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Regional Networks for the development of a Sustainable Market for Bioenergy in Europe

Case study: Reconstruction of the Kindergarten “Slanchevi lachi” in Vakarel, Ihtiman Municipality, Bulgaria

Supported by INTELLIGENT ENERGY EUROPE

Acknowledgements

This report has been produced as part of the project BioRegions. The logos of the partners cooperating in this project are shown below and more information about them and the project is available on www.bioregions.eu

The feasibility study has been developed by Energy Agency of Plovdiv.

Title of the project

Improving the Energy Efficiency and Reconstruction of **Kindergarten "Slanchevi Lachi"** in Vakarel, Ihtiman Municipality.

Objectives of the project

- Reduction of greenhouse gas emissions
- Reduction of energy bills
- Improvement of energy efficiency
- Decrease the dependency on fossil fuels
- Decrease the operational and maintenance costs
- Utilization of local resources
- Stimulation of local biomass stakeholders
- Improvement of the building conditions
- Installation of new boiler with efficiency over 85 %

The project aims to cut-down the energy (demand) consumption and energy costs for heating and consequently, the operational and maintenance costs of the beneficent – kindergarten in Vakarel. These will be achieved through:

1. Improving the thermal characteristics of the building's envelope
2. Thermo-modernization of the roof
3. Windows replacement
4. Switching from heating based on oil to heating based on biomass. Switching to biomass heating will reduce energy costs and moreover, it will stimulate local biomass producers and will lead to efficient utilization of local resources.

Description of the project

Sredna Gova Bioregion targets

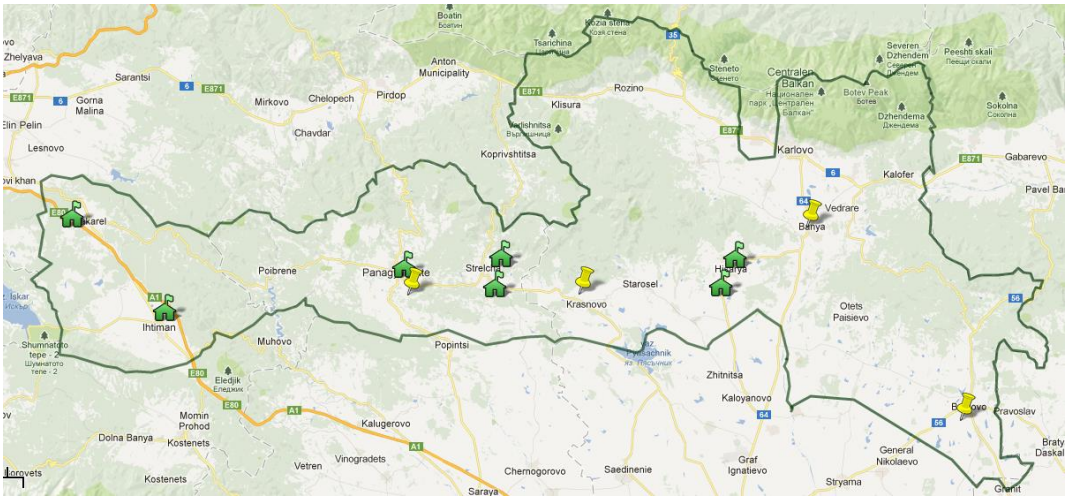
The objectives of the Bulgarian Sredna gora BioRegion till 2020 are:

- ✓ 25 % of the total energy consumption to be supplied from modern utilization of biomass - using less biomass at higher efficiency of the heating systems
- ✓ 20% increase in energy efficiency through reduction of the use of electricity for heating water and through integration of residential heating systems with high COP (COP more than 85 %)
- ✓ 85% share of biomass (60% in 2010) of the total energy consumption

Site selection:

Vakarel is a town 25 km away from the capital of Bulgaria – Sofia. Vakarel is situated in Ihtiman Municipality, part of Sredna Gora mountain region. Ihtiman Municipality is part of the Bulgarian BioRegion as well.

The kindergarten "Slanchevi Lachi" in Vakarel was selected as a pilot implementation project within the BioRegions project.



Map or the BioRegion Sredha gora

The kindergarten is located in Vakarel, Ihtiman Municipality. It has been selected for the following reasons:

- the social and public functions of the kindergarten;
- the need to improve the educational infrastructure;
- the current high heating costs;
- the location - in terms of potential for supply of biomass.

Project Operator:

The Kindergarten "Slanchevi Lachi" in Vakarel is a public organization in the Ihtiman Municipality. The mission of the organisation is to educate children from 3 to 7 years old. About 40 children and 9 staff members are daily involved in activities within the kindergarten. The growing heating costs place significant burden on the limited budget of the organisation.

Fuel Supply:

1. Black coal and electricity
   An increase in the price of black coal and electricity for small customers could be expected in the future, taking into account the uncertainty on the Bulgarian coal market for small customers. Moreover, fossil fuel imports cause outflow of capital from rural border region.

2. Biomass
   There are several sawmills providing biomass for energy purposes in the region. Furthermore, local biomass market with facilitated contracting among smaller local biomass producers is being established in the frame of the BioRegions project.

Technology analysis

Basic information

The building of the kindergarten "Slanchevi Lachi" is located in Vakarel, Ihtiman Municipality, which is part of the Bulgarian BioRegion. The building is over 25 years old and does not meet the current requirements for thermal buildings characteristics. The kindergarten is used all year long (≈50 weeks, 5 days a week, 11h/day). Additional basic information about the building is shown in Table 1.

Table 1 Basic information for Kindergarten "Slanchevi Lachi"

Kindergarten "Slanchevi Lachi"	
Year of construction	*1985*
Type of construction	*Panel*
Built-up area	*461 m²*
Gross floor area	*706 m²*

Building information

- Traditional extruded bricks without any heat insulation are used for the walls.
- The roof is flat, without any air internal layer. It is constructed with concrete slab without any waterproofing and the zinc cover, which helps only for driving water and snow away.
- The PVC windows cannot open, which doesn't allow access of sufficient fresh air and thus, is a prerequisite for mold and moisture.

Heating system information:

The current heating system is being operated according to the kindergarten's working schedule – around 11 hours/day, starting at 7:00 and finishing at 18:00. The kindergarten was designed for bigger capacity that could hold several groups of children. However, at the moment there are only two groups of children or approximately 50 people in the kindergarten including 9 staff people.

Until 2008, a hot water boiler on oil with installed capacity of **250 kW** was used for the kindergarten heating**.** The rising prices of oil lead to a change of the heating system. Since 2008, the kindergarten has been heated with electrical energy, wood and coal. Highly inefficient calorifier heaters and conventional stoves on firewood and black coal, generating both emissions of fine particles and CO_2, are used. All these constitute a very inefficient heating system, which is one of the reasons for not achieving the required health standards for thermal comfort in the building.

The boiler, and in particular its heat exchange surface, is in bad technical condition, which suggests that the maximum useful thermal output is lower than the total installed capacity of 250 kW.

Project design:

The building's energy performance analysis showed massive heat loss through the surrounding structures and elements (roof, walls, windows and floor) and identified the need for reconstruction and modernization of the heating system, including changing the current mode of heating. The project is going to implement the following measures that will improve the building's energy efficiency.

Heat insulation of the facades:

- Heat insulation of the facades with ESP insulation: δ = 100 mm, λ = 0.037 W/mK.

Heat insulation and waterproofing of the roof:

- heat insulation of the roof with XPS insulation: δ = 120 mm, λ = 0.03 W/mK;
- replacing the old sheet iron with new waterproofing LT sheet iron;
- replacement of the compromised drainage system which affects the thermal and waterproofing characteristics of the building.

Heat insulation of the floor:

- heat insulation of the floor with total surface of 22.3 m² with XPS insulation: δ = 100 mm, λ = 0.03 W/mK. The U-value of this part of the floor will be 0.27 W/ m²K and the U summarised of the floor will be 0.62 W/ m²K.

Replacement of windows:

- replacement of 40 m² PVC windows (that cannot open at present) with 4 chamber PVC windows with 60 % opening.

Replacement of the heating system:

- installation of an automatic pellets boiler with a system for automatic regulation with ECE over 90 %;
- installation of new flat panel radiators with thermostatic valves and new pipe system with polypropylene pipes.

Expected results from the realized measures for improving energy efficiency in the building:

After the implementation of the energy measures, the building will fully satisfy the standards for energy efficiency as well as heat and energy savings in compliance with the EU requirements.

The U - values that are going to be achieved after the implementation of the measures are shown in Table 2.

Table 2 U-values of the constructions before and after the energy savings measures

U - values , W/m²K		
Type of construction	**Before**	**After**
Facades	1,42	**0,29**
Floor	3,32	**0,62**
Windows	2.0`	**1,24**

Suppliers:

A pellet boiler supplier and a construction company for complex refurbishment of the building will be selected through a public tender.

Financing of the project

Investment costs of the project were initially estimated to be about 64 635 €. Because the kindergarten in Vakarel is an allowance organization of the Ihtiman Municipality, the project investment costs will be covered by the Kozloduy International Decommissioning Support Fund (KIDSF).

The Kozloduy International Decommissioning Support Fund (KIDSF), administered by the European Bank for Reconstruction and Development (EBRD), has been established to support the decommissioning activities of the nuclear power plant and to mitigate the finacial loss from the units' early closure. Some of the objectives of the KIDSF are to assist in restructuring, upgrading and modernisation in the energy generation, transmission and distribution sectors as well as to improve energy efficiency in Bulgaria.

Financial evaluation of the project

The following table summarizes the costs, benefits and main assumptions used as input to the financial model that was used. The model was designed by the partners in the BioRegions project to evaluate the financial viability of case studies. Capital and annual operation and maintenance costs after the project implementation are presented. The benefits from the project represent the avoided costs for energy.

- **Capital costs:**

Delivery of materials and equipment	**€**
PVC windows	2 518,40
insulation	22 737,91
heating installation	14 207,54
electrical installation	556,60
Total	**40 020,45**
Construction works	
change of PVC windows	1 265,08
insulation works	19 890,33
repair and replacement of heating installation	3 386,17
optimization of the electrical installation	73,81
Total	**24 615,39**
Total amount of invesments	**64 635,84**

- **Operation & maintenance (O&M) costs:**

Operation & Maintenance costs	**€**
Annual operation costs	1000
Annual maintenance costs	5000
Total	**6000**

A detailed analysis of the financial viability can be found in the next section.

Financial evaluation of the project

Three scenarios have been evaluated – with 100% grant, with 40% grant and without any subsidy. The results are summarized in the table below.

Table 3 – Financial evaluation of 3 scenarios of funding.

				With 100% Subsidy	**With 40% subsidy**	**Without subsidy**	
Capital costs	Investment costs			64 636			EUR
	Subsidy	Amount		64 636	25 854	0	EUR
		Ratio		100	40	0	%
	Loan	Amount		-	38 782	64 636	EUR
		Interest		-	5	5	%
		Payback time		-	3.5	5.9	years
O&M costs	Maintenance			5 000			EUR
	Operation costs			1000			EUR
Evaluation criteria	Net present value		NPV	76 363	11 401	-31 907	EUR
	Internal rate of return		IRR	-	11.8	0.6	%
	Year of implementation			2013			-
	Lifetime (evaluation)			15			years
	Discount			8			%

The evaluation shows that the project is viable only in case of receiving public funding covering more than 40% of the investment costs.

Expected results

- ✓ The energy consumption will decrease by 192 722 kWh/y.
- ✓ The expected energy and fuel savings as a result of the implementation of the energy efficiency measures are expected to be around 14 400 €.
- ✓ The environmental effect after the implementation of the measures is estimated to be 225,35 t/y CO_2 emission savings

The calculation of CO_2 savings, IRR (internal rate of return) and PB (payback period) is based on the energy savings and the effect achieved after the implementation of the measures for energy efficinecy of the building.

Project Timeline

Preparation of the project including application submission took place in November 2011. Implementation of the project is planned to start in 2013.

Conclusions

The implementation of the project in Vakarel, Ihtiman Municipality is in compliance with the approved Biomass Utilization Action Plan designed for the Sredna Gora BioRegion which covers six municipalities. Complex refurbishment of the building and switching to biomass for heating will improve energy efficiency and simultaneously reduce dependence on imported fossil fuels with increasing prices. Consequently, utilisation of local biomass contributes to energy independence and stabilises the heat prices on acceptable level.

Public financial support is strongly needed for the implementation of such projects that bring important social and economic benefits to the local communities as well as better environment.

To achieve the objectives of the project and for implementation of similar projects, accessibility to low-interest loans and grants to support the projects should be assured. ESCO schemes are also possible as a tool for implementation of energy efficiency and biomass heating projects, especially when long term biomass heat supply can be contracted.