Ecotechnology Research Report
Spring 2009
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Mittuniversitetet
MID SWEDEN UNIVERSITY

Six Research Profiles

Mid Sweden University has six prioritised thematic research profiles:

- Cultural Heritage, Democracy and Enterprise
- Digital Communities
- Learning and Education
- The Challenges of the Welfare State
- The Forest as a Resource
- Tourism, Sports Science and Adventure Technologies

Introduction

The research of the Ecotechnology group is linked to sustainable development. We focus on analyses of energy and technological systems on the basis of their fundamental components and relate them to energy and material efficiency, renewable resources and forestry. Interactions among these fields, as well as implementation issues, are important parts of the analyses.

The aim of the research is to increase our understanding of how resource-efficient and cost-efficient systems, with low environmental impact, can be designed, analysed and implemented. The research approach is inter- and multidisciplinary and, where appropriate, oriented towards the analysis of complex systems. The approach to systems analysis is often applied in a life cycle perspective, based on knowledge of engineering and the natural and social sciences. The research is part of Mid Sweden University's research profile "The Forest as a Resource".

The PhD program in Ecotechnology and Environmental Science covers interdisciplinary studies of human society in interaction with nature, in particular with a focus on the development of new systems for a long lasting use of natural resources. The students are trained in scientific methodology and critical analysis for a continued career in academia or outside the university.

The Master's Program in Ecotechnology and Sustainable Development aims to build and strengthen the competence needed for a holistic approach towards sustainable development through the efficient use of natural resources. The undergraduate program in Ecotechnology is a three-year program leading to a Bachelor's degree in Environmental Science. The courses in Environmental Engineering and in Environmental Science are core courses in the study programs.

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Winter at Campus Östersund, Mid Sweden University. Photo: Stefan Linnerhag
Frontpage photo: Thomas Holmberg

Researchers

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The project cluster: Forest as a resource in sustainable societal development

Forest management

Growth potentials of biomass in Jämtland and Västernorrland, Sweden

There are numerous ways to increase the production in the forest. These include selection of tree species, genetic improvement, plant material, soil preparation, forest fertilisation, thinning management regimes, and optimal rotation period. Sweden stretches across 1500 km from its southernmost to northernmost point. Tree growth differs significantly throughout the country depending on local factors, such as soil and climatic conditions.

In this project the potential of existing and new forest management methods are studied to increase the production of biomass in Jämtland and Västernorrland. Differences in production are analysed for pine, spruce and other possible species by using computer models of forest growth. The distribution between different assortments - as lumber, pulpwood and biomass for energy purpose - at an increased growth is examined, and innovative forest management practices is studied. The potential of cultivation of fast growing ligneous biomass on surplus agriculture land is also analysed.

Jämtland and Västernorrland County in Sweden

Project period: 1 January 2008 – 31 December 2010

Contact: Johan Bergh, Leif Gustavsson and Bishnu Poudel

Adoption and diffusion of new forest management practices

Increased use of sustainably produced forest biomass to replace fossil fuels and non-renewable materials reduces greenhouse gas emission and mitigates climate change. An increased supply of biomass from Swedish forests is possible through introduction of new forest management practices. However, the diffusion of such practices will be largely influenced by the attitudes and perceptions of the forest owners since they make the adoption decision. It may be convenient and economical for them to use the existing management practices, but difficult to adapt to the new practices that are likely to be associated with various uncertainties and requirement for new knowledge, finance, and other logistical support. Forest owners need to understand the benefits and risks of new management practices, both in the short- and long run. In this project we study the knowledge, attitudes, and perceptions of the individual private forest owners towards new forest management practices. About 50% of the Swedish forest area is owned by private individuals.

Project period: 1 January 2008 – 31 December 2010

Contact: Krushna Mahapatra, Johan Bergh, Leif Gustavsson and Kerstin Hemström

Systems for efficient recovery and processing of biomass

Systems for efficient recovery and transportation of biomass

Biomass can be recovered, stored and handled in different ways which have implications for the economic, environmental and resource efficiency of biomass use. In this project we study how these efficiencies are altered by the choice of technical and logistic solutions for removal and transportation of biomass. Different options for large-scale and small-scale users and for processing and further distribution and export are analysed, and the potential carbon dioxide and oil use reduction per hectare of forest land are estimated. The efficiency of large and small scale systems and different locations are compared, and implications of an increased production and supply of biomass on these systems are considered. Consequences of an increased production and recovery of biomass for the carbon balance will be studied. Based on the results, efficient systems for removal, transportation and use of biomass will be discussed.

Project period: 1 January 2008 – 30 June 2011

Contact: Johan Bergh, Leif Gustavsson, Jonas Joelsson, Bishnu Poudel and Nguyen Le Truong

A harvester used in SCA's forest in final fellings.

Biorefineries for efficient use of biomass

The efficiency of forest resources use can be improved through co-production of several products. In biorefineries, various kinds of bioresources can be used to co-produce energy services such as electricity, transportation fuel, pellets and district heating and material products such as wood and fiber products and bio-based chemicals. The system analysis concept is used in this project to compare energy, carbon and economic efficiency of various biorefinery co-production systems. We consider the new technologies for bioenergy conversion in the context of and new methods of forest management which increase forest productivity, and analyze how the choice of technological and logistical solutions for recovery and transport of forest resources influences the use of biomass resources, taking into account scale of operation and transport distances.

Project period: 1 January 2008 – 30 June 2011

Contact: Leif Gustavsson, Jonas Joelsson and Nguyen Le Truong

Ortviken Paper Mill, SCA Graphic Sundsvall.

Wood construction and energy efficiency in built environment

Wood construction for energy efficient built environment

Energy efficient buildings largely based on renewable materials and energy will contribute to a sustainable built environment. We conduct environmental and economic analysis of construction and operation of traditional buildings and low energy buildings, and with different energy supply systems. We analyze primary energy use and greenhouse gas emission in a life-cycle perspective considering the production, operation, demolition and disposal of buildings. We include the entire material chain from natural resource extraction, material processing and assembly, building operation, and various post-use material-handling options. A focus of our work is the implications of using wood as a structural material in building construction. We analyse the potential environmental benefits coming from integrating and optimising the biomass and energy flows within the forestry, manufacturing, construction, energy, and waste management sectors.

Project period: 1 January 2008 – 30 June 2011

Contact: Ambrose Dodoo, Leif Gustavsson, Roger Sathre and Itai Danielski

Diffusion of wood-framed building technologies and energy efficiency measures in buildings

There are environmental benefits of improving primary energy efficiency of Swedish residential buildings. In the production of new apartment buildings the primary energy use could also be reduced by replacing concrete frames with timber. However, the successful implementation of such changes will depend, in addition to economical and technical factors, on the action of various actors which is guided by the institutional set up. For single-family houses, the homeowners are central actors in the diffusion process. They choose what measures to implement in existing houses. In apartment buildings the tenants have little control over decisions taken. The owner, contractor, consultant, architect, engineers, material suppliers etc. have the key roles. In the operation phase, a professional administrator usually makes the operation and investment decisions. Hence, the administrative organisation needs extra attention. External actors such as utilities, installers, retailers and energy advisors all have the possibility to motivate the owners/administrators of existing residential buildings to implement energy efficiency measures.

The diffusion of energy efficiency measures in residential buildings depend on how a need for such measures is created, what factors influence the choice between different measures, through what channels people and organisations receive the information that underlie their decision, and in what way the measures finally is implemented. In this project we study the attitudes and perceptions of the residential property owners to adopt various energy efficiency measures. We map out the external actors' views on energy efficiency and how they influence the owners. A part of the project is also to analyze various factors guiding selection of frame materials used in the construction of new multifamily houses. Particularly, we will investigate the attitudes of the relevant actors such as the owners, construction industry professionals, policy makers, and the general public towards wood as a construction material.

Project period: 1 January 2008 – 30 June 2011

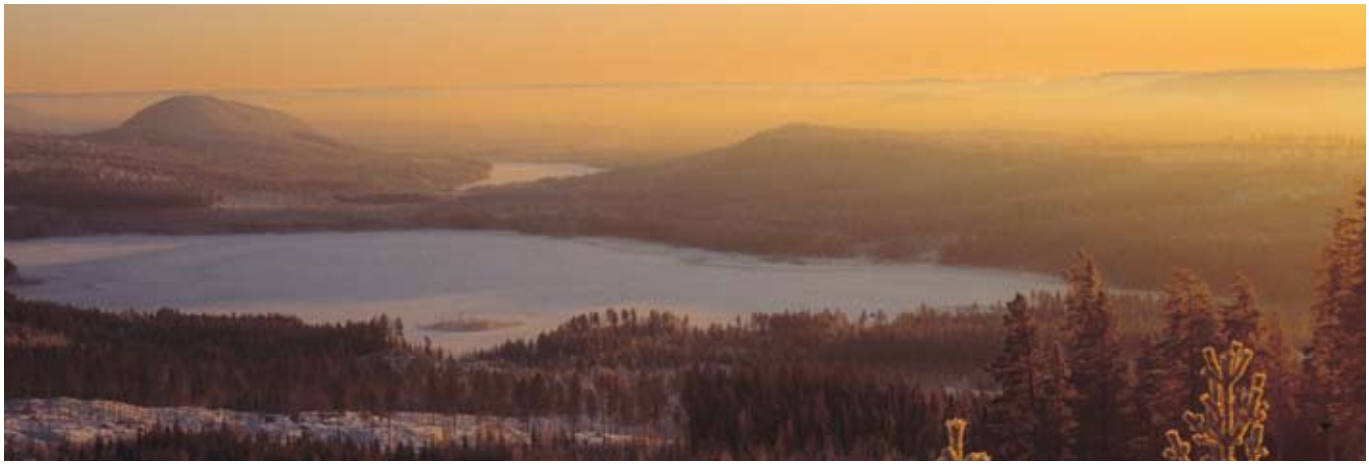
Contact: Leif Gustavsson, Kerstin Hemström, Krushna Mahapatra and Gireesh Nair

Integrated studies, implementation of research results and establishment of networks

Forest resources can contribute more effectively to sustainable development if the entire resource chain is integrated, encompassing the sectors of forestry, manufacturing, construction, energy, and waste management. Hence, we will integrate the results from the different projects in the project cluster "Forest as a resource in sustainable societal development" to better understand the full potential of the resources. We will also interact with actors in the entire forest products chain, from forest owners to end users of wood products, to understand their needs and constraints and to spread knowledge about our results. This will be done, for example, by study visits, seminars, web sites and by creating networks. Representatives from key actors within the region will constitute a reference group for this part of the project. Popular scientific articles will be produced to spread the research results to the public.

Project period: 1 January 2008 – 30 June 2011

Contact: Leif Gustavsson and Nils Nilsson



Winter forest view in Jämtland, Mid Sweden.

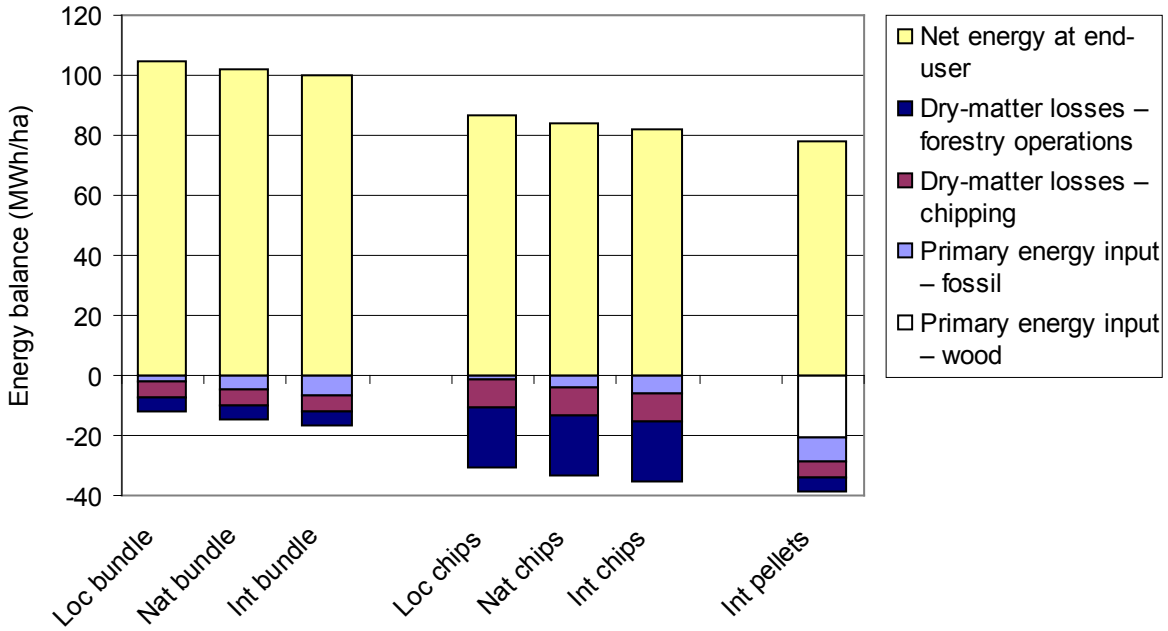
Recent doctoral theses

Forest fuel systems - comparative analyses in a life cycle perspective
Lisa N. Eriksson, doctoral thesis 2008

Forest fuels can be recovered, stored and handled in several ways and these different ways have different implications for CO_2 emissions and net recovered amount of biomass. Comparative analyses were made on different forest-fuel systems with a focus on the recovery and transport systems.

When determining potential CO_2 emissions avoidance, the transportation distance was found to be of minor importance as the type of transportation system. Large-scale, long-distance transportation of biofuels from central Sweden has the potential to be cost-effective and also attractive in terms of CO_2 emissions.

The most important factor analysed was the type of fossil fuel (coal, oil or natural gas) replaced together with the net amount of biomass recovered per hectare of forest land. Combined recovery of logging residues, stumps and small roundwood from thinnings from the same forest area give a high potential of reduced net CO_2 emissions per hectare of forest land. Compensation fertilization becomes more cost-effective and the primary energy use for ash spreading becomes low. The potential amount of available forest fuel as logging residues and stumps from final fellings and small roundwood from thinnings in Sweden was estimated to about 66 TWh per year. This may cost 1 billion €2007 to recover and 6.9 Mtonne carbon may be avoided if fossil coal was replaced.



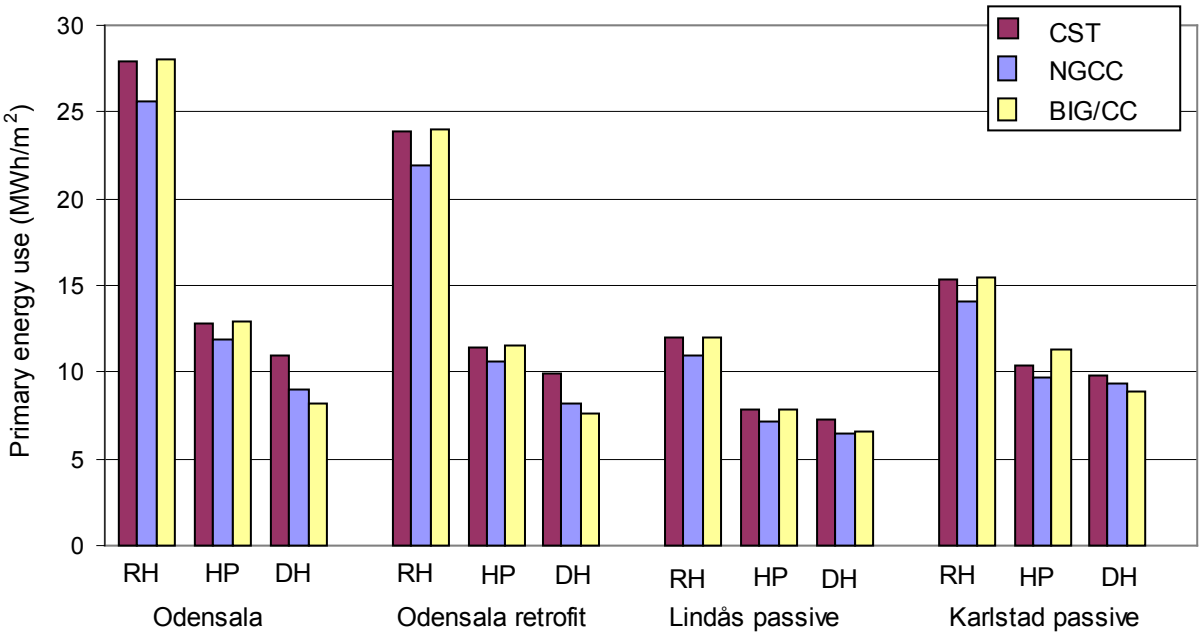
The figure shows energy balance per hectare of clearcut for different bio-fuel supply chains - bundle, chip and pellet system for local, national and international end-users. The differences in net bio-fuel at the end-user between the systems depend on differences in dry-matter losses and energy inputs. The chip system entails higher dry-matter losses in forestry operations and chipping than the bundle system. In the pellets options, part of the biomass is used in the drying process.

Primary energy efficiency and CO_2 mitigation in residential buildings
Anna Joelsson, doctoral thesis 2008

The Swedish building stock offers considerable opportunities for improving primary energy efficiency and reducing CO_2 emission. Increased energy efficiency of building envelopes, heating system conversion, and various technologies and fuels for production of electricity and heat were analysed with respect to primary energy use, CO_2 emission and societal cost. Both the production and operation phases of building life cycles were included, for several types of residential buildings. The studies were performed using process-based systems analysis in a life-cycle perspective where the energy chains were considered from the natural resources to the useful electricity and heat in the buildings.

The results show that for existing electric heated single family houses, the choice of heating system has a greater influence on the primary energy use than energy-efficiency measures on the house envelopes. The amount of primary energy used in the production of a new low-energy building is significant over the life cycle of the building. One way of reducing both the primary energy use and CO_2 emission in the production phase is to use constructions with wooden frames. The results show that wooden houses with a low energy demand and efficient energy supply systems will give very low carbon emission over their life cycle.

The house owners decide upon the changes to be implemented, and the changes must be perceived as sufficiently attractive to be adopted. The house owners' economic situation and their perceptions are related to the societal economic perspective and different policy instruments. The consumer electricity tax and subsidies for the conversion of electric heating encourage house owners to act according to current national energy policy. However, the effect on the house owners' annual cost was smaller than price variations between different energy suppliers.



Primary energy use for operating (space heating, hot water, household electricity) a conventional house built in the 1970s (Odensala) and the two passive houses (Lindås and Karlstad), when using different energy supply systems: resistance heating (RH), a heat pump (HP) and district heating (DH), based on coal (CST), natural gas (NGCC) or biomass (BIG/CC) for electricity and district heat production.

The choice of supply system has a considerable impact on the operating primary energy use. Implementing the energy-efficiency measures in the single-family house in Odensala (Odensala retrofit) lowered the primary energy use of operation by 14% if it was assumed to be heated by resistance heating. District heating and heat pumps were clearly more energy-efficient than resistance heating, and the natural gas combined cycle (NGCC) technology was more efficient than coal-based steam turbine technology CST. Choosing biomass-based district heating (DH+BIG/CC) instead of resistance heating resulted in a 70% lower primary energy use.

Diffusion of innovative domestic heating systems and multi-storey wood-framed buildings in Sweden
Krushna Mahapatra, doctoral thesis 2007

The diffusion of innovations that promote sustainable use of forest resources and energy efficiency will reduce greenhouse gas emission and dependency on oil. The 'systems of innovation' (SI) approach was used to analyse the diffusion of multi-storey wood-framed buildings and wood pellet heating systems in Sweden. This approach was complemented with the 'adopter-centric' approach to analyze diffusion of competing innovative heating systems.

The systems of innovation analyses showed that several sources of path dependency, resulting from the establishment and growth of the concrete-based construction system over the past 100 years, hindered the expansion of a wood-based multi-storey construction system. However, development of the wood construction system was possible due to government policies and funding, the wood industry's interest in expanding the market for value-added wood products, and the involvement of the wood research community.

The growth of the pellet market during the last decades was mainly due to the national energy policy, an abundance of raw material and existence of district heating systems. But, a lack of coordination between the fuel and equipment suppliers in the early phase of market development, relatively high operating cost, lack of information and dissatisfaction among early adopters contributed to a slow growth rate.

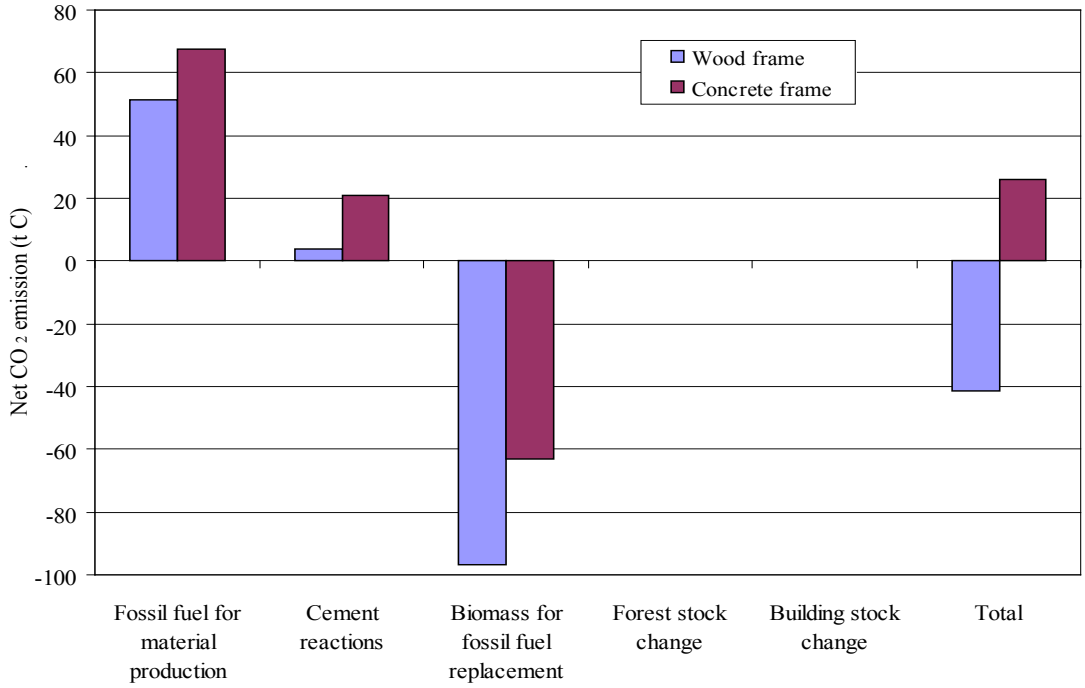
The 'adopter-centric' model was operationalized through household questionnaire surveys: one covering the whole of Sweden in 2004 involving 1500 randomly selected homeowners, and another in the city of Östersund in 2005 of 700 homeowners who had resistance heaters. The same homeowners in Östersund were resurveyed in 2006 to study the influence of a marketing campaign and a package district heating offer. Results showed that about 80% of the respondents, particularly those with resistance heaters, did not intend to install a new heating system. But, the marketing campaign and the package offer motivated 78% of the respondents in Östersund to adopt district heating system. Economic aspects were the most important factors in respondents' choice of a new heating system. Low priority was given to environmental aspects. Hence, economic policy instruments to internalize the external costs are likely to be effective in inducing homeowners to install innovative heating systems. Also, the provision of a government investment subsidy to replace resistance heaters with innovative heating systems seems to be appropriate. Homeowners thought that a heat pump had more advantages over a pellet boiler and therefore, such systems diffuse faster in Sweden.

The valley of the Indal River in Mid Sweden.

Life-cycle energy and carbon implications of wood-based products and construction
Roger Sathre, doctoral thesis 2007

The mechanisms by which wood product substitution can affect energy and carbon balances include: the energy needed to manufacture wood products compared with alternative materials; the avoidance of industrial process carbon emission from e.g. cement manufacture; the use of wood by-products as biofuel to replace fossil fuels; and the physical storage of carbon in forests and wood materials. In this thesis, a life cycle perspective was employed encompassing the entire product chain from natural resource acquisition to material disposal or reuse. A methodology was developed and was then used to compare functionally-equivalent buildings with wood-frames and reinforced concrete frames. The results showed that less primary energy is needed to produce the wood-framed buildings than the concrete-frame buildings. CO_2 emission was significantly lower for the wood frame buildings, due to reductions in both fossil fuel use and cement calcination process emission. The most important single factor affecting the energy and carbon balances was the use of biomass by-products from the wood product chain as biofuel to replace fossil fuels.

Different forest management regimes were studied in an integrated carbon analysis to quantify the carbon flows and stocks associated with tree biomass, soils, and forest products. Intensified forest management that produces greater quantities of biomass leads to net CO_2 emission benefits by augmenting the potential to substitute for fossil fuels and non-wood materials. The increased energy use and carbon emission required for the more intensive forest management, as well as the slight reduction in soil carbon accumulation due to greater removal of forest residues, were more than compensated for by the emission reduction due to product substitution. In the long term, the active and sustainable management of forests, including their use as a source for wood products and biofuels, allows the greatest potential for reducing net CO_2 emission. Implementation issues related to the wider use of wood-based materials to reduce energy use and carbon emission were also explored, including analyses of the effects of energy and taxation costs on the economic competitiveness of materials, and of added value in forest product industries.



Carbon balance over the complete life cycle of functionally-equivalent apartment buildings made with a wood-frame or a concrete-frame. Production of materials for the wood-frame building releases less carbon emissions from fossil fuels and cement process reactions. The wood-frame building produces more biomass residues that can replace fossil fuels. Over the complete life cycle, there is little or no change in carbon stock in the forest biomass and building material. The total life cycle carbon balance is significantly lower for the wood-frame building than for the concrete-frame building.

Other recent research

Bioenergy; costs, environmental impacts and use of natural resources

We explored costs, environmental impacts and resource use for different types of biomass-based systems and related them to fossil-fuel based systems. Evaluating potential ways to replace fossil fuels with biomass is complex, as many interacting factors and their development over time have to be taken into account. The focus of interest has been to identify efficient ways to reduce CO_2 emissions and oil use through the use of biomass, and to study trade-offs between these two objectives.

We studied opportunities to increase the use of biomass in the energy sector, including potential expansion of current technologies and systems, for example in the district heating sector, as well as the introduction of new technologies, such as gasification-based polygeneration of electricity, transportation fuels and electricity. The potential to increase the biomass use efficiency in pulp and paper industry through energy efficient pulping technologies and black liquor gasification was also studied. Black liquor gasification is a novel technology for the recovery of pulping liquors in chemical pulp mills.

The results indicate that the use of biomass can significantly reduce oil use and CO_2 emissions, but there is a trade-off between the reductions in oil use and CO_2 emission. Biomass gasification is found to be an important technology to achieve large reductions, irrespective of whether oil use or CO_2 emission reduction is prioritised. Oil use and/or CO_2 emissions can be reduced efficiently

- if oil-fired boilers or electric heating is replaced by district heating from biomass-based combined heat and power generation,
- if electricity or motor fuel is produced from black liquor gasification in pulp mills or
- if wood is used instead of concrete in building construction.

The introduction of plug-in hybrid cars appears to be a promising option for reduced CO_2 emissions and oil use in the transportation sector. More fossil motor fuel can be replaced if biomass is used to generate electricity for plug-in hybrid vehicles than if it is used to produce motor fuel.

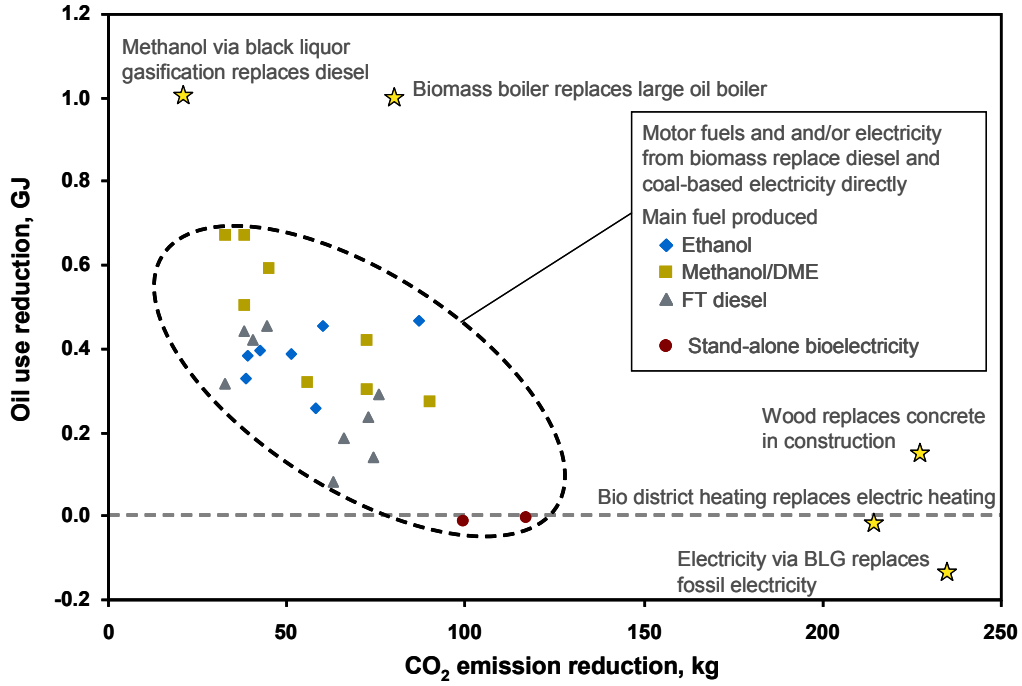
Contact: Leif Gustavsson and Jonas Joelsson

References:

Gustavsson, L., Holmberg, J., Dornburg, V., Sathre, R., Eggers, T., Mahapatra, K. and Marland, G. (2007). Using biomass for climate change mitigation and oil use reduction. Energy Policy 35(11): 5671-5691.

Joelsson, J. M. and Gustavsson, L. (2008). CO_2 emission and oil use reduction through black liquor gasification and energy efficiency in pulp and paper industry. Resources, Conservation & Recycling 52(5): 747-763.

Joelsson, J. M. and Gustavsson, L. Reduction of CO_2 emission and oil dependency with biomass-based polygeneration. Manuscript.



CO_2 emission and oil use reductions with 1 GJ of biomass input. Motor fuel and electricity co-production from biomass is compared to biomass use in heating, construction and pulp mill applications. Several options are shown for motor fuel and electricity co-production, with different motor fuel types and with motor fuel and electricity produced in varying proportions.

Forestry and use of wood to mitigate climate change

A comprehensive analysis of the climate effects of increased wood use in the construction sector requires the integration of a range of models, including models of wood substitution, sector product markets, and forest management at regional and stand levels. In this project we developed such an integrated modeling framework to demonstrate the viability of the approach and to identify needed improvements.

We developed four wood construction scenarios depicting wood consumption up to the year 2030 for the European construction sector. The roundwood demand in each year was distributed among supplying countries by a partial equilibrium model for the forest sector that encompasses forestry, wood-using industries, and markets for roundwood and forest products. Resulting data on harvest volumes or timber prices were then used in a forest regional model for Sweden, where harvest levels were derived by assuming that forest owners maximize their net present value over an infinite horizon with current prices. More detailed analysis of the management implications was performed with a stand model, an individual-tree, distance-independent growth and mortality model that finds optimal steady state stand management programs (planting density, timing and form of thinning and time of final harvest).

Preliminary modeling results showed that by 2030, the increased wood demand causes softwood sawlog prices to increase from the base case level. The growth in softwood lumber production makes sawlog chips supply more abundant and leads to decline in the pulpwood harvests and price. The changes in the price relations between sawnwood and pulpwood lead to a change in the management programs towards prolonged rotations, leading to a medium term reduction of sawnwood supply. Long term steady state conditions indicate small differences in carbon stock due to the price increases predicted by the scenarios. Sawnwood output increases, but is in most cases balanced by a similar reduction of pulpwood. Rotations are prolonged and for several stand types the number of thinning is increased.

This modeling system represents an ambitious effort to combine models from different disciplines into one coherent system. The experience has identified several areas that need improvement. The most problematic part of the system appears to be the linkage between the partial equilibrium model for the forest sector and the forest regional model. In particular, the reaction of supply stemming from different price relations between sawnwood and pulpwood needs to be harmonized. The detailed stand level model and the regional forest model could also be better integrated with each other. A number of common parameters that are used in the different model, such as carbon emission factors and discount rates, need keen attention to ensure overall consistency.

The work is a cooperation between Mid Sweden University, Swedish University of Agricultural Sciences, Finnish Forest Research Institute (METLA), University of Helsinki, VTT Technical Research Centre of Finland, Norwegian University of Life Sciences (UMB), and Norsk Treteknisk Institutt.

Contact: Leif Gustavsson and Roger Sathre

Reference:

Eriksson, L.O., Gustavsson, L., Hänninen, R., Kallio, M., Lyhykäinen, H., Pingoud, K., Pohjola, J., Sathre, R., Solberg, B., Svanaes, J., and Valsta, L. Climate implications of increased wood use in the construction sector: Towards an integrated modeling framework. Manuscript.

Photo: Thomas Holmberg

Primary energy use and carbon balance of the Limnologen building

We analyzed the primary energy use and CO_2 emission over the lifecycle of the Limnologen building, an eight-storey apartment building in Växjö, Sweden made with a wood structural frame. The analysis covers all the life cycle phases of the building, including the acquisition of raw materials, the processing of raw materials into building materials, the assembly of materials into a ready building, the occupation or use of the building, the demolition of the building and the disposal of the demolition material.

We found that the operation of the building uses the largest share of lifecycle energy use, becoming increasingly dominant as the life span of the building increases. The type of heating system plays a major role for primary energy use and CO_2 emission, since it affects what type of energy supply chains are used. A biomass-based district heating systems achieves low primary energy use and very low CO_2 emissions. During the construction phase of the building, more bioenergy can be obtained from residues from the wood products chain (forest residues, wood processing residues, and construction site residues) than is used to produce the building. Additional bioenergy can be obtained at the end of the building life cycle if wood-based demolition residues are recovered and used as biofuel. The use of recovered biofuels to substitute for fossil fuels significantly reduces the net emission of CO_2. We need to adopt a life cycle perspective involving construction, the use and demolition of buildings as well as energy supply when thoroughly evaluating the primary energy and climatic impacts of buildings.

Contact: Leif Gustavsson, Anna Joelsson and Roger Sathre

Reference:

Gustavsson, L., Joelsson, A. and Sathre, R. Life cycle primary energy use and carbon emission of an eight-story wood-framed apartment building. Manuscript.

The Limnologen buildings, eight-storey apartment buildings in Växjö, Sweden made with wood structural frames.

A synthesis of research on wood products and greenhouse gas impacts

Sathre and O'Connor have reviewed scientific literature addressing the net life cycle greenhouse gas emissions of wood construction products. A total of 48 international studies were reviewed for findings on fossil energy used in wood manufacturing compared to alternatives, the avoidance of industrial process carbon emissions as with cement manufacturing, the storage of carbon in forests and forest products, the use of wood by-products as a biofuel replacement for fossil fuels, and carbon storage and emission due to forest products in landfills. Interpretation of the various findings sought to clarify whether actively managing forests for wood products is better, worse or neutral for climate change versus leaving forests in their natural states and instead using non-wood materials. Data from a subset of the reviewed studies were then used in a meta-analysis of displacement factors, that is, the quantification of greenhouse gas emission avoided per functional unit of wood used in place of other materials. All of the studies reviewed found that the production of wood-based materials results in less greenhouse gas emission than the production of alternatives. Over the complete life cycle of wood products, the great majority of studies also found lower total emission for wood products. End-of-life management of wood products is the single most significant variable for the full life cycle carbon profile of wood products. The few studies with scenarios in which the greenhouse gas emission of wood products is greater than of alternatives addressed worst-case wood disposal options. The overall consensus provides a clear carbon rationale for increasing wood substitution in place of other products, provided that forests are sustainably managed and that wood waste and by-products are used responsibly.

Contact: Roger Sathre

Reference:

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Funding

Funding bodies supporting our research include:

- Mid Sweden University
- Swedish Energy Agency
- County Administrative Board of Jämtland
- Sveaskog AB
- SCA Forest Products
- Norrskog/Sågverkens träprodukter AB (SÅTAB)
- Jämtkraft AB
- Centrum för byggande och boende med trä (CBBT)
- Nordic Forest Research Co-operation Committee (SNS)
- Växjö University
- European Commission: Objective II, European Structural Funds

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Mid Sweden University

Mid Sweden University is situated in a region that reaches from sea to the high mountains between the Gulf of Bothnia and the border to Norway. It is characterized by great forests, rivers and lakes, and gives many opportunities for outdoor activities.

Mid Sweden University is a network-university with campuses in three cities: Härnösand, Sundsvall and Östersund. We combine the intimacy of a small university, enabling close contact between students, staff and the surrounding community, with the variety and resources of a large university.

The six prioritised research areas of Mid Sweden University, mentioned on the first page, often address regional issues along with their national and international concerns.

There is a wide choice of undergraduate courses with strong links to research. A large part of the educational programme is multi-disciplinary. In several disciplines Mid Sweden University is one of the leading educational institutions in distance education in the country. The concept of flexible learning describes our approach to teaching and learning.

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