IEA Bioenergy

Task 38 - Greenhouse Gas Balances of Biomass and Bioenergy Systems

The influence of Emissions Trading Schemes on bioenergy use

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Abstract:

A growing number of countries are implementing greenhouse gas (GHG) emissions trading schemes. As these schemes impose a cost for GHG emissions they should increase the competitiveness of low carbon fuels. Bioenergy from biomass is regarded as carbon neutral in most of the schemes, therefore incurring no emission costs. Emissions trading schemes may therefore encourage increased use of biomass for energy, and under certain conditions may also incentivize the construction of new bioenergy plants. This paper first identifies design elements in emissions trading schemes that influence the use of biomass. It then discusses the experiences with the EU-ETS so far and compares the design elements of the EU-ETS with different existing and emerging trading schemes in the US, Australia and New Zealand, with focus on factors that may influence the use of biomass. Furthermore, the paper analyses how incentives for bioenergy change as the price of carbon changes and which trade offs may have to be considered, if emissions trading schemes are linked.

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TABLE OF CONTENTS

List of Figures

1. Introduction

A growing number of developed countries are integrating emissions trading schemes into their national climate change policies. The European Emissions Trading scheme (EU-ETS), implemented in 2005, is the largest scheme so far, and the frontrunner in this development. The primary aim of emissions trading is to control GHG emissions by providing economic incentives for emission reductions.

As emissions trading schemes impose a cost for GHG emissions, in theory they should increase the competitiveness of low carbon fuels. Bioenergy from biomass is regarded as carbon neutral in most of the schemes, therefore incurring no emission costs. Emissions trading schemes may therefore encourage increased use of biomass, and under certain conditions may also incentivize the construction of new biomass plants. Current and planned ETSs vary significantly in their size, their design characteristics and their geographical scope. Encouraging other regions to implement comparable ETS systems which may link with the EU-ETS is one of the strategic goals of the current European climate policy. Emerging schemes including those proposed in the USA and in Australia, also provide for linking to other markets.

This paper first identifies design elements in emissions trading schemes that influence the use of biomass. It then discusses the experiences with the EU-ETS so far and compares the design elements of the EU-ETS with different existing and emerging trading schemes in the US, Australia and New Zealand. The design elements include the way certificates are allocated to the capped entities, if and how the CO_2 price is regulated, whether the transport sector is included in the scheme, and whether the scheme includes offset mechanisms involving land use. In a second step the paper analyses how incentives for bioenergy change as the price of carbon changes and which trade offs may have to be considered, if emissions trading schemes are linked.

2. Emissions trading and bioenergy

This chapter first gives an introduction to the concept of emissions trading, then assesses under which condition ETSs may stimulate the use of bioenergy and finally compares different ETS schemes regarding their incentives for bioenergy.

2.1. The concept of emissions trading

There are two alternative approaches to implementing emissions trading, namely "cap and trade" and "baseline and credit" schemes. In a cap and trade scheme, a central authority (usually a governmental body) sets a limit or cap on the amount of a pollutant that can be emitted. Companies or other entities are required to hold emissions permits each representing the right to emit a specific amount. The cap imposed on total allowances allocated should create scarcity, a precondition for a market. The administering entity may allocate permits directly to companies, for example based on past emissions or level of production, or sell permits for example via auction. An example of a baseline and credit scheme is a scheme under which companies are required to meet benchmark emissions intensity per unit of production. If a company's emissions are lower than the benchmark, credits are generated. In either approach, companies that are unable to meet their emissions target through internal actions must buy credits from those who pollute less. Under such systems, in theory, emissions reductions ought to be carried out where they are least expensive. The system should encourage measures to reduce CO_2 emissions such as switching to lower emission fuel mixes and investing in low carbon technologies. In a cap and trade scheme, the emissions reduction achieved is certain[1], as emissions are constrained by the cap. The stringency of the cap is a major determinant of the CO_2 price. However offsets can change the CO_2 price. Generally speaking, offsets are emission reduction credits that can be generated through abatement actions outside the covered sectors that are used to offset emissions from sectors covered in an emissions trading scheme, or by a company, individual or government as a voluntary measure. In emissions trading schemes offsets have the function to add flexibility to the scheme by giving companies the opportunity to find cheap reduction measures outside the capped sector, while still achieving the intended decrease in net GHG emissions. The most commonly known offset mechanisms are the project-based mechanisms Joint Implementation ("JI") and the Clean Development Mechanism ("CDM") established under the Kyoto Protocol, but more and more offset schemes outside of the Kyoto framework are being developed in emerging domestic-level emissions trading schemes.

[1] Except if companies that exceed their cap are required only to pay a penalty and not to make good the difference. If offshore offsets are allowed the emissions reduction will not be achieved domestically.

2.2. Effects of a CO2 price signal on bioenergy use

As emissions trading schemes set a price on CO_2 emissions they increase the competitiveness of low carbon fuels. Bioenergy from biomass is regarded as carbon neutral in most of the schemes[2]; therefore using bioenergy incurs no emission costs. Emissions trading schemes, if well designed, thus have the potential to stimulate the use of bioenergy[3]. Whether emissions trading is effective in increasing the use of bioenergy depends on several features of the scheme design, including the carbon price and the permit allocation method.

Decisions regarding a short-term fuel switch to biomass are based on the so called "Short Run Marginal Costs (SRMC)". The SRMCs are affected by variable costs, including fuel costs. When there is a carbon price, set for example through emissions trading, "CO_2 costs" which depend on the fuel specific CO_2 emissions as well as the CO_2 price have to be added to the SRMC. These additional CO_2 costs shift the competitiveness of different fuels towards low carbon fuels, and therefore create incentives for a fuel switch to biomass. In practice this is only an option for plants that are able to take a range of fuels. With no carbon price, coal has the lowest SRMC of all options. As the CO_2 price increases, the variable costs for both gas and coal-based power plants rise because an emission allowance will be needed for each unit of CO_2 emitted. The extent of the increase in cost of fossil fuel-based plants depends on the CO_2 emissions intensity of the fuel used. As coal has a higher emission intensity than gas, the extent of the increase in costs is higher than for gas-based plants. Modeling results show that for Europe at CO_2 prices between 10 and 20 Euro the SRMCs for biomass are lower than for coal, so biomass as a fuel becomes competitive.[4]

Decisions on investments in new plants are mainly based on the so-called "Long Run Marginal Costs" (LRMC). The LRMCs include variable costs but also fixed costs, including costs of capital. When there is a carbon price, CO_2 costs have to be added also to the LRMC, increasing the competitiveness of new bioenergy plants. Biomass plants start becoming competitive with coal plants in a range of about 40-50 Euro/ton per tonne CO_2[5] assuming that all allowances are sold ("auctioned") to the companies. If allowances were given out for free, no additional CO_2 costs would arise. Differences between ETSs in expected carbon price and permit allocation method therefore mean that some will provide greater incentive for new bioenergy plants than will others, as is discussed in the next chapter.

[2] Bioenergy is regarded as carbon neutral in the energy sector, following the convention of reporting to the UNFCCC: annual biomass used for energy is considered carbon neutral because the carbon was recently sequestered and is assumed to be removed again by growing plants; carbon stock changes due to harvest of woody biomass for bioenergy are assumed to be reported in the LULUCF sector, therefore they are not included in the energy sector as to do so would lead to double-counting (IPCC, 1997; IPCC, 2006). For further discussion of the carbon neutral status of bioenergy see Bird, Pena, Schwaiger and Zanchi, 2010. Review of existing methods for carbon accounting. CIFOR occasional paper.
http://www.cifor.cgiar.org/publications/pdf_files/WPapers/WP54CIFOR.pdf

[3] Schwaiger et al. 2011: The future European Emission Trading Scheme and its impact on solid and liquid biomass use. Special Issue in Biomass and Bioenergy, forthcoming.

4 Ibid

5 Ibid

2.3. JI/CDM and bioenergy

The Kyoto Protocol provides for two project based flexibility mechanisms: Joint Implementation (JI) and the Clean Development Mechanism (CDM). Under JI an Annex I[6] country can invest in emission reduction projects in any other Annex I country as an alternative to reducing emissions domestically. The CDM allows emission-reduction (or emission removal) projects in Non Annex-I countries (developing countries) to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. The generated credits can be used as offsets in most ETSs. Accepting international offset credits may not only lower the costs of reducing GHGs but will help speed the deployment of clean technologies worldwide including support for all types of bioenergy to become more competitive and attractive. Biomass projects play a major role in both JI and the CDM. Biomass projects under JI include for example fuel switching in district heating networks. More than 2400 projects have been approved so far, another 2500 are in the approval process[7]. Under the CDM biomass energy projects are successful project types, with a share of more than 13% of all approved ("registered") projects[8]. Both the CDM and JI allow certain types of projects that either reduce emissions or sequester carbon through afforestation or reforestation (AR) activities. AR projects haven't been a successful project type[9]: so far only a few AR CDM projects have been registered, and there are no registered JI AR projects.

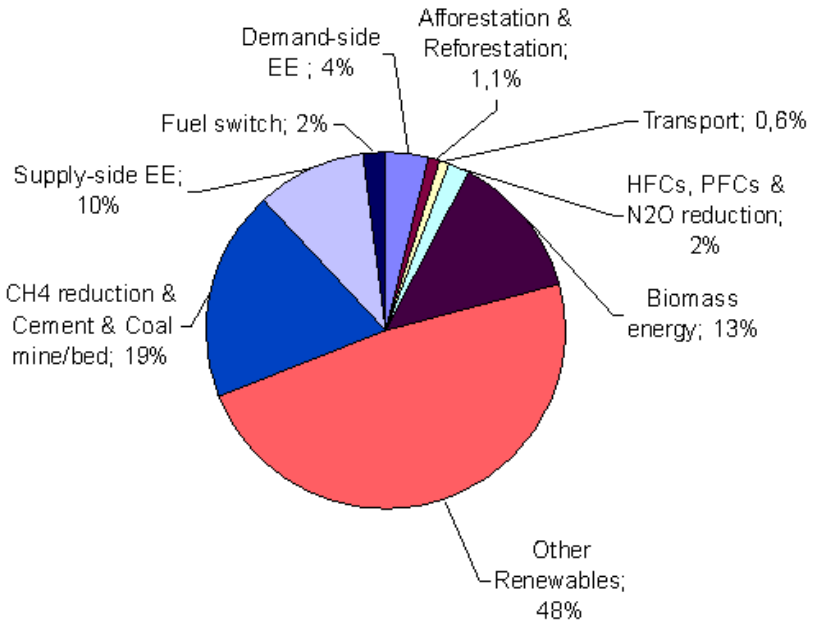

Figure 1: Share of registered CDM bioenergy projects (Source: UNEP Risoe, 2010)

[6] Annex I to the UNFCCC lists the countries that are considered developed and have a target for emissions limitation under the KP.

[7] UNEP RISOE CENTRE, 2010. http://www.cdmpipeline.org/cdm-projects-type.htm

[8] Ibid

[9] One reason that AR projects have been unattractive is that these project can only generate temporary credits, in recognition of the potential impermanence of forest sequestration.

Given the unclear status of the negotiations for an international post-2012 climate agreement, it is unclear whether and to what extent the current Kyoto project mechanisms will be continued or replaced by new forms of international offset mechanisms and what role bioenergy projects will play in the future. The CDM, however, could also continue without a post 2012 agreement if major buyers such as the EU continue to accept these credits for compliance.

2.4. Alternative existing and emerging cap-and trade systems and impact on bioenergy

The EU-ETS, operational since 2005, is the largest multi-country, multi-sector greenhouse gas emissions trading scheme world-wide. In the United States dynamic initiatives have been launched at the state level, especially on the east coast (Regional Greenhouse Gas Initiative) and the west coast (Western Climate Initiative). Additionally several legislative proposals for a federal system have been under discussion in US Congress. On the other side of the globe, New Zealand has implemented an ETS from July 2010, Australia has proposed a national ETS, and also Japan and South Korea are discussing the implementation of such a scheme. In the following chapter the EU-ETS, as well as planned schemes in the US and Australia, and the recently commenced New Zealand scheme, are analyzed in more detail and their incentives for the use of biomass are discussed.

2.5. The EU-ETS

The EU's ETS was implemented to minimize the economic costs of meeting Europe's commitments under the Kyoto Protocol. The EU ETS currently is one of the main pillars of the European Union's climate change policy. The scheme establishes a cap on GHG emissions from covered sectors. The cap approach guarantees that its environmental goal is met, however the costs that companies will face in meeting this goal cannot be fully predicted. The first phase of the EU-ETS ran from 2005-2007, and included about 12,000 industrial plants. It covered about 46% of total EU CO_2 emissions (about 40% of total GHG emissions) and included the most emissions-intensive sectors: iron and steel, minerals, pulp and paper production, refineries, and the power sector. The transport sector is not covered. The second period runs from 2008-2012 and coincides with the first Kyoto commitment period. The third period will run from 2013-2020[10]. During the first and second periods of the EU-ETS, the number of allowances allocated to companies and the method of allocating them were determined by member states in National Allocation Plans (NAPs). Most allowances have been allocated free of charge based on historical emissions (known as "grandfathering"). More than 95% of allowances were grandfathered in the first period and more than 90% in the second phase. The EU-ETS directive doesn't provide for a domestic offset scheme, however the "linking directive" allows covered entities to use CERs and ERUs

[10] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC

for compliance and as a result increases the diversity of low-cost compliance[11]. This directive allows companies under the EU-ETS to use JI and CDM credits in the second phase, up to 11 per cent of their emissions allocation. CDM credits from afforestation/reforestation (AR) activities however are excluded. In contrast to trading schemes in other countries, the EU has not had, and so far does not envision employing mechanisms for price control in the EU-ETS.

Implications for bioenergy

While in the second phase of the EU-ETS a small share of allowances are auctioned, starting in 2013 allocations will be determined at the EU level and, with a few exceptions, allowances for the power sector will be fully auctioned. Exceptions may be made for highly efficient co-generation plants and district heating as well as for electricity producers in some new EU member states. Under current regulations allowances are not required for CO_2 emissions from power generated from any type of biomass. Therefore the scheme has the potential to increase use of biomass in the power-producing sector. However, the incentive depends on the price of allowances, and the level of future CO_2 prices cannot be predicted with any confidence. Prices will depend on factors such as economic and emission growth, and method of allocation of allowances. In the first phase of the EU-ETS the CO_2 price was very volatile. It was over €30 per tonne for a short time, before falling to almost zero due to the over-allocation of emission allowances during this phase. Volatility of the CO_2 price has been lower in the second phase than in the first phase. In the second phase the price reached about €25 per tonne, but at the time of writing (November 2010) is €15 per tonne[12]. The price ranges were high enough to stimulate the use of biomass as fuel, but far too low to incentivize the construction of new biomass plants.[13] During the third phase a higher CO_2 price is expected, however if the current economic crisis continues to impact industrial and electricity demand, and the EU doesn't move to a higher reduction target for 2020 low carbon prices may prevail through to 2020.

[11] EU (2004), Directive 2004/101/EC of the European Parliament and of the Council of 27 October2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms.

[12] Point Carbon, November 2010

[13] Schwaiger et al. (2007): "Needs and challenges in implementing key directives –EU Emissions Trading Directive". NoE Bioenergy. WP IA-12. Final Report 2007

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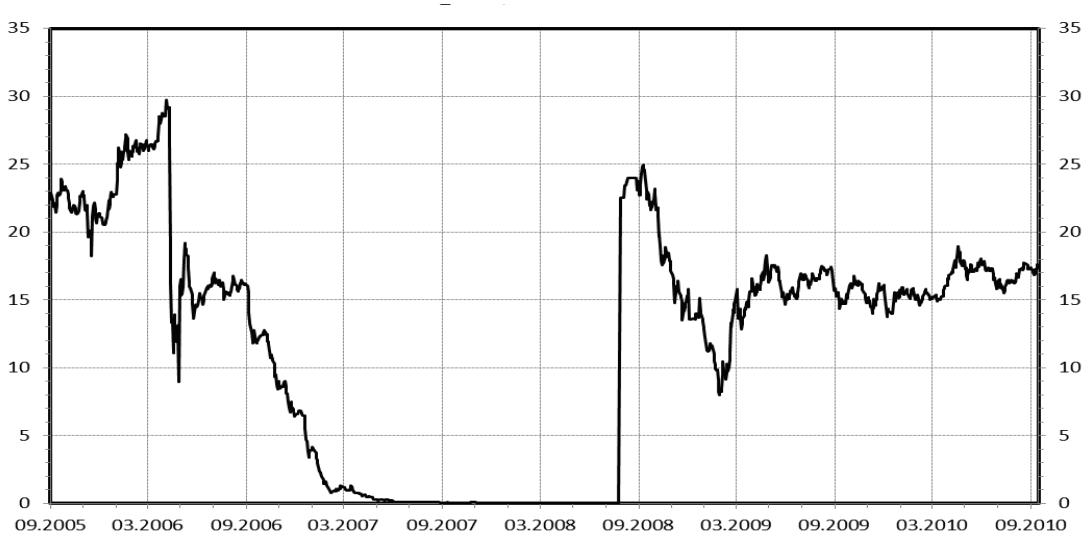

Figure 2: Historic EU allowance spot price, 2005-2010 (Source: Thomson Reuters Datastream)

Figure 2 shows the volatility of the CO2 price in the last years. In phase one of the EU-ETS the price dropped to zero in 2007 as the system was over allocated and allowances couldn't be banked into the second trading period. The figure shows that in the second phase of the scheme the price so far has been far more stable than in the first.

2.6. Emerging Emissions Trading Schemes

2.6.1. United States

Bills to regulate greenhouse gas emissions have been introduced in US Congress on many occasions since 1998. Most of the bills include an emissions trading scheme. However so far no bill has had enough support to be passed by Congress. Given the outcome of the midterm elections in November 2010, prospects for successful climate legislation on the federal level have been greatly diminished in the foreseeable future: the new Republican majority in the House of Representatives and strong conservative gains in the Senate and in various states have closed the window of opportunity for federal emissions trading for several years. On the regional level however there is a new dynamic after Californians have voted strongly in favour of cap-and-trade on GHG emissions in November 2010, rejecting a ballot initiative to suspend the introduction of the state's global warming bill, AB-32. A cap and trade scheme from 2012 seems likely in California and several other states of the Western Climate Initiative, a network of US states and Canadian provinces, seeking to reduce greenhouse gas emissions collectively by 15 per cent below 2005 levels by 2020. On the east cost the Regional Greenhouse Gas Initiative (RGGI) has been operating since 2009. Within RGGI ten Northeastern and Mid-Atlantic states have capped and will reduce CO_2 emissions from the power sector by 10% compared to 2009, by 2018.

Waxman Markey bill

The most significant initiative that came out of Congress since the 2008 elections is a bill by Henry Waxman and Edward Markey, titled the American Clean Energy and Security Act of 2009 (ACES 2009)[14]. Even if after the results of the midterm election there is no national legislation expected to be implemented in the US in the short term, this bill will be one of the blueprints for future national cap-and trade initiatives, reflecting discussion in the US over the last two years. In contrary to previous bills it doesn't provide for a price cap, however includes several other price control mechanisms. An ETS based on the Waxman-Markey bill would capture approximately 85% of US GHG emissions. Unlike the EU-ETS and other US climate bills, the Waxman-Markey bill does not specify the details of allocation. The Waxman-Markey bill foresees a mixed upstream-downstream system. In this context, upstream entities are those who extract, refine or import fuels that when used release GHGs. Downstream parties are those that combust fuels. The bill provides for downstream coverage in the electricty sector, i.e., obligations fall on electricity generators, and large industrial emitters (emitting more than 25,000 tons CO_2-eq. per year). Upstream coverage is foreseen in the transportation sector. The Waxman-Markey bill defines a number of preconditions for offset projects to be eligible, such as standards, methodologies, and protocols that require that credited emission reductions or sequestration are permanent, additional, verifiable, and enforceable. Until 2020, the provisions under the Waxman-Markey bill would limit offsets to 30% of the emissions allocation, to be split evenly between domestic and international offset credits. The bill provides that a specified quantity of allowances would be set aside each year for a "Strategic Reserve", from which allowances would be auctioned on a quarterly basis subject to a specified minimum auction price. The Waxman-Markey bill permits unlimited banking of allowances for use during future compliance years.

Implications for bioenergy

Estimates of carbon prices for the first decade under the bill range from $11-$16 per ton of CO2 under EPA forecasts to $15-$26 per ton under Congressional budget office projections[15]. Therefore it would be far too low to significantly stimulate the establishment of new biomass plants regardless of whether allowances are initially granted for free or auctioned. On the other hand this price would be high enough to stimulate the use of biomass as a fuel. Bioenergy (including biofuels) generated from "renewable biomass" - for which the bill defined criteria- is assumed for the purposes of the bill to be a carbon-neutral feedstock. Bioenergy producers using feedstocks that do not meet this definition, however, would be treated as capped entities and would be required to submit emissions allowances like producers of fossil energy. As the bill includes liquid fossil fuels under the cap-and-trade program it provides an incentive also to increase biofuel production and utilization, as a compliance strategy. The bill furthermore provides incentives to stimulate the growth of the bioenergy industry to meet this new demand: the Act's combined efficiency and renewable electricity standard requires that 20% of electricity come from energy savings and renewable power, including biomass energy, by 2020. Regarding offsets, ACES establishes a domestic agricultural and forestry offset program. The bill specifies the types of agricultural offsets that will qualify and allows the US Department of Agriculture (USDA) to add more categories.

[14] http://www.pewclimate.org/acesa
[15] http://thebreakthrough.org/blog/2009/06/aces_analysis_full_breakthroug.shtml

These provisions ensure that agriculture will supply a significant proportion of offsets and that the USDA will play a strong role in the domestic offset program. The ACES also allows the use of international credits. It would allow projects that protect existing forest carbon stocks (REDD projects). The extent to which different types of international credits can be used is not well defined.

The Regional Greenhouse Gas Initiative (RGGI)

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by ten US Northeast and Mid-Atlantic states to implement a regional cap-and-trade system[16]. RGGI, which represents the first mandatory GHG emissions trading scheme in the US, began operations in 2009. Emissions from fossil-fuel electricity generators larger than 25 MW are restricted under the cap, with a goal of stabilizing these emissions between 2009 and 2014 and reducing them by 10 percent compared to 2009 by 2019. Each participating state will receive an emissions budget and is free to determine how to allocate 75 percent of the corresponding allowances among industries. At least 25 percent of the allowances have to be auctioned and the income must be assigned to consumer benefit or strategic energy development purposes, such as new technologies and promotion of energy efficiency reducing energy costs. Most of the participating states auction the majority of the allowances. The scheme allows the use of five types of offsets for compliance, one of which is carbon sequestration resulting from afforestation projects. The extent to which covered entities may use offset credits to meet obligations is restricted, with restrictions dependent on allowance prices. Offsets are restricted to 3.3 percent of a generator's emissions during an initial control period. If the 12-month rolling average of allowance prices exceeds US $7 per ton, generators may use offset credits to meet up to 5 percent of their obligation; if the 12-month rolling average exceeds US $10, plants may offset up to 10 percent of emissions[17]. In the latter case, participants may also use credits from the EU ETS and the flexibility mechanisms under the Kyoto Protocol. Offsets thus serve as a safety valve to limit costs of the scheme.

Implications for bioenergy

The RGGI "model rule" defines eligibility criteria for biomass, and it states that CO2 emissions attributable to the combustion of eligible biomass can be deducted from company's CO2 emissions reduction commitment. Eligible biomass includes sustainably harvested woody and herbaceous fuel sources that are available on a renewable or recurring basis (excluding old growth timber), including dedicated energy crops and trees, agricultural food and feed crop residues, aquatic plants, unadulterated wood and wood residues, animal wastes, other clean organic wastes not mixed with other solid wastes, biogas, and other neat liquid biofuels derived from such feedstocks. Determinations as to what constitutes sustainably harvested biomass shall be made by the applicable regulatory agencies in each participating state. The RGGI offset framework provides another incentive for biomass use: it allows credits to be generated through fuel switching to less carbon-intensive fuels by entities not covered by the cap. However, credits can not be created if biomass is used for electricity generation, in order to avoid double counting of reductions in the electricity sector[18]. Because of the modest initial target, reduced electricity demand due to the recession and

[16] www.rggi.org
[17] www.rggi.org
[18] RGGI model rule, p.113. http://www.rggi.org/docs/Model%20Rule%20Revised%2012.31.08.pdf

lower than expected natural gas prices, the market has been over-supplied with allowances and the price has at the time of writing (November 2010) fallen to near the system floor-price of USD 1.86/tCO2 (IEA, 2010). The price is far too low to stimulate the implementation of new biomass plants or even the use of biomass as a fuel.

2.6.2. Australia

The Australian government has committed to cutting greenhouse gas emissions by 60%, compared with 2000, by 2050, and stated a short-term goal of 5- 25 percent by 2020, with the more ambitious target of 25% dependent on agreement for international action[19]. Preparations for an ETS in Australia began back in 2008, when the Australian government published a White Paper proposing the introduction of an ETS on Australia[20]. The design of the planned 'Carbon Pollution Reduction Scheme' (CPRS) was modified several times. But emissions-trading legislation suffered parliamentary defeat in 2010, leaving the 2020 goal in doubt. While it was initially intended that the scheme commence in 2010, it was subsequently delayed until at least 2013, due to lack of bipartisan support for the legislation.[21]. The proposed CPRS would have a very broad coverage including practically all greenhouse gas emissions besides land use change and agriculture, covering initially around 75 per cent of Australia's emissions. Agricultural emissions would be excluded from the scheme, however offsets for agricultural emissions abatement are allowed. Forestry would be included through a voluntary opt-in approach: credits would be generated for increases in carbon stock, up to the long term average carbon stock for production forests, and up to a limit that allows for a "risk of reversal buffer" for unharvested forests. Around 1000 entities above 25 ktCO_2-eq/year would be directly liable for their emissions; smaller sources of combustion emissions would be covered through 'upstream' permit liability on fuel suppliers. In this way, transport and household emissions are also covered by the price signal created in the permit market, although a reduction in fuel taxes in the early years will negate the impact on transport fuel prices. Permits would be auctioned except for free allocations to emissions-intensive, trade-exposed industries such as aluminum, steel and liquefied natural gas. A one-off compensation payment would be granted to coal-fired electricity generators. While the price would be fixed at A$10 a tonne of CO_2-e in the first year, in the following years a price cap is to apply, starting at A$40/t and rising at 5% per year plus adjustment for inflation. The government would sell additional permits into the market at this fixed price. If and when in place, the price cap would loosen the Australian Scheme cap, and the government would have to buy additional Kyoto units. International Kyoto credits can be purchased by scheme participants in an unlimited quantity, however trading is to be restricted to purchases of JI, removal units and non-forestry CDM, subject to future review. It is expected that the bulk of permit purchases by Australian emitters would be from the CDM.

Implications for bioenergy

[19] Jotzo, 2010

[20] http://www.climatechange.gov.au/en/government/initiatives/cprs.aspx

[21] The government has stated that it remains committed to introducing a carbon price. In October 2010, the government established a Multi-Party Climate Change Committee to explore options for the implementation of a carbon price for the Australian economy.

With the capped carbon price, the CPRS is not expected to be an adequate financial incentive for the establishment of new bioenergy facilities, but may provide limited incentive for fuel-switching to biomass[22] However, the enhanced Renewable Energy Target (20% renewable electricity by 2020)[23], in combination with the CPRS, could provide a sufficient financial stimulus for bioenergy. The CPRS could provide a stimulus for reforestation, particularly in areas considered marginal for forestry. Harvest of these forests for timber products is not likely to be financially viable, however, there is strong potential that they could supply biomass for bioenergy.

2.6.3. New Zealand

The New Zealand Emissions Trading Scheme (NZ ETS) was legislated through the Climate Change Response Act (2002) in September 2008 and amended in November 2009. The scheme brings in all sectors of the economy over a seven-year period[24]. The forestry sector has been included in the scheme since 2008, and the stationary energy, industrial processes and liquid fossil fuels sectors have been covered by the NZ ETS since 1 July 2010. A New Zealand Unit (NZU) is the primary domestic unit of trade, which will be issued by free allocation to emitters, with no auctions intended in the short term. The scheme allows also the unlimited use of international Kyoto credits, with the exception of forestry CERs (lCERs and tCERs). The scheme provides several transitional measures: Stationary energy, liquid fossil fuels and industrial processes will have to surrender a 1 tonne unit for every 2 tonnes of emissions. Furthermore the scheme includes a fix price option of NZ$25/tonne allowing sectors facing obligations to pay rather than purchase units, to limit cost and enhance stability in the start up phase. In addition trade exposed/emissions intensive industry is allocated NZUs on a production-based or industry average approach. In the production-based approach allocation is adjusted for change in production level, under the industry average approach allocations are based on average emissions per unit of production for a particular industry. The New Zealand emissions trading scheme is the first to include forestry under the cap, rather than via offsets. Landowners of pre-1990 non-indigenous forests are automatically included, so have emission reporting obligations. Free allocation is being provided as compensation to owners of pre-1990 forests for the impacts of the ETS on land values[25]. Forest owners are able to voluntarily enter the scheme and receive credits of NZUs for forests planted after 1989.[26]

Implications for bioenergy

The price under the NZ system is capped at the price of international offsets, the use of which is unlimited. This price will therefore be far too low to significantly stimulate the implementation of new biomass plants. However it may be high enough to stimulate the use of biomass as a fuel in existing plants.

[22] O'Brien et al 2008 Carbon Trading and Renewable Energy A discussion paper on carbon credits and bioenergy developments for forestry and agriculture Rural Industries Research and Development Corporation, Australia

[23] http://www.esaa.com.au/content/detail/australia%E2%80%99s_renewable_energy_target

[24] http://www.climatechange.govt.nz/emissions-trading-scheme/

[25] (Land values are reduced because the scheme imposes liabilities on the land owner if the land is deforested.)

[26] http://www.climatechange.govt.nz/emissions-trading-scheme/

2.7. Comparing ETS regarding their incentives to use bioenergy

This chapter compares key design elements of existing and planned ETSs regarding their incentives to use bioenergy. These include the expected CO_2 price and concepts to regulate the price, the allocation method, the types of offsets credits allowed and whether the transport sector is included. Finally this chapter draws conclusions on the role of cap-and trade for technological change toward more bioenergy use.

The CO_2 price is a major factor in use of biomass in existing plants. Whether biomass becomes competitive compared to other fuels also depends on the price for biomass, which is country- and biomass specific. Where it is available, cheap biomass residues can used, for example, to co-fire power plants. In other cases high quality, imported wood pellets may be the only source with adequate supply. Some schemes, such as US schemes, define eligibility criteria for biomass that must be met in order for biomass to be regarded as carbon neutral. To incentivize new biomass plants it is estimated that the CO2 price has to be higher than 40-50 Euro/ton of CO_2[27], far higher than the price observed in the EU-ETS since its beginning and in addition most of the allowances need to be auctioned. In the EU-ETS a higher CO_2 price is expected in the third phase than in the first and second phases. If, however, the current economic crisis continues to impact industrial and electricity demand, low carbon prices may prevail through 2020. Furthermore the issue of whether the EU will move to a 30% reduction target by 2020 (from the current -20% goal) will be crucial for the level of the future carbon price: The European Commission expects the Carbon price to rise to €30/t by 2020 in this case, from a projected €16/t Carbon price by 2020 in the 20% case.[28] Prices below 20 Euro per tonne are expected for a federal US scheme, the NZ scheme and for a scheme in Australia. In contrast to trading schemes in other countries, the EU-ETS has not had, and does not envision employing, mechanisms for price control and management. Other schemes such as the planned federal US scheme or the planned national Australian scheme include provisions for price management. In the RGGI system the amount of offsets that can be used depends on the CO_2 price; in plans for a federal US system different concepts for price caps are discussed. The Australian scheme price will be limited in the first years and thereafter determined by the price of international offset credits. Also in New Zealand international offset credits will serve as a price cap. In principle such price control mechanisms give certainty to businesses. In the case of the US, Australia and New Zealand the CO_2 price will be capped low levels limiting incentives for the implementation of low carbon technologies.

Regarding the share of allowances to be auctioned, in the EU-ETS all allowances will be auctioned in the power sector from 2013, in the RGGI system most of the allowance are auctioned, and in Australia most allowance are planned to be auctioned with exemptions for some industry sectors in the first years of the scheme. Both, the planned US and Australian schemes provide for domestic offsets in the agricultural and forestry sectors and therefore may incentivize domestic production of biomass. In particular in the US such offsets may play a major role. The domestic offsets in the agricultural and forestry sectors could positively impact the bioenergy sector through providing incentives to increase carbon stocks. These

[27] Schwaiger et al. 2011: The future European Emission Trading Scheme and its impact on solid and liquid biomass use. Special Issue in Biomass and Bioenergy, forthcoming.

[28] EC, 2010. Towards a comprehensive climate change agreement in Copenhagen

incentives could also have environmental co-benefits through providing economic support for building agricultural soil carbon and retention of forest areas. On the other hand a high offset demand may lead to additional pressures on availability of land, and may if not carefully designed damage other ecosystem values. The EU-ETS and emerging ETSs also aim at accepting international offset credits, such as the CDM. The CDM however plays only a minor role in plans for US systems, compared to credits from new crediting mechanisms including credits from avoided deforestation (REDD)[29]. Furthermore, the EU will allow only a small share of international credits to be used up to 2020, to ensure that the target of reducing GHG emissions by 20% by 2020 is maintained. If the EU decides to reduce 30% by 2020 a higher share of international credits will be allowed to be used for compliance. Some ETS, such as planned schemes in the US and Australia intend to include the transport sector, while others exclude it. Full integration of transport fuels in an EU-ETS would increase the cost-effectiveness of the scheme as there would be a broader range of abatement options, some of which have low cost such as change of car drivers' behavior. The inclusion of the transport sector in the EU-ETS however will create only limited stimulation of use of biofuels. At €40-50/tonne of CO_2 already some biofuels options are available, but many biofuels-for-transport options require far higher CO_2 prices.

As shown in this chapter, the impact of price-induced incentives for new biomass plants or biofuels will be limited. The carbon price signals are restricted in most cases and thus may not be an adequate instrument to incentivize the establishment of new biomass plants. Furthermore, for investments in the energy sector, companies need stable long term expectations regarding the carbon price and GHG policies far beyond the 2020 period while short term volatility of carbon prices should not pose a major hurdle. Most of the ETS, have compliance periods up to 2020, in case of the EU ETS however not even the 2020 reduction target is clear so far. While cap and trade policies allow meeting a given reduction target at least costs, they should not be overestimated regarding incentives for technological change. To incentivize bioenergy options complementary low-carbon technology policies are needed, which have to be tailored to the bioenergy sector and the development stage of specific technologies[30].

[29] Reducing emissions form deforestation and degradation, REDD.

[30] Even at theoretically sufficiently high CO2 prices there may be reasons that investment decisions are not taken due to market imperfections or non-financial barriers; their discussion goes beyond the scope of this paper.

	EU ETS	US federal (Waxman-Markey)	US regional: RGGI	AUS ETS	NZ ETS
Date of entering into force	2005	2012?	2009	unclear	2010
2020 cap % reduction relative to base year	21% (compared to 2005) in case the EU reduces GHG emissions by 20% by 2020 (compared to 1990)	17%	10% (compared to 2009)	5-25% (compared to 2000)	Allowances being issued relate to Kyoto commitment
Domestic offsets	No	Yes	Yes	Yes	No
CDM/JI	Yes, limited	International credits expected to be used	No	Yes, unlimited	Yes, unlimited
Allocation method	Full auctioning in the energy sector from 2013	Not yet determined	Depending on participating state. Majority of allowance are auctioned	Full auctioning in the energy sector	
Approach to price control	Almost no price control	Cost-containment auctions in case of short-term price hikes	Share and type of offsets to be used depend on CO_2 price	first year: permits at a fixed price of $10 per tonne. Price cap for four years. Unlimited use of int. credits	Unlimited use of international credits, acting as a safety valve
Inclusion of transport sector	no	uncertain	no	yes	yes
Eligibility criteria f. biomass	no	yes	yes	No	No

Figure 3: Comparing key design elements of ETS

3. Linking trading schemes and effects on bioenergy use

3.1. The political role of linking emissions trading schemes

Creating a global carbon market is a key goal of EU climate policy. In its post-2012 communication, the European Commission proposes the establishment of an OECD-wide market by 2015 (EU Commission, 2009). A US-EU carbon market would comprise the largest share of an OECD-wide emissions trading system and therefore so far had priority for the European Commission. Linking domestic cap and trade schemes is seen as a fallback option by the EU in case no multilateral climate agreement emerges. The US sees the establishment of bilateral and regional cooperation as part of their view of a bottom-up international climate policy architecture. The US view has already found its reflection in the Copenhagen Accord and the Cancún Agreements.

3.2. Possible forms of linking

There are two main categories of links between trading schemes: direct and indirect links. Direct links allow trade between different systems directly and can be distinguished by whether they allow trading in one or both directions (unilateral, bilateral). In a unilateral linked system entities in one system can purchase and use allowances from the other system for compliance, but not vice versa[31].

Figure 4: A direct unilateral link

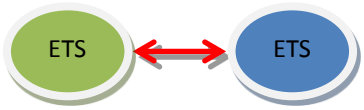

Figure 5: A direct unilateral link

Bilateral linking provides that credits can be freely traded between two systems and allowances of both systems are equally valid for compliance in both systems of linking where more than two schemes are linked can be described as multilateral linking. Indirect linking occurs when systems are not linked directly but join through a common third system. Most emerging emission trading systems will probably be indirectly linked through the Kyoto Protocol's CDM (Clean Development Mechanism) or new crediting mechanisms, because most systems plan to allow regulated entities the use of CERs (Certified Emission Reductions) or other types of international credits.[32]

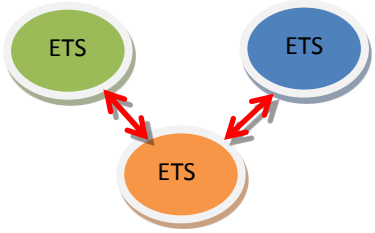

Figure 6: An Indirect link

[31] Tuerk et al, 2009

[32] Carbon Trust, 2009

3.3. Implications of linking for bioenergy

Direct linking

Establishing an operational link between emissions trading schemes could create a greater diversity of sources and abatement options, leading to improved market liquidity and more efficient allocation of resources[33]. Bilateral linking results in a convergence of allowance prices. When two emissions trading schemes are linked, market prices will rise for allowances in one scheme, and fall in the other scheme, until full or partial convergence is achieved. The degree of economic efficiency gain from international or interregional allowance trade is correlated to the difference in the pre-link allowance prices in the linked regimes. The greater the difference, the greater the potential gain in economic efficiency[34].

The main impact that linking of emissions trading schemes could have on bioenergy results from the effects that linking has on the carbon price. As linking changes the carbon price of an ETS, it may increase or decrease the incentives for low carbon fuels and technologies.

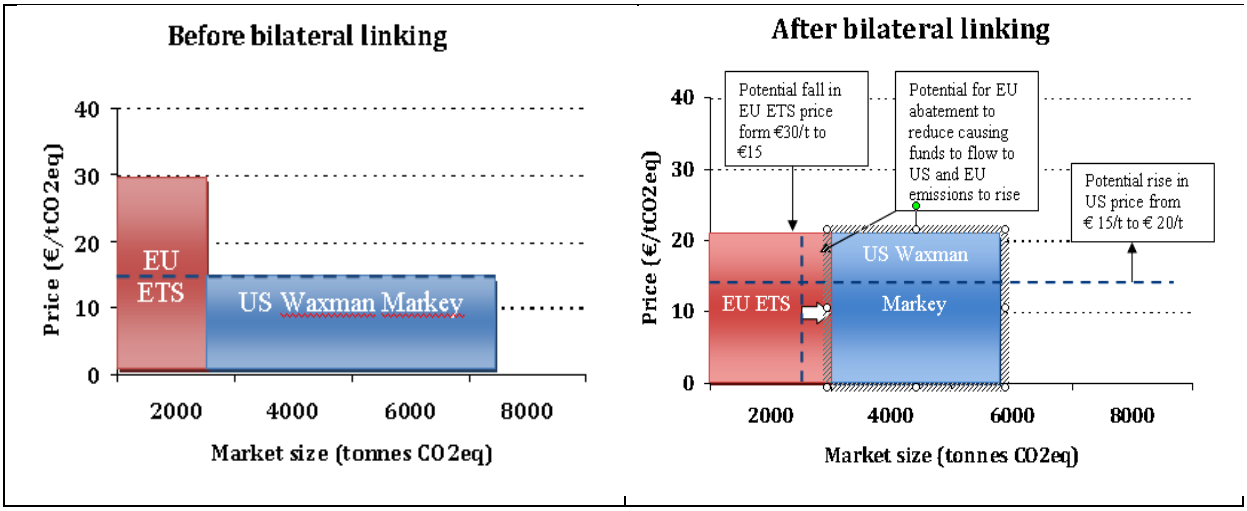

Figure 7: Illustrative impact of linking the EU-ETS with a federal US-ETS on price and abatement (Source: Carbon Trust 2009)

As figure 3 shows, the CO_2 price in the EU-ETS will decrease after linking with a national US scheme and thus will decrease incentives to invest in low carbon technologies in Europe. Linking can also lead to decreased or increased price volatility. If the price volatility is decreased, the investment signal for entities under the scheme is more stable. Furthermore, direct linking can under certain conditions increase the demand of AR offsets. If for example the EU-ETS links to an US ETS and the price of an US ETS allowance is lower than in the EU-ETS, the allowance flow from the US ETS to the EU-ETS will increase the demand for offsets in the US. Entities in the US ETS will sell allowances to European partners and use more offsets for their national compliance. A higher demand for offsets than originally provided by a scheme may on the one hand positively impact the bioenergy sector as additional AR offset projects could generate additional biomass that could be used for bioenergy, but on the other hand may increase also existing environmental pressures.

[33] Tuerk A. Mehling M., Flachsland Ch., Sterk W. (2009): Linking Carbon Markets: Concepts, Case Studies and Pathways. Climate Policy Volume 9, Issue 4, 2009

[34] Ibid

Indirect linking

Depending on the supply curve for offset credits, cap levels, marginal abatement cost (MAC) curves and quantity limits on the import of credits, indirect linking will lead to a complete or incomplete convergence of the allowance price in indirectly linked cap-and-trade markets[35]. If a complete price convergence is achieved, the implications for bioenergy are the same as in the case of direct linking. Indirect links may be achieved by accepting the same source of international credits such as the CDM. A high share of international credits in high price ETS systems may reduce the incentives for bioenergy by reducing the price, however international credit mechanisms, such as the CDM may also incentivize biomass use.

3.4. Barriers to linking and possible timeline for links between schemes

This chapter discusses potential challenges for market linkage. Linking of emissions trading systems does not require that all design features of the affected trading systems be harmonized. Some differences can be tolerated without detriment to the link, and others require only minor technical changes. Significant barriers to effective direct linking trading schemes can arise from: [36]

- relative stringency of targets,
- stringency of enforcement
- eligibility of offsets credits
- intensity targets
- cost-containment measures

First, the relative stringency of targets is one of the most politically critical issues when two or more ETSs consider linkage, and it may be a political precondition for linking that all systems involved have comparable caps. Significant difficulties could arise if some types of offsets credits are considered as eligible in one ETS but not in the ETS of a potential linkage partner. For example, on the one hand the possible federal US scheme is likely to allow domestic credits from the domestic agricultural and forest sectors as well as REDD credits from developing countries. On the other hand, the EU does not currently allow the use of any credits from the land-use sector in the EU ETS. Even if some credits are eligible only in one scheme, they will affect the overall supply of units, and therefore prices, in the combined scheme, as would happen in an EU-US ETS link. Operators in the scheme where the credits are eligible can use the credits for their domestic compliance and sell their domestic allowances to the scheme where the offsets are not allowed. The large degree of uncertainty and technical challenge when linking schemes with absolute and intensity-based targets is likely to make such links politically very difficult[37]. The only countries planning intensity-based trading systems are Canada and Japan. Japan, however, may see a mandatory ETS based on absolute caps after 2013 and Canada plans to move to absolute caps in the long term[38].

[35] Tuerk et al., 2009a

[36] Ibid

[37] Tuerk A. Mehling M., Flachsland Ch., Sterk W. (2009): Linking Carbon Markets: Concepts, Case Studies and Pathways. Climate Policy Volume 9, Issue 4, 2009

[38] Ibid

In order to avoid high CO_2 prices or price spikes, emissions trading schemes may implement so-called cost containment measures, which include offset provisions, borrowing provisions or price caps. If these provisions are present in one of the linked systems, they will be made available to participants in the other system regardless of whether the other system has the same provisions. Consequently the unlimited import of low-cost credits from other sectors and regions will reduce the CO_2 price and total abatement costs in a cap-and-trade system. However, if policy-makers want to ensure that a certain level of domestic abatement is achieved, they may impose restrictions on credit imports. Different views on appropriate limits may inhibit linkages. If a system without a price cap is linked to a scheme with a price cap (e.g. the proposed Australian ETS), the price sets the compliance cost for the combined scheme.

Possible timeline for different types of links

Currently, there are only a few links between trading schemes and markets, restricted mainly to unilateral links to the CDM. Realistically, it can be said that there exist only few candidates for full direct bilateral linkages in the short and medium term. Full bilateral links are probably rather a long-term vision, as they require a harmonization of critical design features, especially cost containment measures. Only schemes in countries that are already close trading partners and have undergone some degree of legal and political integration, such as Australia and New Zealand, may see earlier bilateral links, as policy coordination may be much easier to establish. Also a larger number of unilateral links between national cap-and-trade schemes will be established only in the mid to long–term. So far, no unilateral links have been established between two cap-and-trade systems where the system establishing the link has a dominant effect on allowance prices in the system with which the link is established. Some emerging schemes, such as that of Australia, will discourage the establishment of unilateral links to their schemes in order to prevent a CO_2 price increase. However all existing and emerging cap-and- trade schemes provide for unilateral links to international crediting mechanisms.

4. Conclusions

Cap- and trade has emerged as the preferred policy instrument to reduce GHG emissions in the energy and industry sectors in several industrialized countries, but so far few schemes have been implemented. In contrast to CO_2 taxes, cap and trade schemes are seen not only to be economically more efficient, but politically also easier to implement. As most ETS regard the burning of biomass as carbon neutral, the competitiveness compared to other fuels increases with a rising CO_2 price. The designs of different existing and emerging ETSs vary significantly as each ETS is tailored to achieve certain national or regional policy objectives. The EU for example has a clear priority to meet a defined reduction target, and until recently had no clear view of a desired CO_2 price level. It therefore has not had, and does not envision employing, mechanisms for price control and management. In its recent post-2012 communication[39] the European Commission however explicitly emphasized the need for a high CO_2 price to facilitate the implementation of low carbon technologies. In many other countries, there is greater sensitivity to the level of future carbon prices, and the risk of high prices.

Most emerging schemes such as the proposed federal US schemes or the proposed national Australian scheme therefore include provisions for price management. In principle such price control mechanisms give certainty to businesses. To undertake major investment decisions firms need stable, but also long-term expectations of carbon prices and GHG reduction policies. The comparison of different existing or planned emissions trading schemes in this paper shows that most of them set sufficient price incentives to use more biomass as a fuel. As most emerging schemes plan to cap the CO_2 price at very low levels, however, there will be not enough incentives for the construction of new biomass plants; If emissions trading schemes are linked, as envisaged by the EU and most emerging schemes, this will have effects on the CO_2 price level. Linking therefore involves weighing the economic benefits of a greater market with a larger number of abatement options and more liquidity, against the costs of relinquishing or weakening other objectives, such as a certain CO_2 price level and corresponding incentives to implement low carbon technologies.

International or domestic offsets are an important feature in all existing and emerging schemes. In contrary to the EU ETS, both the planned US and Australian schemes provide for domestic offsets in the agricultural and forestry sectors and therefore may incentivize domestic biomass markets. Such offset systems could on the one hand positively impact the bioenergy sector through increased production of biomass, but on the other hand may lead to additional pressures on availability of land and may negatively affect the sustainability of biomass production. These effects could be intensified by linking trading schemes, as linking may increase the demand for offsets. While domestic offsets play an important role in several schemes, it remains to be seen in which form international offset mechanisms in developing countries, in which bioenergy projects currently play a prominent role, will be continued after the expiry of the Kyoto Protocol. While cap and trade policies are able to meet a given reduction target at low costs, this paper has shown that their role in creating incentives for

[39] EU Commission (2010): Communication Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage (COM(2010) 265).

technological change should not be overestimated. In order to incentivize bioenergy options complementary low-carbon technology policies are needed, which have to be specifically designed for the bioenergy sector.

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