SOUTH EAST EUROPE SEEDW DEVELOPMENT WATCH

CEE bankwatch network

REAL ENERGY SECURITY IS STARING US IN THE FACE

Renewable energy case studies from South East Europe

December 2007

South East Europe Development Watch (SEEDW), formerly known as Stability Pact Watch, is a coalition of South East European environmental non-governmental organisations (NGOs) monitoring and campaigning on investments made by International Financial Institutions (IFIs) and the European Union (EU). SEEDW is a project within CEE Bankwatch Network and includes For The Earth (Bulgaria); Terra Mileniul III (Romania); Eco-Sense (Macedonia); CEKOR (Serbia) and Green Action (Croatia).

Formed in September 2002, the group's focus was originally on ensuring transparency and public participation during the reconstruction process led by the Stability Pact for South East Europe. One of the Stability Pact's main tasks has been to co-ordinate reconstruction, infrastructure development and structural reforms in the region. However, due to the lack of public participation, sectoral policies and environmental legislation within SEE countries, priority has often been given to large-scale prestige infrastructure and to privatisation projects, which too often cause negative environmental and social impacts, and benefit trans-national corporations more than the local population.

The Stability Pact is to be transformed into the Regional Co-operation Council (RCC) in 2008, and the main focus of development has shifted from post-war reconstruction to EU accession, but the need for scrutiny of IFI/EU investments in the SEE region is as great as ever.

SEEDW focuses on:

- monitoring and campaigning on IFI/EU-financed projects: Belgrade bypass, Cernavoda NPP, Chelopech gold mine, Zagreb municipal solid waste incinerator;
- monitoring the development of the TEN-T network to neighbouring countries and the Energy Community of SEE;
- ensuring that investments are oriented towards those with clear public and environmental benefits;
- ensuring the introduction and implementation of environmental legislation and public participation processes in SEE countries;
- and promoting sustainable energy and transport models in SEE countries.

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Executive summary

This publication sets out to provide a quick snapshot of renewable energy projects in south-east Europe. With a host of fossil fuel and nuclear projects currently being proposed across the region, sustainable energy initiatives have it difficult to reach the general public. While international financial flows generally follow the bigger, "easier-to-handle" projects, unfortunately only small drops are adding up to create a renewable energy and energy efficiency future.

It is beyond argument that renewable energy has much lower environmental and social impacts than other energy sources. The only issue remaining is how much it costs. Technologies have evolved to compete with fossil fuel and nuclear energy if life cycle analyses and the externalities of energy production and consumption are considered.

The case studies presented here show that renewable energy can have a significant role in lowering budgets for electricity, heating and hot water. Technologies have evolved both in terms of efficiency and control/monitoring, requiring little intervention from the owner. Commercial loans for renewable energy projects developed by municipalities have contributed to the sector's growth, but the experience so far with such loans is irrelevant (in some countries it may take years to obtain a loan).

Collaboration between public authorities and the private sector in renewable energy projects is also proving to be successful. Yet it can be sometimes difficult to start up renewable energy projects in the public sector, due to a low level of awareness, a lack of any promotion or incentive systems and serious administrative barriers (such as regulations on the connection to the grid, lack of implementing regulations and lengthy permitting procedures). These projects are sometimes part of bigger packages that include energy efficiency measures, which can be there primarily to improve public acceptance for technologies that may seem new, economically risky, costly, or to increase project economic rate of return and achieve higher energy savings. In the end, clear economic advantages are a positive driving force for renewable energy and energy efficiency projects.

Renewable energy projects involve a switch from fossil fuel, with the associated enviro nmental and health benefits, namely reduced green house gases and other pollutant emissions. The social benefits come in a wide range, from providing basic services to lower prices per unit of energy. Tangible economic, environmental and social results generally appear shortly after project commissioning and it can take a few years for the news to spread and replication initiatives to appear. Of course, it always helps to have a framework, a regional or national scheme playing an active role in promoting and funding renewable energy and energy efficiency projects (either national promotion schemes or international schemes, such as emission trading and joint implementation).

Biomass and wind are generally seen to have much more potential than solar photovoltaic at the moment. Photovoltaics are still relatively expensive, and together with a lack or insufficiency of promotion schemes, the development of the sector is currently restricted. Nevertheless solar photovoltaics already offer benefits across south-east Europe, particularly in isolated sites and for those wishing to have an independent power supply.

Besides low cost and clean energy, biomass projects bring a series of benefits that alas aren't highly visible to the public. These include: sanitary cleaning of forests (preventing the dissemination of tree diseases), a reduction in methane emissions (avoiding decomposition of organic matter) and a reduction in soil and water pollution (the use of wood waste from wood processing companies).

Wind power is on the rise as a "new power source" in south-east Europe, as the costs per unit of installed capacity have decreased. Foreign investors are showing substantial interest in the market, but problems persist with access to information on procedures and local potential. Wind power can have certain negative effects if projects are not sited appropriately, the same as with hydro power or any type of industrial project.

A mix of energy sources and technologies can be used at the household level to cover energy demand partially or entirely. Such systems are designed according to local potential, and they include a mix of solar, wind, hydro and biomass technologies.

Renewable energy technologies vary in terms of efficiency and environmental acceptability. Each individual project design should, therefore, be screened against alternatives to identify the most suitable technology for each specific application. In the project development stage, the same significance needs to be given to social and environmental aspects as to technical, economic and financial aspects and the assessment needs to cover the full range of policy, programme, and project options. Strategic impact assessments and life cycle analyses need to be integrated and undertaken as an initial step in the process and give demand-side options the same significance as supply options. Renewable energy must be supported in order to enter energy markets, but any such support must be limited to renewable energy that is produced in sustainable ways.

Renewable energy projects should be considered within a framework for sustainable development that integrates energy demand reduction and efficiency, a mix of renewable energy sources to meet an increasing proportion of overall energy demand and the protection of communities and biodiversity.

Solar energy at old people's home, Silistra, Bulgaria

The city of Silistra is located in north-eastern Bulgaria, on the Danube. It has 59,451 inhabitants working in industry and agriculture. The climate of Silistra is temperate continental, characterised by hot summers, with lots of sun and high temperatures from April to late October, which creates favourable conditions for solar energy projects.

The project "Solar panels for hot water in old people's home" in Silistra was initiated by the municipality in 2000. At that time the mayor and the municipality's energy experts calculated that 9.4 percent of the municipal budget was spent on fuel for heating and decided to take action to reduce these expenditures. ENCON Services was contracted to prepare scenarios for energy savings and namely energy efficiency measures at a municipal school and a municipal administrative building, switching from mercury to efficient high-pressure sodium light bulbs for street lighting and installing solar panels for hot water in the old people's home.

The solar energy project at the old people's home targets the social sector, which according to the Municipal Development Plan suffers from deficient financial resources, with relatively old housing conditions (bad insulation of doors and windows) and increasing numbers of old people in need of this service. The home operates at full capacity, with 220 residents, and there were water supply problems and bad hygienic conditions. There were also serious problems with the heating system and large energy losses in boiler operation. In total, the house was using 135 tonnes of fuel oil annually.

In 2000, the municipality contracted the company Energy for Sustainable Development (ESD), which designed a project for a solar system. The major difficulty was to convince the municipality council to approve a renewable energy project, as people didn't know much about the technology. However, saving 30 tonnes of fuel annually played a crucial role in the decision-making and the municipality councillors gave the green light to the project.

The implementing company is a local company called REGAT, which has a long-term contract with the municipality to monitor and maintain the installation.

The project has been fully implemented and in operation since 2002. The capacity of the old people's home is 220 people, where daily water consumption is 100 l/person. Before the installation of the solar system, thermal energy was supplied by equipment running on fuel oil.

The solar system now provides hot water April through October, and includes:

- flat solar collectors,
- storage tank,
- heat exchanger,
- circulation pumps,
- computerised control system with full tele-monitoring and remote control,
- return/stop valve and heat insulation of the boilers.

The solar collectors occupy 134 m2 and the overall accumulation volume is 4600 l. From April to October the collectors produce 117,879 kWh, covering 64 percent of the hot water demand. One of the most important features of the new installation is the computerised control system with full tele-monitoring and remote control. It is the first project in Bulgaria to apply such technology for solar panels. This allows the project developer – ESD – to monitor and control the operation of the solar system from Sofia via the internet.

Costs

The project became part of the Municipality Program for Energy Efficiency (MEEP) in Bulgaria, which is financed by the US Development Agency (USAID) and is implemented by the American company Electrotec Concepts. The total cost of the solar project was USD 111,023 (approximately EUR 78,113). The municipality used credit for the entire amount from the United Bulgarian Bank (UBB), where 50 percent is guaranteed by USAID. The project's internal rate of return is 28 percent and the investment paid off in 4 years. When the project was completed, there were immediate savings of LEV 40,432 (approximately EUR 20,696) for fuel in 2002, compared to 2001.

The project was something new for both the municipality and the bank. This was the first credit by a commercial bank for solar systems in the social sector. At the same time, it was the first commercially funded municipal project, which according to the municipality's project coordinator helped alleviate the budgetary financing problem and explore a new source of financing from the private sector.

Environmental and social benefits

The project involved a switch from fossil fuel to renewable energy, with the associated environmental and health benefits. The project gives a reduction in CO2 emissions by 29,333 t/year and SO2 emissions by 1,944 t/year.

The social benefits from the project are also significant as it aimed to solve the water and hygiene problems of the elderly in the old people's home. The installation provides hot water using solar energy between April and October, delivering up to 12,000 litres of hot water on a daily basis. There is no water supply problem anymore, which means an improvement in living conditions and hygiene at the old people's home.

The solar project was part of a bigger package including several energy efficiency measures at the old people's home aimed at further reducing energy consumption and achieving better environmental results. The solar installation project did not seem politically viable and economically attractive. Therefore, the municipality decided to group the solar panels installation with other energy efficiency measures in order to increase the economic rate of return of the project and achieve higher savings.

These measures included:
- installation of new burners: fuel savings 7-8 percent;
- automatic regulation of energy consumption by means of 109 thermal valves: fuel savings 8 percent
- insulation of windows and doors: 310 m2 of glass for windows, 6180 m of insulation; fuel savings 5 percent.

Sustainability of the project

Six years after the project "Solar panels for hot water in old people's home" was implemented, there are tangible economic, environmental and social results. It is important to mention that in Silistra the mayor and the deputies are engineers who have clearly set energy efficiency and renewable energy sources objectives high on the local development agenda. Considering the old people's home a success story in the social sector with clear economic and environmental benefits, the municipal administration has developed a coherent Energy Efficiency Program, which includes twelve new

Using Solar Power in Silistra

energy efficiency and renewable energy projects to be implemented in the Silistra area. One of the projects consists of installing solar panels for hot water on the roof of another old people's home in a village that is part of the Silistra Municipality. The innovative element in this project would be the installation of photovoltaic cells, which would allow the profitable production of solar electricity at a preferential price according to the feed-in tariff rate . The administration is currently looking to secure financing for the new projects.

The project was awarded first prize at the EcoEnergy contest for the best implemented project for 2001 and 2002 in the "Buildings" category.

Conclusions

The project "Solar panels for hot water in old people's home" in Silistra can be considered as good practice for a few solid reasons, including

- the use of locally available renewable energy sources
- lower operational expenses compared to other similar installations
- remote control over the operation
- better sanitary and hygienic conditions at the facility
- better comfort for the residents
- reduced municipality expenses for the hot water supply and the opportunity to channel public funds towards other needs

The success of the project also comes from combining energy efficiency and RES measures to achieve higher energy savings and better environmental results. The project shows that social programmes and investments in RES can be turned into attractive investments.

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Interviews

Alexander Penchev, Executive director of ESD Bulgaria, Sofia
Valeri Georgiev, Energy efficiency expert, Silistra Municipality, Silistra
Emil Goychev, Coordinator of the 'old people's home solar project', Silistra

Field visit

Silistra Municipality, Silistra
Old people's home, Silistra

Photos: Keti Medarova-Bergstrom

The Stilin solar project, Croatia

Project background and development process

The Stilin solar project consists of a 36.1 kW solar photovoltaic installation, the largest in Croatia, on the roof of the Black Bull jeanswear factory in Zagreb. The project was initiated by the factory owner, Zelimir Stilin, who wanted to create an independent, energy efficient, futuristic building. He was inspired by an existing solar installation in Zagreb - The Solar House in Spansko, initiated by solar expert Ljubomir Majdandzic of the Croatian Expert Association for Solar Energy (HSUSE).

The solar project consists of 190 monocrystal HIP solar photovoltaic modules made by Sanyo Electric Co, which are arranged into 12 groups, and two inverter systems. One, a three-phase system made by Croatian company Koncar, is used for grid feed-in, however, there were no regulated feed-in tariffs until July 2007 and the company has not yet agreed a contract with the national electricity company. The other system, with three 60 volt Fiamm accumulator blocks and inverters from US company Outback, enables the electricity to be used on the premises. Solar was chosen as an energy source which is most relevant for the daytime hours, when most of the electricity is used in the factory.

The Stilin project was completed surprisingly quickly, in just two months, in 2005, mainly due to the fact that there were no clear regulations on the installation of solar photovoltaics at the time, so it was possible to install the system without time-consuming administrative delays. The same project would require a longer preparation period today.

With a total battery storage capacity of 4500 Ah and an estimated yearly output of 36 500 kWh, the project supplies all the electricity for the factory except in December and January, when it is necessary to purchase additional electricity from the grid.

Costs and financing

The total project cost was HRK 2 235 000 or just over EUR 300 000. Mr Stilin estimates that the project will take 8-10 years to pay for itself, if an agreement with the national electricity company is not reached and the surplus electricity supplied to the grid continues to go unpaid. Overall the installation cost of solar photovoltaic modules in Croatia is EUR 3.4-4 EUR per W .

There is little public financing in Croatia for the development of renewable energy, except for some programmes by the Croatian Bank for Reconstruction and Development and a subsidy by the Environmental Protection Fund, which may pay 2% interest on commercial loans. However there have been some problems with banks accepting the Environment Protection Fund's subsidy. Currently, the most favourable loans for solar energy are said to come from Zagrebacka Banka and Erste Bank.

Solar Project in Stilin, Croatia

Challenges

Without clear rules on feed-in tariffs, until recently installing solar photovoltaics in Croatia has mostly been considered useful in isolated locations, and there has been no financial nor procedural incentive for developing solar electricity generation more widely. Until recently the procedures and permits required for such installations were also not clear, so Mr Stilin's attempts to negotiate with the national electricity company about a feed-in tariff resulted in some superficial interest but also procrastination and demands, and the matter has remained unresolved since 2004. Even with the new tariff system, a great deal of paperwork is required, often involving contradictory demands from different agencies, and due to this Stilin has put attempts to obtain the feed-in tariff on hold. Since it was not Stilin's main intention to supply the grid this was not an undue handicap for the project, but it has increased the pay-back time.

Social and environmental benefits

HSUSE estimates that the project prevents around 21 tonnes of CO2 emissions per year, in addition to preventing other emissions resulting from the transport and combustion of fossil fuels.

Although the project used Sanyo photovoltaics since they were deemed most suitable at the time, there are now two factories in Croatia manufacturing photovoltaics, which employ around 150 workers (Solar Cells Ltd and Solaris Sunceva Energija d.o.o, Novigrad). Therefore, further investments in photovoltaic projects in Croatia could also help to support these companies. The current feed-in tariff system in Croatia favours Croatian companies by lowering the tariff of projects with a higher percentage of foreign components, which is controversial but encourages the development of domestic renewables companies.

Sustainability of the project

The project is sustainable in terms of security of energy supply and environmental impact, and its value is likely to increase in the coming years with rising energy prices. However in purely financial terms solar photovoltaic energy in Croatia is still not viable due to the complicated administrative procedures which increase the costs of project preparation and the fact that the new regulation defining feed-in tariffs for renewable energy caps the payment of tariffs at 1 MW until 2010. The current feed-in tariff for solar photovoltaics is around 46 euro cents per kWh for less than 10 kW, 41 euro cents for 10-30 kW, and above that 29 euro cents, for 12 years.

Conclusion

Croatia has an average solar irradiation of 1200-1600 kWh per m2 per year, creating a very good potential for solar thermal energy. Photovoltaics are still relatively expensive though, and together with the cap on feed-in tariffs, limit the development of the sector. Whilst many see the new regulations as a turning point for renewable energy in Croatia, most proponents of solar photovoltaic energy are frustrated that the government has capped the amount of solar energy receiving the feed-in tariff to 1 MW until 2010, and feel that this will stunt its development, particularly as photovoltaic energy is only due to constitute 0.33% of total renewable energy in the country.

Biomass and wind are seen to have much more potential than solar photovoltaic at the moment. Solar thermal collectors are also of high importance, and HSUSE estimates that they could reduce total primary consumption in Croatia by 5-10 percent with three times less investment than in Denmark.

Nevertheless solar photovoltaics already offer benefits in Croatia, particularly on isolated sites and for those wishing to have an independent power supply. Solar electricity is often seen to be at a disadvantage because of being most powerful during the summer, however with the increasing use of air conditioning in Croatia, demand for electricity during this period is very high. Solar electricity could thus make a great contribution to lowering the expensive summer peak electricity demand in the grid. Whilst the Croatian government should dramatically improve its encouragement of renewable energy, particularly solar electricity, in the meantime solar photovoltaic projects should nevertheless be undertaken, and should be valued and supported for their environmental effects and potential to support the growth of the domestic photovoltaic and installation industry.

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E-mail questionnaire to Mr Zelimir Stilin, Blackbull Jeans
Ms Dubravka Zoric, Hrvatska banka za obnovu i razvitak

Photos: Stilin

Solar energy in Mangalia, Romania

A solar project was implemented in Mangalia to supply hot water and partially heating (in combination with the use of light liquid fuel). The project "Increasing energy efficiency by using solar energy" was implemented by Rominterm in 2005. The objective of this initiative was to increase efficiency in the Mangalia district heating system and significantly reduce fossil fuel consumption and green house gas emissions.

The Mangalia Local Council and S.C. Rominserv formed the Rominterm project company partnership at the end of 2002. In order to increase efficiency in the Mangalia energy system, considering the city's solar potential (over 1,250 kWh/ sq.m/ year), a feasibility study was done (financially supported by the United Nations Development Programme/ Global Environmental Facility) regarding the use of solar energy in combination with the conventional thermal system for hot water and partially heating supply.

The pilot project was developed at plant no. 15, which offers very good conditions in terms of location (on the seashore) and infrastructure - concrete poles (from an old solar installation) ensure a useful area of 360 sq.m of solar collectors.

The technologies used in the project: 360 solar collectors; boilers using light liquid fuel (derived from oil refinement) in order to secure uninterrupted operation of the thermal plant and take over load increase; and new distribution networks with very low losses.

The results of the feasibility study showed that annual production can be approximately 210 MWh, which represents 70 percent of total thermal energy necessary to supply hot water at this plant, and 10% of total thermal energy produced at the plant (including heating). This quantity of thermal energy produced on the basis of solar energy determines savings of approximately 40 tonnes of Calor 3 fuel, i.e. 12 percent of the annual fuel consumption at this plant.

Investment and pay-back

Rominterm invested USD 877,000 in the project "Increasing energy efficiency by using solar energy". The return of investment is 4,7 years, with an internal rate of return of 29 percent.

Plant and distribution network modernization
Rominterm took over 27 district heating plants (concessions in Mangalia, Neptun and Olimp) and started investing in the thermal units as well as the distribution networks to increase their efficiency. The operational efficiency of these plants increased from 60 to 74 percent and maintenance costs as well as operation costs decreased. Another advantage in modernising the plants in Mangalia is lower environmental impact by reducing pollutant emissions in the atmosphere. The entire equipment was replaced at thermal plant no. 15. The distribution network was also completely refurbished by installing pre-insulated pipes, with losses below 3 percent. The lifetime of the equipment now in use is approximately 15 years provided that periodic maintenance works are conducted, and 30-40 years for the pre-insulated pipes.

Thermal energy selling price

Solar thermal energy production prices are lower than the national reference price (RON 107.5/ Gcal) established by the Romanian Energy Regulatory Authority. The thermal energy that Rominterm produces based on light liquid fuel is subsidised, so that the supply price [1] approved by type of fuel for the population, including VAT, is RON 334.8/ Gcal.

Mangalia, Romania

Solar production capacity
Measurements and records in the period 01.09.2005 – 31.05.2006 on thermal energy production based on solar collectors show the following:
- solar thermal energy produced: 82,5 MWh;
- total thermal energy delivered: 247.6 MWh;
- share of solar energy in total production: 34 percent.

Substitution of fossil fuels

The use of solar energy at this plant leads to an annual reduction in light liquid fuel consumption by approximately 40 tonnes (i.e. 12 percent of the annual fuel consumption at thermal plant no. 15). In order to verify fuel savings at a hybrid (solar and fossil fuel) plant, Rominterm commissioned a study to compare this case with a plant running on fossil fuel alone.

Comparison of two thermal plants belonging to Rominterm Mangalia (data regarding production and consumption in September 2005 – May 2006)

	No. of apartments	Production September 2005 – May 2006 (Gcal.)	Fuel consumption September 2005 – May 2006
TP 14	467	2709	450 tones
TP 15	469	2534	376 tones

Source: Rominterm [TP 15 – hybrid thermal plant, solar collectors and fossil fuel]

The table above shows that 10 percent fuel savings were registered at the hybrid thermal plant for approximately the same number of apartments connected to the system. The fuel consumption records are for the winter period (not the best season for solar energy), and so the good fuel savings result demonstrated the feasibility of the project.

Conclusions

The "Increasing energy efficiency by using solar energy" project that was implemented in Mangalia was a big success as thermal energy demand was covered from a renewable energy source (solar collectors) and conventional sources (light liquid fuel) for 469 apartments. The investment in solar collectors for thermal energy production is profitable, so the company will build another hybrid thermal plant (solar collectors and light liquid fuel).

[1] Data regarding the situation with local interest energy services as of 31.03.2006, www.anrsc.ro

Using biomass – the Bansko thermal power plant, Bulgaria

The town of Bansko is situated in south-west Bulgaria in the valley of the Mesta River encompassing the North-Western parts of the Rhodope Mountains and the northern part of the Pirin Mountains. In recent years the town has become the symbol of 'modern' ski tourism which has imposed severe pressure on the environment – especially as there is a biological reserve "Bayuvi dupki" in the area, protected nature sites such as the waterfalls and cave of Bunderitca as well as the Pirin National Park. In 2006 however, the municipality started to improve its environmental record by launching a project to build the first biomass-fuelled thermal power plant in the region.

Description of the project

A group of energy experts exploring biomass as an innovative energy source in Bulgaria initiated the biomass-fuelled thermal power plant project in Bansko in 2005. The company Macronet provided initial financing to conduct a half year preliminary investigation regarding the use of biomass in the Bansko region. They chose the town of Bansko as the area is abundant in wood waste from the wood processing businesses in the region. At that time, the team of experts visited several biomass thermal power plants in Austria, which helped them develop a project applying the same technology in Bulgaria. Later they established Bul Eco Energy Company , which developed a feasibility study for the project, and they started looking for funding opportunities. The investment project was officially announced in August 2005, when the company delivered a presentation of its plans for the biomass thermal power plant to the Bansko community. In 2006, the State Water and Energy Regulatory Agency granted the company two licenses for the production and transmission of thermal energy for 15 years.

The thermal power plant project, designed with a 10 MW capacity, has two stages of implementation. The first stage included the installation of 5 MW. It was completed at the end of 2006 and it is currently operational. The plant supplies hot water and heating to two municipal schools, a cultural centre, the municipal administrative building and a telephony equipment factory. In the beginning of 2007, the second stage was initiated, to install another 5 MW, and the unit is currently under construction. When the second stage is completed, the plant will be able to supply thermal energy to the remaining municipally owned buildings, several large hotels, as well as residences.

The project was planned with a view to utilising the existing thermal energy distribution network (underground pipes). Construction works on the distribution network started in 1989; however, the network was never completed and thus never went into operation. Within the first stage of the biomass project the main branch of this network was rehabilitated and completed so as to connect the power plant with the town's centre via a 1.3 km pipe. Extensions of the distribution network are planned for 2008, when the second stage of the biomass power plant is completed. The total length of the distribution network will be 3.9km.

The biomass plant uses waste wood for fuel. The Austrian company Polytechnik provides the technology. The plant is being built by Enemona Ltd, a company that has 16 years of experience in engineering and construction works in energy related projects in Bulgaria and abroad.

Bul Eco Energy, the company that the team of experts established, organised some meetings in 2005 to present the project to the general public. The municipal council approved the project in 2006 and the mayor issued a permit for the construction of the power plant.

Technology

The Bansko thermal power plant uses wood waste supplied by local wood processing companies as well as wood resultig from sanitary cleaning of forests in a 50 km radius area. When the second stage of the project is completed (end of 2007), the plant will consume 200 tonnes of wood waste per year. According to the production plan it will produce 12,670 MWh in 2007 while the forecast for and after 2008 is to double the production to 23,270 MWh each year realizing 47,291 GJ/year heat savings.

In Bulgaria, reports show that 1.6 million tonnes of wood waste is available on a yearly basis. The wood waste used in the Bansko thermal power plant consists of wood processing leftovers, branches, wood from sanitary cleaning of forests (not more than 6 cm. diameter), forest residues, wood shavings and bran (in small quantities). The main sources of wood waste are the forestry centres 'Mesta', 'Dobrinishte' and 'Simitli'. The municipality has a contract with the regional forestry administration in Blagoevgrad, which guarantees control over wood waste delivery, so no wood is taken from national parks. The wood waste is transported to a temporary storage facility where sorting and processing of the wood material takes place and what are known as wood chips are produced. The wood chips are 20 to 50 mm long and 1-10 mm thick and are the main input for combustion in the biomass power plant. A conveyor belt takes the wood chips from the temporary storage facility to the permanent storage unit.

The advantage of the technology is that it is entirely automated and safe. It consists of a water-cooled hydraulic staircase grate, where the grate-steps move separately and the boiler system can use both dry and wet material. The material is fed to the furnace by means of worm conveyors or hydraulic feed systems. The grate is divided into three combustion areas, partially drying the material in the first zone. In the second zone degassing of the fuel takes place while in the third zone the fuel is completely combusted. Several fans provide combustion air, coordinated for the respective zones and enabling preliminary drying of the biomass and ensuring combustion with efficiency of 86%.

The technical parameters of the power plant after the first stage of the project are:

- maximum output water temperature – 110°C
- minimum water temperature upon entering the boiler – 90°C
- maximum water pressure – 6 bars
- thermal power – 5,000 kW
- efficiency at nominal load and 40% wood moisture – 86%

Temperatures in the furnaces reach 1,100°C and there are special sensors that monitor combustion. The equipment has a back-up generator in case electricity from the grid is unavailable. A back-up water pump is also available in case the water supply ceases.

Economic aspects

The goal of the biomass project is to reduce the expenditures of 14 municipal buildings for heating and, after the expansion to 10 MW, to serve the residential and tourism sectors. The project was planned initially for 3 MW, then two 3 MW units, then two 4 MW units and finally it was designed with two 5 MW units due to the rising interest and the increasing number of hotels and private households showing their willingness to connect to the network.

In the first stage of the project, the investment was LEV 2.4 million (approximately EUR 1.2 million), whereas the expected total cost of the project is nearly LEV 5.28 million (approximately EUR 2.7 million). The investment was rated BBB+ by the Bulgarian credit rating agency, which reflects moderate strength of the investment, relatively low risk due to different financial sources, opportunity for filling a market niche and high support from the municipality. The internal rate of return of the investment is 7.25 percent, which is lower than the general investment requirements, and the pay back period is 8.9 years.

The project is financed through a EUR 1.5 million loan from the Bulgarian Energy Efficiency and Renewable Energy Credit Line (BEERECL), a mechanism established by the European Bank for Reconstruction and Development (EBRD). Co-financing was sought from the Enterprise for Management of Environmental Protection Activities (EMEPA) within the Bulgarian Ministry of Environment and Waters and the EU pre-accession fund SAPARD.

One of the drawbacks according to Bul Eco Energy is that securing co-financing remains a relatively slow process – from the preliminary studies, through administrative approval to the actual construction of the facility. Also, the expenditure for connections to the system is rather high for a single household, as it can reach approximately LEV 15,000 (approximately EUR 7,600). On the other hand, public banks such as EBRD and commercial banks can consider introducing credit lines for this kind of service to private households.

From the point of view of the municipality, expenditures for thermal energy consumption have decreased significantly. The municipality used to pay LEV 50,000 (around EUR 25,000) per month for heating on fuel oil, now down to LEV 20,000 (around EUR 10,000). The municipality was initially skeptical about such a project, as wood waste has rather low energy content, but it is now highly satisfied with the results.

Indirectly, the project has led to the development of new businesses. For instance, the wood waste market barely existed before, and a lot of wood processing companies had to export their wood waste to Greece. Now, Bul Eco Energia has signed long-term contracts with the companies from the region which now deliver their wood waste to the biomass plant and thus reduce transport costs.

Environmental and social benefits

The project was subject to a screening procedure to determine the need for an Environmental Impact Assessment (EIA). The Regional Environmental Inspectorate conducted measurements, the results of which showed no significant environmental impacts, hence no EIA was carried out.

The operation of the biomass-fired plant in Bansko will lead to a reduction in emissions of 2,661 tonnes of CO2 equivalent in 2007 having potential of reducing much more after the completion of the second stage of the project. It is calculated that N2O emissions will be reduced 3 times, CH4 – 3.5 times and NOx – 15 times in comparison to the baseline conditions (combustion of fuel oil). The emissions from the stack contain mainly water vapour, small quantities of particulate matter and gases, which are far below the emission limits established in Bulgarian and EU environmental legislation. The ash is captured in a special container. However, as it is organic, it is suitable for use as fertiliser in the agricultural and forestry sectors. Furthermore, Bul Eco Energy plans to further develop its cooperation with the EBRD and prepare a package for emission trading.

Moreover, the project facilitates the sanitary cleaning of forests, which prevents the dissemination of tree diseases. Also, by collecting and removing the fallen organic matter from trees, its decomposition will be avoided and hence methane emissions can be reduced considerably; we should consider the fact that methane's climate impact is 21 times greater than that of CO2.

The implementation of the project has a direct social impact as the price of energy from biomass for consumers will be significantly lower than thermal energy from fuel oil. The cost for the end consumer is LEV 83 per MWh. In comparison, the price of electricity is LEV 147 and conventional fuel – LEV 84 leva per MWh. Also, consumers have the option of controlling temperature levels as well as stopping the heating when it isn't necessary. The lower energy prices will allow the redirecting of financial resources to other activities. Providing better heating services in schools and kindergartens will ensure the better health of the children and indirectly health costs can be reduced. Currently, there are 14 people working at the facility guaranteeing its smooth operation and quality of services.

Sustainability and innovation

The biomass-fired thermal power plant in Bansko is the first biomass project with such large capacity and high number of beneficiaries. In other parts of Bulgaria there are several other biomass projects but they are comparatively smaller. It is the first municipal project which includes the rehabilitation and utilisation of existing pipes but also network extension. The plant has inspired similar projects in the region, in the towns of Dobrinishte and Gotce Delchev.

The project received the award of best environmental project for 2006 from the Ministry of Economy and Energy Resources. The municipality, with its strong tourism orientation, considers the biomass thermal power plant as one of the sightseeing destinations in Bansko and decided to include it in the map of tourist spots with environmental significance.

Conclusions

The Bansko power plant is the first large capacity biomass project in Bulgaria. It can be seen to have significant economic benefits for the project promoter but also savings for the municipality. It has reduced the municipal energy costs by more than 50 percent, providing low cost green energy to the town of Bansko. It is also the first biomass project in Bulgaria to receive commercial funding from the EBRD, which shows the stability of the investment. It is clearly an innovative project with a replication potential in other towns in this region.

The plant's equipment is automatic, and it is designed to also use wet biomass. Switching from fossil fuel to biomass for energy production has several environmental benefits – significant green house gases emissions reduction, sanitary cleaning in forests and use of wood waste from wood processing companies. The cost of biomass energy is much lower for the end consumer, reflecting the social dimension of the project. Also, the power plant can trigger new entrepreneurship opportunities and it is considered a tourist attraction of the town.

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Gheorgheni – district heating on biomass, Romania

The aim of the project was to develop district heating systems in five cities (Vatra Dornei, Gheorgheni, Vlahita, Huedin and Intorsura Buzaului) based on the use of sawdust or other wood waste products. All five locations are situated in mountain areas and have a stable sawdust supply.

The Gheorgheni case is a fuel switch project addressing the Romanian district heating sector, whose aim is to substitute fossil fuels (oil and gas) with local wood residues such as sawdust, wood chips and bark from the wood processing industry (sawmills etc.) and forestry.

An important aspect of forest carbon management in Romania and other countries in the region is the way wood residues are used or disposed of by wood processing companies. In particular large stockpiles of wood residues have been accumulated in forest areas around Romania. The wood waste stockpiles cause water pollution and also generate large quantities of CH_4 and N_2O emission.

CH_4 has a global warming potential 21 times greater than CO_2, meaning that the greatest part of the GHG reduction generated by the implementation of this project will originate from a decrease in the quantity of wood residues dumped in nature and the corresponding reduction in CH_4 emission.

The calculations made in the project baseline study show that up to 78 percent of the total GHG emission reduction from the project is caused by the decrease in volume of wood residues dumped in nature. Therefore the project can be categorised as a Methane Emission Reduction Project including also CO_2 emission reduction by substituting fossil fuels with biomass. Possible N_2O emission reductions have not been taken into account when estimating the total GHG emission reduction generated by the different emission baselines.

The technology generally used in the project is based on standardised western European district heating technology, with key components such as:
1) High efficiency automatically controlled biomass boiler systems with the most modern flue gas cleaning facilities;
2) Pre-insulated district heating piping components;
3) Consumer connection units with plate heat exchangers for decentralised production of domestic hot water and automatic controlled mixing loops for space heating supply;
4) Pre-insulated heating piping components in basements.

The expected lifetime for the equipment implemented under the project will be a minimum fifteen years for the biomass boiler systems if insufficient maintenance is conducted. For the pre-insulated piping components the lifetime is estimated at thirty to forty years.

A Memorandum of Understanding between Romania and Denmark was signed in 2003 according to the principles of the Kyoto Protocol. A project agreement was signed in 2003 by representatives of the Romanian Ministry of Waters and Environmental Protection and the Danish Ministry of Environment. The aim of the project agreement was to ensure that funds generated by CO_2 trading between Romania and Denmark would be used to finance part of the project investment costs. The project agreement contains the host country's approval of the project as a Joint Implementation Project.

Project funding for the Gheorgheni component was EUR 2.2 million, coming from the Danish Environmental Protection Agency, the Phare programme, the Romanian Government (through the Romanian Agency for Energy Conservation) and the Gheorgheni Municipality.

Biomass District Heating in Romania

Boiler technology

The project introduces boiler technology that makes it possible to use wet biomass as fuel. In this respect wet biomass such as sawdust, wood chips, bark etc. with water content of up to 55 percent is considered. According to representatives of the Gheorgheni district heating utility, sawdust water content was up to 80 percent at times, which had an impact on boiler efficiency but did not impact service quality significantly.

The biomass boiler technology selected for the project can be considered market standard in western European countries, including a combustion chamber lined with heat resistant brickwork and an inclined step grate that supplies the biomass fuel automatically. Water evaporates on the top of the step grate, then the gases in the wood waste are extracted and lastly the dry wood waste is burnt. The flue gas cleaning systems consist of multi-cyclones and bag filter units, and the flue gases are finally discharged through a self-supporting steel stack.

Ash from the combustion process is automatically transported into a closed ash container, and ash is either dumped at a landfill or spread as fertiliser in the forest.

The biomass boiler systems are automatically operated to secure optimal operation of the combustion processes. As biomass is not a homogeneous material, the primary and secondary combustion air supply needs to be continuously controlled in terms of O2 content in the flue gas. The combustion air control together with the automatic fuel supply from the fuel storage and differential pressure control installations can only be operated efficiently using modern control technology. The new boiler systems include technical systems for treatment of replenishment water and automatic fire fighting installations to be switched on in case of back burning in the stoker system. The new biomass boiler systems do not use fossil fuels during start-up.

Modifications in the distribution network

Hot water used to be distributed to consumers in a network built on the four-track principle, with one supply and one return pipe for space heating purposes, one supply pipe for hot water and one pipe re-circulating the hot water. Hot water was produced at the plant and the pipes were laid in concrete channels with very poor pipe insulation or in some places no insulation at all. The project replaced the four-track pipe system with a two-track pipe system, which is the normal standard technology applied in western Europe, and comfort levels improved, along with efficiency. All heating pipes under buildings were replaced in the project with new pre-insulated pipes.

Substitution of fossil fuels

Fuel consumption at the Gheorgheni plant

Oil Fuel	1997	1998	1999	2000	2001
Tonnes/Year	1,181	1,298	858	601	855

The decrease in fuel consumption over the years was not due to an increase in boiler efficiency, but to a lack of funds for fuel acquisition. This meant a decrease in quality of service, which was already at a low level. We need to mention that losses in the district heating system were up to 48 percent. Design biomass consumption at the Gheorgheni plant: 6965.2 tonnes per year. Resulting ash: 37-70 tonnes per year.

The project envisaged measuring sawdust quantities used at the plant, but in reality they are only calculated based on the amount of energy delivered to consumers. According to estimations, 5-6000 tonnes of sawdust were used at the Gheorgheni boiler in 2005, and energy production was 7,600 Gcal.

Research proved that ash contains on average approximately 800 PPM (parts per million) of zinc, 100 PPM of lead, 15 PPM of cobalt, and 8 PPM of cadmium. According to investigations, it is recommended to use ash from biomass-fired boiler plants as fertiliser in forestry to enure that heavy metals do not enter human food chains. According to comparisons of ash with commercial fertiliser, the content of minerals in one tonne of ash is equal to approximately 200 kg of commercial fertiliser.

GHG emission reduction

The crediting period for this Joint Implementation project is 14 years. Total emission reductions will be 715,000 tonnes of CO2 equivalent for all 5 project components in the period 2004-2017, and the Gheorgheni component covers 153,000 tonnes.

Thermal energy selling price

Current prices for thermal energy in Romania are regulated, and the national reference price is 107.5 RON/ Gcal (approximately EUR 30). The Gheorgheni sawdust boiler plant produces thermal energy at a cost of RON 101.2/ Gcal (approximately EUR 29) while most thermal power plants have production costs of RON 170-200/ Gcal (approximately EUR 48-57) and the difference with the national price is subsidized by the national and local budgets.

Data for five public institutions in Gheorgheni shows a RON 230,000 (approximately EUR 65,000) reduction in thermal energy expenditure for the 2004-2005 winter season.

Social aspects

The implementation of the project benefits a large number of the inhabitants in the five cities covered by the project. In all cities the existing district heating systems were in bad condition and some of the districts' heating systems were often out of service or their operation was unstable at best, causing serious problems and discomfort for the inhabitants.

After project implementation, one more district, a high school and a hospital started being supplied by the boiler plant that switched to biomass.

New business areas

The use of wood waste resources introduces new business opportunities in Romania. Wood waste is only utilised to a very limited extent and the potential to extend this business is very large.

Biomass and renewable energy sources represent an essential component in the official Danish energy statistics:

- 36% of district heating production in Denmark is based on biomass and waste incineration;
- wood waste represents approximately 20,500 TJ/ 5,700 GWh of annual primary energy production.

This can be compared to an annual energy production of approximately 300 TJ in the Romanian sawdust project, equivalent to 1.5 percent of the Danish wood waste based energy production.

The forest area in Denmark is approximately 5,200 square km, while the forest area in Romania is approximately 64,000 square km - it is obvious that the potential for further development in Romania is very great. This potential business development does not only involve heat production but also processing of wood waste, handling and transportation of wood waste, which is a large business area in Denmark even though its wood waste production is far lower than in Romania.

Monitoring

The objective of the monitoring plan is to provide a practical framework for collection and management of performance data in order to monitor and verify the GHG emission reduction generated by the Joint Implementation project. The verification is defined as third party periodic auditing of the generated GHG reductions and compliance with the JI criteria.

No plan has been elaborated to monitor the social impact of the project but the heating and hot water services have improved and subsidies for thermal energy are no longer necessary, which means more public funds are available for other types of expenditure.

Public consultation and participation

According to project documents, stakeholder consultation has been conducted through announcements in local Romanian newspapers for a period of a minimum two weeks in all cities covered by the project. Local stakeholders have not submitted any comments or objections against the implementation of the project. No comments have been received from local stakeholders such as NGOs, local environmental authorities, forestry institutions or the wood processing industry.

Conclusions

The project has led to significant environmental improvements, as well as to an increase in life standard. There are no major problems with the Gheorgheni biomass project. There is enough sawdust to supply the plant, and the entire thermal energy demand in Gheorgheni could probably be covered by biomass plants. Current municipality plans include a 30 MW sawdust cogeneration unit (thermal energy and electricity production), a project to be implemented in partnership with a Hungarian company.

The utility reported problems related to sawdust supply, regarding the wood chips, stones and sand content, which means more maintenance is necessary. There are 110 contracts with sawdust suppliers, but the utility now has to transport the sawdust by its own means. This is mainly due to the establishment of companies exporting sawdust pellets, which means competition for boiler supply. The utility does not pay for the sawdust at the moment, but the situation may change in the near future.

The Trtar-Krtolin windfarm, Croatia

Trtar-Krtolin windfarm near Sibenik, with 14 turbines, is the second wind farm project in Croatia, after the 7-turbine facility on the Island of Pag. It began operation in July 2006, after a preparation period of several years. It was initiated by EnerSys, a German company primarily oriented towards wind energy and also solar, which is now a subsidiary of German renewables company WPD. Trtar-Krtolin was EnerSys's first wind power project in Croatia.

The project was started as a kind of pilot project for EnerSys's involvement in developing wind power in Croatia. Wind power on a larger scale was chosen because it offers the best return on investment due to the high wind availability in this area of Croatia and the rapid improvements that have taken place in the efficiency of wind turbines in recent years. A fairly large-scale project was needed because of the preparation costs and time required for the legal procedures. Wind power was also chosen because it needs less land than a solar photovoltaic installation of the same capacity, although sun is also abundant in this area of Croatia.

Description of the project

The site is on a hill near the city of Sibenik in a sparsely settled rocky karst area. The windfarm consists of 14 Enercon E-48 turbines with a total installed capacity of 11 200 kW . These are 3-blade gearless turbines with a hub height of 50-76 metres and rotor diameter of 48 metres. Each turbine's rated power is 800 kW.

Total estimated production is around 30 GWh per year - approximately enough electricity for 10,000 households. The electricity is fed into the distribution grid of the state energy supplier, HEP, with whom EnerSys has a contract to supply electricity. The sale of electricity produced by this plant was initially contracted with HEP for a period of 15 years, while the sale price of electricity was set at 90 percent of HEP's average sale price. This was done before regulations were in place to govern the grid connection of renewable energy projects, but the regulations are now in place and Enersys now has a contract for 12 years at a slightly more favourable rate. The current feed-in tariff for wind power facilities of more than 1 MW is 0.65 kn/kWh or around 8 euro cents.

The project was designed by TehnoIng from Zagreb; the turbines were made by Enercon of Germany; the electronics were made by Elis from Rijeka, and the remaining work was carried out by Enersys.

Costs and financing

The total cost of the project was around EUR 13 million, of which around EUR 8.5 million was for the turbine generators, around EUR 3 million for construction equipment and works and the rest for the documentation, planning, and additional electric parts.

According to Enersys, the EBRD was approached to support the project, but declined as the necessary paperwork for the project in Croatia was considered to negatively affect the economic viability of the project. The EBRD also set out a higher

Windfarm in Croatia

interest rate and less favourable terms than the private Croatian bank Zagrebacka Banka and Bank Austria Creditanstalt, which in the end provided loans for the project with a repayment time of 14 years.

In order to be financially viable for EnerSys the project should recover 270 percent of its original costs, including all loan repayments and a basic level of profit for the company, which is expected to take 20 years.

Challenges

The administrative procedures for the project were long and complicated, and the same procedure has to be followed for all commercial energy production projects, whether large or small, making it hard to invest in very small-scale commercial energy production projects at the moment.

For example, gaining a location permit takes a minimum of one year, and the EIA process for a relatively low-impact windfarm is just as long as for a larger, more polluting project. Although it is legally possible for the Ministry of Environmental Protection, Spatial Planning and Construction to request a shorter study than usual, with targeted contents, this makes little difference to the overall timeline of the process.

A Sanitation Permit also had to be obtained because a wind farm comes into the turbine category, and these are considered potential sources of oil pollution. The fact that these turbines have electronics rather than a gearbox containing oil has not been considered in the legislation as it is a relatively recent development. This was made particularly difficult considering that according to Enersys there is only one person for the whole of Croatia who can issue Sanitation Permits, and this person was on sick leave for three months with no-one else appointed to deal with the case.

A second problem area is legal ownership of land, which is unresolved due to the fact that it is still not known for all of Croatia who owns the land due to nationalisation and loss of records. Now the state does not own it but nor does anyone know who does. Sometimes where the owner is known, it is impossible to contact them because they have either emigrated or died and the inheritance rights have not been fully settled, or the land is jointly owned by several members of the family who cannot agree on whether to sell it or not. Efforts at rectifying this situation are being carried out but it is likely to take many years.

The third problem is the timeline for financing by commercial banks because the process of negotiating and obtaining a loan takes 3-4 years. This could be prohibitive for smaller companies trying to make smaller investments. In general balancing of the financing and realisation of the project needs to be carried out carefully as the wind turbines are made to specifications, and therefore they have to be paid for a year before they become available to enter service.

Social and environmental benefits

The primary benefit of the project has so far been ecological because when the project began, wind power in Croatia was not commercially viable, although this is now changing.

According to Enersys, the annual operation of the windfarm potentially saves:
• 36.6 thousand tonnes of lignite
• 9.15 thousand tonnes of black coal
• 6.7 thousand tonnes of natural gas
• or 137 kg of enriched uranium.

Wind generation has low emissions during its life cycle. Enersys estimates that the following emissions are potentially avoided by the annual operations of the windfarm:
• 45.1 tonnes of SO_2
• 22.3 tonnes of NO_2
• 1.2 tonnes of dust or particulate matter
• 29 585 tonnes of CO_2

The average Croatian CO_2 emissions for energy production are lower than the potential CO_2 emissions due to the high use of hydropower - according to the national electricity company HEP's annual report its electricity production emits around 328.09 g of CO_2 per KWh, so compared with current average production the windfarm's generation of 30 GWh per year prevents emissions of around 9 842.7 tonnes of CO_2 per year.

Wind power can have certain negative effects if projects are not sited appropriately; however the site of Trtar-Krtolin was chosen to avoid negative impacts as much as possible. It is situated near, but out of sight of, the Krka National Park, and was subject to an environmental impact assessment to ensure that it would not disturb bird migration routes. The site was chosen to be as far from settlements as possible whilst still being accessible, and the rocky and arid nature of the terrain means that it is of little use for other purposes and that the turbines do not appear particularly unsightly against the backdrop.

State of the art equipment has been used, which reduces noise from the turbines. Primarily for economic reasons blades were chosen with an absolute minimum of noise and therefore maximum efficiency, and the turbines have electronics rather than gearboxes, so there is no gear noise. Since the commencement of generation there has only been one complaint about the sound of the turbines during the night which can be heard from the area on the opposite side of the windfarm from the main road. On further discussion this turned out to be a low level of noise which cannot be heard during the day because of the sound of the crickets, and the company has assessed that it cannot do any more to reduce the noise than was already done in the project planning stage.

General monitoring of the construction was carried out as stipulated in Croatian law, however there is no requirement for monitoring of the real-life impacts of the windfarm on birds and bats, which could be useful when planning future projects.

Sustainability of the project

When the project first started, wind offered ecological advantages but was not economically viable in Croatia. However, this is changing and the Trtar-Krtolin wind farm is now reaching the stage of breaking even. This is a result of both rising fossil fuel prices and the fact that globally there has been a huge technological leap (by a factor of 10) in the last two years and each turbine can now provide much more energy than before. Within the next few years, according to Enersys, it is expected that the price of wind power in Croatia will be on a par with fossil fuels.

Although the project has been led by a German company, as shown above there have also been some business opportunities for small and medium Croatian companies in subcontracting. According to Enersys, these companies have proved more adaptable than larger companies in reacting to the rapid changes in the market.

Conclusion

Although it was necessary to remain calm, be persistent and extremely patient during the project development phase, so far Enersys concludes that the project has more positive than negative aspects, and is working on another wind farm project in Croatia.

Paradoxically, the second project that Enersys is now working on is proving harder to obtain the necessary paperwork, due to the fact that 18 approvals are needed for the location permit, as opposed to 12, two years ago. Clearly the legal procedures in Croatia need to be changed and simplified to allow for smaller and less polluting energy projects to gain the necessary permits more quickly or to reduce the number of permits needed. Due to the current legal problems Enersys estimates that it is highly probable that only 2 percent rather than the planned 5.8 percent of energy generated from renewables in Croatia by 2010 will be realised.

However, even with the current barriers wind is showing itself to be increasingly viable in Croatia, and well-situated wind turbines should have an important part to play in the country's energy future. Since the new regulations on feed-in tariffs for renewable energy came into force in July 2007, those considering wind power projects can be relatively certain that they will receive a fixed feed-in tariff for a period of 12 years. This should increase wind power's attractiveness to commercial banks, but in the meantime support from public funders will be crucial.

All information not referenced above comes from Interviews with:
Zeljko Samardzic, Enersys
Tonci Panza, Croatian Chamber of Commerce

Photo: Enersys

Small hydro Gradiste, Serbia

The small hydro plant in Gradište is owned by Brane Veljković, a 50-year old mechanical worker from Knjaževac, eastern Serbia, who built it by himself in 1992-1994 on the family property. The small hydro was built out of sheer enthusiasm. The facility is situated 12 kilometres from Knjaževac, in the Gradište village, within the Nature Park Stara Planina. It was built on the Aldinačka river, a tributary of river Trgoviški Timok in its middle flow, in the most narrow part of a gorge. One hundred metres downstream there is a deserted water mill, evidence of good natural conditions for small hydro plants. Engineering works and administrative procedures started in 1992 and were completed in autumn 1994, when the unit was connected to the grid.

Technology

Unlike impulse hydro plants, which use a large head of water and where only the built-in pipe is prerequisite for production, the works on the small hydro unit in Gradište included building a dam and a reservoir. The construction works were done manually, with small quantities of explosive. The reservoir lake is 1 ha, and its average depth is five metres. The unit's installed capacity is 42 kW and uses a 7.3 metre water fall from a dam.

The reservoir is situated on empty limestone, and serves as a watering pond for wild animals such as deer and ducks, which were not present before. A local fish species in the Aldinačka river called 'prekuša', similar to trout, has found good conditions in the reservoir, and since the lake was formed its population has increased in size and number. The dam allows for a permanent discharge of 50-60 l/s into the river the entire year. About 50 metres from the dam, water returns to the river bed. Erosion processes develop in the upper watershed area, of the torrent flow of Aldinacka river, and the dam also functions as a deposition area for sediments and slows down torrents, thus protecting downstream areas. When the Gradište was constructed, the EIA laws were not in place. However, an impact assessment for the dam was performed as a part of the licence for a hydraulic engineering project.

The plant has two turbines. One of them is a 50-year old Czech turbine, with old automatic equipment regulating all levels of discharge. Its capacity is 14 kW on a maximum discharge of 200 l/sec. The second turbine is a self-manufactured "pipe-with propeller turbine" with installed capacity of 28 kW that uses a fixed discharge volume of 600 l/s.

Small hydro plants in Serbia can operate from October to June, with low water debit the rest of the year. At good hydrological conditions the unit can produce 100 MWh per year. In 2006, the Gradište hydro unit produced about 75.5 MWh, as a result of drought conditions.

When the turbine units started delivering electricity, problems of private property in electricity production emerged. In the first years of operation, there was no compensation or payments for the energy that was delivered to the network, only owner's household payment relief. The situation changed in 1998 after a joint action by a group of small hydro owners. Currently, the price for the electricity sold by small hydro units is 2.83 dinars (around EUR 0.036) per kWh (average electricity selling price in Serbia, in 2006, was EUR 0.038). This price does not stimulate investments, as it does not

Small Hydro in Serbia

secure a reasonable pay back period, even without calculating exploitation and maintenance costs. The maintenance costs are low, related to cleaning the water and the bottom of the lake. The main disturbance in production is due to the instability of the electricity network in the village, with occasional cutoffs. This problem is solved by using simple accumulators and small electric motors.

Detailed costs

The detailed building costs are difficult to estimate. As this wasn't a strictly commercial project, and bearing in mind the time of construction - UN economic sanctions, hyper-inflation, no bank support etc., the estimated costs of the construction works were roughly EUR 10,000. These costs covered manual masonry works and mining works on the surrounding rocky area. The turbines cost USD 1,000 per kW of installed capacity.

Challenges

The administrative and paperwork for the construction of the Gradište hydro unit was significant. It was necessary to get 40 different permits, approvals, signatures etc. A large number of these permits are in the hands of various administrative bodies in Belgrade. On the local level, the situation is the same - the owner waited for three years for the local construction permit. Another problem was the buying of nearby land to follow the stream on both river banks. Private owners exchanged and sold the land easily, despite the expectations of tradition. The 'state-owned' land was more problematic. With regard to the forest land, governed by the public company 'Srbijašume', the owner had to make an 'exchange': first it was one ha private land for one ha of forest land, and later for other cases it was raised to a factor of eight. In the case of the Gradište hydro unit, the process of exchange took nearly a year, and it was only completed after a personal meeting with Srbijašume's director. Another public company, 'Srbijavode', which manages water flows, riverbeds and river banks; issues certain permits with long and unclear administrative procedures. They also collect royalties for the use of water; the calculation base for these royalties is not the quantity of water that is being 'used', but the amount of electricity that is being produced. The payment of royalty can be avoided if the plant has no utilisation permit. This is the reason why no existing hydro power plant has a utilisation permit, even the largest hydro in the Balkans, the Đerdap hydro plant.

Beginning in autumn this year, 13 owners of small hydros in the Knjaževac municipality will be required to legally establish electricity production companies. In the existing legal and business environment this will bring additional obstacles to building small hydro units.

Environmental and social benefits

The project's environmental benefits are primarily related to the production of clean energy, replacing fossil fuels.

The costs of the project are minor in comparison to the social benefits. The Serbian tourist organization has helped make the site into a tourist attraction, and many foreign and domestic visitors have come since August 2006 for peace and tranquility in the beautiful wild countryside. There are also other places downstream for developing tourism, such as a watermill, cliffs and rocks for climbing, etc. Since the Aldinačka river has drinkable water it is suitable for fish cultivation. In a small fish pond of 30 m^3 nearby the central building the production of one tonne of trout fish is possible.

Conclusion

There are still no incentive mechanisms and implementing regulations in Serbia to develop renewable energy, including small hydro. The revaluation of Serbia's hydro potential is one of the priorities in the Energy Sector Development Strategy by 2015, but still only on paper. The Act on conditions for gaining the status of privileged power producer (renewable energy producers) hasn't been adopted yet, despite the fact that the deadline was August 1, 2005. Those who still decide to invest in small hydro projects face bureaucracy, unclear and long procedures. It is up to the government to change the situation, to adopt and implement relevant laws and acts, to simplify the administrative procedure, and to establish credit mechanisms for renewable energy projects. It is unclear why we are waiting, bearing in mind that Serbia has the potential to build approximately 900 small-size hydro-power plants with total capacity of 500 MW.

From interviews with:
The owner of HE Gradište Brane Veljković, Knjaževac

Geothermal water use – Banja Junakovic, Serbia

The most important and the largest users of geothermal energy in Serbia are spas. The use of geothermal waters is mainly for balneological purposes, with some 60 spas using geothermal waters for balneology, sports and recreational purposes. Geothermal energy is not used for power generation. Exploration has shown that geothermal energy use in Serbia for power generation could represent a significant component of the national energy balance. The prospective geothermal reserves amount to 400 x 106 tonnes of oil equivalent.

Research and production of geothermal energy in Serbia is strictly carried out within the public enterprise NIS - Naftagas (The Oil Industry of Serbia), which owns the drills and determines prices. Currently 24 wells are being used, out of which 11 are for district heating and the rest for balneology and recreation. Total installed capacity is 23 MW, which only represents 9 percent of the geothermal potential.

Geothermal water prices in Vojvodina depend on water temperature and they range between EUR 0.1 and EUR 0.24 per cubic metre while for example prices for district heating in Serbia range from EUR 0.37 to EUR 0.74 per square metre (depending on the town).

Location

Banja Junaković is situated in north-western Serbia, in Prigrevica, Vojvodina region, four kilometres from Apatin and the Danube. It is close to the Special Nature Reserve Gornje Podunavlje, one of the largest protected marshlands in the Panon Basin and in Europe.

As well as the tourist capacities and health rehabilitation facilities there are recreation facilities for a wider range of visitors: open swimming pools, tennis courts etc.

Basic resource and technology

Banja Junaković uses natural springs of underground water for balneology and recreation as well as heating purposes. Four springs of medicinal water have been identified so far, out of which one spring, with the best intensity, is being used. The well is 650 metres in depth, and contains water with a temperature of 51.8º C. Optimal yield is 11,8 l/s, while the possible substitution of fuel oil is 1228 tonnes per year.

The water of Banja Junaković has features which place it in same category as Karlovy Vary in The Czech Republic, Harkanj in Hungary and Lipik in Croatia. According to the assesment of the underground water owner, NIS – Naftagas, the medicinal water reserves are, highly rich, and suitable for permanent uses at the current rate and for new investments.

According to the Report of the Belgrade Institute for Rehabilitation, an institution licenced to analyse water's therapeutic characteristics, the water from Banja Junaković falls into „richly mineralised waters with high quantity of "Sodium, Chloride, Iodine, Hydricarbonate and Hydrogen Sulphide" and "can be used for balneotherapeutic therapy as an accompanying medical treatment bath, when cooling to relevant temperatures, in illness of the locomotor apparatus (rheumatism,

traumatic consequences, conditions after breaking of bones and operations on bone structure), gynecological illnesses, neurological illnesses (neuralgia, polineuritis) and inhalation therapy in chronic obstructive lung diseases".

Technical characteristics

Thermal water emerges at the surface by itself, which enables simple and cheap production. Methane and other dangerous gases are eliminated from the water, which is then directed to the primary plant, for three type of usage: medical rehabilitation, heating and bathing for visitors and employees. For all purposes, the thermal water is being used without any chemical or mechanical treatment. For heating purposes, the thermal water goes through a heat exchanger. During cold weather, with outside temperature below 2°C, gas-fired boilers are used to bring water temperature to standard. The area covered by the central heating system is 12.000 m².

Within the system for hot water usage for baths, the thermal water is particularly aggressive. This is the reason for the current rehabilitation of the distribution network (metal eroded pipes are being replaced with plastic ones).

Challenges

The special problem of geothermal water use is its release to a recipient. After being used, the thermal water is channeled to the Danube river, where water temperature is below 30º C. The well owner should consider investing in an injection well, to return the water back to the deposit.

Another important problem at the Junaković spa is access to thermal water information and the non availability of full inventory data. The public enterprise NIS - Naftagas delivers 22,000 m³ of thermal water per month and determines the price per cubic metre. Full and detailed information on the thermal water resource and its conditions is in the hands of the state. The future owner of the Junakovic spa would have to create close cooperation with all public institutions involved, from republic to local level. A good opportunity for improvement is the existing windmill for electricity production at the entrance of the Junakovic spa complex. This 70 kW wind turbine has not been put back to operation since the war in ex-Yugoslavia, when it was damaged; the turbine used to produce enough energy for external lighting in the entire spa complex.

From Interviews with:
Dragan Ignjatov, Banja Junaković

Geothermal energy in Oradea, Romania

Oradea is one of the Romanian cities where a renewable energy source is used to produce thermal energy for household consumers, private companies and public institutions. Transgex Oradea supplies heating and hot water using geothermal wells. The price that Oradea and Beius pay for thermal energy is much lower than the price of energy produced in common district heating plants. A major advantage of this renewable energy source is that there are no direct greenhouse gas emissions; there are emissions during production of the equipment, as well as from the use of gas-fired boilers to increase water temperature, in some cases. The potential of the geothermal source in Oradea is 250,000 – 300,000 Gcal/ year, while total consumption was 900,000 Gcal in 2005, so that a third of thermal energy demand in Oradea can be covered by the geothermal source. Once the entire geothermal capacity is used, a significant quantity of conventional fuel will be replaced; moreover a large volume of greenhouse gases will not reach the atmosphere. Transgex Oradea has an exploitation licence for 200,000 Gcal from geothermal sources; if this entire quantity is exploited, carbon dioxide emissions will be reduced by approximately 14,300 tonnes per year [1]. The entire geothermal system in Oradea is designed so that it does not have a negative environmental impact.

The technological process includes intake, distribution and injection back to the deposit or release into the Petea stream:
- production well extracting water from a depth of 3,200 metres, where water temperature ranges between 72 and 105 degrees Celsius;
- Transgex's primary distribution network and the secondary distribution network, owned by the Oradea City Hall, are very new (2004), they have pre-insulated pipes, and losses are below 10%;
- Injection well, which reintroduces the water in the deposit;
- Release to the Petea stream, where water temperature is already 30 degrees Celsius, as it comes from a geothermal source.

Transgex owns 48 wells in the Bihor and Satu Mare counties. In Oradea, Transgex operates 11 production wells and 1 injection well. During peak load (maximum consumption), 20-25 days per year, gas-fired boilers are used to bring water temperature up to standard. Transgex's investment plans include building injection wells for the entire volume of water it uses, as residual water release taxes represent 20% of thermal energy production costs in Beius, for example.

Key features

- the use of a renewable energy source; the use of a neutral energy source in terms of carbon dioxide emissions;
- the use of local energy resources; reduction in environmental impact of fossil fuel use for thermal energy production, including a significant reduction in pollutant emissions ($SO2$, NOx, $CO2$, CO and particulate matter);
- stable consumer prices (decoupling from oil prices); elimination of subsidies for district heating from the national and local budgets;
- much lower thermal energy prices compared to production at the Electrocentrale Oradea;
- rehabilitation of the transport and distribution networks: the pipes were replaced and energy losses were reduced.

Reduction in greenhouse gas emissions

The potential of the geothermal source in Oradea is around 250,000 Gcal. Transgex's latest investment was a Joint Implementation project implemented together with the Danish Environmental Protection Agency, to exploit 20,000 Gcal. Project cost [2] was USD 1.17 million [3] and a part of the investment was represented by trading greenhouse gas emission certificates (the project brings an emission reduction of approximately 14,000 tonnes CO2 equivalent for 10 years). The reimbursement period at the Romanian Energy Efficiency Fund is 3 years, and the return of investment is 2.5 years.

Transgex Oradea supplies heating and hot water in Beius even though the district heating services have officially been suspended there [4]. The company exploits two geothermal wells in Beius [5]. Greenhouse gas emission reductions in Beius are 9,738 tonnes of CO2 per year. Along the 10 year crediting period, CO2 emissions will be reduced significantly (approximately 240,000 tonnes) by using geothermal energy in the two cities.

Thermal energy selling price

Thermal energy consumption in Oradea was 900,000 Gcal in 2005; Transgex's share was 70,000 Gcal. The price of 1 Gcal from geothermal sources was RON 85 (including VAT), as against a national reference price [6] of RON 107.5. The other thermal energy supplier in the city, Electrocentrale Oradea, had a price of RON 140, and received state subsidies.

Replacement of the distribution network

Transgex Oradea also invested in the refurbishment of the system of pipes taking the thermal energy to the consumer. Thus, the primary distribution network (owned by Transgex) and the secondary distribution network (owned by the City Hall) are in very good condition, as they were commissioned in 2004. Pre-insulated pipes were installed, with very low losses, below 10 percent.

Substituting fossil fuels and financial savings

The implementation of the latest Transgex project (exploiting 20,000 Gcal) involves the following savings in primary energy resources:

- by using a renewable energy source, the project brings a reduction in fossil fuel consumption at the Electrocentrale Oradea [7]; the reduction is 9,000 tonnes of oil equivalent;
- maintenance and other costs are very low; unlike the cogeneration plant and the old equipment, the capacities are more efficient and completely automated, bringing significant financial savings by reducing maintenance and operation costs. The use of plate heat exchangers leads to much lower energy losses;
- emission reduction: USD 1 investment brings a reduction of CO2 emissions by 12 kg per year, or USD 1 investment brings USD 0.06 annually from the sale of CO2 emission reduction certificates (at a quotation of EUR 4 per tonne of CO2 equivalent).

Social aspects

The use of geothermal energy in Oradea and Beius brings both financial benefits for the consumers (lower price) and comfort (quality service with low levels of losses in the network). This ecological solution is the only available one in Beius, as the Emergency Ordinance 48/ 2004 took the city off the list of cities with a district heating service.

Beius has 12,000 inhabitants and 1,400 apartments, 900 of which are currently connected to Transgex's district heating network. The entire consumption is covered by the geothermal sources (3 thermal units using liquid fossil fuel were replaced). Geothermal production was 14,000 Gcal in 2005. An increase in production to 22,000 Gcal is estimated for 2007. The geothermal projects in Beius are co-financed by the Danish Environmental Protection Agency.

A 30% reduction in state subsidies [8] to the cogeneration plant motivated the Oradea municipality to increase the share of geothermal energy in total thermal energy production. Thus, Transgex S.A. and the Local Council formed a public-private partnership [9]. By 2007, state subsidies for thermal energy producers had to be eliminated, so that the contract between

Transgex S.A. and the Local Council planned for an extension in the use of geothermal energy and the modernisation of the thermal units and the distribution networks. Transgex currently supplies heating and hot water to 3,200 apartments (through 43 owners' associations) and hot water alone to 3,500 apartments [10].

Plans for the future

Transgex's short term objective (2 years) is to increase production to 150,000 Gcal. One of the projects in the company's investment plans is a mixed project to supply 86,000 Gcal in the Nufarul district. This is a mixed project, using a geothermal source and natural gas (36,000 Gcal based on gas and 50,000 Gcal from the geothermal source), as water temperature is 72 degrees Celsius at the source (minimum 100 degrees Celsius is required). The plans include a production well and an injection well. Project cost is EUR 6.2 million, and the company plans to obtain co-financing from the Environmental Fund.

Conclusions

The use of geothermal sources in Beius and Oradea significantly improved environmental and living conditions. The geothermal potential is considerable, so that if maximum exploitation and revaluation is reached Transgex S.A. will be covering approximately 30% of thermal energy demand in Oradea and 100 percent of thermal energy demand in Beius. Modernising the Oradea district heating system is part of Transgex's investment programme. The company owns drilling licences for deposits in the north-western part of the country that represent 50% of Romania's geothermal potential.

[1] Source: the Romanian Energy Efficiency Fund
[2] The investment consists of connecting 5 thermal units (the Iotia Nord district) to well no. 4767 Oradea.
[3] 36 percent the Romanian Energy Efficiency Fund, 8 percent Transgex S.A. Oradea, 56 percent emission trading – Danish Environmental Protection Agency.
[4] Governmental Ordinance no. 48/ 2004, Official Gazette no. 563/ 24.04.2004, Part I.
[5] Sources 3001 and 3003, with a debit of 120 litres/ second and water temperature of 120 degrees Celsius.
[6] Governmental Decision no. 1254/ 2005, published in the Official Gazette no. 938/ 20.10.2005.
[7] Electrocentrale Oradea has two large combustion installations: three boilers on natural gas and fuel oil and three boilers on lignite.
[8] Emergency Ordinance adopting measures regarding thermal energy supply for the population, for heating and hot water through public district heating systems, Official Gazette, Part I, no. 563/ 24.06.2004.
[9] Geoterm was established, where Transgex has 88.5 percent of shares and the Oradea Local Council has 11.5 percent of shares.
[10] Source: Transgex.

Renewable and energy efficient house in Kadino, Macedonia

The pilot idea to carry out such a project was to use renewable energy sources (wind, solar) in order to produce electricity and hot water for a small weekend house in the village of Kadino, the Skopje Municipality. The house was 50 m2. Sieto, a private company, installed a 400 W wind turbine, a 50 W photovoltaic solar panel and two 100 Ah rechargeable batteries 7 years ago. This equipment produced enough electricity for lighting as well as to power a TV set and radio. The pilot house was also equipped with a computerised monitoring system that regularly analyses and archives data regarding electricity production and consumption. The incoming data was so encouraging that Sieto decided to turn the small weekend house into a house for permanent residence where electricity and hot water demand would be covered 100 percent from solar and wind equipment for 8-9 months per year (except during winter). For this purpose, Sieto expanded the existing house by new construction, for which special measures for heat insulation were used

Description of the project

The total area of the new house is 192 m2, 111 m2 of which is residential area and the rest of which is basement and additional (storage) space. Currently, a family of four lives in the house except during extreme weather conditions. The following three systems, using wind and solar power were installed:

• One wind generator W-200 type with nominal power of 1 KW and fan diameter of three metres, expected to produce 250-300 kWh each month (considering wind measurements in this region).

• Ten photovoltaic solar panels type PW1000 with total installed capacity of 1000 W which would enable average monthly electricity production of 250-300 KWh in summer. The energy is stored in eight 100 Ah, 24 V rechargeable batteries (total capacity of 800 Ah).

• For hot water production, a solar collector system (closed type) consisting of five solar collectors and a 300 litres insulated tank (with two pumps and electric heater) was installed. The hot water is used both for the heating purposes of the house and as sanitary hot water for the washing and dishwashing machines and for showering in two kitchens and two bathrooms.

Currently in Macedonia there is no legislation to enable the purchase of electricity produced outside of the electricity company, which would enable Sieto to sell the extra produced and stored electricity and therefore, using the electricity produced on the spot is the most practical solution for this project. Also, in order to achieve the maximum efficiency of the whole system, the most viable option in economic terms is to use the energy at the time it is produced, and store a small portion for when production decreases. To achieve this, and to enable energy storage with minimal losses, the following method is used: the energy produced by the wind turbine is not only stored in the batteries (considered as a conventional method), but the energy is also used to heat the water in the central reservoir. This method enables maximum use of the wind power. This way, the energy produced can be used where needed mostly, for an electrical appliance, and if the wind is strong, the surplus of energy is directly used for water heating.

In order to prevent energy losses, the house has thermal insulation. The old part of the house has a facade insulation consisting of: 5 cm pressed Styrofoam, followed by 2 cm air filled space and then bricks. The new part of the house has a "sandwich" system consisting of: outer facade Styrofoam, bricks, air filled space, Styrofoam, mineral padding (fire

insulation boards) and bricks. In order to prevent heat transfer, Sieto did not construct a normal concrete brace connection wall, but used metal rods instead. Heat sensors have been inserted on three locations (facade, in the middle of the walls and inside the house) to provide information on heat loss. For experimental reasons Sieto installed both wooden and PVC thermal insulation windows in different parts of the house. The window size has been calculated to prevent heat loss, while ensuring there is enough light in the rooms. It has been shown with time that in spite of their age (20 years old), wooden windows provide much better insulation than the brand new PVC ones.

The house is equipped with class "A" energy efficiency appliances. The lighting in the house consists of high efficiency light bulbs (developed by Sieto, up to seven times more energy saving than normal energy saving bulbs). The lighting outside the house (in the yard) are also produced by Sieto and are special energy saving spot lights with diodes. Living in such a house requires certain adaptation processes. Using high consumption appliances should take place at peak energy production, between 11 am and 3 pm. Cooking should be done on gas appliances in order to save energy. But most importantly, heating should not be done using thermoelectric heaters. The house has a specially designed central heating system (a combination of low temperature floor heating and central radiator heating). Total costs for the energy equipment at the house, including all accessories, were around EUR 20 000.

In developing the complete system to satisfy the needs of a household, the investor paid special attention to the following:

- Producing electricity to power electrical appliances
- Producing hot water
- Producing electricity and hot water for heating.

Electricity production

The house is connected to the electricity grid, but this does not mean that the system can transfer excess electricity to the grid. In order to make possible the accumulation of energy, the battery system needs to be over-sized, which significantly increases the price of such a system. Therefore, the alternative system for electricity production in the house was designed in a way to fully cover the consumption of all electrical appliances 9 months per year; during winter, the system only covers lighting, refrigerator, TV and radio.

The system consists of: wind turbine, solar photovoltaic panels, system for accumulation of excess energy and computer equipment controlling the system (production and consumption).

The wind turbine and solar panels produce 24V DC (direct current) electricity.
This electricity is turned into 220 V/ 50 Hz AC electricity by means of DC/AC inverters, and then taken to appliances. The so called heavy duty inverters were produced by Sieto and they can operate 24 hours a day, 365 days a year.

The computer system, also specially designed by Sieto, does regular archiving of data regarding electricity production and consumption, keeps a record of peaks and helps reduce supply problems. The system can identify where electricity is most needed and direct it there; in absence of stored energy, the system supplies the house with electricity from the grid. The battery system is designed to always keep 30% for emergency, and it enables autonomy from the grid for 48 hours without charging.

Producing hot water

Hot water production is done in five solar collectors with a total active area of 10 m2, connected to a 300 litre tank. A mixture of non-toxic antifreeze and water is circulated in the collectors. The liquid heats up, an electric pump circulates it and a heat exchanger transfers the thermal energy to the water in the tank. In summer, the hot water is used in the kitchen, bathroom and for heating the pool water. In winter, the water is pre-heated in the solar collectors, then water in the tank is also heated by the wind turbine and the exchanger in the fireplace in order to bring the water temperature to standard.

Producing energy for heating

In winter, the main energy consumption is heating. The central heating system in this house consists of low temperature floor heating and radiators. It is connected to the other two systems (for production of electricity and production of hot water) by two exchangers, which enables maximum efficiency in the entire process.

The hot water tank (used for sanitary water storage) is connected to the central heating system. The water in the tank is first pre-heated in the solar collectors and by the electrical heater powered by the wind turbine. In combination with the exchanger in the fireplace (in case of days with no energy production), the system ensures circulation of hot water to heat the house.

Environmental benefits

The system installed in the house produces on average 500-550 KWh of electricity each month. Compared to fossil fuel systems, this amount of electricity determines CO_2 emission savings of 290 kg per month. The system for hot water production will produce around 5000 KWh per year. By heating water using solar energy, CO_2 emissions are reduced by 175 kg per month.

Thus, apart from obvious energy saving (the energy would otherwise come from a thermal power plant), the system helps reduce negative climate impacts (CO_2 emission reduction), as well as local negative impacts on the environment and human health generated by fossil fuel combustion.

Conclusions

This house is a perfect example of the possibilities for energy efficiency and the use of renewable energy sources on a household level. In a country like Macedonia, where renewable energy sources are not massively used, and to some extent not familiar to the wider public, this project shows that renewables can be used not only to produce energy at competitive prices, but also to protect the environment and to decrease greenhouse gas emissions.

A positive initiative in Macedonia has been the recent decision by the Government to subsidise households that install solar collectors, by participating with up to EUR 300 for each collector installed. Still, more needs to be done in order to illustrate the possibilities of renewable energy sources and energy efficiency.

Current energy legislation in Macedonia does not allow the connection of renewable energy sources to the grid and thus it does not enable the distribution of energy produced in an "environmentally friendly way". The laws also do not impose certain restrictions and regulations regarding construction of new buildings and insulation materials to be used, so it is to some extent questionable whether buildings and houses in the country are really "tucked in" and saving energy.

Still, it's clear that positive initiatives such as this house need to be multiplied. People are not convinced it works until they see it next door. This is exactly what the Government should start in line with existing subsidies - it should financially support renewable energy projects and initiatives in order to trigger similar projects all over the country. Moreover, the Government of Macedonia should start promoting energy saving home appliances (class "A") and introduce financial incentives for purchasing energy efficient appliances in order to help households save energy and contribute to overall energy savings in the country.

References:

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• Interview with Zvonko Markovski, owner of the renewable and energy efficiency house

Energy-independent house in Mereni, Romania

The village of Mereni in Constanta County has one of the few energy-independent houses in Romania. The household is at the periphery of the settlement and covers its energy needs with four PV panels, two solar collectors and a small wind turbine. The owner of this ecological residence decided to invest approximately EUR 12,000 in these energy production systems because he had had access to information regarding the use of renewable energy sources, and the grid connection alternative was expensive (and he would have had to pay for the electricity, of course). The system operates in optimum conditions and there has been no occasion when the house didn't have energy. The house has three rooms, a kitchen and bathroom. It has all the necessary household electrical equipment, and two people live there on a permanent basis. Renewable energy sources can supply thermal energy and electricity for a house so that it can be energy independent (not connected to distribution networks). Thus, depending on the systems that are used to exploit renewable energy sources, houses can have various types of equipment, such as:
a) PV panel – wind turbine – solar collector;
b) PV panel – wind turbine – micro-hydro;
c) PV panel – wind turbine – micro-hydro – solar collector;
d) PV panel – wind turbine – micro-hydro – biomass.

Systems at points a) and b) generally add a unit fired by fossil fuel to ensure security of supply for all periods when due to natural causes the renewable energy sources cannot be exploited. The last of these systems, "PV panel – wind turbine – micro-hydro – biomass", is a complete system that can ensure energy independence in any season and weather.

A hybrid system was installed in Mereni, a combination of solar (thermal and electric), wind and a solid fuel unit (wood and/ or coal) which adds to the solar collectors in winter.

Equipment

a) Electricity is supplied by
- a hybrid electricity production system made of a 1,000 W – 24 V Bergey wind turbine [1], type BWC XL1, 4 PV panels [2] 120 W – 24 V each, 3,000 VA – 24 V – 220 V RipEnergy sinewave inverter, 12 Topin gel batteries [3]; for exceptional cases, when the batteries are almost empty, a gasoline-fired generator can enter operation, charge them and cover consumption (not the case so far).

Energy Independent House in Romania

b) Thermal energy is supplied by:
- solar collectors in combination with a wood-fired Viadrus thermal unit; the system is made of two plane solar collectors, 200 litres double spiral boiler, solar controller, circulation pump and accessories.

The batteries, wind turbine and PV panels are connected to a computerised control panel, so that supply is automatically interrupted when the batteries are fully charged. If it isn't supplied, the set of batteries can cover consumption for 48 hours. The system only requires the owner's intervention in winter, to supplement thermal energy supply – water is pre-heated in the solar collectors, then its temperature is increased in the wood-fired boiler.

Total cost of the hybrid system in Mereni was approximately EUR 12,000. The owner considers it to have been a very good investment and is very happy about his choice. The house in Mereni is a success story in the efficient use of renewable energy sources in Romania.

Your Notes

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