Quality standard for statistics on wood fuel consumption of households

(taking into account the relative importance for the 20-20-20 goals)

Working Group 2: Methodology

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1 Contents

1. Foreword

This standard should serve as support for the implementation of reliable statistics on wood fuel consumption of households.

The standard focuses on consumer based surveys e.g. with 'face to face' interviews or interviews by 'telephone' (ideally as computer assisted telephone interview) and not on model based calculation of wood fuel consumption in households (like in UK).

In case of negligible importance of wood fuels consumption of households that means less than 5% of applicable renewables, approximate methods based on modelling and expert estimates could be an acceptable alternative.

2. Definitions

Demolition wood (in energy statistics normally counted as recovered wood): used wood arising from demolition of buildings (roofs and floors, etc.) or civil engineering installations (EN 14588:2010).

Firewood: spitted wood pieces from whole trees without roots or chemically untreated wood residues, either deciduous (hard) or coniferous (soft) wood with different length, depending on the type of firewood burning appliance (1 m, 50 cm, 33 cm, 25 cm).

Non-standardized wood fuels: segregated wood fuels from gardens, parks, roadside maintenance, vineyards, fruit orchards, hedges, used wood and demolition wood, etc.

Standardized wood fuels: wood pellets (EN 14961-2:2011), wood briquettes (EN 14961-3:2011), wood chips (EN 14961-4:2011), firewood (EN 14961-5:2011), all for non-industrial use, e.g. in households and small commercial and public sector buildings.

Used wood (in energy statistics normally counted as recovered wood): mechanically treated wood from wooden packaging like pallets, etc.

Wood fuels: includes all fuels consisting of wood matter.

Wood residues: by-products and residues from the wood processing industry, also compressed to pellets, briquettes, logs, etc., with the exception of sawdust, which is mainly used for wood pellets.

3. Introduction

Compared to fossil fuels and standardized wood fuels, statistics on non-standardized wood fuel consumption is a **tricky field**, because of three problems.

1. Non-standardized wood fuels are very **inhomogeneous**, because of:
   - their composition of different wood species with different volume to mass conversion factors,
   - widely different energy contents, due to
   - widely different water contents.
2. Non-standardized wood fuels have a **special market situation**, because of:
   - a high share of non-purchased quantities,
   - widely different sources,
   - 'grey' or informal markets,
   - different consumption behaviour compared to fossil fuels and electricity (e.g. infrequent users, who may be unable to give reliable data on quantity of wood fuel used and frequency of use; careless use of wood fuels if they are free of charge; etc.).

3. Wood fuels is **difficult to survey** because of:
    - often inexperienced respondents,
    - no standards available,
    - often no existing bills,
    - many different units used,
    - no possibility for data check with information on amounts and values.

This makes it very difficult to produce reliable statistics on **wood fuel consumption** – including both standardised and non-standardised wood fuels. Therefore there is an **increased necessity** on **transparent data collection**, **data validation procedures** and **comprehensive metadata documentation**.

It is obvious, that if wood fuel consumption in a country is low and its share in reaching the 2020 goals is negligible, it does not make sense to put large efforts in good quality data but on the other hand increasing **importance of wood fuel** consumption pushes the **need of high quality** data. That's the reason why three levels of importance with different data quality needs are defined.

4. The 3 levels of importance

1. **>30% of applicable renewables**: in this case the sampling error (with 95% confidence) should not exceed **± 3%**. That means the maximum influence of that error on the reported share is **> ±0.9 and < ±3%**.
2. **10 to 30% of applicable renewables**: in this case the sampling error (with 95% confidence) should not exceed **±10%**. That means the maximum influence of that error on the reported share is **±1 to ±3%.**
3. **<10% of applicable renewables**: in this case the sampling error (with 95% confidence) should not exceed **±30%**. That means the maximum influence of that error on the reported share is **< ±3%.**

Unfortunately the sampling errors are the only type errors that can be quantified in a straight forward way. In practice, all other types of errors can be assessed only via expert estimates. To achieve comparable results on European level, it is highly necessary to make the calculation process completely transparent in a detailed and standardized quality report, including conversion factors as well as the description of training measures, model assumptions and data validation processes. The quality report should follow the proposed format given in Annex 3.

This is of special importance for the consumption of private households, because the consumption patterns vary widely and are dependent of many aspects which are hard to quantify, whereas the consumption in industry is better documented and easier to validate.

Table 1 gives an overview about the level of importance, concerning the 20-20-20 goals, wood fuel reaches in the individual member states, under the assumptions that 90% and 70% of the solid biomass come from wood fuels, respectively.

Table 1: 2020 goal for heat from solid biomass and the levels of importance for wood fuel with the assumptions of 90% and 70% shares of wood fuel on the overall solid biomass

Source: Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States (2011), Energy Research Centre of the Netherlands & European Environment Agency, http://www.ecn.nl/publications/ECN-E--10-069 (accessed on 20 March 2012); Statistics Austria, own calculations.

Member states	Total biomass for heating and cooling in households (ktoe)	Expected amount of energy from renewable sources corresponding to the 2020 target (ktoe)	Share of biomass in households on the overall renewable consumption in 2020	Share of household wood fuel (assumed as 90% of solid biomass)	LOI	Share of household wood fuel (assumed as 70% of solid biomass)	LOI
Belgium	354	5 369	6.6%	5.9%	3	4.6%	3
Bulgaria	1 012	1 718	58.9%	53.0%	1	41.2%	1
Cyprus	12	263	4.5%	4.1%	3	3.2%	3
Czech Rep.	1 375	4 382	31.4%	28.2%	2	22.0%	2
Denmark	948	4 904	19.3%	17.4%	2	13.5%	2
Germany	5 975	35 492	16.8%	15.2%	2	11.8%	2
Estonia *)	607	863	70.3%	63.3%	1	49.2%	1
Greece	595	4 341	13.7%	12.3%	2	9.6%	3
Spain	2 117	19 408	10.9%	9.8%	3	7.6%	3
Finland	1 100	10 700	10.3%	9.3%	3	7.2%	3
France	7 400	3 5711	20.7%	18.6%	2	14.5%	2
Hungary	918	2 879	31.9%	28.7%	2	22.3%	2
Ireland	24	2 269	1.1%	1.0%	3	0.7%	3
Italy	3 620	2 2617	16.0%	14.4%	2	11.2%	2
Lithuania	39	1 399	2.8%	2.5%	3	2.0%	3
Luxembourg	35	484	7.3%	6.6%	3	5.1%	3
Latvia	794	1 918	41.4%	37.3%	1	29.0%	2
Malta *)	0	53	0.0%	0.0%	3	0.0%	3
Netherlands	159	7 074	2.2%	2.0%	3	1.6%	3
Austria	2 905	9 217	31.5%	28.4%	2	22.1%	2
Poland *)	4 634	10 381	44.6%	40.2%	1	31.2%	1
Portugal	604	6 035	10.0%	9.0%	3	7.0%	3
Romania	2 676	7 267	36.8%	33.1%	1	25.8%	2
Sweden	1 180	19 223	6.1%	5.5%	3	4.3%	3
Slovenia	394	1 331	29.6%	26.6%	2	20.7%	2
Slovakia	55	1 572	3.5%	3.1%	3	2.4%	3
UK	709	20 505	3.5%	3.1%	3	2.4%	3

ktoe... kilotons of oil equivalent; LOI...Level of importance; *) For Estonia, Malta and Poland no data on household level are available. For these countries, the level of importance was calculated with the overall quantities of biomass for heating and cooling.

One can see that three member states (Greece, Latvia and Romania) changed the level of importance by applying the different assumptions. All other countries remain in the same level. In nine countries (Belgium, Cyprus, Ireland, Lithuania, Luxembourg, Netherlands, Sweden, Slovakia and UK) fuel solid

biomass in general is of such low importance, that the level of wood fuel importance is 3. In one country (Malta) biomass does not play any role at all.

9 steps to ensure a satisfying data quality for reliable information:

1. Consumption surveys with representative samples and adequate frequencies (ideally the survey should be part of an existing general energy survey to enrich the data available for analysis and to minimise costs)
2. Well trained and experienced interviewers and an appropriate questionnaire design.
3. Well defined common wood fuel mix at regional or national level (depending on the regional spread of the most frequent tree or wood species)
4. Defined regional or national average water content of wood fuel (depending on storage period)
5. Average mass by volume unit(s) based on wood fuel mix and water content
6. Average calorific value(s) based on the defined wood fuel mix and water content
7. Default values for consumption by purpose (space heating, water heating, cooking) based on experts experience as basis for data validation
8. Well documented data validation procedure
9. Availability of time series (at least 3 survey cycles are necessary to get an impression on data reliability)

Especially the points 1, 2 and 9 - as resource intensive aspects - are closely linked to the three levels of importance, while for the other steps well established standards should be available for all three levels equally.

5. Specification of level specific minimum requirements

5.1 Level 1

Survey frequency

Every 2 years.

Sample size

It should be determined by the methodology department of the National Statistical Institutions to meet the statistical requirements for the appropriate statistical error. A stratified sampling plan could improve the representativeness of the sample and the quality of the results.

E.g. Austria: total number of private households: 3.6 million; sub-sample size for the 'Labour Force Survey' (LFS): 22 500; desired sample size for the survey "Energy consumption of households": about 40% of the LFS sub-sample: ~9 000.

E.g. Slovenia: total number of population 2 million; sample size: 6 000 households. The sampling plan is stratified by location of the building (rural/urban), by the main heating system in the building, age of the building and the number of dwellings in the building.

Alternatively, an adequate panel could be established.

Interviewer training

In any case interviewers should have a good knowledge on the different wood fuels, like firewood, wood pellets, briquettes and chips, as well as wood residues. Furthermore, the interviewers should be well trained on consumption patterns of different types of wood fuel burning appliances and household purposes (e.g. space heating, water heating and cooking).

In case of face to face interviews, practical leaflets with region-specific examples about the use of wood fuels in private households, and training in assessing stored quantities visually could assist the interviewers.

Grossing up procedures

Any additional information available, like sales statistics on types of wood fuel burning appliances (e.g. vessels for burning wood chips) and durability assumptions, should be used to achieve a more accurate overall population.

Time series availability

At least 4 survey cycles should be available in the period 2010-2020.

5.2 Level 2

Survey frequency

Every 3 to 4 years

Sample size

It should be determined by the methodology department of the National Statistical Institutions to meet the statistical requirements for the appropriate statistical error.

Different methods like stratified clustering or establishing a panel can help to reduce sample size and to save resources.

Interviewer training

In any case, interviewers should have a good knowledge on the different wood fuels, like firewood, wood pellets, briquettes and chips, as well as recovered wood. Furthermore, the interviewers should be well trained on consumption patterns of different types of wood fuel burning appliances and household purposes (e.g. space heating, water heating and cooking).

In case of face to face interviews, practical leaflets with region-specific examples about the use of wood fuels in private households, and training in assessing stored quantities visually could assist the interviewers.

Time series availability

Three survey cycles should be available in the period 2010 to 2020

5.3 Level 3

Survey frequency

Every 5 to 10 years

Sample size

It should be determined by the methodology department of the National Statistical Institutions to meet the statistical requirements for the appropriate statistical error.

Methods like stratified clustering or establishing a panel can help to reduce sample size and to save resources.

Interviewer training

In any case interviewers should have a basic knowledge on the different wood fuels, like firewood, wood pellets, briquettes and chips, as well as wood residues and in assessing stored quantities visually.

Time series availability

At least two survey cycles should be available in 2020

5.4 All levels

Preparation to the survey

If using a questionnaire for the first time, or important changes are introduced to the existing questionnaire, it is useful to conduct a test survey on a small sample (100-200 households), a few months before the main survey. The test survey points out the questions which cause major problems to the respondents and allows adjusting these questions, thus improving the questionnaire for the main survey.

Letter of notification

It is recommended to send a letter of notification to the chosen households before the survey starts. With this letter the households are informed about the purpose and the content of the survey, as well as the data they will be asked for. The households can also be asked to prepare the data on energy consumption (quantities and expenses), electrical appliances (energy classes), light bulbs and cars (fuel consumption, distance travelled). The notification letter could be accompanied by examples of energy bills, to assist the households providing the requested data.

Default values

The gross calorific value (GCV) of bone dry wood matter is nearly on the same level for all wood species. There is only a minor difference between coniferous wood (19 MJ/kg) and deciduous wood (18 MJ/kg), due to the higher resin and lignin content of coniferous wood. Therefore, the energy content of wood is much more dependent on the water content than on the wood species.

Furthermore, there is a difference between water content (based on wood wet weight) and moisture (based on wood dry weight). In the firewood business, the water content is used and is expressed as the percentage of water on the total wood weight. For example, 1 ton of wood chips with a moisture content of 40 % consists of 400 kg water and 600 kg wood dry matter.

Firewood and wood chips are normally stored for at least two years before use. During the first year, the water content from fresh cut wood decreases from about 55%, with a net calorific value (NCV) of about 7.0 MJ/kg for a firewood mixture of 50% deciduous and coniferous wood, to about 30%, and after the second year to about 20% with a corresponding NCV of about 12.2 MJ/kg and 14.3 MJ/kg, respectively.

Table 2 and 3 give standard values for wood fuels, which could be used if no national standards are established.

Table 2: Volume conversion factors for wood chips and different firewood assortments

Source: Instruction Manual for the Calculation of Wood Fuel Parameters (2008), Austrian Energy Agency, http://www.klimaaktiv.at/article/archive/12740/ (accessed on 20 March 2012).

Assortment	Solid (m³)	Bulk (m³)	Stere (m³)
Wood chips G30 [1])	1.0	2.500	-
Firewood (1.0 m piece length)	1.0	-	1.429
Firewood (0.3 m piece length)	1.0	2.000	1.176

[1]) Particle size up to 30 mm

Table 3: Standard values for wood chips, pellets, briquettes and different firewood assortments

Source: Advised conversion factors for wood based fuels for wood balance and energy balance calculation (2009, available in German only), Austrian Energy Agency, http://www.klimaaktiv.at/article/archive/12740/ (accessed on 20 March 2012). An English translation of all tables is given in Annex 3.

Assortment	Water Content (%)	Weight ($t_{air\ dry}$)	Volume			NCV [4]) (MJ)
			bcm [1])	stere [2])	scm [3])	
Wood chips G30 [5])	35%	1.0	3.906	-	1.560	11 394
Wood pellets [6])	8%	1.0	1.534	-	2.232	17 284
Wood briquettes [7])	8%	1.0	1.314		2.024	17.142
Deciduous (hard-) firewood	20%	1.0	2.740	1.957	1.370	13 911
Coniferous (soft-) firewood	20%	1.0	4.000	2.857	2.000	14 711
Firewood mixture [8])	20%	1.0	3.252	2.323	1.626	14 311
Wood residues	10%	1.0	-	-	1.667	16 715

[1]) 1 bulk cubic meter (bcm) = 1 m³ of loosely poured wood
[2]) 1 stere = 1 m³ of stacked wood pieces with a length of about 1.0 m;
[3]) 1 solid cubic meter (scm) = 1 m³ solid wood
[4]) Net (lower) calorific value; conversion to kilowatt hours (kWh): 1 mega joule (MJ) = 0.278 kWh
[5]) Particle size up to 30 mm, values refer to a 50:50 (%) mixture of coniferous and deciduous wood
[6]) Produced from Spruce (coniferous wood)
[7]) Values refer to a 50:50 (%) mixture of coniferous and deciduous wood
[8]) Values refer to a 50:50 (%) mixture of coniferous and deciduous wood

Because non-standardized wood fuels consist of widely inhomogeneous material, no default values can be given. But the net calorific value for this material can be determined individually, depending on the water content, by means of the following formula.

$$NCV_w = (NCV_0 * (100 - w) – 2.447 * w) / 100$$

NCV_w ... net calorific value of wood with the water content *w*
NCV_0 ... net calorific value (19.0 MJ/kg for coniferous wood; 18.0 MJ/kg for deciduous wood) of absolute dry wood (*w* = 0) = GCV
w ... water content (%)
2.447 ... heat of evaporisation for water at 25 °C (in MJ/kg)

Example: wood mixture from hedges (70% deciduous wood, 30% coniferous wood), water content 35%: NCV = ((0.7 * 18 + 0.3 * 19) x (100 - 35) - 2.447 * 35) / 100 = 11.0 MJ/kg

For determining default values for the consumption of wood fuel in households by purpose (space heating, water heating, cooking) comparisons with other MS could be done.

For example, the consumption of firewood in households by purpose (space heating, water heating, cooking) in Austria is shown in Annex 1, Table A1 and A2.

6. Data validation and plausibility checks

The essential characteristics of data validation and plausibility checks for wood fuels on household level are:

- reliable quantities with corresponding units (kg, m^3)
- reliable monetary values for the corresponding fuel quantities and vice versa
- upper limits for fuel quantities and values
- fuel mixture (all fuels used in the household, not only wood fuels)
- end-use categories of all reported fuels (space and water heating, cooking)
- main fuel for space heating and predominantly used heating system
- additional fuels for space heating

Missing data for fuel quantities can be imputed by means of average market prices.

If no values are available, e.g. if used wood fuel is free of charge, or bills got lost, wood fuel quantities can be estimated with default values referring to the consumption per person or per m^2 living space.

7. References

EN 14961-2:2011: Solid biofuels - Fuel specifications and classes - Part 2: Wood pellets for non-industrial use. 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 (see EN 14961-1:2010, Table 1): - 1.1 Forest, plantation and other virgin wood; - 1.2 By-products and residues from wood processing industry; - 1.3 Used wood. NOTE 1: For the avoidance of doubt, demolition wood is not included in the scope of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (EN 14588:2010, 4.52). NOTE 2: Torrefied pellets are not included in the scope of this European Standard. Torrefaction is a mild pre-treatment of biomass at a temperature between 200 °C to 300 °C.

EN 14961-3:2011: Solid biofuels - Fuel specifications and classes - Part 3: Wood briquettes for non-industrial use. 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 (see EN 14961-1:2010, Table 1): - 1.1 Forest, plantation and other virgin wood; - 1.2 By-products and residues from wood processing industry; - 1.3 Used wood. NOTE For the avoidance of doubt, demolition wood is not included in the scope

of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations (EN 14588:2010, 4.52).

EN 14961-4:2011: Solid biofuels - Fuel specifications and classes - Part 4: Wood chips for non-industrial use. 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 (see EN 14961-1:2010, Table 1): - 1.1 Forest, plantation and other virgin wood; - 1.2 By-products and residues from wood processing industry; - 1.3 Used wood. NOTE For the avoidance of doubt, demolition wood is not included in the scope of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (EN 14588:2010, 4.52).

EN 14961-5:2011: Solid biofuels - Fuel specifications and classes - Part 5: Firewood for non-industrial use. 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 (see EN 14961-1:2010, Table 1): - 1.1.1 Whole trees without roots; - 1.2.1 Chemically untreated wood residues; - 1.1.3 Stem wood; - 1.1.4 Logging residues (thick branches, tops, etc.). NOTE For the avoidance of doubt, demolition wood is not included in the scope of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (EN 14588:2010, 4.52).

EN 14588:2010: Solid biofuels - Terminology, definitions and descriptions. This European Standard defines terms concerned in all standardisation work within the scope of CEN/TC 335. According to CEN/TC 335 this European Standard is applicable to solid biofuels originating from the following sources: - products from agriculture and forestry; - vegetable waste from agriculture and forestry; - vegetable waste from the food processing industry; - 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 from construction- and demolition waste; - cork waste; - 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. The embedding of the scope within the biomass/biofuel field is given in Figure 1. NOTE 1: CEN/TC 335 considers 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 [8]. NOTE 2: There are more terms included within this European Standard as covered by the mandate due to clarification and differentiation. NOTE 3 Changes of ownership of the fibrous vegetable waste between paper and pulp company and the operator of the co-incineration plant in which the waste is used does not affect the inclusion of the waste in the scope of mandate M/298. Other standards with a different scope than this European Standard can have different definitions than this standard.

8. Annexes

8.1 Annex 1: Example for data validation procedures (Austria)

Questions with regard to firewood in the household energy consumption survey:

- Type of the main heating system
- Mainly used fuel for space heating
- Type of a possible additional heating system
- Additional fuels for space heating
- End-use categories of the used fuel (yes/no): space heating, water heating, cooking and / or else (the latter only with concern to electricity)
- Amounts: in kilogram, stere or bulk m³ wood fuel
- Monetary values as prices in Euro

Table A1: Default values for the annual fuel consumption for space heating in private households (as of the year 2010)

Fuel	Detached/Semidetached houses			Apartment houses		
	Construction period					
	A	B	C	A	B	C
Firewood (kg/m²)	58.3	41.7	24.4	45.7	33.2	24.1

Source: Statistics Austria. A...till 1960, B...1961 to 1990, C...1991 to 2005

Table A2: Default values for the annual fuel consumption for water heating and cooking in private households (as of the year 2010)

Water heating (all fuels)		4.32	GJ/Person
Cooking (all fuels)	1 person	1.35	GJ
	2 persons	1.71	
	3 persons	1.96	
	4 persons	2.57	
	more than 4 persons	3.18	

Source: Statistics Austria.

Rules applied to complete and validate the reported data (simplified):

- Amounts reported by the households in m³ are converted to kilogram. To give an example, 1 stere (1 m³ stacked) wood pieces with a length of 1 m correspond to an air dry weight of ~430 kg (Table 3).
- Extremely high amounts of firewood are cut using a defined threshold of max. 40 m³ (~17 200 kg) by household.
- If only monetary values are reported, the amount in kg is calculated using a default market price per unit. In case of exceeding the quantity threshold, the amount and the value are cut simultaneously.
- If no end-use category is reported, but the amount is at least as high as the average amount of firewood needed to heat the flat (e.g. ~24.1 kg/m² for a flat in an apartment house with a

construction period from 1991 to 2005; Table A1), firewood is assumed to be used for space heating.

- If firewood is the main fuel used for space heating, and no fuel is reported for water heating, it is assumed that water heating is done with firewood. The same procedure is applied to cooking.
- If neither amounts nor monetary values of firewood but certain types of use are reported, the pair of varieties have to be estimated by using consumption defaults for water heating, cooking and space heating:
  - *Water heating*: the average share on the overall annual energy consumption depends on the number of persons in the household (see table A2) and the number of all fuels used for water heating. As an example, the energy needed for water heating in a household with four persons is 17.28 GJ (=4.32*4) per year. If only firewood is used, you get a corresponding amount of ~1 200 kg (=17.28*1000/14.311) of firewood. If water heating is done with three fuels, e.g. firewood, hard coal and charcoal briquettes, the share of firewood is ~400 kg (=1 200/3).
  - *Cooking*: the average share on the overall annual energy consumption depends on the number of persons in the household and the number of all fuels used for cooking. For four persons, the energetic need for cooking would be ~2.57 GJ per year (Table A1). If only firewood is used, you get a corresponding amount of ~180 kg. If cooking is done with e.g. firewood, hard coal and charcoal briquettes, the share of firewood is ~60 kg.
  - *Space heating*: the share on the overall annual energy consumption depends on the household´s size in m², on whether firewood is the main fuel or not, and on the number of fuels used for space heating. In the simplest case, only firewood is used for space heating. The amount of firewood for space heating is estimated with the average annual amount (e.g. ~24.1 kg/m² for a flat in an apartment house with a construction period from 1991 to 2005; Table A1) needed to heat 1 m². For a household of 90 m², about 2 170 kg (=24.1*90) of firewood would be needed for space heating. If more than one fuel is used, it has to be distinguished between the main fuel, with an assumed share of 70%, and the additional fuels, with an assumed share of 30% in equal parts. For example, firewood is the main fuel beside three additional fuels (e.g. hard coal, lignite and charcoal briquettes). Thus the amount of firewood is reduced to ~1 520 kg (=2 170*0.7) and the amount of the additional fuel results in ~217 kg each (=650/3).

Having computed the shares for water heating, cooking and space heating, these three parts are summed up to the total estimated amount of firewood in one household. As in the example above, a household with 4 persons, 90 m² living space and firewood as the only fuel, need about 3 550 kg (=1 200+180+2 170) firewood for space heating, water heating and cooking.

These examples should give an overview, how to deal with different fuel combinations. The fuel specific average amounts for space heating (developed in collaboration with the Technical University Vienna) are based on the fuels' typical net calorific values and on the energy needs per m², considering different periods within the buildings were constructed. In detail, the calculation of the amount for space heating is more complex, as we take into account estimation for the overall energy consumption of a household and all other reported information.

8.2 Annex 2: Conversion factors

Source: Advised conversion factors for wood based fuels for wood balance and energy balance calculation (2009, available in German only), Austrian Energy Agency (accessed on 20 March 2012), http://www.klimaaktiv.at/article/archive/12740/.

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
scm equivalent (SW & HW mixture)	35%									m³ fill volume
					1.000	0.641	0.417	2.029	7.304	scm
					1.560	1.000	0.650	3.165	11.394	t-air dry
					2.398	1.538	1.000	5.235	18.846	t-abs. dry
					0.493	0.316	0.191	1.000	3.600	MWh
					0.137	0.088	0.053	0.278	1.000	GJ
Chippings G30 (SW & HW mixture)	35%	1.000			0.400	0.256	0.166	0.810	2.917	m³ fill volume
		2.500			1.000	0.641	0.417	2.029	7.304	scm
		3.906			1.560	1.000	0.650	3.165	11.394	t-air dry
		6.024			2.398	1.538	1.000	5.235	18.846	t-abs. dry
		1.235			0.493	0.316	0.191	1.000	3.600	MWh
		0.343			0.137	0.088	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Chippings G50 (SW & HW mixture)	35%	1.000			0.330	0.212	0.138	0.671	2.416	m³ fill volume
		3.030			1.000	0.641	0.417	2.029	7.304	scm
		4.717			1.560	1.000	0.650	3.165	11.394	t-air dry
		7.246			2.398	1.538	1.000	5.235	18.846	t-abs. dry
		1.490			0.493	0.316	0.191	1.000	3.600	MWh
		0.414			0.137	0.088	0.053	0.278	1.000	GJ

Chippings from sawmills (SW & HW with & without bark mixture)	30%	1.000			0.350	0.208	0.146	0.720	2.592	m³ fill volume
		2.857			1.000	0.595	0.417	2.059	7.414	scm
		4.808			1.681	1.000	0.700	3.461	12.460	t-air dry
		6.849			2.398	1.429	1.000	5.235	18.846	t-abs. dry
		1.389			0.486	0.289	0.191	1.000	3.600	MWh
		0.386			0.135	0.080	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Chippings from sawmills (SW & HW with & without bark mixture)	50%	1.000			0.350	0.292	0.146	0.665	2.395	m³ bulk volume
		2.857			1.000	0.833	0.417	2.183	7.859	scm
		3.425			1.200	1.000	0.500	2.278	8.201	t-air dry
		6.849			2.398	2.000	1.000	5.235	18.846	t-abs. dry
		1.504			0.458	0.439	0.191	1.000	3.600	MWh
		0.418			0.127	0.122	0.053	0.278	1.000	GJ

Off-cuts (large) (SW & HW with & without bark mixture)	45%	1.000			0.500	0.379	0.208	0.975	3.511	m³ bulk volume
		2.000			1.000	0.757	0.416	2.178	7.840	scm
		2.639			1.321	1.000	0.550	2.573	9.263	t-air dry
		4.808			2.404	1.818	1.000	5.235	18.846	t-abs. dry
		1.026			0.459	0.389	0.191	1.000	3.600	MWh
		0.285			0.128	0.108	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Off-cuts (small) (SW & HW with & without bark mixture)	40%	1.000			0.600	0.416	0.250	1.194	4.296	m³ bulk volume
		1.667			1.000	0.694	0.416	1.991	7.168	scm
		2.404			1.441	1.000	0.600	2.869	10.328	t-air dry
		4.000			2.404	1.667	1.000	5.235	18.846	t-abs. dry
		0.838			0.502	0.349	0.191	1.000	3.600	MWh
		0.233			0.140	0.097	0.053	0.278	1.000	GJ
Sawdust (SW & HW with & without bark mixture)	10%	1.000			0.330	0.165	0.149	0.766	2.758	m³ bulk volume
		3.030			1.000	0.500	0.450	2.322	8.358	scm
		6.061			2.000	1.000	0.900	4.643	16.715	t-air dry
		6.711			2.222	1.111	1.000	5.235	18.846	t-abs. dry
		1.305			0.431	0.215	0.191	1.000	3.600	MWh
		0.363			0.120	0.060	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Other wood and wood waste (KN 4401 30 90)	10%									m³ bulk volume
					1.000	0.600	0.540	2.827	10.177	scm
					1.667	1.000	0.900	4.643	16.715	t-air dry
					1.852	1.111	1.000	5.235	18.846	t-abs. dry
					0.354	0.215	0.191	1.000	3.600	MWh
					0.098	0.060	0.053	0.278	1.000	GJ
Bark (SW)	50%	1.000			0.300	0.236	0.118	0.543	1.953	m³ bulk volume
		3.333			1.000	0.786	0.393	1.807	6.505	scm
		4.237			1.272	1.000	0.500	2.299	8.276	t-air dry
		8.475			2.545	2.000	1.000	5.278	19.001	t-abs. dry
		1.842			0.553	0.435	0.189	1.000	3.600	MWh
		0.512			0.154	0.121	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Pellets (Spruce)	8%	1.000			1.455	0.652	0.600	3.130	11.269	m³ bulk volume
		0.687			1.000	0.448	0.413	2.151	7.743	scm
		1.534			2.232	1.000	0.920	4.801	17.284	t-air dry
		1.667			2.421	1.087	1.000	5.278	19.000	t-abs. dry
		0.316			0.459	0.206	0.189	1.000	3.600	MWh
		0.088			0.128	0.057	0.053	0.278	1.000	GJ
Briquettes (SW & HW mixture)	8%	1.000			1.541	0.761	0.700	3.624	13.045	m³ bulk volume
		0.649			1.000	0.494	0.455	2.352	8.468	scm
		1.314			2.024	1.000	0.920	4.762	17.142	t-air dry
		1.429			2.198	1.087	1.000	5.235	18.846	t-abs. dry
		0.273			0.420	0.208	0.191	1.000	3.600	MWh
		0.077			0.117	0.058	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Hardwood mixture (Deciduous wood)	20%	1.000	0.588	0.714	0.500	0.365	0.292	1.410	5.078	m³ bulk volume
		1.700	1.000	1.214	0.850	0.621	0.497	2.400	8.639	stere (25-30 cm)
		1.400	0.824	1.000	0.700	0.511	0.409	1.975	7.109	stere (1m)
		2.000	1.176	1.429	1.000	0.730	0.584	2.821	10.155	scm
		2.740	1.610	1.957	1.370	1.000	0.800	3.864	13.911	t-air dry
		3.425	2.012	2.445	1.712	1.250	1.000	5.000	18.000	t-abs. dry
		0.685	0.402	0.489	0.342	0.250	0.200	1.000	3.600	MWh
		0.190	0.112	0.136	0.095	0.069	0.056	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Softwood mixture (Coniferous wood)	20%	1.000	0.588	0.714	0.500	0.250	0.200	1.022	3.678	m³ bulk volume
		1.700	1.000	1.214	0.850	0.425	0.340	1.737	6.252	stere (25-30 cm)
		1.400	0.824	1.000	0.700	0.350	0.280	1.430	5.149	stere (1m)
		2.000	1.176	1.429	1.000	0.500	0.400	2.043	7.356	scm
		4.000	2.353	2.857	2.000	1.000	0.800	4.086	14.711	t-air dry
		5.000	2.941	3.571	2.500	1.250	1.000	5.278	19.000	t-abs. dry
		0.947	0.557	0.677	0.474	0.237	0.189	1.000	3.600	MWh
		0.263	0.155	0.188	0.132	0.066	0.053	0.278	1.000	GJ

Assortment	Water content (%)	bulk volume m³	stere (30 cm pieces)	stere (1 m pieces)	scm	t-air dry matter	t-abs. dry matter	CV (MWh)	CV (GJ)	by
Firewood (SW & HW mixture)	20%	1.000	0.588	0.714	0.500	0.308	0.246	1.224	4.408	m³ bulk volume
		1.700	1.000	1.214	0.850	0.523	0.419	2.079	7.485	stere (25-30 cm)
		1.400	0.824	1.000	0.700	0.431	0.345	1.713	6.168	stere (1m)
		2.000	1.176	1.429	1.000	0.615	0.492	2.445	8.801	scm
		3.252	1.912	2.323	1.626	1.000	0.800	3.975	14.311	t-air dry
		4.065	2.389	2.903	2.033	1.250	1.000	5.139	18.500	t-abs. dry
		0.791	0.465	0.565	0.396	0.243	0.195	1.000	3.600	MWh
		0.220	0.129	0.157	0.110	0.068	0.054	0.278	1.000	GJ

8.3 Annex 3. Example for a standard documentation (Austria)

Standard documentation
Meta information

(Definitions, explanations, methods, quality)

on

Wood fuel consumption in households

This documentation is valid as of the reporting period:

< Reporting period >

Status: **<TT.MM.JJJJ>**

Organizational unit

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2.1.11 Classifications used

2.1.12 Regional breakdown of the results

2.2 Production of statistics, processing, quality assurance measures

2.2.1 Data capture

2.2.2 Coding

2.2.3 Editing and verification of data sources used

2.2.4 Imputation (where responses are missing or data incomplete)

2.2.5 Grossing up procedures (weighting)

2.2.6 Compilation of the final data set, (other) models and statistical estimation techniques used

2.2.7 Other quality assurance measures

2.3 Publication (accessibility)

2.3.1 Preliminary results

2.3.2 Final results

2.3.3 Revisions

2.3.4 Publication media

2.3.5 Treatment of confidential data

3. Quality

3.1 Relevance

3.2 Accuracy

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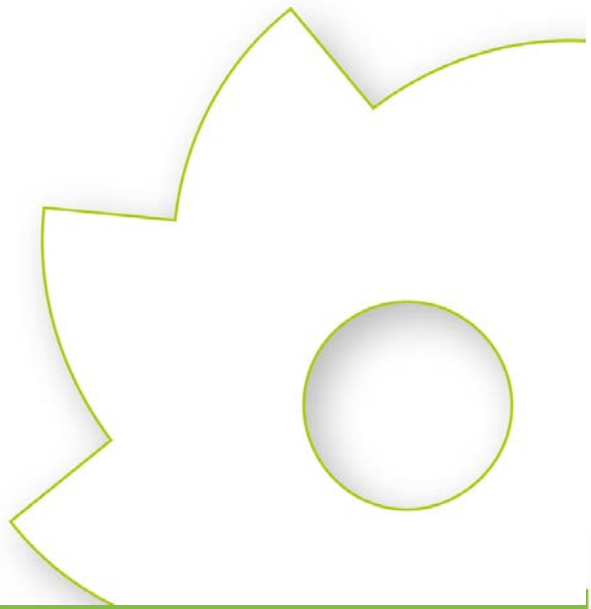
For further information please visit www.ca-res.eu



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