Aim and research questions

The general aim of the project was to analyze welfare effects in Sweden resulting from the already committed, and the suggested, adjustments in national as well as EU energy and climate policy. The work can be divided into two main areas. 1) To further develop the theoretical dynamic modeling framework introduced in Brännlund et al. (2009) to analyze specifically the role of carbon sinks in the short and long term under different assumptions about type of biomass and carbon neutrality. 2) Building a computable general equilibrium model (CBA) to simulate welfare effects of various scenarios in Sweden related to the conversion from fossil fuels to bioenergy and biofuels.

Methods

The research methods have relied heavily on economy-wide CGE modeling, Cost-Benefit Analysis (CBA) and dynamic welfare economics (growth models). A CGE model was developed within a thesis (Furtenback, 2011) that integrates the ecology and the economy explicitly and the carbon cycle is central in analyzing the role of biomass. Theoretical growth modeling (Brännlund et al., 2009, Lundgren and Marklund, 2013) was utilized to shed light on welfare issues connected to the use of bioenergy. A comprehensive and empirical CBA based on a theoretical growth model was used to assess the pros and cons of using intensive forest management for bioenergy.

Main results

Sequestration of CO2 in forests is becoming more and more prominent in the policy debate. Technically there are several ways to boost sequestration: increase forest area; change management of existing forests; prolong life expectancy of wood products; more bioenergy. But we have to take into account that changing the use of the forest will also have repercussions for forest owners and the forest industry.

The project constructs a CGE model (Furtenback, 2011) where the forest and the economy are intertwined. The ecological model is a forest growth model that describes the forest dynamics and the economic module determine the harvesting strategy. The model can assess various policy scenarios connected to e.g. promotion of carbon sequestration.

We take closer look at three scenarios. Scenario 1 - Compensation is given to forest owners for CO2 sequestration and a tax is levied because CO2 is released at harvest. Scenario 2 - Same as scenario 1 but now a tax rebate is given to the forest owner depending on what products the harvest is used for and how long these products prevent CO2 from being released into the atmosphere. Scenario 3 - In addition to scenario 1 and 2 tax rebate is given to the forest owner that saves harvest residues in the forest.

Results suggest that the societal cost of these scenarios is initially large due to time delays before carbon sequestration has reached a significant level. The use of biomass is likely to shift from pulp industry to wood products because of age specific differences in the biomass used within different parts of the forest industry. Simulations also show a transfer of income to forest owners from other agents. These transfers are more pronounced if there are tax rebates already established. The introduction of tax rebates increases the societal cost of policy due to loss of tax revenue.

The expansion in biofuels has been extensive in recent years and will continue, likely at an increasing rate. The arguments used by countries for justifying this development are mainly connected to climate effects, environmental effects, energy security effects, and net economic effects. If the net impact of these effects has a nonnegative net effect on welfare, the conversion from fossil fuels to biofuels is justifiable from a societal point of view. In Lundgren et al. (2009) and Lundgren and Marklund (2013b) we discuss biofuels in light of welfare economics and ask ourselves: why biofuels? First we present an overview of the relevant literature and then introduce a theoretical framework for analysis. The review shows that promoting biofuels does not necessarily improve societal welfare. Our theoretical model point to why this may be the case. Based on our model we suggest a policy that tax all emissions of CO2 and subsidize growth of biomass.

In Lundgren and Marklund (2013a) we build on Lundgren et al. (2009) and take a closer look at the assumption of carbon neutrality. As an illustration we use a hypothetical intensive forest management project (MINT) aimed to increase growth and the use of bioenergy. The analysis shows that it is important not just to account for the positive effects of growth and bioenergy, such as substitution of fossil fuels and carbon storage, but also account for carbon emissions associated with bioenergy. Otherwise the positive climate effects are overstated. This result is especially relevant for Swedish forests that grow slowly with long harvest cycles. See also Lundgren and Marklund (2012) for a discussion on this issue.

Brännlund et al. (2012) use the framework in Lundgren and Marklund (2013) to assess empirically the socio-economic costs and benefits of intensified forest management. Aside from private economic effects on forest production we evaluate various relevant external effects; e.g., effects on recreation, acidification, and carbon balance. The CBA is exemplified by using data from a governmental report from 2009 (MINT) that investigated effects on the forest sector of intensified forest management. The CBA show that intensified forest management generally is profitable from a private point of view. If it is also beneficial from a societal point of view depends on the size of the external effects, carbon sequestration, fossil fuel substitution, and emissions from bioenergy.

Peer-reviewed scientific articles (asterix = key publications)

*Brännlund, R., O. Carlén, Lundgren, T., P-O Marklund (2012). The costs and benefits of intensive forest management, Journal of Benefit-Cost Analysis 3(4).

Brännlund, R. and Boisvert, R. (2011). The Use of Biomass to Produce Electricity. Eurochoices, 3, 26-30.

Geijer, E., Bostedt, G., and Brännlund, R. (2011). Damned if you do, Damned if you don't –Reduced Climate Impact vs. Sustainable Forests in Sweden. Resource and Energy Economics, 33, 94-106.

*Lundgren, T., P-O. Marklund, R. Brännlund, B. Kriström, (2009), The Economics of Biofuels, International Review of Environmental and Resource Economics, Vol 2, 237-280.

*Lundgren, T., P-O. Marklund (2012), Bioenergy and carbon neutrality, Journal of Forest Economics 18(1), 91-93.

*Lundgren, T., P-O. Marklund (2013a), Assessing the welfare effects of promoting biomass growth and the use of bioenergy, in press Climate Change Economics.

Books and book chapters

Brännlund, R., P. Söderholm, R. Lundmark (2010). Kampen om skogen – koka, såga, bränna eller bevara. SNS förlag: Stockholm, Sverige.

*Furtenback, Ö. (2011). Three essays on Swedish energy and climate policy options. Doctoral thesis 2011:81, Faculty of Forest Sciences, SLU.

*Lundgren, T., P-O Marklund (2013b), Biofuel economics – A review, Encyclopedia of Energy, Natural Resource and Environmental Economics, Elsevier, London, UK. Ed. J. Shogren.

Reports and working papers published on www.cere.se

Brännlund, R., O. Carlén, Lundgren, T., P-O Marklund 2009). En samhällsekonomisk bedömning av intensivodling av skog.Faktaunderlag till MINT-utredning om möjligheter till intensivodling av skog, SLU, Rapport. ISBN 978-91-86197-44-5.

Eriksson, M. (2013). The role of the forest in and integrated assessment model of the climate and the economy. CERE Working Paper 2013:1.

Popular science articles

Lundgren, T. and P-O. Marklund (2012) Bioenergi, klimat och Ekonomi, Miljöforskning – Formas tidning för ett hållbart samhälle, No 1, March 2012.