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Interaction of the EU ETS and national climate policy instruments – Impact on biomass use

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A B S T R A C T

Policy-makers apply multiple policy instruments simultaneously in the climate and energy policy field at both EU and Member State levels. This creates interactions between instruments that can be complementary and synergistic but also conflicting. This article focuses on the interactions of climate policy instruments and their impact on biomass use. The objectives are to examine interactions of the EU Emissions Trading System (EU ETS) with the main national climate policy instruments and to identify the influence of these on biomass use. The work draws experiences from seven EU countries (Austria, Finland, Germany, the Netherlands, Poland, Sweden and the United Kingdom), with a special focus on Finland and Sweden. The analysis explores the effects of policy interactions and is based on an examination of literature, and interviews with biomass experts in research, industry and policy spheres. Results indicate that the combined effects of climate policy instruments have a tangible impact on biomass use, whereas the causal links to the EU ETS are difficult to assess separately. Policy impacts found include increased competition for biomass resources, changes in fuel mixes and a contribution to upward pressure on wood prices. Differences in these effects are linked to differing national policy mixes and energy-carrier portfolios – an example being the relative differences in the importance of peat to the energy mix in Finland and Sweden. Analysis and comparison of the effects in the selected countries can yield insight on how to improve the design of policy interventions that impact biomass use. This study confirms the importance of identifying interactions between policy instruments so as to recognise – and manage – synergies and conflicts. The development of more synergistic and coordinated policy instrument mixes would also be beneficial for the bioenergy field.

1. Introduction

Within the European Commission funded *Bioenergy Network of Excellence* (NoE), the project "The EU Emissions Trading Scheme and Biomass" explored a range of issues related to the linkages between bioenergy and the EU Emissions Trading System (hereafter 'ETS'). The project principally addressed climate policy interaction and its effects on biomass use.

Energy and climate policy are inherently interlinked. The European Commission's "Climate action and renewable energy package" [1] is one example of the overlap and integration of these two policy fields. It sets targets for the year

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2020 to increase renewable energy and energy efficiency and reduce greenhouse gas (GHG) emissions. Contributing to the achievement of the various targets in the climate, energy and environment policy field, multiple policy instruments have been designed and implemented simultaneously, both at the EU and Member State levels. The ETS is an important instrument for EU climate policy, covering 40% of total CO_2 emissions in the EU. In addition, Member States employ a number of national policy instruments in pursuit of their climate and energy policy goals.

As such, the policy environment is becoming increasingly crowded (for discussions of 'policy congestion' see e.g. [2–4]). Targets and objectives of policy instruments often overlap and create interactions that can be complementary (i.e. synergistic) or conflicting. Indeed, there is evidence that various instruments can reduce the effectiveness of others and undermine the success of an instrument – particularly when the targets are contradictory [2,3]. For example, the ETS and support instruments for renewable electricity coexist at the national level in Member States and interact in a complex way as they share an overlapping goal to reduce CO_2 emissions. In this light [5], argues that policy coordination may be necessary in order to mitigate conflicts and exploit synergies. Moreover [2], hold that compatibility of different regimes is crucial for policy design to ensure that various policy instruments do not hinder the objectives and credibility of others.

Biomass is forecast to contribute around two-thirds of the EU's primary renewable energy consumption in 2020 [6]. However, the bioenergy sector has not developed at the rate required to meet policy goals [6], and [7] holds that lack of coordination of biomass-related policies is a contributing factor. We expect this also applies to policy instruments influencing bioenergy use. For instance, the BAP Driver project [8] stresses that consistency and interplay .of policy instruments should be considered when designing support measures.

In the light of the above mentioned points, this paper seeks to contribute to the understanding of views how various climate policy interactions can affect the use of biomass for energy. In particular, the work seeks to assess how the combination of national and international climate policy instruments impact biomass use. In this area a special focus has been placed on seeking evidence of how the EU ETS affects the process.

2. Methodology

This study is based on a literature review of official national documents and related studies, international statistics, and expert interviews. A predominantly qualitative approach was adopted to evaluate the interactions between the ETS and other policy instruments. Those impacts that were anticipated *ex ante* to the ETS, were called as *estimated effects*. The policy impacts that were observed *ex post* are referred to as *observed effects*. The study addressed seven NoE countries involved in the project: Austria, Germany, Finland, the Netherlands, Poland, Sweden and the United Kingdom (UK). However, while the main analysis concentrated on Germany, Finland, the Netherlands, Sweden and the UK, particular focus was given to Finland and Sweden because of a greater availability of data. Data collection concentrated to the period October 2008–January 2009 (follow-up research carried out in late 2009); it focused on compiling theoretical considerations and, in particular, stakeholder perceptions. Due to the dynamic nature of the study field, the paper has speculative elements.

To track the use of biomass before and after the introduction of the ETS in data from two time periods 2000–2003 and 2004–2007 was extracted from Eurostat statistics [9]. The analysis of policy interactions and estimated effects was based on country studies, whereas the statistical data and interviews contributed mainly to the analysis of observed effects. 15 experts were consulted from four countries via semi-structured interviews, mainly by telephone or email. A number of interviewees (9) were selected based on existing relationships with NoE project partners; the remainder were selected on the basis of report or study authorship in the field. The informants represented: energy research and consultant companies (Sweden); forest industry (Finland, Sweden, the UK); governmental energy departments/agencies (Finland, Sweden, the Netherlands); and research centres (Finland, Netherlands).

While opinions have been sought from a range of viewpoints, it is recognised that expert views may not reflect the common 'national' or 'organisational' opinion on this particular issue. Experiences of the effects upon the forestry industry – or 'forest products industry' – were considered to be a vital information source as sector representatives are regarded to deal closely with the topic. The relatively small community of experts combined with the limited resources available to this study largely precluded triangulation of the veracity of 'national expert opinions'. Not least in recognition of the informants' views, they have been presented referring to the organisation of the interviewee in this text. This said, we hold that the interviewee pool utilised serves its purpose as a sample of stakeholder perceptions in the study area.

To explore the interaction of the policy instruments and its impact on biomass use, a two-stage analysis was carried out. Themes addressed in the first stage were determined based on the findings of initial literature and included:

- Climate and bioenergy policy framework and instruments;
- Interaction of the ETS and national instruments: conflicts and synergies.

The themes in the second stage, which form the results of this paper, were:

- Estimated effects;
- Observed effects;
- Measures taken to balance the effect of the ETS (e.g. to offset the disadvantage for certain fuels, like peat).

The depth of analysis varied between the countries due to the differences in data and interviewee availability (e.g. the analysis in Austria, Germany and Poland was restricted to literary and statistical analysis). As a result of this limitation, this discussion does not explore policy interactions in depth nor does it consider other international climate policy instruments. Despite peat not being explicitly considered as a renewable energy source (see the biomass definitions in [10,11]), this study looked into peat due to its importance in energy production both in Finland and Sweden and because these countries consider it a slowly renewable fuel [12].

3. Theoretical considerations and national policy frameworks

3.1. Climate and energy policy interaction in the EU

Although a coherent and coordinated climate policy mix has been called for by both policy makers and analysts, a number of studies [2,4,5,13] claim that the field remains under-researched. While the most important EU climate policy instruments are listed under the European Climate Change Programme (ECCP) [14], it does not explicitly acknowledge the interaction of these policies (cf [3]). The EC has also emphasised the need for a coordinated approach to biomass policy [7,15], but neither of these discussions specifically address policy interaction.

The ETS was introduced as the EU's primary climate policy instrument in 2005. It is often experienced that new types of regulation do not fully replace existing policy instruments, but rather operate in parallel with them [4,16]; this is also the case with the ETS. Interactions of the ETS and other policy instruments have been examined, among others, in the context of green and/or white certificate schemes [17,18], energy taxation [19] and the EU's 'climate and energy package' [1]. The INTERACT project [3] explored the potential interactions between the proposed ETS and other instruments within both EU and Member State climate policy spheres. It concluded that policy combinations can often be more effective than individual instruments in isolation. However, circumstances in which the policies have negative interactions need to be identified, and policies redesigned accordingly [3]. Sorrell et al. [3] also hold that it is important to clarify the policy objectives of instruments that coexist with the ETS. They argue that the ETS guarantees the achievement of a Europe-wide emission target and that instruments that directly or indirectly interact with the ETS will not contribute further to overall emission reductions of the ETS sectors. The reason for this is that they do not affect the overall cap of available emission allowances but only the trading of these allowances [3].

Sijm [20] finds that when the ETS (with a fixed cap of emission allowances) is present, other policies reducing emissions in the participating sectors have zero effectiveness. However, he holds that the ETS and overlapping instruments can coexist because they: improve the design of the ETS; correct market failures, in particular in the field of energy efficiency and R&D; and meet other policy objectives in addition to CO_2 reduction efficiency. In this light, the support for renewables can be justified based to a great extent upon other policy objectives, such as improvement of security of supply, rural income opportunities, and a range of environmental co-benefits [20]. Abrell and Weigt [21] argue that learning effects are another justification for renewable energy support. Moreover, Diekmann et al. [22] are of the opinion that the ETS, as a general instrument aiming to reduce GHG emissions, cannot replace technology specific support for renewables. They indicate that, in the case of Germany, the trading scheme can be expected to have little impacts on the expansion of renewable energy markets as the financial incentives are too low and the investment risk is too high.

While one of the main motives stated to underpin a number of bioenergy policies is the reduction of CO_2 emissions, these policies in practice are often aimed at increasing bioenergy use rather than diminishing emissions [23]. Indeed, policy actions promoting biofuels for transport are held to offer lower climate benefits when compared to substituting biomass for fossil fuels in heat and electricity production; the latter course is generally less costly and provides larger CO_2 emissions reduction per unit of biomass (e.g. [24,25]).

3.2. Climate and bioenergy policy framework and instruments

Six out of seven countries addressed within this study have followed the EU level decision to integrate energy and climate policy in one policy document and have recently adopted a new energy and/or climate strategy (Table 1).

Despite multiple policy instruments found in each of these countries at national level, the coordination of the use of the support instruments appears to be minimal. None of these jurisdictions have a 'full-grown', coherent national biomass action plan (BAP) that could coordinate policies connected to biomass use as called for by the EU BAP [15]; nor has this kind of integrated biomass plan yet been developed elsewhere in Europe [8]. Nonetheless, some type of national BAPs have been prepared by three of the countries: Germany, the Netherlands and the UK. Austria has generated a preliminary study for the plan while Finland, Poland and Sweden have no official BAP (for more information on national BAPs cf [33,34]). Policy coordination is expected to improve along with national renewable energy action plans (NREAPs) required by the Directive on renewable energies (hereafter 'RES-Directive') [11].

The role that bioenergy can play in reducing national carbon emissions is addressed by the majority of examined countries. According to a German report [35], biomass promotion can potentially contribute to the fulfilment of agricultural, energy and environmental (and thus climate) policy targets – however, it also indicates that inherent costs and the conflicts between these targets need to be taken into account. In the UK, climate change is the primary motivation for the establishment of a national BAP [36]. The contribution of biomass to the achievement of national climate and energy goals is supported also in Finland [29] and in the Netherlands [37]. While bioenergy clearly is seen to narrow down carbon emissions, inefficiency of biofuels for transport to reduce emissions is acknowledged in Germany [35], UK [36,38] and Sweden [39]. The German work notes that prioritising biomass in the transport sector does not adequately exploit the potential of biomass in climate change mitigation [35]. While the Swedish [39] clearly recognise this issue, they argue that liquid biofuels are a vital and effective area for biomass utilisation from the point of view of security of supply, which is a quite distinct and different issue.

As Table 1 demonstrates, the countries employ various policy instruments in efforts to fulfil their climate and energy strategy objectives and there appear to be clear overlaps and linkages between all seven countries. Primary support instruments for renewables (and bioenergy) are often deployed, as

Table 1 – Climate and bioenergy policy framework and instruments in the selected NoE countries – status in February 2009 [8,26–32].

	Key climate instruments[a]	Key bioenergy instruments[b]	Climate and energy policy[c]
Austria	Feed-in tariffs, investment subsidies, tax incentives, R&D funding, environmental standards [26,28]	See key climate instruments [8,27]	2008–2012 (2007) [26,28]
Germany	Feed-in tariffs, Climate Legislation Package, National Climate Protection Initiative [26]	Feed-in tariffs, investment subsidies, quota and tax exemption for biofuels, obligation to use RES-heat, biogas feed-in ordinance [8,27]	Until 2020 (2008) [26]
Finland	Energy taxes, investment subsidies, feed-in tariffs, R&D funding, energy efficiency measures [26,31]	Investment subsidies, tax refunds, feed-in tariff for peat-based electricity, R&D funding [8,31]	up to 2020/2050 (2008) [29,31]
Netherlands	Feed-in tariffs, R&D, investment subsidies/tax incentives, energy taxes, standards and regulations, voluntary agreements [26]	Feed-in tariffs, tax reduction, research subsidy on sustainable energy and energy savings [8]	2007–2011 (2007) [26]
Poland	Tradable green certificates and quota obligation, Red Certificate System (GoO for high efficiency co-generation), tax subsidies and soft loans, energy crop subsidies [26]	See key climate instruments [8,27]	No integrated package, but 3 legislative changes in 2007 [27]
Sweden	Electricity certificates and quota system, energy taxes, investment grants, energy efficiency improvement programme, Climate Investment Programme [26]	Electricity certificates and quota system, tax exemption for biofuels (transport), CO_2 tax (heat), investment subsidies, subsidies for car purchases (biofuels) [8]	Until 2020/vision 2050 (2009) [32]
UK	Climate tax, quota obligation and certificate system, Climate Change Agreements, Renewable Transport Fuel Obligation [26]	Quota obligation and certificate system, tax incentives, investment subsidies, energy crop subsidies [8,27]	2020/2050 (2006/2008) [30]

a In addition to the national climate instruments listed in this column, all countries participate in the EU ETS.
GoO = Guarantee of Origin.
b The column presents the possible differences between climate and bioenergy policy key instruments based on different sources; it does not necessarily signify that there exists a specific instrument only for bioenergy promotion.
c The column shows the scope of the most recent energy and/or climate policy strategy; the publication/adoption year is presented in brackets.

one of the interventions to mitigate climate change. However, there is not always consistency in approaches. For instance in the UK it has been shown that the multiplicity of national biomass support schemes causes confusion – in 2006, there were some eight support schemes for biomass alone [38]. Also, carbon savings are not explicitly connected to the design or the performance of support instruments. The UK report on the role of bioenergy in reducing emissions [38] finds that governmental policy has not facilitated the development of newer and more efficient technologies towards commercial viability because it does not link incentives to carbon savings. In contrast however, such links are seen both in the measures of the German [40] and the UK [36] BAPs and regarding support scheme evaluations in Austria and the Netherlands [8].

3.3. *Interaction of the EU ETS and national support instruments*

In addition to the INTERACT study [3], studies in Sweden [41], Germany [22] and the UK [42] demonstrate how important it is to identify policy instrument overlaps and interactions, and that there are both synergies and conflicts between the ETS and national policy instruments. Regarding synergies, the combination of the ETS and feed-in tariff/energy tax has stimulated the fuel switch from fossil fuels to renewables in the Netherlands. In Sweden, the CO_2 tax and ETS complement one another in the sectors outside the ETS. The combined effect of electricity taxes and the EU ETS is indirect, but they both can be considered to seek to decrease electricity consumption through higher electricity prices. Moreover, the ETS and the electricity certificate scheme have appeared to function satisfactorily together (with the exception of peat, see section 4.1); however the experience is still considered to be limited [41].

Regarding contradictory policy objectives, a reduction in cost-effectiveness for CO_2 reduction in terms of combined use of ETS and feed-in tariff, green certificates or CO_2 taxes is recognised by Germany [22], the Netherlands [20], Sweden [41] and the UK [42]. A UK project emphasises that the time scale of policies is important; the cost-effectiveness of climate policy has the potential to be improved by renewable energy support instruments in the long-term. As such, there is a recognition (or belief) that a loss of efficiency for the economy in the short-term can be balanced by long-term benefits [42]. As one example of how such phenomena may be taken into account, Diekmann et al. [22] suggest that to avoid conflicts of climate change effects between the RES-E policy instrument and the ETS, the emission cap should be adjusted to reflect the positive climate impact of renewable energy. Thus, the contribution of the support instrument to reduce CO_2 should be integrated into the national allocation plans or the determination of the emission cap at the EU level [22].

4. Results and discussion

4.1. *Changes in fuel mix and ancillary benefits*

When considering the estimated effects of the ETS, Finland is an example of a jurisdiction that has performed work to assess those effects *ex ante*. Finnish studies indicated that the competitiveness of wood fuels would increase while peat would be displaced by wood or even coal [43,44]. In addition, at least two Finnish regions (central [45] and Eastern Finland [46]) have evaluated the likely effects. As an example, the Eastern Finnish study found that long-term impact of the ETS on the regional labour market could be as much as 2000 person years. While benefits are anticipated to accrue e.g. for machinery manufacturers exporting forest machinery, disadvantages include decreased employment along with lesser peat use [46].

4.1.1. *Statistical development*

As to observed effects during the period when the ETS was introduced (2004–2007), consumption of biomass – including wastes, according to Eurostat categorisation – grew in most of the examined NoE countries (total average percent change across the seven countries was 35%) (Fig. 1). The largest increase has taken place in Germany (82%), whereas Finland's biomass consumption remained almost at the same level (−0.4%) (note that Finnish statistics [47] show 25% increase in the consumption of biogas, recycled and waste based fuels in 2007 compared to 2004). The consumption of wood and wood wastes, included in the statistical category of biomass and wastes, generally increased in all countries (15%; Germany again leading with 30% increase). At the same time, fossil fuels consumption diminished in all countries (3%) with the exception of Poland.

To provide a basis for comparison with the above, Fig. 2 depicts the development in consumption in the period before the ETS was in place – i.e. the period 2000–2003. It can be seen that positive trends were already experienced in this earlier period. However, both biomass and wastes, and wood and wood wastes, grew at slightly slower rates compared to 2004–2007 (16 and 13%, respectively). In this period, all countries except the UK increased fossil fuel consumption somewhat (total growth 2%).

Electricity generation from biomass powered stations in 2004–2007 follows the same tendency as the gross inland consumption and increased in all countries except in Finland (total growth 60%) (Fig. 3). Wood generated electricity production grew in total 45%. Poland led growth in electricity production both in terms of total biomass and wood and wood wastes (201 and 207%, respectively). During this period, fossil

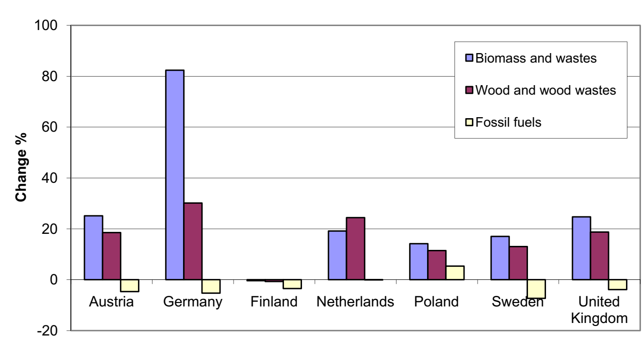

Fig. 1 – Total percent change in gross inland consumption from biomass and wastes, wood and wood wastes and fossil fuels between 2004 and 2007. Fossil fuels include solid fuels (excl. peat), crude oil and petroleum products and natural gas [9].

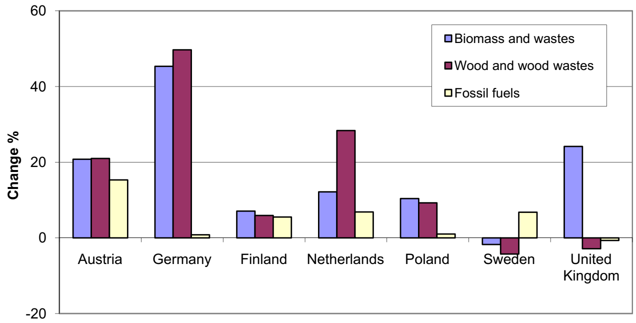

Fig. 2 – Total percent change in gross inland consumption from biomass and wastes, wood and wood wastes and fossil fuels between 2000 and 2003. Fossil fuels include solid fuels (excl. peat), crude oil and petroleum products and natural gas [9].

fuel generated electricity increased by 2% across the seven NoE countries. Sweden's fossil fuel based power production decreased the most (32%).

The growing trend of bio-based electricity was already visible in the earlier period of 2000–2003. Electricity production from biomass and wastes grew by 32% (Fig. 4), whereas electricity from wood and wood wastes increased on average by 39%. Nevertheless, the growth of wood-based electricity was actually higher in many countries (5 out of 7) compared to the later period. The fossil fuel generated electricity grew by 8% in all jurisdictions in the 2000–2003 period.

These developments suggest that national support instruments along with the ETS have contributed to significant changes in fuel mixes. While the empirical basis of this study is insufficient to establish a direct causal link to the ETS, such is suggested in some cases example – a study of Convery et al. [47] for example supports this linkage in the case of Germany and the UK. Other sources backing up the linkage include a Swedish study [41] indicates expectations of both the national green electricity certificate scheme and the ETS promoting the use of bioenergy; the CO_2 tax is also thought to boost biomass in combined heat and power (CHP) production in the long-term even if not in short-term [41]. Suhonen et al. [48] indicate a belief among bioenergy experts that the most important

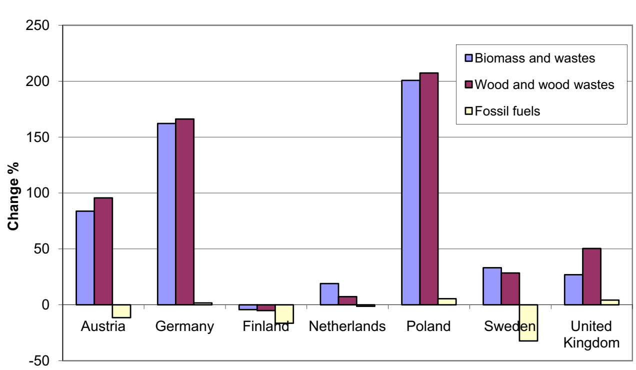

Fig. 3 – Total percent change in gross electricity production from biomass and wastes, wood and wood wastes and fossil fuels between 2004 and 2007. Fossil fuels include coal, oil and natural gas fired power plants [9].

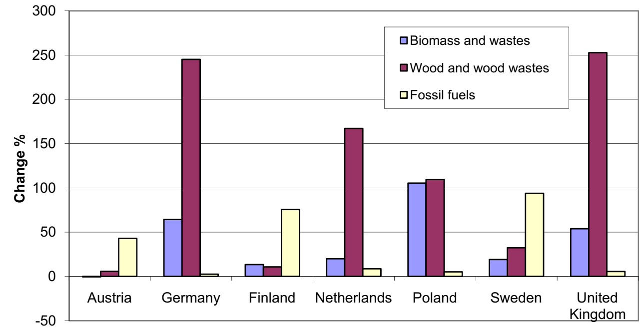

Fig. 4 – Total percent change in gross electricity production from biomass and wastes, wood and wood wastes and fossil fuels between 2000 and 2003. Fossil fuels include coal, oil and natural gas fired power plants [9].

political measures affecting the EU bioenergy market development in the near future will be fiscal and subsidy policies, common legislative obligations and the EU ETS.

Perhaps the clearest impact of the ETS has been on the use of peat that is treated like fossil fuels in the scheme; out of the seven NoE countries its use concerns only Finland and Sweden. Before the ETS, i.e. between 2000 and 2003, peat consumption grew by 70% in Finland and by 49% in Sweden. The ETS appears to have affected the high growth in both countries; however such effects are not the same. In Finland where peat use is far more prevalent than in Sweden (Fig. 5), peat consumption still grew between 2004 and 2007 (15%), despite peat use becoming more expensive because of the ETS. Finland partially compensated for the ETS by suspending its energy tax for peat in 2005 [12]. In addition, the Finnish feed-in tariff for peat has enabled its use since May 2007, and may have contributed to the positive trend. Thus, the introduction of this new support instrument can be considered as a 'balancing measure'. In Sweden, both biofuels and peat are eligible for electricity certificates, receiving the same level of support. However, the introduction of the ETS reduced the competitiveness of peat compared to biofuels in CHP production and the certificate scheme has not been strong enough to offset the disadvantage [12] (confirmed by the informants [49–51]). Consequently, peat use decreased 30% in Sweden between 2004 and 2007. To balance the effect of the ETS, Sweden has also planned a reduction of the CO_2 tax on fuels in industry for district heating and CHP plants in the ETS scheme [52].

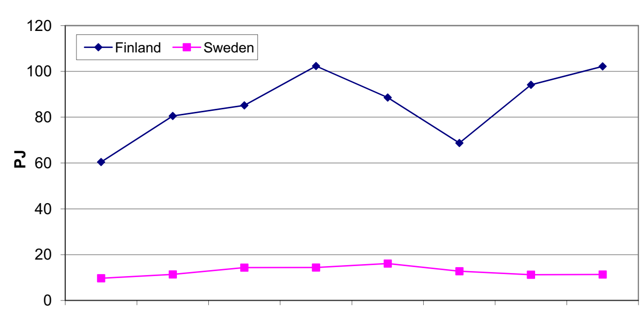

Fig. 5 – Gross inland consumption of peat between 2000 and 2007 in Finland and Sweden [9].

4.1.2. Expert views

The Finnish forest industry representative [53] considers emissions trading as a powerful steering mechanism as it impacts the industry's fuel choices. Interviews carried out by the Swedish Energy Agency [41] confirm the importance of the ETS. Informants from two Swedish energy utilities indicate that the emissions trading and electricity certificate schemes are key instruments for their business. According to these interviews, the earlier CO_2 and fuel tax regime affected decisions on investment in new biofuel-fired boilers, increased peat burning and reduced coal use. Burning peat would have terminated along with the ETS without peat being eligible for electricity certificates. These two companies also plan to increase biogas production and/or combustion in the long term as a result of the ETS [41].

As another example of the ETS driving fuel switching, a discussion in the Netherlands between the end of 2008 and the start of 2009 has concerned the support for replacing coal with biomass in coal-fired power plants – considered as the cheapest option to meet renewable energy targets (Dutch energy agency informant [54]). Based on some estimations, at a CO_2 price of 20 Euro t^{-1}, the willingness to pay for easily combustible biomass reaches current market prices for solid biomass fuels [55,56]. Under such conditions, no additional support is needed for co-firing, provided that no additional capital investments are needed. Moreover, the Dutch informants [54,57–60] consider that the support for co-firing should be linked to the CO_2 price as well as to the power price and the price of coal.

4.2. Biomass for energy or materials?

4.2.1. Competition for biomass resources

Informants in both Finland and Sweden indicate that competition between different biomass uses is indeed occurring but, when viewed as a whole, is not (yet) serious. In contrast, the Finnish forest industry informant [53] claims that there is already significant true competition between board industries and the energy sector, confirming to some degree anticipated ETS effects of increased competition for woody biomass raw material along with a CO_2 price increase [43,44]. According to the Swedish forest industry expert [50], the balance is tight in some regions, and in some areas pulp wood is already being sold to the energy sector. Moreover, as Sköldberg and Rydén [61] indicate, competition can increase in the future due to the use of biomass for transport and export of biomass to other European countries. Another factor increasing the future competition in Finland and Sweden may be the export taxes for wood from Russia [51]. In Finland and Sweden biomass is already imported at considerable scale; in 2006 around 15–20% of biomass was imported as raw material for industry (e.g. sawmilling, pulp and paper) and as fuels for heat and electricity production [61].

In the UK, competition has not yet been discussed intensively. However, the UK forest industry informant expresses concerns over the growing competition in the international bioenergy market [62]. He indicates that his sector sees the domestic policy affecting the use of biomass and boosting the competition more than the ETS. Indications of competition at local level have been seen for example in South-West Scotland with a large wood powered electricity plant. The threat of displacement (discussed in [63]) concerns not only panels industry but also the saw and timber industries [62]. A report forecasting the future of wood fibre in the UK indicates that there is already a very fine balance between wood fibre demand and supply, and that this situation is likely to become unbalanced in the relatively short-term as new large users of wood fibre enter the market. National incentives, such as the Renewables Obligation and the planned Renewable Heat Incentive scheme are considered to be a major factor in determining the future scale of future wood fibre use [64]. Such views support the position of the UK informant [62].

In addition to the higher carbon price within the revised ETS (post 2012), the ambitious targets required by the RES-Directive may increase the competition for wood. Forest product industries perceive this as a direct threat, emphasised particularly by the Finnish forest industry representative [53]. International bioenergy trade is growing rapidly, driven to a significant extent by a combination of large resource potentials and low production costs in certain countries and high demand for biomass in other countries. This increased demand is in many cases driven by considerable policy incentives in user-countries [65]. A forest industry report [63] highlights the potential for displacement of woody material presently used by the wood panels industry when the incentivised market for woodchips as a fuel grows – in their eyes, this is in essence presented as a 'market distortion'. Competition for the available bioenergy feedstocks is seen as likely to increase in the UK, which in turn will likely drive up market prices for biomass fuels [36].

There are various opinions of the impact on the European pulp and paper sector. The threats include higher energy and fibre raw material prices if it is not exempted from the future auctioning of CO_2 emission allowances [66]; the ETS is also expected to reduce its competitiveness [48]. Industry is also held to suffer from the current adverse economic situation, other structural threats – such as growth in production capacity of pulp in countries such as Brazil, and rising electricity prices due to the ETS. This situation however, does not affect non-European competitors, and pressure on the industry is exacerbated by the increase in wood prices [67]. Nevertheless, it can also be argued that a decrease in pulp and paper production can in turn reduce the amount of bioelectricity produced (concomitantly this should also reduce electricity demand); the issue would need to be investigated further. In turn, Helynen et al. [68] consider it improbable that the Finnish forest industry raw material would significantly be shifted to energy use, or that raw material prices would considerably rise due to the increased energy use of wood. On a positive account, climate policies can be regarded as drivers transforming the role of forest industry to develop new business opportunities through the production of biomaterials and liquid biofuels, which can compensate the loss in competitiveness [67].

4.2.2. Balancing the use of wood for energy and materials

A lively debate, especially in Finland, has addressed the diversion of good quality wood and wood fibre into the energy sector rather than utilising its inherent physical properties in paper, structural materials, and the like. Currently, this is driven by energy sector's relatively higher ability to pay, which is in turn supported by higher emission allowance prices and policy support. Vested forestry interests such as the Finnish Forest Association [69] put forward arguments about the need to utilise wood for energy only at the end of the paper recycling process, instead of using the wood directly for energy. Some actors also argue that the ETS in its current form does not add value to wood outside the energy use. Hassi (in [70]), for example, is of the opinion that to fully recognise a tree's value, emissions trading should be applied to all wood use, including construction. Such use can also contribute to climate gas reductions via the displacement of energy or carbon intensive materials such as steel and concrete. The UK forest industry representative [62] claims that businesses and jobs can be lost if energy use of wood overrides the material use. The ability of harvested wood products to store carbon and mitigate GHG emissions has been highlighted by both the UNECE and FAO [71].

Furthermore, the forest sector claims that the use of round wood in their industry creates considerably more welfare and employment than energy production from wood – a view supported also by Jokinen [72]. According to the Finnish forest industry informant [53], pulpwood is already being used for energy production for countries such as Austria, Czech Republic and the UK at least in part due to the EU ETS and national support mechanisms. This counters the views of the UK and Swedish informants [50,62], which point to the strength of domestic policy and RES-Directive targets in steering biomass utilisation.

4.3. *Effects upon prices*

Prior to the ETS, an increased demand for wood fuels along with a rise in wood prices was found to be linked in Finland and Sweden [61]. The increased use of biomass for energy competing directly with the raw material of wood product industry is projected to lead to a general increase in timber prices. The intricate relationship of wood demand relates to the tight linkage between the forest industry and energy sector in Finland and Sweden. In fact, the energy sector can now be seen as a part of the forestry industry complex, connected by the same material flows [73].

In their examination of competition for biomass, Sköldberg and Rydén [61] indicate that prices and willingness to pay in different sectors are of greater importance than national physical quantities of available biomass. However, Olsson et al. [73] point that there remains insufficient knowledge of how the wood energy markets actually function, and that such knowledge gaps are particularly acute in the area enfolding the development of wood prices and the price formation. Not least due to this dearth of information, this study has not addressed biomass price development in any detail.

Nevertheless, this analysis does indicate that there is prima facie evidence of increased biomass prices that are linked to the ETS implementation. This is supported by the claim of the Finnish forest industry representative [53] that the ETS is putting an upward pressure on wood prices. According to the forest industry representative in Sweden [50], prices of pulp wood and forest residuals continue to approach one another – another indication of price based upon energy content rather than material functionality. The Swedish refined wood fuel prices rose 41% between 2004 and mid-2008, whereas the price of industrial by-products grew 27% in the same period [74]. This analysis cannot however determine causality in this instance as there are various other reasons for the price development that are worthy of further examination if clarity is to be achieved. For instance, the period of 2006–2008 was particularly volatile with the resources boom followed by the global financial crisis.

A Finnish governmental energy expert points out that when the price of wood rises, the wood supply concomitantly increases [75]. Thus, the availability problem considered by the forest industry is primarily a wood price related problem. This supports the views of Sköldberg and Rydén [61]. The same expert [75] argues that increased competition for forest resources might start to pose a threat to wood availability when CO_2 allowances are above 30 Euro t^{-1} due to the usage of mainly domestic wood. The power plants are however not yet in the wood material niche of the forest industry at current emission allowance prices; over the past two years (2009–2010), the EU ETS carbon price has fluctuated between 9 Euro t^{-1} (February 2009) and 17 Euro t^{-1} (April 2010) [76,77].

4.4. *Linking effects to policy instruments*

It is not straightforward to attribute these effects to the ETS or indeed to any other individual support instrument. Rather, it appears probable that such effects are the overall outcome of the mix of instruments (a view shared by a Finnish [78] and two Swedish informants [50,79]). As this study did not look into CO_2 emission reduction – the main objective of the ETS – all impacts discussed are unintended consequences of the policy. This applies also to bioenergy instruments apart from fuel change. As shown, many of the impacts have been anticipated at least to some extent, but better understanding is still needed in order to maximise the synergies and minimise conflicts.

The findings of this study are supported by the argument that strong market growth has always been achieved by the combination of policies, rather than single policy instruments [80]. The study does provide evidence that it also applies to bioenergy development, which is typically reliant upon the synergistic effects of several success factors; policy instrument performance cannot be separated from the social, industrial and political environment in which these mechanisms are applied [81].

Differences in the effects are linked to differing national policy mixes and energy-carrier portfolios. Especially for Finland and Sweden, important explanatory factors include forest industry's position, energy production structure and bioenergy support measures. Perhaps more importantly, while energy agencies and research institutes may have a more objective viewpoint, forest industries' views are influenced by their own interests and belief that they are vitally important for the society; their arguments of an 'unlevel playing field' must at least be subject to serious investigation. Another factor is the forest ownership structure. In Finland, state-owned forest constitutes some 15%, whereas in Sweden the State owns 25% and the forest resources are larger overall [53]. Thus, in Sweden there are, in principle, more biomass resources available and competition for biomass resources may be less visible.

According to Lund [82], the effects of the policy measures may well appear after the ending of support schemes; as such, the impact of the ETS might not yet be clearly seen. It is expected that the ETS effects will become more visible in the second trading period. The first phase of the scheme – considered a trial period that provided experience for the second period [83] – experienced a number of shortcomings, not least an over-allocation of emission allowances and price uncertainty due to the lack of market transparency. In this vein, a Finnish regional study indicated that employment effects are expected to be stronger after 2010 when ETS effects strengthen [46]. Based on the statements of the Swedish [50] and the UK interviewees [62] – describing shortage of wood locally due to the competing uses of biomass – policy effects may be more accentuated at regional level.

5. Conclusions

This study confirms the importance of examination of the interactions between policy instruments. Such knowledge is imperative to recognise – and manage – synergies and conflicts. Despite difficulties in separating ETS effects when assessing outcomes, both the literature and views obtained from specialists in the field appear to lend weight to views that the EU ETS is amplifying existing policies, and has had a large enough effect in some cases to require 'balancing measures'. These both indicate that it is having a tangible effect on biomass utilisation. More research on regional and local levels would be needed to clarify the lower level impacts, as biomass is used for products that can be subjected to both local and international competition.

To advance coordination and coherence in bioenergy policy frameworks, the design and application of policies should ideally take account of such interactions and measures should be adjusted accordingly. One general approach that shows merit is to clarify objectives of policy instruments and make them consistent. Further, it appears to be useful to link CO_2 reduction and its costs to the performance of policy instruments. This study supports views that more coherent and integrated biomass strategies will assist in finding the most efficient or desirable uses of biomass resources.

In closing, we believe that that there is significant room for improvement in the areas addressed by this analysis, but question the premise that an 'optimal mix' of instruments will ever be achievable. Various support instruments together form a complex network of interactions with dynamic and uncertain outcomes, many of which may never have been envisaged prior to implementation. This said, the development of more synergistic instrument mixes and improved coordination have a great potential to be beneficial for biomass-related policy fields.

Disclaimer

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