BELLONA

BELLONA'S POSITION

This position paper provides arguments for development of renewable energy sources on the Kola Peninsula, summarizes the scientific findings of the Kola Science Centre study of alternative energy potential in the region, and makes recommendations that outline a plan of action for implementation of renewable energy on the Kola Peninsula.

Introduction

For many years renewable energy sources, which include solar, wind, hydro, tidal, wave and bioenergy, have been disregarded as serious energy alternatives. Today, the largest share of the world's energy needs is still covered by oil (38%), followed by coal (26%), gas (23%), renewables (7%) and nuclear energy (6%) (International Energy Outlook 2007, EIA). Climate change and global warming, diminishing reserves of organic fuel, as well as the risks and negative consequences associated with nuclear energy make the development of renewable energy sources an imperative for the 21st century. Recent reports from the UN Panel on Climate Change provide overwhelming evidence of the negative environmental consequences of climate change and human-induced CO_2 emissions from coal, oil and gas. In addition, the Stern Review on the Economics of Climate Change Report estimates the economic costs to governments of catastrophes from global warming to be 5-20 % of their GNP, exceeding that of either of the two World Wars.

Summary

One of the regions in Russia where a transition to clean energy sources is most urgent is the Kola Peninsula where the Kola Nuclear Power Plant poses an environmental threat for both sides of the border. In order to identify prospects for implementing clean energy, Bellona commissioned the Kola Science Centre of the Russian Academy of Sciences to conduct a study of renewable energy sources on the Kola Peninsula in 2006. The report "Prospects for Development of Non-conventional and Renewable Sources of Energy on the Kola Peninsula" by V.A. Minin and G.S. Dmitriev shows the region possesses an enormous potential for renewables. In particular, the region has one of the greatest wind energy resources in Europe, estimated at 360 billion kWh annually. Using all the renewable energy resources available in the region is more than sufficient to meet the current electrical power demands of the region, or match the power capabilities of the most outdated nuclear reactors, thus permitting their retirement.

Annual energy consumption in the Murmansk region is approximately 16 billion kWh (16 TWh). According to the Murmansk Center for Energy Efficiency, nuclear power provides for approximately 37% of the region's energy requirements, hydro-electric stations 57% and thermal power plants 6%. Other official figures used by the government give the following estimates: 50-60% nuclear, 42 % hydro and 19% thermal. With the exception of large hydro energy, other types of renewables are undeveloped in the region despite their enormous potential. In recent years, the region has had an energy surplus, but an energy deficit will result when the KNPP reactors are decommissioned, unless an alternative is found. Earlier this year proposals for construction of a new KNPP-2 were discussed and subsequently rejected as too expensive. But a second plant is still being contemplated. In addition, the current reorganisation of the nuclear industry in Russia which entails plans for its privatisation, placing nuclear sites and materials in private hands, is certain to increase safety and security risks. Bellona recommends renewable

energy sources as the best alternative to nuclear power on the Kola Peninsula, and strongly urges their development for the benefit of the environment and the economy in Northwest Russia.

Obstacles to renewable energy

In Russia there are several obstacles to the development of renewable energy. First, there is a traditional reliance on, and lobbying for, fossil fuels and atomic power to meet energy requirements. Fossil fuels account for approximately 63% of Russia's electricity generation, followed by hydropower (21%) and nuclear energy (16%). (www.eia.doe.gov) Consideration of renewables is also impeded by Russia’s fossil fuel fixation, and the connection between export of these resources and Russia’s economic and political status. Approximately 78% of Russia’s exports are based on oil and gas. Second, there exists no legislation that specifically addresses the development of renewable energy. The Russian Federation energy policy “Energy Strategy of Russia until 2020” of August 28, 2003 focuses on fossil fuels and nuclear energy and devotes only 3 of its 118 pages to discussing renewable sources of energy. A draft law “On Renewable Sources of Energy” has been discussed for several years, but as of January 2007 is not yet adopted by the state Duma. Third, there are no economic measures such as taxation, subsidies, or quotas that act as an incentive for RES and influence market behaviour. Fourth, until recently the low costs of fuel and the high costs of implementing renewable energy alternatives made their development economically unfeasible. However, rising fuel prices in Russia and technological progress in alternative energy the past decade have decreased costs of their exploitation making the time ripe for renewable energy to be given the attention it deserves. Lastly, peoples perceptions and limited access to information. Notions of nuclear energy as a good renewable energy substitute for oil and gas, and insufficient knowledge about the benefits of using renewable energy have hindered their consideration. Most people are unaware that a solar collector can warm water for the same price as an electric heater (Chistaya Energiya, 2 /2005).

Advantages of renewable energy for the Kola Peninsula

There are numerous reasons for utilising renewable energy sources – accessibility, sustainability, reliability, profitability and ecological purity.

In contrast to diminishing reserves of organic fossil fuels, renewable energy sources are virtually unlimited, easily accessible and sustainable, and do not deplete natural resources. Despite large deposits of oil, gas and coal, Russia’s supply of organic fossil fuels is limited. At the current rate of production, oil and gas are expected to be depleted this century. (Chistaya Energiya 1/2005). Northwest Russia possesses enormous potential for renewable energy sources, especially wind and small river hydro energy. Renewable energy can enable preserving reserves of organic fuels for future generations and help meet the increasing demands for energy in connection with the revival in industrial development in the region.

Renewable energy can enable regional energy security, ensure a stable, reliable energy supply to remote areas, and protect connected customers from cut-offs. In decentralised settlements, located in the eastern portion of the Kola Peninsula, energy is based to a significant degree on fuel imported to the region. Developing renewables where they are available locally will enable diversification of the energy supply. At the present time traditional fuel costs are high, as are tariffs on electricity and heating. Fortunately, the areas experiencing the most difficulty with fuel supply are the same areas that possess the highest potential for renewable energy sources. Renewable energy can ensure a sustainable heating and electric supply to remote settlements with decentralised energy supply relieving them from unreliable fuel supply, unstable fuel prices and high costs associated with fuel transport over long distances. Renewable energy can also be beneficial for connected customers. Winter 2006 caused an energy deficit and electrical power shortages in Northwest Russia and other regions. Renewable energy can protect consumers that are dependent on centralised energy supply, and experiencing cut-offs, by guaranteeing a minimum supply of energy during periods of high demand.

Renewable energy is a profitable sector providing the basis for new employment opportunities and financial income. Developing renewable energy in Northwest Russia can be a means of generating jobs, income and tax revenue in the region. Expanding the industrial base, or utilising the existing one, for production of renewable equipment and parts such as wind converters can boost the local economy through the creation of new workplaces. In addition, producing installations locally will decrease their prime cost by economising on expenses otherwise incurred in connection with their transportation and import. Markets also exist for green equipment and green technology abroad. Denmark, for example, generates revenue by exporting wind turbines, one of its most important products.

In comparison with nuclear energy, renewable forms of energy are non-hazardous to human health; they are risk-free, ecologically clean, producing no waste, requiring no processing and are non-polluting to the local environment. Local environmental safety and health are another important reason to prioritise development of renewable energy sources, rather than nuclear energy, in Northwest Russia. In 2006, the Kola Peninsula was nominated among the top 25 most polluted places on earth in the Blacksmith Institute report "The World's Worst Polluted Places". The most pressing issue on the Kola Peninsula is the condition of the two oldest reactors at the Kola Nuclear Power Plant (KNPP) which exceeded their service life in 2003 and 2004. These reactors should be decommissioned and replaced by a renewable energy source. These reactors are over 30 years old and have lower safety standards than western reactors. According to a safety analysis made by the International Atomic Energy Agency in 1991, the chance of a reactor meltdown is 25% in the course of 23 years (The Arctic Nuclear Challenge, 2001). Nuclear energy entails considerable risks – danger of nuclear accidents, leakages from radioactive waste storage and spent nuclear fuel assemblies, transportation, reprocessing, nuclear weapon proliferation and security issues – none of which are a factor with non-traditional renewable energy.

In comparison with fossil fuels which make harmful emissions to air and ocean, causing climate change and chronic impact on the marine ecosystem, renewable energy sources emit no CO_2 and do not entail the same degree of risks and consequences. Last year, the Russian Federal Agency on Hydrometeorology and Monitoring of the Environment published a report documenting that general warming in Russia the last 100 years is greater than the global average and showing an increased occurrence of extreme acts of nature (Doklad ob Ocobennoctyax Klimata ha Territoriy Rossiskoy Federatsiy za 2006 god). Many of the negative consequences of climate change have detrimental impacts especially for the regions of the north. For northern latitudes the expected consequences of global warming are flooding of islands, erosion and loss of coastline, reduction of biological diversity and extinction of some polar species, collapsing infrastructure, houses and roads in permafrost areas, damage to pipelines, and more extreme, unpredictable weather. Despite the perception often held in Russia that climate change is a positive thing (enabling better access to petroleum resources, greater crop yields and an opening of the northern sea route once the North Pole becomes ice-free) long-term consequences outweigh any short-term benefits. Thawing permafrost, reduced by 7% the last 100 years, is causing the release of large quantities of methane trapped in the frost. There is a potential threat of viruses escaping as well. Developing renewable energy is the means to reducing CO_2 emissions, the key to stopping global warming and preventing the undesirable and negative consequences of climate change. A 1MW windmill can reduce annual CO_2 emissions by 2000 tons if it substitutes a fossil fuel power plant (Wind Energy in Russia, G. Dimitriev, 2001).

Development of renewable energy sources will generate support, rather than opposition, at the local and regional level. Another reason to develop renewable energy solutions is political legitimacy. Neither the local population on the Kola Peninsula, nor the neighbouring Nordic countries (with the exception of Finland) want the risks associated with another nuclear power plant. Results of public hearings in December 2006 to discuss the region's energy policy showed that over 89% of Murmansk citizens attending were opposed to building a new KNPP-2 and 93% were in favour of prioritising wind energy development. A nationwide survey conducted in October revealed only 19% of Russians support atomic energy, a figure comparable to the EU. According to the European Commission, 80% of EU citizens support solar energy while 20% support atomic energy. Internationally, a host of industrialised countries are making plans to implement renewable energy on a large scale. In January 2007, the EU Commission presented an energy package proposing to increase the share of renewable energy to 20% of electricity production by 2020, while Russia plans to increase its share of renewables to 1% by 2010.

Potential for renewable energy on the Kola Peninsula

In 2006 the Kola Science Centre studied the potential of sun, wind, hydro, tidal, wave and bioenergy resources on the Kola Peninsula as alternatives to coal, oil, gas and atomic energy. The report identifies specific geographical areas most prosperous for development of renewable energy, and shows that Russia possesses experience, technologies and industrial capacity in most sectors to lay the foundation for development of renewables on a large scale.

Solar energy

Solar resources are the most abundant of alternative energy sources. However, given the characteristically cloudy conditions on the Kola Peninsula, direct radiation is reduced by 60-70%. Solar radiation data for the region is comparable to that for Sweden. The biggest obstacle to developing this energy source is the absence of solar radiation in the winter, when the demand for energy is highest. Seasonally, there is great monthly variation in sunshine, from zero hours in December to 200-300 hours in June and July when the most intensive solar radiation is observed. Fortunately, solar and wind energy resources peak in opposite seasons making it possible for these two resources to complement one another when used jointly. Scandinavian experience shows application of solar energy can be effective for the entire heat supply system. The challenge is to store solar energy in sufficiently large quantities during the summer months. Reservoirs serving as heat accumulators can be either above ground or underground as in Sweden. The main elements of a simple system are a solar collector, an accumulator for storing energy until it is needed to meet heating requirements of the consumer, and a reserve energy source for use when the sun is absent for prolonged periods of time. An advanced circuit can include an auxiliary energy source such as a wind installation.

The most promising candidates for solar energy are remote isolated consumers with expensive heating costs and difficult fuel supply and southern locations with a high technical potential. In recent years, solar energy was used in a successful Norwegian-Russian project to gradually replace decaying, radioactive strontium batteries in lighthouses along the northern coast of the Kola Peninsula with solar cells. According to the Kola Science Centre's data, radiation in the vicinity of Umba (a remote settlement, pop. 6,500) is similar to that from Ingelstad, Sweden where a solar heating station successfully warms 52 houses. This makes Umba a promising site for a solar project. In the northern latitudes, solar energy potential is inferior and should be considered as a complement to hydro or wind power, the latter of which peaks in winter. In terms of economic feasibility, the high costs of solar panels the past decade (approximately USD $4-5,000 per solar cell unit on the international market, compared with USD$1-2,000 per unit for a wind power installation) served as a barrier to serious consideration of this energy source. However, developments in solar energy, particularly in Norway, are expected to increase effectiveness and push prices down below the current 20-30 cents per kWh. Therefore, solar power projects will be economically feasible in the near future.

Wind energy

The opportunities for large-scale development of a wind energy system in the Murmansk region are just as large as they are in Denmark, Germany, Spain or the United States where wind energy is already a source of revenue. Russia possesses the necessary scientific and industrial capabilities, as well as experience from pilot wind electrical stations in Vorkuta, Kalmyka and Kaliningrad. Wind resources on the Kola Peninsula, while not as large as solar, are enormous and estimated at 360 billion kWh. The greatest wind speed is observed in the coastal regions of the Barents Sea. Along the northern coast of the Kola Peninsula, which is the windiest place in the European part of Northern Russia, it reaches 7-9 meters per second. This average annual wind speed is actually higher than in coastal areas in Denmark, Germany and the Netherlands where wind energy predominates and is profitable. The variation in average annual wind speed is only 5-8%, which is low in comparison with the 15-20% variation for river flow in the region. Maximum wind speeds occur in the winter and coincide with the seasonal peak in heat and energy consumption. This winter wind maximum is in a counter phase to the annual river flow creating an advantageous opportunity for wind energy and hydro power to successfully complement one another when used jointly. During the summer when wind speed is reduced, the maximum wind speed occurs during the daytime when an increased consumption of energy on the part of consumers is usually observed, creating another favourable condition for efficient use of wind energy.

The high wind potential on the Kola Peninsula, the correspondence between winter maximum wind intensity and maximum energy consumption, and the presence of 17 hydroelectric stations with reservoirs create unique conditions for utilizing wind energy on a large scale. The region is also especially favourable for multi-turbine windparks due to the presence of prevailing winds which have the greatest energy concentration and allow a compact, and less expensive, location of wind installations with minimal interference and energy loss. Along the northern shore, south-western winds predominate approximately 50-60% of the year. Particularly prosperous areas for construction of multiple windparks are Dalniye Zelentsy and Teriberka located near the Serebryansky and Teribersky hydro-electric stations, which are connected to the Kola energy system and capable of facilitating large-scale use of wind energy in the region. A system that links windparks to hydroelectric stations will produce the greatest economical effectiveness.

There are also several favourable conditions for utilising wind energy to supply electricity or heat to small isolated settlements, meteorological stations, lighthouses, frontier posts and Northern Fleet establishments, located in windy areas. These dispersed consumers receive electrical energy from autonomous diesel electric stations, rather than from the Kola energy system. They pay high costs for diesel supply due to poor transport arteries; expenses are 30-70% higher along the coast and 150-200% higher in inaccessible inland areas. Wind energy can enable economising of expensive diesel fuel which in the most extreme cases is transported a distance of up to 1500-2000 kilometres. In the windiest areas, wind electric converters can supplant up to 60-70% of fossil fuel. During periods of prolonged lulls in wind, special accumulating units or auxiliary heating systems can be switched on.

In selecting appropriate sites for location of windparks, it is necessary to consider areas with high wind potential, infrastructure (roads) and an entrance to the energy system (Grid) or a high-power sub-station, location of base personell and installation facilities. From a practical point of view, wide open spaces are preferred to hills because this simplifies construction of underground paths and erection of the wind converters.

Profitability of wind power is an important issue. Experience from other European countries, particularly Denmark, show that wind power is economically competitive with other types of energy. Currently the cost for construction of a new windmill is $800-$1000 per kilowatt, but this price is expected to decrease to $600-$700 dollars in the next 10 years. The private pilot windmill at the Murmansk hotel "Ogni Murmanska", including transport, construction of the foundation and erection cost about 4 million rubles, or $750 per kilowatt. With depreciation equal to 7%, operation costs are 3 cents/kWh which is less that the hotel would pay to buy energy from the Grid.

The energy of small rivers

On the Kola Peninsula, the economically feasible hydro resources are already exploited on large and medium-size rivers by 17 hydropower stations which produce 6 billion kWh (6 TW) and provide 42% of the total energy production in the Murmansk region. Ecological and financial limitations make construction of hydro-electric stations on the remaining undeveloped large rivers problematic. "Kolenergo" is working on improving utilisation of the existing hydro-electric stations, but small rivers remain undeveloped. The technical potential of small hydro resources is approximately 4.4 billion kWh, one-third of which is economically feasible to exploit. A confluence of several factors make development of small hydro power advantageous - periodic fuel crises, increases in tariffs on electrical energy, restrictions on construction of large complexes due to their negative ecological consequences, and progress in automation and remote control by hydro-generators. Small hydro-electric stations are defined as stations with an installed capacity under 20-30 megawatts. In the Russian north, the majority of small hydro-electric stations do not exceed 3-5 megawatts. China is the leader in the construction of small and micro hydro-electric stations with over 100,000 plants in operation and produces small turbines based on Russian technology. Two basic trends observed in the use of small hydro-electric stations in industrialised countries, namely the use of dams and water reservoirs created for water supply and the use of small channels and traditional lay-outs, are virtually non-existent in Russia at the present time.

Excluding from consideration the rivers which are significant for the fishing economy of the Kola Peninsula such as the Nota, Varzina, majority of the Umba, Varzyga and Strelna, leaves many prospective rivers for small hydro power. The following rivers have promising sites for small system integrated hydro-electric stations: Pirenga (1 site), Bolshoy Olenka (2), Ura (2), Zapadnaya Litsa (1), Titovka (1), Tumcha (3), Umba (1). Kolenergo and TGK-1 are planning to utilise all these rivers as part of their development. Development of small hydro power plants on the Pirenga and the Tumcha are probably the most feasible and effective.

Small hydro power can provide an inexpensive, independent source of electrical and thermal power to remote areas with de-centralised heating supply, where diesel electric stations are the primary source of electric power and the cost of electrical energy is largely dependent on the cost of diesel. The Murmansk region has previous experience from the 1950s in using small hydro power for the benefit of isolated consumers. At the present time 80-100 settlements exist which are not encompassed by the centralised electric power supply. Their energy requirements vary from 5-10 to 500-800 kilowatts. Three isolated villages are prime candidates for small hydro power: Krasnoschele, Chavanga and Chapoma, as well as the military border settlement Svetly.

Fuel supply to these areas is extremely difficult due to the absence of roadways. Small hydro power can be used as a supplement to diesel electric stations which can cover electric demands during periods of little water and act as a reserve for emergencies. The Ponoy tributary on the Yelreka River, the Chavanga River and the Lotta River are the best candidates for pilot small hydro electric stations that can demonstrate the advantages and efficiency of small hydro power for decentralised consumers.

Tidal energy

Tidal electric power stations are also a source of ecologically clean energy which do not pollute habitat with harmful wastes (unavoidable during operation of thermal electric power stations) and do not require any kind of flooding (unavoidable during construction of large hydro electric power stations on level rivers). Tidal energy is unchangeable throughout the month and is independent of annual and yearly water content, despite intervals in the 24-hour cycle and irregularities during the lunar month. These qualities make it a rather powerful source of energy which can be combined with river hydro electric stations containing water reservoirs. The area of the tidal basin and the tidal height are the most important indicators of theoretical potential. Along the coast of the Kola Peninsula, the relatively small size of the tidal range (2-3 metres) and the limitations of an aquatory allowing a cut-off from the dam, make construction of some possible tidal electric stations economically unprofitable.

There are several promising sites for development of tidal power plants (TPP). The Mezen TPP, currently under development at the Abramov-Michaelovsky Cape where the tide reaches 10 metres has the greatest technical potential. This project requires construction of a pumped storage power station on the Ribachy Cape of the Kola Peninsula, which could guarantee an additional 3 million kilowatts of electrical power to the central north-west provided a high-voltage connection exists to the Mezen station. The expected total annual output for Mezen TPP is 50 billion kWh. Another site is a remote area at the Lumbovsky gulf where the average size of the tide is 4.2 metres and the aquatory is 70-90 km^2. A third site, the Kola TPP, is a pilot project under development in the Dolga Bay and will provide a prototype design for the Mezen TPP. Lastly, there is the Kislaya Bay TPP. Constructed as a pilot project in the 1960s to provide scientific and technical experience necessary for larger, powerful tidal plants like Mezin, it's operation is now terminated. A ship-building factory in Severodvinsk, Archangelsk region, is currently preparing a prototype working wheel for the Mezin TPP which will be tested at Kislaya Bay.

Economic and technical calculations show that it is most economically advantageous to utilise medium- and large-size TPP, combined with water reservoirs and pumped storage power plants, or hydroelectric stations which transform cyclical unevenness into dependable, guaranteed energy. Additional costs for construction of a regulating reservoir and for transmission lines connecting the hydroelectric station with the TPP are compensated for by the exchange of a portion of energy from the thermal station to the tidal. Russian and foreign research conclude the importance of preliminary small pilot tidal electric stations for experimenting with hydraulic turbine equipment when constructing tidal electric power stations with unique output capacities like that of Mezen.

Wave energy

Wave energy possesses a higher energy density than wind and solar energy. Two merits of ocean waves along the Kola Peninsula are their ability to accumulate wind energy over a significant distance and their availability to a large group of consumers along 1000 km of coastline. The disadvantages of wave energy are its periodic instability, dependence on ice conditions, and difficulties of conversion and transmission to the consumer. The possibilities of exploiting wave energy have been explored for over 200 years. However, the practical utilisation of wave energy is very complex necessitating: reception and conversion of energy; a strong reinforcing system capable of withstanding a large load, especially in extreme conditions; evaluation of parameters and behaviour of windy seas; and study of the impacts of a wave installation on the environment. Great Britain, Scotland, and Japan are among the countries that have created and tested a model for wave energy.

An important peculiarity of ocean waves in the northern zone of the Atlantic Ocean is their seasonal irregularity. During the winter the waves are approximately twice as high as during the summer. The Barents Sea is estimated to have an average annual wave energy potential of 22-29 kWh per meter, which is close to data on wind potential in the neighbouring coastal region of Norway. As far as the White Sea is concerned, the average annual potential of wave energy is considerably lower, 9-10 kWh per meter, due to the comparatively small size of the sea and the presence of ice cover in winter.

Wave energy has one of the highest efficiency rates in non-traditional energy. The total net efficiency of wave electric stations in converting energy to electricity is 30-80%. If one calculates wave energy in the Barents and the White Seas using a 60% efficiency rate as a basis then total technical resources of approximately 450 billion kWh (450 TW) per year is estimated. Along the coast of the Kola Peninsula the technical resources of wave energy for a 10 kilometre strip consist of 1.2 billion kWh for the Barents Sea coast and 0.4 billion kWh hours for the White Sea coast. The expected capacities of wave power plants in these locations are 230 MW and 100 MW. Today the cost of wave energy today is approximately 10-20 cents per kWh. This makes wave energy less expensive than solar, but more expensive than wind, and much more expensive than energy produced by conventional power plants.

Bioenergy resources

In comparison with other types of renewable energy on the Kola Peninsula, bioenergy resources are relatively small. In the Murmansk oblast, the potential for bio resources from agricultural waste is approximately 1 billion kWh annually. Processing agricultural waste by the application of anaerobic fermentation provides a solution to three problems: ecological – disinfection of animal wastes and removal of disease-causing substances, food supply – production of high-quality organic fertiliser which increases agricultural productivity by at least 10%, and energy – a partial replacement of liquid and gas fuel by biogas. Russia has conducted research on optimisation of technical methane fertilization of organic animal and bird waste, and began construction of experimental pilot-industrial installations in the 1980's.

Biogas can be produced from the anaerobic treatment of organic wastes. In its purified form biogas is compressed into cylinders and used for operating cars and tractors, or burned for heating. One cubic meter biogas equals 0.6 litres mazut/black fuel oil and is sufficient to power a motor with a 2-horse power capacity for 1 hour or yield 1.25 kWh electricity. Annually, the Murmansk oblast can produce: 2.3 million cubic meters biogas or 1,700 tons fuel oil equivalent from pig manure; 5.6 million cubic meters biogas or 4,000 tons fuel oil equivalent from cattle manure; and 15.1 million cubic meters biogas or 9,800 tons fuel oil equivalent from poultry manure. The marketable yield of biogas is estimated at 12-17 million cubic meters biogas or 7,000-11,000 tons fuel oil equivalent.

In the Murmansk region waste from the forest and wood-processing industry is used in an insignificant volume as fuel for electricity and heating. A main obstacle to utilising timber waste is undeveloped infrastructure. Murmansk possesses the least forest residues of all regions in Northwest Russia and its potential for bio resources from lumber waste is estimated at only 1.5 billion kWh. Therefore, small population points which receive electricity from local diesel electric stations and heat from community boilers are a potential sector for utilisation of lumber waste. There are 150 diesel electric stations and 355 small boilers in the Murmansk oblast, but no pilot projects to use bio wood waste. Introduction of technology for briquettes and pellets from sawdust, and combustible distillates from industry and domestic waste could contribute to the development of bioenergy as a resource.

Implementation of renewable energy

The research conducted by the Kola Science Centre found enormous natural resources on the Kola Peninsula that can benefit both centralised and de-centralised consumers. Technical resources for wind alone are estimated at 360 TWh, which is approximately 20 times the region's current electricity consumption of 16 TWh. Moreover, the research indicates that the potential energy capacity from joint application of wind and hydro resources is more than adequate to replace the energy generated by the 2 oldest nuclear reactors. These two reactors contribute approximately 20-30% of the region's total electrical energy. In terms of economic feasibility, it is only fair to consider the 5.5 billion USD price tag for the proposed, and recently scratched, KNPP-2 and contemplate what 134 billion rubles could do for development of renewable energy on the Kola Peninsula. Bellona advocates developing non-traditional renewable energy sources, as well as energy efficiency measures and clean production methods to reduce the threats posed by nuclear energy and the negative environmental impacts caused by CO_2 emissions from fossil fuels. In order to make real headway in implementing renewables however, it is imperative to create a framework for their development. At the present time the legal, economic and socio-political basis for developing renewables on the Kola Peninsula is absent.

Legislation

Governmental regulation is necessary in order to ensure successful development of renewable energy. A legal and regulatory framework is needed that stimulates growth in renewables and establishes priorities. European countries, for example, have had success with policies that specify concrete targets for renewable energy and allocate resources to its technologies. The EU has committed to increasing renewable energy to 20% of the energy balance by the year 2020, and Sweden has set an ambitious goal to be independent of fossil fuels by then. The countries with some of the highest percentages of renewables in their energy mix, Sweden (46%), Finland (30%), and Denmark (25%) (figures from 2004 according to the European Commission) have supportive governmental policies. In Russia, lack of a clear governmental policy for development of alternative energy sources and lack of government investment are two major hindrances to development of clean energy. For many years there has been a discussion in the Ministry of Energy of a draft federal law "On renewable sources of energy", but no action has been taken to adopt it. In addition, a draft law has been elaborated by the founders of the wind company "Vetro Energo" to regulate small businesses producing clean energy. They defined major obstacles to clean energy alternatives in Russia as limitations on capital investment during company creation, the taxation system, and connection to the GRID (Ekologiya u Prava, 1(22)/2006). The EU-Russian Technology Centre has also identified specific institutional and economic barriers and recommended specific measures to combat them. (Renewable energy sources potential in the Russian Federation and available technologies, 2004). A summary of Russian legislation related to renewable energy is provided in Appendix 1. Bellona recommends creating a regional programme for developing renewables on the Kola Peninsula that contains supportive policies and specific sector targets.

Economic mechanisms

Successful development of renewable energy requires establishment of economic measures that influence market behaviour and make the sector competitive in comparison with traditional energy sources. Experience shows that when economies of scale increase, the costs of implementing renewables decrease and it becomes more profitable. Renewable energy is already economically lucrative in Denmark, Germany, Spain and the US. A number of economic mechanisms are in use such as taxes on fossil fuels that reflect environmental costs, subsidies and tax-exemptions for clean energy production and technology, feed-in tariffs or quotas for power companies that require a percentage of power be produced by renewable energy, and incentives. European countries provide many examples of success. Denmark, which has chosen to focus on wind energy, has a tax on polluting electricity. The German government has chosen to decommission its nuclear power plants in favour of wind and solar energy. By subsidising its solar industry Germany has created a demand for solar panels and thousands of new jobs. Consider that the country is now a global leader in solar cell installations in spite of the fact that it does not have the most optimal solar resources. Sweden made bioenergy profitable by taxing oil and electricity in the 1990s and today bioenergy from district heating warms half of Swedish households. It is also noteworthy that Sweden finances windmill projects through a system of green electricity certificates, whereby power producers are required to buy certificates from producers of renewable electricity who receive certificates based on how much they produce. There are numerous European models that can be used as guidelines when developing economic measures that increase demands for renewables and make it an economically viable industry in Russia. Bellona advocates in particular the development of a market for green certificates as one of the best means of stimulating development of renewable energy sources.

Participation of industry and civil society

Cooperation and involvement of industry, the scientific community, NGOs and authorities is just as important as governmental regulation of, and economic incentives for, renewable energy. Strategic alliances and networking should be encouraged to provide for information exchange, technology transfer, project consultancy, and training personnel. NGOs can function as a link between local communities, scientists, industry and authorities. They can play a vital role in increasing public awareness and participation. In particular, NGO's can spread knowledge about renewable energy and its advantages, organise debates and keep the public informed about developments. In order to harness NGO support it is necessary to provide access to information. Industry also plays a major role by developing technologies and commercialising them. It can transform environmental initiatives into competitive businesses. In order to achieve the best cost-efficient and effective technologies and production, it is imperative to remove obstacles that hinder competition within industries or import of renewable energy technology and equipment. Stopping discriminatory practices that restrict an equitable access to the GRID is equally important. There are a number of consulting companies in Scandinavia with experience from the Russian market that can give project assistance and be potential partners or investors for renewable energy projects in Northwest Russia: ECON, Energy Saving International AS (ENSI), Kan Energi AS, Norsk Energi, Ramboll Group and Varanger Kraft AS. Assistance in delivery and installation of systems in Russia can be obtained through the Center for Renewable Energy at www.energy-center.ru. In addition, there are valuable networks working to promote renewable industries, such as the Russian Association of Wind Industry and the European Wind Energy Association. For information on renewable energy projects and project partners in Europe visit the European Commission energy website at www.ec.europa.eu/energy/res/index_en.htm and select FP6 Demonstration projects.

Renewable energy projects

Pilot projects for renewable energy should be initiated at prospective sites identified by the Kola Science as having the best potential for solar, wind, small hydro and tidal energy. Pilot projects are a means to test technology, identify problems, find solutions, demonstrate economic profitability, and increase public awareness. Once these issues are settled pilots can be followed by large-scale projects. As all energy sources have consequences for the environment, environmental impact assessment should be mandatory prior to building on any site in order to keep negative consequences to a minimum. The World Energy Council has produced a "Renewable Energy Projects Handbook" with guidelines on selecting projects using evaluation criteria. Finally, experience from the Kola Peninsula should be exported to other regions in Russia.

In addition, potential sites could also be identified for exploitation of wave and bioenergy resources in the future. Wave energy has one of the highest efficiency rates of renewable energy and with 1000 kilometres of coastline a suitable site most certainly exists. The value of bioenergy, despite its small technical potential in comparison with other renewable energy on the Kola Peninsula, should not be underestimated. Agricultural waste can be utilised for isolated consumers; domestic waste can be used in city district-heating systems. Barriers and opportunities for bioenergy development in Northwest Russia have been studied by the Barents Energy Working Group Task Force on Bioenergy (Final Report 04/30, 2004).

Financing

Adequate financing and investment are prerequisites for success in renewable energy development and implementation. In countries where large-scale application of renewables is successful, governmental authorities are actively engaged and the industry has grown thanks to heavy subsidising. It is also possible to elicit funds from foreign stakeholders. There are a number of international institutions that provide financial assistance to clean energy and energy-efficiency projects in Russia. A few of the most prominent are the EU-Russia Technology Centre, the Global Environmental Facility (GEF), the International Finance Corporation (IFC), the Nordic Environment Finance Corporation (NEFCO), The Norwegian Barents Secretariat and The Renewable Energy and Energy Efficiency Partnership (REEP). Before initiating pilot projects on the Kola Peninsula it might be wise to apply to one of these institutions for seed money or more substantial funding. Removing investment barriers is another important mechanism. Businesses interested in making investments can contact the Multilateral Investment Guarantee Agency (MIGA) which promotes direct foreign investment by insuring investors against political and non-commercial risks.

Another financial instrument is Joint Implementation (JI) under the Kyoto Protocol, which Russia ratified in 2005. Projects that reduce greenhouse gas emissions such as fuel switching from coal-to-biomass, energy efficiency, or renewable energy may qualify for JI provided the eligibility criteria are met. Under JI an investing country buys carbon credits to meet its Kyoto targets, by making capital investment in emission-reducing projects in a host country which then reaps economic and ecological benefits. Russia has a great potential to host JI projects based on cost efficient GHG reduction, large potential for energy efficiency, and lack of renewable energy intiatives and support mechanisms. As of January 2007, 31 emission-reducing projects were proposed for Russia, but only one of these is located on the Kola Peninsula (www.cdmpipeline.org/ji-project.htm). Several parties are working to identify potential carbon emission reduction projects in Russia that meet JI criteria, including the Core Carbon Group (previously the Russian Carbon Fund), Norsk Energi and ECON. The latter two consulting companies are also training local experts in project design and documentation as part of a programme funded by The Nordic Council of Ministers and the Barents Secretariat. There are no limits on Russia's sale of JI credits, but Moscow requires a Memorandum of Understanding with investor countries prior to approval. Until recently foreign investments were delayed by the Russian government's failure to establish a domestic framework for hosting projects. However on May 28, 2007 Prime Minister M. Fradkov signed a governmental decree containing the Statute on project adoption and review procedures for Joint Implementation projects. http://info.rusrec.ru/en/news/1241

Information exchange

Access to information about renewable energy is needed on the part of the public, environmental groups, and the industry. Information is essential for building local support, attracting potential investors, finding external partners. The mandate of regional offices like the Murmansk Oblast Energy Efficiency Center (MOEEC) should be strengthened. The work of these information centres could be expanded to include renewable energy as well. Development of renewable energy will produce a need for information dissemination on the laws, regulations, standards, subsidies, taxes, incentives, benefits, and new developments governing renewables. Alternatively, a web site can inform and promote renewable energy to the public, industry, and officials. Renewable companies can obtain news updates on their industry, and promote their services to others by registering their company at www.renewableenergyaccess.com a website with global listings.

Renewable energy as a regional effort

In the absence of a cohesive federal policy it is up to regional authorities, scientists, industry, ecologists and society to take a bold initiative and push for development of renewable energy. We see examples of this type of engagement on the US west coast where regional authorities in Washington and California launched environmental initiatives on their own to reduce local and global emissions. The mayor of Seattle, Washington for example committed his state to the Kyoto Protocol, and convinced 401 other mayors to do the same thing, despite the US federal government's refusal to sign the accord (Dagens Nжringsliv 17/18 februar 2007). California implemented the strictest state environmental programme in the US requiring that 20% of energy comes from renewable sources by 2010, and proposing CO_2 reductions of 25% by 2020, and 80% by 2050. California's solar program, which provides subsidies to businesses that install solar panels, is enticing large industries to join the green movement. (Dagens Nжringsliv 11/04/07) In Sweden, Volvo decided to be a CO_2 - neutral company and bought its own windmills to supply its factory with energy. (Aftenposten 02/02/2007) In December 2006, the governor of Murmansk agreed to support environmental groups' demand for a 20% share of wind energy in the energy balance by 2020. More recently, a Working Group on Renewable Energy in the Murmansk Oblast was established in March 2007, by the Oblast Committee for Nature Protection. Bellona welcomes these initiatives as promising first steps towards renewable energy on the Kola Peninsula, and advocates developing a plan of action that fully exploits the enormous potential for renewable energy in the region.

Conclusion

Renewable energy enables production of electricity and heating without emissions and without hazardous waste. Many prerequisites exist for development of renewable energy on the Kola Peninsula: tremendous natural resources, a scientific-technological basis, a host of advantages – sustainability, accessibility, reliability, profitability, and ecological purity. Renewable energy can benefit both centralised and de-centralised users, and are in sufficient quantity to meet both current and future energy demands. There is really no reason not to pursue an aggressive exploitation of renewables on a large scale. Today the decision to exploit fossil fuels and nuclear power, or develop renewable energy sources is really a question of political will.

Bellona recommends development of renewable energy as an instrument for decommissioning the oldest reactors of the KNPP while providing safe, clean, reliable energy that provides for regional economic growth. Prompt government action is necessary to remove legislative, economic and socio-political barriers to renewable energy. In summary, Bellona advocates the following measures for implementation of renewable energy sources on the Kola Peninsula.

- Establish government legislation with concrete targets for renewables and its organisation

- Create economic mechanisms that prioritise and stimulate renewables and their technology

- Involve industry, the scientific community and NGOs in strategic alliances for cooperation

- Initiate pilot projects in geographical areas with high technical potential identified by KSC

- Secure funding from government and financial institutions and attract private investors

- Create an office that informs and promotes renewable energy, its laws and standards

Nordic neighbours can also participate in development of renewable energy, and economic growth, in Northwest Russia by making environmentally responsible financial investments in projects that are mutually beneficial, by creating forums for exchange of technology and know-how, by establishing a market for green certificates that support production of clean energy, and by refusing to import energy produced by nuclear reactors.

The analysis conducted by the Kola Science Centre provides a scientific foundation, and an impetus, for making a transition to renewable energy. Moreover, the findings present an opportunity for many actors. For the Kola Peninsula, development of renewables can produce regional economic growth, energy security and environmental benefits. For industry, on both sides of the border, renewable energy can become a new sector for business development, technology transfer, cooperation and competition. For the Norwegian government, development of renewable energy on the Kola Peninsula should be seen as an arena for closer bi-lateral cooperation on measures that will ultimately reduce the nuclear threat and security risks in the High North. This is indeed an excellent opportunity to put the ambitions of the Soria Moria Declaration into practice.

"*……….The risks of shipping accidents, the challenges from increased petroleum activity, the consequences of climate change, and the danger of radioactive pollution shall be met offensively through our own increased preparedness and closer international cooperation on measures that reduce the dangers."*

[Soria Moria Declaration]

Lastly, Bellona hopes that the current fixation with oil and gas revenues, on both sides of the border, will not blind authorities to the value of renewable energy as a mechanism with which to meet the challenges of climate change we face today.

Appendix 1: Russian Legislation in the Sphere of Renewable Energy

By Olga Krivonos

The 1992 UN Declaration on the Environment and Development proclaimed that the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations. This means that energy policies of the future will not be able to bypass the need to conserve energy and increase the use of renewable energy sources.

For the past ten years, fundamental changes in the overall approach to renewable energy have not occurred in Russia. In 1995 legislative acts were passed and decrees were made at the executive and legislative levels of the Russian Federation, which stipulated that certain measures be taken regarding energy conservation in Russia. A year later, a federal law "On Energy Conservation" introduced the concept of renewable energy and its utilization in the economic turnover, however the necessary conditions for utilizing renewable energy sources were not formalized in the law. Discussions over a new law on the use of renewable sources of energy continued in 1998, when a bill was introduced in the National Duma "On national policy in the sphere of non-traditional renewable sources of energy." One of the provisions in the bill stated that no less than three percent of national investments in the Russian energy industry should go to financing the development of renewable energy. By 2003, the bill passed all three readings in the National Duma, but was rejected by the President and subsequently discarded.

That same year, the Russian government confirmed its Energy Strategy for the Period up to 2020, which nominally acknowledges the necessity of developing and using renewable energy in order to facilitate the policy of energy conservation, as well as the reduction of harmful emissions from energy stations in cities with a complicated environmental situation. In the strategy itself, there is a provision that mentions the necessity of passing a new law concerning the development and utilization of renewable energy sources.

Presently, in accordance with the task of RAO "EES Rossii" a bill has been drawn up regarding government assistance in the development and utilization of renewable energy. It proposes the introduction of a system of "green" certificates based on model of the international Renewable Energy Certificate System (RECS). The bill is yet to be introduced in the National Duma for review.

The Energy Strategy Proposal for the Period up to 2030 has been formulated, which contains a provision concerning the use of renewable energy sources copied from the Energy Strategy for 2020. A member of the Energy Committee of the National Duma, V.B. Ivanov, feels that the new Russian energy strategy should contain concrete tasks and strategies, and not just a desire for renewables.

Representatives from the scientific community, likewise, cannot be ignored on the issue of renewable energy. Two scientists from the Kola Science Center, V.A. Minin and G.S. Dmitriev, have put forth their own vision for a future law on renewable energy, based on the experience of other countries in this realm: tax benefits, guarantee of tax stability and the right to free access to centralized energy supply networks for all small enterprises developing and using energy derived from renewable energy sources.

The prospects for developing renewable energy in Russia are closely linked with the passage of a new law that could become an indicator of the country's transition to a new stage in its attitude toward energy resources - that is, one based on the principle of environmental protection. Today, however, the future of renewable energy sources in Russia is still unpredictable.