Good use of biomass

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Biomass can be used for various applications in many sectors. It is now becoming clearer that the supply of produced biomass is constrained by sustainability criteria. So the question is: 'what are the best places in the economy where biomass should be used?' In short: what is good use of biomass?
At this point in time, around 13% of the global energy used is supplied from sustainable sources. Biomass is responsible for over 75% of this amount, where almost 90% consists of woody biomass. Burning biomass to produce heat and/or power is the main technique used. To a limited (but increasing) extent, liquid biofuels for the transport sector are being produced from agricultural crops. Biomass is also being used in the chemical sector (for example, for making soap) and as an end-product (such as construction material for the building trade). Global analyses show that, in the long term, it is possible to develop biomass potential (amounting to at least 100 EJ) from agricultural and forest residues. This is 20% of the current global energy consumption. If agricultural intensification can be accelerated faster than the increase in food demand, it will also be possible to use a limited range of specially cultivated crops. The Netherlands is expected to be able to produce around 0.15 EJ of biomass in the year 2020. This mainly concerns woody residues, manure and the bio-segment of mixed waste flows. The Netherlands will depend on import of sustainable biomass to reach its obligations.

CRITERIA FOR GOOD USE OF BIOMASS

Before analysing the usage, we first need to define what we mean by 'good use'. Based on earlier analyses and discussion, the Bio-based Raw Materials Platform has defined the following criteria:

1. A high CO_2 reduction per euro additional costs[1].
2. A high CO_2 reduction per hectare of land-use per year.
3. The highest possible contribution to the Dutch economy.
4. Contribute to the security of our energy supply.
5. Minimum loss of nutrients.

[1] The CO_2 reduction should be calculated including the (indirect) effects of land-use change (ILUC). Because further study is required, this aspect is only briefly discussed in the report.

RESULTS OF THE ANALYSIS

We need to emphasise that the analysis presented here only focuses on the main issues and still needs further refinement. However, this analysis indicates a clear differentiation between biomass options.

Results will be presented for the three timeframes:
Today at 2010, 2020 and 2030. It results in a priority listing of the options:

Ranking of options in 2010

Good:

1. Anaerobic Digestion of manure (with little cofermentation material).
2. Using biomass in the steel sector.
3. A number of specific biochemical routes (e.g. 1.3 PDO and ethene from sugar cane).

Average:

4. Auxiliary combustion of biomass at coal-fired power plants.
5. Bio-cogeneration.
6. A number of biochemical options.
7. Bioethanol from sugar cane (assuming there is no great effect from indirect land-use change).
8. Co-fermentation of manure.

Low:

9. Biodiesel from rapeseed, palm oil and soya oil.
10. Bioethanol from wheat or corn.

Ranking of options in 2020-2030

Based on a broad range of existing literature, estimates have been made for the techniques used during the period 2020-2030. These also predict that considerable woody biomass will be used (by-products and residues), which can be used as a source of:

- Heat and power.
- Transport fuel.
- Chemicals.
- Steel production (coal replacement).
- Other products.

It is not possible to determine beforehand which applications will be preferred, with the exception of biocogeneration (which scores well).

Figure 1 **€/ton CO_2 costs for options in 2020**

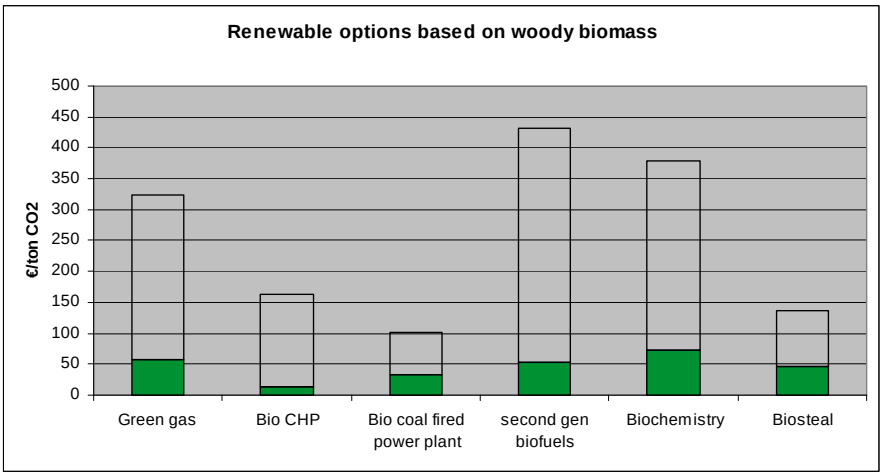

Figure 1 shows that the cost ranges of these options overlap each other. We can therefore expect some stiff competition from biomass. With so many different biomass users it will become increasingly important to harmonise the biomass policy for these sectors. For the electricity sector, particularly, it is also important to compare other options, such as wind energy, which also costs around the same as the favourable bioenergy estimates (low wood price). This comparison lies outside the scope of this analysis.

Scores for options based on €/tonne CO_2

It is remarkable that there are a number of chemical options that will become economically feasible, and that heat and power applications will be relatively inexpensive. Actual use in these sectors will largely depend on government policy, as well as the availability and costs of alternative options for the sector. The compulsory segment of transport biofuels is thus already higher for biomass flows that are used in this sector.

Scores for options based on tonne CO_2/ha/year

The top scores for this criterion are mainly earned for options where wood replaces coal (biosteel and auxiliary combustion at coal-fired power plants). Manure and other residues also score very well for this criterion, because they require only a few hectare of land. First-generation biofuels from a moderate climate do not score well for this criterion.

ADVICE GOOD USE OF BIOMASS

Based on these analyses, a guideline for good use has been defined.

Short-term good use (up to 2020)

Use: Primarily bioelectricity, bioheat, biosteel, fermentation of manure and some biochemicals.
R&D: Sustainable raw material production (= primarily making residues available), biochemicals, biofuels from residues or woody biomass, biorefining, gasification of biomass into green gas.

Medium-term good use (2020-2030)

Use: Bioelectricity, bioheat, biochemicals, biosteel, green gas based on fermentation and gasification and biofuels from residues of woody biomass.
R&D: Biorefining.

Long-term good use (after 2030)

There will probably be a commercial shift from options that use many alternative sustainable options (electricity), to other options (e.g. high-temperature heat, aviation and marine applications), and biorefining will play an increasing role, because we assume a strict climate policy.

GOOD BIOMASS POLICY

The choices for using biomass are strongly guided by government policy. The current compulsory use of biomass in the transport sector, and the subsidies given for using biomass in the electricity and gas sectors, influence the level playing field for good use. In order to correct this, the Dutch government could pay more attention to:

1. The use of biomass in the steel industry (interesting option, in both the short and long terms, but currently entirely out of the picture).
2. Using biomass in the chemical sector (smaller markets are already an interesting option, and important in the long term).
3. More efficient production and processing of biomass (e.g. via biorefining).

The government should also focus less on:

1. Using 1st-generation biofuels based on agricultural crops.

With respect to the form this policy should take, subsidy schemes should focus more on reducing CO_2 as much as possible, using marginal land where possible, rather than the current stimulants per litre, Nm^3 or kWhe, because various options differ widely in terms of performance per amount.

CREATING A LEVEL PLAYING FIELD

Subsidies are less suitable for achieving a level playing field in policy support (in all sectors, from energy, transport, chemicals through to raw materials) for biomass. A general CO_2 tax is an interesting option to limit the entire economy's climate emissions, but is limited to biobased or DE-based options. In theory there seem to be three policy instruments that are suitable for creating a real long-term level playing field for the various sectors, for biomass options in the Dutch economy:

1. A compulsory bio-based segment in all relevant sectors.
2. A compulsory percentage of sustainability in all relevant sectors.
3. A CO_2 norm per product for all relevant sectors.

In addition to these main stimulants, it is probably also useful to provide a temporary additional stimulant (such as subsidies) for a number of part-options. The exact fine-tuning of these options falls outside the scope of this project.