SUSTAINABLE USE OF BIOMASS

– A principle paper from The Ecological Council

THE DANISH ECOLOGICAL COUNCIL
Tomorrow's environment is created today

PREFACE

For several years the Ecological Council has been working with the use of Bio-Energy - solid biomass as well as liquid biofuels and biogas. Since there are many fundamental aspects of this, we have found it necessary to submit a principle paper. The paper has been discussed on the board of the Ecological Council. For technical details we refer to previous publications, see the appendix at the end of the paper.

Background

Today, biomass covers more than 60 pct. of the renewable energy production in Denmark. Biomass includes straw, firewood, wood chips, wood pellets, wood waste and biodegradable waste, but not biogas. To this should be added a considerable import of especially wood pellets (28 PJ), but also firewood and wood chips.[1]

As part of the transition of the Danish energy production is to be based solely on renewable energy sources there will be a demand for an intermediate increase in the use of biomass. This is because biomass in a number of contexts can easily replace fossil fuels, and biomass today is a relatively cheap fuel because so far it has been exempted from energy taxes.

Against this background, this paper deals with three issues:

1. Which main principles should apply to the sustainable use of biomass?
2. How much biomass can be used for energy purposes in the future, if this should be done in a sustainable way, broadly speaking?
3. How should the available biomass resources be applied in the best possible manner - from energy, environmental and broader economic considerations?

1 Danish Energy Agency2012 “Energistatistik 2011” (Energy statistics)

1. THE MAIN PRINCIPLES OF THE ECOLOGICAL COUNCIL FOR A SUSTAINABLE USE OF BIOMASS

The Ecological Council's guiding principles for sustainable biomass use can be summarized in five points..

1

Food products must not be used for energy purposes

Today this problem is most relevant to the production of biofuels that can replace gasoline and diesel in cars, etc. This technology uses large volumes of rapeseed, maize, etc. for the preparation of first generation fuels - like imported bioethanol and biodiesel on the basis of sugar cane and palm oil. This has led to rising global food prices, therefore negative consequences for the developing world and other poor countries. The issue is also relevant in relation to biogas, where maize, etc. is used to some extent today in order to increase gas production.

2

Areas which can be used for food production must only to a limited extent - and after careful assessment – be used for the production of energy crops

This problem is - in a Danish context - relevant to the production of energy crops, such as willow and miscanthus (elephant grass), as well as for plain grass for mowing (harvest cut), for example to be used for biogas. This should be assessed in terms of impact on biodiversity.

3

Biomass must be used for energy purposes only if the use is sustainable

In assessing whether the use is sustainable, the total carbon dioxide contribution must be involved, incl. the indirect land effects known as Indirect Land Use Change (ILUC). That is, if you use land to grow energy crops, formerly used for food or feed, the cultivation of these are forced into new areas. Thus, climate effects must be included.

4

The biomass resources available should be used energy efficiently and strategically. In practice, this means that emphasis should be placed on the following two considerations:

- Thermodynamic efficiency: Biomass must - as all other primary energy resources - primarily be used for the production of high quality energy cogeneration and / or energy for processes (high temperature / steam at high pressure). Biomass should not be used in the manufacture of low quality energy such as heating at 20 degrees (space heating) - thermodynamically it is inefficient. This means that the use of wood in stoves, wood pellet boilers, etc. should be avoided.
- Use when there are no good alternatives: This applies for example to parts of the transport sector (planes, ships, trucks, etc.). If biofuels for these applications are to be produced in Denmark it will take up a significant part of the Danish biomass resources. Therefore, the Danish biomass resources should not be used for purposes, where there are good alternatives.

5

Biomass should not be used in polluting wood burning plants

Private wood burning (stoves / boilers) accounts for 70% of the total Danish particle emissions and should therefore be phased out over time - both because wood smoke particles are harmful, and because they make up the majority of the so-called black carbon, which is a major factor in climate change. In the short term, wood burning should be avoided in cities, and limited to the top combustion units in the country.

2. HOW LARGE QUANTITIES OF BIOMASS CAN BE USED FOR ENERGY PURPOSES

In 2011, the Danish renewable energy production amounted to 134.8 PJ. To this should be added net imports of renewable energy of 39.5 PJ, which consisted mainly of biomass. Based on Danish biomass (including biogas and biodiesel) the Danish energy production in 2011 amounted to 90.5 PJ, see table. It appears that wood is by far the largest fraction. This is calculated as *energy input*. A large part of the wood is used in domestic wood stoves (see below) where it has low efficiency.

Increased use of wood

In Denmark's forests about 1.5 million tons of dry matter is harvested per year. Out of this 36% is used in the timber industry, 28% in the energy sector (decentralized power and heat production), while 36% is used as fuel for space heating in private households. In addition, an estimated 0.7 million tons of dry matter are used per year from fences and gardens exclusively used for firewood.[3]

The amount of energy supplied by Danish forests in 2011 in biomass for energy corresponded to 41.7 PJ, see figure 1.

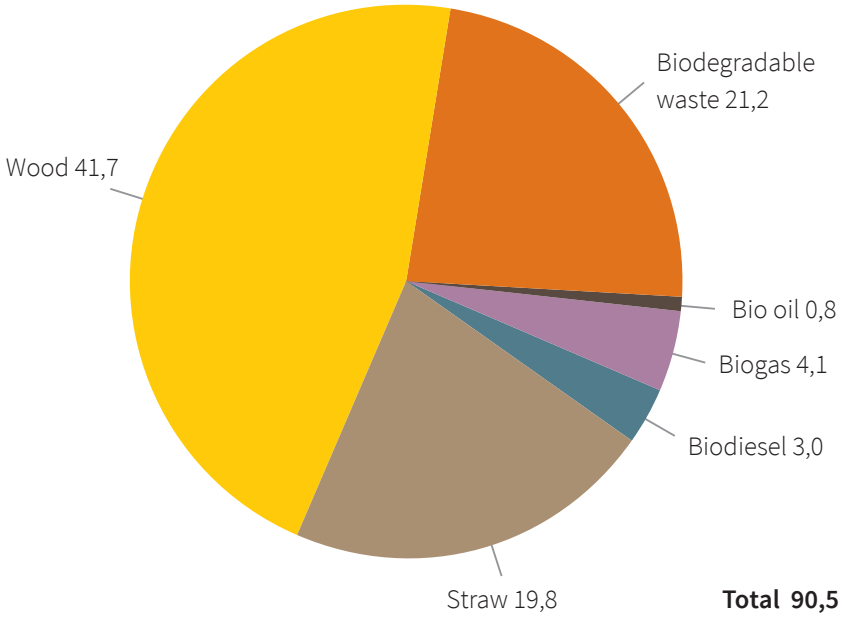


Figure 1:
Danish produced biomass in 2011 - amounts in PJ[2]

Wood is a biomass resource with a number of positive properties:

- Wood is produced in forests, which at the same time can accommodate a variety of community interests including timber production, recreation, nature considerations, groundwater protection, rural employment, etc.
- Wood can be produced in Denmark and thus contribute to self-sufficiency / security of supply.
- Wood has better properties as a fuel than other biomass crops.

2 Danish Energy Agency (Energistyrelsen), "Energistatistik 2011" (Energy statistics)

3 "10 Million Tonne Plan" Uffe Jørgensen AU/DJF and Claus Felby, KU Science pp.6-9 http://www.biorefiningalliance.com/uploads/10miotonsplan_20120628.pdf

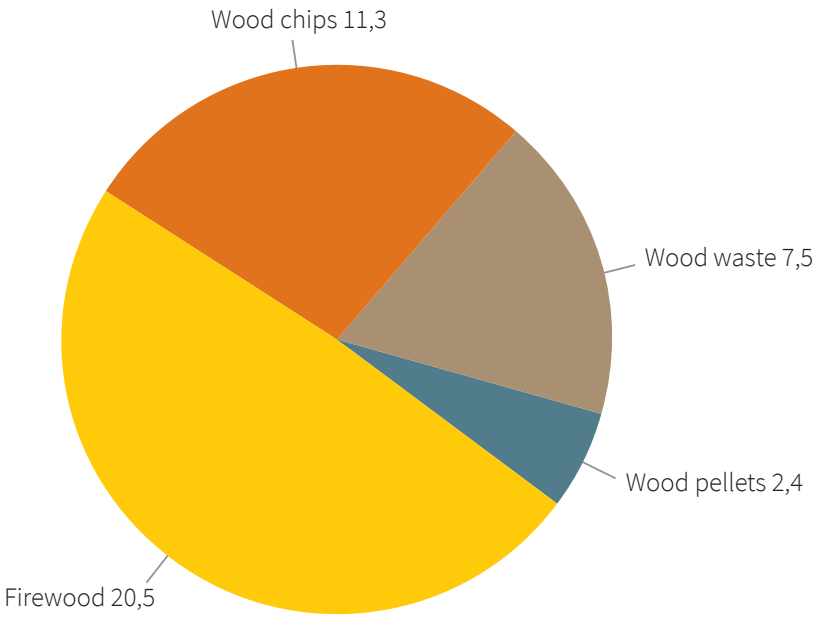


Figure 2: Biomass divided into types of firewood[4]. - amount in PJ

Division of biomass supplied by Danish forests in 2011 (PJ).

In 1989 it was decided politically that Denmark's forest area should be doubled from approx. 12% at that time to approx. 25% by the year 2070[5]. This will be implemented as mixed natural forests with room for deadwood, in particular from old trees, which are associated with high biodiversity.

Wood from forest clearing and wood from forest management should primarily be used as a timber for building materials, etc. However, studies from the University of Copenhagen, Institute for Forest & Landscape show that the existing forestry and afforestation area can increase the amount of wood for energy significantly without reducing the supply of raw materials for the wood industry or limit the possibility of preserving and developing forest biodiversity.[6]

This biomass potential can be exploited via a new forestry model based upon increased use of auxiliary trees by forest owners - also known a nurse trees. The nurse trees grow quickly at first and must be removed from the stand 10-20 years after planting so as not to damage the slow-starting "lumber and furniture trees".

Straw can be used with caution

Straw for burning in straw boilers and CHP plants is an important part of renewable energy sources. Today the contribution of straw to energy supply amounts to 19.8 PJ. It is necessary to continue for some time to use Danish straw for energy purposes. Some 5-6 million tons of straw are produced annually in Danish fields, which correspond to a theoretical potential of 87 PJ. There is, therefore, a major immediate untapped energy potential in straw. But, again, the sustainability requirements should be met. Removal of straw from the fields may lead to a deterioration of humus. It is only a problem in some parts of the country, especially on Zealand and Lolland, though here you can compensate with catch crops. The Ecological Council do suggest in our agriculture proposal that the area of catch crops must be increased significantly. The requirement for catch crops has increased in recent years, but not enough. If manure is added - especially cattle manure, which has a higher dry matter content than pig manure, - it can also replace part of the humus, which straw would otherwise provide. It's also possible to have crop rotation where grass seed is grown in between cereals. It is a good way of increasing the humus content. But conversely – if these practices are not carried out - it is important to continue plowing straw to maintain soil quality.

Mulched straw also contributes with nutrients. There is very little nitrogen in the straw, but straw is a major source of phosphorus and potassium in particular. Many fields are already over-fertilized with phosphorus, so the problem of phosphorus deficiency is not

4 Danish Energy Agency " Energistatistik 2011"
5 The decision was called "Doubling over a generation of trees" defined as 80-100 years. In 2010 there was approximately 14% forest
6 "10 million Tonnes Plan" as above

imminent. However, potassium may be a problem. Again, it helps to spread manure. If it isn't sufficient, the conventional farms can provide a little more potassium fertilizer. It is predominantly the conventional farms that supply straw for energy purposes. This means conversely that an increased conversion to organic farming will lead to less straw available for energy purposes.

The current varieties of cereals are all selected over many years of breeding efforts for maximum grain yield. Straw has been a by-product, which has exceeded the demand for use as bedding and feed in livestock production and for energy purposes. Farmers have therefore had an incentive to cultivate crops with as little straw as possible. However, by modifying the species choice, cereals with large amounts of straw can be used and thereby increase the straw yield without having to reduce the grain yield[7]- but it requires different harvesting methods.

The fact that straw has not been the primary product for cereal production is also reflected in the ordinary harvesting methods that leave a significant portion of the produced straw in the field. If you change the design of the harvester it is possible to increase the harvested straw volumes by between 12 and 30%[8].

Energy crops and biodiversity

The amount of biomass from agricultural land for energy purposes can be increased through cultivation of energy crops. Cultivation of energy crops such as willow and miscanthus can be both organic and conventional. Conventionally, willow is grown with the use of agrochemicals, particularly herbicides and fertilizers - albeit at a low level compared with e.g. cereal cultivation. Fields with conventional willow in line with conventional cornfields have low levels of biodiversity - but better than, for example cornfields. Furthermore, willow cannot be included in crop rotation, since willow has to be grown 15-20 years in a row, which also helps to reduce biodiversity. Biodiversity can be enhanced - while improving the aesthetics – by combining willow trees of different ages and placing strips with other vegetation in between[9].

Growing willow yields a great contribution of humus - from an extensive root system, while there is less soil cultivation - i.e. willow will in some instances be used to raise the humus content of soils, already affected by depletion of humus.

However, there is a need for some kind of compromise between climate and biodiversity issues. If we are to stop the use of fossil fuels in the heat and power sector from 2035 onwards while avoiding imports of non-sustainable

7 Proposed in the report "10 Million Tonnes Plan" as above.

8 Described in "Background notes: Technical Possibilities to salvage a greater proportion of the amount of straw produced." Erik Fløjgård Kristensen, Institute for Engineering Science, Aarhus University 2012

9 This is seen, for example, in Denmark's largest willow farm (Henrik Bach) in Vrå in Vendsyssel (Northern Jutland)

Grass for harvest cut gives as a starting point a very high energy yield per hectare

biomass, we need, in the short term, to produce more biomass ourselves. Cultivation of energy crops must not take place by planting natural areas. However, more biomass can be grown for energy purposes on the land that is already ploughed without lowering the production of food and feed. The cultivation of rape can be replaced by willow, which would give a much higher energy yield per ha - and the majority of rape is already being used for energy purposes (biodiesel in Germany).

We can also replace a minor part of our grain area with willow. Our grain harvest varies from year to year, but on average we have a net export of approx. 15% of our grain production. So we may well reduce grain production a little without being net importers. It should, however, be assessed how our excessive imports of soy from South America can be lowered. But soy cannot necessarily be replaced by grain because of differences in the protein content – this would also require the cultivation of more legumes for example.

Finally, there is the option of using clover (can improve crop rotation) and harvest cut from natural areas for biogas purposes. The Ecological Council proposes in their agricultural plans a comprehensive set-aside / intensification of existing arable (ploughed) land. A large part of this area should be permanent grass, which can be used either for grazing animals or simply for biogas applications. Grazing animals will often be beneficial for biodiversity, but as in the case of ruminants (cows and sheep) it has a climate impact in the form of methane emissions. It should be examined whether a greater proportion of these grasslands can be grown with harvest cut in a biodiversity-friendly way. Grass to harvest cut basically allows for a very high energy yield per hectare[10] – a good yield will still be attainable, although it was less intensive, for example with only one harvest cut per year.

Thus, these conditions influence on our main principle 2. In case of crops / vegetation, which serve other good

10 With two cuttings per year. Source: "10 Million Tonnes Plan" as above"

purposes besides producing CO_2-neutral energy, it may be a good idea to use the land for this. This applies to the cultivation of clover or alfalfa, which is part of an organic crop rotation, or permanent grass to harvest cut on set-aside / extensified areas, but here you have to prioritise between harvest cut and the use of cattle for nature care-taking. In practice, you can divide land so steep and hilly areas are used for beef cattle, while flatter land is used for harvest cut[11].

Biogas can be produced sustainably

Biogas can be produced from many things. Today mostly from agricultural slurry - supplemented with slaughterhouse waste, but also sludge from sewage treatment plants. In the future, there are great opportunities in other raw materials. Some see the use of increased biogas only as a way of maintaining excessive pig farming. In the Ecological Council, we share the concern of the large livestock of Danish agriculture.

But the problem is not due to biogas. We have presented a scenario for 2020 - a step towards an environmentally friendly agriculture.[12] These include a 30% reduction of pig production. This could well be combined with the agreed objective of a tenfold increase in biogas production in Denmark - by relying on other sources. In 2011, 4.1 PJ of biogas was produced in Denmark, of which 3.4 PJ was used for production of electricity and district heating.

Biogas utilization reduces emissions of the greenhouse gases methane and nitrous oxide from manure. It replaces fossil fuels, and reduces leaching of nitrogen from manure. Biogas may help to recycle phosphorus, which is a limited resource and a necessary plant nutrient. Finally, it may promote conversion to organic production - with optimal utilization of the nutrients from the necessary clover and alfalfa fields as well as being good fertilizer for growers who do not have access to livestock or fertilizer.

We need to utilize organic waste from households - and the technology is available. In the Kalundborg area (West Zealand) this waste is collected separately for the biogas plant at Holbaek (Aikan). There is also a promising experiment (Pure Science) - in Amagerforbrænding and Dong Energy. Here the organic waste is converted by enzymes to a "soup", which is separated from other waste and can be added in biogas plants. More sewage sludge, clover from crop rotations and grass from natural areas / extensive farming can also be used. On the other hand, only a very limited amount of maize should be used in biogas plants. The government has recently restricted this, but still they open for an excessive maize share[13]. The Ecological Council recommends to tighten these restrictions and to discourage the use of maize for biogas.

Photo: Lemvig biogas plant (North Jutland). Copyright © www.lemvigbiogas.com

11 If there is a gradient of more than 20%, the large machines are unable to function.

12 Environmental Integration in the EU's agricultural policy. The Danish Ecological Council, 2009

13 Max 25% by weight, and from 2017 max.12%. A much greater proportion of the energy comes from maize (70% and 49% respectively.)

Import of biomass

In 2011 the total Danish consumption of renewable energy from biomass averaged 130 PJ, of which about 40 PJ, corresponding to approx. 30%, was imported, see distribution in Figure 2. Thus, Denmark imports large amounts of biomass for energy purposes and the amount is increasing.

As it appears, pellets dominate imports. The Danish wood pellet production is limited to 2.4 PJ (about 140,000 tons) and is sold mainly to the approx. 80,000 households with pellet burners. Of the 27.7 PJ (approximately 1.6 million tons) imported, 19.3 PJ is used in the cogeneration sector.

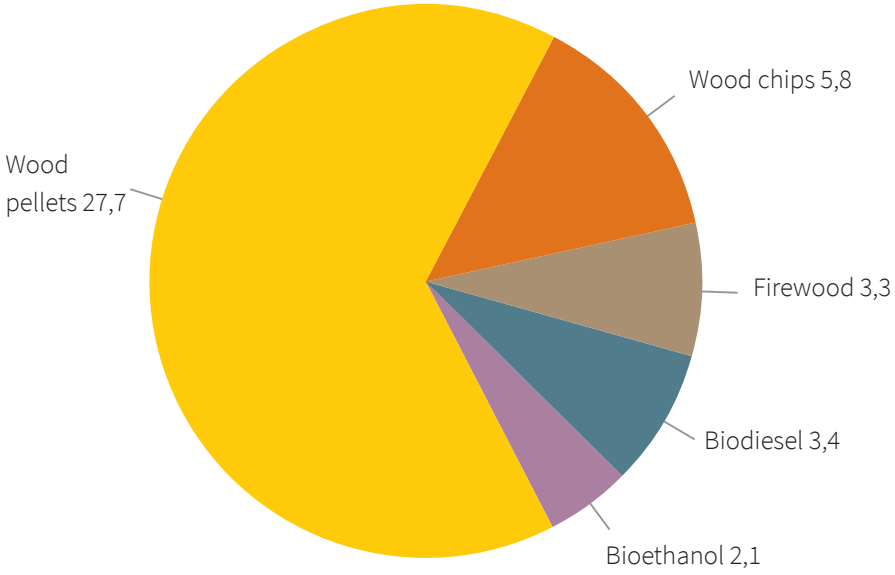


Figure 2: Imported biomass – quantities in PJ[14]
Distribution between the different imported biomass types in 2011.

As discussed in the previous sections efforts should be made to increase the Danish production of sustainable biomass. The relatively modest Danish biomass resources cannot replace both oil consumption in the 330,000 properties with oil burners, gas consumption in the decentralized district heating plants, coal consumption at power stations and motor fuel in the transport sector. In the long term biomass resources must probably be reserved for heavy transport and aircraft. The transition to renewable energy in the electricity and heating sector requires, nevertheless, that coal is replaced by biomass during a transition period - and here the need cannot be met by Danish biomass resources.

It is, therefore, expected that the Danish as well as global demand for biomass will increase strongly in the coming years. This will cause prices to rise and increase the risk of overexploitation of forest resources with loss of biodiversity and increased greenhouse gas emission as a result. It is therefore crucial that an urgent elaboration of binding criteria for the sustainable use of biomass for energy purposes takes place, both in Denmark and internationally.

The pressure on the world's forests is large due to logging and the need for more farmland. From 2000 to 2010 1.3% of the world's forest area disappeared, corresponding to an area the size of France. Currently the deforestation happens at its fastest rate in Brazil, Indonesia and central Africa. To this should be added an increased pressure from the U.S. and Europe to use wood as biofuel or convert forest for the cultivation of energy crops such as palm oil.

It is important that Denmark does not import biomass from non-sustainable production. In particular the cutting of virgin forest must be avoided, such as rainforests of the Amazon or Indonesia. Denmark occupies an area of 10-14,000 square kilometers (1 ½ -2 times the size of Zealand) in South America in order to produce food for our animals. We should not, as a result of the cultivation of energy crops, increase the total import of biomass / crops.

14 Danish Energy Agency, Energistatistik 2011.
15 Danish Energy Agency, Energistatistik 2011. Presentation by Wolfgang Stelte http://www.ens.dk/da-DK/UndergrundOgForsyning/VedvarendeEnergi/bioenergi/bioanalyse/temamoder/Documents/Market%20and%20Price%20Projection%20for%20Wood%20Pellets_Wolfgang_Stelte_DTI.pdf
16 UN Food and Agriculture Organisation (FAO) Global Forest Resources Assessment 2010 (Rome 2010) http://vitalsigns.worldwatch.org/vs-trend/worlds-forests-continue-shrink
17 Or 0.9-1.3 million hectares. Comparable to approx.1/3 to ½ of the cultivated area of Denmark. Source: "Meat with thought" The Danish Ecological Council, 2011

3. HOW TO USE BIOMASS RESOURCES IN THE BEST WAY

Sustainability, resources and temporary solutions

The production and use of biomass must be sustainable. The EU has sustainability criteria for liquid biofuels, but these do not as yet involve indirect effects, so-called Indirect Land Use Change (ILUC) – for example if you grow sugar cane for energy purposes in Brazilian fields, which was previously used for soybeans and thus cut rainforest for soy cultivation instead. On October 17, 2012 the EU Commission made proposals that ILUC should be involved when companies and countries report on the use of biomass. But according to the proposal ILUC will still not count in relation to meeting EU's sustainability criteria for liquid biofuels. For solid biomass, the EU has no sustainability criteria, but there are plans to establish such. Some energy utilities have established criteria themselves.

Power plant companies are focusing their import of wood pellets in recent years. However, a major part of the wood pellets imported from the Baltic countries, the rest of Europe or Canada are not produced sustainably. In the long term when other countries begin to take climate changes seriously, it is likely that the global demand for biomass for energy is growing rapidly - and rising prices may be expected as a result.

In the long term, we believe that Denmark should not use more biomass than can be produced in Denmark sustainably - not because there is basically anything wrong with imports, but be-

From the campign of Action Aid Denmark: stop food-fuel – food must go into stomachs.

cause there will be competition for biomass resources internationally. There are currently a number of unexploited biomass resources in Denmark and production can probably be increased on a sustainable basis. But there is already a considerable import especially of pellets that can only be expected to increase in the coming years.

An increased use of biomass - domestic as well as imported - must be combined with comprehensive energy conservation and investment in other forms of renewable energy like solar and wind. It is crucial that we invest heavily in energy savings in buildings and on efficiency improvements including the electrification of transport and switching to heat pumps, geothermal and solar combined with energy storage for heat supply. In general, significant energy savings should be carried out before or at the same time as a change to biomass and other renewable energy forms, thus avoiding costly over-investment in energy facilities.

A significant increase in the use of biomass must therefore be an interim solution. In the short term, we can hardly do without biomass as part of a transition away from fossil fuels. In the long term, we must cope with especially solar and wind combined with far less energy use - but it will take some decades. In terms of interim solutions, it is important to focus, partly on the sustainability of the biomass used, and partly on the long-term solutions to avoid creating structures, etc., which block the implementation of these.

Strategic and intelligent use of biomass

As mentioned above, biomass resources should be used effectively and strategically. Specifically, this means that biomass resources in the long term primarily should be used for the following purposes::

- In efficient co-generation plants, which together with heat pumps can help to balance the power system, and which to a large extent will be

Compared to power plants, even the best wood stoves – labeled with the Nordic Swan – pollute more than 100 times (per unit of energy produced) more with particles that are damaging to health – even when the stoves burn under optimal laboratory conditions.

based on the wind. In such relatively large facilities the energy efficiency can be maximized and air pollution and climate impacts (due to soot particles) from combustion minimized.

- Production of process energy (heat / steam at high temperature and pressure) in the companies where it is the best way to replace the use of fossil fuels.
- Production of second generation biofuels for transport purposes - primarily for trucks, buses, airplanes and ships (as well as construction machinery, tractors, etc.). Here we primarily focus on biogas for heavy vehicles, while second generation liquid biofuels can be used for airplanes and ships.

Based on this, the use of biomass for exclusive production of low quality heating should be limited. This applies to the use of wood stoves, pellet heating systems and boilers in district heating plants. It is, therefore, also a bad idea as it happens in some places at the moment, when natural gas-fired CHP plants are replaced by pure heating plants based on biomass - after which they are supplied with electricity from a central power plant. Even if the heating supply is changed from fossil to non-fossil fuel, it is a poor utilization of biomass. In addition, you lose the flexibility that the gas-fired CHP plants represent, since they can be adjusted quickly in relation to fluctuating wind power production.

Compared to power plants, even the best Nordic Ecolabel stoves pollute more than 100 times (per unit of energy produced) with harmful particles - even under optimal laboratory conditions. Wood stoves / boilers are also responsible for more than half of the total Danish emissions of soot particles (black carbon). These contribute significantly to ice melting in the Arctic because of deposited soot, which colors the ice gray, so the ice absorbs more of the solar radiation (heat). This accelerates the ice melting and thus global warming. Wood burning is not climate neutral. [18]

Although automatic wood pellet heating systems pollute significantly less than stoves / boilers it is an ineffective solution in the long term, which should not be used in private households - not even in the countryside. Here heat pumps in combination with solar heating and a heat store are a better solution, which is available on the market.

The use of wood stoves or wood pellet heating systems should not be encouraged with subsidies etc., and the indirect subsidy, which until now has been provided through tax exemptions, should be limited.[19] In the short term, wood burning should be avoided

18 See http://www.ecocouncil.dk/index.php?option=com_docman&task+doc_download&gid=927&ltemid=.

19 With the introduction of taxes for a secure energy supply, which includes the trade of firewood and wood pellets. These are no longer exempted from these taxes, but there will continue to be a large percentage of firewood that is not traded and therefore not taxed.

in cities and confined to the best combustion units in the country. The conversion can be done via a green owner tax differentiated according to pollution and geographic location of the heating systems.[20]

If the phasing out of using wood in inefficient and polluting stoves succeeds it will make 36% of biomass production from the Danish forests available for better purposes. Part of this released biomass can probably be used as timber for the wood industry, while some may remain in the forests and increase the amount of deadwood in favor of biodiversity. But a large part will also, during an interim period, be used effectively in chips and wood pellets in the decentralized and centralized electricity and heat supply. In the long term, biomass from Danish forests could probably be used for gasification and refining of fuels and materials.

Today straw is primarily combusted, but power companies seek to avoid increased use of straw. This is because straw is a difficult fuel, which requires special measures to prevent corrosion in boilers. At the same time, the supply may vary greatly from year to year. As an example, farmers in 2010 could not supply the quantities agreed due to a very wet autumn. Straw is also relatively expensive compared to pellets. Therefore, in the long term, the portion of the straw production, which can be considered a waste product, will probably be released from combusting purposes. This includes the amount which is not to be used for feed and bedding purposes for animals or for plowing on humus poor soils.

This will allow for the use of an increasing amount of straw for bio-refining in a biological process in the future. This could be the use of wheat straw into bioethanol, animal feed and solid fuel. According to the researchers behind the report "+10 mio. tons planen" (The 10 million tons plan) the feed fraction, which can be made from straw hemicellulose, provides an additional feed production in the range of 10-20%, which is in addition to the feed, available from grains. Thus, it takes less land to produce the same amount of feed, while producing energy in form of liquid and solid fuels at the same time. If we can manage to produce a share of feed or food in the bio-refineries the production of bioenergy and materials need not cause a reduction in food production. Such a reduction would have effects on land use in other countries.

20 Use of domestic wood stoves in towns and cities is the most damaging to health because of the proximity to neighbours, and at the same time it is unnecessary as most urban areas have access to district heating. With the help of a differentiated tax it is possible to limit the use of domestic wood stoves in urban areas and at the same time promote the more environmentally friendly stoves (at present those labelled with the Nordic Swan) for those who still want a wood stove. The Danish Ecological Council has suggested such a tax system that taxes wood burning compared to other sources of energy that are less damaging to health. It is suggested that the tax is related to the stove itself and not to the wood, because taxing wood may encourage some to burn waste instead. The relationship between wood stoves and pollution is described here: http://www.ecocouncil.dk/index.php?option=com_content&view=article&id=1255&Itemid=24.

KEY RECOMMENDATIONS FROM THE ECOLOGICAL COUNCIL

- Food should not be used for energy purposes, as it leads to rising global food prices. This means that the use of first generation biofuels, based particularly on canola, maize, sugar cane and palm oil should be phased out as soon as possible and replaced by second generation biofuels. These should - due to the limited resources available - primarily be used in aircraft and ships, where currently there are no alternatives to fossil fuels.

- The use of biomass for exclusive heat production in wood stoves, pellet stoves and district heating plants is an inefficient use of energy that should be limited. A differentiated tax should be implemented on wood stoves and boilers, which reduces urban use and promotes the use of the most effective and least polluting combustion units – like wood stoves applying to the Nordic Swan-label criteria.

- The use of wood pellets and wood chips in central and decentralized co-generation heat and power (CHP) plants may be an acceptable temporary solution, if it is ensured that the biomass derives from sustainably managed forests. This is best achieved through certification schemes, once it is ensured that the requirements are met.

- The import of biomass must be limited. Perennial energy crops can be grown in Denmark. This must not take place in nature areas, but on the contrary within the existing agricultural rotation areas, for example by replacing rapeseed by willow.

- Burning of straw should be limited. In the future, an increasing amount of straw should mainly be used for the production of biogas and for biorefineries. The latter may include the use of wheat straw for production of bioethanol, animal feed and solid fuel.

- Sustainable biogas production requires that this is not based on maize. In Denmark a rapid expansion has been adopted. Therefore, we need:
  - A stop to the incineration of mixed (unsorted) municipal waste. Instead we should send the organic fraction to biogas plants, thereby ensuring recycling of the contained phosphorus resource, while at the same time providing a necessary addition of more solid organic matter to biogas plants.
  - A fallowing of vulnerable agricultural land from the rotation (i.e. cultivation with plowing) and designation for permanent pasture, part of which is used for mowing (harvest cut), when the grass is used in biogas plants
  - A promotion of organic biogas plants with the supply of crops such as clover, which is also part of an organic crop rotation.

- Biogas should be used both for CHP and transport - the latter where there are no good alternatives. This especially applies to heavy transport (trucks and busses).

Publications from The Ecological Council on bioenergy

- Environmental Integration in the EU Agricultural Policy, The Ecological Council, 2009
- Technology and environment in agriculture (artikelsamling + 6 baggrundsrapporter, herunder "Biomasse og bioenergi" og "Jordfrugtbarhed og bioenergi"), (in Danish only) 2011.
- Biogas in Denmark – a potential environment friendly energy source, 2012
- Folder about pollution from wood burning, 2011 (in Danish only)

All available on www.ecocouncil.dk.

Christian Ege, Director
On behalf of The Ecological Council

Sustainable use of biomass
- A principle paper from The Ecological Council

February 2014

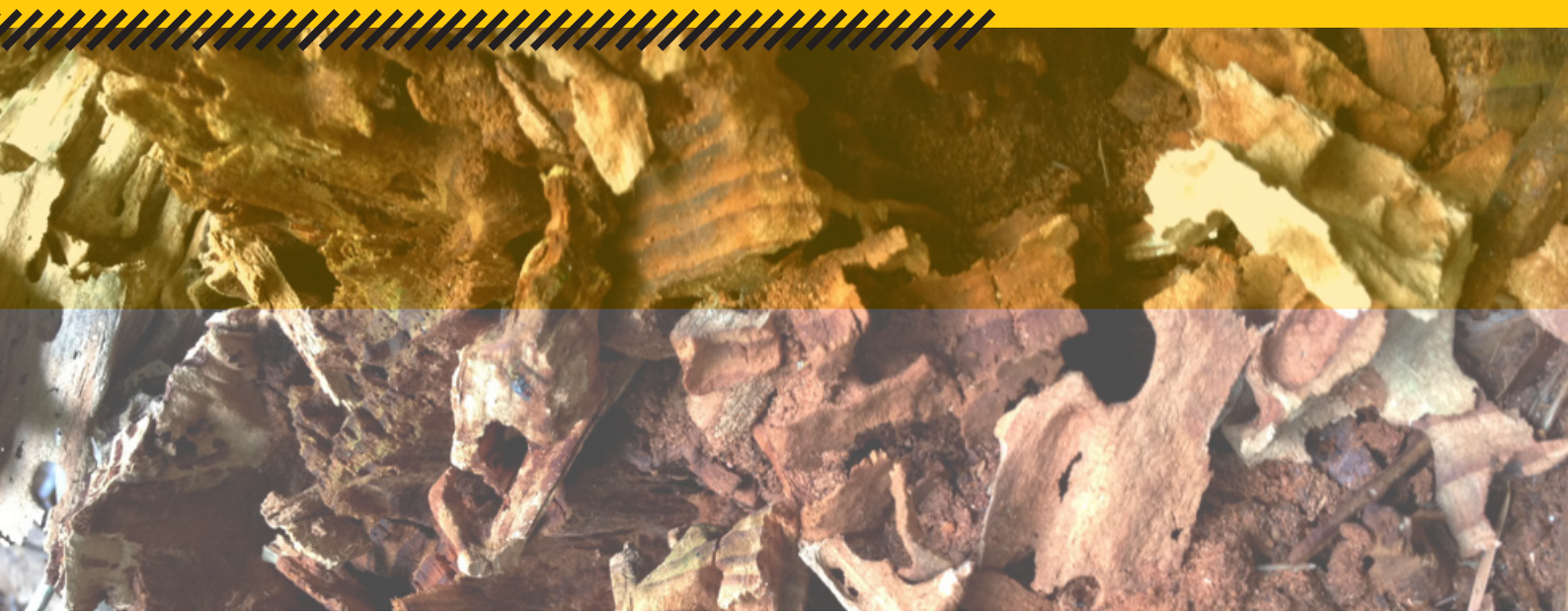
Text: *Christian Ege, Martin Bøndergaard, Bo Normander and Kåre Press Kristensen*
Layout: *Hanne Koch, DesignKonsortiet*
Photos: *Lemvig Biogas, Mellemfolkeligt Samvirke and Hanne Koch*
ISBN: *978-87-92044-67-9*

Produced with financial support from Energifonden (The Energy Fund)

Published by

The Danish Ecological Council
Blegdamsvej 4B
DK-2200 København N

Tlf. +45 33 15 09 77
info@ecocouncil.dk
www.ecocouncil.dk



THE DANISH ECOLOGICAL COUNCIL
Tomorrow's environment is created today