh/kubikmeter)
    - ☐ dimensioner (diameter och längd)
    - ☐ andel finmaterial
    - ☐ mekanisk hållfasthet
    - ☐ Om materialet är kemiskt behandlat
    - ☐ Om bindmedel har användts i tillverkningen
    - ☐ Svavelhalt (S)
    - ☐ Kvävhalt (N)
    - ☐ Klorhalt (Cl)
    - ☐ Skrymdensitet
    - ☐ Askans smältningstemperatur
    - ☐ Askans smältningsförlöp
    - ☐ Andel flyktiga ämnen
    - ☐ Andel bundet kol
    - ☐ Valvbildnings eller bryggbildningsegenskaper

Bränslens biologiska ursprung skall också anges. Briketter kan tillverkas från många biologiska material. Hur noggrant behöver man ange brikettornas biologiska ursprung? K*ryssa i ett av dessa tre alternativ*

- ☐ man borde ange om det är gran, tall, björk, al eller alm, halm från korn eller vete etc.
- ☐ det räcker att ange om det är lövträd eller barrträd, halm eller gräs etc.
- ☐ det räcker att tange om det är från ved, bark eller från åkergrödor

- ☐ Andra bränsleegenskaper man borde uppge vid handel med briketter:

_____

15. Vilka bränsleegenskaper tycker du borde specificeras vid handel med **flisad och krossad biobränsle?** Kryssa i alla som passar.

- ☐ Vet inte, vi har ingen erfarenhet av krossad eller flisad biobränsle

- ☐ Askhalt
- ☐ Fukthalt
- ☐ Värmevärdet (kWh/kg)
- ☐ Energidensitet (kWh/kubikmeter)
- ☐ dimensioner på flis eller kross
- ☐ andel finmaterial
- ☐ man bör ange största dimention på flis eller kross som finns i lasset
- ☐ Om materialet är kemiskt behandlat
- ☐ Svavelhalt (S)
- ☐ Kvävhalt (N)
- ☐ Klorhalt (Cl)
- ☐ Skrymdensitet
- ☐ Askans smältningstemperatur
- ☐ Askans smältningsförlöp
- ☐ Andel flyktiga ämnen
- ☐ Andel bundet kol
- ☐ Valvbildnings eller bryggbildningsegenskaper

Bränslens biologiska ursprung skall också anges. Flis och kross kan tillverkas från många biologiska material. Hur noggrant behöver man ange flisens eller krossens biologiska ursprung? K*ryssa i ett av dessa tre alternativ*

- ☐ man borde ange om det är gran, tall, björk, al, alm eller salix etc.
- ☐ det räcker att ange om det är lövträd, barrträd eller energigrödor etc.
- ☐ det räcker att ange om det är från ved, bark eller åkergrödor etc.

- ☐ Andra bränsleegenskaper man borde uppge vid handel med flisad och krossad biobränsle:

_____

_____

16. Vilka mätenheter föredrar Ni när Ni omsätter biobränsle?

- □ Ton
- □ Ton torrsubstans
- □ Kg
- □ Kg torrsubstans
- □ MWh
- □ kWh
- □ kubikmeter fastvolym [m^3f]
- □ kubikmeter skäppvolym [m^3s]
- □ kubikmeter travvolym [m^3t]

- □ Annat_____

17. Vilka sortimenter tycker du kan inkluderas i termen ”Biobränsle”? Kryssa i alla som passar.

- □ Trädbiomassa från jord och skogbruk. T ex. skogsflis, ved, timmer, salix
- □ Örtartad biomassa från jord och skogbruk. T ex. halm, energigräs.
- □ Biomassa från jord och skogbruk om har behandlats kemiskt. T ex kemiskt behandlade restprodukter från skogsindustrin.
- □ Bark från sågverk och pappersfabriker
- □ Torv
- □ åkerbränslen från livsmedelsindustrin
- □ Trädavfall från byggnadsverksamhet som inte innehåller halogenerade organiska föreningar eller tungmetaller från målning eller impregnering.
- □ Rivningsvirke som inte innehåller halogenerade organiska föreningar eller tungmetaller från målning eller impregnering.

Det var det.Tusen tack för Er medverkan!

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Har Du/Ni andra kommentarer till det standardiseringsarbete som utförs?

Svar:_____

Questionnaire sent to equipment producers and suppliers

Om företagets verksamheter

- Vad är företagets huvudverksamheter inom biobränsle? Kryssa i alla som passar.

    - o Vi tillverkar och/eller säljer utrustning för vedeldning
    - o Vi tillverkar/säljer utrustning för pelleteldning
    - o Vi tillverkar/säljer utrustning för briketteldning
    - o Vi tillverkar/säljer utrustning för fliseldnig 0 – 300 kW installerad effekt
    - o Vi tillverkar/säljer utrustning för storskaliga trädbränsleanläggningar över 300 kW installerad effekt
    - o Vi tillverkar/säljer utrustning för eldning av halm och andra åkerbränslen, 0-300 kW installerad effekt
    - o Vi tillverkar/säljer utrustning för eldning av halm och andra åkerbränslen, över 300 kW installerad effekt
    - o Vi tillverkar/säljer utrustning för eldning av spannmål
    - o Vi tillverkar/säljer utrustning för malning, krossning, flisning eller annan form för sönderdelning av biomassa
    - o Vi tillverkar/säljer utrustning för pressing av pellets eller briketter

    - o Annat_____

- Ungefärliga nyckeltal om Ert företag år 2004. Om företaget arbetar med flera energikällor eller flera affärsområden, ange ungefärligt värde för verksamhet tillhörande bioenergi.

    - o Omsättning ..... SEK

    - o Antal anställda ..... h.t.e[17]

[17] Heltids ekvivalenter, till exempel en heltids anställd ger 1, en del tids anställd (40 %) ger 0.4.

18. Har du/Ni saknat en gemensam europeisk standard inom biobränslen?

    - Ja
    - Nej
    - Vet inte/det har jag aldrig tänkt på

19. 2004 kom en gemensam Europeisk standard för terminologi inom fasta biobränsle; *SIS-CEN/TS 14588:2003 Fasta biobränslen – Terminologi*. Känner Du/Ni till denna standard? Kryssa i alla som passar

    - Den känner jag inte till
    - Ja, jag har hört talas om den eller sett den
    - Ja, vi använder termerna från den i vår verksamhet
    - Vi använder termerna från Svensk Standard – SS 18 71 06
    - Vi har ingen policy på vilka termer vi använder

20. För att kunna kommunicera mellan aktörer i bioenergi branschen är det viktigt att ha en tillräckligt bra gemensam terminologistandard. Om ni känner till terminologistandarden *SIS-CEN/TS 14588:2003 Fasta biobränslen – Terminologi*, har Ni någon kommentar till den

    - Jag vet inte, vi känner inte till denna standard
    - Den är bra
    - Följande är fel eller saknas: (Använd gärna baksidan om platsen inte räcker till)

_____

21. 2005 kom en gemensam europeisk standard för specifikationer och klassificering inom fasta biobränslen; *SIS-CEN/TS 14961 Fasta biobränslen – Specifikationer och klassificering*. Känner du till denna standard?

    - Nej
    - Ja, jag har hört talas om den eller sett den
    - Ja, vi använder den i vår verksamhet

22. För att kunna garantera hållbarhet och prestanda hos Era produkter och utrustning har Ni förmodligen vissa krav på bränsleråvaran som används.

Standarden för specifikationer och klassificering anger ett sätt att märka bränslet. Man skall ange vilket land det kommer från, vilket biologiskt material bränslet består av (om det är träd, gräs, halm etc.), vilken bränsletyp det är (om det är pellets, briketter, ved etc.) och några av bränslets kvaliteter och egenskaper (fukthalt, askhalt etc.)
Målet är att köpare och säljare skall få tillräcklig information om bränslet för att veta om det kan användas i köparens installation och utrustning. Om Ni känner standarden för specifikationer och klassificering *SIS-CEN/TS 14961 Fasta biobränslen – Specifikationer och klassificering*, tycker du/Ni biobränsle som är specificerad enligt denna standard är tillräcklig specificerad?

- Jag vet inte, vi känner inte till denna standard
- Den är bra
- Följande är fel eller saknas: (Använd gärna baksidan om platsen inte räcker till)

_____

Viktigt: Läs igenom fråga 6 och 7 innan du börjar kryssa i. Fråga 6 handlar om driftstörningar och slitage, fråga 7 handlar om prestanda i era produkter.

23. Fel eller varierande bränsleegenskapar kan av och till ge driftsstörningar eller ökat slitage i förbränningsanläggningen, i flishuggaren, i pelletsfabriken osv. Vilka bränsleegenskaper är oftast orsak till störningar i Era produkter och utrustningar?

Kryssa i de egenskaper som ofta ger **driftstörningar eller ökat slitage** i Era produkter

- För hög askhalt
- Föroreningar i bränslet (sand och sten, snö, sopor etc.)
- Asksmältning vid förbränning
- Variation i bränslets fukthalt
- För hög fukthalt i bränslet
- För låg fukthalt i bränslet

- ☐ För litet värmevärde i bränslet
- ☐ För stora partiklar i bränslet (för långa strån, för stora flisbitar, för långa pellets, etc.)
- ☐ För mycket finmaterial
- ☐ Att materialet är kemiskt behandlat
- ☐ Hög svavelhalt (S)
- ☐ Tjära i bränslet, t ex tjärarik tall-ved eller pellets
- ☐ Högt kvävhalt (N)
- ☐ Hög klorhalt (Cl)
- ☐ För stor eller för liten andel flyktiga ämnen
- ☐ För stor eller för liten andel bundet kol
- ☐ Bränslets valvbildnings- eller bryggbildningsegenskaper leder till problem i matningen

- ☐ Andra
  _____

24. Fel eller varierande bränsleegenskaper kan ge sämre prestanda, dvs. sämre verkningsgrad eller större partikelutsläpp i en förbränningsanläggning, lägre produktionshastighet i pelletsfabriken osv. Vilka bränsleegenskaper är oftast orsak till sämre prestanda i Era produkter och utrustningar?

Kryssa i de bränsleegenskaperna som ofta ger **sämre prestanda** i Era produkter

- ☐ För hög askhalt
- ☐ Föroreningar i bränslet (sand och sten, sopor, etc.)
- ☐ Asksmältning vid förbränning
- ☐ Variation i bränslets fukthalt
- ☐ För hög fukthalt i bränslet
- ☐ För låg fukthalt i bränslet
- ☐ För litet värmevärde i bränslet
- ☐ För stora partiklar i bränslet (för langa strån, för stora flisbitar, för långa pellets etc.)
- ☐ För mycke finmaterial
- ☐ Att materialet är kemiskt behandlat
- ☐ Hög svavelhalt (S)
- ☐ Tjära i bränslet, t ex tjärarik tallved eller pellets
- ☐ Högt kvävhalt (N)
- ☐ Hög klorhalt (Cl)
- ☐ För stor eller för liten andel flyktiga ämnen
- ☐ För stor eller för liten andel bundet kol
- ☐ Bränslets valvbildnings- eller bryggbildningsegenskaper leder till problem i matningen

Andra_____

25. I en biobränsleinstallation, antingen om det är en flispanna, en pelletsfabrik, en flishuggare osv., händer det att det blir något fel eller driftstörningar. Felet eller driftstörningen kan t ex bero på fel gjort av operatören, strömavbrott eller dålig kontroll med kvaliteten på biobränslet. Ungefär hur stor andel av driftstörningarna beror på fel i kvaliteten på bränslet, t ex föroreningar, fuktvariationer, för stora bitar, för mycket finmaterial etc.?

    - 10 % av alla fel och driftstörningar beror på fel i kvaliteten på bränslet
    - 30 % av alla ...
    - 50 % av alla ...
    - 70 % av alla ...
    - 90 % av alla ...

Det var det. Tusen tack för Er medverkan!

Har Du/Ni andra kommentarer till det standardiseringsarbete som utförs?

Svar:_____

Appendix 4: Comments from the respondents of the questionnaire

The respondents were given the opportunity to add other things they want stated on for the different fuels, and finally the opportunity to give general comments about standardisation of biofuels (My translation).

General comments to the standardization work:
We have been missing a standard to determine the particle size distribution. In our particular case we need it to measure the particle size distribution for woodfuel powder we burn in our boilers.
Comment to question 6, "Do you know CEN/TS 15234": Att speca uttags (sampling) nivåer känns fel i detta fall. Bör vara upp till användaren att hålla tillrackliga nivåer.
General comment: Tänk på att standarder ska hjälpa, inte själlpa!
Biobränslesektorn är hård ansatt, idag finns det inte utrymme för något merarbete.
Comment to question 17; chemically treated biomass, used wood and demolition wood should be called recovered fuel.

Additional properties requested for woodfuels in general:
- Country and region of origin, declaration of responsible forestry”
- Fuel origin
- Elementäranalys redovisas vid anbudslämnande
- The fuel consumer should have a clear view of the requirements of the installation. The fewer parameters a supplier has to specify the less work and disturbances will occur
- Impossible to specify coniferous or deciduous in GROT. It will always be a mix.
- Risk for contaminations, e.g. RT-chips, metals, stones etc.
- Ash analysis
- Contamination of the fuel
- Content of heavy metals and Cesium in ash analysis should be stated.

Additional properties requested for bark:
- Contaminations, storage time
- Treatment; städbark, shredded, chipped or hogged
- Volume, weight
- Size, treatment
- Ash analysis
- Content of heavy metals and Cesium in ash analysis should be stated

Additional properties requested for briquettes:
- Country and region of origin, declaration of responsible forestry (Ursprungsland, region, och var råvaran kommer från. Deklaration över "ansvarsfullt fört skogbruk
- Contaminations
- Ultimate analysis should be shown at tender procedures (Elementäranalys redovisas vid anbudslämnande)

- Biological origin of the briquettes – it should be stated if the briquettes originates from 1: pure wood like sawdust, woodchips, pulpchips, 2: same as 1 included bark, 3: same as 1 included GROT, 4: same as 1 included straw and grain.
- Ash analysis

Additional properties requested for pellets:

- Country and region of origin, declaration of responsible forestry
- Contaminations
- Ultimate analysis should be shown at tender procedures (Elementäranalys redovisas vid anbudslämnande)
- Weight
- Biological origin of the pellets – it should be stated if the pellets originates from 1: pure wood like sawdust, woodchips, pulpchips, 2: same as 1 included bark, 3: same as 1 included GROT, 4: same as 1 included straw and grain.
- Ash analysis
- Content of heavy metals and Cesium in ash analysis should be stated.

Additional properties requested for chips and hog fuel:

- Degree of mould attack should be stated.
- Volym, vikt
- Föroreningar
- Origin (ursprung)
- Origin of material (Ursprungligt material)

Additional comments from equipment producers:

Residential boilers are manually fed. Thus, the operational reliability depends on the user. Some of the users are clever and can manage considerably variations in fuel quality without problems.

Ash deformation temperature and fine fraction are the main challenges. Control of ash deformation temperature is the most important issue.

If the standard for pellets shall make sense it is necessary to develop methods for continuous measuring of some of the parameters during the production.

Appendix 5: Max content of heavy metals and ^{137}Cs in ash intended for ash recycling in Sweden

Maximum content of heavy metals and ^{137}Cs in ash intended for ash recycling in Sweden.

Component	Maximum value (mg/kg dry matter)
Heavy metals	
Cobber Cu	400
Zinc Zn	7000
Arsenic As	30
Lead Pb	300
Cadmium Cd	30
Mercury Hg	3
Other trace elements	
Boron B	500
Chromium Cr	100
Vanadium V	70
Organic toxic substances	
Polycyclic aromatic hydrocarbons (PAH)	2

Table 2. Maximum content of heavy metals and ^{137}Cs in ash intended for ash recycling in forest (Samuelsen, 2001).

Maximum content of ^{137}Cs in ash intended for ash recycling in forest and crop land is respectively 10 and 5 kBq/kg dry matter (Holm & Möre, 2005)