

# **Biomass Statistics: Wood pellets**

**Update: 5th edition, October 2011**

**Prepared for Danish Energy Agency by FORCE Technology**

## **Objective**

Figures for wood pellets consumption, import and production in the national Danish energy statistics are based on many different sources and calculated based on several not easily available as-

sumptions. The purpose of this document is to make publicly available the background for the figures used in the period 1986 to 2010.

The document was prepared for Danish Energy Agency by FORCE Technology, Mr. Anders Evald.

## **Definitions**

### **Wood pellets**

Pellets made from shavings, sawdust etc. from production of wooden products or from virgin wood, which dried milled and milled before pelletizing. The size is usually 8-10 mm diameter. The wood fibres are uncontaminated; a national Danish regulation determines the distinction between uncontaminated wood fuels and waste.

Pellets made from straw are generally included in the energy statistics fuel category straw.

Pellets made from waste e.g. MSW is not included in the definition. However, as it is difficult to determine the origin of a specific supply of pellets, it is possible that some data-sources include smaller fractions of pellets made from other materials than uncontaminated wood fibres (straw, MSW etc.) in figures and estimates.

### **Unit of measurement**

1 metric tonnesne equivalent to 1000 kg is the basic unit used for trade and measure the mass of wood pellets.

### **Calorific value**

$$19.0 \cdot 0.93 - 2.45 \cdot 0.07 = 17.5 \text{ GJ/tonnesne}$$

The figure 17.5 GJ/tonnesne wood pellets covers the markets average in terms of water content and dry matter heating value. The figure has been used continuously in the energy statistics since **1986**.

The net calorific value of wood pellets is based on an average net value for wood of 19.0 GJ/tonnesne dry matter. This figure is based on a number of laboratory determinations of heating values for uncontaminated wood samples.

The water content of the pellets is determined in different studies to be between 6 % and 8 %.

Thus a heating value of 17.5 GJ/tonnesne based on 7 % water content has been calculated using the formula:

## Figures for consumption

### General remarks on methodology

No consumption of wood pellets in the energy sector is recorded before **1986**. A minor consumption may have taken place before this time, however this is neglected as wood pellet production and use in Denmark generally began in the late 1980'es initiated by the steeply increasing prices of coal for district heating.

In the period before 2001 various rather uncertain methods were used to estimate the consumption in the different consumption categories. After 2001 new data became available based on comprehensive surveys introduced in 2002, and performed so far for the years 2001, 2004, 2006, 2008 and 2010. Historical data for a few previous years (1999 and 2000) were adjusted. For completeness this document includes the methodologies used both before and after these corrections.

### Single family houses and public service

These two consumption categories include fuel use in private households and in larger units in public institutions like schools, sports compounds, other large buildings etc. In early years these two categories were estimated together.

The consumption of wood pellets outside the district heating sector and power utility sector was determined to 312 tonnes in **1986** by Skovteknisk Institut. The figure was based on wood pellet consumption at three known schools. Before that time there was no indication of wood pellets used in private households or schools. It was later estimated that two-third of the estimated consumption outside the district heating and power sector was in private households, thus the 312 tonnes were divided into 104 tonnes in public service and 208 tonnes in single family houses.

The following two years **1987** and **1988** no additional information on wood pellet use outside the heat and power sectors were collected and the consumption figures remains the same.

For **1989** Danish Energy Agency (DEA) and Centre for Biomass Technology (CBT) together estimated that the wood pellets consumption in this sector was 3 000 tonness. Two-third was estimated to be in individual energy systems, and this relationship was introduced for the previous years also.

For **1990** the market leader in wood pellets, the company HP-Briquettes, gave an estimate. The total consumption in Denmark was estimated at approximately 100 000 tonnes and it was further estimated that 90 % of this was used in the heat and power sector and thus 10 % or 10 000 tonness was used outside the power sector. This figure was used in the following three years **1991-1993**, as there were no figures available to indicate the market was growing. The division between private household systems and public service systems in two thirds and one third was continued in this period based on the previous estimate.

For **1994** the consumption was estimated by increasing the 1993 figure with 2 000 tonnes to 12 000 tonnes, again divided 2:1. This estimate was made in co-operation by DEA and CBT based on evaluation of market development for small-scale boiler systems.

From **1995** a similar but more accurate method was used. From this year installation of small-scale wood pellet boilers received public financial support from DEA. The figure in this and in the following years is based on the consumption estimated for 1994 added the annual growth in consumption in new units installed thereafter. The number of new units is determined from number of systems that

received investment support from the DEA with the addition of an estimated 100 % more units established without public support.

The specific consumption is estimated to be 6 tonnes in private installations and 50 tonnes in larger units in schools, institutions and larger buildings. It was estimated for 1995 that 10% of the units were installed by institutions and 90% were installed in private households.

Number of subsidised installations in 1995 were 325, thus the increase in consumption in private households were determined:

$$325 \cdot 6 \text{ tonnes} \cdot 0.90 \cdot 200\% = 3\,510 \text{ tonnes}$$

and in public service buildings (schools etc.)

$$325 \cdot 50 \text{ tonnes} \cdot 0.10 \cdot 200\% = 3\,250 \text{ tonnes}$$

Added to the previous year, private households totals

$$8\,000 \text{ tonnes} + 3\,510 \text{ tonnes} = 11\,510 \text{ tonnes}$$

and public service buildings

$$4\,000 \text{ tonnes} + 3\,250 \text{ tonnes} = 7\,250 \text{ tonnes}$$

For **1996** it was estimated that on top of the number of installations receiving subsidy (1344) only 50% more units were installed. Again an examination of the individual support grants showed that app. 10% of the installations were made by institutions and 90% were installed in private households.

The same method was applied for **1997**, **1998** and **1999**, where the number of support grants was 1005, 949 and 1131 respectively. In these 3 years it was estimated that on top of the number of installations receiving subsidy only 25% more units were installed without receiving subsidy, and a further examination of grants given revealed, that only 2% were large installations (schools etc.) and 98% were private households. In **2000** the increment was calculated to 18 487 tonnes in single family houses, and 3 144 in public service buildings. The increments were calculated by DEA based on the same method as were used in 1997 to 1999. In **2001** the increment was not calculated but estimated to be the same as from 1999 to 2000.

	Single family houses			Public service		
	1994 base	Increment	Total	1994 base	Increment	Total
1994	8 000	0	8 000	4 000	0	4 000
1995	8 000	3 510	11 510	4 000	3 250	7 250
1996	8 000	10 886	22 396	4 000	10 080	17 330
1997	8 000	7 387	29 783	4 000	1 256	18 586
1998	8 000	6 975	36 758	4 000	1 186	19 772
1999	8 000	8 313	45 071	4 000	1 414	21 186
2000	8 000	18 487	63 558	4 000	3 144	24 330
2001	8 000	18 487	82 045	4 000	3 144	27 474

*Table 1: Method and data in tonnes for wood pellet consumption in single family houses and public service 1994 to 2001. Data for 1999, 2000 and 2001 were later adjusted after the Træpillemarkedet 2001 survey was published*

The figures for this market segment grew rapidly during the late 1990'ies, which lead to an increasing uncertainty on the actual consumption. As it was recognised that the method used gave only a rough estimate, a complete market survey (Træpillemarkedet 2001) was initiated in 2002. Based on a questionnaire sent to all importers, manufacturers and dealers of wood pellets in Denmark, a complete overview of the market in 2001 was established. The main result was that the previously estimated total consumption was underestimated by about 180 000 tonnes.

The official version of the 2001 energy statistics were printed before the results of the survey was finished. Figures for year **2001** and also **1999** and **2000** were later changed in the official time-series, not only for the consumption categories single family houses and public service but also for most other categories and for the import/domestic division.

For **2001** the survey states the consumption in single family houses at 222 658 tonnes and in public service at 29 333 tonnes. These figures are a result of a correction according to Table 2 after revised information from one of the market leaders given in 2005.

In Træpillemarkedet 2004 the figures for consumption in the two categories along with industry needed adjustment to compensate for an unlikely fall in the consumption in public service buildings. Public service buildings were adjusted to reflect the same rate of increase as seen in the industry sector, and consumption in single family houses were adjusted down to keep the total of the three sector unchanged.

	<b>Original 2001 data tonnes</b>	<b>Corrected 2001 data tonnes</b>	<b>Original 2004 data tonnes</b>	<b>Corrected 2004 data tonnes</b>
Single family houses	203 500	222 658	313 606	295 173
Public service	48 491	29 333	12 127	30 560
Industry	41 299	41 299	43 026	43 026
Total, 3 sectors	293 291	293 291	368 759	368 759

*Table 2 Corrections made to original data from Træpillemarkedet 2001 and Træpillemarkedet 2004*

The comprehensive market studies have given all market information outside the Energiproducenttællingen (an annual survey on electricity and heat) from **2001** to **2010**. The survey has been performed for the calendar years 2001, 2004, 2006, 2008 and 2010.

The basic methodology in these studies is first a determination of the total wood pellets supply through an (almost) complete data collection from manufacturers and importers of wood pellets. Second the total supply to single family houses, public buildings and manufacturers is determined as total supply minus consumption in larger systems as determined in the Energiproducenttællingen. Last the remaining consumption is divided among the 3 smaller consumption categories. Further details on the methodology are given in Træpillemarkedet 2010 (\_The Wood pellets market 2010).

Consumption data for the years between the comprehensive wood pellet market studies are established either from interpolation or by rough estimates on general market development based on telephone interviews with wood pellet market leaders.

### **Manufacturing industry**

The figures for consumption of wood pellets in industries originate from the Energiproducenttællingen covering in the period **1994** to **1998**. Only industries who either sell heat or electricity take part in this annual survey. The consumption for heating of industrial buildings or processes from wood pellet fired boilers within the industry premises was not included.

From **1999** to **2010** the total consumption of wood pellets in manufacturing industry was established from data in the 5 surveys Træpillemarkedet 2001 to Træpillemarkedet 2010 (previous, intermediate and following years estimated or interpolated).

### **District heating plants**

Up until the late 1990'ies the majority of the consumption of wood pellets took place in the heat and power sectors, especially in district heating systems. It was initially estimated that the consumption in **1986** was 2000 tonnes, which was the first year consumption of wood pellets was accounted for. Estimates for **1987** to **1990** were based on CBT market knowledge. From **1991** the figure originates from Fjernvarmetællingen and from **1994** Energiproducenttællingen. These figures are collected from an annual questionnaire survey where the energy producers specify their annual fuel consumption, including consumption of biomass fuels.

A minor fraction of the wood pellets used in the district heating sector is consumed by autoproducers (companies such as industries, who sell heat as district heating from biomass fuels, but to whom en-

ergy production is only a side business). These figures are also based on the annual heat survey "Fjernvarmetællingen" and later the annual electricity and heat survey "Energiproducenttællingen".

For the year **2001** the total consumption in district heating and CHP plants according to the official statistics is 113 806 tonnes. In Træpillemarkedet 2001 (the wood pellets market 2001) this figure is stated as 108 000 tonnes, which indicates, that an error in the order of 6 000 tonnes (0.1 PJ) is present in the total for this year. Similar deviation in the order 10-12,000 tonnes is observed from the official DEA statistics to the market survey report for 2004, 2006, 2008 and 2010. The reason is that the four market study reports are based on preliminary data from "Energiproducenttællingen", which leads to deviations, when small corrections are made at a later version of the survey.

### **Small scale CHP**

The figures for wood pellets used for production of heat and power in smaller combined heat and power plants (CHP) originate from Fjernvarmetællingen for the **1993** figure and from Energiproducenttællingen from **1994** to **2010**.

The consumption is divided into pellets used for heat and pellets used for power based on DEA allocation procedures.

During production of the 1999 statistics, new revised figures were introduced for the consumption in this sector in the period 1992 to 1999, introducing a consumption in **1992**, and changing as well the consumption in the sector as the distribution between heat and power for the years **1993** to **1998**.

### **Large scale CHP**

Figures for wood pellets used for production of heat and power in larger combined heat and power plants (CHP) are based on Energiproducenttællingen for **1998** to **2010**.

During production of the 1999 statistics, wood pellet consumption was introduced for this sector for the year **1998**, based on "Energiproducenttællingen". The figures for 1998 are in the 1999 statistics, but not in the 1998 edition.

The consumption is divided into pellets used for heat and pellets used for power based on DEA's internal allocation procedures.

## **Annual production and import**

### **Domestic production**

Wood pellets in Denmark is mainly made from wood waste from the Danish furniture industry, a minor but increasing fraction is made by other wood sources i.e. wet wood resources from forestry or wood industry. The amount of domestic produced pellets from dry material is limited by access to shavings and sawdust from this industry. Estimates vary, but currently 50 000 to 100 000 tonnes of dry raw material is probably available within Denmark.

The domestic production is determined in Træpillemarkedet 2010 (the Danish wood pellets market 2010) and the similar earlier studies through questionnaires and telephone interviews with all known pellet manufacturers in Denmark.

## **Import**

The increasing international collaboration in the energy sector, the liberalisation of the energy sector, the potential large biomass resources in other countries and deficit in the domestic resource base for wood pellets result in an increasing amount of wood pellets being imported.

An early estimate on the order of magnitude of the import was made by CBT in 1999 on the amount of imported pellets in the year **1998**. The estimate was based on information, to some extent contradicting, from Danish large wood pellet suppliers. The estimate was that app. 25% of the consumption in 1998 was imported.

Thus the import was calculated from the consumption as:

$$3\,227 \text{ TJ} \cdot 25\% = 807 \text{ TJ}$$

To avoid imports to show as a suddenly occurring event in the statistics, import was calculated in 1999 for the previous years **1994 to 1997** as an increasing percentage of the total wood pellet consumption (1993: 0 %, 1994: 5 %, 1995: 10 %, 1996: 18 %, 1997: 21 %, 1998: 25 %).

For **1999 to 2001** an import percentage of 25 %, 35 % and 35 % were used until 2003, when better data became available from the Træpillemarkedet 2001 survey. Data for **1999 to 2010** import are now based on the 2001, 2004, 2006, 2008 and 2010 surveys, with previous, intermediate and following years estimated or interpolated.

## **Time series**

Time series for wood pellet in energy units year by year for the period **1972 to 2010** are available from DEA's web site.

Danish version [Årlig energistatistik](#)

English version [Annual Energy Statistics](#).

## **Recommendations**

1. The exact procedure for estimation of figures in the time series for intermediate years 1999, 2000, 2002, 2003, 2005, 2007 and 2009 based on the 2001, 2004, 2006, 2008 and 2010 surveys should be documented in more detail.
2. The likely error in the 2001 recorded total wood pellets consumption should be investigated in detail.
3. A very small registration of 0.097 TJ wood pellets in private CHP plants in 2001 leads to a statistical difference of the same size this year. This small error should be cleaned out.

## **References and sources**

### **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.

### **Træpillemarkedet 2001 (The Danish wood pellet market 2001)**

Survey based on a questionnaire sent to the complete list of importer, manufacturers and dealers of wood pellets in Denmark. The figures given divide the market in pellet origin (import, domestic production, export) and market segments. dk-TEKNIK and Danish Energy Agency, 2003.

### **Træpillemarkedet 2004 (The Danish wood pellet market 2004)**

Survey based on a questionnaire sent to the complete list of importer, manufacturers and dealers of wood pellets in Denmark. The figures given divide the market in pellet origin (import, domestic production, export) and market segments. FORCE Technology and Danish Energy Agency, 2005.

### **Træpillemarkedet 2006 (The Danish wood pellet market 2006)**

Survey based on a questionnaire sent to the complete list of importer, manufacturers and dealers of wood pellets in Denmark. The figures given divide the market in pellet origin (import, domestic production, export) and market segments. FORCE Technology and Danish Energy Agency, 2007.

### **Træpillemarkedet 2008 (The Danish wood pellet market 2008)**

Survey based on a questionnaire sent to the complete list of importer, manufacturers and dealers of wood pellets in Denmark. The figures given divide the market in pellet origin (import, domestic production, export) and market segments. FORCE Technology and Danish Energy Agency, 2009.

### **Træpillemarkedet 2010 (The Danish wood pellet market 2010)**

Survey based on a questionnaire sent to the complete list of importer, manufacturers and dealers of wood pellets in Denmark. The figures given divide the market in pellet origin (import, domestic production, export) and market segments. FORCE Technology and Danish Energy Agency, 2011.

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5th edition, October 2011