

Climate politics and forestry

On the multi-level governance of Swedish forests

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- Wilhelm Agrell (2009). *Geopolitics. Competition, conflicts, and wars in the future international system*. External drivers affecting Swedish forests and forestry. Future Forests Working Report
- Gustaf Egnell, Ola Rosvall & Hjalmar Laudon (2009). *Energy as a driver of change*. External drivers affecting Swedish forests and forestry. Future Forests Working Report
- David Ellison, Maria Pettersson & Carina Keskitalo (2009). *Forest governance. International, EU and National-Level Frameworks*. External drivers affecting Swedish forests and forestry. Future Forests Working Report
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- Markko Rummukainen (2009). *Climate change. External drivers affecting Swedish forests and forestry*. Future Forests Working Report.
- Camilla Sandström & Anna Lindkvist (2009). *Competing land use associated with Sweden's forests*. External drivers affecting Swedish forests and forestry. Future Forests Working Report.

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*Future Forests analyzes conflicting demands on forests systems
to enable sustainable strategies under uncertainty and risk*

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1. Introduction: Climate politics in the context of Sweden's forests and forest sector

Forestry and forest-related policy is tremendously diverse and is addressed in a significant number of potentially competing, certainly overlapping issue domains and levels of governance. Generally speaking, the crisscrossing and sometimes colliding policy levels and domains in the politics of climate and forestry at the European Union (EU) and national levels are best categorized into the following three broad dimensions: 1) the progressive though sometimes slow-moving *marketization of the forestry sector* (in particular via the development of the *bioenergy sector* and *carbon offset markets*) and the resulting distributional impacts across new and traditional components of the forestry value chain. 2) Increasing divergence across the market and non- (or *extra-*) market features of the forestry sector, in particular across the bioenergy and wood product domains on the one hand and environmental, biodiversity, ecosystem and social values on the other. And finally 3) the emergence and proliferation of competing actors and interests (in particular due to the emergence of new participants in the forestry value chain), policy domains, levels and even “arenas” of governance. Climate politics is thus an issue with crucial importance for forests and forestry in Sweden.

This paper/chapter has two aims. The first is to ask whether economic and commercial forestry-related interests, sustainability and other competing claims on land use are compatible and capable of finding resolution in a national, EU or even an international level climate and forestry strategy. The second and perhaps more subtle goal is to outline/sketch the points of contact and divergence across the complex array of international, EU, national and even regional level policies and interests. Multi-level (vertical) and multi-sectoral (horizontal) governance is challenged by the emergence of new actors and the proliferation of policy domains (arenas of governance). Successful solutions for the management of Europe's forests and forested areas must consider the full range of actors and interests (local, national, EU level and international). The capacity of multiple levels of governance to adequately address the increasing number of forestry and more broadly based land use claims—in particular in the context of competing interests with varied ability to access multiple levels—is certainly open to question, raising the potential added value of future scenarios for institutional reform.

This paper makes several important claims. The *first* and potentially most important is that the climate debate has fully captured the scene regarding discussions of the future potential for forests, forestry, forest-related industries and related policy goals. The marketizing impact of the climate debate and the mitigation potential of forests and forest-related industries, evidenced most significantly in the emergence of new participants in the forestry value chain, has already significantly impacted the behavior of market players, states and the policy arena. There is however little consensus and much debate even among new participants in the forestry value chain regarding competing strategies and policy tools for the best use of forest resources. In particular, competing strategies of carbon sequestration and fossil-fuel substitution are not always fully compatible or successfully incorporated into adequate policy instruments.

The *second* major claim is that non-market interests for the use of forest resources are clearly at a disadvantage with respect to the increased marketization of forestry and forest-related industries. This has led to the quite remarkable situation that the *European Environment Agency* (EEA) and others, for example, are calling for the introduction of pay-as-you-go type systems for ecosystem services.

The *third* major claim is that current governance structures at the EU, national (and perhaps also the international) level cannot adequately reconcile or coordinate these competing interests. In

fact, at the EU level in particular, but also at the national level in many EU Member states, market and non-market interests compete both for attention and resources in the policy arena. Yet the structure of the political decision-making arena is such that many of these players have little opportunity either to meet, discuss or reconcile their demands. The result is that market and in particular climate-related demands take precedence over a variety of non-market environmental and biodiversity interests. Both current discussions and the existing decision-making structure suggest this situation is likely to persist.

All three of these claims must also clearly be seen as functions of and over time. In important ways we are really only at the initial stages of these debates. As global warming and climate change progress, the relative urgency of mitigation and adaptation will increase and its relative impact on the three pressure points just outlined above will increase. Thus while the competition effects, for example, over forestry resources are only just beginning to be felt, we can expect these to increase quite dramatically over time.

This paper is organized as follows. The first section addresses the relationship between forestry, forest-based industries and the carbon balance. The second section addresses the impact of the changing demands for forestry and land use resulting from the emergence of interest in the mitigation and adaptation potential of forests, forest-based industries and rising demand for the introduction of carbon pricing on forests and even forest-based industries. The third section focuses on the increasing gap between the market and non-market based features of the forestry sector and discusses the potential for the emergence of continued market failures. The fourth section discusses the emergence and proliferation of competing actors and interests and their impact on institutional decision-making structures and policy output. The paper is primarily based on a literature review of published sources as well as EU-level regulation.

2. Looking back: Forest governance in the context of Sweden's forests and forest sector

The Carbon Story

The struggle over the world's forests is long underway. Global warming and climate change have re-written the script for forestry and land use in ways we are only just beginning to sort out. Though debate over the future of the Earth's tropical forests—such as the Amazon—has been more vocal, the future of Europe's forests likewise hangs in the balance. For one, the International Union of Forest Research Organizations (IUFRO) argues Boreal forests are not only the most vulnerable to temperature changes, but temperature changes themselves will be greater in the northern hemisphere than elsewhere. For another, from demands for climate mitigation and adaptation, to the emerging bioenergy/biomass/ biofuels revolution, biodiversity goals, rising water scarcity and diminishing water quality—indeed from almost as many directions as one can imagine—Europe's forests are progressively under siege. Choosing the right balance between forest, biodiversity and ecosystem protection on the one hand, and forest and land use rights on the other—in particular with respect to forest-related climate mitigation and adaptation—is at once an international, an EU-level, a national- and a local-level problem.

Forests, plants and soils sequester approximately twice as much carbon as currently present in the Earth's atmosphere (EEA, 2009: 31). Current rates of deforestation—in particular in the developing world—account for some 20% of the world's greenhouse gas (GHG) emissions.¹ For the time-being at least, IUFRO (2009) estimates the net carbon absorbing function of the world's forests remains positive, sequestering some 25% of the world's GHG emissions. Though forests globally absorb more carbon than they release, this function is threatened by both precipitous rates of deforestation and by globally rising temperatures. The policy brief attached to the 2009 IUFRO report argues that a rise of 2.5°C above pre-industrial temperatures could result in the complete loss of this carbon-regulating function.² Jones et al (2009) find that there is a significant risk of forest cover decline in the Amazon region with temperatures above 2°C. Van Mantgem et al (2009) find that even current increases in temperature are leading to important forest die-off in the US and presumably elsewhere, a finding that provides disturbingly grim support for the 2.5°C threshold.³

Decisions about forestry and land use thus have a significant impact on the world's future carbon balance. Forests and forest soils are potential sources of additional carbon sequestration in Europe. Saikku, Rautiainen and Kauppi (2008) for example note that the planting of forests in the EU27 between 1990 and 2005 led to the absorption of an additional 11% of continental CO₂ emissions. Rhemtulla et al (2009) likewise argue that afforestation represents a significant and underutilized potential for sequestering carbon. On the other hand, converting forest, woodland or grasslands to arable land—whether for additional agricultural crops or the rapidly growing biofuel industry—leads to both the release of sequestered carbon and the loss of carbon sinks. These losses and the rising atmospheric carbon concentration are not easily compensated by the added value arising from additional agricultural output or even by the production of new biofuel resources (EEA, 2009; Houghton and Goodale, 2004).

¹ See e.g. Louman et al (2009: 19).

² IUFRO *Policy Brief* (2009: 14).

³ Putting this into some perspective, a recent projection by Sokolov et al (2009) suggested we could reach temperatures of 5.2°C by 2100 under a business as usual scenario. Though this recent estimate is twice as high as an estimate from 2003, Hansen (2008a) has also recently suggested similar prospects. The concept of how susceptible forests are however to temperature changes and thus potential early dieback scenarios is more controversial.

At the international level the principal struggle—at least concerning forestry and forest-related industries—is being fought over strategies to limit deforestation and formulate definitions of appropriate use. Principal among these strategies is whether a significant forest-based component will be included in the second generation version of the Kyoto Protocol covering the period from 2013 to 2020. Multiple variants of a forest-based component are of course possible. One would be to introduce forest-based carbon sinks into the emission trading scheme. Another would be to strengthen the potential role of forest-based carbon sinks in the clean development mechanism (CDM). A third option is to finalize the inclusion of harvested-wood products in United Nations Framework Convention on Climate Change (UNFCCC) accounting practices. This debate extends to an interest in the protection of the socio-economic livelihoods of individuals (frequently indigenous peoples) dependent on the earth's forests. Though introducing a carbon price on forest carbon sinks in order to create stronger incentives for the preservation and maintenance of the world's forest resources—let alone to accelerate current rates of re- and afforestation—may seem a compelling strategy,⁴ it remains deeply controversial.

Resistance to the inclusion of forest-based sequestration in emission trading schemes comes from many corners. Though deeply divided among themselves, some non-governmental organizations (NGO's) such as the WWF, Greenpeace and CAN-Europe fear the impact the inclusion of forests could have on the price of cap-and-trade carbon allowances and the disincentives this might provide to industry and the power sector to focus on reducing emissions.⁵ Countries in the advanced world express concerns about the problems of *permanence*, *monitoring* forest carbon sinks and *leakage* (i.e. insuring that forests maintained for the purposes of absorbing (more) carbon are not compromised by more rapid deforestation elsewhere).

While the UNFCCC Convention allows the inclusion of carbon removals from land use, land use change and forestry (LULUCF) in net carbon accounting, such removals are not permitted to enter into cap-and-trade type accounting in the EU. However, through the CDM, Annex I countries can invest in carbon sinks in non-Annex I countries on a very limited basis⁶ and use these investments to reduce their domestic obligations. However, due to size restrictions and the time it has taken to approve the CDM mechanism, the *voluntary carbon offset market* has far outpaced the still infant CDM market in forest-based carbon sink development.⁷

At the EU level, the recent conclusion of the European Commission's 2020 Climate Package in December 2008 ultimately failed to make any dramatic steps forward—forest sinks are still not included in the EU's Emission Trading Scheme (ETS) and for the time-being their potential future role remains unspecified. This is partly the result of the timing of EU and international level negotiations. The EU put considerable effort into completing its climate policy negotiations in December 2008 in an attempt to set a precedent for the potential completion of international negotiations in Copenhagen in December 2009. However, there is considerable resistance from within the EU toward any potential “weakening” of the EU ETS. At best, the current EU-level agreement allows for more flexibility in trading non-ETS sector emissions and LULUCF removals across EU Member state borders. It remains to be seen how much the EU level strategy could

⁴ One of the more provocative points raised in this context is the prediction the failure to place a carbon price on standing forests might lead to a very radical global shift from forestry to bio-crop production (see Wise et al, 2009).

⁵ See for example the WWF's July 2008 position statement [Freezing Climate Change](#). KEA3 produced a report for Greenpeace on [REDD and the effort to limit global warming to 2°C](#) (March 2009). See also CAN Europe's briefing paper [No Sinks in the EU ETS](#) (March 2006). On the other hand, other organizations like *ClimateFocus* or *IETA* strongly favor and promote the inclusion of forest carbon sinks in emission trading mechanisms.

⁶ Under the terms of the Kyoto Protocol, CDM projects in forestry cannot exceed 8 kilotonnes of CO₂e (see the LULUCF stipulations under the CDM: http://unfccc.int/methods_and_science/lulucf/items/4137.php).

⁷ Bull estimates that the total value of the carbon offset market grew to 60 billion USD in 2008 and reach 1 trillion USD by the year 2020 (see: “[Global Carbon Markets](#)”, 2008). Other estimates from 2008 put the total world value of the carbon offset market at approximately 64 billion USD with the majority share dominated by Europe (see: “[Can Carbon Credits Slow Global Warming?](#)” *FastCompany.com*, June 23rd, 2008).

potentially be modified either by international negotiations, or—failing an international agreement—by later EU level negotiations.⁸

There are many reasons why a European (and certainly an international strategy) for including forest-based carbon sinks in emission trading schemes would be a good idea. Perhaps the *strongest (first) argument* is the following: while some individual states—in particular those that have a large amount of forest-industry based trade and commerce—may have strong incentives to maintain the sustainability of forestry and land use, others may not. Agricultural interests, in particular, have historically been a powerful force in the destruction of the world’s forests. The European level of governance offers an alternative means to address issues by providing a framework for internalizing the costs of deforestation that might otherwise give rise to market failures. Countries without strong forest-based industries are potentially less interest-driven to maintain sustainability policies. In this sense, sustainability is a public good that European and other political institutions can potentially create and provide. Many countries may be subject to market failures based on factors like low public interest (low levels of affluence, weak civil society, etc.) and the lack of an interest-driven political base (e.g. a strong forest-based industry). Thus the European level of governance may be able to help some states overcome such barriers.

A *second argument* in favor of the inclusion of forestry (as well as other sectors such as commercial/industrial, public sector and residential buildings or the transport sector) in emission trading schemes at the EU and international levels is tied to the general concept of the cost-efficiency of emission reduction mechanisms.⁹ Though the EU expresses broad commitment to pursuing the most cost-efficient strategies for promoting emission reductions, the exclusion of a wide range of sectors with significant potential contributions to the overall socio-economic carbon mix imposes a significantly suboptimal solution.¹⁰ Anger and Sathaye (2008), in particular, argue the inclusion of “avoided deforestation” in emission trading schemes would provide a more effective and cost-efficient mechanism for reducing emissions and transferring resources to the developing world than the current CDM provides.

A *third argument* favoring European level policy concerns current conflict over the value of a *rising forest increment*. While a high degree of forest-based commerce and trade may theoretically favor the long-term sustainability of forestry and forest-based industries, this will not necessarily lead to rising forest increment. In fact, if anything, an active forest-based commercial and trade sector may well impose significant pressure on demands for rising forest increment, since this simultaneously means being able to exploit a smaller share of forest resources (at least in the near term).

A *fourth argument* in favor of EU-level (and even national-level) action supporting forest-based carbon sequestration concerns competition effects between the value-added forestry chain on the one hand and forest-based climate mitigation and biodiversity goals on the other. Standing forests, as such, do not have any explicit value and certainly not one that can easily be represented in monetary terms. Though society may “value” forests and insist upon their protection, this likewise is not as powerful a mechanism for preserving forests as assigning a monetary value to forest permanence. The difficulty of doing this ultimately describes the potential for a “market failure”,

⁸ The EU agreement concluded in 2008 requires the European Commission to re-visit the question of including LULUCF in some type of EU-level emission trading framework after the international negotiations in Copenhagen (December 2009) have been completed.

⁹ See in particular Ellison and Hutyecz (2008).

¹⁰ The McKinsey/Vatenfall series of reports are perhaps most well known for arguing that the current EU strategy fails to focus on carbon mitigation strategies with *negative* costs—i.e. investments which bring almost immediate or very rapid *positive* economic returns—in particular those related to the advantages of increased energy efficiency. See for example: [The Carbon Productivity Challenge: Curbing Climate Change and Sustaining Economic Growth](#) (McKinsey, June 2008). However, even the McKinsey/Vatenfall reports potentially under-estimate and thus undervalue the carbon sink and mitigation potential of forests.

since “markets” for the most part do not “value” forests in the same way that individuals or society might. Placing a more precise “value” on forest permanence by monetizing standing forests places them on more even footing with the rest of the value-added forestry chain and potentially strengthens the role of carbon sinks vis-à-vis other forestry uses.

Further arguments concern the following: 1) the notion of capture and the ability of countries to use the European route to avoid problems of capture from domestic industry, and 2) the notion that the introduction of pricing mechanisms for standing forests ultimately require as international a setting as possible (EU or better) in order to avoid/reduce free-riding, leakage and uneven competitive advantages. Without this, higher prices in Europe mean less competitive industries in the international setting. The alternative, e.g. tariff regimes on wood and carbon intensive products (steel, paper, etc.), is far less palatable though under frequent discussion in the World Trade Organization (WTO) framework.

However, placing a price on the carbon sequestration potential of forests at the EU level may represent a potential threat to forestry and forest management in Sweden and other countries—in particular those that are rich in forest-based resources. As Aulisi (2008) outlines, when thinking about forestry, one has to consider all elements of the forestry *value chain*: from carbon sequestration to biomass power generation, cellulosic ethanol and the more traditional elements of the forestry value chain, paper and timber. The decision to place a carbon price on the sequestration potential of forests may mean that *other* elements of the value chain are potentially placed at a disadvantage over re/afforestation. Though forest *permanence* is presently not under threat—at least in the EU—the sustainability of forest use is coming under significant new pressures, in particular as demand for biomass and cellulosic raw material rises. These competing market forces will challenge and strain existing forestry models in the coming decades.

Though the global debate has taught us to think that the harvesting of trees is equivalent to the progressive devastation of the world’s forests (and thus carbon sinks), in the European context where forests are—for the most part—sustainably managed,¹¹ the opposite tends to be true. Forest-based resources frequently do not release additional carbon into the atmosphere and can often substitute for far more carbon-intensive processes. However, the impact of wood-based resources on the atmospheric carbon balance varies tremendously with respect to use. As biomass in heating and power plants, wood-based resources are at least neutral in their impact on the environment (they only release what they have absorbed) and likewise have an important replacement effect (substituting for coal, oil or natural gas use). However, the potential benefits of wood resources extend well beyond this. When used in construction, for example, they not only continue to retain sequestered carbon (carbon is not released unless the respective buildings are later demolished and the wood is not re-used), their substitution effect (by replacing carbon-intensive building materials such as steel and concrete) is again considerable.¹²

The new climate-related demands placed on forests and forest-related industries give rise to a significant debate over how forest resources should best be put to use. The two main thrusts of this debate and of current policy efforts concern: 1) the degree to which forests and forest-related industries can successfully sequester carbon or 2) forest-based resources can substitute for fossil fuel use. By no means mutually exclusive, these competing goals can be graphically represented by plotting points along two axes. Thus, on a scale from fossil fuel use to fossil fuel substitution (*y-axis*), power generated by coal or natural gas represents high fossil fuel use while wind or solar power represent a high potential for fossil fuel substitution (somewhat higher in the case of wind power due to cost-related factors). The placement of biomass power and heat generation on this

¹¹ One could easily quarrel here about the definition of “sustainability”. While European forests have exhibited a rising annual forest increment over an extended period (there are more trees and greater forest cover now than 10-20 years ago), the relative biodiversity of forests suggests potentially less sustainable practices (see discussion below).

¹² See e.g. Sathre and Gustavsson (2009) and Gustavsson, Pingoud and Sathre (2006).

axis is more complicated. Due to the release of sequestered CO₂, biomass resources are arguably less beneficial in substituting fossil fuels than a broad range of other renewable resources (in particular geothermal, wind, solar, hydro and tidal solutions). Wood-based construction materials, on the other hand, give rise to significantly fewer emissions and their substitution effects are not easily challenged by other competing construction materials.

On the other hand, the ability of different kinds of harvested wood products (HWP) and forests to sequester carbon can be represented along a range from carbon emissions to carbon sequestration (*x-axis*). Thus for example afforestation policies can potentially result in significant rates of carbon sequestration, while the burning of fossil fuels of course results in carbon emissions. Harvested wood products—depending on how they are used—likewise sequester significant amounts of carbon. Whether the sequestration potential of HWP should be rated higher than that of afforestation is potentially controversial. However, one can potentially argue that the cumulative effects of sequestering carbon through HWP are potentially much greater than by afforestation alone.

The graphical illustration below makes a number of important basic assumptions. First, it assumes all biomass materials are harvested from sustainably managed forests. Under the assumption of illegal logging and unsustainable forest management, the placement of biomass for power, for example, would have to be represented as a form of fossil fuel *use* rather than *substitution*. Likewise, paper or harvested wood products would similarly result in lower levels of fossil fuel substitution and carbon sequestration. Second, only *change* in the carbon balance is included in the graph, thus for example pre-existing carbon sequestration is assumed away (not plotted on the graph) while afforestation appears on the graph.

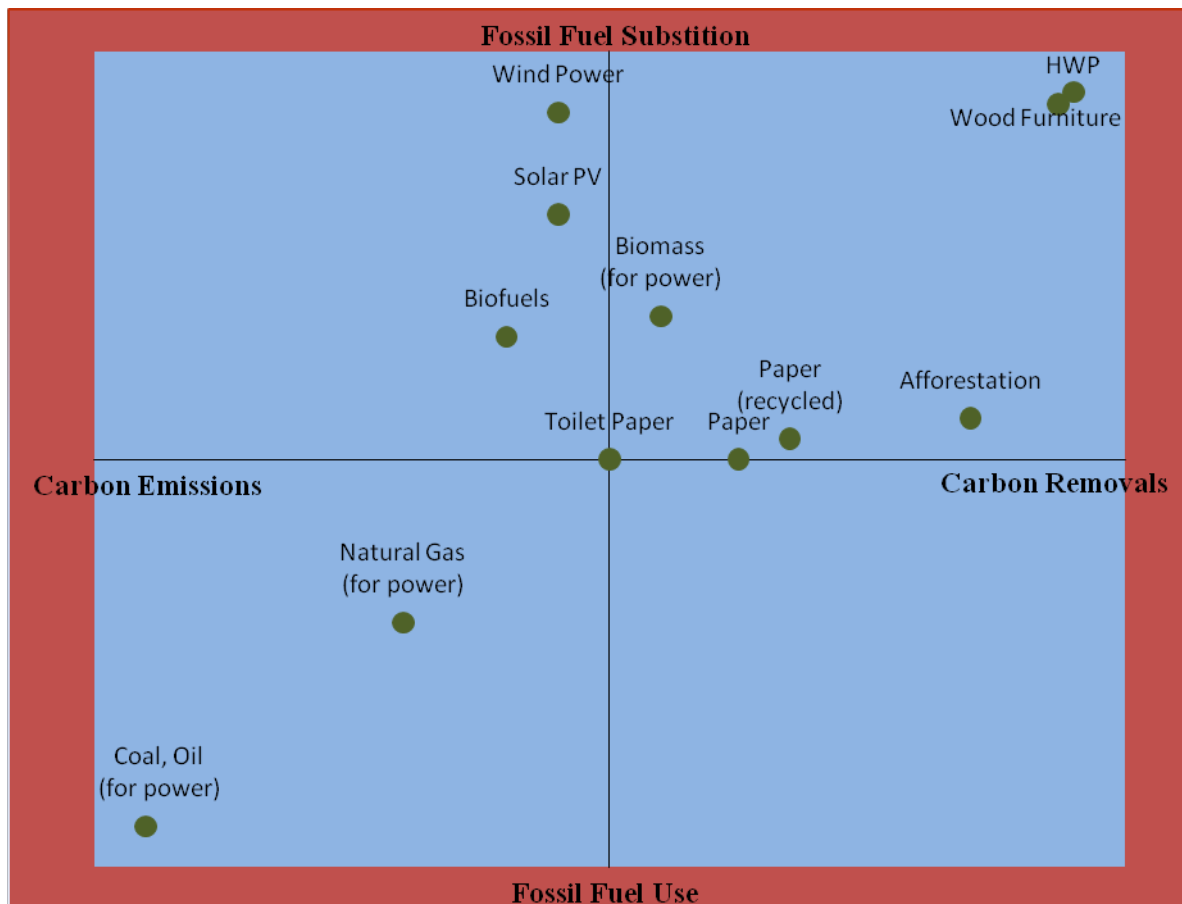
The illustration below highlights the difficulty of choosing a model that accurately and adequately values mitigation potentials and thus meaningfully values carbon sequestration and fossil fuel substitution through forestry and the exploitation of forest-based resources. Based on this illustration, one can meaningfully question, for example, whether EU strategies appropriately value different elements of forest-material based carbon cycles. The European Commission's *Renewable Energy Roadmap*, for example, envisions a large and significant role for biomass material in heating and power production.¹³ In this sense, the EU's Renewable Energy Directive places far more importance on the use of forestry products for biomass-based energy generation and also biofuels than it does for example on the potential replacement effects of wood-based construction materials.

Though currently much discussion surrounds the potential inclusion of forest-based carbon sequestration in emission trading schemes—whether at the EU or international level—this would not necessarily help shift wood consumption to greater levels of afforestation or HWP. For one, the Kyoto mechanism currently has no model to adequately measure and account for the carbon sequestration effects HWP—such as wood-based construction materials or furniture. Though models that incorporate and favor the sequestration potential of wood-based construction materials over steel and cement are under development,¹⁴ their ultimate inclusion—like the potential success of a post-Kyoto arrangement—remain far from certain. Moreover, without complementary EU or national level strategies that coordinate the accounting mechanism with pricing strategies for

¹³ See European Commission (2007: 11), as well as the earlier publication of the European Commission's *Biomass Action Plan* (2005).

¹⁴ The 2006 IPCC [Guidelines for National Greenhouse Gas Inventories](#) provides possible future mechanisms for countries to report the use of harvested wood products (HWP) in their National Inventories. For a discussion of these IPCC mechanisms, see Bache-Andreassen (2009) and Hashimoto (2008). Though these are not currently included in current National Inventory UNFCCC reporting, they could become part of a future post 2012 regime.

wood-based and more carbon intensive products, no “carbon price” would effectively be introduced.¹⁵



Current models clearly tend to favor the principal elements of the *new* forestry value chain over the old. Similar problems arise with strategies being proposed to promote afforestation. In the European context, afforestation is currently promoted with a range of EU and national level programs that fund either the afforestation of non-wooded areas, or the reforestation of former agricultural lands. Such policies typically add to the available supply. Attempts to introduce a carbon price on standing forests by including forestry in EU and international level emission trading schemes, by promoting the use of CDM markets, or by otherwise promoting forestry-based carbon offset markets could potentially have the negative side-effect of raising timber prices (by effectively reducing available supply). This could negatively affect much—though not all—of the forest-related industries (in particular the pulp/paper and wood product industries) and thereby potentially reduce the substitution advantage currently enjoyed by the bioenergy sector.

Given variation in the natural resource base of countries—in particular with respect to forest cover and the related importance of the timber industry—we might also expect states to exhibit preferences that favor different and potentially competing policy strategies. Thus, for example, afforestation strategies may be of more interest in countries where there is considerably less forest cover and where the potential area available for afforestation, as well as the potential to raise the

¹⁵ National-level subsidy and taxation systems can likewise easily subvert or disrupt more *appropriate* “carbon pricing” strategies. See for example Sathre and Gustavsson (2009) on the case of Sweden.

size and share of carbon removals, is greater.¹⁶ Moreover, there may be additional benefits to afforestation (such as increased water purity, potentially increased water supply as well as greater potential to reduce flooding) creating additional incentives to pursue such strategies. For individual states and actors the choice of strategy—whether and how to pursue afforestation and how intensively it should be supported—is no neutral matter. Moreover, where forest-based industries represent a very small share of economic activity, there may be only very weak support for a strategy promoting HWP or a change of international accounting practices.

Levels of governance may provide yet another threat to states hoping to pursue more independent strategies. While there are certainly potential benefits to the upward transfer of policy competence (to the EU level or higher), there are also potential pitfalls. While the reduction of GHG's is certainly a global problem and the setting of emission targets is perhaps best accomplished in as international a setting as possible (in order to reduce or eliminate free-riding, leakage and uneven competitive advantages), many of the details of forestry policy are more difficult to coordinate across larger groups of states. Just as the more timber-rich countries with very sizable forest-based industries are likely to favor policies that keep the price of available timber low (and thus not favor the marketization of standing forests), low forest cover countries may strongly favor strategies more likely to rapidly boost the rate of afforestation.

Significantly, the desire to set a carbon price on forests (whether through an ETS system or the promotion of greater carbon offsetting markets), is more strongly directed at the problems of deforestation and illegal logging in the developing world than it is at regulating the problems of forestry and forest-based industries in the European marketplace.

While ideal models for promoting climate mitigation would presumably focus on the promotion of both high levels of carbon sequestration and high levels of fossil fuel substitution, both the division of interests across states as well as the complications of levels of governance may potentially lead to sub-optimal outcomes. The current EU focus on *bioenergy* at the expense of a serious discussion of the role and importance of harvested wood products or even more significant efforts at afforestation, for example, suggests that less than ideal policy choices are being made. Moreover, the fact that current debates are completely dominated by the carbon story likewise suggests that other important issues affecting forestry and forest-related industries may also receive less attention. As suggested this clearly seems to be the case concerning discussions of European biodiversity.

Finally, imperfect information—in particular about the interactions between different climatic and environmental phenomena—creates additional problems for the development and elaboration of relevant policy goals. In the context of relative policy urgency, the development of adequate policies and pricing mechanisms for climate mitigation and adaptation is seriously hampered by the slow pace of scientific research on the global carbon balance and the factors affecting it. Though many current strategies are based on the 2007 findings of the International Panel on Climate Change (IPCC), these have already been eclipsed by more recent findings. In particular the potential role of *tipping effects*¹⁷ such as the melting of the Northern Arctic ice cap or the melting of permafrost (and the release of methane), though not included in the climate modeling estimates and projections of future temperatures, are now widely believed to have potentially significant future “*feedbacks*” on global warming and climate change.

¹⁶ Spain, for example, has made the greatest use in the EU of rural development funding for afforestation, and has been responsible for as much as 50% of the increased afforestation.

¹⁷ Since the publication of the 2007 IPCC report(s), several reports have been published dealing with so-called tipping effects (see e.g. Lenton et al, 2008; Hansen, 2008a,b). However, tipping phenomena were also addressed in one of the accompanying IPCC reports (see the working group I report on [The Physical Science Basis](#), Ch. 10, in particular Box 10.1 on “Abrupt Climate Change”, p775).

The problem of imperfect information is likewise relevant where forests and the appropriate use of forest resources are concerned. In the context of forests, there are several controversial points that raise difficulties for any discussion of their role and importance in the carbon mix and the development of adequate and meaningful public policy. Thus, for example, there is considerable controversy over the balance of the countervailing forces of *albedo* and the *carbon sequestration* effects of forests. Most recent work suggests that forests in the northern *boreal* regions of the Earth's biomes generally have higher albedo effects than in *temperate* and *tropical* biomes.¹⁸ Such studies, however, may fail to adequately comprehend or measure the role of forest ecosystems and their impact in particular on the water balance, water supply and cooling effects arising from forests' ability both to retain water and to promote evapo-transpiration.¹⁹

A further area of debate/study is on the role of aerosols in global warming. Several authors have pointed to the detrimental effects of rising levels of "*black carbon*"²⁰—in particular its impact on melting in the world's Polar Regions and Greenland.²¹ In the context of the current paper, the impact of aerosols is particularly important with respect to the bioenergy revolution and greatly increased biomass use in power plants and heating. It is further important in the context of biofuels and their use in diesel fuels. Rapidly increasing black carbon emissions from rapid growth in bioenergy use is never discussed in the relevant literature.²²

Finally, the relationships between such factors as biodiversity, old growth forests, tree canopy, forest resilience (*adaptive capacity*) and their relationship to the forest carbon budget are also not well understood. As witnessed for example in current debates over clear-cutting vs. constant cover harvesting strategies, or debates over biodiversity versus afforestation, these factors remain undecided in current debate over the viability of current forest management practices, silviculture methodologies, adaptation and forest-based carbon mitigation strategies.

The Impact of the Climate challenge – Mitigation and the Marketization of Forestry

The *marketization of forestry* has been underway even longer than the struggle over the world's forests. Forests have historically been seen more as a *commercial* than a *public* resource and thus have long been *marketized*. Yet the current and rapidly rising degree of marketization far exceeds historical proportions.

Several factors inflict rising market pressures on forestry and forest-related industries. While rising public interest in forests has imposed market pressures—in particular by restricting use and thus

¹⁸ See for example Jackson et al (2008).

¹⁹ Research on the water balance is cutting edge. Zhang et al (2007) argue, for example, that the impact of increased forestation on water supply is negative. However, these authors fail to estimate the impact of forests on groundwater supply. Other authors however attempt to view the forest-water balance in a more holistic fashion, i.e. in their broader ecosystem context. These authors tend to find more support for the view that forests support increased water supply and aid significantly in improving water balance (see for example Schwärzel et al, 2009; Sheil and Murdiyarso, 2009; and IUCN, 2009).

²⁰ See for example Ramanathan and Carmichael (2008), Ramanathan (2007) and Hansen and Nazarenko (2004).

²¹ In this vein, Al Gore recently called for immediate action to reduce melting ice in the Polar Regions. See for example: "[Al Gore calls for prompt action on melting ice](#)" (*Associated Press*, Apr. 29th, 2009).

²² Mercado et al (2009) recently argued that aerosols (sulphates, black carbon, mineral dust, sea salt and biomass burning) have a positive impact on the ability of plants to absorb sunlight, raising the ability of plants and trees to absorb carbon. In their approach, declining aerosol output has resulted in the declining ability of plants and trees to absorb carbon, exacerbating climate cycles. However this article is not attentive to the differential impact of sulphates (which have clearly declined due to the decline in coal-based power generation in Europe) and black carbon (this incidence of which has increased in N. America and Europe due to rising biomass use and increasing diesel fuel use). Moreover, differences in the reflective properties of these aerosols are presumably likewise important.

available supply—the most powerful marketizing force in forestry and forest-related industries is the threat of climate change itself and the resulting emergence of new features of the *forestry value chain*.²³ The *bioenergy revolution* (biomass and biofuels) in particular has quite radically increased market pressures in forestry and forest-related industries by affecting demand conditions in the marketplace. Moreover, as emission trading schemes increasingly come into force in different parts of the world, one should expect market pressures to increase—in some cases dramatically.²⁴

The progressive marketization of forests gives rise to significant distributional struggles. For one, there are deep struggles over which and how different commodities in the *forest value chain*—as well as features lying outside the forest value chain (such as biodiversity, adaptation or the recreational uses of forests)—should be valued. For another, the distributional impact of marketization is not benign—as with any marketizing process that imposes a new(modified) price structure on new(ly emergent) and traditional practices, there are potential winners and losers.

The *marketization of forestry* of course has at least two pathways. First, new *voluntary markets* are created through the intervention of the private market. This is a kind of spontaneous generation phenomenon: market entrepreneurs seek new opportunities based on demand and supply functions in the marketplace and their intersection with new technologies and/or the ingenuity of entrepreneurs. The bioenergy sector, for example, is a prime example of private sector intervention based on new technologies. Voluntary carbon offset markets are an example of spontaneous generation based primarily on the ingenuity of entrepreneurs.²⁵

Second, public policy likewise plays a potentially important role by creating or strengthening incentives where the market is unable to do so. Thus for example the EU's ETS or discussions of a carbon tax represent schemes that attempt to create or strengthen incentives for market behavior. Over time, these schemes should have the effect of reducing the overall carbon intensity of economic activity. How states and market actors line up on the progressive marketization of forestry and what policy options are promoted or chosen at different levels of governance depends heavily on the distribution of natural resources and interests in individual states.

Sweden provides an excellent test case for the way in which timber rich countries with significant forest-based industries are likely to react to the range of potential policy options available for addressing climate mitigation and adaptation. As the most densely forested of EU Member states (only Finland comes in a distant second and France an even more distant third),²⁶ heavily reliant on a wide range of forest-based industries and seeking new and innovative ways to increase forestry use and productivity, forestry and land use issues are destined to play a significant role in Swedish and EU politics for many years to come. Sweden's total area of productive forest is about 23 million ha. Of this some 50% is owned by small, non-industrial, private owners (some 350 000 in total) and 40% by large forest companies including the state.

²³ Glück et al (2009: 193-194) note three principal drivers of change with regard to forests and forest-related industries: changing prices, exchange rates and transport costs. While all of these are all potentially important at different points in time, currently the biggest driving force is climate change itself, the rise of the bioenergy and the potential for forests and forest-related products and industries to aid in mitigation and possibly adaptation.

²⁴ As the EU biomass power industry awaits the requirement of purchasing all emission allowances (to be introduced in 2013), the role of expectations is already inducing significant change in industry behavior and the exploitation of biomass resources, with further change to come, see: "[Old Wood is New Coal as Polluters Embrace Carbon-Eating Trees](#)" (*Bloomberg.com*, June 2nd, 2009). As noted above, Wise et al (2009) project a quite radical shift from forestry to bio-crop production as the long-term impact of demand for bioenergy products under EU-type emission trading schemes without parallel measures to incorporate forestry and land use in the same emission trading framework (see e.g. Wise et al, 2009).

²⁵ See for example: "[Can Carbon Credits Slow Global Warming?](#)" (*FastCompany.com*, June 23rd, 2008).

²⁶ See MCPFE (2007: 5). As a share of total land use cover Finland's forest area ranks first in the EU (at approximately 64.5%). Depending on whether one counts "wooded lands" as forest, Sweden comes in either second or third. Slovenia's share of forested area is slightly higher than Sweden's, but its share of wooded lands is smaller (Eurostat 2007: 18).

The total export value of forestry and forest products makes up about 10% of all exported products from Sweden and about 4% of Sweden's GNP (Swedish Forest Agency, 2008). Pine (39%) and spruce (42%) are the most important species for forestry and the forest industry and production is dominated by paper, cardboard and to some extent biofuels and wood production (Swedish Climate and Vulnerability Investigation, 2007). The share of wood energy in total Swedish energy consumption approaches almost 15% (surpassed only by Finland with 20% and Latvia with 35%). Moreover, most countries have reported significant increases in wood energy use in recent years (MCPFE, 2007: 80, 99).

The Swedish government actively supports research on forest management and actively pursues a program to increase the productivity and biomass/ bioenergy output of Swedish forests.²⁷ With the highest felling rate, the largest volume and even greater total value of marketed round wood in Europe—surpassing the Russian Federation—powerful economic interests stand behind Sweden's promotion of the sustainability of forestry and forest-based industry.²⁸ Over 9% of Swedish exports are from forest-based industries in Sweden and the sector employs approximately 90,000 people.²⁹ Moreover, according to the Ministerial Conference on the Protection of Forests in Europe (MCPFE) an extraordinarily large share of Swedes goes on regular excursions into forested areas—approximately 75% of Swedes visit such areas at least once a week (MCPFE, 2007: 100).

Carbon removals are a potentially significant element in Sweden's domestic-level climate policy strategy. Based on the 2009 Swedish National Inventory Report, over the period 1990-2007, the share of LULUCF removals has varied from a high of 52.2% (2000) and a low of 31.3% (2007) of total GHG emissions. LULUCF removals amounted to a high of 36.2 MtCO₂e (1998) to a low of 20.5 MtCO₂e (2007). At the same time, a 43.4% decline in LULUCF—primarily *forestry-related* removals—should be cause for some concern. A return to the LULUCF sequestration potential of 1998 would mean that—at 2007 total GHG emissions levels (65.4 MtCO₂e)—LULUCF alone could potentially balance 55.4% of Swedish emissions. As illustrated in Figure I below, assuming GHG emissions continue their current downward trend of approximately -0.52% per year, LULUCF could potentially balance 60.2% of emissions by 2023. A more intensive re/afforestation policy and more dramatic reductions in GHG emissions could further improve these numbers.

²⁷ See for example the text of a [speech by Eskil Erlandsson, Swedish Minister for Agriculture](#) on the occasion of a conference on “Adaptation of Forests and Forest Management to Changing Climate”, Umeå (August 27th, 2008).

²⁸ See e.g. the MCPFE report on the Status of Europe's Forests (2007: 33-37).

²⁹ OECD (2008) and Swedish Ministry of Agriculture Fact Sheet, “[A Forest Policy in Line with the Times](#)” (July 2008).

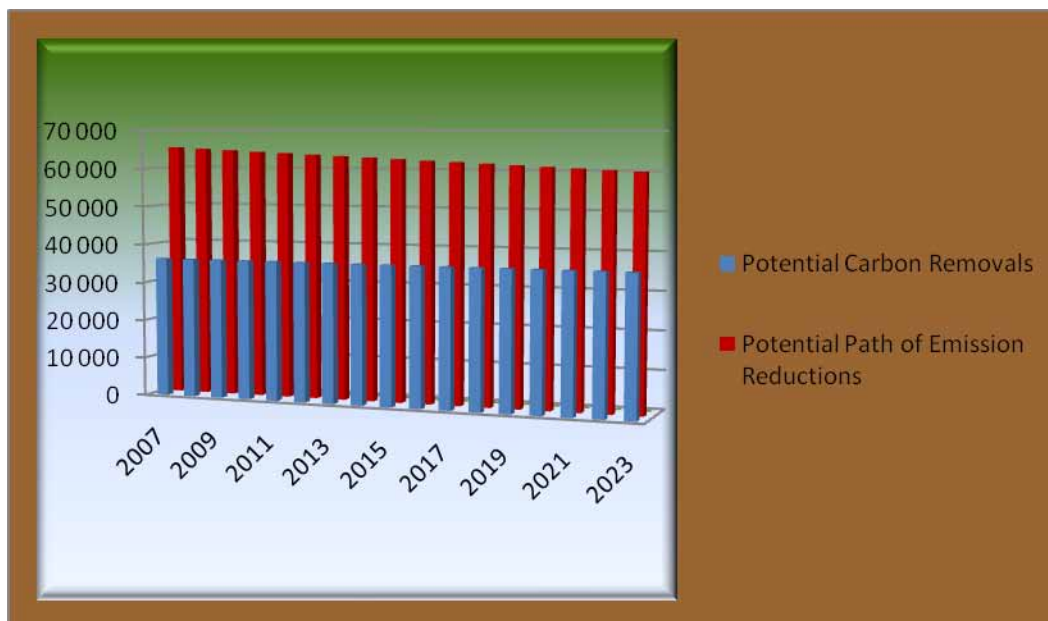


Figure I: Total *Potential* GHG Removals from Forestry in Sweden, 2007-2023

Official projections of the likely future trend, however, suggest the opposite dynamic. Net forestry removals are forecast to decline significantly by 2020. In a report issued by the Swedish Energy Agency and the Swedish Environmental Protection Agency (*The Development of the Swedish Climate Strategy*, 2007), LULUCF removals were forecast to drop by an additional 63.4% (to approximately 7.5 MtCO₂e) by the year 2020.³⁰ The report notes that this projection is based on the anticipation of “increased forest felling” (p.65-6). This report goes on to note that limits are being set such that the forest felling rate in Sweden does not exceed sustainability criteria. However, the transition from 36.2 MtCO₂e LULUCF removals in 1998 to a potential 7.5 MtCO₂e LULUCF removals in 2020 suggests significant tensions exist between the different components of forestry use. Already near the peak of potential forestry use—approximately 86% of its annual increment (MCPFE, 2007: 34), Sweden is feeling the impact of rising demand for forestry-based products.

Current UNFCCC accounting procedures (in turn based on IPCC guidelines) only allow for “*net*” removals, i.e. carbon removals resulting from the additional *forest increment* (additional *growth* minus *fellings*) in any single year.³¹ Thus the forest sink could remain constant in a given country from one year to the next (with no additional increment) and the resulting carbon *removal* would be equal to zero. Yet achieving a steady upward rise in carbon removals through forestry requires

³⁰ Considerable variation persists in estimates of Swedish LULUCF removals. Official reports from at least four different years (2009, 2008, 2007 and 2006) provide substantially different estimates of the LULUCF impact in various years. For example, the 2007 *Development of the Swedish Climate Strategy* report notes 1996 and 2000 as the years with the highest LULUCF removals, while *National Inventory Report 2009* suggests that 1998 and 2000 exhibit the highest LULUCF removals. The *National Inventory Report 2008* suggests that 2005 resulted in positive overall LULUCF emissions (as opposed to removals), while the 2009 inventory report notes this measure was in fact a technical error. Finally, the FAO data for Sweden presented in the 2006 Swedish Environmental Protection Agency report on *The Integration of LULUCF in the EU’s Emission Trading Scheme* again suggests consistent rise in forestry stocks across the period 1990-2005. The FAO numbers, however, are not confirmed by national-level Swedish statistics. The substantial variation in LULUCF data in Sweden and other countries does not augur well for the inclusion of LULUCF in international, or EU ETS and/or non-ETS schemes.

³¹ See for example Petersson (2009: 21-2).

considerable effort—both in terms of increased planting, raising forest productivity or land conversion and in terms of limiting or reducing the felling rate.

Whether some form of carbon pricing of forest and forest-based resources would ultimately be a good strategy in Sweden remains an open question. There are at least two ways of approaching this question. The first is from the perspective of sustainable forest management, the second from the perspective of interests in the forestry and forest-related industries sector. With respect to sustainability, one might ideally expect forest-based industries to have an explicit and intrinsic interest in the sustainable development of the forest industry and thus of forests themselves. If forests disappear, there is of course no resource to exploit and the business will perish along with the forests on which they depend. Sustainability is arguably an inherent interest of forest-based industries—though how “sustainability” is defined may differ substantially across different actors and interests (e.g. biodiversity vs. forest productivity goals).

Given quite rapidly declining carbon removals from forestry in Sweden, the hypothesis that the forestry sector can be entirely self-regulating due to its inherent concern for the sustainability of the industry does not find strong empirical support. This fact raises important questions about the best way to structure future forest management and who should be responsible. Over time, Sweden has exhibited steadily rising forest cover despite the recent decline in the Swedish forest increment. As indicated in Figure II below, available wood supply has been rising gradually since at least the 1920’s. Thus it would of course be premature to argue that Swedish forests are in danger of disappearing. But given the potential advantage to Sweden of including a more consistent accounting of forestry in emission trading measures, it is at best curious that Sweden has not begun adopting policies that push in this direction.

There are, however, a series of arguments that dispute the advantage—at least for Sweden and other timber rich EU countries with significant forest-based industries—of an EU-based or international strategy incorporating forestry into emission trading schemes. For one, such strategies—insofar as these attempt to establish a carbon price for forest-based resources—are likely to run up against opposition from a number of different directions. The Swedish example appears to support this hypothesis.



Figure II: Total Available Wood Supply in Sweden (million cubic meters). Source: Skogsdata 2008 (2008: 18).

On the other hand, a second reason for opposition to introducing a carbon price on forest-based resources is the likely competition that would presumably emerge between different users of that resource. If the value of standing forests—due to their sequestration potential—is raised by the introduction of carbon prices, forest-based industries would then face an additional competitor in

the struggle for access to forest resources. This may not matter so much to forest-based industries that engage in the sale of timber. Higher timber prices (in particular in the context of rising demand for forestry products) may ultimately raise income. However, timber consumers—sawmills, the construction industry and or the pulp and paper industries (also furniture, wood products, the biomass and bioenergy industries)—are harder hit by the changing price structure of forest-based industries and there is already considerable evidence of increasing competition over available wood resources.³²

In important ways, the interests of the timber industry and timber-rich countries around the world are similar to some degree. Though they may exhibit significant variation in the degree of sustainability they pursue, the basic interest in being able to sell and use timber around the world remains broadly similar.

At the more local level, the politics of carbon pricing and emission trading is likely to be all the more problematic where access to sufficient natural resources is already challenged by problems of scarcity. In Sweden, for example, some segments of the forestry industry currently raise flags about the availability of adequate raw material supply (see e.g. Keskitalo, 2008a: 222-3) and a significant share of wood pellets are already imported.³³ Thus the price impact that could result from setting a carbon price on forestry would presumably encourage many in forest-based industries to oppose such measures—in particular in a context where no comparable *world prices* are imposed (via the inclusion of more countries in a renewed international agreement).³⁴

The Swedish Climate Commission report (2008) notes that since Sweden has relatively low GHG emissions but large carbon sinks and a large forest industry, the development of carbon sink regulations will have an especially large role for Sweden. Increased ground fertilization may, while benefitting carbon storage, also have negative impacts on biodiversity or other environmental objectives beyond that of a limited climate impact. Some pilot projects on increasing carbon storage and growth up to 50% through increased thinning and fertilization are currently ongoing. The report notes that changes in forest management to optimize carbon storage may benefit from changes in the forest law and related directives, or by including carbon sinks under the EU carbon trade system (which would in turn require measures to calculate these sinks), and that *potential actions on national level to support carbon storage should be investigated* (Swedish Climate Commission, 2008, my emphasis).

The most recent legislative initiative on Swedish forestry reflects tensions in the forestry industry across various elements of the forestry value chain. The Forest Bill 2007/08:108 (Swedish Ministry of Agriculture, 2007) reports that there is room for increased wood production within the framework provided by present regulation and legislation. The bill notes among other things that long-term sustainable increases in the outtake of wood (declining forest increment), in part through increased forestry investments and improved productivity, is needed to meet increased demand for forest produce including biofuel and to avoid negative impacts on the competitiveness of Swedish

³² The Swedish Forestry Association reports that demand for energy wood has already affected harvesting practices. See; [“Forest Owners Make Profits on Energy Wood”](#) (*Nordic Forest Owners’ Association*, July 28th, 2009). And other industry experts note that there is even competition over how much of harvested treetops should be used for bioenergy vs. how much should be used for sawn timber. Further, according to a FERN report, Finland has decided to promote bioenergy despite objections from forest-based industries that rising demand for biomass material will lead to a rise in prices and increasing competition with other forest products (2008a: 13; 2008b: 7).

³³ Sweden alone imports approximately 20% of the world’s production of wood pellets and demand continues to grow. See, [“Sweden Consumes more than 20% of the World’s Wood Pellets and Demand is Growing”](#) (*International Forest Industries*, Sept. 7th, 2009).

³⁴ The relevant parallel here is the introduction of certification systems to promote the sustainable harvesting of wood products. Since this reduces the supply of “acceptable” wood resources, it has an impact on price. The distributional impact of changing price structure presumably does not affect all forest-based industries equally. Higher prices for the timber industry raise incomes while creating competitiveness problems for downstream industries (sawmills, pulp and paper, furniture and wood products industries, etc.).

industry. Noting this may result in increased conflicts between sectors, the bill stresses the need for the forestry and other sectors to work together to find adequate compromises on Swedish forest policy.

The MCPFE notes that, according to the Swedish position, “forests contribute to long-term climate change mitigation more efficiently by providing biofuels and low energy-cost materials than [mitigating climate change] through active carbon sequestration”. Moreover, “active carbon sequestration may reduce the potential for high and/or efficient biomass production. No policy for active sequestration has therefore been adopted” (MCPFE, 2007: 127). And forest owner associations in particular are strong supporters of policies to enhance the use of HWPs.³⁵

Though rising levels of CO₂ are reportedly correlated with increased forest growth (and increased forest productivity), thus potentially dampening supply constraints, how rapidly increased growth will have an impact and what kind of impact is cause for considerable uncertainty. Moreover the growth cycle of Swedish forests ranges from approximately 60-100 years. Some authors do not predict rising output in Europe before the second half of the century (2050-2100) (Osman-Elasha et al, 2009: 106-7). The greatest amount of forest growth is forecast for the northern Boreal regions, with some degree of declining growth forecast for bordering temperate regions—due in particular to the aggregate effects of changing tree mix (Kellomäki et al, 2005: 32-3). Few appear willing to risk predictions on the overall impact of changing tree mix on total forest harvest and timber quality, though reservations are expressed by stakeholders on this point (see in particular Keskitalo, 2008).

The Swedish government has thus far chosen not to include forest-based carbon sinks in fulfilling its UNFCCC and EU level commitments and has so far declined to sell any carbon allowances resulting from rises in its annual forest increment. In the long run this policy strategy only seems to make sense in the context of the above discussion.

Moreover, the above discussion likewise appears to help explain why Sweden so strongly favors the introduction of a carbon tax. Most recently, Sweden announced plans to make use of its assumption of the EU presidency in July 2009 to push for revisions of the current EU climate strategy by promoting the introduction of an EU-wide carbon tax.³⁶ Since it affects only carbon emissions and carbon use, a carbon tax would presumably be far more “forest-resource friendly” than the inclusion of forests in an emission trading scheme. At the same time, significant changes to the EU climate agreement reached in December 2008 would be tremendously difficult to make at this late date.

One factor could potentially shift the balance of interests in favor of including forest-based carbon sinks in a European emission trading scheme. If included in a meaningful way in an international post-Kyoto agreement (or at the EU level, though so far this has not been part of the discussion), the carbon sequestration role of HWP could provide a framework for balancing at least some interests in the forestry sector. If the carbon sequestration value of HWP is ultimately included in accounting practices, this could potentially go some way toward balancing bioenergy, carbon sink and HWP interests.

At least two big issues, however, must still be resolved before this can happen. Perhaps the biggest problem is how the carbon sequestration value of HWP will be counted. Currently four “official” IPCC models and additional proposed models are under consideration in the UNFCCC Copenhagen negotiations (see e.g. Petersson et al, 2009). One big question—in particular for timber rich countries—is 1) who would get the benefit of exported HWP (exporters or importers)

³⁵ See in particular the position statements of the Confederation of European Forest Owners (CEPF 2008) and the Nordic Family Forest Owners organization (NFFO 2009).

³⁶ See for example; “[Sweden Advocates EU Carbon Tax](#)”, (*Tax-News.Com*, May 18th, 2009).

and 2) how this would be monitored. Some countries, for example Norway, have raised significant objections to models allowing importing countries to count HWP. This might have the adverse effect of promoting the consumption of HWP from the developing world, thereby potentially counteracting efforts to stop deforestation. However, allowing exporting countries to count HWP does not necessarily resolve this problem either. Mechanisms to ensure sustainable forestry practices are also necessary and may be the only way to achieve some kind of international consensus on this issue. Requiring countries to guarantee sustainable forestry before allowing them to include HWP in their accounting practices thus seems essential.

For timber producers and the HWP industry, it is presumably important that they be able to get the benefit of such accounting practices—in particular so that HWP are valued more equally relative to bioenergy products or the desire to promote standing forests as carbon sinks. This raises the second major question: how the carbon sequestration potential of HWP will ultimately be reflected in the pricing structure of industry products. On the one hand, higher relative prices for more carbon intensive materials (such as steel or concrete) resulting from emission trading schemes and the imposition of the requirement to purchase carbon allowances should clearly drive greater demand for HWP. On the other hand, how a change in accounting procedures will be translated into HWP prices is less clear. Will consumers of HWP, for example, be able to write off a pre-defined amount of carbon sequestration, or receive financial compensation in the form of a rebate? Such issues—for the time-being at least—remain unclear.

All in all, the marketizing impact of the climate debate and the related policy structure is clearly not neutral. Moreover, the interests of countries with regard to such issues as the development of carbon sinks and their inclusion in emission trading schemes presumably depends on significantly on the natural resource base of the countries concerned and the relative importance of forest-based industries. Though mechanisms are available for resolving some of these issues and compensating competing interests, pushing these through complex decision-making processes is not simple matter.

Finally, how the further marketization of forestry and forest-related industries will affect other extra- or non-market forestry issues is likewise complicated and is addressed in the following section.

Putting a Value on Forests – Markets, Ecosystems and Forest Valuation

The marketization of forests is particularly problematic where it is unable to set or define an appropriate value across all domains of the forestry sector. The development of a market system and a set of policy tools that value *fossil fuel substitution* and *carbon sequestration* has a far more difficult time valuing other features of forests—in particular ecological and social values. Thus, for example, whether market systems can appropriately value biodiversity or protect the social and recreational values attached to forests poses important questions. Where features such as *ecotourism*, for example, are more profitable, this is potentially less problematic. Far more serious problems arise however when considering forests (and nature or the environment more generally) as a provider of “*ecosystem services*”, such as their role in protecting and preserving water resources, as opposed to merely repositories of carbon.

If traditional disputes between the forest-based industry and environmentalists tended to contrast commercial versus other “environmental” interests (broadly defined), the climate debate has further heightened and emphasized these contrasting positions. On the one hand, climate mitigation and adaptation interests in forests clearly drive demand for increased forest use—whether this comes in the form of demands for *increased forest increment* in order to promote the role of forests as carbon sinks, or in the form of increased use of forest-based products in order to

reduce carbon-intensive emissions (biomass heat and power production, wood-based construction materials, etc.). The climate challenge clearly places increased pressure on forest uses. Yet the “*marketization*” of these products through the establishment of a carbon price on forests and forest-related products is only likely to strengthen the basic conflict between the marketized features of the forestry sector and those that remain outside the market (in particular biodiversity, ecosystem services, etc.).

Two factors in particular appear to drive this phenomenon. For one, part of the problem arises from the fact that the ascription of values to such forestry sector features as biodiversity, ecosystem services or the ‘*beauty of nature*’ is exceedingly problematic. For another, scientific uncertainty further complicates such valuations. For example, despite the increasing share of science available to defend the importance of biodiversity, in much the same way that *climate deniers* continue to disturb the progress of the policy fight against global warming, some might still dispute the relative *value* of biodiversity.

Interests in biodiversity, recreation and other forest-related values not clearly driven by market-type considerations may thus suffer from the rising marketization of forests and forest-based products. Not surprisingly, NGO’s like Forests and the European Union Resource Network (FERN) and Taiga Rescue Network (TRN) argue strongly that forests should not be included in the EU ETS or in an international emission trading scheme because they do not appropriately consider issues related to biodiversity and the socio-economic interests of individuals (in particular indigenous peoples).³⁷ The creation of large monoculture type tree plantations—at the expense of both biodiversity and the livelihood of indigenous peoples—provides at least one example of the way in which marketization through the introduction of carbon pricing mechanisms can distort or disrupt other value systems. In Europe, FERN and BirdLife International grow increasingly critical of the conflict between EU afforestation strategies supported through the Common Agricultural Policy’s European Agricultural Fund for Rural Development (EAFRD) and competing initiatives at improving and protecting the EU’s biodiversity.³⁸

FERN and BirdLife International note in particular that the EAFRD approach has strongly favored afforestation—for the most part at the expense of biodiversity. Despite the fact that EAFRD funds can be used both for afforestation and for the support of biodiversity goals, most countries draw heavily from Axis 1 funding (improving long term competitiveness) but draw only sparingly from Axis 2 funding (improving and protecting the environment). However, the second strong criticism from these organizations is that even when Axis 2 funding is used, it is frequently not clear that these monies are being used for “environmental” purposes. While the FERN report can point to examples of significant afforestation projects in individual countries, these are frequently carried out without due regard to biodiversity needs and have even resulted in the planting of invasive tree species (2008: 11-14). BirdLife International notes that even environmental Axis 2 spending is rarely clearly divided into categories that make it impossible to determine what sums are being spent on biodiversity as opposed to other environmental spending and some spending—in their view—is even detrimental to biodiversity goals (2009: 7-8).

Not surprisingly, these two organizations favor shifting a far more significant share of expenditure over to biodiversity and environmental protection initiatives—in particular efforts that help complete Natura 2000 goals.

The EEA essentially argues that Europe has not yet fully grasped the importance of biodiversity. In order to maintain biodiversity and ecosystems, these must be more fully integrated into key

³⁷ See for example the FERN position paper on the potential inclusion of forest sinks in the Kyoto Protocol (FERN, 2001).

³⁸ See in particular the FERN report on [Funding Forests into the Future](#) (FERN, 2008) and the BirdLife International report [Could Do Better: How is EU Rural Development Policy Delivering for Biodiversity](#) (BirdLife, 2009).

sectors—in particular into agriculture, forestry and fisheries.³⁹ More and more use is currently being made of the term “*ecosystem services*” in what appears to be an attempt to change the language of the debate on biodiversity and the importance of forests. The ecosystem services approach essentially attempts to place a market price on the use of ecosystems and the goods and services they provide. This approach is likewise promoted by a relatively broad range of other European and international actors (the International Union for Conservation of Nature (IUCN), IUFRO, and the MCPFE). The concept of the ecosystem approach was first introduced in the framework of the CBD (2002) and the United Nations Forum on Forests (UNFF, 2003). The MCPFE has been one of the principal organizations attempting to integrate the ecosystem approach with that of sustainable forest management (SFM) in Europe.

Adaptation vs. Mitigation?

The problem of *adaptation* and its inclusion in national and EU level policy goals is similar to the problem of biodiversity and the other areas discussed above. In many ways, interests with respect to the need for adaptation resulting from the impacts of climate change have not even really been formulated. To-date, the EU has neither defined nor set a clear strategy for Adaptation to climate change. The EU is currently at the White Paper stage, meaning that the European Commission—along with the help of stakeholders and other experts from EU Member States—has already gone through several rounds of consultation and discussion. Launched under the framework of the Second European Climate Change Programme (ECCP II) in 2005, the Adaptation agenda has gradually gained momentum, leading first to the Commission’s publication of a Green Paper *Adapting to Climate Change in Europe* in 2007 and then a White Paper *Adapting to Climate Change: towards a European Framework for Action* in April 2009.

The White Paper strategy has four basic pillars which define a future course for the preparation and formulation of an EU strategy: 1) building a knowledge base, 2) integrating adaptation into key EU policy areas, 3) employing market-based and public-private partnerships, and 4) pursuing international cooperation on Adaptation. However, it will be some time before the EU has a fully developed Adaptation strategy. The White Paper envisions the development of a strategy over the period 2009-2012 and plans to be ready to implement an official Adaptation strategy by 2013.

For the most part EU Member states have been encouraged to develop Adaptation strategies on their own and thus far 9 out of the 27 EU Member states have done so. Sweden, for example, completed its strategy paper in 2007. However, in particular due to the tremendously varied climate impact across the geographic regions of Europe, in order to be able to develop an appropriate EU-level strategy, many more EU Member states must first complete the task of developing independent strategies. Of most interest perhaps is the fact that EU climate policy from 2013-2020 has now dedicated some resources to funding for Adaptation and the development of adaptation strategies. Countries are permitted to use a share of their revenues from the sale of unused carbon allowances for goals related to adaptation.

On the Swedish level, similarly, forest owners in various parts of Sweden, for example, do not have a specific set of policy interests with respect to adaptation and have only really just begun thinking about some of the possible implications and climate change and its impact on forestry and forest-based industries. Awareness, for example, of shorter winters, earlier thaws and the related awareness of potentially shortened harvesting periods, has begun to take root. Some discussion of the consequences of change in the tree mix has also taken place. But for the most part thinking on adaptation in forestry and the forest-based industries is at a very early stage. For the most part, the potential economic impact resulting from climate change is still heavily obscured in uncertainty.

³⁹ See: “[Europe Must Grasp the True Value of Biodiversity](#)” (EEA Highlight, Apr. 27th, 2009).

Observed impacts of climate change can be seen in some unusually warm years during the last 15 years, such as 2006 and 2008. In addition, “the rise in temperatures and precipitation over the past 15 years has been unusually large, from a 100-year perspective” (Swedish Climate and Vulnerability Investigation, 2007). There have also been large storm events, such as Gudrun in January 2005 and Per in January 2007. Storm Gudrun caused storm-felled timber in much of southern Sweden, in total 75 million m³ (twice that of the storms of 1969), equivalent to a whole year of felling for the country as a whole or to ten years of felling in some districts. Gudrun also caused major infrastructural damage and disruptions in electronic, railways and road communications, totaling an estimated cost of SEK 21 billion (of which SEK 11-12 billion to forestry) for the storm. Gudrun can be linked to mild weather with a lack of ground frost which made the storm felling particularly severe. In addition, the structure of the forest, with a composition focused on spruce that to a large extent was felled in the storm, may have affected the severity of the impact. Storm Per caused storm fellings of about 16 million m³ in southern Sweden (Swedish Climate and Vulnerability Investigation, 2007). Rot in spruce trees is already considered to cost SEK 500-1,000 million annually through decreasing the timber value, and pine weevil damage as well as elk grazing pressure are also current impacts on forest, resulting in that spruce is chosen on grounds where pine would otherwise have been more beneficial (Swedish Climate and Vulnerability Investigation, 2007).

Forest industry representatives have also noted that wetter winter grounds may result in larger risks for windfall, and that shorter winters may potentially result in higher survival of game (increasing grazing damages) (pers. comm., KSLA Conference 2009). Previous studies of stakeholders’ perceptions of weather and climate change describe that some persons who have been working in forestry for a long time (20-30 years) note differences between present conditions and those when they started working. In a study in southern Norrbotten county in northern Sweden, stakeholders noted among other things warmer temperatures, sometimes less snow in the area as wind patterns have changed, and that there are shifts in seasons. For instance, while Easter have in the area traditionally been seen as the time to leave winter roads due to thawing, thawing incidents have during the last few years from about year 2000 occurred during winter and sometimes resulted in that already logged wood cannot be accessed for transport out of the area. Similar changes were noticed in the autumn, with lower reliability as to the dates when winter roads and softer grounds are frozen sufficiently to be accessed for logging (Keskitalo, 2008a).

Expected impacts and vulnerability

Expected impacts of climate change include both positive impacts (increased growth) but also potential disruptions and negative impacts. In general do projections indicate warmer climate and increased occurrence of extreme events, precipitation increase in winter, a longer vegetation season, new tree species and northwards expansion of existing broadleaf (oak and beech), and disruptions through storms and pests. Warmer climate and longer vegetation season as well as new tree species will increase growth. Pine, spruce and birch growth rates may by 2100 be 20-40% higher than today. The highest growth rate increase is expected in northern Sweden, whereas drier summers may negatively impact spruce growth in southern Sweden. “Spruce and birch will become more competitive compared to pine in Norrland, while the reverse is true in Svealand and Götaland. In the south, drier summers will mean that an increase in growth as regards spruce will change to a decrease during the latter part of the century” (Swedish Climate and Vulnerability Investigation, 2007). The increased growth will result in increased earnings in forestry and forest industry, and could be added to by rotation periods being shortened and by potential cultivation of species for which the climate is currently restricting the northern limit, such as oak, beech, and hybrid aspen and poplar for biofuel. To impede grazing by cloven hoofed game, which is expected to increase and thereby increase grazing pressure in a further climate, fencing may need to be increased to some cost. Conditions for non-native conifers such as hybrid larch, Sitka spruce and Douglas fir that are already cultivated may improve. With increased growth, conifer wood density will, however, decrease, resulting in potentially poorer quality although larger dimensions if

logging cycles are maintained. In southern Sweden (Götaland and Svealand), reduced summer precipitation is expected to disadvantage especially drought-sensitive species such as spruce and birch while advantaging pine and oak.

The Swedish Climate and Vulnerability Investigation notes that: “Damage to forests is primarily caused by insects, fungi, grazing animals, storm winds and heavy wet snow” (Swedish Climate and Vulnerability Investigation, 2007). The increasing growth rate and taller trees may increase storm felling even in the absence of increased storm rates. Spruce and then pine are the most storm sensitive species. The potential for increased extreme weather events and storms in particular in southern Sweden, decreases in ground frost and wetter winters will also increase storm risks and make logging more difficult, both by impeding logging by decreasing access on winter roads and on softer grounds as well as impeding transport. Heavy and wet snow may also become more common in northern Sweden, increasing snow breakage. Warmer and wetter conditions will also increase fungal and insect pressure. Root rot on spruce due to the bracket fungus may also increase and spread throughout much of the country with warmer temperatures, and require increased forest management actions in particular during thinning. Pine weevil attacks (currently estimated that it would cost SEK 0.5–1.0 billion annually untreated, with countermeasures on plants costing some SEK 100 million annually) and spruce bark beetle may increase, in particular as the spruce bark beetle may be able to swarm several times per year. The pine processionary moth and pine wood nematode currently not existing in Sweden could also potentially spread to Sweden in a warmer climate. Costs for combating forest fires, which in Sweden have only averaged some SEK 7-8 million annually, may also increase to as much as SEK 200-300 million annually in southern Sweden (Swedish Climate and Vulnerability Investigation, 2007).

These sorts of impacts have been noted also by Swedish forestry representatives who to a large extent described corresponding risks (pers. comm., KSLA Conference 2009), and who especially described concerns about windfall especially as wetter winter grounds result in larger windfall risk, and about shorter winters potentially resulting in higher survival of game (increasing grazing damages).

Impact monitoring and management

The Swedish Climate and Vulnerability Investigation notes that a number of monitoring measures are needed. In particular does climate change issues need to be included in forest-related training and in education and communication with individual forest owners by the Swedish Forest Agency’s regional organization and forest sector organizations (the investigation noting in particular the need for separate resources to the Swedish Forest Agency for an information campaign). “The deregulated forestry policy means that, to a large extent, it is the forest owners’ own decisions now and over the next few decades that will govern the state of the forest this century, which is extremely important for one of our most important business sectors as well as for other social functions” (Swedish Climate and Vulnerability Investigation, 2007).

The investigation also notes the need for increased knowledge about local variations in climate, methods for spreading risk including mapping the suitability for different tree species over geographical areas, adaptation measures for practical forestry, broadleaf tree management, mixed stands and new species, dynamics determining wind damage and tools for minimizing such damage, forest fire, and population dynamics and adaptations in regard to pests and game increase. In addition, technical developments are needed to minimize logging damage on unfrozen ground, and to assure that adaptation measures in forestry do not have negative impacts on biodiversity (ibid.).

The Climate and Vulnerability Investigation proposes several measures beyond existing state financing of fire and airborne monitoring of damage. These include that:

- The instruction for the Swedish Forest Agency should be amended to responsibility for adaptation to a changed climate.
- The Swedish Forest Agency should be commissioned to lead a review of the Forestry Act and the Agency's associated directives and general advice with respect to climate change, and assess whether the environmental objective Healthy Forests is affected by climate change parameters
- The Swedish Forest Agency should in consultation with the Swedish University of Agricultural Sciences develop a system for monitoring and evaluating damage and costs of climate-related parameters such as game, storms and insects, and establish trial areas for tree species selection and management
- The Swedish Forest Agency should undertake an information campaign to forest owners on climate change (for this being attributed SEK 10 million over three years)

Adaptation in Swedish forestry

Swedish adaptation to climate change with relevance for forestry is treated mainly in the Climate and Vulnerability Investigation (2007) and its sub-reports. In addition, the Climate Investigation (2008) and the climate bill (2009) are important sources. Sweden's climate policy has traditionally focused on mitigation, which is described in a number of sources, including Swedish Ministry of Sustainable Development (2005) and Swedish Government (2005, 2001). The Swedish perspective on adaptation has also to a larger extent focused on developing countries, as evident in the establishment of a Commission on Climate and Development (Swedish Ministry of the Environment, 2008).

The main commission including work on adaptation is thus the climate and vulnerability investigation, appointed in June 2005 following government acceptance of the proposition National climate policy in global cooperation (prop. 2005/06:172). The commission finalized its report in October 2007: Climate and Vulnerability Investigation (2007). The report as a whole to a large extent focuses on climate change as an additional security threat, and mentions for instance propositions in 2005 on coordination in a crisis situation and the planned development of a coordinated agency on crisis management from 2008 onwards (Climate and Vulnerability Investigation, 2007). Previous to this, the Climate and Vulnerability Investigation notes that there have existed a commission and a proposition on security and awareness (both in 2001); climate change is, however, not explicitly mentioned in these. Funding for climate change adaptation should be developed for larger-scale investments with the aim to decrease vulnerability to extreme weather events and long-term change (Climate and Vulnerability Investigation, 2007). Other roles are also attributed: the state meteorological institute (SMHI) is made responsible for knowledge development regarding climate change, the Swedish Environmental Protection Agency provides responsibility for following and reporting climate change adaptation, and all sector agencies (for instance, with forestry as one example) are appointed responsibility for adaptation to climate change in their own issue area (Climate and Vulnerability Investigation, 2007).

The investigation report suggests that adaptation to climate change in Sweden needs to start explicitly given the risks for flooding and erosion in many areas. The report suggests that the County Administrative Boards should have a central role in climate adaptation. The County Administrative Board should provide support especially to municipalities; undertake regional analyses of climate change impacts and summarize information; follow up sectoral and private adaptation work; and initiate the development of catchment level groups (Climate and Vulnerability Investigation, 2007); these suggestions were eventually forwarded into the Bill (2009).

Forest adaptation measures

The Climate and Vulnerability Investigation notes a number of potential adaptation measures. In particular is spruce, the species with the highest production value on some forest land, seen as especially threatened by increased storm and pest damage as well as by drought. Shortening the rotation periods, thinning early and hard and adapting logging planning to avoid edges that are very exposed to wind, together with combating spruce bark beetles through removal of dead spruce wood and setting of traps, could serve as adaptations in relation to spruce. Increased focus on pine, mixed stands and oak in southern Sweden could be used to counter drought risk, and to increase variation and spreading of risk. Existing insurances against fire and wind damage are also seen as needing evaluation, as they seldom give full compensation or compensate damage to smaller areas. The Climate and Vulnerability Investigation notes:

There is considerable uncertainty surrounding exactly how the climate will change and future demand for different tree species. Land owners must however be prepared for the fact that the risks will increase over time, particularly in traditional forestry targeted at maximum production. For many, the increased production will make up for the damage, although individual land owners may be seriously affected (Climate and Vulnerability Investigation, 2007).

As a result, means of increasing variation and spreading risk are targeted. These could include, for instance, mixed stands with conifers and birch, pine and oak on drier lands, or the planting of fast-growing tree species in some stands, as well as increased variation in thinning and felling regimes, including continuity forestry on some areas. “There is insufficient knowledge about optimum management of mixed stands and species other than spruce and pine, however, and this needs to be developed in order to achieve good-quality, wider ranging advice” (Climate and Vulnerability Investigation, 2007). Consequently, the investigation notes that there is:

a need for an overhaul of the rules and recommendations as regards the choice of tree species, provenance choice, clearing, thinning and final felling, as well as for fertilising, the use of non-native tree species, rotation periods and rules aimed at minimising pests. This overhaul should be targeted at strengthening the potential to achieve the forest policy’s two objectives of a good yield and the protection of biodiversity in sustainable forestry in a changed climate (Climate and Vulnerability Investigation, 2007).

Game, for instance moose, management would also need to be adjusted, for instance by increased hunting, and protection for seedlings and young forest increased, for instance through greater access to grazing of broad-leaf forest resulting in less damage to young trees.

In addition is stump treatment during logging to prevent root rot relevant to extend under conditions of climate change; counter-measures to pine weevil need to be investigated. Preventative measures to forest fires need to be extended, both for monitoring, communicating fire restrictions and learning from examples in southern Europe. Monitoring for damage (storms, insects, fungi, grazing and logging and transport) also needs to be extended. Increased costs due to accessibility problems on grounds and roads, such as using technical aids (for which rules would also need to be developed), clearing ditches or developing new forest roads (for which a test procedure may need to be developed to avoid conflicting with environmental objectives on streams and wetlands), could to some extent be countered through increasing stocks in the forest compared with present levels.

The investigation also notes that the Swedish Road Administration needs to consider climate change when planning maintenance. “Improving 70 percent of the forest roads to a higher standard that permits transport during the majority of the year, and equipping an equally large proportion of

the lorries with variable air pressure, would cost around SEK 2 and SEK 1.5 per cubic meter (solid volume excluding bark) respectively” (Climate and Vulnerability Investigation, 2007).

Swedish forestry representatives at a conference held in February 2009 (pers. comm., KSLA Conference 2009) to a large extent described that measures such as these are considered and to some extent already under implementation. Among ongoing adaptations among forest companies were the following:

- Development and tests of new plant material such as exotic species
- Adjustment of silvicultural and management programs to a shorter harvesting cycle and storm risk
- Improvement of forest roads to deal with warmer winters and limited access to winter roads
- Development of forestry machines able to operate on non-frozen, waterlogged grounds

So far, however, there was limited adjustment to larger forest fire risk. Many of the representatives also considered potential strategies for risk spreading and variation. These included

- Discussions of mixed stands and substitution of spruce: some participants also requested changed recommendations for use of different tree species.
- Consideration of more active forest management with increased thinning, using tree species with shorter rotation times, and increasing preparedness to insect attacks. Also this point was seen as potentially resulting in needs for changes in advice and action programs for certain insects

With regard to the potential environmental impacts of certain measures discussed above (such as higher density of forest stands and planting of exotic species), participants also noted that environmental consideration could be increased or emphasized through maintenance of buffer zones, control of invasive species and potentially increased environmental consideration in certain areas. This would potentially require including migration paths for different species in the regulative framework for biodiversity, modifications to hunting and game management, changes in the regulative framework for exotic species in order to support mixed species stands with such inclusion in order to spread risks (and potentially also over time changes in the limits for difficult to regenerate areas). Among forestry representatives, one person also noted that the impacts of climate change on forestry would lead to “generally increased importance of planning ... logistics, risk analyses, fire and other crisis management, monitoring and adaptive management”. As a result, raising the awareness and management among forest owners may become more crucial in the future. Some participants also noted that the point that adaptation to climate change supports production would need to be highlighted, as well as that regulation frameworks on several levels would need to be adapted. In addition, with these multiple demands on forestry, it may also be necessary to improve or increase actions to decrease conflicts between forest use sectors (pers. comm., KSLA Conference, 2009).

The Forest Bill 2007/08:108 (Swedish Ministry of Agriculture, 2007) also provides suggestions with relevance for adaptation to climate change along the parameters discussed above. The bill reports that there is room for increased wood production within the framework provided by present regulation and legislation. The bill notes among other things that long-term sustainable increases in the outtake of wood, among other things through forestry increasing their investments, is needed to meet increased demands for forest produce including biofuel, and to avoid negative

consequences on the competitiveness of Swedish industry. Noting that this may result in increased conflicts between sectors, the bill notes that forestry and other sectors need to work together to realize Swedish forest policy. The bill notes that the Swedish Forest Agency should be responsible for evaluations of the definition of exotic species, which is presently seen as unclear in legislation. In addition, the Swedish Forest Agency should evaluate the limitations for *Contorta* pine, given among other things the larger resistance of *Contorta* pine in comparison with pine to certain pests.

Research studies on adaptation to climate change in forestry also exist. The Swedish University of Agricultural Sciences is responsible for monitoring of forest for the state, and has among other things developed forest decision support systems such as Heureka and forest databases. With regard to adaptation, much of Swedish studies on adaptation have taken place under the framework of the Climate and Vulnerability Investigation and its sub-reports, which to some extent summarizes existing Swedish-based work on adaptation to climate change in forestry. There also exists research studies in particular with regard to storms (e.g. Blennow and Olofsson, 2008) as well as with regard to forestry and forest industry stakeholder perceptions of adaptation and adaptation needs (Keskitalo 2008a, 2008b). These latter note for instance the risks perceived from pests, changes in temperature and precipitation and seasonal shifts, as well as impacts of increased tree growth and potential shifts in benefitted tree species. Adaptations on the regional and local level in selected cases (interviews made 2003-2005) in particular highlighted adaptations to limitations in site accessibility due to thawing and decreased reliance on winter roads, i.e. to effects that have a direct impact. Adaptations to more long-term changes such as changes in forest growth rate and associated changes in quality or in benefitted species were seen in the context of a market framework, where potentially lower prices for lower qualities would potentially be compensated by higher production (Keskitalo 2008a, 2008b).

Integrating Climate and Forest Policy: A Multi-Level Issue

Policy-making for forestry and forest-related industries has only grown more complex and multifaceted with the passage of time. Though there are increasing calls for greater *policy integration*⁴⁰ in the area of climate politics or for the introduction of mechanisms based primarily upon concepts of multilevel governance, decentralization and participation,⁴¹ this is dynamically reflective of the increasing degree of policy proliferation and complexity—not only in terms of the sheer number of policy domains, but also in terms of the steadily increasing number of policy levels (regional, national, EU and international). Though the causes of such proliferation are themselves complex, to some degree the increasing number and complexity of claims being placed on forestry and forest-based industries by an increasingly broad range of actors and interests is the direct outcome of the emerging climate challenge and increasing pressure and urgency to mitigate, adjust and adapt. Though the start of the paper pointed strongly at the importance of the role of marketization in the forestry sector and its ability to overpower other less market driven interests, other factors may also play an important role. This section emphasizes in particular the institutional side of the argument and the EU level, suggesting that institutional features at the EU and national levels may also hold responsibility, the point being that if EU (and perhaps national level institutions) were better structured, certain concepts and interests would more easily be integrated into the relevant policy frameworks.

Previous literature on the problems of governance focuses on a number of strategies for improving the management of climate policy. Mickwitz et al (2009) provide perhaps the most focused and detailed discussion to date. Their account does not adequately distinguish between the dynamics of policy incorporation (i.e. when the climate politics agenda is introduced into the policy sphere) and

⁴⁰ See in particular PEER report No. 2, [Climate Policy Integration, Coherence and Governance](#) (Mickwitz et al, 2009) on the topic of policy integration with respect to climate politics.

⁴¹ See in particular Glück et al (2009).

policy integration (i.e. how the climate policy agenda might be integrated across a broad range of related policy domains). That aside, these authors recommend a number of instruments to bring about greater policy integration (communicative, organizational and procedural instruments that ultimately attempt to give greater place and prominence to the climate debate in national agendas, institutional arrangements and assessment and consultation procedures) (Mickwitz et al, 2009: 49).

Identifying which institutions are responsible for forestry policy is complicated. The gradual evolution of forests and forestry policy from a strategy geared toward the economic development of forests, to one that encompasses a much broader image of forests and their environmental and social value has left behind it an institutional struggle that continues to the present day. Especially at the EU level, several Commissions or Directorate Generals (DG's in EU parlance) are responsible for different aspects or elements of forestry, forestry use and forestry governance policy. Thus for example, at the EU level, forestry policy is more traditionally guided by DG Agriculture and to some extent by DG Enterprise and Industry (presumably due to its commercial importance), while DG Environment has progressively taken over a number of areas of specific relevance to forestry, in particular biodiversity, Natura 2000, the Water Framework Directive (WFD), Adaptation and the Invasive Alien Species (IAS) initiative.

Table I: European Commission Competence in EU Forest Policy

DG Agriculture and Rural Development	DG Enterprise and Industry	DG Transport and Energy	DG Environment	Joint Research Council (JRC)	EEA
CAP and Rural Development Bioenergy Afforestation Natura 2000/biodiversity Competitiveness forestry EU Forest Strategy Forest Action Plans (FAP's)	Competitiveness forest industries Trade and forest industries Innovation and forest industries	Climate Strategy Renewable Strategy Bioenergy Biofuels Forest sinks Renewable Energy Roadmap	Biodiversity Adaptation WFD Natura 2000 Floods Directive Forest Fires (+WGFFP) LIFE+ Birds Directive Habitats Directive Invasive Species	EFFIS EFDAC Inforest Action (?)	UNFCCC GHG Inventories Adaptation Bioenergy Water Forests Environmental Assessments Biodiversity
DG Dev	DG Regio	DG RTD	DG Health and Consumer Protection (SANCO)	DG Internal Market and Services	DG External Trade
FLEGT	Regional Policy European Solidarity Fund Structural Funds	Research EU-Medin EU AgriNet COST Actions	Seeds and Plant Propagating Material Standing Committee on SPPM		Trade and forest industries

Apart from the four European DG's listed in Table I with major, significant policy agendas affecting forests and forestry, at least 6 further DG's manage policies related to or affecting forestry and forest-related industries. On the other hand, as illustrated in Table I above, both DG Enterprise and Industry and DG Energy and Transport are likewise responsible for various policies that touch on forests and/or forest-based industries. In particular DG Energy and Transport is now responsible for the broad range of packages dealing with the EU's climate policy. The renewable energy strategy, as envisioned in particular in the *Renewable Energy Roadmap*, the *Biomass Action Plan* and detailed in the first two Renewable Energy Directives, points to a significant role for bioenergy (primarily biomass and biofuels).⁴² Thus, Special Report No 9/2004 from the European Court of Auditors (ECA) *Forestry Measures within Rural Development Policy* pointed to the difficulties arising from the fact that responsibility for forestry policy was divided across many different Commissions:

⁴² To what extent this broad range of policy fragmentation across different EU level institutions also gives rise to institutional rivalry remains unclear. However, there are suggestions on the margins that these divisions—in particular between DG Agriculture and Rural Development on the one hand and DG Environment on the other are cause for inter-institutional struggle.

“... many different DGs and units are involved in the Commission’s approval process of the RDP and OP (3) and thus in the approval of forestry measures. DG Agriculture was responsible for the analysis of the RDP. While the OP were mainly under the overall coordinating responsibility of DG Regional Policy. In total more than eight units within DG Agriculture and seven other DG’s (e. g. Environment, Energy and Transport, Health and Consumer Protection) are involved in forest related issues. This division of forestry related matters amongst so many departments within the Commission threatens coherence and complicates decision-making.” (ECA, 2004: 10)

3. Looking forward: conclusion and take-home messages

Summarizing the above discussion, three general problems arise repeatedly in the literature with respect to forestry and forest use. First, EU level competence is broadly distributed and ultimately fragmented across multiple institutions. This may ultimately be an effect of the lack of an unambiguous EU mandate—supported by relevant clauses in the Treaty—to regulate forestry and forest use at the EU level. Second, existing institutional features intended to further integrate forestry policy at the EU level—in particular the *Inter-service Group on Forestry* introduced in 2002—are not clearly successful in their goal. Third, further attempts to improve the institutional framework for forestry policy at the EU level have thus far not been successful.

The EU-level *Inter-service Group on Forestry* (“established in 2002 to facilitate cooperation and coordination of forestry-related work between relevant Commission services”) is technically responsible for insuring that forestry policy is coordinated across some 11-13 EU-level DG’s. Chaired by DG Agriculture, this body has two main purposes: to ensure the flow of information and to seek agreement across departments. There is also an Inter-service Group on International Forestry Issues responsible for the preparation of Commission positions on international issues. To what extent the general Inter-service coordination strategy is successful is controversial. Birdlife International argues, for example, that the work of the *Inter-Service Group on Forestry* as well as DG Ag’s *Standing Forestry Committee* (SFC) should ultimately be opened up to NGO’s. According to Birdlife International, the power and position of DG Environment should be elevated in order to more successfully introduce forestry issues.⁴³

The modalities for greater integration of forestry policy at the EU level have ultimately been raised and addressed on multiple occasions by various actors. In addition to the above comments, the Commission also raised the question of potential reforms in the interest of creating greater coordination across the different elements of EU forestry policy in the framework of its reporting on the EU Forest Strategy.⁴⁴ The Commission’s position on re-organization appears to be relatively resolute. The Commission has responded to requests for a separate legal basis for forestry in the EU framework and both greater “vertical” and “horizontal” coordination.

The Commission argues that a stronger legal footing for forestry policy including climate priorities in the EU is not feasible without greater interest from the Member states. The Commission responds to requests for greater “vertical” coordination—in particular in a single EU-level directorate general (DG)—by noting that a new unit has recently been established in DG Agriculture and Rural Development that is responsible for creating a stronger focus on forests and the forest industry. This unit—Unit AGRI F.6: Bioenergy, biomass, forestry and climate change⁴⁵—addresses the combination of forestry and climate issues and was specifically responsible for coordinating work on the EU Forest Action Plan. Further, with respect to “horizontal” coordination, the Commission points again to the role of the *Inter-Service Group on*

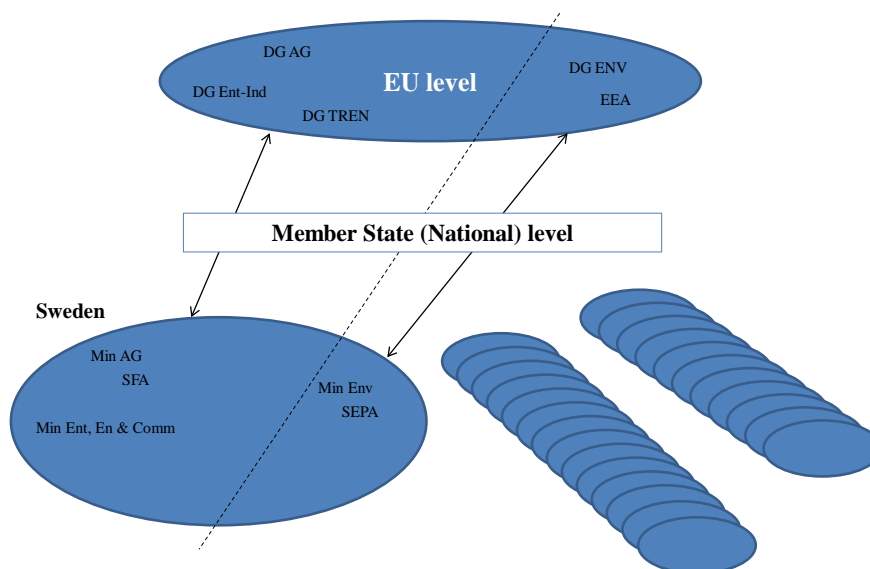
⁴³ See for example the communication from Birdlife International on the [Commission Draft on EU Forest Action Plan](#) (Apr. 7th, 2006).

⁴⁴ See the European Commission’s communication, “[Reporting on the Implementation of the EU Forestry Strategy](#)”, COM(2005) 84 final.

⁴⁵ This Unit appears to have been renamed to Unit H.4. Bioenergy, Biomass, Forestry and Climate Change at some later point in time. The newer Unit H.4. was responsible, among other things, for writing the “Report on Implementation of Forestry Measures Under the Rural Development Regulation 1698/2005 for the Period 2007-2013”, (European Commission, 2009).

Forestry and argues that this body has been “an effective tool of coordination and is working satisfactorily.”⁴⁶

Fig. III: Political Power Poles?



Generally speaking, there appears to be relatively strong coordination of interests around two poles: on the one hand the agricultural, energy and industry oriented Commissions/ Ministries appear to favor strategies related to bioenergy, biomass and afforestation, while on the other hand environmental ministries, the EEA and environmental agencies (such as the Swedish Environmental Protection Agency (SEPA)) tend to favor more environmentally oriented goals such as biodiversity and the promotion of Natura 2000 natural conservation areas. As suggested above, there is a fairly strong divide across industry-related forestry issues and the interests expressed by the EEA, the ECA and by NGO’s like Birdlife International and FERN. These organizations repeatedly insist that many of the more environmental issues—in particular those related to biodiversity and Natura 2000 goals—are being neglected by EU policy. The division of interests outlined here suggests there is a balance of power across EU-level of institutions that is presumably duplicated at the national level. The diagram in Figure III above attempts to represent this graphically and is presented *only* for conceptualization purposes.

Some preliminary conclusions as well as identification of potential development paths can be drawn from this very brief analysis of institutional divisions and policy fragmentation. One is that there is currently some institutional rivalry and competition between different bodies, as well as resource imbalances, which together result in *policy fragmentation*. A business-as-usual development pathway would continue these problems and potentially impede the development of more coherent forest policy. However, developments that would support more coherent policy could also take place, along some of the suggestions that have previously been forwarded.

Perhaps the most important conclusion is that the introduction of additional consultation procedures or many of the more detailed proposals appearing in Mickwitz et al (2009: 49-61), or attempts highlight and promote the advantages of multilevel governance, decentralization and

⁴⁶ See for example the “[European Parliament Resolution on the Implementation of a European Union Forestry Strategy](#)”, (Feb. 16th, 2006: 3).

participation (Glück et al, 2009), may be entirely inadequate to resolving such deeply-seated and broadly-situated institutional divisions and policy fragmentation. One could however propose more radical institutional reforms that might begin to resolve at least some of these dilemmas. However, it is important in this context to recognize the role and importance of marketization phenomena and the force of economic interests—in particular the way in which these cut across or through institutional arrangements (as suggested above in Figure III).

Assuming that the basic problem regarding the coordination of forestry policy is the fact that there is too much institutional division across relevant policy domains and thus ultimately poor coordination and fragmentation of policy output, then at least one relevant proposal might be to *coordinate forestry and forestry policy at the EU level under one single Commission*. However, which Commission this should be is not immediately clear. Both DG Environment and DG Agriculture currently have strong vested interests in this policy area. Moreover, if the principal rivalry is really across these two institutions (and perhaps also DG Energy and Transport), moving competence in forestry over to one or the other institution is potentially problematic.

A second alternative, given the relative importance of forestry—in particular in the climate change framework—might be to create a *Forestry DG*. However in this case some might question whether forestry alone rises high enough on the scale of important policy domains to warrant its own DG. This is presumably questionable. Currently, there is some discussion of creating a Climate and Energy DG. This proposal has been strongly criticized by some, in particular for attempting to shift policy competence at a strategically difficult period in time (just prior to the Copenhagen negotiations in December 2009).⁴⁷ Though such an institutional structure might lend too much weight to the Energy sector—too much of the EU policy focus is already on the energy sector—the potential elevation of the climate agenda to Commission status is potentially appealing.

A final alternative that builds to some degree on these various ideas would be to create a *Climate Commission* and place principal competence for forestry policy within that framework.⁴⁸ This would have the advantage of correcting the current degree of decentralization and fragmentation of forestry policy. Further, this would place the principal focus on forestry firmly within the context of climate change. Though it is perhaps possible to argue that this institutional framework could still potentially lead to the neglect of biodiversity issues, the opposite may be more likely. In particular since much of the research on biodiversity suggests it is fundamental to the survival of forests—in particular in the context of forest resilience and afforestation strategies—placing this knowledge in a more centralized decision-making framework integrated within an approach to climate policy could give it greater prominence. Moreover, creating an independent climate commission that is not dependent on the energy sector could further dampen the overwhelming role of the energy sector in climate policy, thereby potentially broadening the overall approach.

To some degree, the institutional division across DG AG and DG Environment may itself explain why some issues receive less attention than others. Just how such reforms might affect outcomes in forestry and forestry-related policies related to climate mitigation and adaptation is perhaps less clear. But given the relatively uneven treatment of forest-related industries in the climate mitigation and adaptation debates, placing forestry more fully at the center of some of these discussions would presumably be an advantage—in particular for more timber-rich countries. In the long run, all of these developments would necessarily impact the way issues are treated also with relevance for adaptation and linkages between adaptation, mitigation and other issues also domestically within Sweden.

⁴⁷ See e.g.: “[MEPs Angry at Plans for Energy Shake-up](#)” (European Voice, May 14th, 2009), FERN’s *EU Forest Watch* newsletter (June 2009, Issue No. 139) and the [letter from EU GLOBE members](#) (May 18th, 2009).

⁴⁸ The idea for integrating forestry policy within a climate commission first arose in group work discussions during the Joensuu Forestry Networking Workshop, May 24th-29th, Joensuu Finland.

Finally, this paper raises important questions about the structure of political bargaining processes at the EU and national levels, and also at the international level. Why some policy strategies are favored over others and who the principal actors are in the decision-making processes are key questions for future analysis and discussion. The failure of EU and also international policies, for example, to address a set of policy options that would adequately promote fossil fuel substitution and carbon sequestration – in particular through the promotion of forest resources – is conspicuous. At the EU level, whether this can be explained as a result of competing interests across countries (with some countries favoring afforestation over the promotion of HWP or biomass), or as a result of the fact that the development of the EU climate strategy for promoting emission reductions was allocated to the Directorate General for Transport and Energy (DGTREN) rather than to a DG that was more detached from the energy sector remains open to question, one that begs an informed reply.

References

- Anger, Niels and Jayant Sathaye (2008). "[Reducing Deforestation and Trading Emissions: Economic Implications for the post-Kyoto Carbon Market](#)", LBNL 63746, Lawrence Berkeley National Laboratories.
- Aulisi, Andrew (2008). "[For the Love of Timber: A Different Look at a Natural Resource](#)", in Garcia, Brian and Eric Roberts (eds.), *Carbon Finance – Environmental Market Solutions to Climate Change*, New Haven: Yale School of Forestry and Environmental Studies (Ch. 13: 295-325).
- Bache-Andreassen, Lihn (2009). "[Harvested Wood Products in the Context of Climate Change: A Comparison of Different Models and Approaches for the Norwegian Greenhouse Gas Inventory](#)", Reports 2009/12, Statistics Norway.
- BirdLife International (2009). [Could Do Better: How is EU Rural Development Policy Delivering for Biodiversity](#).
- Blennow, K. and Olofsson, E.(2008). "[The probability of wind damage in forestry under a changed wind climate](#)". *Climatic Change*, 87: 347-360.
- CEPF (2008). "[Family Forest Owners in Combating Climate Change](#)", Brussels: CEPF Liaison House.
- ECA (2004). [Forestry Measures within Rural Development Policy](#), European Court of Auditors Special Report No 9/2004.
- EEA (2009). [EEA Signals 2009: Key Environmental Issues Facing Europe](#), Luxembourg: Office for Official Publications of the European Communities.
- Ellison, David and Attila Húgyecz (2008). "[An Initial investigation of the EU's 2020 Climate Change Package and its Potential Domestic Impact](#)", Working Paper No. 186, Institute for World Economics, Hungarian Academy of Sciences, Budapest.
- European Commission (2009). "[Report on Implementation of Forestry Measures Under the Rural Development Regulation 1698/2005 for the Period 2007-2013](#)", Brussels: Commission of the European Communities.
- European Commission (2007). "[Renewable Energy Road Map: Renewable Energies in the 21st Century: Building a More Sustainable Future](#)", Brussels: Commission of the European Communities [COM(2006) 848 final].
- European Commission (2005). "[Biomass Action Plan](#)", Brussels: Commission of the European Communities [COM(2005) 628 final].
- Eurostat (2007). [Forestry Statistics](#), Edition 2007, Luxembourg: Office for Official Publications of the European Communities.
- FERN (2008a). "[Funding Forests into the Future? How the European Fund for Rural Development Affects Europe's Forests](#)", Moreton in Marsh: FERN, May.
- FERN (2008b). "[The Case of Mainland Finland: Funding Forests into the Future? How the European Fund for Rural Development Affects Europe's Forests](#)", FERN report, FERN, March.
- FERN (2001). "[Sinks in the Kyoto Protocol: A Dirty Deal for Forests, Forest Peoples and the Climate](#)", FERN Briefing Note, Brussels: FERN, July.
- Glück, Peter et al (2009). "Governance and Policies for Adaptation", in Seppälä, Risto, Alexander Buck and Pia Katila (eds.), [Adaptation of Forests and People to Climate Change – A Global Assessment Report \(and Policy Brief\)](#), Vienna: International Union of Forest Research Organizations: 187-210.

- Gustavsson, Leif, Kim Pingoud and Roger Sathre (2006). "[Carbon dioxide balance of wood substitution: comparing concrete- and wood-framed buildings](#)", *Mitigation and Adaptation Strategies for Global Change* 11(3): 667-691.
- Hansen, James et al (2008a). "[Target CO2: Where Should Humanity Aim?](#)" *The Open Atmospheric Science Journal* 2: 217-231.
- Hansen, James (2008b). "[Tipping Point: Perspective of a Climatologist](#)", in Fearn, Eva (ed.) *State of the Wild 2008-2009: A Global Portrait of Wildlife, Wildlands and Oceans*, Washington D.C.: Island Press: 6-15.
- Hansen, James and Larissa Nazarenko (2004). "[Soot Climate Forcing via Snow and Ice Albedos](#)", *PNAS* 101(2): 423-428.
- Hashimoto, Seiji (2008). "[Different Accounting Approaches to Harvested Wood Products in National Greenhouse Gas Inventories: their Incentives to Achievement of Major Policy Goals](#)", *Environmental Science & Policy* 11(8):756-771.
- Houghton, R.A., and C.L. Goodale (2004). "[Effects of land-use change on the carbon balance of terrestrial ecosystems](#)" in R.S. DeFries, G.P. Asner, R.A. Houghton (eds.), *Ecosystems and Land Use Change*. American Geophysical Union, Washington, D.C.
- IUCN (2009). "[Final report study on the Economic value of groundwater and biodiversity in European forests](#)", Brussels: IUCN Regional Office for Europe.
- IUFRO (2009). [Adaptation of Forests and People to Climate Change – A Global Assessment Report \(and Policy Brief\)](#), Vienna: International Union of Forest Research Organizations.
- Jackson, Robert B. et al (2008). "[Protecting Climate with Forests](#)", *Environmental Research Letters* 3: 1-5.
- Jones, Chris, Jason Lowe, Spencer Liddicoat and Richard Betts (2009). "[Committed Terrestrial Ecosystem Changes Due to Climate Change](#)", *Nature GeoScience* 2(July): 484-487.
- Kankaanpää, Susanna and Timothy R. Carter (2004). "[An Overview of Forest Policies Affecting Land Use in Europe](#)", Helsinki: Finnish Environment Institute.
- Kellomäki, S., Strandman, H., Nuutinen, T., Peltola, H., Korhonen, K.T. and Väisänen, H. (2005). "[Adaptation of Forest Ecosystems, Forests and Forestry to Climate Change](#)", FINADAPT Working Paper 4, *Finnish Environment Institute Mimeographs* 334, Helsinki, 44 pp.
- Keskitalo, E. C. H. (2008a) "[Vulnerability and adaptive capacity in forestry in northern Europe: a Swedish case study](#)". *Climatic Change* (2008) 87:219–234.
- Keskitalo, E. C. H. (2008b) *Climate Change and Globalization in the Arctic: An Integrated Approach to Vulnerability Assessment*. London: Earthscan Publications.
- KSLA-seminarium februari 2009: "Vilka beslut fattas idag inom skogssektorn för att möta klimatförändringarna?" (including presentations from Sveaskog, Norra skogsägarna, Södra skogsägarna, Stora Enso, Holmen skog, Skogsstyrelsen, Miljödepartementet, WWF, Svenska jägareförbundet, Svenskt friluftsliv).
- Lenton, Timothy M., Hermann Held, Elmar Kriegler, Jim W. Hall, Wolfgang Lucht, Stegan Rahmstorf and Hans Joachim Shellnhuber (2008). "[Tipping Elements in the Earth's Climate System](#)", *PNAS* 105(6): 1786-1793.
- Louman, Bastiann et al (2009). "Forest Ecosystem Services: a Cornerstone for Human Well-Being", in Seppälä, Risto, Alexander Buck and Pia Katila (eds.), [Adaptation of Forests and People to Climate Change – A Global Assessment Report \(and Policy Brief\)](#), Vienna: International Union of Forest Research Organizations: 15-27.

- MCPFE (2007). [State of Europe's Forests 2007: The MCPFE Report on Sustainable Forest Management in Europe](#), Warsaw: Ministerial Conference on the Protection of Forests in Europe.
- Mercado Lina M. et al (2009). "[Impact of Changes in Diffuse Radiation on the Global Land Carbon Sink](#)", *Nature* 458(Apr. 23rd): 1014-1018.
- Mickwitz, Per et al (2009). [Climate Policy Integration, Coherence and Governance](#), Helsinki: Partnership for European Environmental Research (PEER).
- NFFO (2009). "[Nordic Family Forestry Owners' Position on Forests and Climate Change](#)".
- OECD (2008). [OECD Economic Surveys: Sweden](#), Paris: Organization for Economic Cooperation and Development.
- Osman-Elasha, Balgis et al (2009). "Future Socio-Economic Impacts and Vulnerabilities", in Seppälä, Risto, Alexander Buck and Pia Katila (eds.), [Adaptation of Forests and People to Climate Change – A Global Assessment Report \(and Policy Brief\)](#), Vienna: International Union of Forest Research Organizations: 101-122.
- Petersson, Hans, Mattias Lundblad, Jón Guðmundsson, Kim Pingoud, Sten Gyldenkaerne, Lars Vesterdal, Michelle Slaney, Gro Hylen and Tarja Tuomainen (2009). [Enhanced Incentives for Mitigation Effects in the Land Use, Land Use Change and Forestry Sector in the Next Global Climate Change Agreement](#), TemaNord 2009:553, Copenhagen: Nordic Council of Ministers.
- Ramanathan, V. and G. Carmichael (2008). "[Global and Regional Climate Changes Due to Black Carbon](#)", *Nature Geoscience* No. 156: 221-227.
- Ramanathan, V. (2007). "[Role of Black Carbon in Global and Regional Climate Changes](#)", Testimonial to the House Committee on Oversight and Government Reform, Washington D.C., (October 18th, 2007).
- Rhemtulla, Jeanine M., David J. Mladenoff and Murray K. Clayton (2009). "[Historical Forest Baselines Reveal Potential for Continued Carbon Sequestration](#)", *PNAS* 106(15): 6082-6087.
- Saikku, Laura, Aapo Rautiainen and Pekka E. Kauppi (2008). "[The Sustainability Challenge of Meeting Carbon Dioxide Targets in Europe by 2020](#)", *Energy Policy* 36(2): 730-742.
- Sathre, Roger and Leif Gustavsson (2009). "[Using Wood Products to Mitigate Climate Change: External Costs and Structural Change](#)", *Applied Energy* 86(2): 251-257.
- Schwärzel, Kai, Karl-Heinz Feger, Janet Häntzschel, Alexander Menzer, Uwe Spank, Falko Clausnitzer, Barbara Köstner and Christian Bernhofer (2009). "[A Novel Approach in Mode-Based Mapping of Soil Water Conditions at Forest Sites](#)", *Forest and Ecology Management* (in press).
- Sheil, Douglas and Daniel Murdiyarto (2009). "[How Forests Attract Rain: An Examination of a New Hypothesis](#)", *BioScience* 59(4): 341-347.
- Swedish Climate and Vulnerability Investigation (2007) [Sweden facing climate change – threats and opportunities](#). Swedish Government Official Reports SOU 2007: 60. Department of the Environment. Stockholm.
- Swedish Climate Commission [Klimatberedningen] (2008) [Svensk klimatpolitik SOU 2008:24](#). Miljödepartementet, Stockholm.
- Swedish Forest Agency (2008) [Swedish Statistical Yearbook of Forestry](#). Jönköping: Swedish Forest Agency.
- Swedish Government (2001) [Sveriges klimatstrategi. Proposition 2001/02:55](#). Stockholm, Sweden.
- Swedish Government (2005) [Nationell klimatpolitik i global samverkan. Regeringens proposition 2005/06:172](#). Stockholm, Sweden.

Swedish Ministry of Sustainable Development (2005) [Sweden's fourth national communication on climate change under the United Nations Framework Convention on Climate Change. Ds 2005:55](#), Stockholm.

Swedish Ministry of the Environment (2008). [The Government's climate policy](#). April 2008 Information sheet from the Swedish Ministry of the Environment, Stockholm.

Swedish Ministry of Agriculture (2007) Forest Bill 2007/08:108. [En skogspolitik i takt med tiden](#) ["Forest Policy in step with the times]. Ministry of Agriculture, Stockholm.

Van Mantgem, Phillip J. et al (2009). "[Widespread Increase of Tree Mortality Rates in the Western United States](#)", *Science* 323: 521-524.

Wise, Marshall et al (2009). "[Implications for Limiting CO2 Concentrations for Land Use and Energy](#)", *Science* 324(May 29th): 1183-1186.

Zhang, Lu et al (2007). "[Afforestation in a Catchment Context: Understanding the Impacts of Water Yield and Salinity](#)", Industry Report 01/07, CSIRO Land and Water Science Report Number 01/07, Canberra.