Available at www.sciencedirect.com

ScienceDirect

http://www.elsevier.com/locate/biombioe

Energy wood resources in Northwest Russia

Y. Gerasimov*, T. Karjalainen

Finnish Forest Research Institute, Joensuu Research Unit, Yliopistokatu 6, 80101 Joensuu, Finland

ARTICLE INFO

Article history:
Received 22 April 2009
Received in revised form
8 November 2010
Accepted 22 December 2010
Available online 14 January 2011

Keywords:
Energy wood
Logging residues
Non-industrial round wood
Wood procurement
Wood processing by-products
Lifted stumps

ABSTRACT

The energy wood procurement possibilities for the eight regions making up Northwest Russia were assessed. Wood byproducts from logging and mechanical wood processing were considered for energy production based on actual cut, sawmill and plywood production figures for 2006. Of the total calculated potential of 31 million solid m^3 (62 TWh), nearly 70% (21.8 million m^3) is from logging. The remainder (9 million m^3) is from sawmill and plywood production. The approximate available energy wood by region would be: 2.3 million m^3 from the Republic of Karelia, 2.7 million m^3 from the Republic of Komi, 5.4 million m^3 from Arkhangelsk, 4.6 million m^3 from Vologda, 3.8 million m^3 from Leningrad, 2.0 million m^3 from Novgorod, 0.8 million m^3 from Pskov, and 41,000 m^3 from the Murmansk region. There are large differences in the potentials between and within the regions. This is due to the differences in their forest resources; differences in their utilisation of these resources; the available infrastructures; and some limitations on logging. Nearly 65% of all the potential energy wood from logging is non-industrial roundwood, 19% is spruce stumps removed after final felling, 8% is unused branches and tops, and 8% is defective wood resulting from logging. About 58% of the total potential energy wood from logging is coniferous. However, there are large differences between the regions and within the regions in the species proportions. Currently about 40% of the allowable cut is used. This means that it would be possible to intensify the utilisation of the forest resources and thereby also to increase the use of wood for energy production. Full implementation of the allowable cut could provide 73.5 million m^3 of energy wood (147 TWh). In addition, if the technical potential for thinnings is utilised, the total potential energy wood provided by logging, and mechanical wood processing could be 104 million m^3 (208 TWh).

1. Introduction

Fossil fuels such as oil, natural gas, and coal account for 91% of Russia's energy consumption. Their shares of the total supply have decreased less than 2% in the last ten years. Two-thirds of these fossil fuels are sourced from Eastern Siberia, from which they are then delivered to other parts of Russia, which are thus very dependent on Siberia for their energy. In Northwest Russia, which includes: the republics of Karelia and Komi; as well as the Arkhangesk, Leningrad, Murmansk, Novgorod, Pskov, and Vologda regions, the energy consumption was 81 Mtoe or 943 TWh in 2006. Fossil fuels also dominate the energy consumption in Northwest Russia, where the shares of natural gas is 44%, oil 19%, coal 16%, nuclear 18%, and renewables 2% of the total consumption. There are regional differences, for example in the Republic of Karelia and the Pskov region, the shares of renewables are higher, but still around 7% [1,2].

Forests cover approximately 52% of the land in Northwest Russia. The total growing stock is estimated at 10 billion m^3, of which nearly 6 billion m^3 is mature and over mature forests.

* *Corresponding author*. Tel.: +358 10 211 5162; fax: +358 10 211 3251.
E-mail address: yuri.gerasimov@metla.fi (Y. Gerasimov).
0961-9534/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.biombioe.2010.12.039

Approximately 29% of the growing stock is pine, 42% spruce, 21% birch, 6% aspen, and 1% other tree species. The annual allowable cut of 106.2 million m^3 under bark (u.b) is defined solely for the felling of mature stands, of this total 56.4 million m^3 are coniferous and 49.8 million m^3 are deciduous tree species [3]. The tree species distribution of the growing stock and the annual allowable cut differ markedly due to the approach used in Russia for calculation of the annual allowable cut. The actual cut in 2006 was only 50 million m^3 u.b., of which 40.2 million m^3 was harvested from mature stands, 5.1 million m^3 from thinnings and 4.7 million m^3 from other fellings (e.g. for road construction and agricultural purposes). Northwest Russia produces one third of the industrial roundwood in Russia, 61% of the pulp and paper, 37% of the plywood, and 28% of the sawn timber [4].

Northwest Russia has a good potential for energy wood production since a large share of the wood resources currently are not utilised by local industry, especially deciduous tree species. The Russian domestic forest industry is based largely on the utilisation of coniferous tree species, thus domestic demand for deciduous tree species is low.

Thinnings, which represent nearly 60% of the area harvested in Nordic counties, are applied far less in Northwest Russia, where they are reported to represent only 12% of the total felled volume [5,6]. Thus in Northwest Russia, from a forest resource point of view, it would at least be possible to expand the use of deciduous tree species and wood from thinnings for modern energy production. There are, however, regional differences in the intensity of utilisation and availability of forest resources.

Another source for biomass from forests for energy production is logging residues. In Russia, the current forest management norms require the collection of logging residues from a site after logging. These residues are primarily unused, and even the small portions that are used have traditionally not been used for energy production purposes. How residues are collected, varies depending on the different logging methods used. If the traditional full-tree method and technologies are applied, no additional work in the forest is required to collect residues such as branches and tops, since they are removed and accumulate at a roadside yard in forest and even at a central processing yard in an inhabited locality (town or village). A central processing yard is a place where tree-length wood transported from different roadside yards is bucked to the desired length and sometimes delimbed and debarked. If the cut-to-length logging method is applied then, although logging residues are collected right at the harvest site (usually on strip-roads) by law, any further loading, forwarding and unloading of woody biomass from the harvest siteto the roadside storage would require additional work and costs. These examples indicate how felling methods influence not only the availability of logging residues, but also delivery costs.

The objective of this paper is to estimate the general energy wood potential for the whole of Northwest Russia, as well as more specific potentials for each of its regions. First, the methodology that is used for estimating the energy wood resources is described, which includes an estimation of unutilised roundwood potentials that could be used for energy purposes, as well as for manufacturing conventional products in mechanical forest industries (sawmills and plywood mills). The assessment of wood energy resources is limited to forests that are in use and legally available to supply wood, and is based on three possible scenarios for development of logging and wood processing in the Northwest.

2. Materials and methods

Before estimating the potential annual wood fuel supplies of Northwest Russia, it was necessary to analyse the availability of wood byproducts from logging and mechanical wood processing that when combined make up the energy wood potential. The availability of energy wood from logging was determined from the central processing yards of logging companies that use the traditional tree-length logging method and from harvest sites. All the energy wood from logging was determined as volumes of wood in cubic metres over bark (o.b). The potential energy wood from mechanical wood processing was determined by analysing the availability of the byproducts of sawmills and plywood mills. To approximately convert the calculated volumes of energy wood into energy units, it was assumed that the wood had a moisture content of 50%, which according to Hakkila [7], provides an energy content of 2 MWh/m^3.

The following sections describe the assessment units, data sources, and calculation of energy wood from logging at cutting sites and at central processing yards as well as from mechanical wood processing. Three scenarios for the energy wood potential according to the intensity of forest use are also presented. These scenarios show the quantitative potentials based on variations in the intensity of traditional cutting, implementation of an improved thinning regime, mechanical wood industry expansion based on increased raw material availability, and other specified assumptions.

2.1. *Assessment levels*

Energy wood potentials for Northwest Russia were assessed for byproducts from logging and mechanical wood processing operations. The potentials were assessed at the regional level for the eight regions of the Northwest including: Arkhangelsk, Karelia, Komi, Leningrad, Murmansk, Novgorod, Pskov, and Vologda.

During the Soviet period, the forests were usually administered, divided, and designated by their planned or related land-use. In Northwest Russia, of the total 117.9 million ha of forest area now managed by the forestry administration, 110 million ha, was earlier managed in a similar way by the Federal Forestry Agency (Rosleskhoz), 6.8 million ha were earlier classified as agricultural forests, 0.9 million ha were classified as military forests, while the remainder was composed of small areas that had other classifications [8,9]. The data available on forests is still affected by these past designations, therefore the areas previously designated as agricultural forests and other forests were assessed as a regional aggregate. The energy wood potentials from logging operations in each region on forestland that was earlier managed by the Federal Forestry Agency were assessed at the level of the state forest unit. This is the most detailed level available for any