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1 SUMMARY

Within its Energy and Climate Package, adopted by the European Parliament in December 2008, the European commission set a 10% minimum for the market share of renewables in the transport sector in 2020. To find the appropriate instruments to reach this target and the instrument mix with which biomass use in general could be best stimulated are the main questions of this project.

An important instrument of the European Climate Policy is the European Emissions Trading Scheme (EU-ETS), which started operation in 2005. Previous work done within Bioenergy NoE showed that only a high share of auctioning of allowances and a high CO_2 price provide necessary incentives for a higher biomass use. According to the Energy and Climate Package, all allowances will be auctioned in the energy sector from 2013 on, with exceptions for a few CEE countries. Based on work done within the project, a model has been developed to analyse at which CO_2 price biomass becomes competitive in case of 100 per cent auctioning or at a lower level.

The European Commission furthermore decided not to include the road transport sector into the EU-ETS until 2020. Whether the inclusion of the road transport sector in the EU-ETS, could help introducing biofuels, a separate trading scheme for biofuels should be set up, or biofuels should be addressed with other policy instruments, was another main question of this project. The first result shows that an integrated scheme would hardly have any effects on the use of liquid biofuels in the transportation sector, but might cause higher CO_2 prices for the energy and industry sector. A separate trading scheme has been implemented in the UK in 2008, California is planning such as scheme in addition to include the road transport sector into the future ETS. Within this project the design of such as system has been elaborated based on the comparison of several policy instruments to increase the use of liquid biofuels in the transportation sector.

Policy interaction was a further major focus of the project. At present, multiple policy instruments are applied simultaneously in the climate and energy policy field at both the EU and Member State levels. The targets and objectives of these instruments often overlap, creating interactions between such instruments. This interaction can be complementary and synergistic, yet various instruments can also reduce the effectiveness of one another and undermine meeting the objectives of each instrument, when the targets are contradictory. This task analysed the interactions between the EU-ETS and national climate/bioenergy support instruments and their impact on biomass use in the seven NoE countries involved in the project. The country analyses confirmed that it is important to identify the overlaps and interactions of policy instruments as there can occur both synergies and conflicts. The effect of the EU-ETS alone on biomass use is difficult to isolate, however the changes in fuel mix in the NoE countries suggest the combined effect of the national policy instruments and the EU-ETS. Competition for biomass resources is not yet seen as serious, however it is anticipated to tighten in the future due to high carbon allowances and the RES targets set at the EU and national levels. National biomass action plans have the opportunity to coordinate all biomass related policies, and include the consideration of the interplay of support measures.

2 OBJECTIVE

In its Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport the European Union (EU) sets a minimum percentage for each member state to replace fossil fuels with liquid biofuels reducing greenhouse gas emissions (GHG) (on an average 5,75% by 2010). The targets were failed in 2005, therefore the EU is reinforcing the legislative framework directive with a 10% minimum for the market share of biofuels in 2020.

At the same time the European Union implemented the European Emission Trading Scheme (EU-ETS) in 2005 as a main instrument to reach its Kyoto commitments on Climate Change when trading CO_2 allowances. The road transport sector, currently excluded from the EU-ETS, will not be involved into the scheme by 2013 but may be included at a later date. However, some member states are currently discussing pilot activities on a national level. Whether a trading mechanism is the best way to increase liquid biofuels and how such a system should be designed was one of the main questions of this JER. One of the key issues with respect to trading mechanism for the road transport sector was whether it should be included directly in the existing EU-ETS or whether a separate, parallel scheme should be newly set up. Furthermore, important design issues of a trading scheme for the transport sector (such as the question who should trade, the motorist, the car manufacturers or the refineries) were analysed.

Another main research question addressed in the project was to analyse the interaction of the EU-ETS between national climate/bioenergy policy instruments and its effects on biomass use in the NoE countries. Multiple policy instruments are applied simultaneously in the climate and energy policy field at both the EU and Member State levels. The targets and objectives of these instruments often overlap, creating interactions between such instruments. It is important to identify the overlaps and interactions of policy instruments as there can occur both synergies and conflicts. This task attempts to look into how different policy instruments fit together and involves the examination of questions such as whether the combination of national and international climate policy instruments, most importantly EU-ETS, impact positively on biomass use and to what extent the implementation of these policies could be optimised with mechanisms supporting biomass use. The result of this task is to assist the better coordination of the interplay of various climate policy instruments regarding biomass in NoE countries.

Furthermore, within the project the tool analysing the competitiveness of biomass at different CO_2 prices was modified, adapted and expanded.

3 MAIN TASKS

3.1 THE EU-ETS AND BIOMASS – TOOL DEVELOPMENT (JR-LEADER)

This task continued the assessment of the main EU-ETS related influences on biomass use in NoE countries. This included general allocation methods and the design of existing NAPs (National Allocation Plans) in participating NoE. The designed tool was applied for the analysis of the competitiveness of country specific biomass use including a variation of EU-ETS allocation methods, CO_2 price, electricity/biomass costs, plant efficiencies and national support instruments. Output of this task was a clear picture under which conditions and options biomass could become as competitive as fossil fuels.

3.2 INTERACTION OF THE EU-ETS WITH OTHER CLIMATE POLICY INSTRUMENTS (IIIEE - LEADER)

This task comprised an analysis of the interaction of the EU-ETS between national climate/bioenergy policy instruments and their impact on biomass use in the NoE countries. This task attempted to look into how different policy instruments fit together and aimed to identify and discuss the overlaps and interactions between the EU-ETS and national climate and bioenergy policy instruments. The analysis adopted a practical approach to study interactions and their effects in the seven NoE countries involved in the project, and examined the national climate and bioenergy policies, main policy instruments, as well as estimated and observed effects of the instruments on biomass use at the national level. Expert views gave an important input for the country analyses.

3.3 THE EU-ETS AND BIOFUELS IN THE TRANSPORT SECTOR (ECN-LEADER)

The task focused on options for emissions trading in the transport sector, at first by designing elements for such a trading scheme, and defining the consequences on the use of liquid biofuels. It addressed the question whether to integrate the transport sector into the EU-ETS or to set up a separate trading scheme (with a link to the EU-ETS), and analysed the impacts on the use of liquid biofuels. Furthermore options for the overall design of such a scheme have been discussed (upstream or downstream), including the question who participates in the scheme (refineries, fuel importers, car manufactures or car owners), and how the allowances should be allocated (i.e. for free, auctioning or a mix of allocation methods). In addition the task assessed briefly the performance of the EU-ETS to stimulate low carbon fuels compared to alternative instruments such as taxation or regulation. Finally it analysed the interaction of a trading scheme for the transport sector with existing biofuel regulations, such as the biofuels directive.

4 RESULTS

This chapter presents the main findings on the tasks outlined above. These results are based on the existing literature, expert interviews and a simple tool to analyse the competitiveness of biomass in power generation under the EU ETS. This tool is illustrated in the section below.

4.1 THE EU-ETS AND BIOMASS – TOOL DEVELOPMENT

4.1.1 Objective

To analyse the competitiveness of biomass in power generation under the EU ETS, including different CO_2 price levels, an analytical tool has been developed within WP12 based on previous studies of the IEA. It aims at assessing the influence of the CO_2 price on the Short Run Marginal Costs (SRMC) and the Long Run Marginal Costs (LRMC) of power generation.

4.1.2 The Tool

The SRMCs are calculated by taking in account fuel costs and other variable costs. While the SRMCs are the basis for the daily operational decisions which fuel to use, investment decisions regarding new plants are usually based on the Long Run Marginal Costs (LRMC) of a plant which include not only fuel and other variable costs but also fixed costs such as investment or capital costs.

The carbon “emission allowance” will increase the variable costs for fossil-fuelled power plants and thus its short-run marginal costs since an emission allowance will be needed for each unit of CO_2 emitted while generating power. In case of full auctioning of emission allowances, adding CO_2 costs means a change in both the SRMC and LRMC of fossil-fuel power plants. However, in case of free allocation of emission allowances to power producers, notably to new entrants, the SRMC will increase (as using these allowances represents a so-called ‘opportunity cost’) while the LRMC does not change (as in this case the free allocation is considered as an investment or production subsidy which compensates the opportunity cost of the allowance).

Since there can be major differences in biomass prices (regarding biomass types and countries considered), for each country two biomass prices are calculated – L for the lowest and H for the highest price. Also, two different prices are assumed for the gas price. With no CO_2 included, SRMCs are the lowest for coal, and the highest for gas. The cheapest biomass is used in Finland and

the UK (from 2.1 €/GJ), while the most expensive is in Germany, Austria and the Netherlands (up to 10 €/GJ).

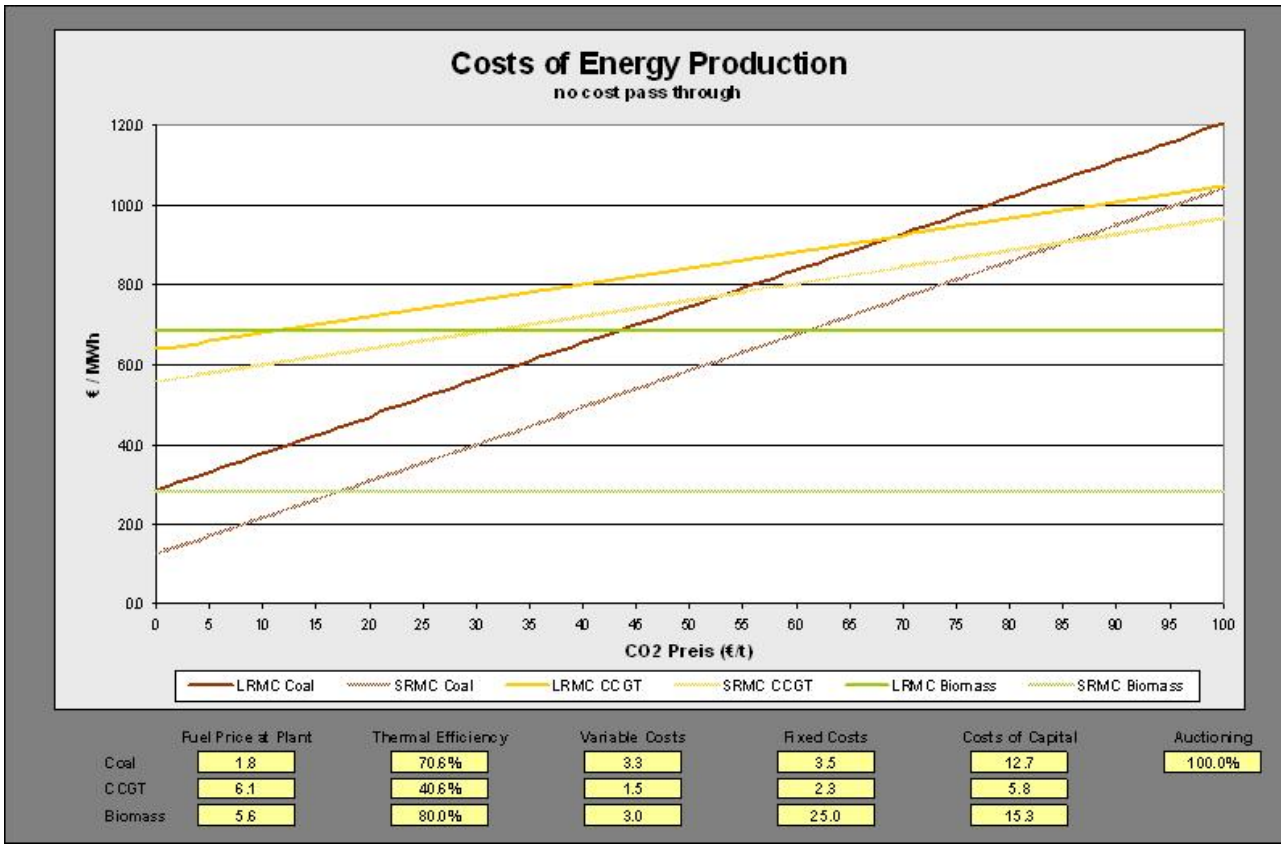

Figure 1: Costs of power production depending on different CO_2 allowance prices– tool further developed based on the modelling results of IA-12.

Table 1: Competitiveness of new biomass plants under full auctioning in the power sector[1]

Country	**CO_2-price in €/tCO_2 at which a new biomass plant become competitive with a coal CHP plant (at two different national biomass prices, i.e. low/high)**
Austria	**26/50**
Germany	**22/40**
United Kingdom	**28/50**
The Netherlands	**22/52**
Sweden	**26/39**
Finland	**27/35**

[1] The calculation were made assuming a coal price of 2€/GJ, the two biomass prices (expensive and cheap) were provided by the NoE project team.

Different thermal efficiencies were used for LRMC and SRMC calculations. For example, for SRMC calculations of a coal power plant a thermal efficiency rate of 37% is used (which refers to the average of the operating coal power plants), while for LRMC calculations a rate of 40% is used (since it refers to new plants which have a higher efficiency).

The tool illustrates the Short Run and Long Run Marginal Costs (SRMC, LRMC) depending on the fuel specific CO_2 emissions and the CO_2 price added to the cost of energy generation. The basic features of the tool were developed within IA12. Within this JER the tool was expanded to a user friendly application. Figure 1 shows a screenshot of the current model, where data on fuel prices, thermal efficiencies and different types of costs can be varied by the user. It allows fast calculations for specific plant data and country circumstances.

The EU council and the European Parliament adopted in December 2008 the Energy and Climate Package. The package provides that in the energy sector allowances will be fully auctioned from 2013 (with some CEE countries such as Poland having a lower share). Based on the NoE model it can be calculated at what CO_2 price new biomass plants will become competitive under full auctioning.[2]

The level of the CO_2 price up to 2020 is unclear, as it depends on several factors such as economic or emissions growth. In the first phase of the EU-ETS the CO_2 price was over 30€ per tonne for a certain time, before it went to almost zero, due to the over allocation of emission allowances during this phase. In the second phase the price reached the level of about 25€ per tonne, but currently is much lower. For the third phase a higher CO_2 price than in the first two phases is expected (up to 40 %/tCO_2), as the allocation was stricter than in the first two phases. As mentioned, however, it is hard to predict the CO_2 price as it largely depends on the economic growth up to 2020.

Table 1 shows at which CO_2 prices new biomass plant will become competitive under different assumptions on the biomass price, coal price, plant efficiencies and plant size (The assumptions were made for a medium–sized plant, for small plants the costs would be higher). Assuming a CO_2 price of over 30€ per tonne in the third phase, the EU-ETS with full auctioning in the power sector provides a powerful incentive to make biomass plants competitive. Table 1 gives a first indication to what extent in this case countries need additional incentives to make biomass plant competitive. In Poland the share of auctioning will be smaller than in other NoE countries. Assuming the same price level for biomass than in other EU-countries, more additional policy instruments will be needed to make new biomass plants competitive.

[2] It should be noted that the extent to which CO_2 costs are passed through to power prices – and, hence, the extent to which the competitiveness of biomass is affected – depends on factors such as the structure of the power market and the incidence of specific allocation provisions, notably whether emission allowances to new entrants are freely allocated or not (for details, see Sijm et al., 2008).

4.2 INTERACTION OF THE EU-ETS AND NATIONAL CLIMATE POLICY INSTRUMENTS

4.2.1 Objective

The objective of this task is to analyse the interaction of the EU-ETS with national climate and bioenergy policy instruments and their impact on biomass use in the NoE countries. This task examines how different policy instruments fit together. It involves the examination of questions such as:

- Whether the combination of national and international climate policy instruments, most importantly EU-ETS, impact positively on biomass use? and
- To what extent the implementation of these policies could be optimised with mechanisms supporting biomass use?

More specifically, the objective was to identify and discuss the following issues within the NoE countries participating in this project:

- interactions of the EU-ETS and the main climate and bioenergy policy instruments;
- effects of the interactions, such as conflicts and/or synergies between policy instruments;
- coordination of bioenergy policy in the country;
- linkage of bioenergy to climate policies and support measures, such as linkage of support; instruments to the efficiency and/or effectiveness of CO_2 reduction.

The research also addresses the research needs indicated by Sipilä et al. (2008), that include the assessment of the influence and relevance of the EU-ETS on biomass use in the context of other policy instruments directed to support the achievement of energy and climate policy goals. The result of this task is to assist the coordination of the interplay of different climate policy instruments with biomass utilisation in NoE countries. In particular, this task aims to provide policy recommendations and highlight further research needs on how to better coordinate bioenergy policies and to achieve the largest possible benefits of biomass as efficiently and as sustainably as possible. These recommendations will support meeting the meeting of targets within the EU Biomass Action Plan (EC 2005), the ambitious targets of the EC 'Climate action and renewable energy package' of March 2007 (EC 2007a) and the targets set in the new Directive on the promotion of the use of energy from renewable energy sources (EP 2008).

4.2.2 Initial approach to policy interactions

The initial research on policy interactions addressed the following themes, and is briefly discussed in this chapter:

- theoretical background of policy interaction;
- national biomass strategies and linkage to climate change policies;
- national support instruments for biomass in NoE countries.

4.2.2.1 Introduction to policy interaction

At present, multiple policy instruments are applied simultaneously in the climate and energy policy field at both the EU and Member State levels. Thus, the policy environment is becoming increasingly crowded and complex. The targets and objectives of instruments often overlap and create interactions between these instruments. This interaction can be complementary (i.e. *synergistic or mutually reinforcing*), but various instruments can also reduce the effectiveness of another and undermine the meeting of objectives of an instrument – particularly when the targets are contradictory.

Even though a coherent and coordinated policy mix has been called for, there have been relatively few studies on energy and climate policy interaction. The most important EU climate policy instruments are named under the European Climate Change Programme (ECCP) (ECCP 2008). However, while the ECCP lists a wide array of policies, it does not explicitly acknowledge the interaction of these policies. The INTERACT project, 'Interaction in EU Climate Policy' (Sorrell 2003), developed a systematic approach to analyse policy interaction and used this approach to explore the potential interactions between the proposed EU-ETS and other instruments within both EU and Member State climate policy spheres. The project analysis was extended to five EU countries: Germany, Greece, France, the Netherlands and the United Kingdom. The project demonstrated that policies can work effectively in combination and that such combinations can often be more effective than individual instruments in isolation. However, the project results also highlight that there is a need to identify the circumstances in which the policies do or do not create positive interactions, and to design policies accordingly (Sorrell 2003).

The INTERACT project stressed that it is especially important to clarify the policy objectives of those instruments, which coexist with the EU-ETS. The reason given for this is that the EU-ETS guarantees the achievement of a particular, Europe-wide emission target. Those instruments, which directly or indirectly interact with the EU-ETS, will not contribute further to overall emission reductions as they simply make available allowances which may be purchased and used by other participants (Sorrell 2003). Sijm (2005) concludes that once the EU-ETS is operational, the

effectiveness of other policies to reduce the CO_2 emissions of the participating sectors becomes zero, this being the case in a perfect economical environment without market failures. However, there are three major justifications given for the coexistence of the EU-ETS and overlapping instruments: i) improving the design of the EU-ETS, ii) correcting for market failures, iii) meeting other policy objectives besides CO_2 efficiency.

In this light, support for renewables can be justified by objectives such as improving the security of supply, raising rural income opportunities and reducing other environmental effects (Sijm 2005). It can be argued that EU-ETS, as a general instrument aiming to reduce GHG emissions, cannot replace target-oriented support for renewables. Diekmann et al. (2008) indicate that the trading scheme can be expected to have little impacts on the expansion of RE markets as the financial incentives are too low and the investment risk is too high. In addition, learning effects usually justify the use of renewable energy support schemes[3] (Abrell and Weigt 2008).

In general, the main economic motive behind policies for bioenergy and other RES is the reduction of CO_2 emissions. However, policies promoting bioenergy are primarily intended to reach a certain amount of bioenergy use instead of efficient reduction of carbon emissions (Hansson & Sterner 2006). It should be noted that targets (one kind of policy instruments itself) promoting biofuels for transport tend to offer fairly low climate benefits compared to substituting biomass for fossil fuels in heat and electricity production, which generally is less costly and provides larger CO_2 emissions reduction per unit of biomass (e.g. Berndes & Hansson 2007). It also needs to be clearly recognised that interventions often have markedly different underlying motives (e.g. security of liquid transportation fuel supply vs. greenhouse gas reduction).

As an example, policy interactions can be defined as follows: 1) coexistence without interaction, 2) direct interaction, 3) double regulation, 4) double counting, 5) differential treatment and equivalence of effort, and 6) link between trading schemes and fungibility[4] (del Rio González 2007). The policy interaction can be categorised as a) national or international, b) same or different policy context, and c) parallel functioning or coordination (Oikonomou et al. 2007). The energy research group of University of Groningen in the Netherlands has been developing a decision support tool, ECPI, which is focused on energy and climate policy instruments, and aims to provide a tool for policymakers and policy relevant stakeholders (Oikonomou et al. 2007).

The theoretical framework of policy interaction offers justification to the research on the effects of different energy and climate policy interactions. As an example, the UK's Climate Change Simplification Project (UK Defra 2007) reviewed the three major climate change instruments with a purpose to eliminate avoidable overlap of the instruments, simplify existing regulations and

[3] Support for renewables can foster the learning by doing effects and thus lead to reduced energy costs in the future (Abrell and Weigt 2008).
[4] The quality of being capable of exchange or interchange.

consequently ensure that the administrative burden on business and regulatory burden economy as whole are kept to a minimum. Climate change policy has to take into account multiple, various market failures at all levels of the economy. Thus, some overlap between instruments is unavoidable. Nevertheless, as UK Defra (2007) highlights, it is fundamental to recognise the overlaps and manage them to remove any unnecessary burden.

At the EU level, the interactions of implementing various targets have been assessed for the EU's 'climate and energy package' (EC 2008). Furthermore, the Green-X project on optimal promotion strategies for renewable electricity has analysed trade-offs between different support instruments[5]. Interactions of the EU-ETS and green and white certificate schemes have been examined by Harrison et al. (2005), whereas the interaction between energy taxation and EU-ETS has been assessed for the Green Paper on market-based instruments (EC 2007b).

4.2.2.2 National biomass strategies and linkage to climate change policies

The EU Biomass Action Plan (BAP) has stated that the establishment of national biomass action plans (nBAPs) is one of the key actions to boost bioenergy market. Of the eight NoE member countries, the Netherlands and the United Kingdom have submitted their biomass plan to the European Commission. The Dutch Biomass Action Plan was published in 2003; however it has not been updated since. The UK Biomass Strategy was published in May 2008, and the UK government has outlined a strategy for each sector: industry, energy and transport. The aim of the UK strategy is to have a holistic approach covering economics and end markets, technology and scale issues to ensure the best use of the biomass resource.

Germany and Austria have their national BAP in a preparation phase. In Germany, the nBAP development is a joint exercise of two ministries (environment and agriculture), but there have been substantial uncertainties about the contents and the structure of the nBAP. However, the German nBAP development process is ongoing, and the plan is to include a strategic approach for electricity, heat and transport sector. The criteria for comparison of bioenergy options in these three sectors includes security of supply (substitution of imported fossil fuels), economic evaluation (e.g. CO_2-reduction costs), effect on climate protection (CO_2-reduction per ha), environmental effects (biodiversity) as well as added value and job effects in the rural areas. The Austrian nBAP proposal was published by the ministry for agriculture and forestry, environment and water management in 2006. However, the plan is still under discussion, and has not yet been issued as an offical BAP. In Finland, Sweden and Poland there is no official nBAP (see further discussion on the status of national biomass action plans in country analyses).

[5] For more information: http://www.green-x.at/

The UK specifically mentions climate change to be the primary motivation for its national BAP; the role that bioenergy can play in reducing carbon emissions in the country has also been investigated by the House of Commons (2006). This report explicitly acknowledges that heat and electricity production from biomass is more efficient in terms of reducing carbon emissions and that biofuels for transport do not present the most effective or efficient way of making a significant difference to the UK's carbon emissions in the long term. Also it notes that a multiplicity of biomass support schemes causes confusion; in 2006 there were some eight support schemes for biomass alone. According to the report, UK Government policy has not leave room for newer, more efficient technologies to develop and become commercially viable because it does not link incentives to carbon savings.

In addition to the UK, Germany (SRU 2007) and Sweden (Energimyndigheten 2008a) have discussed on the role of bioenergy in their climate change policies. The German report "Climate Change Mitigation by Biomass" (SRU 2007) states that biomass promotion can contribute in varying degrees to the fulfilment of agricultural, energy and environmental policy targets. However, the inherent costs and the conflicts between these targets need to be taken into account. Also this report acknowledges that prioritising the use of biomass in the transport sector does not adequately exploit the potential of biomass in climate change mitigation. Also some biomass strategies are linked to climate strategies at the regional level, such as in the Hanover and Bavaria regions of Germany.

4.2.2.3 National support instruments for biomass

An excel sheet was circulated in 2007 among the NoE country representatives to collect information on the support instruments for bioenergy in the three principal bioenergy sectors (i.e. electricity, heat and transport) (7.1). It can be seen that there are rather clearly defined support instruments for bioelectricity (feed-in tariffs in Austria and Germany, tradable green certificates with a quota system in Poland, Sweden and the UK, and tax support/investment grants in Finland), whereas in the heat and transport sectors the support instruments vary more.

4.2.3 Policy interaction analysis

This chapter describes the analysis to study the EU ETS and climate policy interactions and their impact on biomass use in the seven NoE countries involved in the project. It adopts a practical and qualitative approach due to a lack of expertise within the group to study the topic within a more theoretical framework. There are differences in terms of the depth of the research between the countries as detailed below:

- The status in Finland, the Netherlands, Sweden and the UK were examined through document analysis and expert interviews. Experts represented various organisations:

research and consultant company (Sweden), forest industry (Finland, Sweden and the UK), a governmental energy department (Finland), governmental energy agency (Sweden, the Netherlands) and research centres (Finland, the Netherlands). Altogether 15 experts were contacted (includes only those who gave relevant information; see Annex 2: Interviewed experts for the persons consulted).

- Austria, Germany and Poland were assessed by means of document analysis; Austria and Poland were assessed only in terms of climate and bioenergy policy in the country and main climate/bioenergy instruments.

The definition of an interview in this case is a semi-structured discussion on the phone or by email on the theoretical interactions of the EU-ETS and support instruments in the country and possible connection with issues related to the current biomass use in the country. It must be noted that experts may have their own strong views, which may not always reflect the common 'national' opinion or view on the issue. However, the opinions have been presented in the country analyses referring to the expert's background/organisation.

The results of the interaction analysis are presented by each country in the following sub-topics (see Annex 3: Interaction analyses of the NoE countries):

- climate and bioenergy policy, including current biomass use for energy and targets;
- main climate and bioenergy policy instruments;
- interaction of the EU ETS and national instruments (possible conflicts and synergies);
- estimated effects of the instruments on the use of biomass (before and after the introduction of the EU-ETS) including competition between different uses of biomass, change in fuel mix, increased biomass prices etc.;
- observed (/realised) effects of the instruments (after the introduction of the EU-ETS) - see previous,
- measures taken to balance the effect of the EU ETS.

This study also includes the discussion on peat due to its importance in energy production both in Finland and Sweden. As the approach of the examination is of practical type, the emphasis is on the effects of the instruments that informants and analysts consider have arisen. However, no true evaluation has been done in terms of linking statistical bioenergy development and the support instruments. Theoretical examinations of policy instrument interactions are presented when available or found. This study does not take into account the interactions and the effects of the other international climate policy instruments, such as Joint Implementation (JI) and the Clean Development Mechanism (CDM).

4.2.4 Conclusions

This chapter summarises the results of the country analyses (Annex 3: Interaction analyses of the NoE countries) and the various conclusions that can be drawn from them. Key issues, future research needs and/or policy recommendations are stated after each subtopic.

Bioenergy support instruments and their linkage to climate policies:
Firstly, it can be seen that the NoE countries included in this analysis employ various policy instruments to reach their climate and energy strategy objectives. Five out of seven examined countries have recently adopted a new energy and/or climate strategy: Finland and the UK in 2008; Austria, Germany and the Netherlands in 2007. Sweden is expected to adopt its integrated strategy in the spring 2009.

Concerning the measures of the national climate and energy strategies and the support of biomass, there are clear overlaps and linkages between them in all seven countries. Finland regards the use of wood-based fuels, waste fuels and biogas as essential in meeting the strategic targets, whereas the Dutch "Platform for Biobased Raw Materials" supports meeting the national energy and climate change goals. The primary economic support instruments for renewables (and bioenergy) are often deployed to mitigate climate change. Nevertheless, carbon savings are not generally connected to the performance of the support instruments. An indication of considering it is seen in the UK BAP and the German BAP under development as well as in the case of the evaluation of the support instruments in Austria and the Netherlands.

Despite the multiple measures implemented nationally, the coordination of the use of the support instruments is minimal. Any of the examined NoE countries do not have a 'full-grown', coherent biomass action plan, which would coordinate the policies connected to biomass use. However, it should be noted that this kind of integrated biomass plan has not yet been developed either elsewhere in Europe (the definition of a BAP is not yet clear; see more from BAP Driver 2009).

- National BAPs have the opportunity to coordinate all biomass related policies and measures, and include the consideration of the interplay of support measures.
- CO_2 reduction and its costs should be linked to the performance of the policy instruments.

Theoretical interaction (synergies and conflicts):
In addition to the INTERACT study, theoretical interaction studies found in the case of Sweden, Germany and the UK show the importance of identifying the overlaps and interactions of various policy instruments in place. It can be concluded that there are both synergies and conflicts between the EU ETS and national policy instruments. The combination of the EU-ETS and feed-in tariff/energy tax stimulates the fuel switch from fossil fuels to renewables, as mentioned in the case

of the Netherlands. In Sweden, electricity tax, green electricity certificates and the EU-ETS all seek to decrease electricity consumption; the CO_2 tax and EU ETS complement one another in the sectors outside the ETS. In terms of conflicts, the reduction of cost-effectiveness from the viewpoint of CO_2 reduction in the case of combined use of EU ETS and feed-in tariff/green certificates/CO_2 taxes is recognised by Germany, the Netherlands, Sweden and the UK. As the UK Defra (2007b) emphasises, the time scale of policies is important; the cost-effectiveness of climate policy has the potential to be improved by RE support instruments in the long-term. Thus, these possible long-term benefits must be clearly recognised and balanced against the loss of efficiency to the economy in the short-term.

- It is important to identify the overlaps and interactions of policy instruments as there can occur both synergies and conflicts.
- Long-term benefits of policies need to be acknowledged as they can outweigh the short-term disadvantages.

Linking instruments and effects on biomass use:

The estimations of the effects of the EU-ETS on the biomass use, particularly before the introduction of the trading system and at the regional level, were found to be assessed at least in Finland. The competitiveness of wood fuels was expected to be increased while peat use was assumed to be replaced by wood and even coal. Increased demand for wood fuels and increased wood prices were linked both by Finland (before the ETS) and Sweden (in 2006). Swedish electricity certificate scheme and the EU ETS were expected to promote the use of bioenergy. UK has noted the concerns over the growing competition in the international bioenergy market, but due to the ambitious national renewable energy targets rather than the EU-ETS.

Since the introduction of the EU-ETS, the expected impacts have largely been realised. Based on statistics (see Annex Table 2- Annex Table 4), the use of biomass and wastes grew between 2004 and 2006 in each of the examined NoE countries, the most in Germany (46%). More particularly, the consumption of wood and wood wastes increased in all countries (UK leading with 31% increase 2004-2006). At the same time, fossil fuels consumption mostly diminished, apart from Austria and Poland. These developments suggest the change in fuel mix due to the national support instruments and the EU-ETS.

Regarding the effects in Finland and Sweden, perhaps the clearest impact of the EU-ETS has been on the use of peat. In Finland, where the peat use is far more important than in Sweden (Sweden uses peat around the fifth of the Finnish use, see Annex Table 5), peat use has increased despite the introduction of the EU ETS. The Finnish feed-in tariff for peat can be considered to have contributed to this trend. However, in Sweden biofuels and peat are equal in the system, and the electricity certificate has not been strong enough to offset the disadvantage. Measures to balance the

effect of the EU-ETS have been taken at least in Finland and Sweden in the form of introduction of a new support instrument (for peat in Finland) and reduction of a level of energy tax (Sweden).

Based on the expert opinions in Finland and Sweden, competition between different uses of biomass resources is not yet seen as serious (not much discussed yet in the UK). Nevertheless, as Sköldberg and Rydén (2006) state, this competition can increase in the future due to the use of biomass for production of fuels for the transportation sector and export of biomass to other European countries. In Finland and Sweden the import of biomass is of considerable size, in 2006 around 15–20% of biomass was imported as raw material for industry and of biofuels for heat and electricity production (Sköldberg and Rydén 2006). In terms of raw material competition, other factors increasing it in the future between Finland and Sweden can be the export taxes for wood from Russia. It also noteworthy that in Finland, the linkages between power industry and forest industries may be more powerful than the effect of the national support mechanisms. In the light of the current adverse economic situation, decrease in pulp & paper production can in turn reduce the amount of bioelectricity produced. This can be the case in the countries such as Finland and Sweden where forest industry is tightly linked with the energy production sector. However, differences between Finland and Sweden include different energy production structure and support measures to promote the use of biomass (for example in Sweden more hydropower and higher energy taxes).

The analysis of competition regarding the use of biomass has shown that prices and willingness to pay in different sectors are of greater importance than national physical quantities of available biomass (Sköldberg and Rydén 2006). Even if this examination did not look into the biomass price development in a detailed way, it can be concluded that there is recognised a tendency in the increase in prices. For example in Sweden, the highest prices of biomass in the middle of 2008 were for refined wood fuels around 24 €/MWh (262 SEK; in 2004 206 SEK/19€[6]). The price of industrial by-products has risen 41% since 2004 until the second half of 2008 (Energimyndigheten 2008c). There are various reasons for the price development, which would need to be examined further.

It is a challenging task to link the effect and the instrument; it is not straightforward to attribute the effects – such as fuel choice change, increased competition for raw material and the higher prices of timber – to the ETS or other support instruments. Nevertheless, there seem to be rather a combined effect of mix of instruments responsible of a certain development than an effect of the EU-ETS alone. It is acknowledged that the effects of the EU-ETS may be more visible in the second trading period, as there is still rather little experience of the EU ETS and the first phase of the scheme had several shortcomings. There were more observed effects found in Finland and Sweden, but this can simply be explained by more detailed research in these two countries, and the narrow scope of the research in general. The effects may be more visible at regional level compared to national level; there are indications of this in Finland, Sweden and the UK.

[6] Exchange rate 1€ = 10.77 SEK, without taxes

While this task has assessed the effects of the support instruments mainly in the near past, it is vital to look into the impacts of the various factors affecting the development of biomass use for energy in the future. Concerning the competitiveness of the European pulp and paper industry, it is foreseen to suffer from higher energy and fiber raw material prices in the future if the revision of the EU-ETS does not exempt the industry from the auctioning (PTT 2008). In Finland, the EU-ETS is anticipated to weaken the competitiveness of the industry (Suhonen et al. 2008). Moreover, the ambitious RES targets, required by the new RES Directive, with high carbon allowances can increase the competition for wood and endanger wood processing for products.

- The effect of the EU-ETS alone is difficult to isolate; the changes in fuel mix suggest the combined effect of the national policy instruments and the EU-ETS.
- Competition for biomass resources is not yet seen as serious , however it is anticipated to tighten in the future due to high carbon allowances and the RES targets set at the EU and national level. The reasons behind biomass price increase are multiple.
- When evaluating the effects of support instruments, it is important to understand the different national settings in the countries, not only in terms of support mechanisms, but also regarding for instance forest industry position, energy production structure and for which purposes biomass is used (in the energy and material sectors).
- More research on regional and local level effects is needed, as biomass is used for products, which can be subjected both to international and local competition.

<u>Balancing the use of wood for energy and materials:</u>
There has been discussion especially in Finland on the good quality wood being diverted to energy production instead of its use for paper or materials. According to the Finnish forest industry representative, pulpwood is being used for energy production for example in Austria, Czech Republic and in the UK. Behind this phenomenon are considered to be both the EU-ETS and national support mechanisms. Climate change benefits of wood's material use are acknowledged; yet for now there are no incentives, such as CO_2 allowances, which would be connected to wood building. As the UK's forest industry representative states, businesses and jobs can be lost if energy use of wood overrides the material use.

According to Bringezu et al. (2007), sustainable biomass strategy should consider the interrelations of material, energy and land use, and it should be included in a cross-sector strategy for sustainable use and management of resources. Often limited biomass resources can be used more efficiently when there is a coordinated approach on biomass use. This can be enabled by the application of 'cascade principle' (e.g. using first wood products that can be recycled, then for energy).

- A cascade principle should be applied to enable more efficient use of biomass resources; this needs to be considered in an integrated biomass strategy.

- The recognition of the material use of biomass with incentives should be explored.

Policy coherence and optimisation of instruments:

Improving policy coherence contributes to balanced decision-making. Thus, national biomass action plans and strategies should take into account the interaction of both national and international support instruments. In addition, as Diekmann et al. (2008) points out, such an integrated strategy can prohibit the sectoral competition for support, that is among various electricity, heat and transport applications.

In many cases, the promotion of renewable energy is part of a comprehensive energy and environment strategy. Because of possible intersections and indirect interactions between the various policy instruments in the strategy, the design and the application of the respective policies should take account of these interactions and the measures should be adjusted accordingly (Diekmann et al. 2008). One recommendation is to make targets of the policy instruments consistent in order to reduce perverse incentives and better align domestic instruments with national and international policy objectives, as in the UK's Climate Change Simplification Programme (UK Defra 2007b). Furthermore, monitoring and evaluation framework of policies is needed; energy performance would be more easily tracked against the objectives.

It can be questioned whether an optimal mix of instruments would be possible to design on the whole. All the measures from different support schemes together form a complex network of interactions, with a certain outcome, that might or might not have been thought prior to implementation of the support schemes. In any case, the development of more synergistic instrument mixes would be beneficial for biomass-related policy fields.

- Competition for support among various biomass applications can be avoided by a coherent and integrated biomass strategy.
- The design and the application of policies need to take account of the eventual interactions between climate and energy policy instruments, such as conflicting targets; monitoring and evaluation of policies is essential.

4.3 THE EU-ETS AND BIOFUELS IN THE TRANSPORT SECTOR

4.3.1 The EU-ETS and the transport sector

The transport sector and its options for emissions trading is currently not included in the EU-ETS. There is an ongoing discussion on how to include the sector and which designing elements for such a trading scheme should be forced. This task focused on these designing elements and on the consequences on the use of liquid biofuels. It addressed the question whether to integrate the transport sector into the EU-ETS or to set up a separate trading scheme (with a link to the EU-ETS), and assessed the impacts on the use of liquid biofuels.

4.3.2 Abatement costs in the transport sector

Figure 2 and Figure 3 show the costs of CO_2 avoidance compared to the potential for eliminating the CO_2 emitted by the corresponding fossil fuels, as a fraction of fossil energy involved in the total energy used in the pathway.

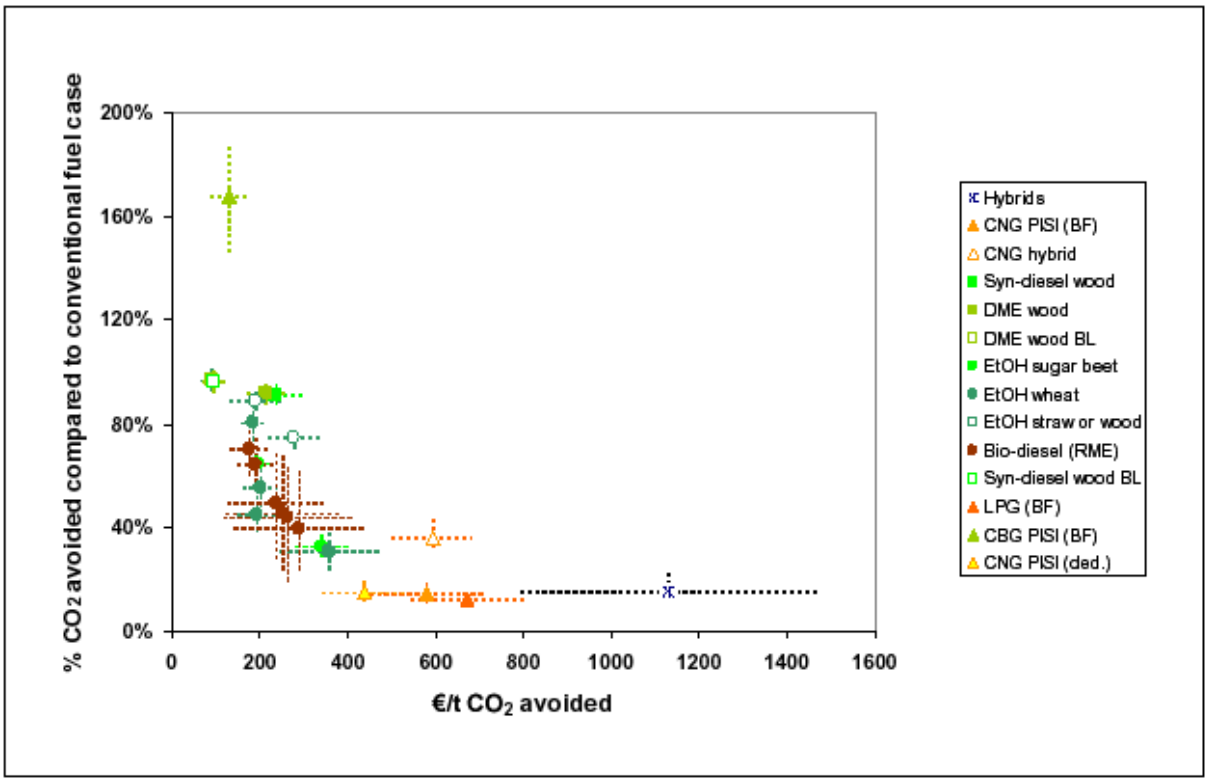

Figure 2: Cost and potential for CO_2 avoidance, Oil @ 25 €/bbl (Source: WTW Report 010307)

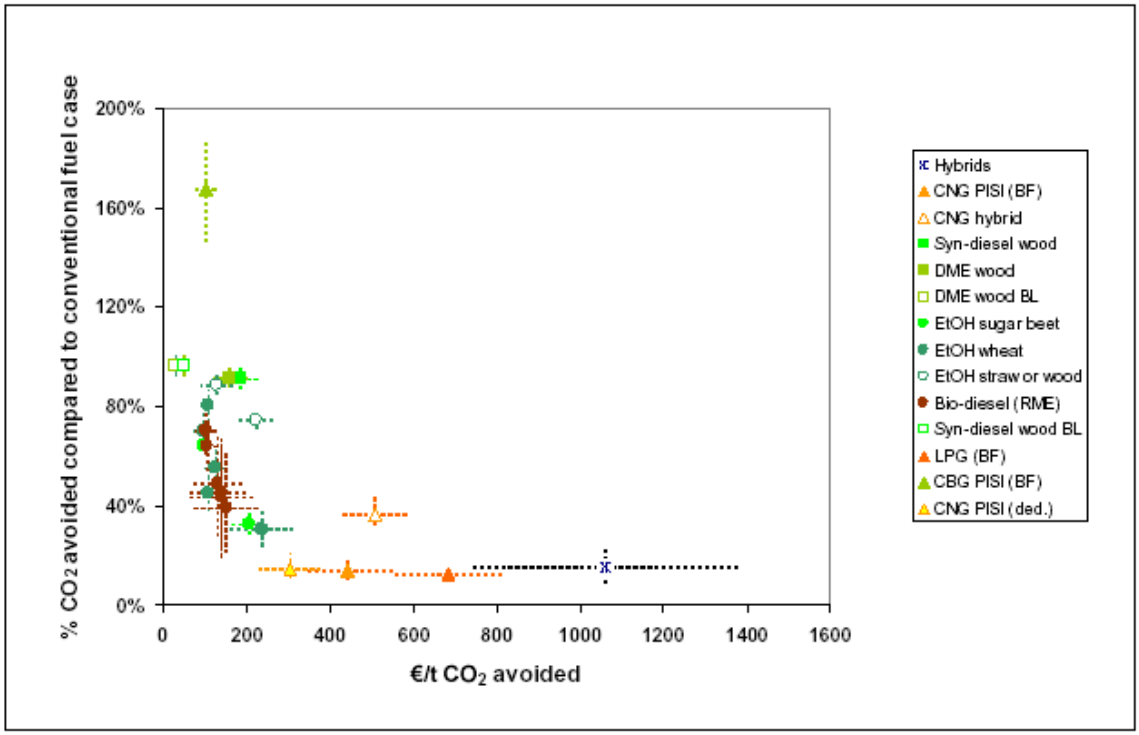

Figure 3: Cost and potential for CO_2 avoidance, Oil @ 50 €/bbl (Source: WTW Report 010307)

The net two figures are other cost estimates and show GHG mitigation costs for modern-day and for future technologies.

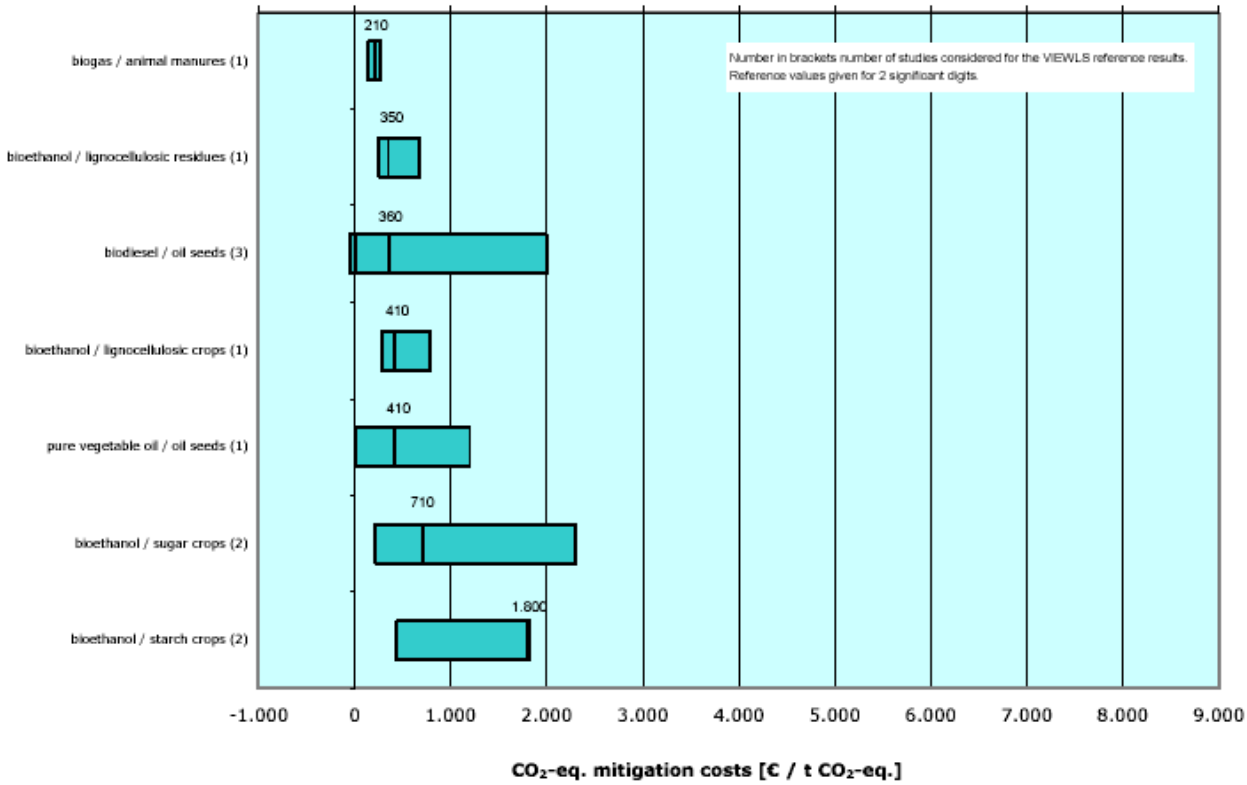

Figure 4: GHG Mitigation Costs - Modern-day Technologies (Source: VTT)

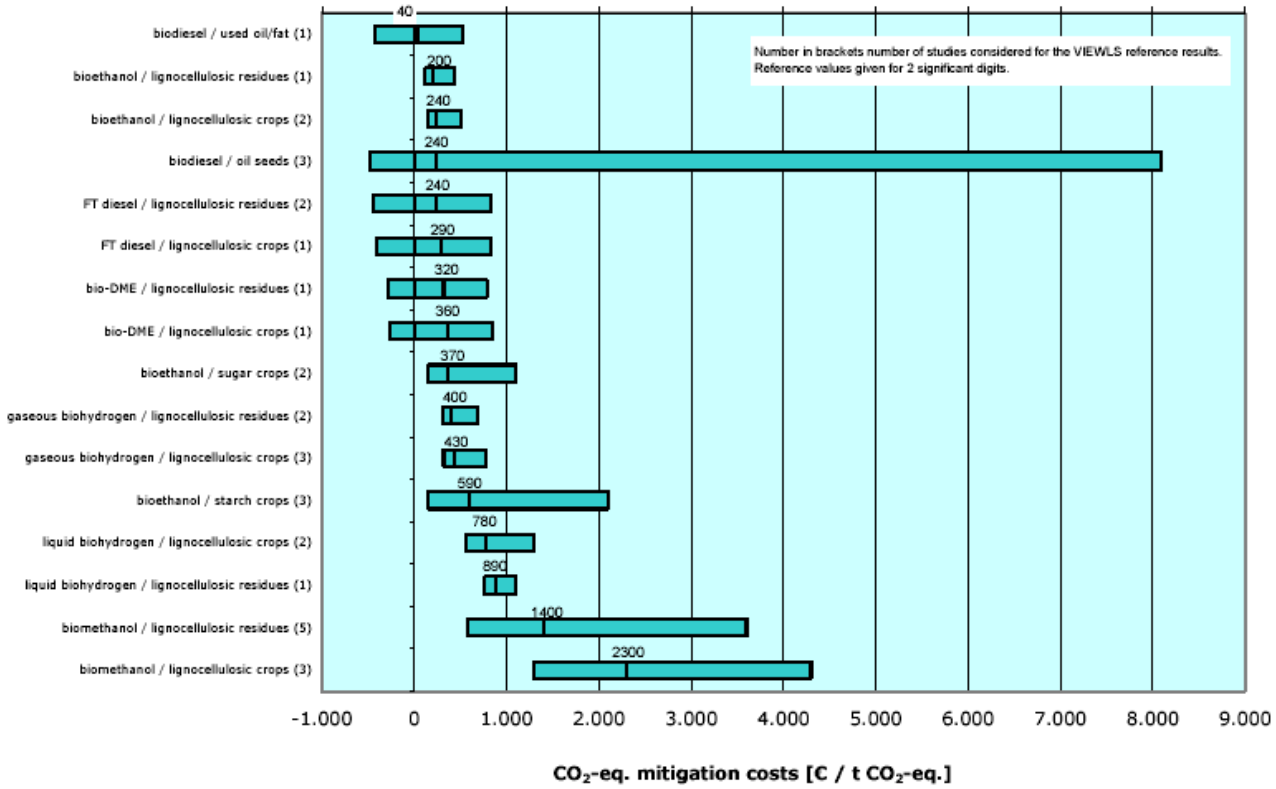

Figure 5: GHG Mitigation Costs - Future Technologies (Source: VTT)

Figure 4 and Figure 5 illustrate the high abatement cost of many measures in the transport sector, compared to abatement cost between 20 and 40 Euro per tone for many measures in the energy sector.

4.3.3 Emissions trading in the transport sector

The transport sector accounts for 21 percent of the EU's total greenhouse gas emissions. Against the background of global warming and the related international commitments on emissions reductions, the EU considered an inclusion of transportation in the EU-ETS. The inclusion of aviation has already been fixed for 2012; the inclusion of other transport modes was discussed but finally has been rejected in the Energy and Climate Package. Other emerging emissions trading schemes (e.g. the Californian trading scheme) regard the transport sector as essential for the success of the scheme.

4.3.4 Comparing different instruments

This chapter describes and compares different policy instruments for reducing emissions and increasing the use of liquid biofuels.

4.3.4.1 General policy options for reducing emission in the transport sector

If the aim of policy make is to reduce emissions in the transport sector.

Three main policy options are available:

- Regulation (command and control measures):

  Regulation includes for example technology standards or fuel mandates. The costs arise when implementing a regulation and are not clear at the time of implementation.

- Market-based instruments:

  Market-based instruments include taxation and Emissions trading. When implementing a tax the costs are clear, the environmental outcome is unclear. When implementing an Emissions trading scheme the environmental outcome is clear, however there is no certainty about the costs. An ETS gives more flexibly compared to regulation and thus reduces the cost of emissions reductions. Furthermore, an ETS internalizes external costs but fails to address other (technology) market failures such as the failure to appropriate privately the benefits of R&D.

- Information: Information includes labelling or "eco-driving". Such policy options are already under implementation in some EU member countries such as France.

4.3.4.2 Specific design options for Emissions Trading in transport sector

Type of the Emissions Trading System (ETS):

- Cap & Trade (CT) system

In a cap- and trade system the government sets a cap on the amount of emissions. Companies are issued emission permits and are required to hold an equivalent number of emission permits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, limiting total emissions to that level. Companies that need to increase their emission allowance must buy credits from those who pollute less. The transfer of allowances is referred to as a trade.

- Baseline & Credit (BC) system

In a baseline and credit program a baseline is set by the government and companies can create credits by reducing their emissions below the baseline level of emissions.

Linkage of the EU-ETS and transport sector:

There are several options if and how to integrate the transport sector in the EU-ETS:

- Full integration of all transport sectors and EU-ETS

  This option was ruled out in the EU energy and climate package, only the aviation sector will be included from 2012.

- Full separation of all transport sectors and EU-ETS

  Also this option was not chosen by the European lawmaker, aviation will be include in the trading scheme from 2012.

- Hybrid, limited linkages between transport sectors and EU-ETS

  Integration of some transport sectors (aviation, shipping), while other transport sectors either (i) have their own, separate ETS, or (ii) rely on other instruments. This is the approach which will be implemented by the European Union. While aviation is included in the EU-ETS from 2012, and shipping will be included from 2013 in case no international agreement under a post-Kyoto treaty will regulate shipping emissions, the other transport modes are excluded and will rely up to 2020 on other instruments.

Coverage:

The coverage of the trading system can include CO_2 or other greenhouse gases, the geographical scope can be national, EU wide or global.

Trading entity:

Regarding the trading entity a down-stream approach, a mid stream or an up-stream approach can be distinguished.

- Down-stream approach

A down-stream approach builds on a direct limitation of CO_2 emissions. The absolute cap for the target period will be broken down on the different sub-sectors. With regard to passenger transport, allowances could be allocated to the final consumers on an average per capita basis, e.g. with CO_2 debit cards (IFEU, 2002). With regard to goods transport, emissions could be allocated to the transport companies. The allocation procedure could be based on grandfathering, auctioning or a combination of both of the elements.

- Mid-stream approach

A mid-stream approach with vehicle manufacturers as trading entities is based on a change in the relative price of different types of vehicles; it provides incentives for innovation in low carbon technologies. For the different product lines, the emission relevant factors are calculated. Allocation

of allowances would be based on grandfathering depending on the companies' market shares and product attributes in a certain base year. The companies' costs of emissions trading would be shifted to the consumers. A mid-stream approach based on transport service providers includes both CO_2 emissions from public passenger transport and good transport cards (IFEU, 2002). The allocation procedure would be grandfathering based on historical level of transport services as measured in passenger kilometres or tonnes kilometres per year. Costs would again be passed through to the consumers.

- Up-stream approach

An up stream approach with fuel suppliers (refineries or importers) as trading entities could integrate all emissions related to fuels. The allocation procedure could be based on grandfathering or auctioning or a combination of both. The costs would again be passed through to the consumers cards (IFEU, 2002).

4.3.4.3 Choosing the appropriate policy instrument

The choice of a policy instrument depends on the overall policy objective: Is the aim

i) to reduce global emissions cost-effectively
ii) to control transport emissions or
iii) to encourage specific transport technologies, such as the increased use of biofuels?

Within this JER different policy options have been discussed based on a literature review (see Annex II) and the specific expertise of the research team.

The JER work focused on the questions:

a) whether the road transport sector should be included directly in the existing EU-ETS or whether a separate, parallel scheme should be developed and
b) its possible influence on liquid biofuel use.

The debate whether transport should be included in the EU-ETS was carried out controversially within EU policymakers. One main problem is the huge difference regarding the abatement cost in the energy/industry sectors and the transport sector (see chapter 4.3.2).

An integrated system (Figure 6) may lead to net flow of credits from energy/industry to the transport sector, with little abatement activities being carried out in the transport sector as companies within the transport sector will purchase their allowances from the energy and industry sector accompanied with gaining CO_2 price levels within the EU-ETS.

Figure 6: Qualitative assessment of an integrated market system with a full integration of the transport sector into the existing EU-ETS and equalized (possibly higher) allowance prices

An integrated system would probably cause the following effects:

Positive: - Increase the cost-effectiveness of the total scheme.

Negative: - Entities in the transport sector would purchase credits from the energy and industry sectors (abatement cost cheaper).

- An increase of the EUA price would lead to a decrease of industrial competitiveness and possibly to carbon leakage (hardly any mitigation of transport emissions).

A hybrid market (Figure 7) with limited linkages between transport sectors and EU ETS would have only moderate effects on the CO_2 price in the energy and industry sector.

A separate scheme for the road transport sector (Figure 8) would have only little impact on the use of biofuels due to the high costs of biofuels. To see an effect the CO_2 price or the CO_2 tax would have to be very high. The CO_2 price signal would first incentives cheap reduction measures in the transport sector, the more expensive one, and this includes many biofuels options, may not be affected unless certificate prices are very (prohibitively) high given their high abatement costs of biofuels. This would significantly increase the transportation costs with effects on other sectors of the economy. There is a high incidence of other market failures (besides cost externalities) for specific biofuel technologies, including technological learning (i.e. cost reductions) of biofuels, high risks, uncertainties, etc. .

Figure 7: Qualitative assessment of an hybrid market system with linkages between the sectors with higher costs in the transportation sector and lower costs in the energy/industry sector

A hybrid system would probably cause the following effect:

Neutral: - In a mixed system with hybrid linkages of the EU-ETS and a transport ETS the performance depends on specific design features.

Figure 8: Qualitative assessment of a separate market system with high CO_2 allowance prices in the transport sector and a relatively low CO_2 prices in the energy and industry sector.

A separated system would probably cause the following effects:

Positive: - A full separation of the EU-ETS and the transport sector would have no impact on the EU-ETS.
- Effective tool to control transport emissions if it was designed as a cap and trade system. Increase the cost-effectiveness of the total scheme.

Negative: - The carbon price in transport sector might, however, become (unacceptable) high.

The choice of the policy instrument depends on whether policymakers want to limit emissions in the transport sector or increase the use liquid biofuels. Aiming at a simple reduction of emissions (regardless of how this will be achieved) a separate cap-and trade scheme would be the appropriate instrument, whereas focusing on an increase of biofuel use a regulation would be the appropriate instrument, but there is uncertainty about the costs. However a regulation could be accompanied by a trading mechanism (a "baseline and credit scheme) in order to increase flexibility and to reduce cost. This approach was taken in California and the UK and will briefly be discussed in the next chapter.

4.3.5 Separate trading mechanisms based on a fuel standards

A separate trading scheme for the transport sector in order to increase the use of liquid biofuels is currently being implemented in the UK (within the Renewable Transport Fuel Obligation, RTFO) and planned in California, USA. Such a scheme could also take into account specific problems related to liquid biofuel production and use such as sustainability questions.

California-Low carbon standard for transportation fuels (LCFS)

The California-Low carbon standard for transportation fuels was established in 2007 in order to reduce GHG emissions and reliance on foreign oil. It aims at reducing the carbon intensity of California's transportation fuels by at least 10 % by 2020. The LCFS is a complementary instrument to the planned ETS in California which also includes transport, but by now there are no plans to establish a link between the two instruments. It is structured like an ETS (Baseline and Credit) in which companies must apply to the regulator of the system to achieve credits based on performance beyond a regulatory standard. The LCFS applies to all providers (refiners, blenders, producers or importers) of transportation fuels. These providers may purchase and blend more low carbon fuels into gasoline products or trade credits. As a measure of carbon intensity the LCFS uses the concept of „Global Warming Intensity" (GWI) which also takes sustainability issues into account for example by including land use conversion effects in the production process of biofuels. The LCFS allows banking in order to ensure the cost effectiveness of the scheme while it rejects borrowing

because it reduces the incentives for present innovations. Obligated parties can either comply or pay a fee set at the marginal cost of society to reduce CO2 emissions (which is different from paying a fine for non-compliance). Companies are allowed to buy offsets generated in the aviation or in the maritime sectors, but not from outside the transportation sector. In order to allow technologies to develop the LCFS' compliance path should not require significant short term reductions in carbon intensity.

UK Renewable Transport Fuel Obligation (RTFO)

The RTFO requires fossil transport fuel suppliers as of April 2008, to ensure that biofuels constitute

- 2.5 % of total road transport fuels in 2008-09,
- 3.75% in 2009-10, and
- 5% in 1010-11 and beyond

The RTFO requires reporting regarding the sustainability. Certain criteria have to be fulfilled for fuels to be eligible for credits. Furthermore, different biofuels are rewarded according to the level of their carbon saving

The RTFO includes a trading scheme in which fossil-based, so fuel suppliers can meet their renewable fuel requirement by

- Selling renewable transport fuel for which they get certificates
- Purchasing certificates from another company
- Paying a "buy-out" prices per unit of renewable fuel that the company should have supplied, but did not

The buy out fees will contribute to a fund, with the money reallocated to the companies who submitted certificates, which is an addition incentive to supply biofuels

5 CONCLUSIONS

The EU Energy and Climate Package adopted in December 2008 by the European parliament sets the framework for Europe's energy and climate policy up to 2020. In the energy producing sector, hundred per cent of the allowances will be auctioned (with the exception for a few countries). Based on the earlier NoE modelling work it could be assessed for each country at which CO_2 price biomass will become competitive with fossil fuels, giving also an indication to what extent other instruments are necessary.

The road transport sector, currently excluded from the EU-ETS, will not to be involved into the scheme until 2020. However, there is an ongoing discussion on appropriate policy measures to reduce emissions via regulation, market based instruments (such as emissions trading) and information. Thereby the group assessed the performance of different instruments and trading types (Cap & Trade, Baseline & Credit), as well as defined three options to implement emissions trading into the EU-ETS: a full integration to an integrated market, a full differentiation leading to separate markets a hybrid system with limited linkages between the affected sectors.

The project concludes that a separate trading system for the road transport sector may reduce transport emissions. However it would have only little impact on the use of biofuels. The CO_2 price signal would first incentives cheap reduction measures in the transport sector; the more expensive one, and this includes many biofuels options, may not be affected unless certificate prices are very (prohibitively) high given their high abatement costs of biofuels.

If the policy goal is to increase the use of biofuels (and not only to reduce emissions), a regulation system should be rather preferred than a cap-and trade system. The project concludes that adding a trading mechanism to a regulation (a "baseline and credit" scheme in this case) could lead to more flexibility and lower costs. Furthermore, such a scheme could be specially designed to address issues of sustainability and to accelerate the implementation of strategic technologies. This approach was taken in California and the assessment illustrates that it could also be the way forward for the EU.

Concerning the interaction analysis, various conclusions can be drawn based on the country cases (see for more detailed conclusions chapter 4.2.4). Firstly, it can be seen that the NoE countries included in this analysis employ various policy instruments to reach their climate and energy strategy objectives. However, the coordination of the support instruments to find the most efficient policy mixes is minimal. National biomass action plans have the opportunity to coordinate all biomass related policies and measures, and include the consideration of the interplay of support measures. In addition, a coherent and integrated biomass strategy can forbid the sectoral competition for support, and assist in finding the most efficient uses of biomass resources.

In terms of the effects of the instruments on biomass use, the changes in fuel mix suggest the combined effect of the national policy instruments and the EU-ETS. Competition for biomass resources is not yet seen as serious, however it is anticipated to tighten in the future due to high carbon allowances and the RES targets set at the EU and national level. More research on regional and local level effects would be needed, as biomass is used for products, which can be subjected both to international and local competition.

In addition, it can be concluded that the design and the application of policies need to take account of the eventual interactions between climate and energy policy instruments, such as conflicting targets. Furthermore, long-term benefits of policies need to be acknowledged as they can outweigh the short-term disadvantages.

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7 ANNEXES

7.1 ANNEX 1: SUPPORT INSTRUMENTS FOR BIOENERGY IN 2007

Annex Table 1: Support instruments for bioenergy in NoE countries in 2007.

	Electricity	Heat	Transport
Austria	• **Green Electricity Act** • **Ecology-oriented taxation concept (2005) energy tax on gas and electricity** 4.36 cents/Nm3 + 20 % VAT for natural gas 1.50 cents/kWh + 20 % VAT for electricity Approx. 12 % of tax revenues are remitted to the Federal provinces for the implementation of energy saving and environment protection measures. This also includes measures for the promotion of renewable energy sources • Relevant housing construction subsidies • Agro-economical aid • Supporting schemes for trade and industry – besides the promotion system according to the Eco-Power Act as such • Umweltförderung im Inland (UFI) Funds available last year: € 80,3 Mio. Funds available this year: € 90,238 Mio.		• Tax package in respect of energy/mineral oil taxation (adopted in 2003) • Promotion of E85 fuels
Germany	• **Renewable Energy Sources Act (EEG)**: Network operators give priority to connection, purchase and transmission and provide a fixed compensation for a 20- year period; *Feed-in tariffs for biomass and biogas in 2008* : <150 kW 10.8 €cents/kWh 150 kW- 500 kW 9.3 €cents/kWh 500 kW - 5 MW 8.4 €cents/kWh 5 MW - 20 MW 7.9 €cents/kWh Fuel Bonus <500 kW biomass & biogas 5.6 €cents/kWh 500 kW - 5 MW Biogas 3.7 €cents/kWh, solid biomass 2.4 €cents/kWh Technology bonus 2.0 €cents/kWh Conegeration bonus 2.0 €cents/kWh *Landfill gas and sewage gas tariffs for 2008:* <500 kW 7.2 €cents/kWh 500 kW - 5 MW 6.1 €cents/kWh	• **Market Incentive Programme (MAP)**: Investment subsidies (primary private households), low-interest loans with partial debt waiver (commercial and public sector applicants); Although this program addresses the electricity and biogas market as well, it supports first of all small scale heating systems. In 2004 some 22.3 % of the budget were allocated for bioenergy : 20 M€ for heating systems < 100 kW, 8.2 M€ for cogeneration systems > 100 kW and 10 M€ for biogas plants.	• **Biofuel Quota Act**: Quota for addition of biofuels (2007: 4,4 % diesel, 2 % petrol; 2010: overall 6 %), pure biofuels above the quota receive tax breaks
Finland	• Investment grant up to 40% [Vna 2002/625] • Feed-in tariff for peat [Vna 2007/322] • Tax return for renewables(wind, hydro less than 1MW, bio, ref, biogas, heat from chemical processes): bio 0,42c/kWh; woodchips 0,69c/kWh [Vna 1996/1260] • Feed-in tariff for electricity produced from biogas under preparation	• No excise duty for solid biofuels in heat production [Vna 1996/1260] • No excise duty for bio-based fuel oil used in heating [Ve 61/2007] • Simplified tax procedure for small producers of bio-based fuel oil[Ve 61/2007]	• 5,75% in 2010 [2007/446] • No excise duty for bio-based fuel oil used in machinery [Ve 61/2007] • Simplified tax procedure for small producers of bio-based fuel oil[Ve 61/2007] • No excise duty for liquid biofuels used by YTV in public transportation
Netherlands	**MEP/SDE:** feed-in subsidy, including for cofiring wit biomass; **EIA & VAMIL** investment subsidies; **Coal covenant:** agreement to enhance the share of biomass in power generation; **Green investment schemes:** soft loans/fiscal facilities to enhance the attractiveness of green investments)	**EIA** (investment subsidy): some indirect support might occur in CHP-installations, where the support mechanism is primarily targeting electricity production; *Expected shortly* : **Feed-in premium** on biogas injection into the natural gas grid; *Expected shortly:* **Investment subsidies** for domestic heat options such as solar thermal	**Biofuel consumption target** (both for petrol and diesel replacements); **EIA/VAMIL** (investment subsidies; for 2nd generation biofuels only); and some (incidental) **subsidy programmes,** for instance to reduce CO2 emissions in the transport sector ("Innovative Biofules for Transport"), RD&D subsidies ("Unique Opportunity Regulation") or an announced programme to adjust filling stations for biofuels

Annex Table 1: Continued - Support mechanisms for bioenergy in NoE countries in 2007

	Electricity	Heat	Transport
Poland	• **Decree of Ministry of Economic Affairs of 19 December 2005 on guaranties of origin for electricity and heat coming from RES** (amendment of 3 November 2006): suppliers of electricity to the end-customers are obligated to submit guaranties of origin for electricity coming from renewable sources (commonly described as 'green certificates') to the President of Energy Regulatory Office (URE) (in 2010 - 10.4%). Guarantees of origin for RES-electricity and heat mechanism has worked since 1 October 2005. • **Energy Law of 10 April 1997**, updated for 4 August 2007: up to 5MW-plant the license for electricity or heat generated from RES is free of charge (licenses are demanded for all producers RES-electricity and heat); fee for connection of RES plants to the gird reduced up to 50%, • **Act on subsidies to arable lands and sugar subsidy of 26th January 2007**: additional payment for: hop, pasture plants, some other plants, 'Energy crop premium': yearly extra charge 45 €/ha for farmers (since the beginning of 2007 for energy crops cultivation).	**Decree of Ministry of Economic Affairs of 19 December 2005 on guaranties of origin for electricity and heat coming from RES** with amendments of 3 November 2006: suppliers of heat to the end-customers are obligated to submit guaranties of origin for heat coming from renewable sources to the President of the Energy Regulatory Office (URE).	• **Bio-components and Biofuels Act of 25 August 2006**: up to 5% of biocomponents in traditional fuels; definition of National Indicative Target; farmers could produce and storage biofuels for their own purposes, • **Decree of Council of Ministers of 15 June 2007 on National Indicative Target for 2008-2013**: detailed percentage share of bio-compound and biofuels' in the total market, e.g. 5.75% in 2010, • **Long-term programme for biofuels promotion of 24 July 2007**, • **Act on excise tax changes of 11 May 2007**: for motor petrol 1.565 PLN/each liter of bio-components; for driving oils: 1.048 PLN/each liter of bio-components, • **Act on subsidies to arable lands and sugar subsidy of 26th January 2007**: farmers, who plant rape for energy purposes are getting additional national payment in the amount 176 PLN/ha of rape cultivation, • **'energy crop premium'** – yearly extra charge equaled 45 €/ha for farmers (since the beginning of 2007 for energy crops cultivation).
UK	**Renewables Obligation** on electicity suppliers to source a percentage of electricity from renewable schemes, with tradable renewable obligation certificates (ROCs). Investment subsidies for large and small scale CHP schemes. Agricultural subsidies for energy crop growers.	**Investment subsidies** for large and small scaleheat schemes. Agricultural subsidies for energy crop growers.	**Renewable Transport Fuels Obligation** on transport fuel suppliers to deliver a percentage of renewable fuels, with tradable renewable transport fuel (RTF) certificates. Agricultural subsidies for energy crop growers.
Sweden	• **TGC/quota obligation scheme**: Renewable Electricity Certificates (May 2003 ->) • **Fiscal incentives/ energy taxation**: - general energy tax - CO2 tax since 1991 (biofuels and peat exempted), general rate in 2006 92 öre/kg of CO2 (around 0.1€/kg CO2) - sulphur tax 30 SEK per kg of sulphur emissions (around 3.3€/kg) from coal and peat - environmental levy on the NOx emissions since 1992 SEK 40/kg of NOx emissions (4.3 €/kg) - electricity production is exempted from energy and CO2 tax - manufacturing industry, horticulture, farming, forestry and acquaculture pay no energy tax on fossil fuels and only 21% of the CO2 tax	• **CO2 tax** introduced in 1990/1991 - on all fossil fuels • Further raised CO2 tax paired with lower income tax • Support for district heating • Investment grants for biofuel projects • Investment grants for conversion from oil heating to heating with pellets.	• Carbon (CO2)taxation since 1991 • Project support (tax deduction) for the first ethanol factory • Public support for ethanol vehicles (buses in Stockholm, ordering of flexifuel vehicles (FFV)) • Good support from some oil companies (e.g. OK-Q8) • Long term tax exemption for transport biofuels • Low level blending expands market • Requirement for gas stations to offer biofuels ('Pumps Act' April 2006) • Free parking for environmental friendly cars and exemption from congestion charges • Government subsidy for environmental friendly cars (2007)

7.2 ANNEX 2: INTERVIEWED EXPERTS

Experts interviewed/consulted by country (only including those who gave relevant information):

Finland:
Ahti Fagerblom, Metsäteollisuus Ry. (Finnish Forest Industries)
Eija Alakangas, VTT
Martti Flyktman, VTT
Pekka Tervo, TEM (Ministry of Employment and the Economy)
Tiina Koljonen, VTT

Sweden:
Bo Ryden, Profu
Håkan Sköldberg, Profu
Lars-Erik Axelsson, Skogsindustrierna (Swedish Forest Industries Federation)
Matti Parikka, Energimyndigheten

The Netherlands:
Bert Daniels, ECN
Kees Kwant, Senternovem
Marc Londo, ECN
Marijke Menkveld, ECN
Ton van Dril, ECN

The United Kingdom:
Stuart Goodall, Confederation of Forest Industries (UK) Ltd

7.3 ANNEX 3: INTERACTION ANALYSES OF THE NOE COUNTRIES

7.3.1 Austria

Climate and bioenergy policy:

The Austrian Climate Strategy, initially formulated in 2002, was adopted by the Council of Ministers following its evaluation and revision on in March 2007. The strategy covers the period 2008-2012 and includes all sectors, particularly focusing on those not covered by the EU-ETS. The revised strategy outlines comprehensive range of measures required to meet the national Kyoto Protocol target, emphasising the role of industry, housing construction, development of local public transport and the purchase of CO_2 emission credits from other countries until 2012. Other important measures include supporting the use of renewable energies, improving energy efficiency and promoting the use of environmental technologies (IEA Climate Change Database 2008 & Lebensministerium 2008a).

Austria has not yet adopted a coherent bioenergy strategy, but a biomass action plan in preparation. The proposal for the Austrian nBAP was published by Federal Ministry of Agriculture, Forestry, Environment and Water Management in September 2006 with the prognosis for the development of the biomass market until 2010 and 2020. The Austrian Energy Agency made a preliminary study; however, the BAP is still under discussion.

The share of RES-E in total electricity consumption was 59.8 % in 2007, whereas the EU target for 2010 in Austria is 78.1 %. The proposed RES Directive target for Austria is 34 % in 2020 compared to the share of renewables of 23.3 % in 2005. These targets are considered to be highly ambitious and need a broad set of measures promoting energy efficiency, mobilise new biomass resources and increasing imports. In addition, there are various targets set nationally. The Austrian government programme 2007-2011 has defined targets for renewables; the objectives particularly concerning biomass use are (however, currently not regarded as realistic because indicative, BAP Driver 2009) (IEA Global Renewable Energy Database 2008):

- Increase of RES in TPES to 25% by 2010, and by 45% by 2020, which is contributed by the objective to double the use of biomass by 2010;
- Increase the share of RES-E to 80% by 2010, and 85% by 2020, compared to electricity production of 1997;
- Switching households to use RES: at least 100 000 by 2010 and at least 400 000 by 2020
- Increase use of alternative fuels in the transport sector to 10% by 2010 and to 20% by 2020, development of a methane-based transport fuel with a share of at least 20% methane by 2010, provide fuel coverage with a network of E85 and methane filling stations by 2010;
- Improve the legal framework for feeding biogas into the gas distribution network.

By means of the amendment to the Austrian Eco-Electricity Act ("Ökostromgesetz"), the share of green electricity in Austria is to be doubled to 15 % by the year 2015 (Lebensministerium 2008b). There are no differentiated RES heat targets for the moment.

In 2006, biomass and wastes contributed in Austria as follows (Eurostat 2009):

- 53 % (3737 ktoe) of primary production of RES (RES contributed 7019 ktoe, or 73 % to total primary energy production),
- 12 % (4000 ktoe) of gross inland consumption,
- 5 % (3.2 TWh) of total electricity production.

Main climate/bioenergy policy instruments:

The Austrian climate and energy policy instruments overlap, and the same instruments supporting biomass use can also be considered to promote climate change mitigations:

- Investment subsidies: 'green' residential and commercial buildings
- Tax incentives: reduced VAT on biomass, transport biofuels tax subsidies
- Eco-Electricity Act ("Ökostromgesetz"): feed-in tariff
- R&D funding, in particular from the new Austrian Climate and Energy Fund
- Environmental standards for biomass heating technologies
- Rural development programme, including biomass

The Climate and Energy Fund supports the implementation of the Climate Strategy by means of research, targeting sustainable energy technologies, increased energy efficiency and CO_2 reduction in transport, and promoting deployment and diffusion of technology in the marketplace (IEA Climate Change Database 2008). The feed-in tariff period for biomass and biogas was extended from 11.25 years to 5 years in the amendment of the Eco-Electricity Act. The tariffs for all green power technologies will be re-evaluated in 2009 (Lebensministerium 2008b).

No linkage to carbon savings is seen in the design of the support measures. However, subsidy programme evaluation is linked to CO_2 reductions (BAP Driver 2009).

Interaction of the EU-ETS and national instruments (conflicts and synergies)/effects:

There are no studies found concerning the interaction effects of the support instruments and the EU-ETS. The competition between the use of biomass for energy and alternative uses is regarded as relevant. Conflicts have traditionally existed for wood resources (material vs. energy use), but recently also for food uses. However, the issue is seen as uncertain and complex (BAP Driver 2009).

7.3.2 Finland

Climate and bioenergy policy:

The long-term climate and energy strategies from 2001 and 2005 were updated in the end of 2008 when the new climate and energy strategy ”Long-Term Climate and Energy Strategy” was adopted. It includes detailed insights into climate and energy policy measures up to 2020, and suggestions up to 2050. If no measures were taken, Finland’s greenhouse gas emissions would exceed those of 1990 by around 20%, almost entirely because of emissions from energy and industry sectors. EU ETS acts as an important measure to cut emissions in these sectors. Finland aims to cut emissions from other sectors, such as transport, house-specific heating and agriculture, by an average of 16 % from the 2005 level, by 2020 by means of national measures (TEM 2008).

The new strategy aims to intensify and change structures for current support systems for renewable energy. It acknowledges that the accomplishment of targets will need an in intense boost in the use of wood-based energy, waste fuels and biogas with additional input from heat pumps and wind energy. The use of forest chips is to be boosted by two or three times over current levels (TEM 2008).

There is no explicit bioenergy strategy or a biomass action plan specifying objectives for biomass use in the country. However, it is expected that a more detailed plan on renewable energy will be made based on the new climate and energy strategy. The goal of the new climate and energy strategy is to increase the share of renewable energy to 38 % by 2020 (from 28.5% in 2005), in line with the obligation proposed for Finland by the European Commission in the new RES Directive (EP 2008); this is considered as highly challenging (BAP Driver 2009). One of the most essential tools in achieving the ambitious RES target is the National Forest Programme. This aims to increase the use of forest chips from 3.4 Mm^3/year in 2006 to 5 Mm^3/year by 2010, and to 8-12 Mm^3/year by 2015[7] (Finnish Forest Association 2008).

In 2006, biomass and wastes contributed in Finland as follows (Eurostat 2009):

- 88% (7651 ktoe) of primary production of RES (RES contributed 8654 ktoe, or 49 % to total primary energy production)
- 20% (7574 ktoe) of gross inland consumption.
- 14% (10.9 TWh) of total electricity production.

The share of renewable electricity of total electricity consumption was 24% in 2006, and the target set by the EU for 2010 is 31.5%.

Main climate/bioenergy policy instruments:

[7] 5 Mm^3 of forest chips corresponds to circa 6 TWh and 8 Mm^3 to circa 10 TWh, when the assumed energy content of wood fuel is 15 GJ/t (20% moisture content); 1.4 cubic meters equals 1.0 tonne of solid wood; 1 solid cubic metre equals 2.5 cubic meters of forest chips (bulk-m^3).

According to Valtioneuvosto (2008), the main climate instruments and measures included in the new climate and energy strategy include:

- support of research, technology and innovations;
- economic instruments: energy taxation, investment subsidies and feed-in tariffs;
- education, guidance and communication;
- energy efficiency measures, such as funding of energy efficiency of buildings;
- renewable energy action plan;
- waste management measures, such as strategy to decrease landfilled waste of biological origin.

The principle instruments supporting bioenergy include:

- investment subsidies,
- tax return for RES/tax refunds on electricity price,
- a feed-in tariff for peat generated electricity,
- R&D funding.

No linkage to carbon savings is seen in the design of the support measures. Along with the implementation of the new strategy, a feed-in tariff system will be introduced. This option is being investigated by a working group established by the Ministry of Employment and the Economy.

Theoretical interaction of the EU ETS and national instruments (conflicts and synergies):
Interaction or the combined effect of the steering measures are not discussed in the new strategy nor there has been found any analyses on the theoretical interaction of the support measures.

Estimated effects of the instruments:
The estimated effects of the EU ETS were studied in 2002 and 2004 by Elektrowatt-Ekono (2002 & 2004a). Before the introduction of the EU ETS, it was expected that competitiveness of peat will decrease compared to other fuels. In addition, peat was estimated to be replaced by wood but also with coal when the CO_2 prices are higher. Another expected effect of the EU-ETS was the increased competition from the woody biomass raw material when the CO_2 price increases (Elektrowatt-Ekono 2002 & 2004a). In 2004, it was estimated that the prices of the wood fuels would increase and the demand of the wood fuels would grow compared to the supply. If the price of carbon was to exceed 20€/ CO_2t, the demand for forest chips would reach the objective of the RES promotion programme of the 10TWh use (Elektrowatt-Ekono 2004b). Even if the calculations behind the estimations are outdated, it is interesting to examine whether the estimated effects took place after the introduction of the ETS.

From the regional point of view, at least three Finnish regions have assessed the effects of the ETS before its introduction. For example in Southwest Finland (Varsinais-Suomen Energiatoimisto 2004), it was estimated that in the case of 20€/t CO_2, the supply of wood fuels in the market would

be 600 GWh, whereas the demand would have been 900 GWh. In Central Finland, the technical-economic harvesting potential was expected to be increased by the EU ETS, along with the use of agricultural biomass for energy. It was estimated that the ETS would not have a great effect on recycled fuels, whereas a negative impact was estimated to incur to the energy use of peat (Määttä and Paananen 2005).
Also in Eastern Finland, in the case of 20 €/t CO_2 allowance, it was estimated that wood will replace peat and coal in the electricity and heat production up to the limits of the competitiveness and availability (forest residues increase 1500 GWh, i.e. +300% from 2002 to 2010; peat use decrease 60 GWh, i.e. -1%; oil use decrease 880GWh, i.e. - 48%, use of coal finishing completely). In the power plants, a 5-20% increase was estimated in the wood fuels share, and in the heat centers even a 100% share, depending on the feasibility of the combustion technique. The overall flow on emplyment effects of the EU ETS were estimated to be as much as 2000 person years in a long term; the employment effects will be stronger after 2010 when the ETS effects strengthen. Positive effects were estimated to be brought by the ETS for machinery manufacturers, depending, among others, on the development of exports of forest machinery and the development of regional value chains (Itä-Suomen Energiatoimisto 2004).

Concerning the estimated impacts of the EU-ETS in the future, a study on the prospects of EU and Finnish bioenergy markets until 2020 foresees the EU-ETS to be harmful to the competitiveness of the Finnish industry. In addition, this analysis, based on expert views, assumes that the most important political measures affecting the bioenergy market development in the near future will be fiscal and subsidy policies, common legislative obligations and EU-ETS (Suhonen et al. 2008).

Observed effects of the instruments:
Finnish energy statistics show that the share of fossil fuels in the total energy consumption decreased 5% from 2004-2007 (from 52% to 48%, respectively), whereas the use of RES stayed the same (25%) (Statistics Finland 2005). More detailed examination reveals that wood fuels consumption remained mostly the equal 2004-2007 (-1%), whereas peat consumption increased 15% during the same time period. Other fuels, including among others biogas and recycled and waste-based fuels, were consumed 25% more in 2007 compared to 2004. Despite the wood fuels use staying essentially equal since the introduction of the EU-ETS in 2005, the use of forest residues (forest chips from branches, tree tops and stumps) for energy is reported to be strongly increased in 2005 and 2006 (in 2006 around 3 million m^3 , whereas in 2004 it was around 2.3 Mm^3, Finnish Forest Association 2008).

Peat is co-fired with biomass in Finland in CHP and condensing power plants, and used also in heat production. The peat use was decreased by 23% in 2005 compared to 2004 partly due to the decrease in competitiveness of peat after the introduction of the EU-ETS. In 2007 however, the peat use reached record numbers (28.4 TWh), compared to 19.1 TWh in 2005 (Statistics Finland 2008). Peat use has increased encouraged by a feed-in tariff for peat in condensing power plants since May

2007. In Finland, the use of peat is connected to the use of wood; when the CO_2 allowance price was very low in 2007, the recycled wood use was low as well (peat does not have CO_2 tax in heat production).

A forest industry's energy advisor considers emissions trading as a powerful steering mechanism as it affects the industry's fuel choices by providing an incentive to use renewable energy. The high price of emission allowances increases the energy sector's ability to pay for wood, directing wood to combustion, which could be processed into products. Therefore wood fuels have become more attractive in energy production when using peat becomes expensive through ETS.

According to a Finnish governmental expert, increased competition for forest resources might start to pose a threat to wood availability when CO_2 allowances are above 30€/t CO_2 due to the usage of mainly domestic wood. A Swedish consultant states, that the export taxes of Russian wood are expected to have a bigger impact in 2008 compared to previous years. Finnish pulp and paper industry has been importing wood from Sweden due to rising export taxes for Russian wood. In addition, pellets have recently been exported from Finland to Sweden. According to a Finnish research centre expert, pellets have been burnt recently in power plants because all the peat has already been used (not enough peat because of rainy summer in 2008). There is a small amount of chipboard (i.e. particle board) industry in Finland compared to Sweden. However, it may compete for the same raw material with pellet producers as the pellet production has increased in Finland[8].

The forest industry representative also sees that there is a true competition between board industries and energy sector as they both use wood processing by-products such as saw dust and chips. Currently forest residues are being used both in the energy sector and in the power plants of the forest industry (pulp & paper plants). As such, the EU-ETS has raised the prices of the forest chips and therefore has hampered 'the resource availability' of board manufacturers.

The requirements of the EU 'climate & energy package' will make Member States to think hard about their options to reach their country-based targets. The forestry industry expert considers that the proposals for the revised ETS Directive and the new RES Directive will have an impact on the competition for the biomass resource; higher CO_2 prices and ambitious RES targets can lead to more severe competition for biomass. Regarding the Finland's renewable energy target set by the EU (EP 2008), Finland should increase the share of RES almost 10% by 2020. At the moment the share of logging residues is 1%, and this share could be increased to 3% according to the forest industry (Mäntyranta 2008). Even if forest residues have their potential, round wood will have great chances to be used in energy production – as the Finnish Forest Association states, there is an EU requirement to generate renewable energy but not to produce paper. Industry believes that it can compete for round wood if the market is not distorted by state incentives; however, market-based

[8] Wood pellets are usually made of compacted waste sawdust, which is a by-product of sawmilling and other wood transformation activities.

incentive could work if it was designed not to support the combustion of round wood (Mäntyranta 2008).

In 2006, it was estimated that the willingness to pay for biofuels was expected to rise in Nordic countries (in Sweden, up to 200 SEK/MWh (22€/MWh) or more in the future) and timber prices would also increase (Sköldberg and Rydèn 2006). According to the forest industry expert, it is reasonable to assume that the emission trading will also put upward pressure on the prices of wood and recovered paper, since they can be used as a raw material in energy production. If a 10 or a 20 % increase is assumed in the raw material cost, it would mean 1450 million or 2900 million € extra costs to the industry annually in Europe, as stated by the Finnish forestry industry expert. In addition, there are many ongoing investments on power plants that will use biofuels, which are seen to contribute to the increasing competition. While it is difficult to analyse the exact effect of ETS on wood prices, in recent years the prices have gone up; however, there are several reasons behind that development.

In addition to the peat related discussion, there has been considerable debate on the effects of the EU-ETS especially on the use of wood in Finland. Concerning the material use of wood, according to Finnish Forest Association (Mäntyranta 2008), it is against the principles of sustainable development to use the wood directly for energy instead of making first paper out of it, and using it for energy at the end of the recycling process of the paper. Furthermore, the use of round wood in the forest industry creates welfare and employment considerably more compared to the energy production from wood. Already now over a half of the wood used in forest industry is transformed to energy at the plant so that the direct use of wood would increase the energy production by only half of the potential (Mäntyranta 2008).

It can also be argued that the EU-ETS in its current form does not add value to the wood outside the energy use. However, the CO_2 allowances should be connected for example to wood building, which would also decrease building with energy intensive materials such as steel and concrete (Finnish Forest Association 2005).

<u>Measures taken to balance the effect of the EU ETS:</u>
Feed-in tariff for peat was introduced in 2007 to mitigate the negative effects of the EU-ETS for peat.

7.3.3 Germany

Climate and bioenergy policy:

Germany can be considered to be well on its way to achieving the Kyoto target of a total reduction of 21 % by 2008-2012, as the national greenhouse gas emissions in 2007 were 22.4 percent below emissions in the Kyoto base year (1990/1995). In addition to the climate protection measures that have been initiated, the current success in reduction is also due to low temperatures and other favourable conditions (BMU 2008).

The latest climate policy document is from 2007, called "Integrated Climate and Energy Programme", which aims to reduce CO_2 emissions 40 % by 2020 compared to 1990 levels. This programme was legally transpositioned by the German government in June 2008 when it approved a new climate package of measures. The new legislative package focuses on the transport and building sectors (IEA Climate Change Database 2008).

Concerning bioenergy policies, a national bioenergy strategy has been proposed by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, but it has not been agreed by the government. Therefore it is still in progress and discussed by the ministries involved.

The national RES target imposed by EU in the new RES Directive for Germany is 18% by 2020, compared to 5.8 % of 2005. The German government decided on aiming to increase the share of RES-E to 25-30% by 2020. There are also ambitious targets for each bioenergy sector (stated directly by the BMU/ BAP Driver 2009):

- Electricity: 6% by 2020 (3.3% in 2006)
- Heat: 11% by 2020 (5.7% in 2006), also specific targets in the RES Heat Act
- Transport: 12% by 2020 (target under discussion; 6.6% in 2006)
- Biogas feed-in: substitution of natural gas use by biogas 6% by 2020 and 10% by 2030

According to the country's renewable energy agency, RES (wind, biomass, water, solar and geothermal energies) will together represent a 47% share of Germany's total electricity consumption by 2020 (EurActiv 2009).

In 2006, biomass and wastes contributed in Germany as follows (Eurostat 2009):

- 76 % (16175 ktoe) of primary production of RES (RES contributed 21169 ktoe, or 15 % to total primary energy production).
- 4.6% (16120 ktoe) of gross inland consumption.
- 3.3% (21.2 TWh) of total electricity production.

The share of RES-E in total electricity consumption was 15.2% in 2007, when the EU target of RES-E for Germany is 12.5 % for 2010.

Main climate/bioenergy policy instruments:

The most important climate instruments and measures include:

- Renewable Energy Sources Act (EEG): feed-in tariff scheme
- Climate Legislation Package enacted under the Integrated Climate Change and Energy Programme (29 measures)
- National Climate Protection Initiative (national and international measures)

The Integrated Climate and Energy Programme promotes security of supply, economic efficiency and environmental protection through 29 measures, of which an important part is measures to support the expansion of renewable energies.

The main instruments promoting bioenergy are:

- Renewable Energy Sources Act (EEG): feed-in tariff scheme (electricity)
- Market Incentive Programme: investment grants (heating/cooling)
- Biofuel Quota Act: quota and partial tax exemption (transportation)
- Renewable Heat Act (EEWärmeG): obligation to use RES heat in new buildings
- Gas Grid Access Ordinance: biogas feed-in

Theoretical interaction of the EU ETS and national instruments (conflicts and synergies):

The interaction of emission trading and different national policies to promote renewable energy has been modelled by Abrell & Weight (2008). They conclude that a green certificate trading scheme (with a quota) or a feed-in system, such as the German EEG, combined with an emissions trading scheme can drop the carbon price to zero due to the high share of CO_2-neutral renewable generation. In addition, the authors argue that a renewable quota with the EU ETS leads to a further welfare loss. This welfare loss is even larger if the support scheme is differentiated by technology. Efficient differentiation tends to be impossible, as the learning effects (usually justifying the use of renewable energy support schemes) are difficult to estimate.

Effects of the instruments:

It can be considered that the support of renewable electricity production in Germany thus far has been highly effective (Diekmann et al. 2008). This can also be seen from the fact that the RES-E target of 12.5% by 2010 (imposed by the EU) was reached already in 2007. The study evaluating the effects of the Renewable Energy Act (EEG) (Diekmann et al. 2008) examines the interaction of the EEG with the EU ETS; other important instruments concerning interaction with the EEG are the flexible Kyoto mechanisms (CDM, JI), energy taxes, the promotion of cogeneration, the regulative framework and further instruments for the promotion of renewable energy. The EEG and the EU-ETS interact in and impact upon the three markets of renewable energy, CO_2 certificates and electricity. ETS can enforce the support mechanism through higher power prices. However, the EEG and the ETS conflict in the effects on climate change if the cap is adjusted lower in order to reflect the positive climate impact of renewable energy. Therefore, the contribution of the EEG to

reduce CO_2 must be integrated into the national allocation plan or the determination of the emission cap at the EU level, as suggested by the authors (Diekmann et al. 2008).

Graichen et al. 2008 studied the impact of the EU ETS on industrial competitiveness in Germany, but biomass use is not considered in this study.

7.3.4 Netherlands

Climate and bioenergy policy:

In September 2007, the Dutch government launched the "Clean and Efficient: New energy for climate policy" programme with a scope of 2007-2011. Energy Transition project (2008-2013) complements this programme; the Energy Transition Taskforce published the Transition Action Plan in May 2006 (IEA Climate Change Database 2008).

The Dutch government is on track towards meeting its Kyoto target of 6% reduction of greenhouse gas emissions by 2012. A major part of this reduction, however, is met by means of purchasing foreign offset credits, such as JI or CDM credits. In addition, the Dutch government has formulated ambitious climate and energy targets for 2020 in order to become one of the cleanest and most energy efficient countries in the world. These targets include:

(1) to cut greenhouse gas emissions by 30% compared to 1990 levels,
(2) to double the rate of yearly energy efficiency improvement from 1 to 2% in the coming years, and
(3) to reach a share of renewable energy of 20% by 2020 (compared to 2.9% in 2007).

With its energy and climate programme, the Dutch government has formulated a set of measures that will enable the country to achieve the climate and energy targets. It includes a set of measures for each economic sector and for Dutch citizens, such as market instruments, standards, subsidies, innovation and climate diplomacy. The other important action plan, connecting more visible to the use of biomass, that is Transition Action Plan, establishes four concrete ambitions for the year 2050 (IEA Climate Change Database 2008):

- More efficient energy use: savings of 1.5% to 2% per year until 2050.
- Substantial use of green raw materials and renewable energy.
- Reduction of CO_2 emissions by half (relative to 1990).
- Stronger position for the Dutch business community.

The Dutch Biomass Action Plan from 2003 is somewhat outdated and not actively pursued (BAP Driver 2009). However, the "Platform for Biobased Raw Materials" part of the Energy Transition project states to aim to replace 30% of the raw materials in the total energy supply of the country with biobased raw materials by the year 2030 (Rabou et al. 2006).

In 2006, biomass and wastes contributed in the Netherlands as follows (Eurostat 2009):

- 89% (2123 ktoe) of primary production of RES (RES contributed 2389 ktoe, or 3.9 % to total primary energy production),
- 3.3% (2643 ktoe) of gross inland consumption.
- 6.7% (6.6 TWh) of total electricity production.

The share of RES of total electricity consumption was 7.6% in 2007, when the RES-E Directive target of 2010 is 9.0%. The proposed target in the new RES Directive for the Netherlands is 14% by 2020, whereas the share of RES in 2005 was 2.4%.

Main climate/bioenergy policy instruments:

The primary climate policy measures include:

- feed-in subsidies (MEP/SDE),
- R&D,
- investment subsidies/tax incentives (EIA/VAMIL),
- energy taxes,
- standards & regulations,
- voluntary agreement ("covenants").

The key measures to promote bioenergy are MEP/SDE (subsidy for the sustainable production of electricity; biomass projects receive a fixed feed-in subsidy per MWh; noteworthy is that both refer to the same tool but the Dutch abbreviation of this tool has changed over time from MEP (up to 2006) to SDE (starting from 2006) due so some adjustments made), EIA (tax reduction) and EOS (research subsidy on sustainable energy and energy savings)

The effectiveness of support schemes is measured according to the policy goals set for the support scheme; cost-effectiveness is not always measured, but involves the evaluation of the effectiveness in terms of EUR per reduced tonne of CO_2, varying between 10-50 €/CO_2t (BAP Driver 2009).

Theoretical interaction of the EU ETS and national instruments (conflicts and synergies):

In terms of synergies between EU ETS and renewable energy feed-in subsidies/(fossil fuel)energy taxes, they all stimulate fuel switch from fossil fuels to renewables. However, cost-pass through of EU ETS and energy taxes may lead to "double taxation" of households. Considering conflicts between EU ETS and RE/R&D/investment subsidies, EU ETS is technology-neutral and efficient, while RE/R&D/investment subsidies are technology specific and may be less cost-effective from a CO_2 mitigation point of view.

Estimated effects of the instruments:

Overall, (the interaction of) the instruments will result in a significant greenhouse gas reduction, energy saving and a switch towards renewables, in particular of (off-shore) wind energy. One may question, however, whether the ambitious targets for the year 2020 will be met - notably with regard

to energy savings and some renewables (i.e. bioenergy) - given the lack of financial means to further these goals and the lack of policy consistency regarding renewables.

Observed effects of the instruments:
Up to now the real effects of the instruments have been generally low, except buying JI/CDM offset credits, in which the Netherlands has been a successful frontrunner. In addition, energy efficiency in industrial sector is usually high (compared to world standards). However, the share of RE in total energy use is still low (less than 3%) and only slowly growing despite all efforts made.

Recently, there has been discussion on the support of replacing fossil fuels with biomass in coal-fired power plants. If the ambitious RES target is to be achieved, wind power is not considered to be enough. Therefore, biomass based power is planned to play an important role in meeting the targets, and the most relevant option is to increase the co-firing of biomass with coal. A proposal for the government is planned in the near future on strengthening the biomass co-firing, including the examination of advantages and disadvantages of co-firing. Currently, co-firing biomass received 5.3 €cents/KWh, which was lowered from a higher feed-in tariff earlier. Some estimations have been made in which carbon price additional funding is needed for co-firing and when the feed-in tariff is enough; at a CO_2 price of 20€/ CO_2t, additional funding is considered to be needed, whereas at 50€/ CO_2t, no additional funding would be required. Governmental agency representative states that the support of co-firing should be linked to the CO_2 price as well as to the power price and the price of coal.

Measures taken to balance the effect of the EU ETS:
R&D subsidies have been introduced to encourage certain technologies which are not adequately encouraged by the EU ETS (e.g. large subsidies to demonstration plants of Carbon Capture and Storage).

7.3.5 Poland

Climate and bioenergy policy:
In 2007, the Polish government adopted three important legislative changes concerning climate change policy and measures. These include:

- Act on Electricity Production from Cogeneration,
- Amendment to the 1997 Energy Law and
- Long-term Programme for Promotion of Biofuels or Other Renewable Fuels.

In July 2007, the Long-term Programme for Promotion of Biofuels or Other Renewable Fuels for 2008 – 2014 was adopted by the Polish government, and focuses mainly on liquid biofuels. The programme aims to improve energy security, environmental protection and the development of rural

areas (IEA Global Renewable Energy Database 2008). The 1997 Energy Law was amended in 2007 and supports the previously mentioned programme for RES. An Act on Biocomponents and Biofuels (adopted in August 2006, connected to the long-term programme) defines the national indicative targets for liquid biofuels from 2007 until 2014.

Poland does not have an integrated biomass strategy or a BAP. The BAP has been discussed at the Ministry of Economy and process started but has been outrun by other priorities (BAP Driver 2009).

The share of RES-E in total electricity consumption was 3.5% in 2007, whereas the EU target for Poland is 7.5 % for 2010. The proposed RES Directive target for Poland is 15 % in 2020 compared to the share of renewables of 7.2 % in 2005. The targets defined by the EU are regarded as challenging but possible (BAP Driver 2009). Other targets concerning biomass use include (no specific heat targets):

- Biofuels share of 5.75% by 2010 and 7.55% by 2014,
- Ministry degree in 2006 set the share for RES-E to be bought from 2010-2014: 10.4% yearly,
- The Development Strategy for Renewables (adopted in 2001) has set a target to increase the share of renewables in total primary energy balance to 7.5% by 2010 and to 14% by 2020 (from 2.5% in 1999).

In 2006, biomass and wastes contributed in Poland as follows (Eurostat 2009):

- 96 % (4844 ktoe) of primary production of RES (RES contributed 5054 ktoe, or 7 % to total primary energy production),
- 5 % (4776 ktoe) of gross inland consumption,
- 1.2 % (2.0 TWh) of total electricity production.

Main climate/bioenergy policy instruments:

- Tradable green certificate system and quota obligation (2005-2012),
- Red Certificate System: guarantees the origins of electricity produced by high efficiency cogeneration,
- Tax subsidies: excise tax exemptions for biofuels, electricity, corporate income tax reduction,
- Investment subsidies and soft loans,
- Subsidies for the growing of energy crops designated for biofuels production,
- Creating zones accessible only to ecological public transport, reduction of ecological fees and preferences (in public tenders) for biofuel-powered vehicles,
- Support for afforestation of agricultural land within Rural Development Program.

Interaction of the EU ETS and national instruments (conflicts and synergies)/effects:
No information available on interaction studies. The BAP Driver (2009) report states that potential conflicts between the energy use of biomass and other uses have been considered, mostly in terms of food production, but also in terms of industrial use (wood using industries).

7.3.6 Sweden

Climate and bioenergy policy:
The basis for the Swedish Climate Strategy dates to 2001 (Gov. Bill 2001/02:55). The climate policy resolution was made in 2005 with targets for 2008-2012 (The Swedish Parliament adopted Government Bill 2005/06:172 National Climate Policy in Global Cooperation on 17 June 2006). The Government plans to put forward a new bill on climate and energy policy in the spring 2009 in order to meet the EU targets and maintain a leading role in climate and energy conversion.

Swedish greenhouse gas emissions are expected to have fallen by 4 % in 2010 in comparison with the base year of 1990. It appears that Sweden will reach its short-term climate target of -4% for the period 2008-2012. The Government is of the opinion that there should be a medium/long-term objective for greenhouse gas emissions. The 'Checkpoint 2008 committee' analysed a target of 25 % lower emissions for Sweden by 2020 (Swedish Energy Agency 2007a). It considered that Sweden's strategy to attain such a target should contain the following three elements:

- Reduced allocation of emission allowances under the EU emissions trading scheme,
- Continued development of EU policy instruments and national policy instruments in the sectors outside the EU emissions trading scheme and
- Purchasing of emission reduction units from investments abroad.

The electricity certificate system was introduced in 2003, and it has the objective to increase the use of electricity from renewable sources by 17 TWh between 2002 and 2016 (Swedish Energy Agency 2007b). The proposed RES Directive target for Sweden is 49% in 2020 compared to the share of renewables of 39.8% in 2005. This is the highest target in the EU.

There are no specific targets for biomass, therefore it is to be defined how much it will contribute to the overall RES target. There is not a biomass action plan defined in the country. The country has a long history of biomass use for energy and the sector development has been considered as successful even without an action plan or a roadmap for biomass use (BAP Driver 2009).

In 2006, biomass and wastes contributed in Sweden as follows (Eurostat 2009):

- 64% (9415 ktoe) of primary production of RES (RES contributed 14813 ktoe, or 46 % to total primary energy production),
- 19% (9415 ktoe) of gross inland consumption,

- 6.4 % (9.2 TWh) of total electricity production

The share of RES-E in total electricity consumption was 52.1% in 2007, when the EU target for Sweden is 60% for 2010.

Main climate/energy policy instruments:

The most important (economic) climate instruments include:

- electricity certificates combined with a quota system
- energy taxation (energy tax as such, CO_2 tax, sulphur tax)
- investment grants
- energy efficiency improvement programme for energy-intensive industry (PFE)
- Climate Investment Programme (KLIMP)

Bioenergy is mainly supported by the electricity certificates (electricity), energy tax in the form of a tax exemption for biofuels (transport) and CO_2 tax (heat) as well as investment subsidies (heat and electricity). Support schemes are considered to offer long-term and stable conditions for the development of bioenergy with strong, general incentives and simple and transparent system (BAP Driver 2009).

Theoretical interaction of the EU ETS and national instruments (conflicts and synergies):

The interaction of the economic instruments has been assessed by the Swedish Environment Protection Agency (2007). Their study on combined effects of instruments in industry concluded that the CO_2 tax and the EU ETS complement one another in non-ETS sectors. Nevertheless, in the ETS sectors, CO_2 tax is not cost-effective and can contribute to the increase in EU emissions. In the case of the electricity tax and the EU ETS, combined effect is indirect (e.g. higher electricity prices). Tax on electricity, electricity certificates and ETS all aim to reduce electricity consumption. The electricity tax may help to achieve the objective of the electricity certificate scheme, even though the interaction between those instruments is intricate (Swedish Environment Protection Agency 2007).

ETS and electricity certificate scheme have appeared to function satisfactorily together, however the experience was then limited to one year. One exception is the conflict concerning peat, which qualifies for electricity certificates but is also included in the ETS. The trading scheme is likely to reduce the use of peat for energy as it is less competitive compared to biofuels. Electricity certificate scheme supports both peat and biofuels, and they receive the same level of support (Sköldberg and Koljonen 2006, Swedish Environment Protection Agency 2007).

Estimated effects of the instruments:

Different support instruments have contributed to the increased competitiveness of biofuels, especially in the combined heat and power (CHP) production. The report of the Nordic Energy Perspectives project estimated in 2006 that the willingness to pay for wood rises in the future, high price was considered to be more than 200SEK/MWh or 22€/MWh (Sköldberg and Rydén 2006).

However, the increasing use of biomass for energy competes with the forest-based raw material of pulp and paper plants; this is estimated to lead to a general increase in timber prices.

According to Swedish Environment Protection Agency (2007), both the electricity certificate scheme and the EU ETS were expected to promote the use of bioenergy (based on modelling analysis of the impact of the instruments in place in 2005). The CO_2 tax is not expected to have any short-term impact on the use of biofuels in CHP production; however, it is thought that the CO_2 tax will increase the use of biofuels to some extent in the long term.

Observed effects of the instruments:
Based on Swedish energy statistics (Energimyndigheten 2008b), biofuels and peat in total energy supply increased 11% from 2004 to 2007, whereas the production of fossil fuels (oil, gas and coal products) decreased by 4% at the same time period. Electricity production from biofuels increased 22% between 2004 and 2007 (Energimyndigheten 2008b). The use of peat (in total energy consumption) decreased 30% between 2004 and 2006 (Eurostat 2009).

According to the document prepared for the government (Swedish Energy Agency 2007a), the policy instruments in place have contributed to the positive trend in emissions, and Sweden's climate strategy has proved to be effective. The use of fossil fuels has fallen considerably in particular in the residential and service sector, and this can be attributed especially to energy and carbon dioxide taxes.

Forest industry representative considers that EU-ETS will have an impact on the use of biomass in the energy sector but the targets in the RES directive and the biomass action plans in different Member States will have a more important role.

Regarding change in fuel mix, peat use has decreased as the electricity certificates have not been enough for peat producers. From the view point of the two power companies interviewed by the Swedish Environment Protection Agency (2007), emissions trading and the electricity certificate scheme are key instruments for their business. According to the interviews, the previous carbon dioxide and fuel tax regime affected decisions on investment in new biofuel-fired boilers, and increased peat burning. These investments reduced coal use.
Burning peat would have terminated when the ETS was introduced without peat being eligible for electricity certificates. In addition, another impact of the ETS for the two power companies in question is that plans are being made for biogas production and combustion in the long term.

In Sweden, forest industry is the biggest producer as well as consumer of bioenergy from the forests. The competition for the biomass resources between the energy sector and the forest industry are debated. According to the Swedish forest industry representative, prices of pulp wood and forest residuals (branches and tops) are getting closer to each other. So far forestry industry does not see a

big competition between the energy sector and the forest industry for pulp wood. Nevertheless, in some regions the balance is tight and locally pulp wood has been sold to the energy sector. Demand of biofuels (especially solid biofuels) has increased, but the competition is not yet seen as serious. Timber price has increased 20-30% and willingness to pay for woodchips is close to what was estimated in 2006, according to another expert.

Measures taken to balance the effect of the EU-ETS:
Budget Bill for 2008 (Gov. Bill no. 2007/08:1) states that the CO_2 tax on fuels in industry for district heating and CHP plants in the EU-ETS scheme will be reduced in 2 stages (Swedish Energy Agency 2007b).

7.3.7 United Kingdom

Climate and bioenergy policy:
The UK has several objectives for reducing greenhouse gas emissions. These objectives are: the Kyoto Protocol target; the domestic CO_2 goal; and the targets outlined in the UK Climate Change Bill. The UK Climate Change Programme (2006) is the key strategy of the UK for its work on tackling climate change. The UK has passed legislation which introduces the world's first long term legally binding framework to tackle the dangers of climate change. The Climate Change Bill was introduced into Parliament on 14th November 2007 and became law on 26th November 2008 (UK Defra 2008).

The new Climate Change Act introduces, among others:

- Legally binding targets for greenhouse gas emissions reductions of at least 80% by 2050, and reductions in CO_2 emissions of at least 26% by 2020, against a 1990 baseline.
- A carbon budgeting system which caps emissions over five year periods, with three budgets set at a time, to set out our trajectory to 2050.
- The creation of the Committee on Climate Change, a new independent, expert body to advise Government on the level of carbon budgets and where cost effective savings could be made.
- Further measures to reduce emissions include powers to introduce domestic emissions trading schemes more quickly and easily through secondary legislation; measures on biofuels; powers to introduce pilot financial incentive schemes in England for household waste; powers to require a minimum charge for single-use carrier bags (excluding Scotland).

The UK Biomass Strategy (UK Defra 2007a) is the country's biomass action plan, and contains the government's strategy for three sectors: industry, energy and transport. The national strategy as a biomass action plan is considered to be far from complete, up-to-date or in line with the EC requirements (BAP Driver 2009). There is no clear linkage between the CO_2 reduction and the

support instruments, but the UK Biomass Strategy at least shows a hierarchy of biomass use in terms of cost of carbon saving (£/tonne of carbon). It came into conclusion that biomass heating is the most effective form of bioenergy, particularly in industrial and commercial applications. The next effective form of use is CHP and after that co-fired electricity in large fossil fuel plants. The least cost-effective biomass uses are dedicated biomass power plants and transport biofuels (UK Defra 2007a).

The UK declares a target for 10% RES-E by 2010 and an indicative target of 20% by 2020. Targets for bioenergy are:

- There are no specific targets for bioelectricity.
- National biofuel targets 5% in 2010 (stipulated by RTFO).
- No formal targets exist for heat from renewables.

In 2006, biomass and wastes contributed in the UK as follows (Eurostat 2009):

- 80% (3251 ktoe) of primary production of RES (RES contributed 4048 ktoe, or 2.2 % to total primary energy production),
- 1.6% (3628 ktoe) of gross inland consumption,
- 2.5 % (9.9 TWh) of total electricity production

The share of RES-E in total electricity consumption was 5.1% in 2007, whereas the EU target for the UK is 10 % for 2010. The proposed RES Directive target for the UK is 15 % in 2020 compared to the share of renewables of 1.3 % in 2005.

Main climate/energy policy instruments:

The most important climate instruments and measures include:

- Climate Change Levy (CCL): a tax introduced in 2001 to target high energy consumption by industrial installations
- Renewables Obligation (RO): quota obligation and certification system for electricity sector)
- Carbon Trust: range of government funded support instruments)
- Climate Change Agreements: for business; consist in quantitative objectives of energy use reduction to be met by 2010
- Renewable Transport Fuel Obligation (RTFO)
- Environmental Transformation Fund (ETF): funding for low-carbon technologies

The main instruments promoting bioenergy are:

- Renewables Obligation
- Tax incentives (such as tax reduction for bio-oil)
- Bioenergy Capital Grants Scheme: investment subsidies; for large and small scale CHP schemes
- Agricultural subsidies for energy crops

In addition, the national rural development programmes put forward a support framework for development of biomass production and strengthening of the supply chain (Prebble 2008).

Theoretical interaction of the EU ETS and national instruments (conflicts and synergies):
In the end of 2007, the Department for Environment, Food and Rural Affairs (Defra) issued a consultation paper, "Climate Change Simplification Project", to review Defra's three major climate change instruments – EU ETS, Climate Change Agreements (CCAs) and the proposed Carbon Reduction Commitment (CRC) (UK Defra 2007b). The aim of the review was to eliminate avoidable overlap, simplify the existing regulation, and ensure that the regulatory burden on the economy is kept to a minimum. Review included several recommendations, which intended to make the existing set of climate change instruments more coherent and cost-effective, while recognising there may be short term constraints on rationalisation. The recommendations included:

- On-going evaluation of domestic instruments such as CCAs and CRC (i) in the context of global action to reduce emissions and (ii) in terms of effectiveness in dealing with downstream market failures and inducing behaviour change.
- Examining the overlap in emissions directly targeted by EU ETS and CCAs and considering splitting the CCA target for current CCAs (if possible) and for post-2010 CCAs
- Making targets consistent.
- Removing unnecessary trading schemes.
- Aligning monitoring, reporting, and verification requirements.
- Undertaking further analysis to examine (i) the interaction of CHP policies with other instruments and (ii) the potential for greater alignment of Pollution Prevention and Control's other objectives with climate change objectives.

Regarding conflicts between the instruments, the target setting (quota) of the Renewables Obligation (as well as the EU RE target, for that matter) specifies the use of certain technologies (in this case RES) but is considered to restrict the flexibility and limit the efficiency benefits of trading schemes like EU-ETS. Certain share of RES-E is required to be achieved albeit this might not be the most cost-effective way to reduce emissions *in the short-term*. This interferes the ability of the trading mechanism to search for the most cost-effective means for emission reduction, which in turn contributes to the efficiency loss for the economy. However, the RES support measures have the potential to diminish abatement costs and improve the cost-efficiency of climate policy *in the long-term* by means of increasing R&D investment and by removing barriers for RES development (UK Defra 2007b).

Regarding the theoretical interaction of the EU-ETS and the main bioenergy support instrument in the country, Diekmann et al. (2008) argue that an EU-ETS combined with a quota system, such as the UK's Renewables Obligation, does not increase the use of renewable energy as the rise in electricity prices is offset by a decrease in the price of green certificate.

Estimated effects of the instruments:

A study prepared for the British Confederation of Forest Industries, explores the opportunities and challenges arising from climate change for the forest and wood-using industry (Prebble 2008). Use of woody biomass as bioenergy represents an opportunity to enhance renewable energy supply as well as encourage improved woodland management. According to this study, the proposed introduction of the Carbon Reduction Commitment in 2010 is expected to have a wide effect on the forest and wood-using industry in terms of reduction of energy use (Prebble 2008). However, the specific effect of various climate change instruments is not discussed in detail in terms of bioenergy. The study acknowledges the threat of displacement of woody material seen by the wood panels industry when the incentivised market for woodchips as a fuel grows.

It is noteworthy that UK imports around 80% of its timber needs (coming usually from Scandinavia and Baltic countries). While the EU Member States 'chase supply' in order to meet their respective national renewable energy targets, the UK must compete in the growing international market of bioenergy. Yet, this can put strains on supply and divert feedstock away from the most appropriate use for the biomass, that is of local heat and power (Prebble 2008).

Observed effects of the instruments:

The forest industry representative contacted shed light on the national issue on competition for biomass and how much of it could be attributed to the national support instruments for renewables and EU ETS. The support instruments in the country are considered to provide a strong stimulus for the energy use of wood. The threat of displacement (mentioned in Prebble 2008) concerns not only panel industry but also the saw and timber industries. There is not yet huge impact of RES support instruments, but the demand is rising for biomass. The forest industry representative sees that principally domestic policy is affecting the increasing use of biomass and boosting the competition, not the EU ETS. Some indications of competition for biomass resources have been seen locally, for example in the South-West Scotland where there is wood powered electricity plant.

7.4 ANNEX 4: ENERGY CONSUMPTION OF BIOMASS, PEAT AND FOSSIL FUELS IN 2004 AND 2006

Annex Table 2: Gross inland consumption of biomass and wastes in NoE countries in 2004 and 2006 (ktoe) (Eurostat 2009)

	2004	**2006**	**Change %**
AT	3482	4000	14,9
DE	11017	16120	46,3
FI	7305	7574	3,7
NL	2183	2643	21,1
PL	4126	4776	15,8
SE	8297	9415	13,5
UK	2891	3628	25,5

Annex Table 3: Gross inland consumption of wood and wood wastes in NoE countries in 2004 and 2006 (ktoe) (Eurostat 2009).

	2004	**2006**	**Change %**
AT	3233	3549	9,8
DE	7783	8816	13,3
FI	7125	7403	3,9
NL	646	786	21,7
PL	4062	4586	12,9
SE	7467	8332	11,6
UK	928	1218	31,3

Annex Table 4: Gross inland consumption of fossil fuels in NoE countries in 2004 and 2006 (ktoe), including solid fuels (such as hard coal and coke), crude oil and petroleum products and natural gas, excluding peat (Eurostat 2008 and 2009)

	2004	**2006**	**Change%**
AT	25760	25873	0,4
DE	290816	286206	-1,6
FI	20429	20051	-1,9
NL	79003	74898	-5,2
PL	88420	93646	5,9
SE	18870	17893	-5,2
UK	207393	204674	-1,3

Annex Table 5: Gross inland consumption of peat in Finland and Sweden in 2004 and 2006 (ktoe) (Eurostat 2009)

	2004	**2006**	**Change %**
FI	2116	2249	6,3
SE	385	268	-30,4

7.5 ANNEX 5: SELECTED CONTRIBUTIONS OF THE EMISSIONS TRADING & THE ROAD TRANSPORT SECTOR CONFERENCE (LONDON, MAY 2007)

Simon Barnes (Society of Motor Manufacturers) emphasised that improved car technologies alone would not be sufficient to substantially reduce CO_2 emissions in the transport sector and thus policy instruments were needed. Stressing the high abatement costs in the transport sector, Barnes discussed a number of different instruments (see Annex Figure 1) and concluding that emissions trading would be better than "some" other instruments.

	Effective - reduces CO2	Efficient	Equitable
Fuel duty	elasticity issues	yes	yes
New car CO2 regulation	no - does not manage use phase	Cost definition and equity issues	no - only covers cars
Carbon Trading	yes	depends on modus operandi	partially - may impact non transport sectors
Educational programmes	no - no guarantee of put into practice	yes	yes
Demand management	to be determined - London experience claims to	to be determined - London experience claims to	could have social implication
Alternative Fuels	yes - but percentage varies	no - cost are higher than fossil fuels	sustainability issues
Speed limit enforcement	yes	Partially cost implications	yes
Integrated Approach	ownership and effectivesness	yes	yes

Annex Figure 1: Comparison of different policy instruments

With regard to the different design options of a trading scheme, Barnes identified an upstream approach including the companies in a trading scheme the most efficient option (see Annex Figure 2).

	Oil companies	Drivers	Vehicle manufacturers
Effective	yes - covers all fuels sold	yes - if it includes commercial drivers	Partial - assumptions to be made on vehicle mileage
Efficient	yes - low costs and easy to implement	no - high cost of introduction - low trading volumes	Partial - modus operandi - other sector inclusion
Equitable	yes	yes	Partial - modus operandi - global manufacturing

Annex Figure 2: Aggregate carbon abatement cost curve for the UK

Kirsty Clough, WWF UK, discussed how to best tackle emissions from surface transport, to include the sector in the EU-ETS or to implement a combination of specific policies for transport. She warned that the transport sector would be a net buyer in an integrated scheme which would lead to a lock in of high carbon investments and to soaring emissions. There would be an upward pressure on the carbon price which could fuel pressure from the manufacturing industry for weaker caps which finally would destabilize the scheme and mean that very little emission abatement takes place overall.

Clough said that including fuel suppliers may be the favoured option as it is administratively simple and there is certainty over actual emissions, but supplier have little control over emissions – vehicle purchasing decisions, travel patters driver behaviour, etc. The main lever to reduce transport emissions could be biofuels, but there may be overlap with the RTFO/biofuels Directive. The Carbon price would probably be passed through to consumers, the impact would look like a modest fuel tax. Clough said including road transport in the EU-ETS does not drive a change in the transport sector, what would be the added value?

Clough furthermore discussed a combination of policy option for transport, such as a separate scheme for road transport, tighter mandatory fuel efficiency target, with trading between car companies tax incentives- greater VED differential, fuel duty.

- National road user (and lorry road user) charging to prioritize CO_2
- Low carbon fuel standard- in which clean an certified biofuels could play a prominent role
- Enforcement (and reduction) of speed limits
- Investment in alternative transport modes
- Investment in new technologies

Clough concluded that a focus on the EU-ETS could reduce the political space and appetite for other measures and that it is imperative that a combination of targeted policies and measures to directly address the rising emissions from road transport is implemented as soon as possible.

Bettina Kampman, CE Delft, laid out the different design options for a trading system for the transport sector as already discussed in the Last NoE meeting.
She said that Emissions trading for the transport sector is a viable solution as it

- Provides a means for the government to directly control CO_2 emissions
- Promotes cost effective CO_2 emissions reductions
- Rewards all possible abatement options
- Guarantees that CO_2 emission goals are met
- Cost to governments can be limited
- Public acceptance may be higher that with a CO_2 tax on fuels

But with a downstream system transaction cost will be high, *with an upstream system supporting policies are essential* (oil companies have limited control over fuel consumption)
According to Kampman the bedt option is:

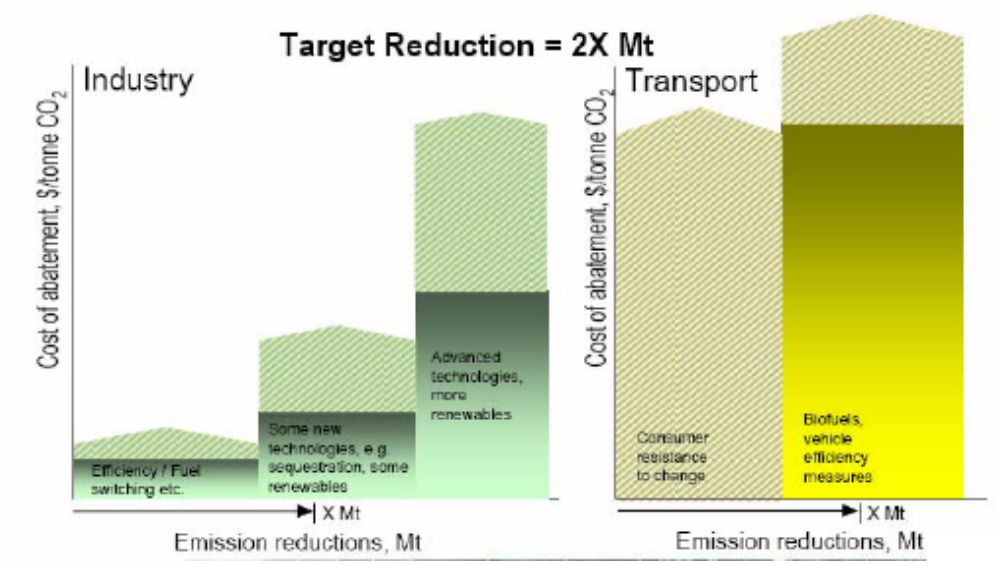
- Trading entities: oil companies
- No link with the EU-ETS
- EU –wide (UK may start on its own)
- Auctioning of credits

David Hone (Shell) emphasised the high abatement costs in the transport sector compared to rather moderate abatement costs in the industry sector.

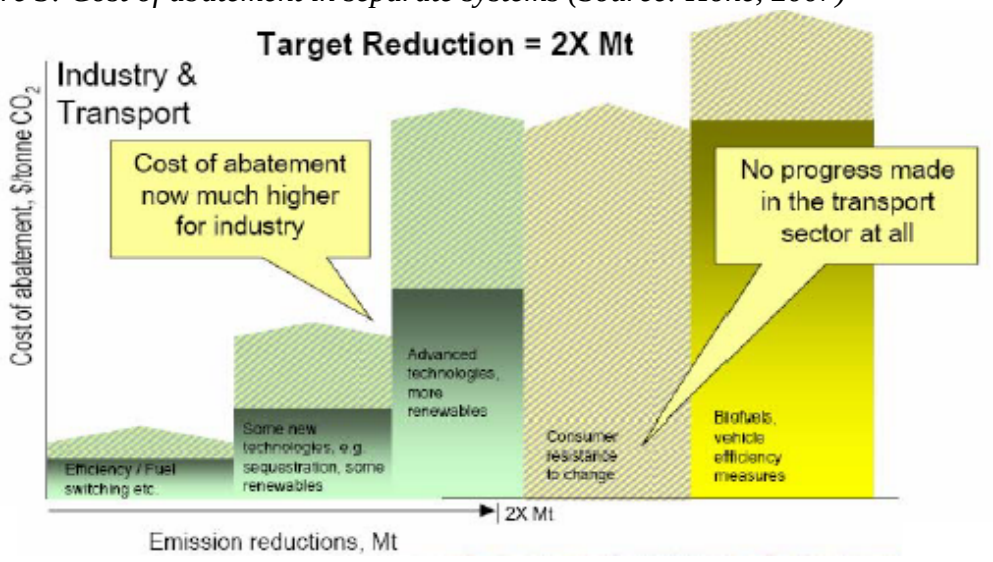
In the transport sector the abatement cost would be

- $120-$200 per tonne of CO_2 for a 5-10 mpg vehicle efficiency improvement over 15-20 years, but with other policies in place as well; and
- $200-$400 per tonne of CO_2 for further hybrids, fuel switching to biofuels, and a change in consumers behaviour

Including the transport sector in the EU-ETS would lead to a greater burden for the industry sector. As illustrated in Annex Figure 3 and Annex Figure 4 , the effective abatement cost in the sector thus would vary depending on the type of scheme – integrated in the EU-ETS or separate – chosen.



Annex Figure 3: Cost of abatement in separate systems (Source: Hone, 2007)



Annex Figure 4: Cost of abatement in an integrated scheme

Because of the high cost of abatement David Hone suggested a range of different measures to limit CO_2 emissions in the transport sector, including

- an expansion of the access to biofuels and to introduce advanced bio-fuels (ligno-cellulose ethanol),
- more ambitious vehicle efficiency standards,
- a call on certain fuels to promote vehicle efficiency,
- measures to change consumers behaviour - both type and use of vehicle, and
- an ongoing development of long term options (e.g. plug in hybrids, hydrogen).

7.6 ANNEX 6: INCLUDING ROAD TRANSPORT INTO THE EU-ETS: OVERVIEW OF DIFFERENT STUDIES

The EPA Study 2006

Based on an analysis of the scope and costs of different trading schemes, the study of the Swedish Environmental Protection Agency selects three schemes as generally feasible to be implemented for the sub-sector road transport and thus to be examined in detail:

- a cap and trade scheme at down-stream level,
- a cap and trade scheme at up-stream level, and
- a benchmark and credit scheme at mid-stream level.

For cap and trade schemes, the stringency of the emission cap is identified as crucial for the expected emissions reductions. While cap and trade schemes generally ensure specified reduction targets, benchmark and credit systems offer only relative emissions reductions.

The mid-stream approach based on a benchmark and credit system can only target fuel efficiency of vehicles, while cap and trade systems also promote other reduction measures.

In order to guarantee emissions reductions in the transport sector a closed system seems preferable. An open system could, however, promote cost effectiveness allowing for least cost abatement. Incentives for innovations are stronger in closed trading systems as emission reductions within the sector in this case are binding. In an open system, innovation efforts depend on the cost effectiveness of the measures compared to that of measures in other sectors. Thus, innovation might occur within other sectors and not in the transport sector. A benchmark and credit system would specifically encourage emissions reducing innovation in the transport sector.

Competitiveness effects strongly depend on the overall design of the scheme – national schemes, for instance, are subject to competitiveness effects to a larger extend than international ones. In addition, national schemes might lead to CO_2 leakage promoting fuel purchases outside the country borders. Benchmark and credit systems show lower effects on competitiveness if all vehicle manufacturers are included in the scheme.

Flanking instruments could be implemented in order to strengthen the trading schemes and to overcome some of their weaknesses concerning (cost) effectiveness and innovation. Alternative policy instruments could ensure the same effects. A CO_2 tax on fuel, for instance, could be an adequate alternative to an up-stream approach accompanied with much lower transactions costs. In

contrast to a cap and trade system, the environmental impacts of such a tax are uncertain, but the costs to consumers are known.

The study comes to the following conclusions:

Cap and trade schemes with end consumers (vehicle drivers) or fuel suppliers as the trading entities both are regarded feasible. However, if end consumers are the trading entity, transaction costs may be very high. Baseline and credit schemes for vehicle manufacturers seem feasible for passenger cars and light commercial vehicles and would be connected with relatively low transaction costs.

With a cap and trade system a specified emissions reduction target could easily be ensured. In addition, this type of schemes encourages all possibilities of CO_2 mitigation, whereas benchmark and credit schemes only induce mitigation efforts in engine and vehicle technology. Flanking instruments as driver awareness programs could, however, improve the effectiveness of benchmark and credit schemes

A closed system would ensure sectoral emissions reductions with carbon leakage being rather small as the transport sector is not subject to international competition. Open systems would guarantee better cost effectiveness as mitigation measures can be implemented on a broader scope.

Competitiveness effects depend strongly on the design of the scheme, and on the stringency of the cap. The effect of introducing a cap and trade system would be very similar to an additional charge or CO_2 tax on fuel, which has much lower transaction costs.

The IFEU Study (2001)

The German IFEU study examines different flexible mechanisms in the transport sector. The study identifies four different approaches for the inclusion of transportation in the EU-ETS:

- an up-stream approach based on fuel suppliers,
- a mid-stream approach based on vehicle producers,
- a mid-stream approach based on transport service providers, and
- a down-stream approach based on final consumers.

A down-stream approach builds on a direct limitation of CO_2 emissions. The absolute cap for the target period will be broken down on the different sub-sectors. With regard to passenger transport, allowances could be allocated to the final consumers on an average per capita basis, e.g. with CO_2 debit cards. With regard to goods transport, emissions could be allocated to the transport

companies. The allocation procedure could be based on grandfathering, auctioning or a combination of both of the elements.

A mid-stream approach with vehicle manufacturers as trading entities is based on a change in the relative price of different types of vehicles; it provides incentives for innovation in low carbon technologies. For the different product lines, the emission relevant factors are calculated. Allocation of allowances would be based on grandfathering depending on the companies' market shares and product attributes in a certain base year. A gateway approach should be used in order to assign specific emissions reductions targets to the different product groups based on the target of the total sector. The companies' costs of emissions trading would be shifted to the consumers.

A mid-stream approach based on transport service providers includes both CO_2 emissions from public passenger transport and good transport. The allocation procedure would be grandfathering based on historical level of transport services as measured in passenger kilometres or tonnes kilometres per year. Costs would again be passed through to the consumers.

An up stream approach with fuel suppliers (refineries or importers) as trading entities could integrate all emissions related to fuels. The allocation procedure could be based on grandfathering or auctioning or a combination of both. The costs would again be passed through to the consumers.

In addition, the IFEU study draws the following general conclusions: While cap and trade systems are generally economically more efficient, specific systems provide a higher level of flexibility. An open system linked with the EU-ETS entails lower overall abatement costs. With respect to transaction costs, up-stream approaches should be preferred to a downstream approach because of the lower number of trading entities. For the two different mid-stream approaches, a scheme based on vehicle manufacturers is connected with lower transaction costs than a scheme based on transport service providers for the same reasons. In addition, an up-stream approach scores best in terms of competitive distortions because it is based on a homogenous product.

Based on these findings, the IFEU study suggests an up-stream approach with an absolute reduction target integrated in the framework of the EU-ETS.

The IFEA study 2003

Based on its 2001 study, IFEA examined the potentials of including the transport sector in the EU-ETS. The study analysed the different levels of a possible implementation (up-stream, mid-stream or down-stream), different transport modes (road, rail, water or air) and different transportation functions (passenger or goods transport).

The study again suggests an up-stream approach because of high ecological efficiency connected with low costs, a down-stream approach is completely rejected due to high transaction costs.

The Deuber Study (2002)

The Deuber Study investigates the potentials of including individual motor car traffic in the EU-ETS, as this sub-sector accounts for the highest transport emissions of the transport sector and the highest technical emissions reductions are expected.

Emissions reductions in individual motor car traffic can be achieved through a reduction in kilometres travelled, a switch between transport modes, a reduction of the vehicles' energy intensity or a reduction in the CO_2 intensity of the fuels used, where a reduction of energy intensity or CO2 intensity can be regarded as long-term measures.

Other instruments – as labelling of vehicles with regard to fuel consumption – were analysed as alternatives to emissions trading.

An up-stream approach is rejected because of insecurities concerning the influence of consumers' demand on the development of low carbon vehicles and insecure incentives for investment decisions in new emission efficient vehicles.

A mid-stream approach is suggested because it induces innovation in vehicle production and can be combined with other regulations (see above) in the sub-sector. Such an approach would also require lower administrative costs. A benchmark and credit system which is based on the manufacturers' fleet emissions (specific emissions of different vehicles weighted with their sale figures) was the suggested mid-stream approach. Allocated allowances would be based on historical emissions of the companies' fleets in the reference year 2000. The allowances will be tradable between manufacturers only, but allowances from other sectors in the EU-ETS might be imported.

The FIFO Study (2005)

Based on an extensive literature survey, the German FIFO chose an up-stream approach for as the most efficient alternative for including transport in emission trading. A petroleum tax, a CO_2 tax, a car tax, a truck toll and a mid-stream approach were considered as supplementary instruments.