

**Forests and energy in the Karelian Arctic: an attempt at a regional model**

**V. M. Pohjonen  
University of Joensuu  
Joensuu, Finland**

Karelian Arctic can be defined as an ecological zone stretching from Estonia to the Barents Sea, between 27 and 32 longitude, along both sides of the border

between Finland and Russia. It is characterized by abundant boreal forests, some of them the last wilderness forests in western Europe.

**FOREST BIOMASS RESOURCE IS INCREASING**

According to recent studies (e.g., Kauppi et al. 1992) forest biomass and its annual growth are currently increasing in Europe. This has especially been the case in northern Europe: Sweden, Finland, and most apparently in Russian Karelia, although long term forest inventory results from this region are missing.

Forest damage in severely polluted areas, such as in Monchegorsk in the northern part of the Karelian Russian Arctic, do occur. But as a whole the fraction of damaged forest areas is still small: in western Europe only 0.5 per cent of the total.

There are three apparent reasons for the increase in woody biomass. First, silviculture and forest management have advanced to sustained forestry, and even to progressive forestry. Second, industrial nitrogen emissions have created a forest fertilization effect. Third, increased carbon dioxide content in the atmosphere has a positive effect on the growth of the trees.

Increased woody biomass, its conservation, sustained use and prevention of further forest damage, are the greatest challenges for man and society in the Karelian Arctic.

### RENEWABLE ENERGY, BIOMASS FUELS, FOREST ENERGY

Developments in the energy sector both in Finland and in neighbouring countries indicates that more emphasis will be placed on renewable energy. This is mainly due to increased awareness of environmental issues. This kind of development accelerated in the spring of 1992 with the incidence of radioactive emissions from the Sosnovyi Bor nuclear power plant near St. Petersburg. An active search has been initiated to find local alternatives to nuclear energy in the Karelian Arctic. The international organization Greenpeace suggested in March 1992 the use of small power plants, utilizing local renewable energy sources.

Finland has advanced know-how in the use of bioenergy. All biofuels accounted in 1991 for 18 per cent

of national energy consumption. The most important biofuel is woodbased energy (13 %), accompanied by peat fuel (5 %). The forest industries have developed surplus electricity production based on waste wood, sawmilling, and chemical pulping. Energy-saving district heating systems have been developed over the past years. High technology has decrease of the minimum economical size of power plants. Simultaneously the proportion of electricity to district heating power has increased. The most modern Finnish wood-based power plant is in the town of Kuhmo, with electrical power of 5.4 megawatts and district heating power of 13 megawatts. The bulk of the woodfuel comes from the Kuhmo sawmill.

### MODELS FOR SUSTAINED DEVELOPMENT

The future sustained development in the Karelian Arctic will be based on renewable resources, the most abundant of which is the forest. It produces both raw materials and energy. These are developed in an integrated plant into sawn timber, pulp, electricity and district heat.

The basic model is the Kuhmo integrated plant. It can be replicated as such or as modified

in various towns in the Karelian Arctic. The base of the model is a local, modern saw mill. Besides sawn timber it produces saw milling residues, which are the main fuel. Additional fuel is the harvesting residue, and currently precommercial harvesting wood from the local forests. The high quality chips from saw milling are used for pulping.

**Model 1: Kuhmo enlarged**

- Raw material need: 345 000 m<sup>3</sup>/a (solid)
- Outputs: 150 000 m<sup>3</sup>/a sawn timber  
111 000 m<sup>3</sup>/a chips for pulping (loose m<sup>3</sup>)  
8.0 megawatts electricity  
25.0 megawatts district heating power

**Model 2: Kandalaksha**

- Raw material need: 690 000 m<sup>3</sup>/a (solid)
- Outputs: 300 000 m<sup>3</sup>/a sawn timber  
222 000 m<sup>3</sup>/a chips for pulping (loose m<sup>3</sup>)  
15.0 megawatts electricity  
47.0 megawatts district heating power

**THE CASE OF KEMIJÄRVI**

The pulp mill in Kemijärvi was established in 1964. As raw material it uses 900 000 m<sup>3</sup>/a Scots pine (*Pinus sylvestris*) and 300 000 m<sup>3</sup>/a of white birch (*Betula pendula*). The pulp output of the mill is 220 000 ADT/a. The output level is regarded as too small for the future. Suspicions about the sufficiency of raw material in Finnish Lapland are an

obstacle for the plans to enlarge the Kemijärvi plant.

Additional raw material for the Kemijärvi pulp mill could be obtained from Kuhmo and Kandalaksha type integrated plants in the Karelian Arctic. Transport of pulp mill chips could be organized through the North East Passage, by renovating the Kemijärvi - Kandalaksha railway.

**Model 3: Kemijärvi**

Raw material need: 900 000 m<sup>3</sup>/a Scots pine (current)  
720 000 m<sup>3</sup>/a Scots pine (new)  
300 000 m<sup>3</sup>/a white birch (current)

Outputs: 220 000 ADT/a pulp (current)  
120 000 ADT/a pulp (new)  
electricity, surplus of 30 % to be sold

## ECOLOGICAL AND SOCIAL CONCLUSIONS

The regional, ecological and social model for the Karelian Arctic is based on local woody biomass. It is currently increasing. This is a favourable starting point to develop renewable resources.

The overall target of sustained use also includes nature conservation. The planned conservation should be implemented completely. The silviculture and forestry as a whole are sustained and also energy-oriented and multipurpose. The harvests at all times should be within the frame of sustainability, thus preserving biodiversity in the Arctic.

Sustained, energy-oriented forestry can be developed to a level where the establishment of new nuclear

power plants in the Karelian Arctic is unnecessary; the overall target also includes closure of the old nuclear plants as threats to the fragile nature and societies in the area.

Sustainability is extended from the use of natural resources to society and to employment. Employment based on local, renewable resources is continuous, and there will also be an increase in job opportunities in the forestry sector as well as in other sectors linked to it. There will be new export and import opportunities: knowhow and machinery from west to east, electricity and pulp chips from east to west.

### **Reference:**

- Kauppi, P.E., Mielikäinen, K. & Kuusela, K. 1992. Biomass and carbon budget of European forests, 1971 to 1990. *Science* 256: 70-74.