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Biofuel policies for dynamic markets

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Elobio: a very short introduction

I. The problem:

Increased demand for biofuels could have significant long-term impacts on several commodity markets. Current disputes on this issue (with rising prices in today's markets) require responsible policy.

II. The objective:

Formulation of efficient and low-disturbing policy options that enhance biofuels while minimizing the impacts on e.g. food and feed markets and biomass for power and heat.

III. The activities:

- Review of current experiences with biofuels and other renewable energy policies and their impacts on other markets;
- Iterative stakeholder-supported development of low disturbing biofuels policies;
- Model-supported evaluation of these policies' impacts on food & feed and lignocellulosic markets;
- Assessment of selected optimal policies' impact on biofuels development, potentials and costs.

The Elobio Policy Paper series

In the course of the project (November 2007 – April 2009), the Elobio team will prepare a short series of Policy Papers presenting Elobio results and news in the context of the actual policy debate on biofuels. Key target audience are policy makers at the EU and EU member state level. Contributions will largely be based on (intermediate) results of the project.

Contact Elobio

ECN – Energy Research Centre of the Netherlands
info@elobio.eu
www.elobio.eu
0031 224 564431

The role of policy in mitigating risk of second generation biofuel projects

Tjaša Bole and Marc Londo, Energy Research Centre of the Netherlands

Because of perceived technology risks, biofuel projects employing advanced production technology turning lignocellulosic feedstock into second generation biofuels face a much higher cost of capital compared to projects using conventional, first generation technology. To overcome this investment hurdle and achieve a significant contribution of second generation to the biofuel mix in Europe, a certain level of policy support will be required in the short to middle term. A number of policy options and combinations were tested for their effectiveness and efficiency in bringing advanced biofuels on the market. An initial high investment subsidy together with the double counting mechanism, the latter already proposed in the European Renewables Directive, can achieve a market share of almost 20% by 2020 at a policy cost of less than 1 billion eur. However, to fulfill its purpose best, double counting must be discontinued when learning effects have lowered the cost of the technology sufficiently to compete with first generation, otherwise it reduces the long-term size of the biofuel market and suppresses the production volumes of advanced biofuels.

1. Introduction

Despite important technological advances of the past few years, second generation biofuels are largely still at a demonstration stage and seem to be lacking investment to move toward full commercialization. One of the main barriers hampering a more significant market share for advanced biofuels are the perceived risks of second generation biofuel projects. First and second generation biofuel chains have very different risk profiles, which translate to different costs of capital for biofuel projects employing more established or newer technologies. Higher perceived risks will result in higher cost of capital, mainly because it will need to be financed to a larger extent by the more risk-tolerant equity finance, which also requires higher returns. This influences the rate of market deployment and consequently affects their technological learning curve and further cost reductions.

In this policy paper we provide a short summary of:

1. The risks related to first and second generation biofuel projects.
2. The related cost of capital and its implications for market deployment of advanced biofuels.
3. An analysis of what policy options can overcome the initial investment hurdle for advanced biofuels, help lower their cost of capital and achieve wider market deployment.

2. Risk profiles of biofuel projects

As with all investments, investing in biofuel production is not without risk. There is a large body of literature exploring various risks related to investments in renewable energy technology employing a range of risk-categorizations (e.g. Jager and Rathmann, 2008). In this paper, we narrow our focus on risks that are as much as possible specific to biofuels projects, and the way they are perceived by finance providers, since their view will determine whether a biofuel project will be able to obtain finance or not.

A number of biofuel finance experts were approached to qualitatively evaluate the most important risks related to biofuel projects. According to the answers received from the surveyed experts, first and second generation biofuel projects exhibit very different risk profiles – although similar risks play a role for each, their perceived influence (or weight) is very different.

Table 1: Risk profile of first and second generation biofuels

Risk Type	***1st generation***	***2nd generation***
Technology risk	Low-medium	High
Market risk	High	Medium
Regulatory/Policy risk	High	Medium
Geopolitical risk	Medium	Low
Stakeholder acceptance	High[1]	Low

N=7

The relevance of a risk for an investment decision often lies in the availability of mitigating options. What follows is a short discussion of the main types of risks and mitigating possibilities or the lack of those.

Technology risk

Refers to performance level, unexpected maintenance, necessary upgrades etc. Technology risk is especially relevant for new technologies, such as second generation biofuels, which have a short or even no track-record in large-scale production installations producing a product of consistent quality for longer period of time. Although parts of the technologies employed for the production of second generation biofuels have been used for other purposes for some time now, the entire production chain remains unproven on a large, commercial scale, thus remaining highly risky from the point of view of investors and lenders.

Because of technical reasons and a lack of sufficient successful demonstration projects so far, capital providers see technology risks related to investments in second generation production facilities as "high," which completely alienates risk-averse banks but even most private equity. As Zider (1998) points out, "betting on a technology risk in an unproven market segment is something even venture capital would avoid."

Crucially, from the position of finance providers there is not much that can be done to mitigate technology risk. To some extent it can be managed by requiring a working prototype before the investment is made, and by staging investments, so that later financing rounds are tied to the achievement of certain milestones in technology development (Wüstenhagen & Teppo, 2006). However, while this will provide a certain level of security for the investors, it might further extend the project timeline and further delay large-scale implementation.

Therefore, increasing the number of commercial-scale demonstration plants to bring some initial quantities of second generation biofuels on the market, thus building the technology's track record, would be the most effective way to mitigate technology risk.

Market risk

Mainly refers to fluctuations of the feedstock and biofuel prices and the correlation between the two or rather the lack of it. At the moment it is much more relevant for first generation biofuels, which use volatile foodstuffs as their main feedstock. However, it could become increasingly significant for second generation installations as well, since they will have to be

[1] Note that "high" in this case refers to "high risk of stakeholders acceptance" or in other words "high likelihood of stakeholders un-acceptance". The converse is true for second generation.

very large to be economical (requiring around a million tonnes of dry biomass a year, IEA Bioenergy, 2009) and will need to source its feedstock form an already very tight market for woody biomass.

Contrary to technology risk, market risk can be mitigated to a certain extent by investing in a multi-feedstock plant, hedging and securing long-term contracts can increase price predictability, at least for the short to middle term. The biorefinery concept maximizes the use of the biomass resource and brings revenue from different markets, lowering the risk of a slump in one of them. Although market risk remains high, these mitigation options make it less uncontrollable and thus a somewhat smaller issue compared to technology risk.

Regulatory risk

Regulatory risk refers to possible changes in targets for biofuels, discontinuation of support programs, additional requirements, such as sustainability criteria etc. Interestingly, regulatory risk is perceived as a bigger issue for first than for second generation biofuels, although the latter are even more dependant on government support than their first generation counterparts. The main reason for this is the expectation among capital providers that sustainability criteria will play an increasing role in governmental support for biofuels and in this respect, second generation technologies are widely known to perform better than first generation.

As most biofuel production still requires policy support it is important whether investors and lenders consider this support as adequate and stable, or insufficient and unreliable. Among venture capitalists investing in the sustainable energy sector, political risk is seen as very high and is particularly disliked by investors because it seems harder to manage or even outside their area of influence (Wüstenhagen & Teppo, 2006).

Geopolitical risk

Geopolitical risk partially overlaps with regulatory risks but refers more specifically to biofuels that largely rely on imported feedstock, which makes them subject to political measures in the feedstock exporting countries. This is especially relevant for first generation biofuels from cereals or vegetable oils, as the feedstock they require can be subject to export bans in periods of higher food prices, as during the food price shocks in 2008. Nevertheless, this is only perceived as a “medium” risk for traditional biofuels.

Mitigation measures for geopolitical risk would be similar to those for market risk: securing long-term contracts with suppliers and feedstock from a number of sources, although this can increase input costs.

Stakeholder acceptance risk

Refers to the negative publicity received by biofuels during the food crisis of 2007/2008, which was seen as real threat to the reputation of finance providers who could be associated to biofuel production and has caused some lenders to categorically deny funding to any kind of biofuel projects.

Mitigating the risk of stakeholder un-acceptance is a public relations exercise few banks and investors are willing to engage in. It involves disseminating significant amount of information over a complicated topic, on which even the scientific community is not completely aligned. Since the demand for biofuels is mostly policy induced, the role of governments in increasing public acceptance for biofuels should be much more significant. A credible and consistent sustainability certification scheme can go a long way in lowering this barrier.

3. Biofuel projects' cost of capital

The risk profile analysis indicates that technology risk is the main hurdle towards wider market deployment of advanced biofuels. Lack of sufficient technological track record makes conventional finance sources wary of funding biofuel production installations employing second generation technology. Until the perceived technology risk is overcome, second generation biofuel project can only obtain financing through grants or from venture capital, which has a much higher risk-tolerance than other forms of equity (and debt) but also requires a much higher return on investment. Compared to first generation, the cost of capital for second generation biofuel projects is in the range of three to five times as much (i.e. WACC of 20-30% as opposed to 6-12%). Without additional support, the biofuel market does not allow second generation installations to generate sufficient returns to be of serious interest to any form of private capital supplying project finance.

At the same time, it is the biofuel finance experts' general expectation that once second generation biofuels become fully commercial, they will be able to attract a similar financial structure as first generation today, hence more or less equalizing the cost of capital of the different technologies. However, to reach full commercialization of advanced biofuels, policy support is likely to play an important role.

4. Towards a significant role for second generation biofuels

When planning policy support, we should distinguish between a "pre-commercial" phase, when both the cost of capital and cost of technology are very high and a "market-expansion" phase, where a proven technological track record has made conventional project finance sources (including debt) available. The cost of capital in the latter are significantly lower, and at the same time technological learning effects have started lowering the cost of this capital intensive technology. Each phase is likely to require different kind of support as part of the most cost-effective policy combination.

Several combinations of policy support were tested for their effectiveness (amount of biofuel produced) and efficiency (cost of policy). To bring some initial quantities on the market, only a substantial direct investment subsidy of over 50% of capital investment was found to be able to bridge the initial investment gap (neither a tax break nor double counting on their own managed to achieve that). Such high subsidies are of course not sustainable in the long term. However, coupled with other policy options they represent an important instrument for achieving wider deployment of second generation biofuels. The table below presents an overview of some of the most promising policy combinations:

Table 2: Overview of selected policy cases

Case	Policy option(s)
1a	~~Contiunuous~~Continuous (high) investment subsidy
1b	Investment subsidy gradually phased-out
2	Initial investment subsidy + parallel partial tax break
3	Initial (high) investment subsidy + subsequent soft loan
4a	Initial (high) investment subsidy + ~~continous~~continuous double counting
4b	Initial (high) investment subsidy + double counting discontinued after 2020

The above policy cases were inserted as input into Biotrans, a techno-economic model which optimizes the biofuel mix for a given set of input parameters, including a target (in our case

10% of transport fuel by 2020) biophysical feedstock supply and cost and a selected set of policy measures (for details on the Biotrans model please see Deurwaarder et al., 2007). Figure 1 shows the amounts that could approximately be produced in 2020 and 2030 under those scenarios, if all else stays equal.

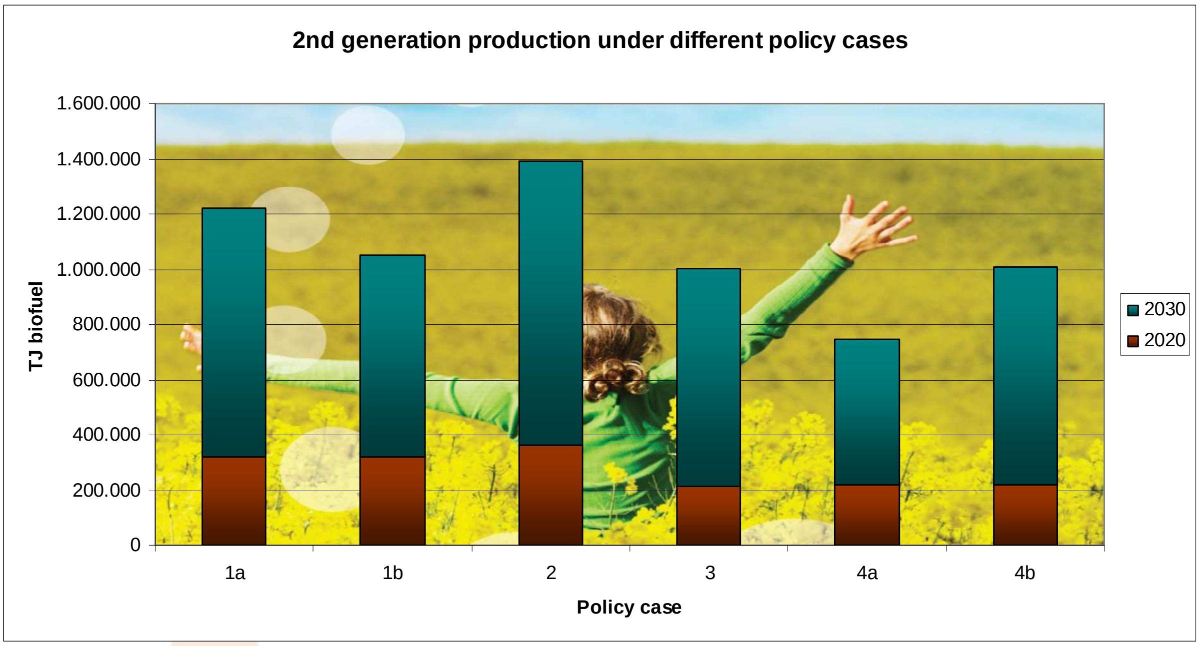

Figure 1: Second generation biofuel production under different policy support combinations

The most effective policy in the long term appears to be a combination of initial investment subsidy (discontinued within 3 years of first appearance of second generation on the market) and a continuous tax break. However, a look at the cost of the different policy options reveals that the most effective policies are not also the most efficient ones and those differences in policy costs are very large, as can be seen from table 2 below:

Table 3: Effectiveness and efficiency of selected policy cases

Case	Effectiveness (market share of 2nd gen by 2020)	Effectiveness (market share of 2nd gen by 2030)	Efficiency (total policy cost in €2005/GJ biofuel)
1a	++ 22,0%	+++ (~40%)	-- (~15)
1b	++ 22,0%	++ (~35%)	-- (~10)
2	+++ 25,0%	+++ (~45%)	--- (~20)
3	+ 15%	++ (~35%)	- (~5)
4a	++ 18,0%	++ (~30%)	+ (~2)
4b	++ 18,0%	++ (~35%)	+ (~1)

Of the policy combinations tested in this study, the most favorable one, which achieves a relatively high market share for advanced biofuels (around 18% by 2020 and 35% by 2030) at a reasonable policy cost (around 1€/GJ biofuel or cumulatively less than 1 billion €) is high initial investment subsidies discontinued after commercialization is reached, coupled with double-counting, which is also terminated after a certain period of time. In our case, a completely arbitrary cut-off date at 2020 has been selected and while more research could be done to determine the optimal cut-off date, it is clear, that to fulfill its purpose best, double counting should be discontinued as soon as learning effects have lowered the cost of the technology enough to make it more competitive with conventional biofuels. Otherwise, it can reduce the overall size of the biofuel market while substituting hardly any production of conventional biofuels with advanced ones.

5. Conclusions

To overcome the risk perceived by finance providers, second generation biofuel technology needs to build up a sufficient track record. This can only be achieved by a number of commercial-size plants operating steadily for a certain period of time. To bring these initial quantities on the market, a significant level of support in the form of high investment subsidies is likely to be necessary.

Once the initial investment hurdle is overcome, learning effects and lower cost of capital should make second generation biofuel projects more interesting for investors. However, model runs show that until 2020 there should be sufficient supply of cheaper first generation feedstock to keep the still more expensive advanced biofuel chains a niche market. To expand their market share beyond 10%, some sort of policy support will remain necessary beyond successful commercialization of the technology. Double counting seems to be able to support market expansion of second generation biofuels, however, it must be discontinued after a certain period of time to best fulfill its purpose.

If the aim is to have advanced biofuels contribute a noteworthy amount of transport fuels by 2020 (at least over 15% of all biofuels), the budget for support will need to run in the order of several hundred million €. It is highly unlikely that a market share of over 20% can be achieved within this short timeframe at acceptable policy cost.

6. References

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