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Climate - Policy
PÓLIMP
BRIEFING NOTES

Sustainability criteria for biomass

The importance of transparency, sustainability co-benefits, and trade-offs

Knowledge need

An important knowledge need for bioenergy stakeholders in Europe is the harmonisation of sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling, both on Member State and EU levels. The development of a transparent and consistent sustainability framework, including a harmonised set of sustainability criteria, would ensure a level playing field for biomass use and would significantly reduce the level of uncertainty for bioenergy investors. This, however, also requires a better understanding of the real environmental, economic and social costs and benefits of using biomass sources for energy purposes. In addition, increasing the awareness and transparency of sustainability trade-offs and co-benefits in the public debate about bioenergy and the energy transition would further facilitate the development of a harmonised sustainability framework.

At a glance

Thematic area Renewable energy

Key words bioenergy; sustainability; policy; impacts; co-benefits; trade-offs

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Summary

Harmonising sustainability criteria for solid and gaseous biomass resources across Europe should help to reduce uncertainty and ultimately the costs of achieving climate and renewable energy targets. This note addresses the importance of considering sustainability trade-offs and co-benefits as opposed to using biomass solely for climate reasons. It concludes that a multi-criteria framework could serve as a starting point for discussing which sustainability impacts are valued more and are considered relevant at various government levels.

Policy framework

The EU Renewable Energy Directive (RED) sets mandatory sustainability criteria for transport biofuels and bioliquids used in other sectors. Despite the fact that the largest share of the EU`s renewable energy demand is covered by biomass resources (see Figure 1), the European Commission has adopted only non-binding recommendations for Member States regarding sustainability requirements on the use of solid and gaseous biomass sources in the energy sector. Recommendations are similar to those applied for biofuels and bioliquids and are applicable to biomass installations with a minimum of 1 MW electric or thermal capacity. Additional recommendations include the design of national support schemes to stimulate higher efficiency of bioenergy plants and to keep records of the origin of primary biomass used in the energy sector.

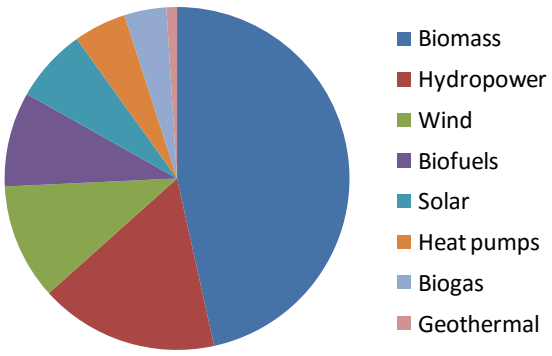

Figure 1. Shares of renewable energy sources in the EU`s total renewable energy demand in 2014. See also the European Commission factsheet on the Renewable energy progress report on europa.eu

Due to the lack of a harmonised and binding sustainability scheme, many Member States and market actors have independently developed their own voluntary sustainability schemes and certificates to prove the sustainability of biomass use. Therefore, sustainability criteria may vary depending on national, regional and sectoral interests and priorities and do not necessarily ensure sustainability for the entire supply chain. The presence of divergent sustainability schemes, however, may cause frictions in the competitive national and international energy markets, as well as introduce the risks of inefficient and unsustainable use of biomass resources. To reduce these risks and increase transparency, several Members States (e.g. the UK, the Netherlands, Denmark and Belgium) have already adopted or drafted legislation on a set of sustainability criteria for solid and gaseous biomass use.

Impacts of bioenergy pathways

Bioenergy production can result in a number of environmental, economic and social benefits such as significant greenhouse gas (GHG) emission reductions, improved energy security and production efficiency as well as new sources of income and additional job opportunities along the whole biomass value chain (especially in rural areas). On the other hand, if the bioenergy is produced in an unsustainable manner, these benefits rapidly vanish and may even result in more negative sustainability impacts than its fossil counterpart.

Individual national and EU-level climate and energy targets (2020 targets) stress the importance of the reduction of GHG emissions and the overall increase of energy efficiency, while other impacts that might carry sustainability risks, including economic and social impacts, are often overlooked.

Sustainability co-benefits and trade-offs

When assessing the sustainability performance of a bioenergy pathway relative to its fossil counterpart or another bioenergy pathway, certain co-benefits may arise where a positive effect on sustainability indicator X is accompanied by a positive effect on indicator Y (e.g. GHG emission reduction in combination with increased employment). Contrary to such co-benefits, there might also be sustainability trade-offs, meaning that any positive performance on one indicator might come at the expense of the performance of another (e.g. lower GHG emissions, but higher particulate matter (PM) emissions or lower employment). The relative importance (weight) of individual impacts is determined by development priorities of the respective society and government.

In ideal circumstances, policy makers would try to look for positive synergies to increase the public acceptance of climate and energy policies. However, in most cases, the discussion about co-benefits is not that transparent, and in many cases any potential sustainability trade-offs are ignored.

In the following section, the importance of considering sustainability co-benefits and trade-offs prior to policy decisions will be illustrated by examples based on bioenergy pathways in the Netherlands.

Bioenergy pathways in the Netherlands

We have selected 5 representative Dutch bioenergy pathways to perform a sustainability assessment and attempt to discover which type of pathway provides the highest/lowest contributions to a specific sustainability impact. The selected bioenergy pathways are the following:

- Imported wood pellets for electricity production in co-firing power plants
- Domestic wood chips for district heating
- Partly imported used cooking oil for biodiesel production
- Agro-food residues for biomethane production
- Animal manure digestion for biomethane production

Depending on a country's socio-economic and environmental development priorities and targets, certain preferences can arise with respect to bioenergy. We explore this dynamic by assuming that sustainability comprises of 1) GHG emissions, as an environmental indicator; 2) the energy balance, as energy efficiency indicator; 3) production costs, as an indication of the cost-effectiveness; and 4) employment effect, as a social indicator. Based on these strategic development preferences, a simple co-benefit and trade-off analysis can be performed. It is important to note that any such comparison is highly sensitive to the indicator selection and the weighting method that is applied.

Considering that most renewable and bioenergy policies are strongly driven by the ambition to reduce GHG emissions, there is an implicit need to substitute fossil fuels. Therefore, focusing on the net impacts, the avoided fossil reference impact deducted from the bioenergy pathway impact, is one of the dominant approaches to assess sustainability impacts. By using wood pellets instead of hard coal, the least sustainable fossil fuel is avoided. In the case of wood chips and biomethane there is a substitution

of the use of domestic natural gas while biodiesel substitutes fossil diesel.

Figure 2 shows the net sustainability impacts of the selected bioenergy pathways (showing total and also domestic net impacts where relevant) and allows to scan for trade-offs and co-benefits.

In terms of GHG emission reductions, the wood pellet pathway shows the most favourable impact as it is substituting hard coal, although this comes at the expense of having one of the worst net energy balances, and high net additional production costs.

The wood chips-based district heating and biomethane production from agro-food residues are amongst the best in terms of creating additional (net) employment while still scoring quite favourably on net increase in production costs, net energy balance and net GHG emissions performance (when compared to the other bioenergy pathways).

Biodiesel production from used cooking oil has the lowest net production costs, but also the lowest net employment impacts. While the total (domestic) GHG performance of the manure biomethane pathway is amongst the best in class, it also shows the highest net energy balance and the highest net production costs per unit of energy.

This clearly shows that sustainability trade-offs do exist, and it is a key challenge to identify the proper sustainability balance and select those bioenergy pathways that are best aligned with national/regional development priorities.

Geographical distribution of impacts

The national comparison of bioenergy pathways also shows that the geographical distribution of a given impact might also have an influence on how one assesses any co-benefit or sustainability trade-off – especially when the biomass product is imported.

For example, in the case of the Dutch wood pellet pathway, GHG emissions and energy use related to wood pellet production would only increase abroad since production and long distance transportation of wood pellets occur outside of the Netherlands. At the same time, the domestic GHG emissions and fossil energy use would be reduced, as a result of the substitution of coal combustion for electricity production. From the Dutch perspective this is environmentally optimal (lower domestic pollution levels), but then again this pathway does not generate as much net employment domestically as all other bioenergy pathways would. This is because additional labour for wood pellet production mainly takes place in the US and Canada, while domestically, the labour volume remains relatively stable, as labour is merely redistributed from coal-related to pellet-related activities.

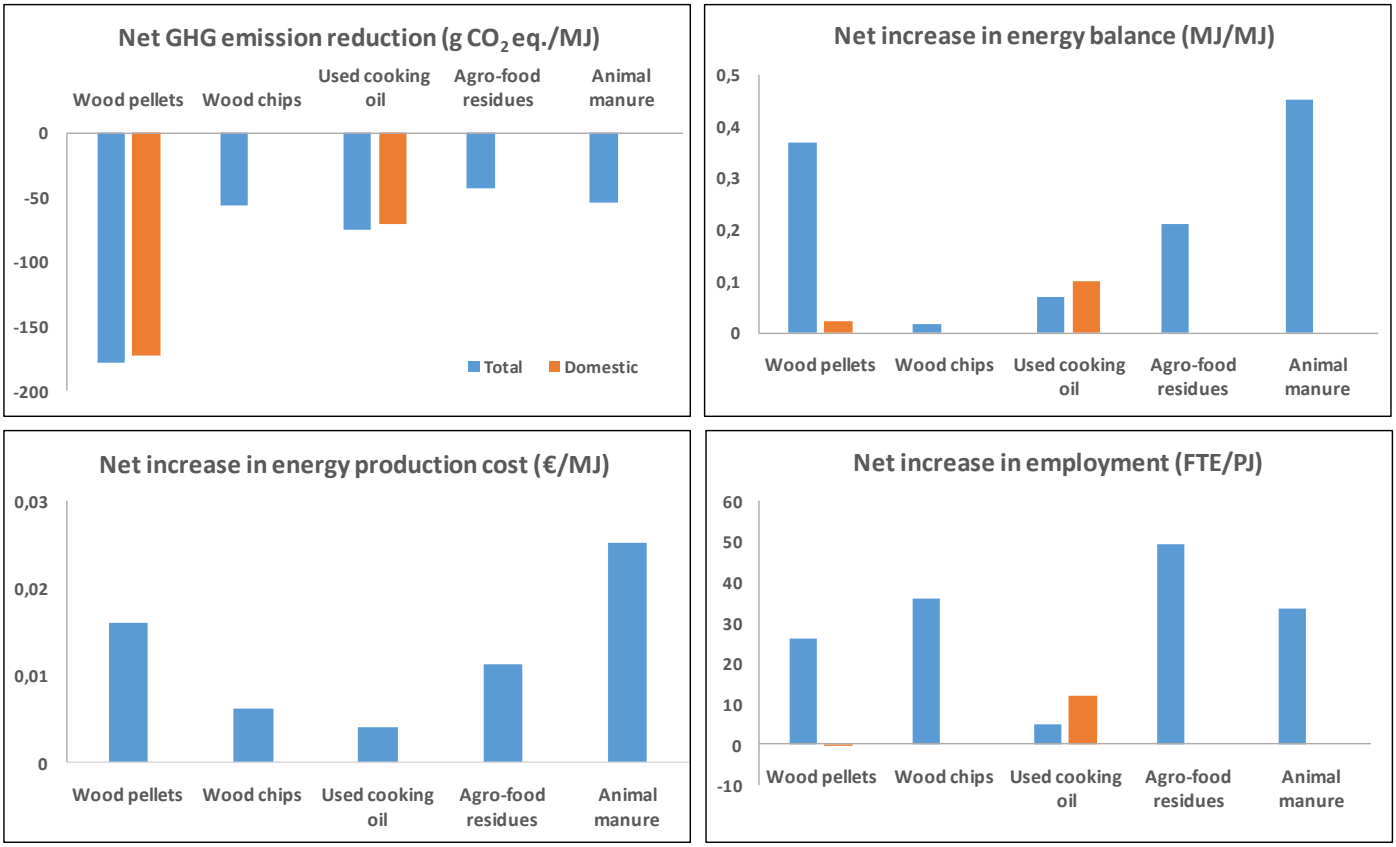

Figure 2. Net total and (where relevant) domestic sustainability trade-offs and co-benefits of the selected Dutch bioenergy pathways based on a limited set of indicators selected as national strategic development preferences

For biodiesel production, this effect is much less pronounced since only part of the used cooking oil is imported while handling of the feedstock (e.g. filtering and purification) and production of the bioenergy all occur on the domestic level.

The key variable here is if, and to what extent, the positive impacts can be maximised domestically, while some or most of the negative effects are 'exported' to the supply countries. So from the national perspective, 'exporting' some sustainability impacts – in some cases – can be a rational strategy, although it still leads to negative sustainability impacts in other countries along the supply chain.[1] From an economic point of view this 'exporting' would correspond to achieving lower production costs, or lower reported national GHG emissions.

From the environmental perspective, it would simply correspond to a geographical (re-)distribution of pollution or resource depletion. However, in some circumstances a certain environmental impact in country X might be valued differently than in country Y (while having exactly the same impact). A society might value additional PM emissions in country X (highly urbanized and already confronted with serious air quality issues) entirely different from the same increase in PM emissions in country Y (low populated area with very few background PM concentrations). The same goes for deploying water intensive processes and technologies in water scarce or water abundant areas.

Policy implications

Considering sustainability trade-offs and co-benefits of bioenergy pathways would facilitate the development of an efficient and transparent sustainability framework, both on the national and EU level. When comparing the sustainability impact of one bioenergy pathway with another, we have shown that any positive performance on one indicator might come at the expense of the performance of another (e.g. lower GHG emissions, but lower employment). On the other hand, there might also be co-benefits, where positive effects are seen on multiple indicators (e.g. GHG emission reduction and increased employment).

A simple multi-criteria framework could be used for comparing the sustainability performances of both 'bioenergy to bioenergy' and 'bioenergy to fossil energy' comparisons. The multi-criteria framework could serve as a starting point for discussing which impacts are considered relevant at the (inter)national and regional level (indicator selection) and which performances are valued most (weighting of various development priorities) by the public. The reflections on sustainability trade-offs and co-benefits provided in this paper have been developed only for illustration purposes and may greatly vary depending on national/regional objectives and development priorities. In fact we suggest that local circumstances and conditions should have a strong influence on what is considered to be sustainable development in the field of bioenergy.

In any case, everyday international trade-flows exhibit a certain geographical (re-)distribution of pollution. In our opinion more awareness and transparency about this phenomenon is needed, so that also more rational decisions can be made with regards to which biomass resources to use. We also argue that in this case, any geographical (re-)distribution of environmental impacts is not by definition a zero-sum game, as the absorptive capacity of the respective regional ecosystems and societies could differ.

Read more

This Briefing Note is based on the results of the Dutch report developed in the framework of the EU co-funded BIOTEAM project. More information on the project and the final report on the comparative sustainability assessment of various Dutch bioenergy pathways are available at www.sustainable-biomass.eu.

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The **POLIMP** project aims to address gaps in knowledge and to inform policy at various decision-making levels regarding the implications of international climate policies under discussion. www.polimp.eu

[1] Under the UNFCCC the National GHG Inventory Reporting is performed on a national level (meaning that only national sources and sinks are included in the inventory and not GHG emissions embedded in products or services).

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