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A Guide to Biomass Heating Standards

Ensuring quality and reliability in the biomass heating supply chain.

ANY OTHER and BETTER IDEA for the TITLE???

INTELLIGENT ENERGY EUROPE
FOR A SUSTAINABLE FUTURE

5 January 2011

FOREST

Table of contents

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COMITATO TERMOTECNICO ITALIANO ENERGIA E AMBIENTE - CTI - www.cti2000.it

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Deleted: 1 . INTRODUCTION . 3¶
2 . WHAT IS A STANDARD? . 4¶
2.1 . General . 4¶
2.2 . What is a standard? . 4¶
2.3 . What are the benefits of standards? . 6¶
2.4 . Where can be Purchased European Standards and draft standards? . 8¶
2.5 . How are standards made? . 9¶
3 . USEFUL STANDARI ... [1]

1 Introduction

The key to a successful and sustainable biomass heat market is customer confidence in the entire supply chain from the fuel through to the installation of efficient and reliable boiler systems and ongoing maintenance. Without this confidence in the whole supply chain, biomass heat will struggle to compete with fossil fuels where the supply chains are well established.

This guide is designed to help you build stronger supply chains through a widespread use of Standards to ensure quality and reliability for the end user. It focuses on the official European Standards issued by CEN (European Committee for Standardization) and adopted by EU countries. This is complemented by some other examples of national non normative documents when relevant.

This guide gives an overview of the contents of Standards and explains how to use them as support tool for businesses. Its aim is also togive references on where to find Standards and to improve their use in the market; but it should be seen as a replacement for formal use of the actual Standards documents.

This guide can be used by

- businesses interested in providing services and products related to biomass heating in the capacity range between 100 kW and 10 MW
- developers and building owners interested in biomass heating for buildings which they own, manage or for which they have some other kind of responsibility
- wider market actors interested in effective supply chains and partnerships in the field of biomass heating
- final users interested in "high quality" supply and use of fuels, boilers and energy services.

The information given in this guide should be used to help the establishment of partnerships and agreements where the role of the exchanged product (e.g. fuel, boiler) is a key element for both the parts and references to Standards could help in writing or adopting contracts and agreements.

The biomass heating supply chain is illustrated in the diagram in Figure 1. This shows the key interfaces, indicated by the "two way yellow arrows", where quality standards exist and could support and provide knowledge to different operators in the supply chain. Where arrows are missing no Standards are available.

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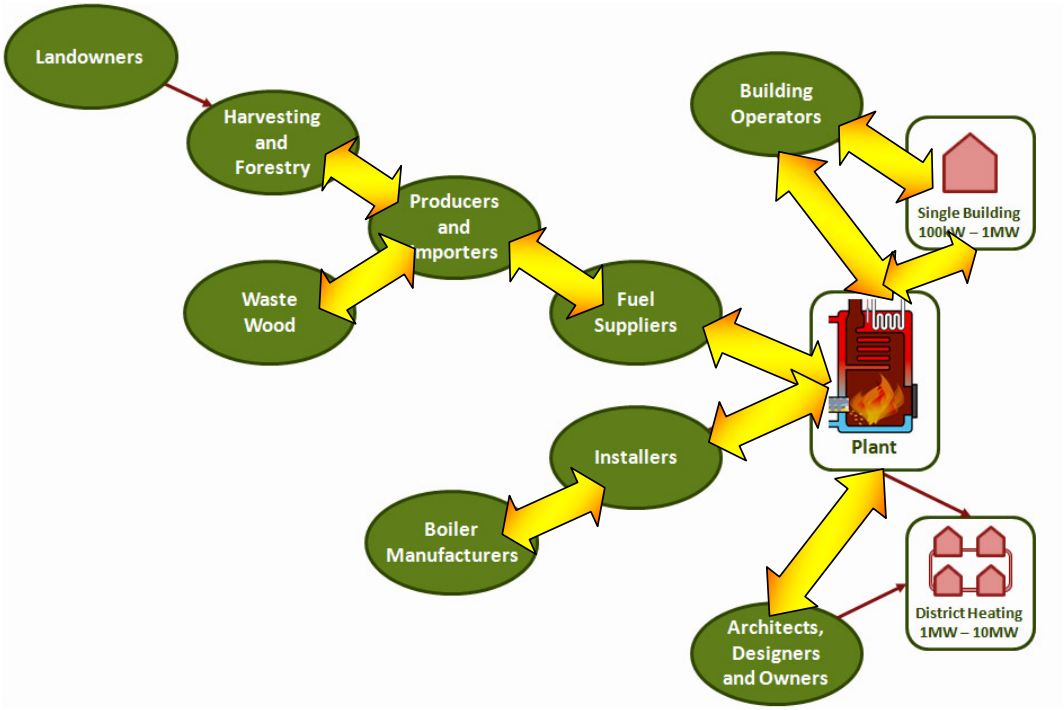
Figure 1 - General scheme of the heat from biomass chain



2 Understanding and using standards

In order to explain in a clear and understandable way what Standards are, how Standards are produced and what their role is in the current market, as main references the public sections of some Standardisation Bodies (CEN[1], BSI[2], UNI[3]) websites have been taken and adapted.

2.1 What is a standard?

The BSI's website says "put at its simplest, a standard is an agreed, repeatable way of doing something". More officially CEN defines a standard (French: Norme, German: Norm) as a document, designed for common and repeated use, to be used as a rule, guideline or definition. It is both consensus-built and approved by a recognized body.

Standards are created by bringing together all interested parties such as manufacturers, consumers, and regulators of a particular material, product, process or service. All parties benefit from standardization through increased product safety and quality as well as lower transactions costs and prices as it is described below.

Standards are voluntary, consensus-based and as such do not impose any regulations. They provide the test specifications and test methods (interoperability, safety, quality, etc.

[1] Taken from CEN website: www.cen.eu/cen/Pages/FAQ.aspx
[2] Taken from BSI website: www.bsigroup.com.
[3] Taken from UNI website: www.uni.com

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The application of standards is voluntary. However, laws and regulations (European, national or local) may refer to standards and even make compliance with them compulsory. At EU level Directives, Regulations and other EU legislation may refer to European Standards. In particular, this is the case within the framework of the 'New Approach' where European Standards are used to provide presumption of conformity to 'Essential Requirements' of the Directives. The 'Essential Requirements' are mandatory and their certified fulfilment allows to mark products with the 'CE marking' (sometimes improperly known as 'CE Mark') that represents the declaration that the product conforms to all applicable European legislation.
However, products that comply with European Standards cited in the Official Journal of the European Union under a New Approach Directive benefit from a presumption of conformity with the Essential Requirements of that New Approach Directive. A manufacturer that chooses not to follow the given standards then has the obligation to demonstrate conformity with the Essential Requirements of the Directive.

A useful example is represented by Directive 89/106/ECC (CPD - Construction Products Directive) that applies to construction products, meaning any products produced with a view to their incorporation in a permanent manner in construction works. CPD states that all the products involved in a building construction or are part of a building must respect some essential requirements related to health, safety and environment. This practically means that products falling within its scope (for example concrete, sand, bricks, but also stoves, fireplaces, chimneys, boilers) must meet these requirements before they can be placed on the European market. In these circumstances, manufacturers may choose any technical solution that fulfils the essential requirements. If they follow the relevant harmonized European Standard(s), they benefit from a "presumption of conformity" to the essential requirements set out in the Directive, while if they choose their own method, they must provide a 'technical file', which sometimes must include reports from recognized testing agencies that they are in conformity with the relevant Directive. At this step it should be clear that following a European Standard is the simplest route.

At European level the recognized body in charge for standard production is the European Committee for Standardization - CEN. Through its services, it provides a platform for the development of European Standards (ENs) and other consensus documents. CEN's 31 National Members work together to develop these publications in a large number of sectors to help build the European internal market in goods and services, removing barriers to trade and strengthening Europe's position in the global economy. More than 60.000 technical experts (provided by National Standardisation Bodies) from industry, associations, public administrations, academia, and societal organizations are involved in the CEN network that reaches over 480 million people. The European Commission (EC) and the European Free Trade Association Secretariat (EFTA) act as CEN's Counselors in terms or regulatory or public interest.
CEN works in a decentralized way. Its members – the National Standardization Bodies (NSBs - see the complete EU list of NSbs in clause 2.4) of the EU and EFTA countries – operate the technical groups that draw up the standards; the CEN Management Centre (CMC) in Brussels manages and coordinates this system.
CEN is one of the three European Standardization Organizations (ESOs) whose main objective is to remove trade barriers for European industry and consumers. The other two are CENELEC and ETSI.

CEN fields of activity cover various sectors such as Air and Space, Chemistry, Construction, Consumer Products, **Energy and Utilities**, Food, Health and Safety, Healthcare, Heating, Cooling, Ventilation, ICT, Materials, Measurement, Mechanical Engineering, Nanotechnology, Security and Defence, Services, Transport and Packaging and others.
CENELEC is the European Committee for Electrotechnical Standardization of which the main field of activity covers the Electrotechnical domain.
ETSI is the European Telecommunications Standards Institute of which the main field of activity is Telecommunications (applicable standards for Information & Communications Technologies including fixed, mobile, radio, broadcast, internet and several other areas).

CEN produces European Standards (EN) that automatically and mandatorily become national standards in the 31 member countries. In addition, CEN produces some other technical documents such as Technical Specifications (TSs) and Technical Reports (TRs)
TSs can be used by CEN Technical Committees as a European Pre-Standard for innovative features of technology. They are also helpful in a case where various alternatives need to co-exist in anticipation of future harmonization.
TRs are documents produced within a CEN Technical Committee that provide background information, for example on how to implement standards in specific cases.

Most standards are prepared at the request of industry. The European Commission can also request the relevant standards bodies to prepare standards in order to implement European legislation. This type of standardization activity is 'mandated' by the European Commission. In most cases, such initiatives are supported by the EFTA Secretariat.
All CEN activities are undertaken by a collective of stakeholders, manufacturers, users, research organizations, government departments and consumers. In CEN Technical Committees, experts are mandated by national member bodies, with formal decisions by national delegations. Representatives of the CEN Members act as secretaries to the various technical groups and manage the projects and the production of standards and other documents.

Everyone could participate to the standardisation works through his NSB that establishes ad hoc national mirror committees. Each mirror committee represents the national interface for a specific CEN Technical Committee, moreover it could work on specific national standards.

2.2 What are the benefits of standards?

Standards are a powerful tool for supporting innovation and increasing productivity. Effective standardization promotes forceful competition and enhances profitability. Standards allow a company to:

- attract and assure customers;
- demonstrate market leadership;
- create competitive advantage;
- develop and maintain best practices;
- comply with European legislation.

European Standards are a powerful marketing tool

Compliance with widely recognized European Standards is an effective means of differentiation in a competitive marketplace. In addition, manufacturing products or supplying services that conform to appropriate standards maximizes their compatibility with those manufactured or offered by others, thereby increasing potential sales and widespread acceptance.
As consumers become better informed about their choices, conformity to recognized standards becomes increasingly important. Two examples are the European Standards for toys (EN 71 series) and the European Standards for lifts (EN 81 series), which are used internationally; another example coming from the biomass sector is represented by solid biofuels EN Standards (EN 14961 series) as shown below.

Standards are a respected badge of quality
Certification marks are earned by businesses whose products and practices consistently prove conformity to relevant standards. These marks (such as the Keymark) are easily recognizable and act as badges of quality, safety and performance.

Standards can strengthen infrastructure
Standardization can deliver measurable benefits when applied within the infrastructure of a company itself. Effective communication along the supply chain and with legislative bodies, clients and customers is good business. Business costs and risks can be minimized, internal processes streamlined and communication improved. Standardization promotes interoperability, providing a competitive edge necessary for effective worldwide trading of products and services.

Above all, any business, large or small, can benefit from the conformity and integrity that standards will bring. Through the development and adoption of best practice guidelines companies and organizations can make sure they are meeting consumer concerns and keeping up with best practice. Some other Frequently Asked Questions4 could help in understanding "Standards".

Are standards only relevant to large businesses?
Standards address quality, efficiency and best practice, which are pivotal for both small firms and larger companies. They create competitive advantage, inspire trust and reduce business cost whilst opening markets. Start-ups can benefit from these factors just as much as established firms.

Are standards only for products?
There are a great many standards that ensure the quality, compatibility and safety of vast selection of manufactured goods. However, there are also many standards that have a similarly positive influence on service provision and business management.

How much time and effort will it take to introduce a standard to my business?
All that is necessary is to purchase the most appropriate standard, then to implement it in all relevant areas of operation. For added authority, compliance can then be independently verified. In some cases, this stage may be mandatory.

Do standards inhibit innovation?

[4] Taken from BSI website

Standards are able to promote innovation by defining performance without compromising intellectual property. Where interoperability is a key factor, standards serve to promote knowledge sharing and network benefits, enabling greater innovation.

Do we really need standards if we have the best solution already?
It is not always enough to have the 'best' technological solution. Standardization creates customer confidence, market growth and technological evolution. This allows effective and profitable competition through such factors as product differentiation.

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2.3 Where can be purchased European Standards and draft standards?

Standards are publicly available documents that may be purchased from CEN's National Members and Affiliates for a reasonable fee, always taking into account that they are protected by copyright and associated exploitation rights.

European Standards are the result of extensive efforts performed by the market players, who provide the expertise and fund the infrastructure of standardization in Europe. They represent an exceptional value for the users, who support this work and infrastructure through their purchase, but CEN does not sell or distribute Standards or any other deliverable.
All European Standards (ENs) and drafts (prENs), as well as any other approved document (Technical Specifications (TSs), Technical Reports (TRs) and CEN Workshop Agreements (CWAs), can be purchased from the CEN following National Members through their shops/e-shops. Each of the quoted website has an on-line catalogue helping the search of standards (available or withdrawn).

AUSTRIA	ASI - ON	Austrian Standards Institute - Österreichisches Normungsinstitut	www.as-institute.at
BELGIUM	NBN	Bureau de Normalisation/Bureau voor Normalisatie	www.nbn.be
BULGARIA	BDS	Bulgarian institute for standardisation	www.bds-bg.org
CROATIA	HZN	Croatian Standards Institute	www.hzn.hr
CYPRUS	CYS	Cyprus organisation for standardisation	www.cys.org.cy
CZECH REPUBLIC	UNMZ	Czech Office for Standards, Metrology and Testing	www.unmz.cz
DENMARK	DS	Dansk Standard	www.ds.dk
ESTONIA	EVS	Estonian centre for standardisation	www.evs.ee
FINLAND	SFS	Suomen standardisoimisliitto r.y	www.sfs.fi
FRANCE	AFNOR	Association française de normalisation	www.afnor.org
GERMANY	DIN	Deutsches Institute für Normung e.V.	www.din.de
GREECE	ELOT	Hellenik Organization for Standarization	www.elot.gr
HUNGARY	MSZT	Hungarian Standards Institution	www.mszt.hu
ICELAND	IST	Icelandic Standards	www.stadlar.is
IRELAND	NSAI	National Standards Authority of Ireland	www.nsai.ie
ITALY	UNI	Ente Nazionale Italiano di Unificazione	www.uni.com
LATVIA	LVS	Latvian Standards Ltd	www.lvs.lv
LITHUANIA	LST	Lithuanian Standards Board	www.lsd.lt
LUXEMBOURG	ILNAS	Institut Luxembourgeois de la normalisation, de l'accreditation, de la sécurité et qualité des produits et services	www.ilnas.lu
MALTA	MSA	Malta Standards Authority	www.msa.org.mt
THE NETHERLANDS	NEN	Nederlands Normalisatie-instituut	www.nen.nl
NORWAY	SN	Standard Norway	www.standard.no

POLAND	PKN	Polish Committee for Standarization	www.pkn.pl
PORTUGAL	IPQ	Instituto Português da Qualidade	www.ipq.pt
ROMANIA	ASRO	Romanian Standards Association	www.asro.ro
SLOVAKIA	SUTN	Slovak Standards Institute	www.sutn.sk
SLOVENIA	SIST	Slovenian Institute for Standarization	www.sist.si
SPAIN	AENOR	Asociación Española de Normalización y Certificación	www.aenor.es
SWEDEN	SIS	Swedish Standards Institute	www.sis.se
SWITZERLAND	SNV	Schweizerische Normen-Vereinigung	www.snv.ch
UNITED KINGDOM	BSI	British Standards Institution	www.bsigroup.com

or from the following CEN Affiliates

ALBANIA	DPS	General Directorate of Standardization	www.dps.gov.al
ARMENIA	SARM	National Institute of Standards	www.sarm.am
AZERBAIJAN	SCSMP	State Agency on Standardization, Metrology and Patent of Azerbaijan Republic	www.azstand.gov.az
BELARUS	BELST	State Committee for Standardization of the Republic of Belarus	www.gosstandart.gov.by
BOSNIA HERZEGOVINA	BAS	Institute for Standardisation of Bosnia and Herzegovina	www.bas.gov.ba
EGYPT	EOS	Egyptian Organization for Standardization & Quality	www.eos.org.eg
REPUBLIC OF MACEDONIA	ISRM	Standardization Institute of the Republic of Macedonia	www.isrm.gov.mk
GEORGIA	GEOSTM	Georgian National Agency for Standards, Technical Regulations and Metrology	www.gnims.caucasus.net
ISRAEL	SII	Standards Institution of Israel	www.sii.org.il
JORDAN	JSMO	Jordan Standards and Metrology Organization	www.jsmo.gov.jo
LEBANON	LIBNOR	Lebanese Standards Institution	www.libnor.org
LIBYA	LNCSM	Libyan National Centre for Standardization and Metrology	www.lncsm.org.ly
REPUBLIC OF MOLDOVA	INSM	National Institute of Standardization and Metrology	www.standard.md
MONTENEGRO	ISME	Institute for Standardization of Montenegro	www.isme.me
MOROCCO	SNIMA	Service de Normalisation Industrielle Marocaine	www.snima.ma
SERBIA	ISS	Institute for Standardization of Serbia	www.iss.rs
TUNISIA	INNORPI	National Institute for Standardization and Industrial Property	www.innorpi.tn/en
TURKEY	TSE	Turkish Standards Institution	www.tse.org.tr
UKRAINE	DSSU	State Committee of Ukraine for Technical Regulation and Consumer Policy	www.dssu.gov.ua

2.4 How are standards made?

It is worthwhile to spend few words explaining how standard are made in order to show that they are drafted by people and businesses and that everyone could act in this process at different levels and with different engagements.

The task of drafting formal full consensus standards is usually delegated by a technical committee to a drafting group or panel made up of experts coming from industry, professional associations, certification bodies, laboratories, research organizations and university, final users, public authorities and other stakeholders.

Another interesting aspect is that there are specific rules for drafting standards that must be adhered to. These are designed to ensure that standards meet their aim of providing, for common and repeated use, rules guidelines or characteristics for activities. They are founded on usability, verifiability and commonality and, as said before, the main requirement that a standard must have is "the consensual" meaning that if a strong disagreement on a standard rises during the drafting work the work must be stopped till the consensus is found.

In order to achieve full consensus standard are developed through formal stages of drafting and consultation, also public.

3 Useful Standards for the biomass heat chain

3.1 General

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As showed in the first part of this guide, standards represent a valuable tool to help the market by giving operators a common language on products and fuels, but how does this tool work?

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In order to explain the role that standards could have in the biomass heating supply chain, some considerations have to be given to looking again at the scheme represented in figure 1, where the whole chain is schematizied and single components are grouped in "funcional" ensemble and the interfaces are represented by jellow arrows.

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When a business meets its supplier or customer or any other figure involved in its work the first requirement that both the parts have to follow is to speak a common language and to have the same understanding about the object of the business. This is obviously a must for every commercial exchange, for this reason it' is preferable to focus on some examples specific to the supply chain we are dealing with in this guide.

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For example the action of "buying a big bag of wood pellet" could be very simple, but if seller and buyer are not so confident or knowledgable, as often happens, the possibility that the product exchanged doesn't satisfy the buyer requirements is very high.

As most people should know, several parameters define the quality of a biofuel, for example the ash content, heating calorific value and moisture content, but others should also be taken into account. How is it possible to be sure that the pellet bought meets the customer needs? This is the role of the Standards.

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In this case for example the Standard EN 14961-2 should be considered as it defines the quality requirements of wood pellet: the buyer should only know that a Standard exists and ask for a declaration of the provider stating conformity to the specific Standard. The declaration could be simply managed, for example, with a label on the package or in several different ways, with or without a third part certification.

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The declaration or the label stating the conformity to the EN 14961-2 also gives the figures relevant to all the parameters defined by the standard, thus by only reading the label the buyer acknowledges main of the information he needs.

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All the Standards quoted in this guide and related to a biofuels should be considered with this approach, but Standards could also refer to appliances, boilers, management systems or other "objects".

In the following chapters the relevant Standards for each part of the chain are described, taken into account the copyright which forbids quoting parts of the normative text.

4 Standards for Biomass fuel

The first point on standards for biofuels that should be noted is that "Solid biofuels are fuels"; this apparently simple sentence has a deep significance since for the most people terms like "pellet" or "chips" are closer to terms like "green, natural, plants, wood" than to "fuel" and this is one of the common mistake that should be avoided.

Gasoline or diesel fuel sold wherever in the world are consistent with specific standards, EN 228[5] and EN 590[6] respectively, stating their chemical and physical characteristics. Fuels not compliant with these standards simply can't be used orsold since. A a simple consequence of this is that, car manufacturer's guarantees are only valid if a standard fuel is used. More serious consequences are related to the safe use of such fuels or, from an economic point of view, their market price in relation to energy content. For these and other reasons nobody in the world uses fuels which don't comply with the standards.

This approach should be kept in mind moving from the main common fossil fuels to the solid biofuels or (generally speaking) with all the other fuels. Indeed, following the example of gasoline and diesel, biodiesel was the first biofuel characterised by two European Standard: the EN 14214[7], firstly published in 2003 and reviewed in 2009, for automotive purposes and the EN 14213[8] for biodiesel used as heating fuel.

4.1 European standards

The main standards in the area of biomass fuels are the EN 14961 series. Under this code six European standards are going to be published, thus available, in all the EU Countries through their National Standardisation Bodies (see the full list in clause 2.4).

These documents are, at the moment, the unique European Standards dealing with solid biofuel specification, and, even if they refer to biofuels for non industrial use[9] (as stated in their titles), waiting for more specific standards they could be used as reference also for industrial uses. An overview of these standards are given in the box below:

EN 14961 - 1 *Solid biofuels. Fuel specifications and classes. Part 1: General requirements.* Already published.

This European Standard determines the fuel quality classes and specifications for solid biofuels. According to the mandate given for the standardisation work, the scope of the CEN/TC 335 only includes solid biofuels originating from the following sources:

a) products from agriculture and forestry;
b) vegetable waste from agriculture and forestry;
c) vegetable waste from the food processing industry;

[5] EN 228 Automotive fuels - Unleaded petrol - Requirements and test methods
[6] EN 590 Automotive fuels - Diesel - Requirements and test methods
[7] EN 14214 Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods
[8] EN 14213 Heating fuels - Fatty acid methyl esters (FAME) - Requirements and test methods
[9] The EN 14961 series is dedicated to non industrial use, as fuel intended to be used in smaller appliances and boilers such as household and small commercial and public sector buildings up to some hundreds kW.

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d) wood waste, with the exception of wood waste which can 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 originated from construction and demolition waste;
e) 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;
f) cork waste.

EN 14961 - 2 *Solid biofuels. Fuel specifications and classes. Part 2: Wood pellets for non-industrial use.* To be published early in 2011.

This European standard determines the fuel quality classes and specifications of wood pellets for non-industrial use. This European standard covers only wood pellets produced from the following raw materials: Forest, plantation and other virgin wood; By-products and residues from wood processing industry; Used wood.

EN 14961 - 3 *Solid biofuels. Fuel specifications and classes. Part 3: Wood briquettes for non-industrial use.* To be published in early 2011.

This European standard determines the fuel quality classes and specifications of wood briquettes for non-industrial use. This European standard covers only wood briquettes produced from the following raw materials: Forest, plantation and other virgin wood; By-products and residues from wood processing industry; Used wood.

EN 14961 - 4 *Solid biofuels. Fuel specifications and classes. Part 4: Wood chips for non-industrial use for non-industrial use.* To be published in early 2011.

This European standard determines the fuel quality classes and specifications for non-industrial wood chips. This European standard covers only wood chip produced from the following raw materials: Forest, plantation and other virgin wood; By-products and residues from wood processing industry; Used wood.

EN 14961 - 5 *Solid biofuels. Fuel specifications and classes. Part 5: Firewood for non-industrial use for non-industrial use.* To be published in early 2011.

This European standard determines the fuel quality classes and specifications for firewood for non-industrial use. This European standard covers only firewood produced from the following raw material: Whole trees without roots; Chemically untreated wood residues; Stem wood; Logging residues (thick branches, tops, etc.).

EN 14961 - 6 *Solid biofuels. Fuel specifications and classes. Part 6: Non woody pellets for non-industrial use for non-industrial use.* To be published by the end of 2011, beginning of 2012.

This European Standard determines the fuel quality classes and specifications of non woody pellets for non-industrial use. This European Standard covers only non-woody pellets produced from herbaceous biomass, fruit biomass and their blends and mixtures. Herbaceous biomass is from plants that have a non-woody stem and which die back at the end of the growing season. It includes grains or seeds crops from food processing industry and their by-products such as cereals. Blends are intentionally mixed biofuels, whereas mixtures are unintentionally mixed biofuels.

EN 14961 part 1 is a very general standard that explains how to classify the biomass to be used for energy purposes and lists the major traded forms of solid biofuels, see **table 1**. For each of these forms a typical and average size is defined (not mentioned here for copyright problems), thus referring to this standards it is possible to say that pellets are those compressed biofuels having a diameter lower than 25 mm while briquettes are those with a diameter greater than or equal to 25 mm. As explained before, even if trivial, these specifications are fundamental for the establishment of a common language.

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Table 1 - Major traded forms of solid biofuels (Source EN 14961-1)

Fuel name	Common preparation method
Whole tree	No preparation or delimbed
Wood chips	Cutting with sharp tools
Hog fuel	Crushing with blunt tools
Log wood/firewood	Cutting with sharp tools
Bark	Debarking residue from trees Can be shredded or unshredded
Bundle	Lengthways oriented & bound
Fuel powder	Milling
Sawdust	Cutting with sharp tools
Shavings	Planing with sharp tools
Briquettes	Mechanical compression
Pellets	Mechanical compression
Bales, Small or big square bales, Round bales	Compressed and bound to squares Compressed and bound to squares Compressed and bound to cylinders
Chopped straw or energy grass	Chopped during harvesting or before combustion
Grain or seed	No preparation or drying except for process operations necessary for storage for cereal grain
Fruit stones or kernel	No preparation or pressing and extraction by chemicals.
Fibre cake	Prepared from fibrous waste by dewatering

Following this general part, the most relevent standards for larger heating applications in the EN 14961 series are part 2 (wood pellet) and part 4 (wood chips). Briquettes and firewood are not considered in this guide in detail since they are used only in small appliances, but if needed the user should know that an European Standard is available also for them.

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EN 14961-2 defines the main parameters that should be considered for stating the quality of wood pellet and for each of them typical values for three quality classes (A1, A2 and B) are specified. Class A1 and A2 represents pellets from virgin wood or chemically untreated wood residues. They differ mainly for the ash content, while class B allows chemically treated industrial wood by-products and residues and used wood. A note has to be written about class B since not all the national legislations in EU allow the use of treated wood, thus the standard contain deviations according with national situation.

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The same approach is adopted by EN 14961-4 on wood chips that defines 4 classes (A1, A2, B1, B2). Class A1 and A2 represents wood chips from virgin wood or chemically untreated wood residues, in this case with different ash and moisture contents. Class B1 and B2 extend the source of biomass to include (B2) chemically treated industrial wood by-products and residues and used wood.

All the quoted standards define a list of parameters to be used for stating the quality of each biofuels and for each parameters a set of values are defined. The main parameters to be considered for non-industrial pellets and woodchips are listed in table 2.

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Table 2 - Key parameters for non-industrial pellets and woodchips according with EN 14961-2 and 4.

Parameter	Meaning	Notes for Pellet	Notes for Wood Chip
Origin and source:	It has to be clearly stated according with the different sources allowed by each standards.		
Diameter for pellet or Dimension for chips	It is a physical value that could influence the plant/appliance feeding system.	For pellet diameter could vary from 6 to 8 mm ± 1 mm. A higher diameter could affect the correct functioning of the stove.	The dimension is important for the appliance feeding systems; it also could lead to bridging phenomena in the bulk storage
Moisture:	This parameter mainly affect the energy content and the storage. Moreover it is often used to define the contractual price of the biofuel.	It has to be lower than 10% since an higher content could scale and damage the pellet.	It is on of the key parameter for the chips. For class A moisture could vary up to 35%.
Ash:	Ashes are the mineral residues remaining after a complete combustion. Their amount has to be as low as possible. An high value means bad quality of biomass or a bad management during the production of the biofuel. An high ash content leads to a more frequent maintenance of the plant/appliance/boiler (removing of ashes in the combustion chamber or cleaning of the glasses).	High quality pellet (A1) shall have an ash content lower than 0,7%. A2 class allows a higher (up to 1,5%) ash content, while B admits and ash content up to 3%.	Ash content for wood chips is approached in a similar way as the pellet. The
Mechanical durability	It represents the capability of pellets to resist to crumble and break down to sawdust. It is one of the main requirements for pellet since affects its storability and integrity especially if pellet is subjected to several handling steps	It has to be the highest, more than 97,5 %	Not relevant
Fines at factory gate	It represents the percentage of sawdust in the package. Sawdust can't be handled by the feeding systems of pellet appliances.	It has to be the lowest; no more that 1% is allowed.	Not relevant
Additives	Additives are materials which should improve the efficiency of pellet production. Pellet producers generally use starch, corn or potato flour, vegetable oil.	Type and amount have to be clearly stated	Not relevant
Net calorific value	It represents the energy content of the biofuel and is strongly connected with moisture content. Attention has to be paid for the unit used to declare this parameter. A typical mistake is to declare the gross value instead of the net, giving an overestimation of the fuel energy content.	An high calorific value could mean that pellet is made by other material than wood (plastics, glues, etc.),	
Bulk density	It is a key parameter since allows to calculate "quantities". It represents the weight (mass) of the bulk for unit of volume.	It has to be higher than 600 kg/m^3	It has to be higher than 150-200 kg/m^3
Nitrogen, Sulphur, Chlorine, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc	Chemical compounds/elements have to be considered indicators of possible contaminants of the original biomass. For this reason higher contents than expected can indicate a pollution (voluntary or involuntary) of the raw material.		

Few words have to be spent about the complete set of European standards that could be useful for organizations involved in the biomass heat market. We are referring to all the previously quoted

Standards on fuel specification but also to all the other Standard dealing with test methods and the sampling procedures on solid biofuels that CEN issued in the past years. Table 3 lists the complete set of published standards and Table 4 lists the current standards under review.

Table 3 - List of published CEN Standards on Solid Biofuels at 31/12/2010.

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Standard Code	Title	Note
CEN/TS 15234:2006	Solid biofuels - Fuel quality assurance	Under review - See table 4
CEN/TS 14778-1:2005	Solid biofuels - Sampling - Part 1: Methods for sampling	Under review - See table 4
CEN/TS 14778-2:2005	Solid biofuels - Sampling - Part 2: Methods for sampling particulate material transported in lorries	Under review - See table 4
CEN/TS 14779:2005	Solid biofuels - Sampling - Methods for preparing sampling plans and sampling certificates	
CEN/TS 14780:2005	Solid biofuels - Methods for sample preparation	Under review - See table 4
CEN/TS 15370-1:2006	Solid biofuels - Method for the determination of ash melting behaviour - Part 1: Characteristic temperatures method	Under review - See table 4
CEN/TS 15149-3:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 3: Rotary screen method	Under review - See table 4
CEN/TS 15150:2005	Solid biofuels - Methods for the determination of particle density	Under review - See table 4
CEN/TS 15104:2005	Solid biofuels - Determination of total content of carbon, hydrogen and nitrogen - Instrumental methods	Under review - See table 4
CEN/TS 15289:2006	Solid Biofuels - Determination of total content of sulphur and chlorine	Under review - See table 4
CEN/TS 15105:2005	Solid biofuels - Methods for determination of the water soluble content of chloride, sodium and potassium	Under review - See table 4
CEN/TS 15290:2006	Solid Biofuels - Determination of major elements	Under review - See table 4
CEN/TS 15297:2006	Solid Biofuels - Determination of minor elements	Under review - See table 4
CEN/TS 15296:2006	Solid Biofuels - Calculation of analyses to different bases	Under review - See table 4
CEN/TR 15569:2009	Solid biofuels - A guide for a quality assurance system	
EN 14961-1:2010	Solid biofuels - Fuel specifications and classes - Part 1: General requirements	The other 5 parts are going to be published. See table 4
EN 14918:2009	Solid biofuels - Determination of calorific value	
EN 15103:2009	Solid biofuels - Determination of bulk density	
EN 14774-1:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 1: Total moisture - Reference method	
EN 14774-2:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 2: Total moisture - Simplified method	
EN 14774-3:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 3: Moisture in general analysis sample	
EN 15148:2009	Solid biofuels - Determination of the content of volatile matter	
EN 14775:2009	Solid biofuels - Determination of ash content	
EN 15210-1:2009	Solid biofuels - Determination of mechanical durability of pellets and briquettes - Part 1: Pellets	
EN 14588:2010	Solid biofuels - Terminology, definitions and descriptions	
EN 15149-1:2010	Solid biofuels - Determination of particle size distribution - Part 1: Oscillating screen method using sieve apertures of 1 mm and above	
EN 15149-2:2010	Solid biofuels - Determination of particle size distribution - Part 2: Vibrating screen method using sieve apertures of 3,15 mm and below	
EN 15210-2:2010	Solid biofuels - Determination of mechanical durability of pellets and briquettes - Part 2: Briquettes	

Table 4 - List of on going CEN draft Standards on Solid Biofuels at 31/12/2010.

Draft Code	Title
prEN 16126	Solid biofuels - Determination of particle size distribution of disintegrated pellets
prEN 16127	Solid biofuels - Determination of length and diameter for pellets and cylindrical briquettes

FprEN 14961-2	Solid biofuels - Fuel specifications and classes - Part 2: Wood pellets for non-industrial use
FprEN 14961-3	Solid biofuels - Fuel specifications and classes - Part 3: Wood briquettes for non-industrial use
FprEN 14961-4	Solid biofuels - Fuel specifications and classes - Part 4: Wood chips for non-industrial use
FprEN 14961-5	Solid biofuels - Fuel specifications and classes - Part 5: Firewood for non-industrial use
prEN 14961-6	Solid biofuels - Fuel specifications and classes - Part 6: Non woody pellets for non-industrial use
FprEN 15234-1	Solid biofuels - Fuel quality assurance - Part 1: General requirements
prEN 15234-2	Solid biofuels - Fuel quality assurance - Part 2: Wood pellets for non-industrial use
prEN 15234-3	Solid biofuels - Fuel quality assurance - Part 3: Wood briquettes for non-industrial use
prEN 15234-4	Solid biofuels - Fuel quality assurance - Part 4: Wood chips for non-industrial use
prEN 15234-5	Solid biofuels - Fuel quality assurance - Part 5: Firewood for non-industrial use
prEN 15234-6	Solid biofuels - Fuel quality assurance - Part 6: Non-woody pellets for non-industrial use
FprEN 14778	Solid biofuels - Sampling
FprEN 14780	Solid biofuels - Sample preparation
FprCEN/TR 15149-3	Solid biofuels - Determination of particle size distribution - Part 3: Rotary screen method
FprEN 15150	Solid biofuels - Determination of particle density
EN 15104:2011	Solid biofuels - Determination of total content of carbon, hydrogen and nitrogen - Instrumental methods
EN 15289:2011	Solid biofuels - Determination of total content of sulfur and chlorine
EN 15105:2011	Solid biofuels - Determination of the water soluble chloride, sodium and potassium content
EN 15290:2011	Solid biofuels - Determination of major elements - Al, Ca, Fe, Mg, P, K, Si, Na and Ti
EN 15297:2011	Solid biofuels - Determination of minor elements - As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, V and Zn
EN 15296:2011	Solid biofuels - Conversion of analytical results from one basis to another

A "pr" in the draft code means that the work are ongoing.
An "F" in the draft code means that the relevant works are close to the end and the publication is foreseen by 2011.
The last six drafts, without "pr", are going to be published as EN in the next months.

4.2 National standards and guidance

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As mentioned before National Standards could be available/used at local level giving different figures, but in this case it has to be taken into account that National Standards shall be withdrawn when European Standards with the same scope are published. For example all national standards defining requirements for non-industrial pellets shall be withdrawn by august 2011, the same deadline is mandatory for briquettes, wood logs and wood chips.

One example of national standard is represented by the Austrian ONORM M 7133 for "chipped wood for energetic purposes". As already shown in Table 2, important quality characteristics for wood chips are bulk density (weight), size and water content. Depending on the size, M7133 establishes the classes indicated in table xxx:

Table 5 - Classes of woodchips based on typical size according with Onorm M 7133.

	"fine wood chips"	**"medium wood chips"**	**"coarse wood chips"**
typical size	under 3 cm (G30)	under 5 cm (G50)	under 10 cm (G100)
typical field of application	mainly small-scale	industrial wood chips, mainly medium to large scale	large scale

M7133 defines also classes based on moisture (see table xxx), noting that water content depends on the type of wood and is, besides bulk density, the main criteria to determine the fuel price.

Table 6 - Classes of woodchips based on moisture content according with Onorm M 7133.

W 20 air-dried	**W 30 storable**	**W 35 limited storable**	**W 40 moist**	**W 50 harvest-fresh**
water content <	water content ≥	water content ≥	water content ≥	water content ≥

20%	20% and < 30%	30% and < 35%	35% and < 40%	40% and < 50%

Standards on fuel from other countries?

5 Standards for production, transport and storage

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Intro text?

5.1 European standards

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The production, transport and the handling of biofuels are very important parts of the supply chain, for this reason the EN 15234 series on "fuel quality assurance" has been drafted and the final text will soon be available (end of 2011) for the market replacing the current and simpler version represented by CEN/TS 15234:2006.

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These Standards are based on the same approach used for the EN ISO 9001 "Quality management systems. Requirements", and are thus easily applicable by the larger operators involved in the biofuel production. The key standards in this series are listed in the box below:

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EN 15234-1 *Solid biofuels - Fuel quality assurance - Part 1: General requirements.* To be published in mid 2011

EN 15234-2 *Solid biofuels - Fuel quality assurance - Part 2: Wood pellets for non-industrial use.* To be published in late 2011

EN 15234-3 *Solid biofuels - Fuel quality assurance - Part 3: Wood briquettes for non-industrial use.* To be published in late 2011

EN 15234-4 *Solid biofuels - Fuel quality assurance - Part 4: Wood chips for non-industrial use.* . To be published in late 2011

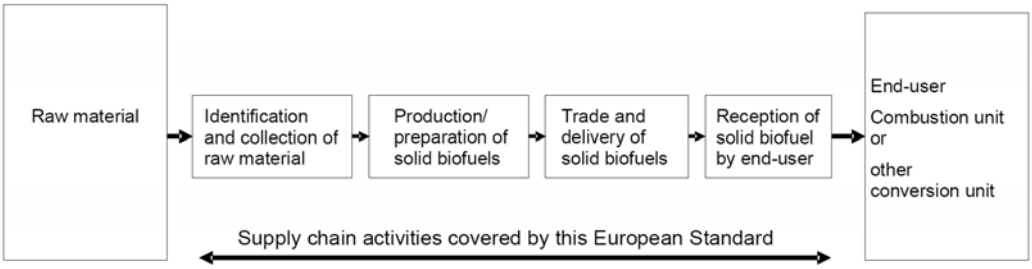
EN 15234-5 *Solid biofuels - Fuel quality assurance - Part 5: Firewood for non-industrial use.* To be published in late 2011

EN 15234-6 *Solid biofuels - Fuel quality assurance - Part 6: Non-woody pellets for non-industrial use.* To be published in late 2011

The general part of this set (EN 15234-1) defines the procedures to fulfil the quality requirements of solid biofuels and describes measures to ensure adequate confidence that the biofuel specifications (EN 14961 series) are fulfilled. This European Standard covers the whole chain, from supply of raw materials to point of delivery to the end-user, while the quality assurance systems applied to the operation of conversion plants fuelled by solid biofuels are outside the scope of the standard, moreover even if health, safety and environmental issues for solid biofuels are important and need special attention, they are outside the scope as well.

By applying this standard it is possible to ensure traceability and to demonstrate that all the processes along the biofuel supply chain (as simplified in Figure 2) up to the point of the delivery to the end user are under control, thus the final quality of the product is assured.

Figure 2 - Solid biofuel supply chain. Excerpted from the introduction of prEN 15234-1:2010. Please refer to the EN 15234-1 published since each prEN is subject to change without notice.



The other five parts of the EN 15234 series deal with specific requirements for pellets, briquettes, chips, firewood and non woody pellets.

Any European Standard deals with the storage systems even if it is another key issue in the biomass heat market. In this case only national standards, if available, could be used.

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For example the Austrian standards ONORM M7136 *"Compressed wood in natural state - Woodpellets - Quality assurance in the field of logistics of transport and storage"* and M7137 "*Compressed wood in natural state – Woodpellets – Requirements for storage of pellets at the ultimate consumer"* define requirements for the logistic system and for final customer storage systems.

5.2 National standards and guides

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Some non normative guides¶

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Several non normative guides could also be available at national level even if attention has to be paid since they are not official Standards, thus they haven't any "legal" validity.

One of these is worthwhile to mention even if it is not an official Standard. In October 2008 the Nordic Innovation Centre issued the document Nordtest Method NT ENVIR 010:2008 "*Guidelines for storing and handling of solid biofuels"* downloadable for free from the Innovation Centre website[10]. The document has been drafted by a panel of experts mainly coming from organizations already involved in the standardisation work of CEN, thus with adequate skill and competence.

The guide gives recommendations for utilizing best available knowledge, experience, methods and technology in storage and handling to secure the quality of the solid biofuel and to minimize health and safety risks. It is intended for persons and organisations that manufacture, plan, sell, install or use machinery, equipment, tools and entire plants related to the production, purchase, sale and utilization of these fuels on a commercial and industrial level. The guideline is not addressed to single households and individual small producers

Other interesting documents are available on the web. An interesting reference is the Irish CCWEP website (http://www.ccwep.ie/default.asp) where some useful documents are available including a guide to selling wood fuel and a guide with basic specifications of boilers. The County Clare Wood Energy Project (CCWEP) is a Forest Service funded project whose aim is to promote the installation of wood biomass boilers fuelled by wood chip from farm forests in the county.

[10] At the time of rafting the Forest Guide the NIC guide is available at http://www.nordicinnovation.net/_img/envir010.pdf

In Italy some interesting guides on woodchips and pellet are available in the website (http://www.aiel.cia.it) of AIEL (Italian Association for Energy from Agriculture and Forestation).

Other references from other countries?

6 Standards for Boilers

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The last, but not the least product to be addressed to in this guide is the boiler.

6.1 European standards

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Up to today the main European standard dealing with boilers is the well known EN 303-5, currently under revision, thus a new version is foreseen by the end of 2011, beginning of 2012. Hoping this Forest guide could be useful for several years, it is worthwhile to describe the new future version of EN 303-5 and not the current one.

EN 303-5 deals with *Central-Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 500 kW - Terminology requirements, testing and marking*.

More in detail, EN 303-5 applies to heating boilers up to a nominal heat output of 500 kW which are designed for the burning of solid fuels only and are operated according to the instructions of the boiler manufacturer. Boilers can have natural draught or forced draught and the stoking can be manual or automatic.

This standard covers only boilers including burners as a unit.

Solid fuels to be used according to this standard are:

- Biogenic fuels Biomass in natural state in form of:
  - Log wood with water content w ≤ 25 %;
  - Chipped wood (wood chipped by machine with and without bark, usually up to a maximum length of 15 cm) water content from 15 % to 35 % or more;
  - Compressed wood (pellets without binding agents, made of wood and/or bark particles; permitted are natural binding agents such as molasses, vegetable paraffins and starch); Pellets according to EN 14961-2;
  - Compressed wood (briquettes without binding agents, made of wood and/or bark particles; permitted are natural binding agents such as molasses, vegetable paraffins and starch); Briquettes according to EN 14961-3;
  - Sawdust up to w 50 % moisture;
  - Non woody biomass such as straws, reeds, kernels and grains.
- Fossil fuels
  - Bituminous coal;
  - Brown coal;
  - Coke;
  - Anthracite.
- Other solid fuels (e.g. peat)

The standard contains requirements and test methods for safety, combustion quality end efficiency, operating characteristics and maintenance of heating boilers and covers also all external equipment that influences the safety systems (e.g. backburn safety device, integral fuel hopper).

An interesting section of EN 303-5 is represented by a classification scheme based on emission levels. One of the main requirement of the Standard is that combustion shall be of low-emission. This is satisfied if emission values do not exceed some defined thresholds for Carbon Monoxide (CO), Dust/particulate matter and Organic Gaseous Compounds (OGC).

For this reason EN 303-5 is often used by local authority, within their regulations, to move the market towards high efficiency boilers and to incentivise the use of efficient boilers with low emission levels.

Unfortunately this is the only European Standards dealing with boilers. A lot of other standards exists on small appliances as fireplaces and stoves, but they are out from the scope of this guide.

6.2 National standards and guides

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7 Standard for designers and architects.

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Between the great number of standards issued by CEN, there is another EN that could be useful for designers and architects working with biomass heating systems.

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This standard is the EN 15316-4-7 *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-7: Space heating generation systems, biomass combustion systems*.

This standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings directive(EPBD,

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It forms part of a series of standards aimed at European harmonisation of the methodology for calculation of the energy performance of buildings. All the standards of this series are systems standards, meaning that they are based on requirements addressed to the system, in which the product is installed, as a whole and not dealing with requirements to the products within the system.

Reading the scope of the standard it is clear that EN 15316-4-7 presents methods for calculation of the additional energy requirements of a heat generation system by biomass combustion in order to meet the distribution and/or storage sub-system demand. The calculation is based on the performance characteristics of the products given in product standards and on other characteristics required to evaluate the performance of the products as included in the system.

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This method can be used for the following applications:

- judging compliance with regulations expressed in terms of energy targets;
- optimisation of the energy performance of a planned heat generation system, by applying the method to several possible options;
- assessing the effect of possible energy conservation measures on an existing heat generation system, by calculating the energy use with and without the energy conservation measures.

8 Summary

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Can we provide a summary of key points that business need to consider and take on board just to round the guide off

This guide was developed in the framework of the "Forest" project. FOREST's objective is to work directly with bio-businesses in this supply chain to develop and consolidate long term supply chain partnerships that will give the end user confidence in the total bio-heat system and encourage investment from larger non-domestic heat users.

FOREST stands for "FOsteRing Efficient long term Supply partnerships". The project is funded by Intelligent Energy Europe (IEE), a European Commission programme. Further information about FOREST and the information and tools it is developing can be found at www.forestprogramme.com.