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Q&A: Reducing biomass for combustion in electricity and heat supply

CONCITO – Denmark's Green Think Tank - launched in October 2021 the report on 'Optimised biomass usage in electricity and district heat production towards 2040' prepared by Ea Energianalyse. The report concluded that biomass is not carbon neutral and found that Danish biomass burning should be reduced by 40-55% by 2030 compared to today.

Based on the report, CONCITO recommends halving biomass burning by 2030 and ensuring this by introducing a tax on biomass.

Below you can find questions and answers related to the report and CONCITO's recommendations.

Does CONCITO's proposal affect how Denmark measures up to the Danish climate target?

No, it does not. The achievement of the 70% greenhouse gas emission reduction target by 2030 should continue to be measured using the UN methodology. Accounting and regulating international biomass emissions are additional and part of Denmark's global climate strategy to limit emissions abroad.

Is taxing biomass in Denmark contrary to international climate rules?

No, it is not. CONCITO proposes maintaining the current UN accounting methods while simultaneously regulating biomass with a tax. This is in line with CONCITO's proposal to regulate public procurement to limit climate-damaging production abroad or our proposal to tax air travel. Biomass can easily be taxed without the emissions being accounted for in the Danish accounts. There is no international ban on taxing biomass.

Is it double regulation to tax biomass in Denmark?

No, it is not. Currently, there is no economic regulation of the carbon loss from biomass extraction from forests or fields. Therefore, introducing a tax on biomass would not lead to a double payment. If there is a truly binding regulation of carbon in forests and soils in the long term, the biomass tax should be reviewed. In that case, however, biomass would be more expensive as the carbon loss in forests and soils would be reflected.

Does a tax on biomass contribute to a decrease in consumption?

Yes. There is a significant effect on biomass combustion by introducing a tax, as heat pumps take over a larger share of heat production. Without a tax, Ea Energianalyse estimates that consumption will fall by 20% by 2030 relative to today. With a tax (carbon price), it will fall by 40-55% (depending on whether plants are allowed to close before the end of their technical lifetime).

EU CO2 quota prices have risen sharply since the analysis was published; what do the much higher quota prices mean for the conclusions?

Since the analysis was published, the EU CO2 allowance price has risen to around 600 DKK/tonne (December 2021). This is more than 50% higher than what was calculated in the analysis. If the tax is to follow the price of allowances, this will imply a tax of around DKK 20/GJ. If the quota price remains at its level, wood pellets without tax (DKK 60/GJ) are cheaper than coal and quotas (DKK 20+55/GJ). Together with a biomass electricity production subsidy of 15 øre/kWh electricity, this suggests an increased use of wood pellets for condensing power production. This potentially increases Denmark's biomass consumption significantly, with high import and subsidy costs. Ergo, the high allowance price potentially leads to additional biomass being burned in Denmark, making CONCITO's recommendations and conclusions more relevant.

Doesn't biomass consumption fall by itself?

A proportion of biomass consumption is reduced by itself, like heat pumps, in particular, have become, and will become, more competitive, while a number of biomass plants will lose their electricity production subsidies in the coming years. Ea Energianalyse's new analysis estimates that consumption will only be reduced by 60% by 2040, which is not optimal from a climate perspective, considering the CO2 cost of biomass.

In a previous analysis carried out by Ea Energianalyse for the Danish Energy Association and Danish District Heating Association (2020), biomass consumption in 2040 decreased by 70% on its own. The difference in results is because Ea Energianalyse has chosen to make several corrections to the reference case in the new report. The corrections are due to fewer expected heat savings, a smaller contribution of excess heat from power-to-X, downward adjusted biomass prices, and upward adjusted heat pump prices.

What would a reduction in biomass phase-out cost society?

An optimized reduction of biomass for burning will have a positive global climate benefit of €3.6 billion due to less carbon loss in forests and soils.¹

At the same time, the reduction will cost Danish society DKK 1.6 billion due to costs of conversion in the energy system. However, this cost is significantly cheaper than a forced full phase-out of biomass. In a report from 2020, Danish Energy and Danish District Heating commissioned Ea Energianalyse to calculate the cost to society of a forced full phase-out of biomass. This lands at DKK 14 billion in 2025 and DKK 9 billion in 2030 in lost investments and more expensive heating bills.

¹ Burning biomass leads to a climate cost in the LULUCF sector of DKK 12.2 billion in the reference scenario and DKK 8.6 billion in the scenario with payment for biomass emissions when emissions from straw and wood biomass are calculated at 15 and 35 kgCO₂/GJ, respectively. This gives a saving of 12.2 - 8.6 = 3.6 billion DKK if burning is reduced.

Does a biomass tax lead to higher heating bills?

Yes. Slightly. CONCITO estimates that it will lead to an average heating price increase of DKK 500 per year for Danish district heating customers over the next 20 years². The price increase is mitigated by the fact that part of the heat is produced without the use of biomass. At the same time, a reduction in biomass consumption contributes to limiting the price increase for district heating customers through a tax.

What does a biomass tax imply for public finances?

In 2030, halving consumption to about 50 PJ biomass and a tax of about DKK 15/GJ would, on average, amount to about DKK 750 million/year in revenue for the state. In addition, there will be a slight reduction in the cost of subsidies for biomass cogeneration.

By 2040, consumption will have fallen to 28 PJ. With a tax of DKK 20/GJ on average, just over DKK 550 million/year is obtained.

Shouldn't we phase out fossil fuels first?

We need to do both. CONCITO also calls on the Danish Parliament to work for a phase-out of fossil fuels. For example, CONCITO already recommends raising the CO₂ tax to the EU quota price level. This will send a strong signal to, among others, the North Jutland power plant to stop burning coal before 2025. The analysis and the recommended biomass tax are based on the quota price, thus ensuring that biomass pays the same for its real CO₂ emissions as fossil fuels.

Is biomass not sustainable?

CONCITO has examined the sustainability of Denmark's biomass consumption, which is among the highest in the world, in a previous note on Denmark's consumption and prioritization of biomass for energy purposes (2020)³. The conclusion of this note was that biomass consumption in Denmark should be significantly reduced.

Ea Energianalyse's observations on biomass emissions are based on a study by the University of Copenhagen that the Danish Energy Association and Danish District Heating Association helped to initiate⁴. It concludes that the biomass used in Danish plants is, on average, not sustainable. The average consists of real residual biomass and fractions with much higher than average emissions. In other words, it may be possible that parts of the Danish biomass use are based on sustainable biomass as real residues such as sawdust, while Denmark also burns unsustainable biomass.

² On average, energy system costs increase by a present value of DKK 1.6 billion over 20 years. In addition, there is a tax payment of DKK 8.3 billion to the state over the period. This results in a total additional cost for heating customers of about DKK 10 billion in present value over the next 20 years. This corresponds to approximately DKK 700 million per year. With 1.7 million households supplied with district heating, this means an average annual cost of about DKK 400 per year. (excl. VAT) or DKK 500 incl. VAT per district heating customer.

³ CONCITO (2020) [Danmarks forbrug og prioritering af biomasse til energiformål](#)

⁴ Copenhagen University (2020) [CO₂ emission mitigation through fuel transition on Danish CHP and district heat plants](#). Authors: Anders Tærø Nielsen, Niclas Scott Bentsen, and Thomas Nord-Larsen

Emissions from marginal biomass resources will typically be higher than average. Therefore, a reduction in consumption will primarily affect the biomass resources with the highest emissions.

In June 2021, a new ordinance on sustainability and reducing greenhouse gas emissions for biomass fuels and liquid biofuels for energy purposes, etc., entered into force⁵. It is uncertain whether the Ordinance will significantly change the average emission factor for wood biomass of 35 kg/GJ.

Are there enough global quantities of sustainable biomass resources?

No, and for this reason it is not enough to look at the sustainability of the biomass we burn in Denmark. The global amount of sustainable biomass resources are limited, which means that if we ship the sustainable biomass to Denmark, more unsustainable biomass will be used elsewhere in the world. This suggests that a higher emission factor should be used than that found by Ea Energianalyse. However, Ea Energianalyse' proposal for an emission factor for average wood biomass is a pragmatic starting point for regulation.

Can the report be used when it is based on historical data?

The report is indeed based on the KU report and the historical data they use, describing actual biomass used in ten Danish biomass-fired CHP plants. As the report notes, it is unclear whether the new Danish sustainability criteria will change the figures for additional emissions from burning biomass. Ea Energianalyse considers that the historical data used is the best available basis for estimating the future additional CO₂ emissions from biomass combustion at Danish energy plants.

Does the report distinguish between different types of biomass?

Yes, it does. The report from Ea Energianalyse distinguishes between straw and wood biomass. Straw has a CO₂ emission coefficient of 15 kg/GJ, but wood biomass has an emission of 35 kg/GJ.

No calculation is made for different types of wood biomass, and therefore no account is taken of the fact that some has a lower emission coefficient, but at the same time, no account is taken of the fact that some has a higher one. It is likely that the biomass that would be saved primarily by reducing consumption has an above-average emission coefficient.

How much biomass is imported for electricity and heat?

According to the Danish Energy Agency, Denmark used a total of 159 PJ of solid biomass annually in 2019. A large part of this was used to produce electricity and heat. 57% of the consumption of wood biomass in 2019 was imported. Consumption for electricity and district heating has since increased with HOFOR's new biomass-fired CHP plant commissioning.

⁵ https://ens.dk/sites/ens.dk/files/Bioenergi/14-06-2021_baeredygtighedsbekendtgørelse_-_med_underskrift_og_dato.pdf

Is it even realistic to replace biomass heat?

It will take effort to establish the necessary and climate-friendly alternative heat supply, particularly heat pumps and geothermal and surplus heat. Ea Energianalyse estimates that it is realistic. A higher price for biomass will make alternatives more attractive. The other options will largely be more solar and wind, storage, increased flexibility, transmission, etc.

Is there enough solar and wind power today to replace biomass?

There is not enough solar and wind power to replace biomass with current deployment plans. Therefore, CONCITO also recommends that the pace of expansion of solar and wind power is significantly increased. It is noted that the climate benefit of using wind power to displace biomass used for electricity and heat production is two to three times higher than if the same power is used for power-to-X. This result is based on the analysis's figures for additional emissions from biomass burning. If there are concerns about the adequacy of green power, the Danish government's proposals for reductions in the electricity tax and the power-to-X strategy, among others, should be revisited.

Will we need biomass plants to produce the green Power-to-X fuels of the future?

The challenge with Power-to-X is primarily that, at least in the short term, there is not enough green power for all the purposes we would like to use it for. Wind power displacing wood biomass, as mentioned, has two to three times the climate benefit than if used for PtX. If we get a surplus of green power that is so cheap that PtX becomes viable, it is debatable whether biomass CHP makes economic sense.

Won't we need the biomass to make negative emissions with CCS?

It is difficult to see the economic rationale for CO₂ capture and storage on biomass. Ea Energianalyse estimates that the CO₂ price would have to rise to well over DKK 1000/ton before CCS on biomass-fired plants is economically more attractive than reducing biomass use. This is partly because the climate effect of biomass CO₂ capture is partially eroded because biomass is, in practice, not CO₂ neutral. This results in a higher cost per ton of CO₂ actually saved.

CONCITO estimates that a large number of operating hours are needed at the plants to achieve reasonable economics in CO₂ capture. This will not be the case with biomass in a future energy system, where biomass is expected to act primarily as a backup during periods when the wind is not blowing. Therefore, it is expected to be disproportionately expensive to apply CCS to biomass CHP. On the other hand, CO₂ capture and storage can be applied to waste incineration plants, ensuring heat production that can further displace biomass.

Isn't it a pity for the utilities that have invested in biomass in good faith?

In the 2012 Energy Agreement, the Danish Parliament encouraged investments in converting CHP plants from coal and gas to biomass. As a result, the energy and utilities sectors have invested heavily in converting CHP plants from coal and gas to biomass. At that time, there were critical voices that biomass was not sustainable. Just as the 2012 agreement envisaged a security of supply tax on biomass of DKK 31/GJ of heat, higher than CONCITO's proposal of DKK 15-20/GJ⁶. Technological developments have made electricity generation from offshore wind and solar cheaper than biomass, so it makes sense to reduce the use of biomass and replace it with heat pumps and wind power.

What about the share of biomass consumed outside the collective energy supply?

Today, one-third of Denmark's biomass consumption occurs in households and small businesses using wood pellet boilers. The Ea Energianalyse report carried out for CONCITO examines only the collective electricity and heat supply. To the extent possible, biomass consumption in households should also be regulated and could appropriately be subject to the same tax as that levied on consumption by large installations.

Will there be a CO2 tax on biomass from the EU?

If the EU Commission's proposals for minimum taxes go through, a tax of €3.3/GJ on biomass used for heating will be introduced from 2023. The tax is a positive small first step and sends a signal, but it is still too low to reflect the real climate damage of using fuels like most EU minimum rates. Denmark should go further and introduce a higher tax.

In addition, the EU Commission is proposing tighter regulation of forest carbon pools (so-called LULUCF regulation). If the loss of carbon in forests can be regulated economically, this would be preferable. Sufficiently strong economic regulation in the forests may, in the long term, make a Danish biomass tax unnecessary, which would then be double regulation. In this scenario, however, biomass would be just as expensive as in CONCITO's tax proposal, and the economic rationale for reducing the use of biomass would remain.

Should Denmark not maintain biomass capacity to maintain a high level of security of electricity supply?

Ea Energianalyse has both analyzed scenarios where biomass plants are closed and where they are not allowed to close. Even if the plants are kept, it still makes sense that they produce less and act more as a backup for wind power. The long-term security of electricity supply should be ensured by developing electricity storage technologies, possibly complemented by gas turbines, which have a limited cost according to Ea Energianalyse.

⁶ CONCITO's proposal does not only include heat production, but is added to the entire biomass usage – also including electricity production. The 2012 Parliament proposal for a security of supply tax only applied for usage for heating.