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Climate - Policy
POLIMP
BRIEFING NOTES

Cost-effectiveness of renewable energy support schemes

The case of bioenergy

Knowledge need

An important knowledge need for both public and private stakeholders in Europe is the cost-effectiveness of their actions. Particularly in the field of bioenergy the cost-effectiveness of investments is under pressure, as the availability of biomass resources is often limited. Given the considerable share of bioenergy in the renewable energy portfolios of many EU Member States, it is worth reflecting on the cost-effectiveness of support schemes for bioenergy.

Defining cost-effectiveness

Renewable energy currently requires some public support in order to compete with fossil energy. Most discussions on cost-effectiveness of renewable energy focus on the cost-effectiveness of public support.

The EU guidelines on state aid for environmental protection and energy (2014) set the rules for supporting renewable energy. The goal of these guidelines is to contribute to the EU's climate objectives, while *"avoiding any waste of taxpayers' money and distortions of competition in the EU internal markets."* The general principle is that, ideally, each additional unit of renewable energy should be produced at the lowest cost possible. As a result, government support for renewables should go to those projects that require the lowest support premium, compared to fossil energy prices. Currently, feed-in premium (FIP) and tariff (FIT) schemes are widely used in EU Member States, and the state aid guidelines aim to reduce these *"to a minimum, in view of their complete phasing out."*

As of 2017, the feed-in support is supposed to be granted via *"a competitive bidding process on the basis of clear, transparent and non-discriminatory criteria."* The European Commission presumes this will make that *"aid is proportionate and does not distort competition to an extent contrary to the internal market."*

At a glance

Thematic area Renewable energy

Key words bioenergy; cost-effectiveness; support schemes; feed-in tariffs

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Summary

With public budgets under pressure, the cost-effectiveness of public support for renewable energy is under discussion. This briefing note shows that evaluations of cost-effectiveness should not be limited to financial-economic considerations, but be complemented by an assessment of externalities. In addition, cost-effectiveness should be assessed in the context of several years, to ensure that public support does not cause competitive distortions.

The economic cost-effectiveness of bioenergy

Considering that biomass for energy production is one of the largest contributors to the EU's climate and energy targets for 2020, it is worthwhile to explore what the introduction of competitive bidding would mean for bioenergy options. Bioenergy is expected to contribute a 54.5% share of total gross final renewable energy consumption in the EU by 2020.

The process of competitive bidding can be organised in different ways, such as through setting a fixed support premium for specific renewable energy options (e.g. only for manure co-digestion for CHP production) or for all renewables (where all types of renewable energy projects compete for the same premium).

A key requirement of any competitive bidding process is that the available budget should be limited, to ensure effective use of taxpayer's money.

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The more advanced bidding processes provide a single annual budget, that is open for bidding in several phases. In each of the consecutive phases the minimum support level increases. The bidding continues until the budget runs out (see Figure 1). In this way, the lowest-cost options will receive support first, and as such cost-effectiveness is ensured.

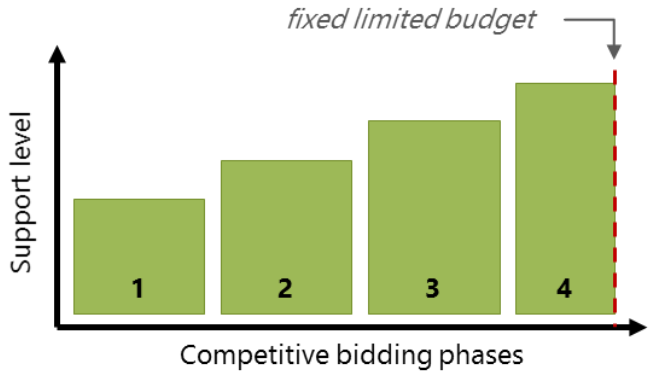

Figure 1. Competitive bidding for renewable energy support.

Repeated annual competitive bidding processes can, however, potentially affect the cost-effectiveness of the overall support scheme throughout the years. In the bioenergy sector this is especially apparent, when similar projects that receive support from different bidding phases and/or years aim to attract biomass from the same pool. Depending on the type, size and remaining potential of the relevant 'biomass pool', new bidding rounds could have an adverse effect on biomass prices. This can occur in cases where similar projects receive a different level of support, and therefore can pay different prices for the biomass. This potentially affects the economic feasibility of existing / new bioenergy projects.

Assuming a limited pool of available biomass, bioenergy projects that receive higher support levels are able to outbid other similar biomass projects. The overall cost-effectiveness of the premium support scheme is then hampered, as there are significant costs related to failing renewable energy projects, that are no longer able to compete for the biomass.

Policy makers should be aware of these 'intertemporal effects' of repetitive annual bidding rounds, which may cause disturbances in (regional) biomass markets. Before each year's bidding round, policy makers could analyse if there is still sufficient biomass available at the assumed prices, to ensure that newly supported bioenergy projects will not outcompete older projects, or vice versa.

Admittedly, it will be very difficult – if not impossible – to develop a pragmatic and robust strategy to prevent such unwanted effects on the biomass markets, especially since any given biogas plant might use up to 10 different types of biomass (co-substrates), and because there can be significant regional differences in biomass markets within countries. However, awareness of the possible effects and the remaining biomass availability are useful indicators.

Social and environmental cost-effectiveness of bio-energy support

A cost-effective premium support scheme typically provides the largest possible volume of renewable energy produced per unit of support – in other words, as many megajoules of renewable energy as possible per euro of support.

However, one of the requirements for state aid to be considered eligible is that the support measure addresses some form of market failure. There should thus be a "need for state intervention." Common grounds for government interventions are market externalities, which relate to costs or benefits that are not included in market prices. These externalities can be negative (e.g. greenhouse gas emissions reduction), or positive (e.g. employment creation).

The discussion of cost-effectiveness thus not only relates to financial-economic aspects, but also on the intention to tackle externalities. The question therefore is, if and to what extent, will the process of competitive bidding automatically results in a set of winning technologies that are not only most cost-effective in economic terms, but also are effective in addressing externalities (e.g. does the support for the lowest cost bioenergy option also deliver the highest net GHG emission reductions or the highest level of additional employment?).

Table 1. LCIA results of bioenergy pathways in the Netherlands.

Bioenergy pathway	**Costs**	**Net GHG**	**Net employ.**
	M €/PJ	*ktCO$_2$eq/PJ*	*FTE/PJ*
1 Wood pellet co-firing	27	-178	+26
2 Wood chips for district heating	11	-56	+36
3 Used cooking oil for biodiesel	17	-75	+5
4 Agrofood residues for biomethane	16	-43	+49
5 Mono-manure digestion for biomethane	30	-54	+33

To illustrate this broader view on the cost-effectiveness of bioenergy support, some results of a life cycle inventory assessment (LCIA) are presented. Table 1 shows the production costs, the net impact on GHG emissions (compared to the fossil energy), and the net employment impact (change in employment in bioenergy relative to fossil energy) for five bioenergy pathways in the Netherlands.

It is assumed that the production costs per unit of energy are a proxy for the economic cost-effectiveness of bioenergy. The social and environmental effectiveness can be explored by calculating two ratios: production costs per (1) net GHG emissions saved, and (2) unit of additional employment.

Table 2. Environmental and social cost-effectiveness ratios.

pathway / ratio	1	2	3	4	5
Costs / GHG reduction	0.15	0.20	0.23	0.37	0.56
Costs / net employment	1.04	0.31	3.47	0.33	0.90

Table 2 shows that for the first ratio, pathway 1 (wood pellet co-firing) is the most favourable, as the costs per unit of GHG emissions avoided are the lowest. Although the production costs per unit of output are quite high for this pathway, the high level of net GHG emission savings indicates that this is a cost-effective solution to reduce GHG emissions. On the other hand table 2 shows that pathway 1 less favourable on the second ratio, showing relatively high costs per additional employment created. Here, pathways 2 and 4 are much more effective.

Cost-effectiveness of public support

It should be noted that production costs are not equal to the level of public support granted to each specific pathway. As such it may not be the right proxy for evaluating the environmental and social cost-effectiveness of public support.

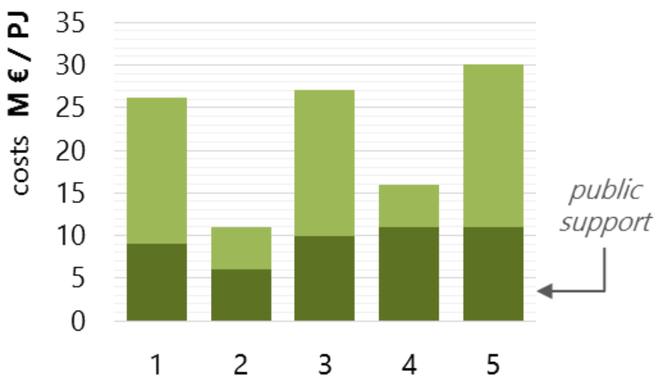

Figure 2. Estimated support levels as share of production costs of bioenergy pathways in the Netherlands.

To validate the environmental (GHG) and social (employment) cost-effectiveness, Figure 2 illustrates the estimated public support levels as a share of the total production costs. For most pathways, the public support is approximately € 10 million per PJ of renewable energy (or € 0.01 per MJ). Only pathway 2 (wood chips for district heating) receives considerably less support. Pathways 1 (wood pellet co-firing) and 5 (mono-manure digestion for biomethane) receive relatively low levels of public support relative to the overall production costs.

Recalculating the two ratios based on public support levels (rather than total production costs), pathway 1 still shows the highest environmental cost-effectiveness, and pathway 2 remains the most cost-effective socially (see Table 3).

Table 3. Cost-effectiveness ratios of public support.

pathway / ratio	1	2	3	4	5
Support / GHG reduction	0.05	0.11	0.13	0.26	0.20
Support / net employment	0.35	0.17	2.04	0.22	0.33

Conclusions

While typical evaluations on cost-effectiveness of support schemes are limited to financial-economic conditions, we have shown that such evaluations should be:

(1) assessed in the context of several years, to ensure that the public support does not cause competitive distortions in the biomass market;
(2) complemented by an assessment of externalities, such as GHG emissions reductions and employment effects.

Read more

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

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