Featured Topics

Forests, Wood Products and Climate Policy

Tarmo Räty

Forests have three key roles in climate policy. Firstly, forests sequester carbon dioxide from the atmosphere as they grow. Secondly, wood products in different forms store carbon that was initially captured from the atmosphere. Thirdly, wood can replace energy-intensive materials or, directly, fossil energy sources. Research has demonstrated that these roles do not conflict with each other. This article discusses first the climate policy potential of wood products in Finland and then goes on to examine forests and wood products in the light of the climate negotiations taking place in autumn 2009.

The agreements on limiting greenhouse gas emissions under the Kyoto Protocol to the UN Climate Convention extend to 2012. The countries that have ratified the Protocol must submit a national greenhouse gas inventory annually to the UNFCCC Secretariat. The inventory is required to give estimates of anthropogenic greenhouse gas emissions into the atmosphere and removals from the atmosphere into so-called sinks. In Finland, forests and wood products are categorised as sinks. In 2007, 32.8 mill. tonnes of carbon dioxide was sequestered by Finnish forests and 1.2 mill. tonnes stored in wood products. These figures correspond to less than half of the country's emissions from the energy supply sector, industry and transport.

Reporting on changes in the forests' carbon store is mandatory under the Kyoto climate treaty. No such obligation applies to wood products. The actual emissions trading system extends only to emissions from the energy supply sector and industry. Negotiations on a successor to the Kyoto climate treaty are being undertaken in autumn 2009. The most significant change will be the stronger climate policy commitment of the emerging economies and the developing countries. In setting national climate policy obligations it will also be necessary to reassess the reporting practices for forest management and land use changes and for wood products, and the significance of these.

Potential Role of Wood Products in Finland's Climate Policy

Construction accounts for about 70% of the domestic consumption of Finnish sawnwood. The wood contained in the country's building stock is therefore central to any assessment of the size of the carbon store. Information on the frame, cladding and floor materials of the building stock and of the civil and hydraulic engineering structures is being collected in national statistics. A comprehensive estimate of the carbon stored in the building stock has been made at approximately five-year intervals since 1990.

The inventory shows that the carbon store in buildings and other wood-based products is approximately 21 mill. tonnes. Detailed information on the relative size of this carbon store for comparison purposes is not available, but the figure is large in international terms. The figures show that Finns use five times more wood products than the EU average. The climate policy goal for construction is to increase the long-term carbon store. The carbon store has been growing at about 1.5% annually in recent years. Although this corresponds to only a small proportion of Finland's annual greenhouse gas emissions, it is a very inexpensive way of bringing about change, as timber construction has a significant multiplier effect on fossil-based greenhouse gas emissions.

The use of wood products can replace fossil energy sources, both directly and indirectly. Using wood as a fuel is climate neutral: it releases no more carbon dioxide into the atmosphere than that which was sequestered by the growing tree. If the wood is from a sustainably managed forest, the carbon balance sheet will remain in balance when the forest is regenerated. However, if the wood replaces the use of oil, gas or peat, which contain fossil-based carbon, the use of wood will actually reduce anthropogenic greenhouse gas emissions.

Indirectly, the use of wood can be a significant replacement for fossil-based greenhouse gas emis-

Table 1. Carbon dioxide balance sheets for different construction units. Embodied emissions in production less sequestered CO_2, CO_2 kg/m².

	Concrete	Breeze block	Brick	Steel	Wood
External walls	90	65/58	96	70	– 13
Interior walls	38	18	32	20	– 9
Facades	42		28	10	– 19

Source: Viljakainen 2009

sions. In comparisons of building structures based on the environmental product declarations drawn up by manufacturers of building materials, the carbon dioxide emissions (mainly fossil-based) of concrete or brick external walls are more than 90 kilos per square metre. The manufacture of a corresponding wooden external wall would store more than 10 kilos of carbon dioxide from the atmosphere. Comparisons with other construction units produce similar results (Table 1). Reducing emissions through choice of building materials is clearly cost-effective, as the costs of building components that are similar in terms of their properties do not differ greatly from each other.

In analysing the entire lifecycles of buildings, the role of building materials in total energy use is small, however. The direct climate impact of heating would in fact appear to be a quicker way of influencing the climate than the choice of building materials. In Finland, the scope for increasing the use wood chips is considerable. In 2007, wood chips accounted for only 1.3% of all energy use, but the target set in the National Forest Programme is to achieve at least a tripling of the use of chips by 2015. Depending on the type of fuel that wood chips replace in generating heating, the amount of fossil-fuel based carbon dioxide emissions is likely to fall by 3.3–6.4 mill. tonnes, or 4.2–8.1% on the 2007 level.

Compared with heat generation, wood processing for use as a transport fuel is efficient only if the amount of energy used in producing such fuel is low. The second-generation transport biofuels under development will allow a reduction in greenhouse gas emissions by as much as 85% compared with fossil fuels. The realisation of this would, however, require a lot in terms of raw material availability and opportunities for utilising the waste heat from the biofuels manufacturing process. Competition in manufacturing transport fuels is global, however, as they can in principle be produced from any plant material. In this competitive arena, Finland's forests are not the most efficient producers of biomass. Their advantage lies in their extensive coverage and in the complementary forms of use of the forests. What is more, Finland's forests do not compete for land resources with food production.

Forests and Wood Products in Global Climate Policy

The climate treaty negotiations under way also concern wood products and forests. It is very unlikely that wood products will be included in the emissions trading that starts in 2013. Nevertheless, the reporting obligation on the carbon stored in wood products will probably be expanded. This will require agreement on the calculation methods.

The first problem of principle is whether the extent of carbon sinks in forests and wood products should be compared against some base period or whether it is enough that the annual changes are monitored. If sinks are always compared against some past base period, this would encourage sinks to be maintained at higher levels all the time and penalise levels below the limit. This could be a problem in terms of forest use if the sink in a certain year was to fall temporarily. Furthermore, it is evidently impossible to define a base year that would be fair to all parties. The alternative is to calculate the sinks on an annual basis. This straightforward calculation method would be beneficial to a country such as Finland, as it would allow the harmonisation of the goals regarding different forest uses with the goals of climate policy.

A greater problem of principle is to determine how forest sinks would be included in setting emission reduction obligations. As Finland's forests currently sequester almost half of the country's anthropogenic emissions, other countries would not wish to grant Finland such a windfall advantage in emissions calculations. In the current treaty period there has been no climate policy parameter as an incentive for increasing sinks. In the case of the carbon sink of Finland's forests, it has only been possible to include a fixed amount of 0.6 mill. tonnes annually in the calculations. This is why it is important that a relative ceiling figure be approved for the post-Kyoto period, which would change in accordance with the sink achieved.

For wood products, there is an interesting debate on whether the carbon stored within them should be calculated towards the carbon balance sheet of the tree growers or of the product users. In addition, it would be natural from the climate change viewpoint to calculate only net atmospheric emissions for the forests and wood products. However, as this is, in practical terms, impossible, there have been two basic options proposed: models based on either the production of wood products or the change in stocks within national borders.

In the production model, all wood products would be included, even those exported from the country. In this model, a net exporter like Finland could include in its carbon store all the wood it produces, regardless of the country in which the wood is located during its different lifecycle stages. This model would open up new opportunities for wood product exports, as the international construction market would be unlimited for a sawmilling industry the size of that found in Finland. On the other hand, the model would not give countries any climate policy incentive to buy Finnish wood products. Technically, the calculation basis would be difficult to implement, but not completely impossible.

By contrast, the stock change model would allow each country to calculate the change in the carbon store within its own national borders for its own benefit. Under the current practice, whereby non-fossil carbon transferred over national borders is not directly covered by emissions trading, the stock change model would favour an increase in the long-term use of wood domestically. Countries importing forest products could include their purchases in their own carbon balance sheet. If this carbon store were one day to be included in emission trading, this would be an incentive for increasing wood use everywhere.

The climate negotiations under way will determine solutions affecting the use of wood, but without economic penalties their effect may be small. In the future, the indirect advantage of deducting the sink of forests and wood products from other emissions would continue to fall outside the forest sector. The solutions presented above can be examined independently of each other, but emissions trading, forest use and wood products must be viewed in their entirety. If non-fossil carbon storage in wood products is to be credited, it would be natural to extend the same incentives and penalties to the entire lifecycle of wood products, from the use of land right through to combustion. The end result would be very hard to predict and both the advantages and disadvantages would be split unevenly among the parties concerned.

Sources:

Bioenergia maa- ja metsätaloudessa Working group on bioenergy production, Ministry of Agriculture and Forestry, 2008. Ministry of Agriculture and Forestry. Memorandum. Helsinki. (In Finnish)

Energy Statistics. Yearbook 2008. 2009. Statistics Finland.

Finnish Statistical Yearbook of Forestry 2008. Finnish Forest Research Institute.

Kansallinen metsäohjelma 2015 – toteutuminen 2007–2008. 2009. Ministry of Agriculture and Forestry publications 3/2009. (In Finnish)

Pingoud, K. & Perälä, A-L. 2000. Arvioita puurakentamisen kasvihuonevaikutuksista. VTT Technical Research Centre of Finland, publications 840. VTT. Espoo. (In Finnish)

Pingoud, K., Perälä A-L., Soimakallio, S. & Pussinen, A. 2003. Greenhouse gas impacts of harvested wood products. VTT research notes 2189. VTT Espoo.

Taverna, R., Hofer, P., Kaufmann, E. & Thüring, E. 2007. The CO2 Effects of the Swiss Forestry and Timber Industry. Scenarios of future potential for climate-change mitigation. Environmental studies No. 0739. Federal Office of the Environment. Bern. 102 p.

Upton B., Miner R., Spinney M. & Heath, L. S. 2008. The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. Biomass and Bioenergy 32(1): 1-10.

Viljakainen, M. 2009. Rakennustuotteiden valmistuksen ja rakentamisen aiheuttamista ympäristörasitteista – riittävätkö uudet energiatehokkuusvaatimukset. Finnish Forest Industries Federation, 10.3.2009. (In Finnish)

Will the Growth in Forest Energy Use Continue?

Antti Asikainen and Perttu Anttila

Use of Wood Chips from Forests has Increased Sharply Since 2000

Finland is committed to raising the proportion of renewable energy sources in its energy production. One of the key means is through increasing the use of 'forest chips', which are wood chips obtained from forests rather than sawmill chips. The National Forest Programme includes the target of increasing the use of forest chips to 8–12 mill. m^3 by the year 2015. According to Finland's National Climate and Energy Strategy the use of forest chips should be increased to 12 mill. m^3 by 2020.

Since 2000, the number of installations using forest chips has tripled to more than 420 (Figure 1). Most of these new installations are outside the forest industry, being mainly municipal district heating plants, although the number of combined heat and power plants has also increased. The use of forest chips has correspondingly grown steadily, apart from a dip in 2007 (Figure 2). About three quarters of the forest chips used in heat and power plants is from crown mass and stump wood from final cutting, and the rest is small-diameter trees from young stands. Almost all the small-diameter trees used by heat and power plants are whole trees, including branches, and only 10% comprises debranched stems. The chips for residential fuelwood comprise mainly small-diameter stems.

Reduction in Commercial Fellings is a Challenge for Increased Use of Forest Energy

The Finnish Forest Research Institute has calculated the forest chip potential for different raw material sources (Laitila et al. 2008). In principle, the potential would be easily sufficient to cover the targets for chip use, as the combined annual harvesting potential of crown mass and stump biomass from final cutting and energy wood from young stands is approximately 16 mill. m^3. It is estimated that final cutting could generate an annual 6.5 mill. m^3 of softwood crown mass and 2.5 mill. m^3 of spruce stump biomass. Most of the crown mass would be from spruce. The estimate of potential assumes that commercial fellings remain at almost 55 mill. m^3.

Final cutting in spruce stands is therefore in a key position in this regard. The forests' spruce reserves have been in full use, and fellings have decreased in the past few years. As it is likely that sawnwood production will remain below the level seen in the early years of this decade for some time yet, this will also be the case for fellings of spruce sawlogs, and so there will inevitably be less crown mass and stump biomass as by-products. The supply of fuel for forest chip users is also hampered by the often wide annual variation in fellings of commercial roundwood.

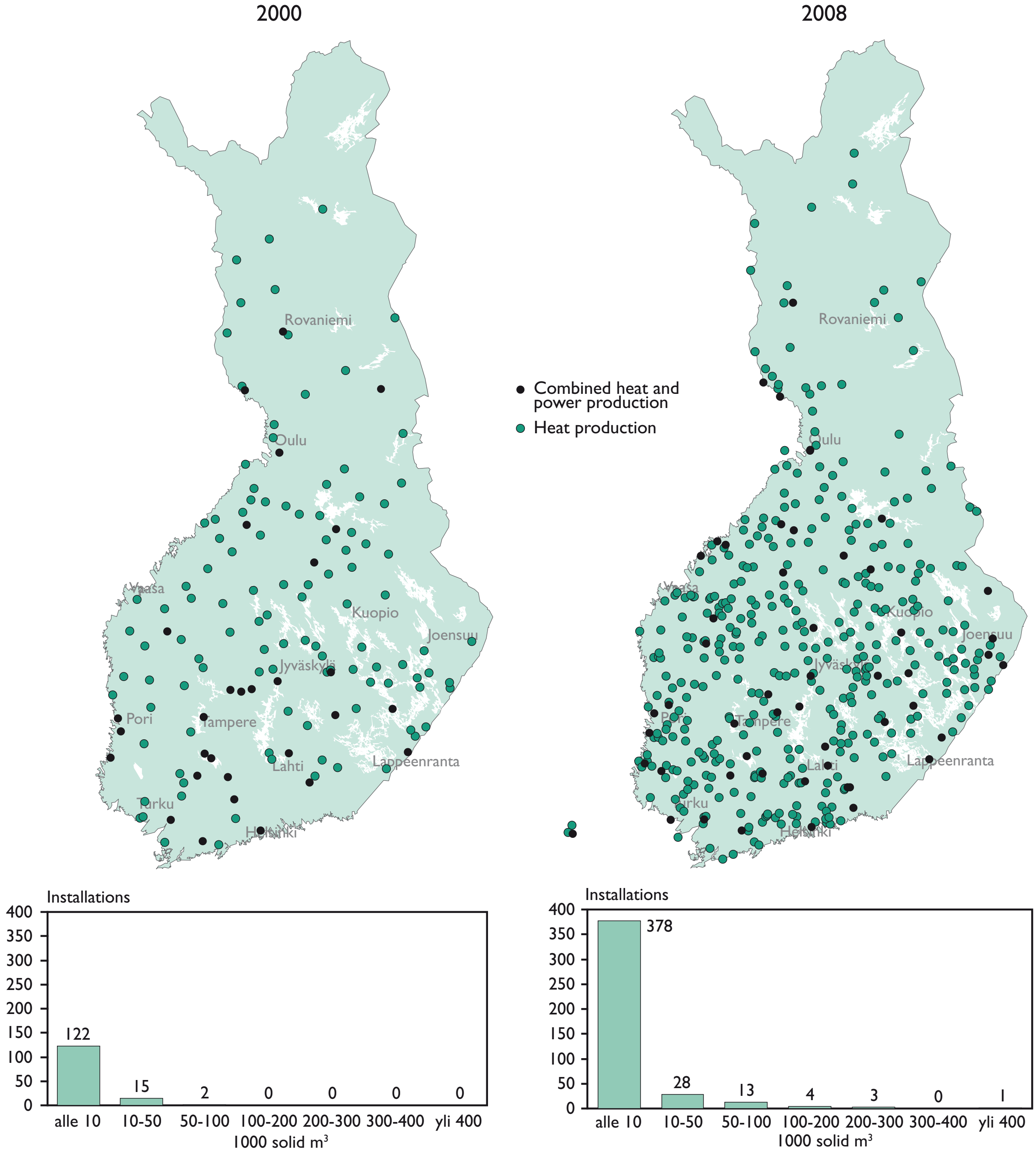
Ways of Increasing Forest Energy Use

The impact of fluctuations in the economy on the availability of forest chips can be reduced by increasing the supply of chips from young stands. When small-diameter trees are the principal product of a felling, then the felling can be carried out independently of the forest industry's roundwood consumption. According to figures from the Finnish Forest Research Institute, the energy wood harvesting potential from advanced seedling stands and young thinning stands is 6–7 mill. m^3.

The forest industry's need for pulpwood has also declined – probably on a permanent basis. The industry's capacity cuts in 2007–2009 have resulted in 9 mill. m^3 of wood being 'liberated' for other uses. With the energy industry's ability to purchase roundwood improving at the same time, and with insufficient amounts of combustible peat being available, some of the wood meeting the dimensional and quality requirements for industrial wood has already been directed for energy production.

In June 2009, the average price of forest chips was already at a level of EUR 18.8/MWh, which corresponds to a factory price of about EUR 37.6/m^3. The average price includes chips from felling residues, from stumps and from small-diameter trees. Chips from small-diameter trees are better in quality and also more expensive than other forest chips, and so the average price is likely to be around EUR 40/m^3 already. Adding together the average costs of harvesting (EUR 12.9/m^3), transportation (EUR 8.6/m^3), chipping (EUR 7.0/m^3) and organising procurement (EUR 1/m^3) in the case of the industry's pine pulpwood results in a procurement cost of EUR 29.5/m^3 (harvesting and transportation costs: Kariniemi 2009). It can be assumed that the transportation distance in the case of forest chips is shorter than for the industry's pulpwood, which would therefore reduce the costs for energy wood. In any event, there would appear to be a stumpage price for the energy use of small-diameter trees, even in the case of sites that remain outside the state subsidies.

Harvesting in young stands has also been limited by the high cost of harvesting, which has been partially compensated by subsidies. Chips from felling residues and stumps and, in today's market, from stems in traditional pulpwood stands, are even now competitive fuels, and they come to market without any production subsidies. Subsidies must therefore continue to be targeted at young stands that have almost no timber meeting the dimensional requirements for industrial wood.



Source: Finnish Forest Research Institute

Figure 1. Heat and power plants using forest chips in 2000 and 2008, and by volume used.

Pulpwood Energy Use: Permanent Change or Temporary Phenomenon?

The energy use of forest chips has grown by about 450 000 solid m³ per year in the period 2000–2008. Two thirds of all the chips are from spruce-dominant final cutting and about one third from young thinning stands. The significant reduction in final cutting in 2008–2009 has directed energy wood procurement increasingly to young thinning stands and to first thinning stands. This trend has also been hastened by the weakening demand and lower prices for pulpwood. At the same time, the willingness to purchase forest chips has improved considerably, in part as a consequence of the general rise in energy prices, and in part due to the poor availability of peat.

With the industry still having abundant pulpwood stocks, and there being a shortage of solid wood fuel in energy production, there are good reasons why the direct energy use of pulpwood should be increasing.

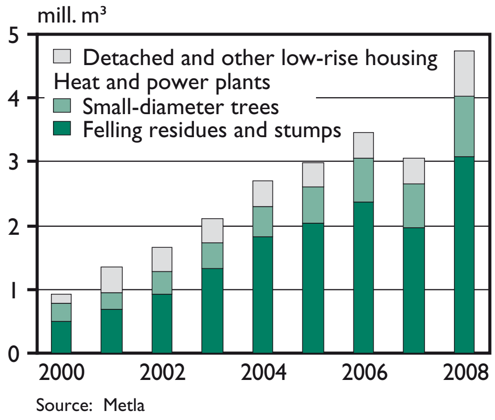


Figure 2. Use of forest chips since 2000.

Over the coming year, the energy use of wood will grow, making up for the drop in demand for industrial wood and providing business for companies in the procurement chain, and thus work for their employees and machinery.

There is also good reason to assume that the energy use of forest chips will continue growing in the future. Many factors driving energy policy and forest policy will steer the trend in this direction. Globally, it looks like the southern hemisphere will increase in significance as a pulpwood producer, whereas in Europe there will be a greater political and economic focus on energy production. This greater focus on energy will also be reflected in Finland's forest uses and the future of the forests, whether or not energy is derived directly from the forests or via the by-products of the processing industry.

Sources:

Finland's National Forest Programme 2015. 2008. Ministry of Agriculture and Forestry. Publications No 3b/2008. 50 p.

Kariniemi, A. 2009. Puunkorjuu ja puutavaran autokuljetus vuonna 2008. Metsäteho results: slide series 13a/2009. 31 p. www.metsateho.fi/uploads/Tuloskalvosarja_2009_13a_Puuhuoltotilasto_aka_1.pdf (In Finnish)

Laitila, J., Asikainen, A. & Anttila, P. 2008. Energiapuuvarat. In: Kuusinen, M. & Ilvesniemi, H. (eds). Energiapuun korjuun ympäristövaikutukset. Publications of Tapio and METLA. www.metsavastaa.net/energiapuu/raportti (In Finnish)

Pitkän aikavälin ilmasto- ja energiastrategia. Government report to Parliament of 6 November 2008. 130 p. www.tem.fi/files/20585/Selontekoehdotus_311008.pdf (In Finnish)

Polttoaineiden hintataso. 2009. Bioenergia 4/2009. (In Finnish).

Torvelainen, J. 2009. Pientalojen polttopuun käyttö 2007/2008. Metsätilastotiedote 26/2009. 4 p. www.metla.fi/metinfo/tilasto/julkaisut/ (In Finnish)

Ylitalo, E. 2009. Puun energiakäyttö 2008. Metsätilastotiedote 15/2009. 7 p. www.metla.fi/metinfo/tilasto/julkaisut/ (In Finnish)