CAPTURED HEAT, TACKLED WIND:

the Most Interesting Sustainable Energy Projects of the Baltic Region

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ABOUT THE PUBLICATION

Global climate change is considered to be one of the greatest challenges to the modern society, however, the society of Lithuania and other Baltic states still gives too little attention to the solutions of this problem and does not tend to support climate change mitigation measures. This may be explained by several reasons. On the one hand, the problem still has not been realized adequately and is considered as something remote and not related to the everyday life of every person, i.e. personal responsibility is not realized and assumed; people do not know how they may contribute to the mitigation of the climate change by changing personal behaviour and consumption. On the other hand, the attitude that some measures of the mitigation of climate change (energy saving, implementation of renewable energy technologies) are too expensive and will not pay off in a short time still prevails. While it is forgotten that there are many other possibilities to mitigate the consequences of climate change, and some of them bring economic benefit as well.

This educational publication is one of many those aiming to inform the society about the problem of climate change and the measures for its mitigation, to increase their attractiveness and to demonstrate how the measures designed to reduce the emission of the greenhouse gases can help in saving money or even to become a new source of income.

The first part of the publication discusses the climate change problem, its reasons and solution measures. The second part provides the successful cases of application of the energy efficiency measures, renewable sources of energy from Denmark, Latvia, Lithuania and Sweden. The examples from Latvia, Lithuania and Sweden discuss the cases when those measures were implemented in small towns, rural areas and agriculture; the examples from Denmark demonstrate application of the energy efficiency measuresin multi-apartment buildings. The target group of this publication were the readers from small towns and rural locations.

We wish that this publication would stimulate the readers' interest in climate change topic and would help to understand that each of us may contribute to the *mitigation of the consequences of the climate change. We hope that presented cases will be a source of inspiration and will encourage the readers to to get more interested in the practical possibilities of the climate change mitigation.*

The publication was prepared together with the European Commission Representation in Lithuania within the frame of the project "Nordic-Baltic NGOs' Cooperation for Sustainable Energy" the main aim of which was to improve capacities of the Baltic countries' non-governmental organizations to influence the climate change policy while improving the knowledge about renewable energy and energy efficiency measures and technologies; as well as to educate the society about the issues on climate change mitigation. The project was jointly implemented by four non-governmental organizations of Nordic and Baltic countries: "Sustainable Development Initiatives – DVI" (Lithuania), Latvian Fund for Nature, Danish Ecological Council and Swedish Association for Renewable Energy.

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CLIMATE CHANGE: A PROBLEM, ITS ROOTS AND RESPONSE

Climate change is called the increase of the average temperature of atmosphere and oceans recorded within the last decades: according to various sources the average annual atmosphere's temperature increased by 0.6-0.9°C during the last century; it started to increase especially rapidly in the beginning of the 20th century. According to the UN Intergovernmental Panel's on Climate Change prognosis, if the emissions of the greenhouse gasses will not be stablised and reduces the average global temperature will rise by 1.8-4°C until 2100. According to the most pessimistic prognosis it may increase even by 6.4°C. During the entire history of the Earth, the average temperature used to rose and to go down,and the climate used to change due to various reasons, therefore it took almos two decades for scientists to agree that undergoing processes are not temporary fluctuations of the temperature, and the most important that the human activities have the greatest influence on this process.

The Intergovernmental Panel on Climate Change was established in 1988 by the United Nations Environment Programme and World Meteorological Organization under the recommendations of G. H. Brundtland's report "Our Common Future". The Panel unites thousands of scientists in the whole world, and its task is to compare and evaluate scientific, technical and social-economic literature on climate change, its impact, mitigation and adaptation possibilities, published in the whole world.

The break in the public debates on the climate change took place in 2006 when Nicholas Stern Review on Economics of Climate Change was released. The former economist of the World Bank argued that in case radical measures to decrease the emissions of the greenhouse gasses will not be taken, safety, health or even lives of million people will be in considerable threat. He suggested taking the measures which would demand significant and immediate investments that yet, bearing in mind current scientific, and technological achievements, as well as a high level of economy the humanity can afford itself.

World's politicians, scientists and the society agree that today's response to climate change must take two directions:

– To mitigate climate change in the future by decreasing green house gasses' emissions,

– To adapt to the possible consequences of climate change and to start preparation for the changes immediately.

HOW CLIMATE CHANGE WILL AFFECT US

One who has little knowledge about the complex problem of climate change may think that the increase of temperature by several degrees may be even of benefit for the northern countries: lesser energy expenditures for heating, better conditions for recreation, larger harvest from certain agricultural crops. For example, it was evaluated that if the average temperature would rise by 4°C in Denmark, the energy consumption for heating in this country would decrease by 25%, while energy consumption for conditioning would increase only marginally; the yealds of cereals in Northern Europe would increase by 15-20%. Nevertheless, such benefits surely will not counterbalance the emerging threats: due to the raised sea level, and highly increased number storms a part of the Baltic Sea Coast will be flooded; the amount of precipitation will decrease during the warm season and will increase during the cold season, extreme rains will increase the risk of floods in locations previously considered as safe; more often heat waves, deteriorated quality of surface and ground water will threaten people's health. Due to the changing climate new threats to biodiversity, agriculture, forests, industry and transport will emerge.

The report of 2007 of the United Nations Intergovernmental Panel on Climate Change "Impacts, Adaptation and Vulnerability" assesses some climate change outcomes as really threatening to people, animals and plants. It says that in one way or another climate change will affect all regions of the world.

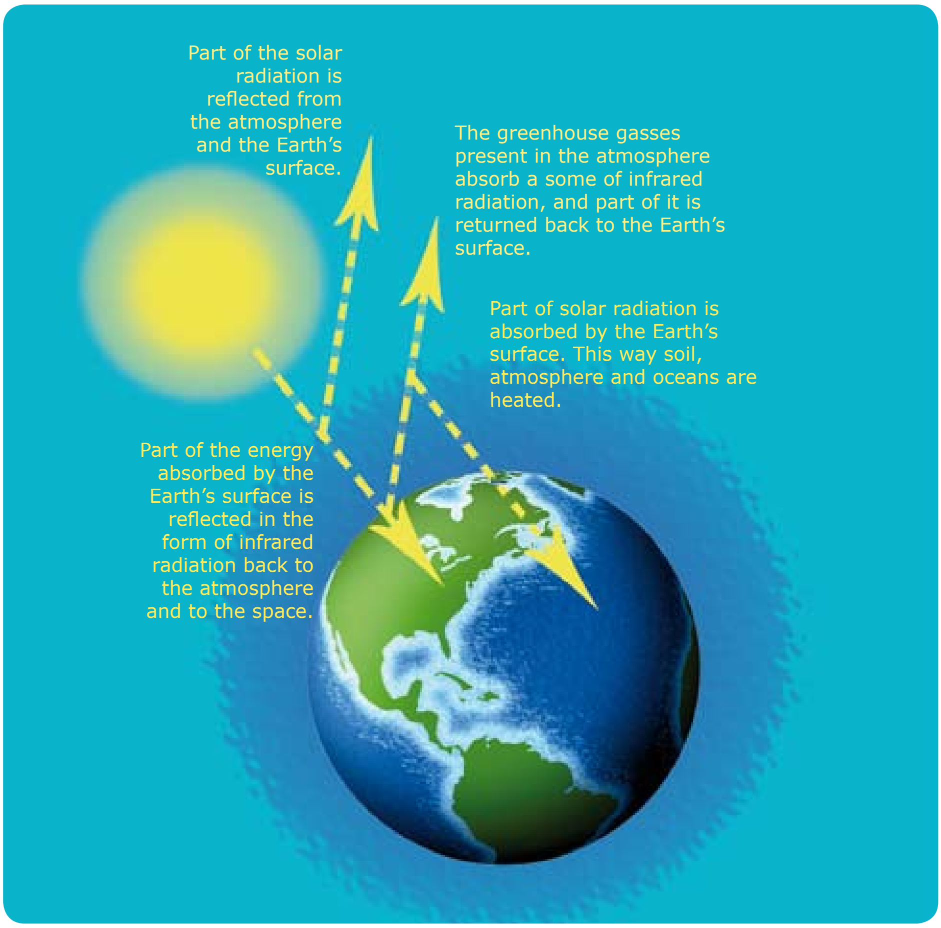
Some of the scientists' prognoses:

- In the middle of this century humid locations will become even more humid, while dry places will become drier;
- Up to a one sixth of the planet's population will face difficulties due to the lack of water;
- Cereals' harvest in the regions near the equator will decrease, and more people will be in danger of starving;
- If the average temperature will increase by more than 1.5-2.5°C comparing to 1990, 20-30% of world's animal and plant species may extinct;
- Due to the increased sea level a considerable part of people residing in low territories will be threatened by floods;
- The number of extreme meteorological phenomena – floods, hurricanes, heat waves – will increase;
- It is likely that climate change will increase people's mortality from the various diseases related to the climate. For example, if the temperature would rise at least by 2°C, the threat to be taken ill with malaria would threaten 210 million people more.

Why Does Climate Change?

Talking about climate change, first of all it is necessary to understand what causes it. The world's climate can be changed by various natural factors: fluctuations of the Sun's radiation, changes in Earth's motions around its axis, gravity and magnetic fields, etc. The impact of volcanoes is considered as especially important, as due to their eruption the atmospheric composition, and the amount of aerosols there may change. Redistribution of the land and water areas, changes of land relief, change of land surface, various fires are also important to climate change. Talking about anthropogenic factors, the greatest impact to the climate is made by the activities due to which the largest amounts of the greenhouse gases is emitted and the concentration of these gases in the atmosphere is increasing.

The level of solar radiation absorption by various greenhouse gasses is not similar. Moreover, these gases very differ in their atmospheric lifetime. Thus the contribution of the gasses to the global warming process, i.e. their **global warming potential**, is different.



A conceptual scheme of the greenhouse effect

The Earth received energy in a form of solar radiations. Part of this energy (approximately 30%) is not absorbed, and being reflected from the atmosphere's and Earth's surfaces returns back to the space. The rest of energy (approximately 70%) is absorbed, it warms-up the land, oceans and is source of the energy for many processes on the Earth. The energy absorbed by the Earth's surface and not used is reflected back to the atmosphere and space in the form of infrared radiation. The atmospheric greenhouse gasses absorb part of infrared radiation while some part of it is reflected back to the surface of the Earth again. Without such effect, which is called a greenhouse effect the average annual temperature on the Earth would be only -18°C, while current temperature is +15°C.

If there would be no greenhouse effect, the average global annual temperature would be only -18°C, while now it is +15°C. The primary greenhouse gasses are water vapours (21°C), carbon dioxide (CO_2; 7°C), tropospher and stratosphere ozone (O_3; 2°C), nitrous suboxide (N_2O; 1.4°C), methane (CH_4; 0.8°C). Approximately 0.8°C falls for the rest of greenhouse gases (SF_6, HFC, PFC, CFC).

The greenhouse gases are of natural and anthropogenic origin and are a regular part of air. The main greenhouse gas due to the man's activity is a carbon dioxide (CO_2). The main source of this greenhouse gas is combustion of the fossil fuels (coal, oil, natural gas, etc.) in power plants and engines. Another important gases are methane (CH_4), the main sources of which are sourcing, transporting and using natural gas and coal; catle breeding, and waste decomposition in landfills; also nitrous suboxide (N_2O) (it's main sources are use of nitrogen fertilisers and production of synthetic fibre), alkyl halides (halogenoalkanes) and ozone (O_3). The increase of concentration of these gases in the atmosphere changes the balance of heat, thus causing changes of the temperature of the Earth's surface As a consequence the nature of precipitation, clouds and winds is changed as well. A more intense warming causes raising of the sea level which partially is due to the melting of glaciers, and partially – due to the increase of the volume of marine water.

One should also not forget that a part of carbon dioxide is absorbed during the photosynthesis: according to the various studies up to 30-50% of CO_2 exhousted while burning the fossil fuel is absorbed by the ocean. Therefore the measures taken to increase level of the CO_2 absorption, so called "carbon sink" (for example, the increase of forested areas) is considered an important measure for the mitigation of the climate change.

How Climate Change Can Be Mitigated?

The main response of humanity to climate change may and must be its mitigation and adaptation to the inevitable consequences of climate change. While effective use of energy and intensive application of the renewable resources are considered to be the main mitigation measures.

Time to time one can hear a sceptical opinion form the side of the public, experts and politicians saying that the climate change mitigation demand enormous investments. However many of the measures are quite simple, like conscious energy saving, change of consumption habits. It is also truth that some technologies are expensive, however they are becoming more and more popular and due to the increase of demand they are getting cheaper. Specialists also emphasize that while a lot of measures for climate change mitigation exist, firs of all those which bring economic benefit must be applied, and only then those requiring considerable investments.

Renewable sources of energy are natural resources that are naturally formed and renewed by nature processes. The main types of renewable energy are solar, wind, geothermal, flood reflux hydroenergy, biomass and biofuels.

Energy efficiency is one of the simplest ways to decrease emissions of the greenhouse gases and to use natural resources in the most rational and sustainable way. More effective use of energy contributes to the development of economics, establishment of new workplaces, households and companies reduce their energy expenditures. The European Union believes, that by 20% increased energy efficiency until 2020, will decrees annual emission of greenhouse gases by 800 million tones, which also means that 100 billion Euros will be saved.

Energy efficiency. Despite the fact that more and more energy is produced by using renewable sources, this energy is not sufficient to meet needs of nations. Therefore energy efficiency and energy saving must be the first step in the mitigation of climate change: energy that was not used had not to be produced.

It is considered that renewable energy still is not always economically feasible, but with the increased market demand and more intensive usage of these measures, the prices of technologies decrees and will become even cheaper. Without having positive effect on the mitigation of climate change, the most often mentioned advantages of renewable energy is a possibility to use local resources that are cheaper than the fossil fuel, and at the same time are inexhaustible.

International Efforts to Debate the Climate Change

In 1997 in Kyoto city a conference of the United Nations took place. An intergovernmental agreement to reduce the greenhouse gas amounts emitted by developed countries by 5.2% comparing to the level of 1990 within a period of five years (2008-2012) was signed there. As the validity of the Kyoto Protocol was coming to the end and aiming to prepare a replacing document, a conference of the United Nations on climate change COP15 took place in December of 2009 in Copenhagen. It had more than 15,000 delegates from almost 200 countries. The participants of the conference intensively discussed how industrial countries should reduce the greenhouse gases they emit, and how developing countries, such as China and India should limit their emissions in an effective manner; what kind of assistance does developing countries need and how they will adopt themselves to the changes determined by the climate change, as well as how this assistance would be managed and distributed. The conference had passed a decision, which encouraged to reduce the amount of greenhouse gases emissions aiming that the global warming would not exceed 2°C (from level of the the middle of the 19th century), and the atmospheric concentration of the greenhouse gases would not exceed 550 ppm. It is considered, that until this limit the humanity would still be able to withstand climate changes and their consequences.

According to the scientists, if aiming to reach these goals until 2020 the increase of the emitted greenhouse gas must be stopped worldwide, and until 2050 the emitted amounts must be reduced to the level of 1990. To achieve these aims it is necessary to change energy, transport and industry sectors essentially, and all members of the society, organisations and individuals, must make their efforts towards achievement of these goals.

The concentration of the greenhouse gases in the atmosphere is expressed in parts per million – ppm or parts per billion – ppb. 1 ppm means one molecule of certain gas in 1 million molecules of all present gases.

European Union's Efforts

CO_2 emissions in the European Union comprises up to 82% of total emission of greenhouse gases in all 27 EU countries. The fossil fuel (coal, oil, natural gas) is the most popular fuel used for the production of heat and electricity and transport in Europe, and in the world.

15 European Union (EU) member states had obligated themselves to reduce the greenhouse gases emissions by eight percent comparing with the base level of 1990 since the moment when the EU had joined the Kyoto protocol. As the process of European enlargement was going on, and new countries had joined the Union, this obligation became compulsory to them the same way as to all member states. In the European Union's Sixth Environment Actions Programme, climate change was indicated as one of four main sectors of the EU's environment politics. The European Commission has prepared a communiqué "How to prevent global climate change" which assesses the benefits and losses brought by the climate change, as well as the significance of innovation, adaptation and the struggle of other world countries with climate change. The communiqué also determined the guidelines of the EU's climate change policy: to continue the implementation of the Kyoto protocol, to appeal to its successful elements; to encourage the participation of international community and other countries in the struggle against climate change; to apply the measures while involving more economic sectors and restricting the emissions of the greenhouse gases, to develop and implement non-polluting technologies, to adopt to inevitable consequences of climate change, etc.

The EU politics and planned measures in the field of climate change are determined in the European programmes on climate change. They provide particular action in the implementation of the measures for the increase of energy efficiency through the increase of the public consciousness, strengthening of cooperation with developing countries. The first European Climate Change Programme (2000-2004) aimed to establish the most environmental and cost-effective measures for the decreease European greenhouse gases' emissions. These measures would allow to achieve the obligation provided in the Kyoto protocol until 2012. In 2005 the Second European Climate Change Programme was started. Its aim was to establish additional cost-effective measures for the decrease of the European level of greenhouse gases emissions, and once more to assess the potential of emission decrease after the new member states had joined the EU. Considerable attention in this programme was dedicated to the analysis of new measures for climate change mitigation, like, capture and geological storage of CO_2, reduction of greenhouse gases emissions in aviation, etc. Adaptation to climate change was also considered to be one of the most important areas.

In 2007 the general European Energy Sector Policy was formed. It aimed to prevent climate change, to stimulate the growth of economics and establishment of workplaces, as well as to reduce the EU's dependence from gas and oil import. The European Commission proposed international measures to achieve a new global agreement for the solution of the climate change problem and financing of the transfer to the economics of less carbon dioxide emissions. These measures include the creation of the international carbon dioxide market until 2015, and of innovative financing mechanism that would allow all countries to implement their climate change adaptation measures.

20-20-20 aim. In 2007 the European Union passed the package "Energy for a Changing World" obliging members states until 2020 to the following:

– The emission of the greenhouse gasses must be reduced at least by 20% comparing with the level of 1990. In case an international agreement on climate change would be achieved, this objective index would be raised to 30%;

– Renewable energy should comprise at least 20% of all used energy; until 2020 at least 10% of the used fuel must be biofuel;

– To save 20% of the primary energy comparing with the level of 2005 through alication of the energy efficiency measures.

Carbon Emission Permit is a permit to emit one tone of the carbon dioxide equivalent of greenhouse gases in 2005-2007 (during the first period of the EU Emission Trading Scheme) and in 2008-2012 (during the second period of the EU Emission Trading Scheme).

The European Union had prepared quite a number of measures to stimulate energy producers and users to whattch upon their emission. It is thought that the most significant are and will be the setting up of the European Union Emission Trading Scheme, electricity production from renewable sources of energy, cogeneration of the electricity and heat production, more intensive energy saving in buildings, and energy efficiency in large industrial companies, motivation of users to use more effective devices.

As the European Union's scheme on carbon emission trading is one of the most important measures for reducing the greenhouse gases emissions, we will discuss it in more detail. This scheme started to function in the entire EU in 2005. Large and average power plants, oil processing companies, various industries participate in this system. The overall goal of the EU Emission Trading Scheme is to reduce the amount of the emitted carbon dioxide in the most cost-effective way.

Trading of emissions is allocated in two levels: macro level and micro level. When the emission permits are allocated at the macro level, the overall amount of permits is established to all the EU companies participating in the scheme in a particular country. When the emission permits are allocated at the micro level, the overall amount of permissions is distributed to particular companies participating in the scheme in a particular country. The companies receiving permits have a right to sell them if a lesser than permitted amount of greenhouse gases is emitted in their operation. In the future, aiming to strengthen the EU Scheme, it is planned to include in the system more types of greenhouse gasses, to extend application of the scheme to other industries that also contribute to the generation of the greenhouse gasses and to start trading of emissions in auctions.

Everyone Can Contribute

Every resident of the EU is attributed with 11 tones of the greenhouse gases emitted to the atmosphere per year.

Several tips on personal climate friendly behaviour:

- Use car as rare as possible: every year cars emit up to 10% of all greenhouse gases of the EU;
- Save heat, electricity and water: one third of all energy used in EU is consumed in households;
- Support local producers and buy local food products;
- Choose recycled products;
- Sort waste;
- Consume les.

How and what energy resources to use, how much of energy to use, where and how to live, what transport to use, what food to choose, what products to use and how to manage waste. These factors of persons' everyday life behaviour have a significant impact on the climate. Many researchers emphasize that for the effective mitigation of the climate change it is necessary not only invest into energy saving, renewable energies, carbon sink measures, but also to take simple and usually even not costly personal actions. Changing personal consumption habits without reduction of the quality of life, makes possible to reduce the negative environmental impact considerably. Every person is free to decide what and which products or services one needs.

On the other hand, it is necessary to support various initiatives of climate change mitigation in order to lay down the background for such economics which would be as less dependant on the fossil fuel as possible. And this is when each of us, as a citizen of the country, may express our will.

CASES OF PRACTICAL CLIMATE CHANGE MITIGATION MEASURES' APPLICATION

Denmark

Latvia

Lithuania

Sweden

DENMARK: RENOVATION OF MULTI-APARTMENT BUILDINGS

In Europe approximately 40% of overall consumed energy is used for heating of public and private buildings. Due to this all europeans should be interested in how to save energy. Recently great attention has been given to the necessity of the renovation of multi-apartment buildings, however, due to the lack of proper examples, the society doubts about the benefit of renovation. This publication presents several successful cases of multi-apartment buildings renovation in Denmark.

"Sealand" house community in Hedeboparken district, Roskilde

Year of construction: 1971
Renovation done in 2004-2005
There are 22 staircases and
159 apartments in the buildings.
Central heating system.

Building under renovation *(Photographer Soren Dyck-Madsen)*

Hedeboparken, Roskilde, after renovation *(Photographer Soren Dyck-Madsen)*

Background situation

The houses of the "Sealand" House Community were constructed in 1971. In 2004, before the renovation of the buildings, a survey on the residents of "Sealand" was performed, and it indicated, that the main problem was a low level of heat comfort retained in the premises despite intense heating and use of considerable amounts of energy,. This was due to worn-out and damaged concrete structures of the buildings. Due to cracks and gaps so-called cold bridges emerged in the walls, thus the heating losses increased. Another discomfort indicated by the residents was constant noise coming from a nearby busy road. Besides, it was necessary to replace old roofs which were not only poorly insulated but also leaked in some places. The buildings were renovated in 2004-2005. After the walls, foundations and roofs had been insulated, the heating losses have decreased. Moreover, the entire heating system has also been replaced.

Implementation of the project

Aiming to increase thermal resistance, the building was covered by an additional insulation layer of 125 mm without removing the old insulation of 75 mm. After that the building was reveted with a layer of yellow bricks, which had also improved aesthetic view of the building. Thanks to such solution the expenditures for the maintenance of the building's facade would be lesser in the future as well.

All old windows of the building were replaced by plastic ones and the balconies were glazed. Windows with special sound insulation were installed on the side directed to the noisy street. Although these windows looked a bit more clumsy, the residents assessed them especially positive as they were not bothered by the street noise any more, the noise could be heard only if the windows were open.

Worn-out roof insulation was replaced completely and the roofing was renewed and repainted thus giving a building brightened and renewed image.

During the project it was decided to shut-down old local heating boiler and to connect to the town's central heating system. Recently the connection to the central heating system is especially encouraged in the Nordic countries as this way the heat is used more effectively and the overall negative environmental impact is reduced: the air pollution as well as emission of greenhouse gases are reduced.

The main heating system channels held in the basements were equipped with bolts due to which the system is used more efficiently. Aiming to optimise the functioning of the equipment, it was decided to retract the usage of pumps.

Completely deteriorated system of heated floor was replaced by radiators. Heat sensors reacting to the fluctuation of outdoors temperature were installed as well. This additional measure allowed to control the indoors climate more efficiency.

After the renovation, the living conditions and microclimate comfort has obviously improved, not even talking about considerable energy saving – this is especially felt in the apartments near the side walls of the building. The residents started to use the spaces of the glazed balconies more and the audibility of the traffic noise reduced greatly.

Heat consumption (MWh/100 m^2) before and after the renovation in 1994–2005

"Sealand" House Community in Bakkegaarden, Roskilde

Year of construction: 1954–1959
Renovation done in 2004–2005
There are 168 apartments in the buildings.
Central heating system.

Bakkegaarden district, Rosklide after renovation *(Photographer Soren Dyck-Madsen)*

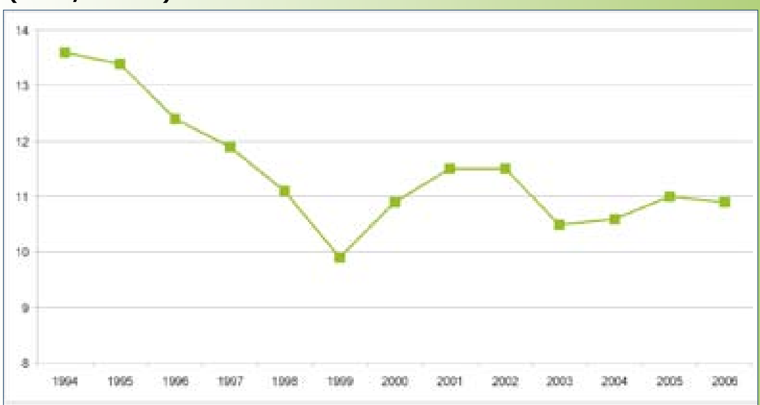
Background situation

According to the residents, the general level of heat comfort was especially low in the apartments near the side walls. The balconies of the buildings were worn-out and the roofs had to be changed.

Implementation of the project

Renovation works started in 1998: the roof insulation was completely replaced and new roofing was mounted. After the building was reveted with an additional layer of bricks, the walls reached the thickness of 1,000 mm. The balconies were glazed with one-layer glass, i. e. even without well insulated window frames the old buildings of the 1950s started to look especially modern. The old heating system was replaced with vertical pipeline radiators and hot water. Mechanical ventilation system to which if necessary cooking stoves' hoods may be connected was installed.

(MWh/100 m²)



Heat consumption (MWh/100 m²) including hot water

In the first year after the renovation surprisingly the residents received bigger bills for the electricity and heating than usual. As it became clear later, the residents decided to use the additional balconies' space which occurred after they were glazed and started to heat them with electricity. Eventually due to high costs they refused that, and electricity consumption returned to the usual level.

“Sealand” House Community in Bjergbakkenrajon, Roskilde

Bjergbakken district, Rosklide, after renovation *(Photographer Soren Dyck-Madsen)*

Year of construction: 1970 m.
Renovation done in 2004–2005
15 apartment buildings, 361 apartments.
Concrete structure.
Central heating system.

Background situation

All buildings were quite in bad condition: concrete structures were crumbled and cracked; quite a number of cold bridges had appeared, especially between the basement and the first floor; the side walls of the buildings were insufficiently insulated. After an energy audit of the buildings was performed it was stated that even 45% of walls under the windows had cold bridges. Due to leaky windows and cold bridges the residents constantly suffered from mildew and fungus, especially in bathrooms.

Due to blocked and broken rain drainage system, the basements were often flooded. Flat roofs were completely worn-out and deflated. Ventilation systems were installed under the roofs and it was practically impossible to clean them, and the roof of one building was torn away during a storm.

Implementation of the project

All buildings were coherently renovated: all roof structures were replaced and two-ridge roofs were covered with an insulation layer of 250 mm. Improving the insulation of walls, the facades were additionally insulated with a 125-250 mm layer and new brick walls were built along the side walls. For the improvement of the basement insulation, the gap between the old and new wall was additionally insulated. A new drainage system helped to solve the problem of the constantly flooded basement.

Windows’ frames were replaced by wood and aluminium frames with glass packages. All windows of the basement, that earlier were glazed with one layer of glass, were also replaced. In addition the overall area of windows was reduced. Sliding system structures were used for the glaze of the balconies.

Therefore after the renovation the buildings started to look modern, living conditions improved, the level of thermal comfort increased and fungus and mildew was exterminated. Unfortunately, the monitoring of the energy and water use before renovation was not done. It was assessed that in 2006, already after the renovation, approximately 14 MWh/100 m^2 of heat was used. This number includes energy used for the preparation of hot water. Nevertheless, these assessments are based only on the data of a half of one heating season. According to the consumption statistics in similar not-renovated buildings, it may be stated that now the residents save about 25% of energy.

Building in Osterbrogade district, Copenhagen

Multi-apartment building was built in 1925
Renovation was done in 1994

Solar collectors were installed on the buildings' fron-wall
(Photographer author Soren Dyck-Madsen)

Talking about building renovation and effective use of sun energy for the heating of buildings, the view of this building's facade with installed "solar wall" is often used as a some kind of business card promoting use of solar energy. This is one of the first examples when a multi-apartment building was renovated by implementing energy saving and renewable energy measures: in 1994, after the renovation, a solar collector of 178 m^2 was installed on the facade for the heating of the ventilation system's air. The building was also equipped with other measures for effective energy saving, for example: solar collectors for water heating, old windows were replaced with triple glass packages, the system on the recycling of heating was installed and the efficiency of the central heating system is controlled by automatic sensors.

Due to renovation energy consumption in the building reduced from 125 kWh/m^2 to 61 kWh/m^2, i.e. up to 51% energy is saved.

LATVIA: RENEWABLE ENERGY FOR PUBLIC NEEDS

This chapter presents the examples on biofuel, mixed solar and wind and biogas equipment in Latvia, which provide heat and electricity for public buildings and other spaces. The described technologies are promising and may be applied more widely not only in Latvia, but, considering the situation and fuel availability, in other countries as well.

Effective Solid Fuel Boiler in Dundaga Health and Social Support Centre

Location: Dundaga town, Kurzeme region, Northern Latvia.
Type of renewable resource: biomass (wood).
Owner: Municipality.
Amount of thermal energy produced per year: 100–150 MWh.
Installation costs: approximately 2,300 LVL (approximately 11,200 litas or 3,300 EUR).
Annual maintenance costs: 9,000 LVL (approximately 43,900 litas or 12,700 EUR).

Wood is one of the most popular traditional fuels in Latvia, especially in rural areas. Burning of firewood produces more than the half of all energy used in household in Latvia, and even more in Kurzeme, where the infrastructure of natural gas supply is not developed sufficiently and the resources of forests are especially rich. In the 1980s in many small towns of Kurzeme, at that time the centres of collective farms the central heating system heated by coal or burner fuel was well developed. After Latvia restored its independence in 1990, the fossil fuel has become more expensive, the central heating system collapsed and the residents had to transfer to local individual heating with firewood.

Solid fuel boiler
(Photographer Elmars Peterhofs)

Background situation

Dundaga has approximately 1,800 residents including a lot of children and elder persons. 72% of the township's territory is covered by forests. The main occupations of local people are forestry, diary industry, fish processing and tourism. There are eight areas belonging to the European network of protected areas Natura 2000 in the township. The largest of them is the Slitere National Park.

Implementation of the project

Dundaga Health and Social Support Centre is the primary health care and nursing services' provider in the township. The local municipality has established it when a hospital was closed during the Latvian health care system's reform. The Centre was established in the building constructed in 1932, and which was renovated and well insulated in 2007. Until the renovation the building was heated by stoves heated with firewood. However, this way of heating was ineffective, costly and the stoves were already old. After the renovation an effective boiler of 50 kW power was installed in the building's wing constructed specially for this purpose. This energy effective and cost-effective equipment is heated with solid fuel and firewood that are the most available local energy resource in Dundaga.

Dundaga Health and Social Support Centre *(Photographer Elmars Peterhofs)*

Technical characteristics

Boiler: ATMOS DC 50S, 50 kW power;
Heated area: 908 m^2;
According to the technical specification of the manufacturer a recommended heated area should have been 380 m^2, however, the building is well insulated thus the sufcient level of the thermal comfort is maintained;
For the maintenance of the heating system 50 kW of electricity is consumed each month.

Economic incentives, future perspectives

The building is heated for 7-8 months per year. The main heating costs are purchase of fuel and staff salaries: two employees have been hired to prepare wood and to supply the boiler.

7,600 LVL (approximately 37,010 litas or 10,700 EUR) every year is spent for the salaries of the boiler house's operators;

1,400 LVL (approximately 6,820 litas or 2,000 EUR) are spent to purchase and prepare fuel;

The average heating price of 1 m^2 per season – 1.25 LVL/m^2 (approximately 6 litas or 1.7 EUR).

If one would compare these figures with figures from Riga, where the costs of central heating and hot water preparation are among the lowest in Latvia and reaches 1 LVL/m^2 (approximately 4.87 Lt/m^2 or 1.41 EUR/m^2), or with the costs of the firewood heating of an individual house, then these heating costs will not be the lowest. However, remembering that operators are hired, such heating costs are not that high.

Strong sides:

– Firewood is used. It is a local and most available fuel;

– Low heating price;

– Convenient and easy maintenance.

Weak sides:

– Only dry wood may be used in the boiler;

– It is necessary to hire employees to prepare fuel and heat the boiler.

Biogas Cogeneration Plant in Vecsaule

Location: Vecauce, Ziemgale region, Southern Latvia.
Type of renewable resource: production of biogas from agriculture waste.
Owner: state university.
Amount of thermal energy produced per year: 1,800 MW electricity, and 2,400 MW heat.
Installation costs: approximately 800,000 LVL (approximately 3.896 mln. litas or 1.128 EUR).
Annual maintenance costs: 120,000 LVL (approximately 584,400 litas or 169,300 EUR).

Although the power plant of such type is large and does require considerable investments, this example was chosen as biogas is considered to be one of the most perspective types of renewable energy in Lavia. Biogas may be produced by anaerobic fermentation from wood processing industry or agriculture waste, or wastewater treatment sludge. The first two sources of raw material are especially important in rural areas. Lativa's biogas production potential is approximately 120 million m^3 per year, and even 100 millions m^3 of them may be extracted from agriculture waste. Traditionally manure storages are built for the management of manure, and usually do not require considerable investments, while EU provides support for their construction in the country. The plant described below is the first case in Latvia when for the management of manure the biogas production process is used.

Background situation

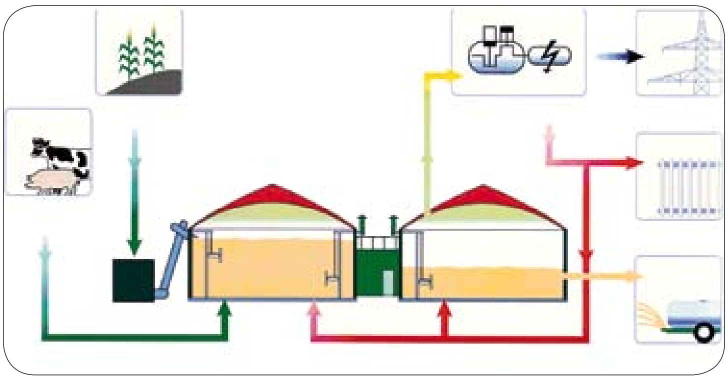
The land of Ziemgale region is the most fertile in Latvia, thus agriculture is very well developed here. The Latvian Agriculture University was established in Jelgava, the largest town of Ziemgale region. The research farm of this university –

"Vecauce" – is the only training farm in Latvia where students get their trainings and industrial practices. Every year about 1,000 students of the university and technical schools are trained here and get acquainted with modern agriculture technologies; graduates and postgraduates perform their research. The farm of 1,800 ha area grows crops, breeds 800 units of catle, while 350 of them are milking cows. Technical and economic research of biogas production had been carried there already from the nineties; therefore a sufficient amount of knowledge, competence and experience had been cumulated.

Implementation of the project

In 2006, after the experience of manure management in Latvia and biogas production in other countries was thoroughly analysed, the project on biogas production was started from the construction of a modern farm. Following the requirements for manure management, two slurry reservoirs of 4,000 m^3 had to be built in the new farm for 500 units of catle, and the construction of it would cost 100,000 LVL (approximately 487,000 litas or 140,000 EUR). Therefore it was decided to refuse such investment and instead of reservoirs to install a biogas facility. Thus one more income generating activity was started in the farm. It is expected that income form the selling the electricity and heat energy produced during biogas production co-generation process should eventually cover the construction costs. The new biogas plant started to operate in the "Vecauce" farm in 2008.

- ***Technical characteristics***
- Bioreactor filling: cattle manure and corn sludge;
- Volume of bioreactor: 2,000 m^3;
- Temperature maintained in the bioreactor: 38°C;
- Biogas contains 50–60 % of methane;
- Electricity production potential: present (2009) – 280 kW with a possibility to increase to 400 kW;
- Thermal output: 356 kW.



A conceptual scheme of biogas production using agriculture raw material *(Dubrovskis Vilis 2007)*

Raw materials are supplied into the raw material tank, from there they flow into the bioreactor where microorganisms decomposte organic matter and produce biogas. A constant temperature and anaerobic conditions are maintened in the bioreactor. The processed substrate is fed to the digestate tank. Gas is purified from contaminants (such as hydrogen sulfide) and is supplied to the cogeneration plant, which produces electricity and heat. The processed sludge is used as an agricultural fertilizer.

All heat produced in the cogeneration plant is used in the farm. One fifth of the produced energy is used in the reactor for the maintenance of the biogas production process. The produced electricity is sold to the grid. The engine producing electricity was bought from the company "UPB".

Economic incentives, future perspectives

800,000 LVL (approximately 3.896 mln. litas or 1.128 mln. EUR) were invested into the biogas plant's reactor. State subsidies, funding from international funds and a bank loan were used. Bearing in mind that this amount does not include the price of the cogeneration plant (it is being leased), the investments are quite considerable. However, this can be explained mainly by the lack of experience in financing and technical implementation of such objects: this is the first agricultural biogas plant in rural Latvia.

Electricity is sold for the support tariff (0.17 LVL/kWh, about 0.83 Lt/kWh or 0.24 EUR/kWh). Income from the sold electricity is about 30,000 LVL (146,100 litas or 42,300 EUR) per month and depends on electricity production schedule. Expenditures for the biogas plant's maintenance are about 10,000 LVL (48,700 litas or 14,100 EUR) per month: raw material purchase, equipment maintenance, operation, etc. Part of income is used to cover the bank loan.

The farm is large enough to double biogas output in the future. As Latvia applies compulsory quotas for the purchase of energy form renewable energy resources, it is planned that biogas will be used to heat the neighbouring town located in 1.5 km distance. Other planned alternative way to use this biogas was for farm transport.

Strong sides:

– Hight potential for training, experience exchange and research;
– Electricity production diversifies the farm's activities, reduces economic risks and is an additional source of income;
– Environment friendly manure management, reduces odors and nitrate pollution;
– Reduces greenhouse gases emissions from livestock farming.

Weak sides:

– Considerable installation costs;
– Cannot be presented as a "green business" model;
– Technological challenges were faced while ensuring maximum output of biogas.

Vecause biogas reactor *(Photographer Zane Lide)*

Autonomous Street Lighting in Salacgriva

Location: Salacgriva town, Vidzeme region, Northern Latvia.
Type of renewable resource: solar and wind.
Owner: Municipality.
Energy produced per year: 300–400 MWh.
Installation costs: 4,295 LVL (approximately 20,920 litas or 6,100 EUR).

The average wind speed in Latvia is 4–6 m/s, and the wind is even stronger in the regions of Kurzeme and Vidzeme near the Baltic Sea: in Ainazi and Salacgriva it exceeds 7.5 m/s, therefore this region is favourable for the successful development of large scale (0.8–1.5 MW) wind-power plants. Two plants of 0.6 MW have been already installed in the town of Ainazi.

Background situation

The Municipality of Salacgriva is situated nearby the estuary of the River Salaca, in the Northern part of the Vidzeme Biosphere Reserve. The highway "Via Baltica" crosses the municipality. There are 6,000 residents in the town of Salacgriva and adjacent villages with a number of elder people and children. The main industries are the processing of wood and fish.

Implementation of the project

During the preparation of the Salacgriva area plan, tourism, port development and wood processing were named as strategic areas of development. This location is a specific Latvia's territory where strong winds prevail, therefore electricity production also was considered as a possibility of potential business development.

On the other hand, several weaknesses of the municipality were indicated as well: outdated infrastructure, non sufficient number of children play-grounds. After inventory was performed, it became clear that the street lighting network is not used properly, and its real owner is unknown. A number of cables with unknown origin and purpose was found, majority of these cables were quite worn-out. The residents complained that the street lighting was weak and dim.

Aiming to solve these and other problems, the municipality declared the environment protection as the priority area. This was also done with a hope that the district will become more attractive for both local people and tourists. Knowing that it is really worth to use this inexhaustible source of energy in the coastal region with prewailing strong winds, the municipality had installed three autonomous wind-solar energy street lamps in one of the children play grounds in 2009.

Although this is a small equipment complex, the society's response was quite active: several articles were published, guests express their positive comments in the website and the representatives of the municipality have presented their experience in various events and conferences many times. Therefore it may be stated that the primary goal – to improve the image of the municipality – was reached.

Technical characteristics

Each autonomous lighting device consists of a mast, solar battery, wind energy generator, energy accumulator and lighting elements with LED lamps. All lamps are of 50 W power and correspond to an analogue of the sodium lamp of 250 W. During a day wind and solar energy is accumulated in the accumulator, and at a night it is used for lightening. Such application of two types of energy sources ensures that the territory will be lightened despite meteorological conditions. The battery automatically switches on when the wind speed reaches 3 m/s. The installed light sensor switches on the lamp at a night time and switches it off immediately the dawn comes.

Autonomous street lighting in a children play-ground *(Photographer Arnis Freimanis)*

Strong sides:

– For the first time in Latvia the lighting of public areas using solar and wind energy was installed;
– Positive image of the municipality is created;
– Independence from energy suppliers, free of costs energy;
– Safety in case of accidents;
– Simple installation.

Weak sides:

– Costs are higher than those of traditional street lighting lamps;
– Sometimes lighting is a bit dim in the second half of the night.

Light emitting diodes (LED) are one of the up-to-date lighting technologies whose advantage is a small size and minor energy consumption. Unlike incandescent light bulbs, where light is emitted by a heated incandescent filament, light emitting diodes are crystals which start to glow when they are connected to the current. Such lamps consume energy about 10 times lesser than incandescent lamps and may be used at least for 10 years.

Economic incentives, future perspectives

The installation of one lamp cost 1,430 LVL (about 6,960 litas or 2,000 EUR). According to the municipality, such decision was very perspective and the usage of autonomous renewable energy resource is very convenient as the present infrastructure has been adjusted and no additional lighting poles or cables had to be installed. The municipality claims that these three lamps will pay-off in three-four years.

If this installation will function well for a year, other municipalities also are planning to install similar solar-wind devices in the places where there is no electricity cables and where their installation would be irrationally expensive.

The municipality of Salacgriva continues to maintain its image of a "green municipality": in 2009 Northern Vidzeme Biosphere Reserve Training Centre was equipped with geothermal heat pumps. Moreover, the district has enough of wind resources to develop commercial large-scale wind power plants.

The lightening lamp with solar batteries and wind generator
(Photographer Arnis Freimanis)

LITHUANIA: RENEWABLE ENERGY FOR RURAL ENTREPRENEURSHIP DEVELOPMENT

While choosing cases from Lithuania, it was aimed to select examples when climate change mitigation measures also had stimulated rural entrepreneurship, and helped to created new jobs for local people. What is common for all described examples is that all of them had been initiated and implemented by rural communities and NGOs which, while implementing these practical measures, sought not only to ensure an additional source of income for their activities, but also to raise level of environmental consciousness and to educate public through dissemination of the information on their best practices that might be replicated in other places.

Wind Power Plant in Smalininkai Community

A rapid expansion of wind power plants takes place in Lithuania in recent years. Although this case presents the construction of a medium scale and quite costly plant, it is the first and so far the only case in Lithuania when the developer and owner of a wind power plant is the local community, i.e. an organization, which intends to use income generated by the sale of electricity for the satisfaction of the local needs. By presenting this case we wish to draw attention to how a community, aiming to improve livelihood of its town, sow new possibilities and dared to settle ambitious and long-term goals.

Location: Smalininkai, Jurbarkas district, Taurage region.
Type of renewable resource: wind (250 kWh wind plant).
Owner: public organization.
Installation costs: 1.039 mln. litas (approximately 301,000 EUR).
Annual maintenance costs 12,000 litas (approximately 3,500 EUR)
Planned annual income: about 110,000 – 130,000 litas (approximately 31,900 – 37,700 EUR)

Background situation

Smalininkai town has 1,600 residents, and almost half of them are children and youth under 18. The town has 3 schools, several small wood processing companies, post office, library and a dispensary. The active community was looking for environment friendly solutions that would unite community, and also would help in removal of socials exclusion. A survey performed in 2007 had revealed that majority of residents considered poor street lighting as one of the biggest problems as well as the fact that the town had almost no pavements. The lack of lighting was especially linked to bad crime situation; many respondents even stated that they would voluntary contribute by their labour in order the lighting system would be improved. Several members of the community were interested in wind energy and from discussions an idea aroused to build a wind plant in Smalininkai and to use its income for social and economic needs of the society.

Implementation of the project

After a small planning grant support was received from the Global Environment Facility’s Small Grants Programme and with the assistance of experts, the possibility to install such wind power plant near the town in the village of Antšvenčiai was assessed. The grant latter received from the mentioned programme and the Lithuanian Ministry of Agriculture allowed to look for further sources of financing, and in a short time Jurbarkas Credit Union granted a loan for the implementation of the project. Part of this loan (630,000 litas) has already been subsidized by the grant of the Lithuanian Environmental Investment Fund, part of the loan's interest are compensated by the municipality of Jurbarkas. For the implementation of the project the local action group of Jurbarkas and Pagėgiai districts "Nemunas" granted additional funding.

As the community of Smalininkai had no experience of investments projects, after the project was started experienced consultants were hired to help in planning and coordination of all stages of the plant's construction. Professional subcontractors were hired to perform many complex works (preparation of construction site, work of plant construction and mounting, connection to the grids). The members of community helped as they could by voluntary labour, machinery and equipment as well as other measures including active educational activities.

The plant was produced in India following the German technology (Wind Technik Nord) and transported in marine containers by ship to Smalininkai. It took two weeks to assemble and erect it. After that the adjustment of equipment took three more months: WTN 250 kW was the first plant of such type in Lithuania, maintenance structure was still in process, therefore adjustment took longer than expected. It is planned that the plant will produce up to 450,000 kWh electricity per year and accordingly the emission of carbon dioxide will be reduces by 51 t every year. The produced energy is already sold for electricity grid.

It is important that during the implementation of the project the community actively cooperated with local politicians, authorities, scientists, technical experts. Due to the community, the society's attitude towards small wind power plants became much favourable. The whole period of the implementation of the project lasted 30 moths. According to the project's team, the preparation of documents and project reports took the most of this time.

Construction of Smalininkai power plant's hub
(Photographer Gintaras Nenorta)

Blades of wind turbine waiting for the assembling
(Photographer Gintaras Nenorta)

Technical characteristics

Wind power plant WNT250:

- Nominal power – 250 kW;
- Rotor’s diameter – 30 m;
- Rotor’s angular diameter – 707 m²;
- Tower’s height – 50 m.

Gondola:

- Gearbox with two asynchronous generators of two speeds 250/50 kW;
- Rotor system with three blades, the diameter of the rotor – 30 m;
- Three blades of the rotor from fibreglass with epoxy;
- Passive device of the disconnection of the rotor system control;
- Automatic systems for orientation towards direction of winds

Tower:

- Tower from steel latticed partitions of hot galvanization;
- Ladder with safety system mounted outside;
- Cables from the gondola to control blocks installed in the central part of the tower.

Generator:

- Asynchronous, 50 and 250 kW;
- Work temperature of the generator – 415 V±10 %;
- Work frequency – 50 Hz ±5 %.

Additional equipment:

Transformer 0,4/10 kV, separators, accounting, connections, SCADA.

- Management system:
- Proper to be installed at home or in a substation;
- Remote control and management system.
- Equipment and safety measures:
- Single completed set of tools;
- Single completed safety set.

Wind plant construction site *(Photographer Gintaras Nenorta)*

Warranty:

- The warranty is provided by the supplier for the period of 24 months. Warranty maintenance is performed in the place; the supplier warrants the supply of spare parts and repair works. The restoration of complete efficiency of the equipment cannot exceed thirty working days. In case the efficiency of the equipment would not be restored within thirty working days, the supplier must provide other equipment for the repair period.

Economic inc entives

According to the experts, the annual profit earned by the Community of Smalininkai should be about 75,000 litas (approximately 21,700 EUR). The community, decided to have savings for the purchase of a new power plant in a future, thus had established the project's reinvestment fund. It is planned that the fund will collect 30% of the profit received. The financing of this fund will be used for capacity building of Smalininkai's community centre and instalment of the public infrastructure in Smalininkai: a new lighting system will be installed in the town. Some funds will be allocated for the education of children and youth and some other social activities. The community is planning to return the loan granted by the Jurbarkas Credit Union and to install a new lighting system in the town within next 5 years.

Strong sides:

- The profit will be used to finance the activity of the public organization,
- The organization started to put away saving for the construction of a new power plant,
- Excellent demonstrative tool encouraging many communities of Lithuania to look for possibilities to create income through use of renewable energy.

Weak sides:

- Considerable financial investment are required, and without additional funding a pay-off the period would be quite long,
- Such a project can be hardly implemented without assistance of external experts.

Solar Collectors for the Processing of Medicinal Plants and Potherbs in Panara

Talking about the use of solar collectors, in most cases it is common to talk about their use for the preparation of hot water. There are much less of examples when the air heated by the sun is used for, lets say, heating of premises or drying of agriculture produce. Seeking to demonstrate the variety of solar energy usage, we present a medicinal plants drying-house installed in the village of Panara, Varena district. According to the implementers of this Project, this construction is the first such kind designed and constructed in Lithuania, and maybe even in the European Union. According to the scientists, drying of such production as medicinal herbs and potherbs, costs of the preparation of hot air usually make about 50-70 percent of overall expenditures, therefore solar collectors allow to considerably reduce costs of the processing of produce.

Background situation

Location: Panara village, Varena district, Lithuania.
Type of renewable resource: sun (solar collector).
Owner: public organization.
Amount of thermal energy produced per year: 127,750 kWh.
Installation costs: about 536,000 litas (approximately 155,000 EUR, including installation costs – 76,000 litas (approximately 22,000 EUR).
Annual maintenance costs: about 35,000 litas (approximately 10,100 EUR), related with the processing of medicinal herbs and potherbs.
The drying facility is used all year round. When there is no drying process, the dried medicinal herbs are processed: granulated, sorted, and packed.
The equipment has been installed and used from 2008.

The Full House community is settled in Panara village, Varėna district, in the area of Dzūkija National Park. The community work with former prisoners and drug addict and assist their reintegration to the society through application of the labour therapy and spiritual education. The community was looking for the ways to involve the residents of its Centre to the therapy activities and at the same time to ensure income source for those activities. As the community had 13 ha of land, a possibility to grow medicinal herbs, potherbs and scented plants was discussed. It was estimated that from the planted land plot of 1.3 ha, 9,500 kg of raw material will be gained; however, it is impossible to process such big amount of green mass by using only natural ventilation. Therefore after consultations with various specialists it was decided to install special herbs drying facility that would use solar collectors. This diverse Project, during which medicinal plants were grown in an ecological farm, and a resource of renewable energy was used for their processing, was funded by Global Environmental Facility's Small Grants Programme i in 2005; and got support from many other sponsors.

Implementation of the project

When starting the project the community firstly started to organise establishment of the herbs' farm, their processing facilities and sale. The land plot of 1.3 ha was planted with various medicinal herbs in 2005. All residents of the Centre actively joined the activity. Scientists of the Department of Heat and Biotechnologies Engineering of the Lithuanian University of Agriculture had assisted community in preparation of the technical drawings and planning of installations of the drying facility; while construction and installation works were done by contractors and the residents of the Centre themselves.

Considering the needs of the community, the specifics of the medicinal herbs farms and the requirements of food production technologies, a special drying facility's building was designed. This 186 m^2 building has premises for the preparation of raw material, drying room, premises for packaging and prepacking, special household premises and bathrooms for employees, storage premises (in the mansard), technical premises for boiler and ventilators. Following the technical project a brick building was built and later covered with wooden finishing planks. The roof of it was covered with lathes.

According to the community representatives, the most difficult structure of the construction was solar collectors installed on the southern slope of the roof. While mounting the collectors, the technical drawings of the roof's structure had

Technical characteristics

About 127,750 kWh of thermal energy is produced per year. While using solar energy about 84% of energy used for processing of herbs is saved, while quality of the produce is still the same.
Area of the solar collector is 140 m², the collectors were installed by contractors, following the recommendations of the scientists from the Lithuanian University of Agriculture. The collector consists of a transparent cover, sun radiation absorbing surface (steel painted in black) and two air chambers.
Two heat accumulation tanks of 1,000 l volume;
Two additionally installed solid wood boilers of 20 kW;
Four centrifugal ventilators of high pressure, each of 3 kW, maximum air flow 7 100 m³/hour;
Up to 10,500 kg of green mass may be processed during the season;
The equipment is used from May until October. During the summer, the most effective activity of the collectors lasts for 8.5 hours, and due to the large are of the solar collector this period is prolonged to 14 hours. During other seasons the need of heat is compensated by solid fuel boilers.

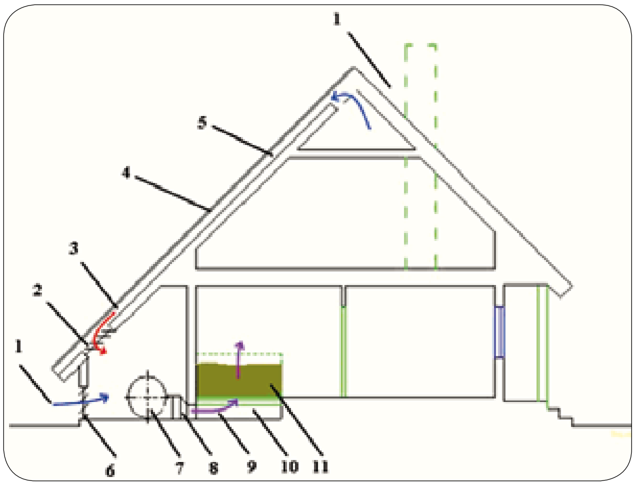
to be changed for several times. A collector is made out of transparent cover and a black sheet of steel divides the cavity in two air chambers this way ensuring air flow along the roof. Black steel sheet absorbs solar energy and transmits the heat to the air chambers situated above and under itself. After the sun is gone, the steel radiates the accumulated heat for a while. The transparent collector's cover must be solid, optically transparent, and resistant to the atmospheric humidity and high temperature. A canal polycarbonate, a popular modern polymeric substance, was used in Panara.

It was also necessary to have an alternative source of heat to ensure the stability of the process in case of the absence of the sun. The building was equipped with two heat accumulation tanks of 1,000 l and two solid fuel boilers. Also, aiming to ensure optimum schedule of medicinal herbs drying, special ventilators providing high pressure and intensive air flow were installed.

Visitors of the drying facility *(Potographer Laimonas Mituzas)*

The success of the project was partially determined by good planning of all activities and the fact that the organization involved experts and specialist of various fields (botanists, ecological farming experts, specialists of medicinal herbs' processing, agrarian engineering and solar energy specialists). Further success was determined by an active involvement of the community's members and their training (members of the community got 74 hours of trainings), lectures and consultations with specialists on the growing of medicinal herbs and their processing, the principles of the functioning of solar collectors and the drying facility's equipment. The community's aim to create a stable source of additional income was a string incentive for them to act. The members of the community are willingly sharing their experience with everyone, and the drying facility already has been visited by 2000 persons. Aiming to share an spread their good experience and lessons learner the community of the Full House has also published a booklet where described their experiences of the project.

A conceptual scheme of the medicinal herbs drying facility is provided below: the air blown to dry raw material must be heated up to 35-40°C. The air sucked by the ventilator is heated in the solar collector installed on the building's roof. The temperature of the air used for desiccations control by bolts (1 and 6) mixing the hot air from the collector (3) with the outdoors air (1). In case when there is a lack of solar radiation or during the night time the used air is heated in the water heater (8). Two solid fuel boilers were installed for the production of hot water. There are four sections in the drying facility; the biggest height of load can reach up to 1 meter, and the longest duration of the load's processing is no longer than 3 days. *(Raila, Novošinskas, Zvicevičius ir Kemzūraitė, 2007)*



Medicinal herbs and potherbs drying facility in Panara *(Photographer Laimonas Mituzas)*

Economic incentives, future perspectives

The drying facility's building was constructed in the end of 2007, and since 2008 the facility has been operating in full capacity. Seeing usefulness of the facility the community had started to look for the possibilities to make the drying process more automatic. Every year the community grows and processes up to 5,000 kg of green mass of medicinal herbs. The income received from the sale of the medicinal herbs became one of the most reliable incomes of the community.

The active community had also worked on improvement of the environment used for its activities: necessary utilities were installed, biological wastewater treatment facility, workshops, public bath and lavatories were equipped, as well as a new chapel for 200 people was built. At present technical projects for the improvement of living conditions are being prepared.

Stipriosios pusės:

– For the first time in Lithuania a solar energy was used for drying of medicinal plants and potherbs,
– Successful results have been achieved by applying scientists' recommendations and methods;
– Excellent demonstration tool;
– The community gained new experience; scientific innovative ideas are implemented;
– About 84% of energy required for herbs processing desiccation is saved without loosing high quality of produce;
– The community is situated in a remote location and therefore the farm is completely ecological.

Weak sides:

– Computerized system should be established for the processing of larger amounts of medicinal herbs;
– Here is a lack of human resources, professionals do not wish to work in a rural location, while the training of the employees is a long lasting process.

Buckwheat and marigolds blossoms gathered in the community's fields *(Photographer Laimonas Mituzas)*

Plantations of Energy Forest in Gražiškiai

Location: townships of Gražiškiai and Vištytis, Vilkaviškis district, Lithuania.
Type of renewable resource: biofuel.
Owner: private farmers, public organization.
Project's implementation costs: planting of plantation – 98,550 litas, tractor – 24,000 litas, other equipment – 22,500 litas.

Renovation of the heating systems is going more and more often, thus the need of small boiler-houses and energy plants plantations is increasing. In 2006, when the community of Gražiškiai started their initiative, there were only 300 ha of such plantations in Lithuania. At that time there were 5 boiler-houses heated by biofuel producing 4.5 MW of heat in Vilkaviškis district: three of them were schools' boiler-houses, and the rest two belonged to the municipality. In addition a special boiler heated by straw was used in Alvitas Community House, and the community of Keturvalakiai was installing a line for straw processing (briquetting).

Background situation

Low fertility soil not favourable for traditional farming in neighbouring townships of Gražiškiai and Vyštytis. The area is hilly and harvest often is destroyed by rain or drought. Small farms prevail in both townships, meadows are rarely mowed, and the local residents are not able to hire machinery to gather the harvest. Bearing in mind these peculiarities of the location, several farmers of the community decided to grow an energy forest. The community of Gražiškiai submitted an application to several funds (Global Environment Facility's Small Grants Programme, Baltic Charity Fund, Ministry of Agriculture of the Republic of Lithuania) and received support of 200,000 litas (approximately 58 000 EUR).

Implementation of the project

At the beginning of its activity, the community approached experts who provided a lot of useful information, like how to plant willows, how to maintain and to harvest plantation. The preparatory works for the planting of plantations had to start in summer before the planting: the soil was ploughed, weeds were

Branch chopper attached to a tractor *(Photographer Lina Kružinauskienė)*

Technical characteristics

In the area of 30 ha, 427,660 saplings of Salix viminalis were planted;
A tractor MTZ80 was purchased;
A branch chopper Farmi CH 260 of the efficiency of 10–40 m³/hour was purchased; lathes are 7–25 mm of length and 260 mm of diameter.

exterminated. Experts claim that if weeds are exterminated at the very beginning, the productivity of willow plantations may be ensured during the entire its growth period. After weeds were exterminated, the fields were ploughed in spring before the planting. Willows were planted in the first half of May while the ground was still wet and there was no threat of frosts. For the planting of one hectare 15,000 units of willow sapling are required: twigs of approximately 20 cm are put into the soil in double rows retaining large distances.

The saplings start to produce the first sprouts after 1-2 weeks. Thus, during the next two-years weeds have to be intensively exterminated. Poor maintenance of the saplings during the first two years may determine poor yields latter. After, when willows spread, weeds cannot overshadow them and scale of maintenance works might be reduced. According to the specialists, the saplings of willows grow up to 1.5-1.8 meters, and after 3 years their height reaches 5-7 meters even in infertile soil.

For more rapid spread of the twigs the survived saplings are cut off in the second-third year after the planting. Those cut twigs may be used as biofuel or as sapling for reproduction. The firs harvest of the energy forest plantation is taken after four years, later willow branches are cut off every 4 years in the period of 30-40 years, i.e. such plantation produces up to ten harvests.

According to the agreement between the community and the project's sponsors, after the end of the project willows will remain the property of the farmers, while The farmers must donate willow trees to other farmers wishing to grow willows under the same or similar conditions, as they received. At the

Planting of willows in spring *(Photographer Lina Kružinauskienė)* beginning of the activity, the saplings were passed to 11 families, and in 2010 already 200 families had received those donations.

During the project the community purchased the equipment needed for the planting and maintenance of willows plantations, chopping of twigs and branches: a tractor, branch chopper, petrol saw. This technique was used to clean melioration ditches, to remove unnecessary brushes, and during the project 300 km of melioration ditches were cleared. At present an agreement is made with the municipality regarding the maintenance of 1,200 km ditches. Chops of the cut-off branches were used to heat the premises of the community, the town's library and presbytery. The community has already concluded preliminary agreements and obligated itself to supply larger quantities of wood chops for the briquette production line that is planned to be established in the district. In the meantime biofuel is not sold as willows still are not cut and the wood chops from clearing the ditches from overgrowing brushes and trees are not of standard shape.

To demonstrate for the community's members benefits of biofuel, biofuel boilers and heating system was installed in the community's house, which premises were repaired and now are constantly used. Four training seminars on energy forest growing, protective zones maintenance, cooperation and other topics were organized for the farmers, and a children camp was organized. Information on the project was actively spread and the community constantly receives inquiries from private persons and organisations, businesses how to grow energy forests.

Economic incentives, future perspectives

During the Project 427,660 units of certified willows (Salix viminalis) were purchased and planted in 30 ha area belonging to 11 families. The land plots were from 1 to 5 ha. In 2010 willows were distributed to 200 families.

Economic benefit of this plant can be visually compared with wheat which has to be planted once per 40 years. 1 ha of willows produces about 20 t of dry mass harvest every year. Approximately 1 kg willow chops produces 1 kWh electricity energy.

Overgrowing brushes and tress are cut and chopped by a team of the community's members who is responsible for the maintenance of the equipment in Gražiškiai. Permanent workplaces have not been created due to administrative obstacles (no permanent accountant, too high taxes), however, the community still has separate account where saves funds needed for the maintenance of the equipment.

Strong sides:

– The plantation requires quite a lot of maintenance in the first year, while later its maintenance is minimal.
– The activity is suitable for infertile and neglected lands;
– The cooperation between small farmers was encouraged: they share machinery needed for work;
– While sharing the saplings the families started to cooperate more closely.

Weak sides:

– Energy forest may not be planted in meliorated areas: willow roots destroy drainage system;
– In the first year large quantities of pesticides are used for the extermination of weeds.

SWEDEN: APPLICATION OF RENEWABLE ENERGY IN HOUSEHOLD IN RURAL AREAS

This chapter provides examples from Sweden decribing how renewable energy is used in private households. It should be emphasized that these initiatives are private, therefore the owners were thoroughly calculating the required installation costs and pay off. In the both cases described below renewable energy was used in the houses for quite a long time: the owners of one house expanded the capacity of the former electricity energy production (by solar batteries), and in the other house the heating system has been successfully working since 2002.

Wind Micro Power Plant in Hagestade

Location: Hagestade, Loderup village, Skane region, Southern Sweden.
Type of renewable resource: wind (wind power micro-plant).
Owner: private person.
Amount of thermal energy produced per year: 600 kWh.
Installation costs: about 8,630 litas.

Hagestade is a location near Loderup village in Skane region in the southern part of Sweden. Here the family of Holger Wendt resides in an old house not connected to electricity grid. Nevertheless the wind power micro-plant, installed by the family itself, and solar batteries produces the energy sufficient for household equipment, water pump, lightening and some other electrical devices. In 2009 with the help of their friends, the family purchased, installed and connected a small wind power plant. Professional assistance was needed only for several instalments.

Technical characteristics

Equipment was started to use in 2009;
Type of wind plant: PWG 400;
Installed power: 450 W;
Planned average annual capacity: 600 kWh;
Hub height – 12 m. The hub was made from steel pipes by a local company;
Diameter of wind turbine – 1,4 m. According to the laws of Sweden, no construction permissions or licences are required for such small equipment.
Voltage: 12 V;
The batteries are started to charge when the wind is 5,5 m/s and automatically are stopped when the wind reaches 13 m/s.

House owner's friends and the seller of the equipment helped to install the wind plant
(Photographer Holger Wendt)

Background situation

The house owner Mr. Holger Wendt already had experience how to use renewable energy for various household needs: wood and liquid gas were used to heat the building and cooking stove, liquid gas – for water heating and refrigerator. Some sun energy was used for heating; a solar battery of 100 W was used for electricity production. The produced energy was enough for lightening and pumps. However, eventually this family of 4-5 members needed more electrical equipment, the need of electricity increased, thus it was necessary to expand electricity production capacity. In Southern Sweden, where plains and strong winds prevail, a wind power micro-plant was the best solution.

Strong sides:

– The family may use electricity even in cloudy days;

– Neighbours' attitude towards the plant of such size is positive.

Weak sides:

– A small land plot is necessary for a wind plant.

Micro-plant turbine *(Photographer Holger Wendt)*

Implementation of the project

After the analysing data on winds from the Swedish Institute of Hydrology and Meteorology it became clear that the strong winds' situation in the location is very suitable for the installation of a wind plant: the average wind speed was 7 m/s, and favourable West wind prevailed. The house owner himself assessed the electricity consumption and had chosen the type of the wind plant. Information on proper size of the plant, its model and installation was provided by the supplier of the equipment who was specialising itself in small plants in farms.

The wind turbine was delivered in a small box of 1.140 x 0.56 x 0.24, which weighted only 19 kg. The house owner together with his friends and the supplier of the equipment installed the wind plant. The cable and the transformer earlier installed for the solar collector system were used for the system. Thus the installation costs were considerably reduced.

The energy produced by the new micro-plant and the solar batteries which had been installed in the farm earlier is accumulated in a 12 volt accumulator. The energy produced by both equipments is enough for the water pump, lightening and transformer which transform the voltage into 220 volts.

Fearing that the vibration would not damage the buildings, the wind plant was not attached neither to the house nor to other buildings.

Economic incentives

The produced electricity energy is used only in the farm. As the farm is not connected to the electricity grid, the energy produced by the wind plant cannot be sold. The owner states that the costs of the equipment maintenance are minimal.

Equipment	Price, LTL	Notes
Hub	6,905	Production and installation
Turbine	1,725	
Transformer 12 v/220 v	-	Existing equipment and installation were used
Electricity cable	-	Existing equipment and installation were used
Workforce	-	Owner's friend helped free of charge
Total investment	8,630	

Micro-plant turbine (Photographer Holger Wendt)

Private house heated by solar collectors and pellets

There are already 1.5-2 thousand of combined heating systems installed in Sweden that consist of solar collectors and boiler heated by biomass pellets. Such combination is very suitable for Swedish conditions as biomass pellets are produced from local raw materials, and there is enough of sun light in the country: due to the long summer days there is almost the same amount of solar radiation as in the Mediterranean region.

Location: Karlskoga, Middle Sweden.
Type of renewable resource: solar collectors and broiler heated by pellets.
Owner: private person.
Heated area – 130 m^2.
Amount of thermal energy produced per year: solar collectors – 5,000 kWh, boiler heated by pellets – 20,000 kWh.
Installation costs: about 51,790 litas (approximately 15,000 EUR).
Solar batteries installed in 2002.

Background situation

Christer and Birgitta Bjork reside in a large house of 130 m^2. The old central heating boiler, run by oil, had to be changed. Fuel prices became so high that the boiler became too expensive, and the owners had started to wonder about such alternatives as geothermal heat pumps and heating by biofuel pellets. Eventually they chose the combination of solar collectors and biofuel pellets. The costs of the installation of all equipments were similar but this system was chosen because it was the most suitable for the existing house's central heating system. The owners wished to use the former ventilation system and thus retain the present microclimate.

The experience of other residents showed that the owners of houses at first must thoroughly to do their "homework": to assess the seasonal fluctuations of hot water consumption, to plan possible places for instalment of solar collectors and boilers, and to estimate what kind of specialists will be needed for the instalment of

Solar collectors installed on the roof *(Photographer Christer Bjork)*

Technical characteristics

Two solar batteries of 3.3 m^2 and 55 kg each;
Volume of the water container – 630 litres;
Equipment has been used since 2002.
Annually the collectors produce 5,000 kWh of thermal energy;
During a season 4,500 - 5,000 kg if pellets are burned and approximately 20,000 kWh of thermal energy is produced.

the equipment and only then to start planning and to search for companies providing the equipment and its installation.

Implementation of the project

When the family decided to start this project, they applied to one Swedish company which started the technical planning and installation of the system required for the heating of the house for two persons (130 m^2). Due to the requirements of insurance companies, it was necessary that the system would be planned and installed by certified specialists.

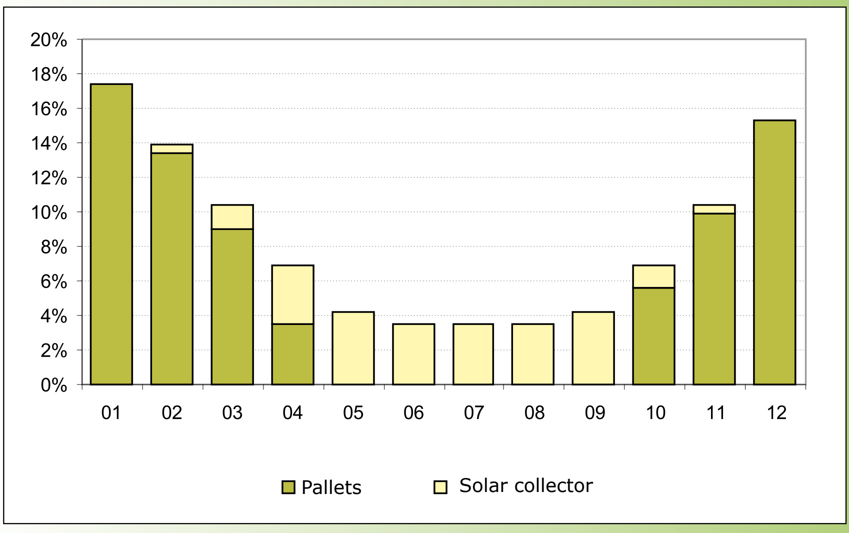
The system was successfully installed in 2002 and since then operates without any interruptions. The solar collectors do not require any special maintenance. The pellet boiler must be maintained every year or every other year. Of course, it is necessary to have a storage for the supplies for the boiler.

The mixed system of solar collectors and pellets allows to satisfy the needs of heating completely in summer as well as in winter: usually from May until September the solar collectors are enough for hot water and the boiler is not used.

Economic incentives, future perspectives

Price of installation:

- Two solar collectors – 17,265 litas (approximately 5,000 EUR);
- Water container – 13,810 litas (approximately 4,000 EUR);
- Biofuel plalets boiler – 8,630 litas (approximately 2,500 EUR);
- Other equipment and materials required for the installation – 5,180 litas (approximately 1,500 EUR);
- Installation works – 6,905 litas (approximately 2 000 EUR);
- Total investment – 51,790 litas (approximately 15 000 EUR).



Seasonal distribution of the average usage of solar and biomass energy in the house of Christer Bjork since 2002

Annual costs of equipment maintenance – 5,180 litas (approximately 1,500 EUR), and according to the calculations of the owners, 6,905 litas (approximately 2,000 EUR) is saved for heating every year.

Investments to the mixed system of solar collectors and pellets boiler are quite large, however, the costs of heating comparing with the system of fossil fuel heating is much lower; "fuel" of solar heater is free of charge, while the price of pellets in Sweden is quite competitive comparing with the fossil fuel. Besides, in some parts of Sweden the state partially subsidizes the expenditures of the installation of the above mentioned systems.

Strong sides:

– Biofuel pellets boiler heats the chimney which heats the whole house;
– Solar panel needs very little maintenance;
– Solar collectors maintenance costs are low;
– Properly installed solar collectors usually are very reliable and operate without interruptions for a long time.

Weak sides:

– It is necessary to have space for storage of pellets;
– Every year or every second year preventative maintenance of the pellets boiler must be performed.

Biofuel pellets boiler and solar heat accumulator in the basement of the house *(Photographer Christer Bjork)*

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