VÄRRI HANNA, KAIKKO JUHA,
HORTTANAINEN MIKA, LINNANEN LASSI
Lappeenranta University of Technology, Finland

REDUCTION OF GREENHOUSE GAS EMISSIONS IN THE DISTRICT HEATING SYSTEM OF VYBORG

The ratification of the Kyoto Protocol makes it possible to utilize the reduction of greenhouse gas emissions financially in Russia. This can promote the essential improvement of the heating systems in cities. In the city of Vyborg it would be rational to rehabilitate the transmission and distribution network, install individual substations and improve the energy efficiency in buildings.

Ратификация Киотского протокола позволяет с выгодой использовать сокращение выбросов парниковых газов в России. Это может способствовать значительному улучшению систем отопления в городах. В городе Выборг было бы рационально модернизировать транспортно-распределительную систему, создать независимые подстанции и повысить коэффициент полезного использования энергии в зданиях.

Russia ratified the Kyoto Protocol at the end of year 2004 and became an interesting possibility for business related to climate change mitigation. The emission reductions generated in different projects can be transformed into emission reduction units and sold on the market. The project «Reduction of Greenhouse Gas Emissions in North-West Russia – Finnish Business Opportunities», administered by Lappeenranta University of Technology, studies technically and economically most feasible ways of climate change mitigation in Russia from the Finnish perspective. The most important means to reduce greenhouse gas (GHG) emissions seem to be the improvement of energy efficiency and increase of wood fuel utilization. (Kokki et al. 2006).

This paper concentrates on investigating the potential of reducing GHG emissions in district heating systems, and especially in the rehabilitation of the district heating system in Vyborg. Russian district heating accounts for over 50 % of the fossil fuel use and approximately 45 % of all domestic energy consumption. More than 70 % of Russian households are connected to the district heating network and the total length of the network is estimated to be 1,8 million kilometers. Many district heating systems are poorly maintained and because of this, their reliability is low and the energy consumption huge. (Bashmakov 2004).

General description of current situation in Vyborg. There are 15 heating plants in Vyborg and they include 45 boilers with a total heating capacity of 323 MW. The boilers are of different age and type. Most of the thermal heating plants are old, but in good condition according to the heat company of the Vyborg city. The main fuel used in Vyborg's district heating system is natural gas. Mazout is used as an auxiliary fuel in the heating plants. Some of the small boilers use mazout or coal as their primary fuel. (Petro-Energo-Audit 2005) The current fuel energy, the share of fuel power and carbon dioxide emissions are shown in Table 1.

Table 1

Fuels in Vyborg

Energy carrier	Fuel energy, Gcal	Share of fuel, %	CO_2 emissions, t
Gas	593080	91.5	139330
Mazout	45300	8.2	14680
Coal	3440	0.3	1360
Diesel	600	0.1	190

The total length of the district heating network is 72,3 km. The district heating system is primarily of directly connected, open type. The main problem in distribution and transmissions networks in Russia, and also in Vyborg, is corrosion. Corrosion reduces the technical lifetime of the pipes and causes high number of pipe breakages and consequently, large heat and water losses. The real amount of the heat losses from the district heating network is not known, because no energy measurements are performed on the demand side. According to the local administration about 30 km of whole district heating network is in a serious need of complete renewal. Considering the condition of the district heating network, the amount of losses can be estimated to be 25 %.

The actual energy consumption is not measured at the user end, but it can be estimated from the energy delivery to the network and from the approximate energy losses there. In the consumer end there are no modern automatic substations equipped with heat metering, control systems or weather compensation systems. The specific heat consumption of the buildings is estimated to be almost three times higher than in Finland. The main reasons for the high heat consumption in Vyborg are poor insulation of the buildings, lack of the control system and metering as well as low price of energy.

Rehabilitation of district heating system. The rehabilitation of the district heating system is divided into three sections: 1) transmission and distribution network, 2) installation of substations and 3) energy efficiency in buildings. The losses in the transmission and distribution network can be reduced from the current level (25 %) to the typical western level (10 %) by renewing 30 km and repairing the rest of the network. The installation of individual substations (including the heat exchangers and control system) in all connected buildings is estimated to reduce the energy consumption by 30 %. This is a costly operation and changes the district heating network significantly, but the estimated reduction in energy consumption is also high.

The energy efficiency in buildings can be improved by the following measures: sealing of the windows, installation of the radiator thermostatic valves, insulation of the pipes and valves, installation of the line balancing valves in the radiator system and implementation of the supply water temperature control in the radiator system. The resulting total reduction in the heat consumption is conservatively estimated to be 15 %.

Results. The estimated reductions of the annual heat consumption and CO_2 emissions for the different rehabilitation measures are presented in Table 2. The individual energy saving measures affect each other, and therefore it is not correct to sum all savings together to get the total savings from the measures.

Table 2

Estimated reductions of heat consumption and CO_2 emissions

Rehabilitation measure	Estimated heat consumption reduction, Gcal/a	Estimated emission reduction, t/a
Transmission and distribution network	107070	25980
Installation of substations	192720	46770
Energy efficiency in buildings	96360	23390

The modernization of the whole existing district heating system would lead to a remarkable reduction of the energy consumption and GHG emissions. It would also have many other positive impacts such as the improvement of heat control on the supply side, improved room temperature control and increased reliability of heat supply.

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