Association européenne pour la Biomasse
European Biomass Association
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Report to project **Key Issues for Renewable Heat in Europe - K4RES-H**

Targets for heat from biomass

WP 4.2. Quantifying energy delivery from individual bioheat installations corresponding to deliverables 8 and 9 of the project

Note for this report

This report aims at completing WP 4.2. Deliverable 7 was realised on the measurements methods. This report deals with the calculation method when measurement is not realised or does not make sense due to the small size of the unit for example. Insights on Germany, Italy and Sweden are given in a second part.

Calculation principles for bioheat

Fixing objectives is a key point but bioenergy and bioheat in particular should also be measurable so that a monitoring can be undertaken. Solutions have to be found because :

- Renewable heat does not appear in Eurostat
- Biomass and waste are sometimes mixed together in a single number
- Traditional biomass used as wood logs in stove is still representing a significant part of the bioheat with calculation procedure rather than measurement

The statistics should take into account the guidelines that will be given to the MS for their national biomass action plans. If we take the example above the following items should appear :

Biomass for heat	→	Bioheat
Biomass for cogeneration	→	Bioheat and bioelectricity
Biomass for electricity	→	Bioelectricity
Biomass for transportation biofuels	→	Transportation biofuels

However for "biomass for heat only applications" a large variation of efficiency exists between technologies starting from open fires (round 10 % efficiency), stoves (40-50%) and automatic boilers (80-90%). Therefore it is proposed to further categorize biomass for heat for example in two items :

1. small scale units for individual households
2. medium- and large scale units for several households or industrial sector

Calculation principles

Whenever possible statistics have to be based on measurements. Such data are generally available when heat is sold and for large scale. But often the biomass for heat and the bioheat are not measured, especially in the case of small scale applications. In this case a calculation methodology is needed. The following equations are proposed for discussion.

Small scale systems

Small scale systems are stoves and boilers (automatic or not) that can use several types of biofuels (logs, chips, pellets).

Two approaches can be used and compared :

a. Based on fuel

amount of biomass for heat (kg) x lower heating value - LHV (kWh/kg) x conversion efficiency (%) = bioheat (kWh)

This approach will be particularly efficient for certain types of biofuels like pellets for which the quantity of biomass is measurable because it is sold (production level or capacity of pellets production units, import/ exports, etc.).

LHV and conversion efficiency can be approximate on the base of studies and test in laboratories. However it should be noted that figures representing real life conditions should be used and not optimal efficiency of the boilers for example. It would also be possible to launch test in real conditions on a significant number of families (100 for example) that will monitor and measure precisely the amount of wood they are using during a winter season. The results will then be used to extrapolate the results to a certain region.

b. Based on use

number of units (n) x installed capacity (kW) x hours (h) x load factor (%) = biomass for heat (kWh)

biomass for heat (kWh) x conversion efficiency (%) = bioheat (kWh)

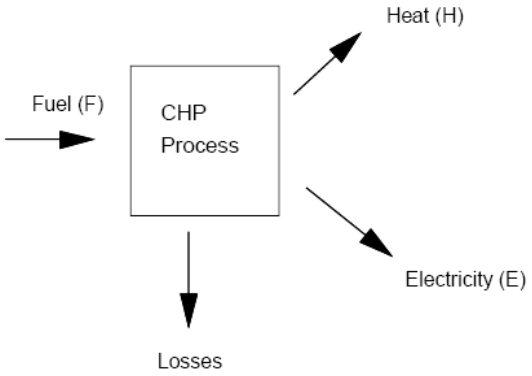
In this approach we need to know the number of units. This should be done through survey and energy questionnaires. However such questionnaire cannot be too detailed and some factors of the equation have to be evaluated like capacity, hours and load factor. This latter factor takes into account the fact that a system does not work always at full capacity. Another approach is to take theoretic hours of full capacity operations. These factors are also depending on regions, climate and year

In addition technologies have to be classified and the calculation carried out for each class. Traditional stoves as additional heating systems have totally different running hours and efficiencies as compared to automatic pellets boilers.

Cogeneration

If the targets do not foresee a specific objective for biomass for cogeneration but only biomass for heat and biomass for electricity, then a special calculation method has to be used to allocate a certain amount of the biomass for heat and for electricity. The EUROSTAT methodology foresees to share the fuel for cogeneration applications according to the proportion of heat and electricity according to a simple principle (see Figure 1) using the formula : Fuel for heat = F * (H/ (H+E))

Figure 1 : Methodology for apportioning fuel input in a CHP plant[1]



For cogeneration units waste heat should ideally be taken into account. When cogeneration units are dimensioned there might be surplus heat during summer time that cannot be used.

Calculation approaches are similar as above :

a. Based on fuel

amount of biomass for cogeneration (kg) x LHV (kWh/kg) x conversion efficiency for heat (%) = gross bioheat (kWh)

then percentage of net bioheat should be estimated

amount of biomass for cogen (kg) x bioheat (kWh) / (bioheat + bioelectricity (kWh)) = amount of biomass for heat (kg)

b. Based on use

number of units (n) x installed electric capacity (kWe) x hours (h) x load factor (%) / electric efficiency (%) = biomass for cogen (kWh)

then same calculation as a.

Recommendations for countries

Germany

How bioenergy is evaluated

[1] EUROSTAT, definition of renewable and waste for the annual questionnaire 2001 and 2002, http://europa.eu.int/estatref/info/sdds/fr/sirene/reneng.pdf

In Germany the production of biofuels for transportation and electricity generation with biomass is well documented, but the statistical reliability of the data for bioheat is distinctly worse. Reason for this is the disability to gather data about solid biofuels. This is especially true for the utilization of wood logs in private households, which are mostly traded in a non-commercial way.

How biomass for individual use in house holds is evaluated

Wood logs are the dominant market for heating systems < 150 kW capacity. Here only 46 % of the demand are sold on official markets in western Germany, in the eastern parts of Germany only 29 % are even traded, nearly 70 % were utilized free of charge. Further on, just 7 – 16 % of the commercial sold wood logs have been traded by professional fuel merchandisers, whereas private and public forests and the wood processing industry are dominating the market. A reconciliation of the utilised wood fuels in forests doesn' t make sense because a huge part of the forests is private owned outside official statistics.

Thus, to gain more or less reliable figures for the bioheat use the official statistic is completely dependent on the results of industrial and consumer surveys. Since the middle of the 1990' s the official statistics reverts to surveys of the GfK, a German market research organization, which evaluate on behalf of the fuel trader " Rheinbraun" the wood fuel consumption of 14.000 customers. The results are completed with own estimation of an expert group and specific data collection.

How bioheat in industry is evaluated

Since the commencement of the energy statistic act data for the bioheat use in the processing industry is available for the first time in 2003. Here the annual heat supply with biomass can be evaluated. But per definition only companies > 20 employees are counted, whereas approximately 49.000 wood processing companies and 6.500 small industry companies with less than 19 employees are not. But despite the fact that in these groups even 10 TWh heat or 2,6 m t wood were utilised as a result of a survey in 2004, this figure isn' t regarded in the official statistic. This is still because of missing reliable statistical data. Further on it cannot be excluded that there are overlappings with other sectors.

Improvement

The requests for a reliable bioheat statistic are contradictory: On the one hand policy makes demand a better data quality to improve the data basis for political decisions; on the other hand, there is a policy to reduce administrative burdens for companies, e.g. by demanding less statistical data as in the past. The results are incomplete statistics. It will be difficult to improve the data quality.

Italy

How bioenergy is evaluated

Biomass for heat and bioheat, in Italy, are significantly connected with the domestic sector (individual households and district heating) and with the industrial sector. Their quantification and evaluation in the individual use households is very difficult, due to the lack of official data, to the extreme fractionation of units over the territory and to the large variation of efficiency existing between technologies starting from open fires (round 10 % efficiency), stoves (40-50%) and automatic boilers (80-90%).

The replacement of individual heating plants with a single centralized, efficient plant (the central district heating station) should be strongly pursued, considering the huge series of positive effects (whether from a technical-operational, economic, or environmental point of view) .

In the Biomass District Heating, spread widely in Italy in the last decade, the bioheat evaluation is much easier: considering that the bioheat is sold, it is normally measured through the installation of differential heat-flow meters at the end-users premises.

With questionnaires and interviews to most of the District heating plants the useful bioheat has been quantified.

A similar approach could not be adopted with the industrial sector, where measurements of biomass for heat and bioheat are not currently carried out, also in consideration of the low value of the industrial residua used as biomass for heat.

In the industrial sector, in fact, there are numerous firms that use residual biomass, derived from their own production cycle for process heat production. In many cases, large companies handle such high quantities of residual biomass that, besides satisfying their own energy needs, they can also make their energy surplus available for other networks.

Among the industries that can benefit from the use of residual biomass we can include, for example, those that deal with the transformation of food products (such as the fruit preserving sector), pasta factories, rice mills, distilleries, olive residue treatment factories, etc.; as well as industries for the primary and secondary transformation of wood, such as sawmills, panel mills, furniture mills, and so forth.

As far as the wood industry sectors are concerned, a 2003 survey conducted by ITABIA shows a production of wood waste of approximately 6 Mt/ year, of which at least 4 Mt is used for energetic purposes (processing and air climatization of work environments).

For an estimate on bioenergy consumption from the oil and rice industries we can refer to indicative data considering that the residues in production (exhausted oil residues and rice husks) – amounting to global annual quantities of approximately 800 kt of dry matter – are almost entirely absorbed by the farms themselves for heat uses and, in some cases, sold to central thermoelectric stations, with a possible extrapolation that brings about a contribution of biomass energy estimated at around 0.2 Mtoe.

Even other sectors of the agro-alimentary industry play an important role in the utilization of their produced waste for energetic ends, in particular:

- pulp and grape marc residues in the wine and alcoholic beverage sector, with an annual production of dry matter estimated at approximately 450 kt.
- nuts, shells, peels etc., from the fruit preserving sector, with an overall annual production of dry matter estimated at approximately 350 kt.

Currently, there is no updated data available that would facilitate an estimate on the national level of the number of plants installed for the production of thermal energy from biomass for industrial purposes. The last study dates back to a survey conducted by ENEA in 1993 which showed that there were approximately 1,300 plants, with an annual bioheat production of about 1 Mtoe.

How biomass for individual use in house holds is evaluated

The most significant portion of biomass for heat and bioheat in Italy is however that relevant to the domestic sector: in this sector, millions of heaters, fireplaces, boilers and wood-burning stoves are currently operating.

The data concerning the global household consumption of biomass for heat is the most difficult to be determined and it has been obtained by intersecting, comparing and interpolating the figures from the most reliable sources (ENEA, ISTAT, UNCEM) with the results of a number of inquiries (CTI, LOMBARDY REGION) mostly based on questionnaires and interviews.

The existing appliances in Italy are nevertheless mostly obsolete and poorly efficient: through the above mentioned inquiries an average efficiency of 35% has been estimated.

With the calculation principle based on fuel, the useful bioheat has been evaluated through the formula:

BIOHEAT (kWh) = amount of biomass for heat (kg) x lower heating value (kWh/ kg) x average conversion efficiency (%)

Recommendations for the future evaluation of biomass for heat or bioheat

Domestic individual users:

1) Organize inquiries based on questionnaires to be diffused in significant representative areas of the Italian territory. Main questions to answer: type and age of equipment, installed power, yearly biomass consumption, working yearly hours, load factor.
2) Create a database of traders/ manufacturers/ importers to monitor new equipment sales (installations/ replacements). There is in fact ample room for more efficient conversion technologies: this would lead to a significant increase in the net energy supply, also keeping the global consumption of wood fuel unaltered.
3) Optimize ISTAT and ENEA methods to monitor national biomass for heat yearly use.
4) Improve extrapolation methodologies (calculation method)

District heating:

1) Maintain continuous updating of district heating plants database.
2) Contacts and interviews with all the plants over 1MW installed power.
3) Collect, for each, plant measurements results.
4) Extrapolation methodologies (calculation method) for district heating plants below 1 MW installed power.

Industrial heating:

1) Create a new database for industries using biomass for heat.
2) Contacts and interviews with all the industrial plants over 1MW installed power.
3) Extrapolation of results (calculation method)

Sweden

How biomass for heat and bioheat are evaluated

Statistics Sweden produces statistics which are used by the Swedish National Energy Agency. These statistics are mainly focused on the use of biomass for energy rather than the production. For heating in small houses, premises and buildings in the commercial, public and services sectors annual inquiries are made. Every fifth year a deeper inventory through inquiries are made.

Statistics are also produced by several national trade associations.

- Svensk Fjärrvärme, statistics on biomass for heat in the district heating sector.
- PiR (Swedish Pellets Producers Association), statistics on production and sales of pellets.
- Trädbränsleföreningen, statistics on production of wood fuels for large scale users.

How biomass for individual use in households is evaluated

Pellets
The Swedish Pellets Producers Association (PiR) collects statistics from the main producers of pellets. These statistics include production, exports, imports and sales. Sales to small scale (individual households) are separated in these statistics. This means info is available for the sales of pellets (in tonnes) to individual households. This statistical info will also be used by the Swedish National Energy Agency, in their annual report " Energy in Sweden".

Example using calculation approach " a) based on fuel":
Amount of biomass x LHV x conversion efficiency = bioheat
In 2005, the pellets deliveries to small scale (individual households) was 590 000 tonnes.
590 000 000 kg x 4,8 kWh/ kg = 2 832 000 000 kWh = 2,8 TWh biomass for heat
590 000 000 kg x 4,8 kWh/ kg x 80% = 2 265 600 000 kWh = 2,3 TWh bioheat

Wood logs and wood chips
Most of this segment consists of wood logs, a minor part of wood chips. The use of wood logs and chips is most common among home owners with good availability of forests, e.g. in rural areas. The use of wood logs or wood chips for heating in individual households are difficult to measure, since most of this biomass is traded locally and often non-commercially.

Statistics Sweden (SCB) collects statistics annually through inquiries on number of installations using different heat sources. Every fifth year a deeper inventory is made.
In 2006 this inquiry was sent by post to the owners of 6 846 (out of 1,7 million total) small houses, randomly selected from the governmental register of home owners. To reduce the decline rate the inquiries were followed up by telephone interviews. Information on the use of biomass for energy has been gathered through letting the respondents state their respective use within certain intervals. The median value is used as the basis for evaluation of the use of biomass for energy.

Recommendations for the future evaluation of biomass for heat or bioheat

In those cases where the energy carrier is sold as a commodity, it makes sense to measure this commodity. Examples of these commodities are pellets, and heat from district heating.

Many of the bioenergy assortments used (especially in small scale individual households) are traded locally, traded non-commercially or not traded at all (as in the case of using wood logs or chips from own land). In these cases surveys of number of installations for further calculation to bioheat makes most sense.

Using statistics produced by existing national associations (e.g. pellets producers associations, district heating associations) will be of great help. These associations

have an incentive to produce and disseminate relevant statistics about production or sales levels. In some cases the statistics will be in amount of fuel (e.g. tonnes of pellets) and in some cases even in energy units (e.g. kWh of heat sold in district heating sector). In these latter cases fuel mixes in the heat production will have to be considered, since co-firing with fossil fuels occurs.

Suggestions

Refined biomass fuels or hot water: Direct measurement and reporting by selling part.

Locally produced biomass fuels: Enquiries to randomly selected users.