WOOD ENERGY 1999–2003: A NEW NATIONAL TECHNOLOGY PROGRAMME IN FINLAND*

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(Received for publication 28 October 1999; revision 15 April 2000)

ABSTRACT

A new national energy technology programme, Wood Energy, has been launched in Finland by the National Technology Agency (Tekes). The programme's total budget for 1999–2003 is FIM250 million (US$45 million), Tekes' share of which amounts to FIM50 million. The programme is co-ordinated by VTT Energy.

In 1998, the energy use of forest chips amounted to 0.5 million m^3 solid. The target of the Wood Energy Technology Programme is to increase the annual use of forest chips to 2.5 million m^3 solid in 2003, i.e., five-fold in 5 years.

It is obvious that the target can be achieved mainly by increasing the use of logging residues from final cuttings, since salvaging residues from cut-over areas is more cost competitive than harvesting smallwood from young sapling stands and early commercial thinnings. Nevertheless, chip production from thinning of young stands will be developed as well.

Increasing the use of forest chips requires that the cost of production is reduced still further, and that is naturally one of the main objectives of the programme. The programme is also helping to develop quality control and storage of wood chips. The quality of chips can be seen as an important cost factor, since the amount of heat obtained from the wood chips, the emissions produced, and the reliability of delivery and use all depend upon it. Improvement of chip quality is not confined solely to forest chips, but it is just as important for wood residues from primary timber processing at mills. For this reason the scope of the programme also includes bark, sawdust, and other solid wood residues from the forest products industry that are suitable for fuel.

Keywords: bioenergy; wood fuel; logging residues; fuel chips; forest chips.

INTRODUCTION

Finland's energy demand is high because of a cold climate, long distances, and energy-intensive industry. At the same time, the indigenous energy sources, which include hydro and wind power, wood, and peat, are scarce and about 70% of energy is imported (Fig. 1). The use of wood fuels is 19% of the total energy consumption, ranking Finland at the top among

* Paper presented at IEA Bioenergy Task 18 "Conventional Systems for Bioenergy" Workshop, Charleston, S.C., 19–25 September 1999.

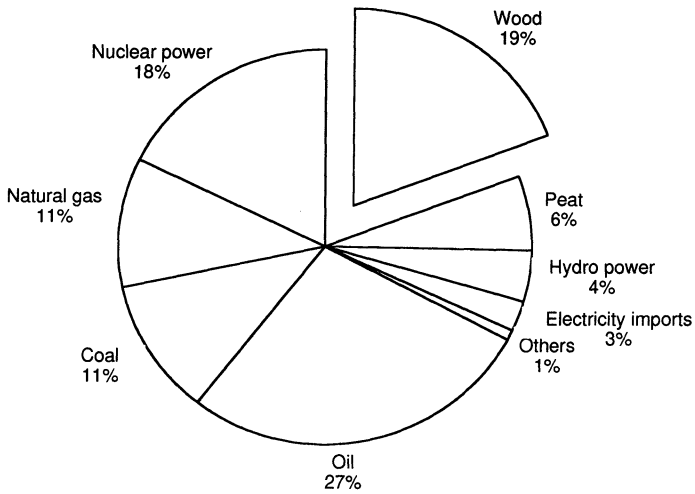

FIG. 1–Total energy consumption in 1998 (MTI 1999)

the world's industrialised countries. More than half of wood fuels was black liquor from the pulping industry (3.2 million tons of oil equivalent (toe)), solid mill residues from the forest products industry covered 1.6 million toe, and firewood was 1.1 million toe.

The efficiency of the power production in Finland is high. One-third of power is produced by combined heat and power (CHP) plants in connection with district heating or industrial processes (Fig. 2). The deregulation of the electricity market has been carried out completely, and the price of electricity has stayed at a low level.

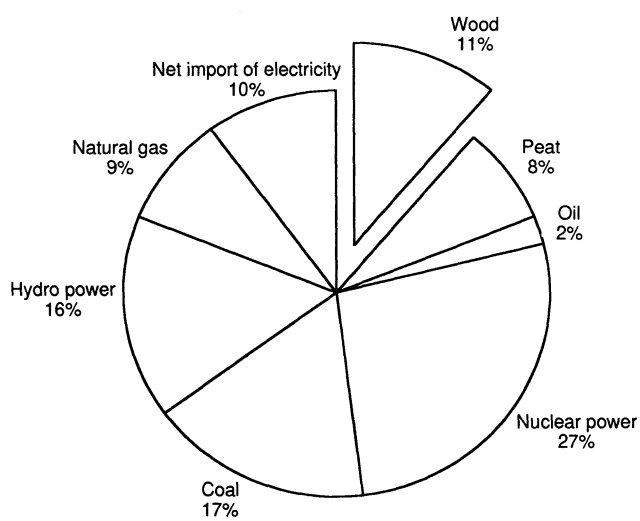

FIG. 2–Electricity generation in 1998 (MTI 1999)

The challenge of the Finnish energy policy is to find solutions to meet the commitments of the Kyoto protocol by reducing greenhouse gas emissions so that by 2010 the emissions are on the 1990 level. The activities focus especially on additional use of natural gas and wood in cogeneration. The goal is to increase the use of wood from 6.0 Mtoe in 1998 to some 7.0 Mtoe by 2010 according to the Ministry of Trade and Industry (Turunen 1999). Since all processing residues from the forest products industries are already used for raw material or fuel, the increase will be based mainly on forest residues.

The harvestable forest energy reserve of Finland comes from four main sources: whole-tree chips from precommercial thinnings, residues from first commercial thinnings, whole-tree chips from unproductive stands, and logging residues from regeneration areas (Fig. 3). The reserve is up to 15 million m^3 solid (3 million toe). However, in 1998, energy use from forest chips amounted to only 0.5 million m^3 solid. Thus, the reserve would enable a significant increase in the use of forest chips for energy, although for economical reasons the potential is probably less than 10 million m^3 solid. Fluidised bed combustion (FBC) boilers for multifuel use in CHP plants, and a wide range of small-scale applications for steam and heat generation, already offer an existing infrastructure to increase significantly the use of wood for energy economically in the near future (Helynen 1999).

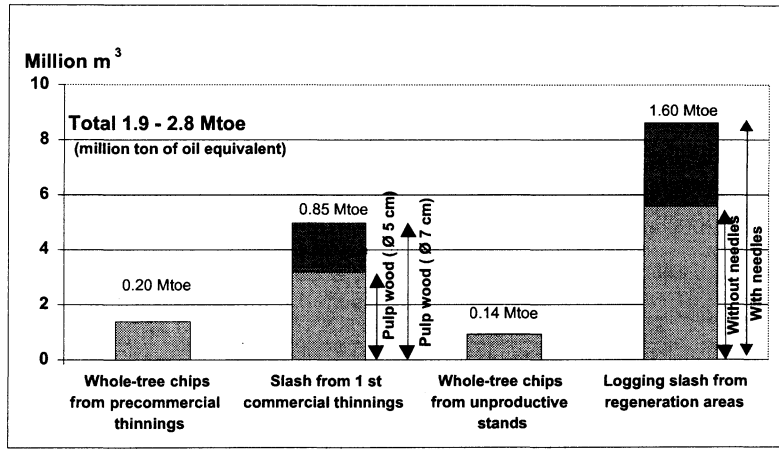

FIG. 3–The harvestable forest energy reserve (Hakkila & Nurmi 1997)

BACKGROUND OF THE PROGRAMME

During 1993-1998, Finland carried out an extensive national Bioenergy Technology Programme. One of its four main sections was on developing new techniques for producing wood fuels economically. Two ministries (Ministry of Trade and Industry, which is responsible for the energy sector, and Ministry of Agriculture and Forestry) were involved. A combination of research, industrial, and demonstration projects promoted information transfer from research organisations to industry and commercialisation of new innovations. According to a national and international evaluation the Programme was successful (Tekes 1999).

Tekes, the National Technology Agency in Finland, with several other organisations, was convinced that a new technology programme dedicated solely to wood energy would be the most efficient way to further promote the use of wood fuels in large-scale applications, and create new products and business opportunities in the wood energy sector.

The programme planning was given to an expert group representing interest groups such as the forest products industry, wood fuel suppliers and contractors, forest owners, energy sector, manufacturers of equipment, authorities of R&D, and research organisations. VTT Energy was chosen to prepare the master plan of the programme.

The benefits of the use of renewable forest energy are recognised globally. In Finland the benefits were ranked by the planning group as follows:

(1) Reduction of greenhouse gas and other emissions from energy production
(2) Improvement of competitiveness and environmentally responsive approach of the energy sector and forest products industry
(3) Silvicultural benefits from the promotion of precommercial and early commercial thinnings
(4) Increased use of indigenous renewable energy
(5) Increase in business opportunities and jobs
(6) Development of new products for export.

The mission of the programme is to remove barriers to the use of forest biomass for energy by means of technological research, development, and demonstration projects carried out in co-operation by research groups, forestry organisations, and industrial partners. The following factors were identified as the main barriers:

(1) High cost of forest chips
(2) Uneven and unpredictable variation of quality
(3) Low volume of production, i.e., there can be no benefit from economy of scale
(4) Uneven seasonal distribution of use at heating plants
(5) Unpreparedness of the forestry organisations
(6) Shortage of experienced machine contractors.

Consequently, the following issues are given the priority in the programme:

(1) Cost and competitiveness
(2) Quality
(3) Security of supply
(4) Operation of large scale systems
(5) Properties of wood fuels in cofiring
(6) Technology transfer, international co-operation
(7) Export possibilities.

TARGETS OF THE PROGRAMME

In 1998, energy use of forest chips amounted to 0.5 million m^3 solid. The target of the Wood Energy Technology Programme is to reach 2.5 million m^3 solid in 2003, i.e., increase the annual use of energy from forest chips five-fold in 5 years.

The target was chosen to be as concrete and measurable as possible, although it is evident that it cannot be achieved only through the results of the Programme. Financial and promotional incentives of the State, energy taxation, price development of fossil fuels, and the extent of involvement of industrial and regional sectors will have a crucial role in reaching the target.

It is obvious that the target can be achieved mainly by increasing the use of logging residues from final cuttings, since salvaging residues from regeneration areas is much more cost competitive than harvesting smallwood from young sapling stands and early commercial thinnings. Nevertheless, chip production from thinning of young stands will be developed as well because of the great silvicultural benefits.

Costs of Wood Fuels

Increasing the use of forest chips does require improved cost competitiveness against other fuels. It follows that one of the main objectives of the programme is the reduction of the cost of chip procurement. During the 1990s new harvesting technology was introduced and developed for the recovery of logging residue from regeneration areas. Three major proven system alternatives were in commercial operation by 1998 (Fig. 4).

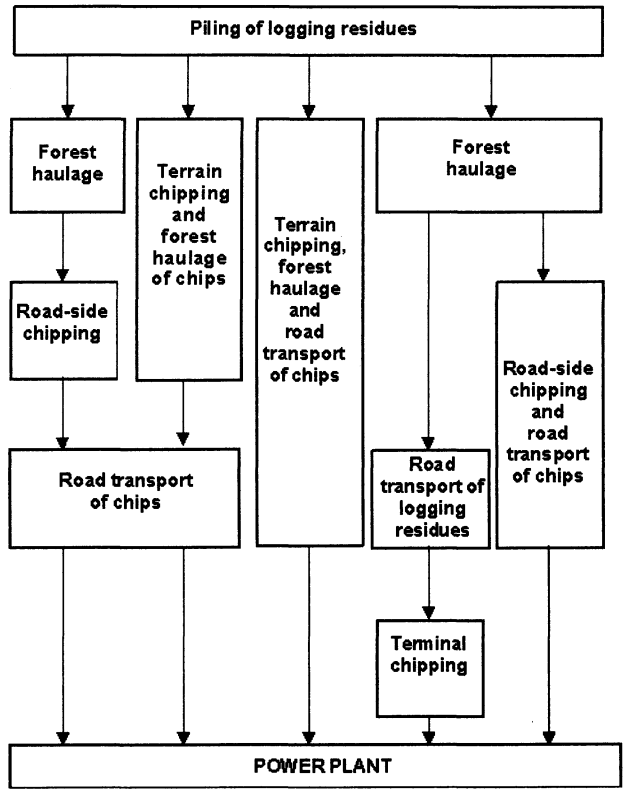

FIG. 4–Proven systems for the production of fuel chips from logging residues (Nousiainen & Aho 1999)

Means to reduce the costs of chips can be divided into the following categories:

(1) Integration of fuel production (planning, harvesting, transportation, terminal operations) in the procurement of industrial wood
(2) Development of centralised fuel processing systems at terminals and at power plants
(3) Exploiting the existing infrastructure of peat production
(4) Development of on-road transport of forest fuels, both as chips and unchipped
(5) Development of the logistics of chip procurement (organising, location of storage, handling of mixed several fuels in different production phases and at plants)
(6) Participation of self-employed forest owners in fuel production, especially to produce fuel from small-sized trees

Quality of Wood Fuels

The programme is developing quality control and storage of wood chips. The quality of chips can be seen as a cost factor, since the amount of heat obtained, emissions produced, and the reliability of delivery and use all depend upon the properties of chips. Improvement of chip quality is not confined solely to forest chips, but it is just as important for residues from primary timber processing at mills. For this reason the scope of the programme also includes bark, sawdust, and other solid wood residues from the forest products industry that are suitable for fuel.

Improvement of wood fuel quality includes the following research areas:

(1) Handling properties of industrial wood and bark residues
(2) Reduction of moisture content
(3) Choice between green chips and brown chips
(4) Technologies and logistics of storage
(5) Cofiring of solid fuels

Demonstration Projects

Demonstration projects are important not only in commercialisation and start-up phases of new technologies, but also revealing weaknesses and bottlenecks of the production chains that need further research and development. As an example, a demonstration project could include introduction and operation of a new harvesting chain over one or two years, during which time follow-up studies and measurements of productivity and profitability would be carried out.

International Co-operation

International co-operation within the Programme is planned to be carried out within the existing frameworks of the European Union (Fifth Framework Programme on Community Research and ALTENER Programme) and the IEA Bioenergy collaboration agreement.

Support Activities

Additional elements in the achievement of the challenging goals of the Programme are studies on the following topics, but most of them will be financed separately outside of this Programme.

(1) Studies on local wood fuel potential, collection of databases on wood fuel resources
(2) Studies on environmental and ecological impacts and nutrient balances
(3) Recycling of ash
(4) Life cycle analysis, quality and environmental certification procedures, audit procedures
(5) Safety factors of work phases of the whole wood energy chain
(6) Promotion of information transfer.

ONGOING PROJECTS

The number of on-going projects was 21 at the end of August 1999. Research organisations were carrying out 13 projects and industrial enterprises had 8 projects, many of which use research organisations as subcontractors. Research areas of the ongoing projects are presented below.

	Research projects	Industrial projects
Planning and logistics	4	
Production	3	5
Quality and energy use	4	2
Impacts of wood energy	2	
Total	13	7

ORGANISATION AND TIMETABLE OF THE PROGRAMME

The programme begun in March 1999, although some projects were started earlier and then linked to the programme.

The programme's total budget for 1999–2003 is FIM250 million (US$45 million), Tekes' share of which amounts to FIM50 million. In June 1999, the total projected costs of the on-going projects were FIM34 million. Most projects were financed by Tekes for at least a 2-year period. Ministry of Trade and Industry will participate in the financing of demonstration projects. Ministry of Agriculture and Forestry will be also among the financing sources.

The scientific Programme Manager is Professor Pentti Hakkila. The administrative Programme Manager is Ms Satu Helynen who is presently a visiting scientist at NREL, Denver, Colorado. Meanwhile, Mr Ismo Nousiainen is the acting administrative Programme Manager. Ms Eija Alakangas is responsible for information transfer and publications. The entire team works for VTT Energy, the co-ordinating organisation of the Programme. Finntech Finnish Technology Ltd Oy is responsible for the financial management.

Up-to-date information about the Programme is also available on the www-pages of Tekes (www.tekes.fi).

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