

Biomass Statistics: Wood waste

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Prepared for Danish Energy Agency by Ea Energy Analyses

Objective

Figures for wood waste consumption for energy in the national Danish Energy Statistics are based on several sources and calculated based on several not easily available assumptions. The purpose of this document is to make publicly available the background for the figures used in the period 1972 to 2016.

The document was prepared for Danish Energy Agency (DEA) by FORCE Technology, Mr. Anders Evald in 2013 and updated in 2017 by Mr. Morten Tony Hansen, Ea Energy Analyses.

Definitions

Wood waste

Wood waste consists of wood residues of industrial origin. It could be bark, industrial wood chips, low quality industrial wood, shavings, sawdust, etc. Products from forestry (forest wood chips, round wood for energy, firewood) are not included - these are handled as separate fuel categories, either wood chips or firewood) in the national energy statistics. Wood waste that is returned to a waste handling facility e.g. demolition wood, used furniture etc. and wood waste containing contaminants like glue, paint or preservatives is not included as these fractions must be treated like industrial waste and handled in waste handling facilities. Such wood waste fractions may be used for energy, however in the national energy statistics they will occur as heat or power from waste incineration facilities.

Classification problems

Figures for wood waste consumption origin from the main source, the "Energiproducenttællingen". Wood waste appear as a sub category of wood and biomass wastes which in 2016 consisted of "other solid biomass" (76%), "wood waste" (15%) and "grain waste" (9%). Data from "Energiproducenttællingen", are generally reliable; however, some uncertainty is introduced due to problems with classification of the fuel. Some biomass plants use forest wood chips, which they in the annual questionnaire classify as wood waste. And the other way around, the energy producers may mark bark or wood waste as forest wood chips.

Further classification problems arise from the increasing use of uncontaminated biomass from other sources, than the five presently used in the national energy statistics, straw, firewood, wood chips, wood pellets and wood waste. Examples of such biomass are grass, olive residues, food industry residues, willow chips, milled garden waste, palm kernel shells etc. As a general principle it is recommended, that such biomass be accounted for in the category closest to the product: grass as straw, willow chips as wood chips etc. By nature, wood waste is the most open category making it the logical place for a rather long list of hard-to define solid biomass fuels.

Unit of measurement: 1 m³ loose volume (lv) wood waste

A cubic meter loose volume refers to the content of a cubicle of 1 m³ containing wood fuel. In contrast to solid volume, loose volume accounts for solid wood as well as the air between the wood particles.

Some historical data are given in this unit; today all data are in metric ton.

Calorific values

Presently used calorific values

In 1992, Evald argued to use a calorific value of 14.7 GJ/ton as an average for all waste wood based on data in ton. At that stage one user, who used app. 40% of the national consumption of wood waste, used relative wet wood while the rest of the market was relatively dry. An average of 20 % was suggested, which lead to a heating value of 14.7 GJ/ton, based on a net calorific value of 19.0 GJ/ton dry matter and the following calculation:

$$19.0 \text{ GJ/ton} \cdot 0.80 - 2.45 \text{ GJ/ton} \cdot 0.20 = 14.7 \text{ GJ/ton}$$

This figure has since then been applied back in history to **1972** and has been used for the whole period to **2016** for all consumption categories.

No data exist to more accurately determine the average moisture in wood waste used for energy purposes. As the moisture content has significant influence on the calorific value as illustrated in the above formula, this results in uncertainty in the resulting calculations of wood waste contribution to the national energy supply.

Earlier used calorific values

Up to **1993** a value of 2.8 GJ/m³ (lv) was used to determine the energy content in bark and 3.2 GJ/m³ (lv) was used for waste wood in general.

Figures for consumption

Sectors

Single family houses

It is assumed, that individual consumers in private households do not use wood waste for energy. Any use of fuel wood from industrial origin in private homes, farms, and estates and similar is included in the figures for firewood consumption, described in detail in a separate note.

Agriculture and forestry

Similarly, there are no data available for the consumption of wood waste in boilers in farms and forestry estates. Nevertheless, in the 4 years **1998** to **2001** a very small consumption of 0.180 TJ, 1.026 TJ, 0.079 TJ and 0.164 TJ respectively is recorded in the official data series. The origin of this data is the annual heat survey "Fjernvarmetællingen" and the annual electricity and heat survey "Energiproducenttællingen" (fuels for heat not sold).

Horticulture (greenhouses)

Wood waste used for heating in greenhouses is included from **1984** to **2016** based on data from Statistics Denmark annual agricultural statistics. In some years in the period, no new data has been available, in which case the figure from the previous year has been used. This is also the case for most recent years, **2011** to **2016**, where the 2010-figure is used.

The figures are collected from a questionnaire, and given in tons, for a fuel characterised as "Fuel wood, wood waste, straw and similar solid fuels". In the energy statistics it is all assumed as wood waste. Figures are calculated to TJ using the standard calorific value of 14.7 GJ/ton.

Public service (public institutions)

There is no data available on institutions (schools, public buildings etc.) using wood waste for energy. Any minor consumption of bark or other wood waste can be considered included in the figures for wood chips consumption.

Private service

A very small consumption of wood waste for private service is registered in the period **1998** to **2003** and from **2007** to **2016**. This is a result of "Energiproducenttælling", where one or a few enterprises report heat sales marginally lower than heat production on wood waste.

District heating plants

The consumption of wood waste in district heating plants for the period **1986** to **1992** was estimated by Skovteknisk Institut and later by Centre for Biomass Technology based on a list of district heating plants in operation in this period. Wood waste consumption was divided between bark and waste wood. After 1992 there have been no distinction between these two fuels types, and in the official statistics the figures have been merged. The figures behind the current statistics are the following:

	1986	1987	1988	1989	1990	1991	1992
Bark in district heating, m ³ (lv)	76 500	76 500	76 500	100 000	100 000	100 000	100 000
Heating value bark, GJ/ m ³ (lv)	2.80	2.80	2.80	2.80	2,80	2.80	2.80
Other wood waste in district heating, m ³ (lv)	21 000	21 000	21 000	21 000	21 000	21 000	30 000
Heating value, other wood waste, GJ/ m ³ (lv)	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Total, TJ	281.2	281.2	281.2	347.2	347.2	347.2	376.0

In 1993, an attempt was made to make these figures cover more precisely the period before 1986, when the district heating plants started using bark and wood waste in the beginning of the 1980'ies. The following table was created, showing the best estimate for wood waste consumption in district heating plants in **1981 to 1992**.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Bark in district heating	9 000	18 000	36 000	63 000	73 000	76 500	76 500	76 500	100 000	100 000	100 000	100 000
Heating value bark	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2,80	2.80	2.80
Other wood waste, dist.. heat.	10 000	10 000	21 000	21 000	21 000	21 000	21 000	21 000	21 000	21 000	21 000	30 000
Heating value, other w.w.	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Total, TJ	57.2	82.4	168.0	243.6	271.6	281.2	281.2	281.2	347.2	347.2	347.2	376.0

However, the figures for 1981 to 1985 were never entered the national statistics tables.

The figure from **1993** was determined in "Fjernvarmetællingen" and from **1994 to 2016** the Danish Energy Agency collected the data in "Energiproducenttællingen".

Autoproducers, heat only

In the time series consumption of wood waste appear in the category autoproducers, heat only. For the period **1972 to 1993** the origin of these data is not documented, however the data is most likely an estimate of wood industries sales of district heating hot water. From **1994 to 2016** a similar figure originates from "Energiproducenttællingen", i.e. wood industries selling district heating to a public district heating network.

Small scale and large scale CHP

Wood waste used for combined heat and power production, CHP, is registered from **1993** in decentralised (small scale) plants and from **1994** also in centralised (large scale) CHP plants. The figures originate from the "Fjernvarmetællingen" in 1993, and from 1994 from the Energiproducenttælling. The consumption is divided into fuels for heat production and fuels for power production using DEA allocation procedures.

Manufacturing industry

The largest sector for wood waste consumption for energy is in the industry sector, mainly wood industry.

The statistical data originates from the Industritællingen, performed by Statistics Denmark every second year, where the total consumption of wood waste for energy in industry is determined through a questionnaire survey sent to all businesses with more than 20 employees. Industritællingen was first carried out in **1980** and the figures before 1980 are estimated. As Industritællingen in periods is only carried out every 2nd or 3rd year, the annual consumption in the years in between has been estimated. This estimation is done by Statistics Denmark. Newer figures have in some years been calculated using an increment on older figures due to a time lack in delivery of data from Statistics Denmark. The time series for industrial consumption of wood waste was changed in 2001 back to 1972 due to methodological changes in Statistics Denmark.

Wood waste recorded in "Energiproducenttællingen" for heat and power production is deducted and the remainder is allocated as industrial energy use of wood waste. The statistical department of the Danish Energy Agency handles the data from the two sources, including division between heat, electricity and process heat, and including division between energy services used on the industry and services sold out of the industry as district heating, electricity or steam.

Autoproducers, CHP

Two Danish wood industries produce electricity. The power produced is mostly sold to the utility net and is listed in the time series under electricity production from private CHP. Some of the heat is sold to district heating networks, but most of the heat is used at the industry itself for heating and for process heat.

The allocation method used for allocating between heat and electricity was changed in the **1999** statistics. Until the energy statistic of **1998**, the benefit of combined heat and power production was divided equally between heat and electricity for the decentralised power plants, whereas at the large power plants the benefit was given to heat production. From the energy statistics for 1999 the same procedure is used for decentralised plants as for centralised plants where the benefit is given to the heat production. In the case where it is an industrial producer, this part could then be further divided between process heat and heat sold to the district heating system. It means that the fuel consumption for electricity is increased compared to the former statistics and the fuel consumption for heat is reduced. The new allocation principle is applied back to **1972**.

Domestic production versus imports

It is assumed that the annual domestic production of wood waste in wood industry is equal to the annual consumption. No imports or exports of wood waste are assumed in the statistics. It is clear, that as wood originates from a variety of sources before it becomes a wood waste fuel, a fraction of the wood waste used for energy in Denmark will by nature originate from imported wood.

In the last few years, export of wood waste is known to take place to e.g. Germany and Sweden. This export is not registered in the energy statistics.

Recent updates on estimation of consumption and import

In recent years the DEA has requested estimates of the development in the consumption and import of wood waste for energy purposes in sectors outside the supply sector, i.e. outside "Energiproducenttællingen". FORCE Technology and subsequently Ea Energy Analyses has assisted the DEA in assessing the development. In practice the assessment is based on a small survey where key market players within fuel supply, consultancy, large consumers in industry, plant manufacturers, boiler suppliers and authorities (subsidy schemes for conversion to biomass) are interviewed by telephone about the recent development. Results are gathered in a short report for the DEA.

The development in consumption data is then based on the consumption in the previous year adjusted with the new developments and adjusted for climatic variations in the relevant sectors.

While export of wood waste to Germany and Sweden has now become common, this export is still not reflected in the energy statistics.

Time series

Time series for wood waste consumption in energy units from **1972/1975** are available from DEA web site:

- Danish version: [Årlig energistatistik](#)
- English version: [Annual Energy Statistics](#)

Data is published in Excel spreadsheets.

Recommendations

1. The heating value could be further evaluated and determined more precisely. This would involve enquiring with a number of important dealers and end-users
2. The economy and extent of the ongoing export of wood waste should be studied
3. Changes to consumption figures for district heating in **1981 to 1985** proposed in 1993 (see table above) should be entered into the statistics
4. The small consumption registered in agriculture and forestry in 1998 to 2001 should be verified or corrected.

References and sources

Danish Energy Agency

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Publications

Evald, 1992

Anders Evald, Notat vedr. forbrug af halm og træ 1991, Centre for Biomass Technology 11. June 1992

Landbrugsstatistik

Landbrugsstatistik (Agricultural Statistics), Danmarks Statistik (Statistics Denmark), issued annually.

Industritællingen (survey on energy consumption in industry)

Survey performed every 2 or 3 years by Danmarks Statistik. Gives figures for energy consumption in industry divided into fuel categories.

Fjernvarmetællingen (the annual heat survey)

An annual survey performed by DEA based on a questionnaire, where all commercial heat producers gives energy related information and data, most important data on fuel consumption and heat production. Fjernvarmetællingen was initiated in 1989 and in 1994 followed by Energiproducenttællingen.

Energiproducenttællingen (the annual electricity and heat survey)

An annual survey performed by DEA based on a questionnaire, where all commercial energy producers deliver energy related data, most important data on fuel consumption, production of heat and electricity.

Energiproducenttællingen was initiated in 1994.