RESEARCH REPORT

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# Perspectives on the further development of national, EU and international climate policy

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| Perspectives on the further development of national, EU and international climate policy | | |
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| Summary<br>The report considers three separate but interlinked topics that are very relevant in the development of climate policy, especially from the Finnish perspective. First, we assess the possible transition to a deeper emission reduction target at the EU level in 2020, namely -30% from 1990 levels, and focus our analysis at the cost-efficiency of emission reductions between different sectors. Next, we consider meeting the current Finnish 2020 target for the sectors not included in the EU Emission Trading Scheme, with more detail to actual emission reduction measures, their costs and reduction potentials, and uncertainties on meeting the target and resulting costs. Our last topic discusses possible ways for including land-use and forestry sinks in the emission reduction targets, and potential implications from this. | | |
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## Preface

This report compiles the research done at VTT Technical Research Centre of Finland in the project FINTargets – "Emission targets in the EU and forest sinks, preparation for future EU and international climate policy"during May 2010 and March 2011.

The report considers three separate but interlinked topics that are very relevant in the development of climate policy, especially from the Finnish perspective. First, we assess the possible transition to a deeper emission reduction target at the EU level in 2020, namely -30% from 1990 levels, and focus our analysis at the cost-efficiency of emission reductions between different sectors. Next, we consider meeting the current Finnish 2020 target for the sectors not included in the EU Emission Trading Scheme, with more detail to actual emission reduction measures, their costs and reduction potentials, and uncertainties on meeting the target and resulting costs. Our last topic discusses possible ways for including land-use and forestry sinks in the emission reduction targets, and potential implications from this.

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The views and results presented in this report are solely of the authors, and do not necessarily reflect the stance of the Finnish Ministry of Environment.

Espoo, 31.3. 20011

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# 1 Introduction

Climate policy is a multi-layered process, ranging from global negotiations under the United Nations Framework Conference on Climate Change to national level actions. From the Finnish perspective, an important step between these levels is climate policy at European Union (EU) level, which to a large extent determines the emission and energy targets that Finland has to pursue.

In the current stage of international negotiations, he European Union is committed to reduce its greenhouse gas (GHG) emissions in 2020 by 20% from the level of 1990. This target is split between two larger sectors, the EU-wide Emission Trading System (ETS), which comprises electricity and heat production and the majority of industrial emissions; and the national targets of the EU Member States in the non-ETS sector, which comprises the remaining emissions controlled by the Kyoto protocol.

Should a comprehensive international agreement to reduce GHG emissions be made in the future, EU has declared that it would shift to a more ambitious 2020 emission reduction target of -30% from 1990 levels. In such a case, it is important to re-assess how the emission targets should be divided into the ETS and non-ETS sectors in order to maintain economic efficiency of emission reductions. This issue is analysed in Section 2, using the integrated assessment model TIAM-Nordic. A more detailed description of this exercise is presented in (Ekholm, 2010).

Being an EU-wide system, the ETS is not attributable to single Member States. On the contrary, the Member States are responsible for meeting the non-ETS targets between 2013 and 2020. This requires policy measures on the national scale that extend many years or decades into the future, and the results of which can not be estimates beforehand with certainty. To address this problem, Section 3 presents a probabilistic analysis of meeting the non-ETS targets in Finland with minimal costs. The full account of this study is documented in (Hast et al., 2011).

One sector that has been so far left out from the EU targets, and being also only partially included in the international emission limitations, is land use and forestry. There is however large pressure to include this important sector, although there are some practical problems for doing so. Section 4 discusses some of these with potential solutions that would, again, maintain economic efficiency.

# 2 The -30% emission reduction target of the EU in 2020

The European Union (EU) is committed to reduce its greenhouse gas (GHG) emissions in 2020 by 20% from the level of 1990. The directive 2009/29/EC and the decision No. 406/2009/EC split the overall reduction target between the EU-wide Emission Trading System (ETS), which comprises electricity and heat production and the majority of industrial emissions, and the national targets of the Member States in the non-ETS sector, which comprises the remaining emissions controlled by the Kyoto protocol.

The directive and the decision include a possibility to increase the emission reduction target of the EU in future to the level of 30% from 1990, in a case of comprehensive international agreement on emission reductions. An increase in the overall reduction target requires a reassessment of both the ETS and non-ETS targets. Towards this aim the European Commission (2010a, 2010b) has conducted an impact assessment of the 30% reduction.

Regardless of the chosen emission reduction target, maintaining economic efficiency requires that the emissions should be reduced with measures, with which the costs of emission reductions are as low as possible. An indicator for this is the marginal cost of emission reductions, which equals the highest cost per tonne that has been incurred in order to reach a given emission target. Cost efficiency would then require that the marginal costs are the same across all economic sectors, as otherwise the reductions within a sector with high costs could be replaced with reductions in a sector with lower costs. This section summarizes a cost efficiency analysis of the 30% target described in more detail in (Ekholm, 2010).

## 2.1 Design of analysis and results

In order to analyse the cost efficiency between sectors and Member States the integrated assessment model TIAM-Nordic[1] was used to calculate scenarios aiming at internal 30% EU-wide emission reductions. Different assumptions regarding the sectoral emission targets and flexibility between Member States in meeting their non-ETS emission targets were made, namely that:

• the additional reductions from the 20%-to-30% shift are allocated to the ETS and non-ETS sectors either *according to the Commission's Impact Assessment* (SEC (2010) 650), or *completely to the ETS sector*;

• there is either *full flexibility* or *no flexibility* between Member States in fulfilling their non-ETS emission targets.

The assumed targets (relative to 2005) for ETS and non-ETS sectors in 2020 at the EU level are tabulated below:

[1] The TIAM-Nordic is a global, linear energy system model based on the TIMES Integrated Assessment Model (TIAM), developed under the IEA's Energy Technology Systems Analysis Program (ETSAP). The TIAM-Nordic version differs from the original TIAM in that it has better regional detail with regard to Europe, modelling the Nordic countries explicitly as single regions as opposed to the Western and Eastern Europe division in the original TIAM. Due to the increased regional detail, also the level of detail regarding the energy system in the Nordic countries has been improved in order to take country-specific factors better into account.

| | Additional reductions to ETS only | Additional to ETS and non-ETS |
|---|---|---|
| ETS target | -46 % | -34 % |
| Non-ETS target | -10 % | -16 % |

The cost efficiency was analyzed by comparing the marginal costs of emission reductions between the ETS and non-ETS sectors of Member States. The marginal cost equals the highest cost per tonne CO2 equivalent that has been incurred in order to reach a given emission target. Cost efficiency would then require that the marginal costs are equal across all sectors, as otherwise the reductions in a sector with high costs could be replaced with reductions in a sector with lower costs.

The marginal costs in different cases are summarized in Figure 1. Two important observations can be made from the figure; one concerning the role of non-ETS flexibility mechanisms, the other concerning target setting between ETS and non-ETS sectors.

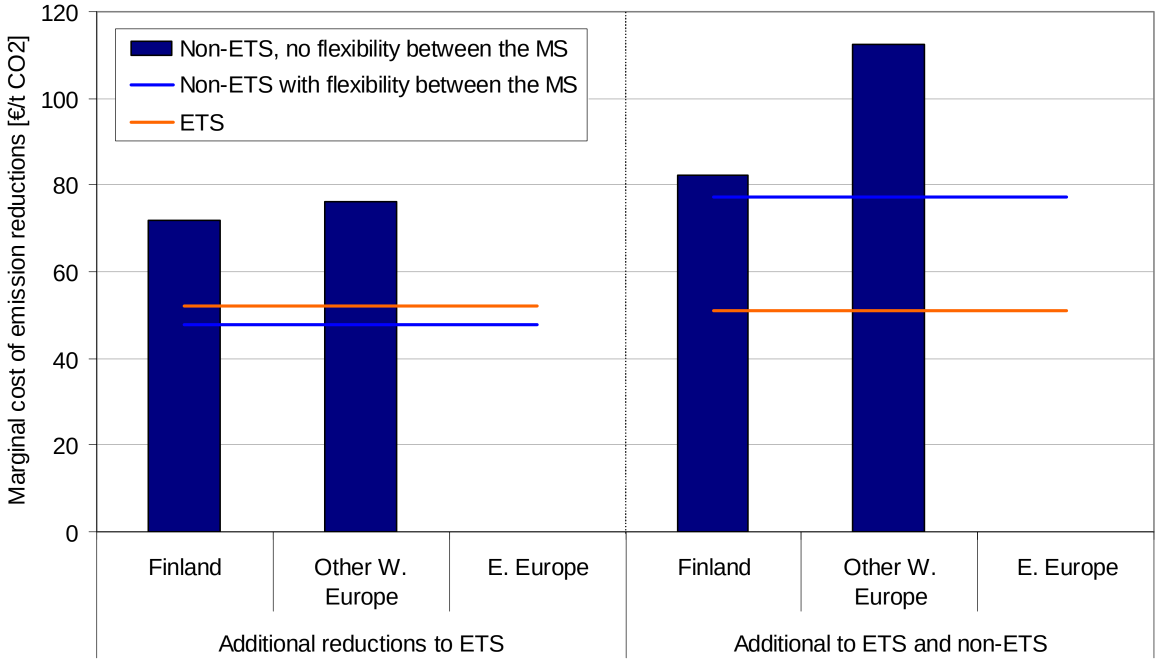


*Figure 1. An estimate with the TIAM-Nordic model on the marginal costs of emission reductions in the ETS and non-ETS sectors for reaching the EU -30% overall reductions in 2020. The additional reductions are allocated either fully to the ETS (left pane) or to both ETS and non-ETS according to SEC (2010) 650 (right pane). For flexibility between Member States in reaching their non-ETS either no-flexibility (bars) or full flexibility (blue horizontal line) was assumed.*

Perhaps the most striking feature of the figure is large disparity between the marginal cost of non-ETS sector in eastern (0 €/t CO2) and western Europe (over 70 €/t CO2) in the case where flexibility mechanisms with non-ETS targets are not included (blue bars). With full flexibility (blue lines) the marginal costs are equal across all Member States. Full flexibility would, however, involve a transfer of some 160 Mt non-ETS emission entitlements from eastern to Western Europe in 2020, i.e. over 25 % of the non-ETS allocation for eastern Europe.

Regarding the cost optimal target setting for ETS and non-ETS sector, the Figure 1 presents a rather divergent view from that of the impact assessment. Should the additional reductions be allocated both to ETS and non-ETS sectors as the results of the impact assessment suggest (right pane of Figure 1), the marginal cost in the non-ETS sector is remarkably higher from that of the ETS. Thus, the sectoral targets in this case are far from cost optimal. Instead, if all additional reductions are allocated to the ETS sector, the marginal costs in ETS and non-ETS sectors (with full non-ETS flexibility between the Member States) are relatively even, and also close to the marginal costs reported in the impact assessment (scenario with internal reductions only). The results from TIAM-Nordic model therefore suggest a very different allocation of sectoral reduction targets than those reported in the Commission's impact assessment.

## 2.2 Conclusions and discussion

Based on Figure 1, it can be concluded that according to the scenarios calculated with the TIAM-Nordic model, the additional emission reductions resulting from a shift to a 30% reduction target by the EU should – based on cost efficiency considerations – be allocated to a large extent to the ETS sector. An economically efficient allocation would require that the marginal costs of emission reductions are equal in the ETS and non-ETS sectors in all Member States. In the case where all additional reductions are allocated to the ETS sector, the marginal cost of the ETS is only slightly higher than in the non-ETS sector, assuming that there is full flexibility in non-ETS reductions between the Member States. If the higher allowed amount of CER credits in the ETS sector would be taken into account, the marginal cost in the ETS might be reduced below the non-ETS cost level. The marginal costs in the scenarios with the 30% are summarized in Table 1.

*Table 1. A summary of marginal cost estimates [€/$t_{CO2}$] for emission reductions in the ETS and non-ETS sectors with the TIAM-Nordic model and in the impact assessment for the European Commission (European Commission, 2010a, 2010b).*

| | ETS | Non-ETS | |
|---|---|---|---|
| | | Flexibility between MS | No non-ETS flexibility |
| TIAM, additional reductions for ETS | 53 | 48 | 0 - 161 |
| TIAM, additional reductions for both sectors | 51 | 77 | 0 - 165 |
| COM 2010, add. reductions for both sectors | 55 | 55 | - |

It is good to note the crucial role of the flexibility between Member States' non-ETS targets in reaching cost efficiency. Without the flexibility mechanism the marginal cost of non-ETS sector would be considerably higher than the ETS cost in Nordic countries and Western Europe. At the same time the non-ETS targets in eastern Europe would be ineffective if there are no transfers in non-ETS allocations. In the scenarios with this non-ETS flexibility the volume of transferred non-ETS allocations exceeds the 5% cap for transfers set down in the decision No. 406/2009/EC. Therefore cost efficiency in the non-ETS sector would require greater freedom for the Member States to transfer their non-ETS emission allocations with each other.

As the transfers of non-ETS allocations function on the level of Member States on an irregular basis, it can be assumed to work in a less efficient manner than the market for ETS allowances, on which the actors operate on a continuous basis minimizing their costs from emissions. Therefore it is possible that transfer mechanism for non-ETS allocations does not equalize the marginal cost as efficiently as has been assumed in this report. Therefore a larger allocation of emission reductions to the ETS would also minimize the risk for excessive costs resulting from this market inefficiency.

There, however, are notable uncertainties associated with the cost efficient emission reduction potentials in 2020, from which the aforementioned differences in the impact assessment's results and the TIAM-Nordic results are a clear indication. Using modelling results for determining the optimal allocation of reduction targets between the sectors – as was done in the impact assessment (European Commission, 2010b) 650 – may yield results that differ notably from the actual cost efficient allocation in reality.

In order to ensure cost-efficiency, flexibility mechanisms between ETS and non-ETS sectors would be necessary. Such mechanisms have been called for already previously, as also have been free transfers in the non-ETS allocations between the Member States. The effects of added flexibility in EU climate policy have been investigated by e.g. Tol (2008), who concluded that a single, complete market for all emissions – instead of 28 separate emission targets – would be the most preferable option.

# 3 Meeting the non-ETS target of Finland in 2020

According to the Decision (406/2009/EC) of the European Parliament and of the Council of 23 April 2009 Finland should reduce greenhouse gas (GHG) emissions in non-trading sectors (non-ETS) at least 16 % below 2005 levels by 2020. In order to meet this target Finland has to implement GHG abatement activities, which will cause costs. A situation where mitigation costs should be as low as possible was studied. Reductions that can be done in sectors of transport, heating, waste disposal, agriculture, working machines and F-gases are then studied. Possible impacts on other sectors like land-use change and forestry (LULUCF) or emission trading sectors (ETS) are outside of the scope of this analysis.

Emissions should be decreased in a linear manner toward the target. Thus, there are annual maximum allowed greenhouse gas emissions for every year during the period from 2013 to 2019. The Member States can however use flexibilities to ensure that reductions can be made cost-efficiently. To simplify the analysis all flexibilities were not included in the investigation. In this study was taken into account that the Member States may carry forward from the following year a quantity of up to 5 % of its annual emission allocation. If the emissions of a Member State are below its annual emission allocation,  it may carry over the part of its annual emission allocation of a given year that exceeds its greenhouse gas emissions in that year to the subsequent year until 2020. The Member States can also trade their non-ETS allocations, which was studied as a separate case.

The objective of this study was to build portfolios that fulfil the reduction target. Each portfolio consists of activities that are chosen to be implemented in the examined timeline 2010–2020 and the year they will be implemented. In this study abatement activities to be implemented were chosen among 17 independent mitigation actions such as replacing oil heating with some another way of heating or increasing the share of biofuels in transport. The costs and reductions related to each mitigation action are described in detail in working paper “Assessment of risks and uncertainties of national greenhouse gas abatement actions in Finland”. However, the amount of GHG reductions and costs are uncertain with every abatement activity and therefore portfolios involve risks to reduce emissions less than predicted or cause higher costs than estimated beforehand. Because abatement activities involve uncertainties, a stochastic optimization model was built so that minimization of the overall costs can be done in a manner that also takes into consideration the uncertainties. Then the amount of risks related to the costs and reductions in different portfolios representing different levels of reductions can be estimated and compared to each other. Because the reductions are uncertain there is a possibility that the target will not be met and for this reason probability to meet the target is examined in different portfolios.

The possibility of trading allocations may change the overall costs and the set of actions that should be implemented according to the optimization. It can also affect the amount of risks involved in optimal portfolio. This is why two cases were compared to each other. In the first case the Member States have to meet the target by national mitigation actions, and in the second case the Member States can also trade non-ETS allocations. Then comparison is made by examining how the costs, reductions gained by national mitigation actions and uncertainties related to them differ from each other in these two cases. In addition to this, difference in the set of implemented actions and their optimal timings in also studied.

## 3.1 Results

Two cases were studied and compared to each other in this study. In the first case the Member States have to meet the target by national mitigation actions, and in the second case the Member States can also trade non-ETS allocations in 2020. Pareto curves in these cases are illustrated in Figure 2. The uncertainties with confidence interval of 68 % are represented wit red line and confidence interval of 95 % with blue line for a few Pareto portfolios. Horizontal axis illustrates the amount of reductions gained by national mitigation actions and vertical axis the overall costs of each portfolio. The dashed line in the left picture represents the case where annual reduction targets do not have to be fulfilled every year. Thus it can be seen as example of how costs and the amount of bought allocations change when non-ETS-trade is possible every year and the price of allocation develops in the same way as the interest rate used in the model.

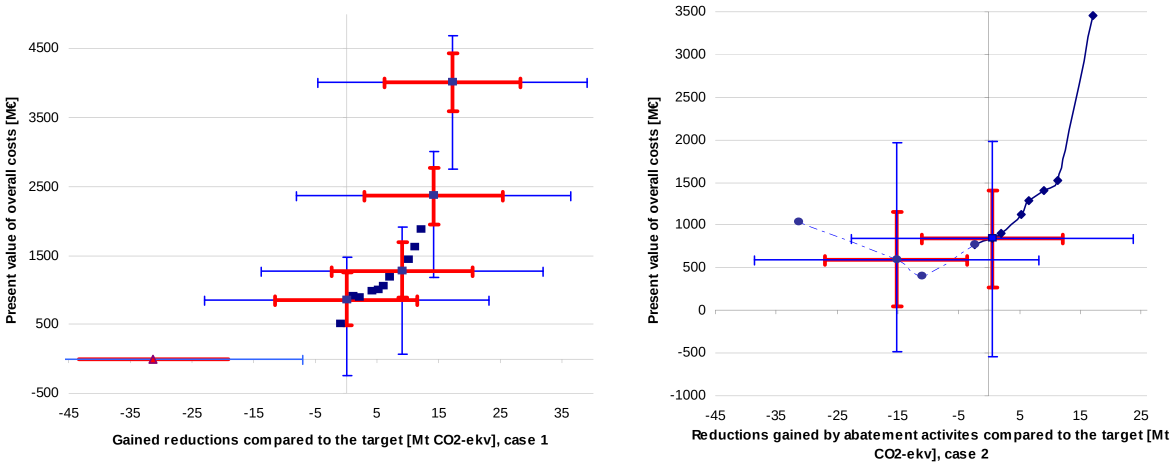


*Figure 2. Pareto curves in cases where non-ETS-trade is (right) and is not (left) possible. The red lines refer to confidence level of 68 % and the blue lines to confidence level of 95 %. The dashes line in the right picture demonstrates the case where allocations can be bought every year. The upper endpoints of the curves indicate the situation where all national abatement actions are implemented in 2010 (the points where reductions gained by national abatement actions are approximately 17 Mt CO2-ekv more than target requires). When none of the actions are  implemented till year 2020 reductions gained by national abatement actions are approximately 31 Mt CO2-ekv below the target (the lower endpoints of the Pareto curves).*

As we can see in the Figure 2 possibility to trade allocations in 2020 lowers the overall cost approximately 10 %. If allocations can be bought every year, costs are almost 48% lower when compared to the case where all reductions are done by national mitigation actions. It can also be seen that when trading allocations is possible either only in 2020 or every year during 2013-2020 costs will be minimized by buying allocation. Yet, buying allocations increases the risks related to the overall costs significantly because the price of allocation unit is very uncertain. It is also assumed that allocations can be bought as much as needed. Therefore risk of not being able to buy the needed amount of allocations is not taken into consideration. The left panel of Figure 2 shows that every portfolio involve risks not to meet the target because confidence levels include negative values of reductions gained more than target requires. The probability to meet the target can however be increased when the costs are allowed to increase.

In order to meet the reduction target some abatement activities have to be implemented as can be seen in Figure 2. The mitigation actions and their optimal timing in Pareto portfolios are represented in Figure 3. The picture in left illustrates what kind of probability there is to implement (or having been implemented earlier) each abatement action in examined years when all reductions are gained by national abatement actions. The picture in right represents the probabilities to implement abatement actions when allocations can be bought in 2020 only.

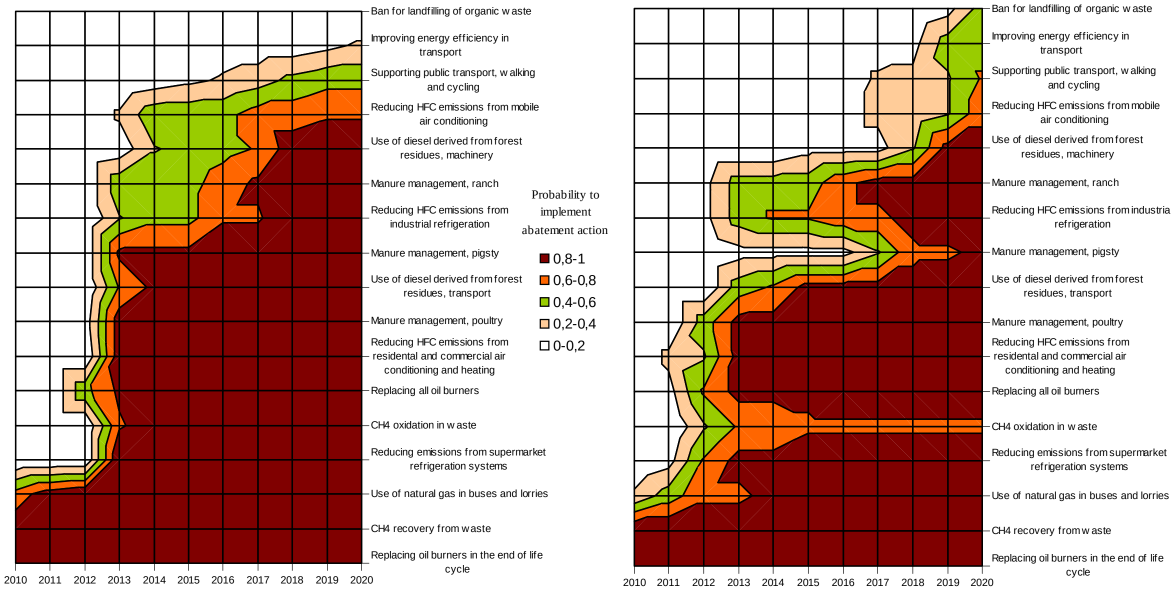


*Figure 3. The annual probability to implement each abatement action when reduction target has to be met by national mitigation actions (left) or in year 2020 allocations can be bought/sold (right) in Pareto portfolios presented in Figure 2.*

In Figure 3 can be seen that when trading allocations is possible the set and timing of implemented actions change. Especially the probabilities to implement abatement actions decrease in actions with high investments in the beginning. This is because optimization is done by minimizing the present value of costs and then investments in further future are more advantageous. The non-ETS-trade seems to postpone the implementation of abatement activities because reductions which are additional from the target's point of view can be sold, which decreases the costs. On the other hand, buying allocations can prevent marginal abatement costs from growing higher than the price of allocation unit. For this reason the possibility of non-ETS-trade makes it more flexible to meet the reduction target.

Sensitivity analysis was performed for the cost minimizing portfolios in different cases (without non-ETS-trade and with non-ETS-trade in 2020) so that the overall costs and gained reductions were studied separately. The uncertainties in gained reductions are caused by the same sources in both cases. The variables which have the most significant impact on the uncertainty in gained reductions seem to be the sector “other emissions”, the baseline of annually driven kilometers by cars and the forecast for average g/km carbon dioxide emissions of new cars. The baseline emissions of agricultural land and working machines have also influence on the amount of gained reductions. Yet, the variables causing uncertainty in costs are somewhat different in different cases. When trading allocations is not possible, the prices of crude oil and diesel as well as the abatement costs for reducing HFC emissions from supermarket refrigeration system are the main reasons for uncertainty in costs. Also the abatement costs for reducing HFC emissions from mobile air conditioning and the price of diesel derived from forest residues have a slight impact on this uncertainty. When trading allocations is possible in 2020 the uncertainty is mainly caused by the sector “other emissions” and the prices of crude oil and allocation unit. The baseline of driven kilometers by cars and the average g/km carbon dioxide emissions of new cars also have effect on the uncertainty of costs.

# 4 Including LULUCF emission and sinks in the targets

## 4.1 Finnish LULUCF emissions and sinks in 2020

The Land use, land use change and forestry (LULUCF) emission category is very important for Finland, due to its large forestry sink. The LULUCF emission sources and sinks can be divided into three main categories in Finland: forest biomass, forest land and other sources (including e.g. croplands, wetlands and harvested wood products). The inventory values for these source categories are presented in Figure 4, which shows that the most important single category defining the total level is changes in forest biomass.

In addition to its large absolute value, changes in forest biomass is the main contributor to the fluctuation in the value of total sinks in Finland. The fluctuations in forest biomass sinks amount on average to ±14% of the 5-year moving average value, and result mainly from changes is loggings, which vary from year to year due to economic cycles.

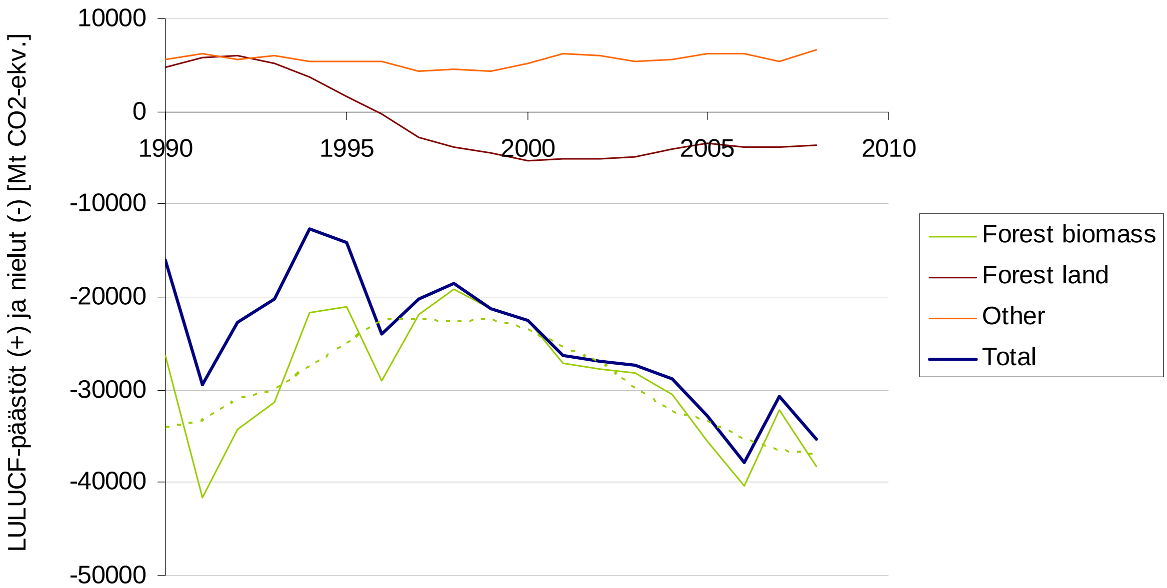


*Figure 4. Finnish LULUCF emissions and sinks between 1990 and 2008 (Statistics Finland, 2010).*

Due to the large role of forestry in Finnish LULUC emissions and sinks, the future level of LULUCF is to a large extent defined by the forestry scenario. Critical factors are wood demand, domestic and foreign supply of wood and the growth rate of forests. Estimates on the forestry potential of Finland have been made with the MELA model (e.g. Nuutinen and Hirvelä, 2006; Kareinen et al., 2008; Metla/MELA team, 2009), while Hetemäki and Hänninen (2009) have made more detailed analysis on the future demand of forestry products and wood imports.

The analysis presented here is based on the results from three scenarios from the MELA model (Metla/MELA team, 2009), and the demand scenario of Hetemäki and Hänninen (2009) augmented with a suitable forestry growth scenario of MELA. The MELA scenarios use three very different decision rules for the future amount of loggings, either maximizing the net revenues from loggings (NTN scenario), carrying out maximal sustainable loggings (SK scenario), or extrapolating the level of loggings from previous years (TH scenario). These scenarios have very diverse levels for future loggings, as the SK and NTN scenario project a considerable increase, whereas the TH projects a moderate decline in loggings in 2020.

The forestry biomass sinks that have been estimated from the described scenarios are presented in Figure 5, which also presents for each scenario a range within which the sink might fluctuate, based on the historical level of fluctuation around the trend. The figure shows that the TH and Hetemäki/TH scenarios would follow the trend between 1998 and 2008, while the SK and especially NTN scenarios would clearly divert from this trend.

It is however important to note that the demand scenario of Hetemäki and Hänninen (2009) did not include the increase in bioenergy due to the renewable energy obligations set by the EU, which is likely to reduce the level of forestry sinks. There, however, are yet no comprehensive estimates on the effect of the renewable energy targets on Finnish sinks. Prior to the targets being set Kareinen et al (2008) estimated a decrease in sinks around 3.1 Mt $CO_2$/yr in 2020 in a scenario in which forestry residue were used for energy at a level of 30 TWh/yr. It is however currently assumed that bioenergy use will exceed this level by roughly a factor of three, and thus the sinks would probably be considerably lower in each scenario presented Figure 5. Nevertheless, this effect is likely to be clearly smaller than the effect of logging levels.

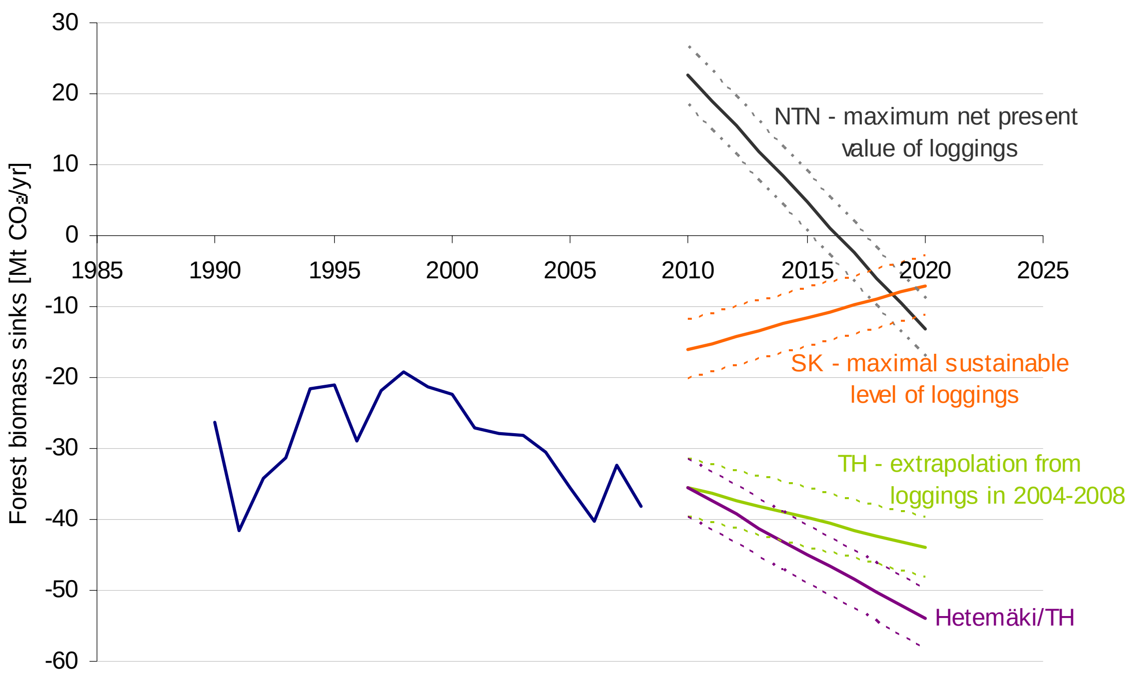


*Figure 5. Finnish forestry biomass sinks between 1990 and 2008 (Statistics Finland, 2010), and in four scenarios based on (Metla/Mela-team, 2009; Hetemäki and Hänninen, 2009).*

## 4.2 Options for limiting LULUCF emissions

Options for limiting the net emissions of LULUCF (including emissions and sinks) vary on what emissions are included, what flexibility mechanisms (both between different sectors and Member States) are available, and what is the actual level to which net emissions are limited. In order for the emission limit to be effective, it has to provide an economic incentive to reduce emissions and increase sinks, at least at a national level but possibly also on the level of a forest owner.

For maintaining economic efficiency between different economic sectors, the level of this incentive should be close to the price of emission allowances in the ETS and the marginal cost of emission reductions in the non-ETS sectors. This could be implemented by directly including LULUCF emissions in the ETS or non-ETS reduction targets, or coupling the sectors through a flexibility mechanism. Otherwise, if the economic incentives would be unequal across the sectors, economically inefficient emission reductions and carbon leakage between the sectors would occur. As different policy frameworks are able to provide equal incentives for reducing emissions in all sectors, an approach that satisfies this property and can also take into account more practical factors, such as the large inter-annual variance in LULUCF emissions, should be selected.

In addition to the policy framework, different calculation options for LULUCF emissions have been discussed. The options are described briefly in the table below, and all assume that the LULUCF emissions and sinks could be used to compensate other emissions, through either direct inclusion in a larger emission pool or a flexibility mechanism.

*Table 2. A summary of different calculation options for limiting LULUC emissions.*

| Calculation option: | Propreties: |
|---|---|
| Cap:<br>The compensation or burden from LULUCF is limited to the cap | - Cap limits “too large” compensations or burdens<br>- No incentive to reduce emissions after the cap has been met |
| Discounting:<br>The compensation or burden is reduced with a chosen discounting factor, e.g. 85% | - Decreases the impact of compensation or burden<br>- As emissions are not accounted fully, ton for ton, the economic incentive for reductions is also decreased |
| Reference level:<br>The total net emission level is compared to a chosen reference level | - Full accounting of emissions creates an efficient incentive for reducing emissions and increasing sinks<br>- If temporal flexibility is not possible, inter-annual fluctuations in LULUCF emissions affect also other sectors |
| Ref. level and band:<br>Comparison to the reference level so that small deviations around the reference level – inside the chosen band – are ignored | - The effect of inter-annual fluctuations are reduced when the net emission level is close to the reference level<br>- When emissions are inside the band, there is no incentive for reducing emissions or increasing sinks |
| Ref. level and zero band:<br>Comparison to the reference level so that net emissions between zero and the reference level are ignored | - The effect of inter-annual fluctuations are reduced when the net emission level between the reference level and zero<br>- When emissions are inside the band, there is no incentive for reducing emissions or increasing sinks |

The resulting compensation or additional burden from LULUCF sinks and emissions for Finland in 2020, based on the scenarios of Figure 5, are presented in Figure 6. Depending to a very large extent on the scenario and calculation option used, the emission compensation or extra burden from sinks ranges from a compensation of 40 Mt/yr to a burden of 7 Mt/yr. For comparison, Finnish emissions without LULUCF in 2008 were at 70.1 Mt $CO_2$-eq. Therefore the forestry scenario and calculation rules for LULUCF have both a tremendous impact on Finnish greenhouse gas targets.

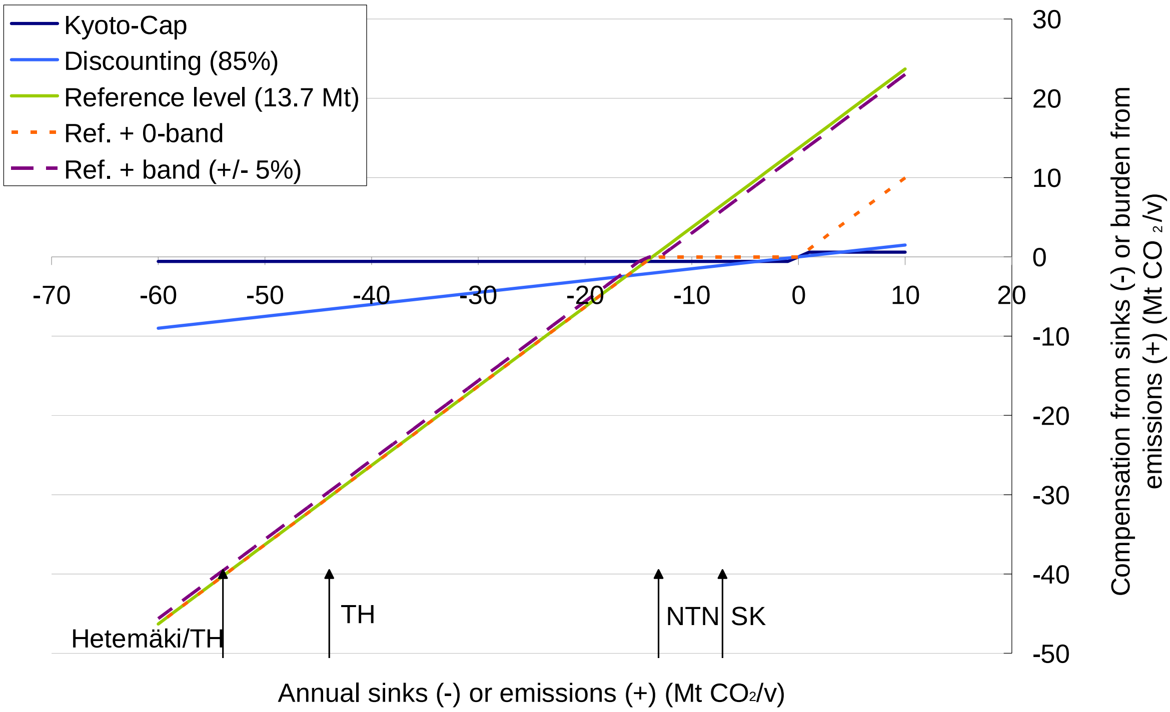


*Figure 6. Finnish forestry biomass sinks between 1990 and 2008 (Statistics Finland, 2010), and in the four scenarios presented in Figure 5, and based on (Metla/Mela-team, 2009; Hetemäki and Hänninen, 2009).*

# 5 Discussion

This report has touched three topics on the future development of climate policy. While the topics were analyzed as separate research questions, they in fact are very interlinked. How the possible shift to a -30% by the EU is divided between ETS and non-ETS, and should these two sectors be more interlinked via some flexibility mechanism, directly affects our analysis of optimal strategies for meeting the non-ETS targets. A similar impact would arise from compensating credits from the LULUCF sector. Also, including the LULUCF sector in the overall EU target, and the framework on how this would be implemented, would possibly also alter the optimal target setting between the sectors.

An overreaching theme in all three analysis described here is the question how economic efficiency for emission reductions would be maintained. The logic behind this is simply that our limited economic resources should be put to use in the most efficient manner, and thus emissions should be reduced where it is the most cost efficient. In order to reach this, climate policy frameworks should be constructed in a manner that creates equal incentives for reducing emissions across all economic sectors and Member States. Even though some practical factors have evidently to be taken into account, sufficient flexibility mechanisms between sectors and Member States should be present.

Due to the intertwined nature of the topics covered, the questions can not be answered in isolation from each other, nor from the even greater framework of international climate negotiations. Therefore it is likely that these issues can not be resolved one by one, but in together in a coordinated manner.

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