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## **Deliverable 4.5**

# **Abstract version of Master Plan**

*for innovative energy structures in Kaunas Region in Lithuania, which could be feasible for funding in the Structural Funds Programmes in the period 2007- 2013.*

Elaborated by LEI, November 2007

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## **1. Background**

### **Regional focus**

The general objective of this Master Plan is to evaluate current energy situation, potential for renewable energies, to develop energy vision, select the most interesting Energy Actions for funding from Structural Funds in Kaunas Region. Thus, the document aims at undertaking action to utilization of local renewable energy sources and potential of energy savings in the region.

Kaunas Region was selected as Energy 4 Cohesion (E4C) target region for its suitability for extended use of renewable energies and energy efficiency actions, namely:

- Rich resources for renewable energy generation particularly biomass resource
- Clear support of the political and administrative decision makers
- Availability of an extended knowledge and data basis for the planning process.

Global objectives of Kaunas Region are in line with the Lithuanian National Energy Strategy. It serves as background and guideline for successful development of Master Plan, after inclusion of specific measures that would assess particularities of individual parts of the Kaunas Region.

The main factors that influence a stable functioning of the energy sector in Lithuania (and in Kaunas Region) are:

- I. Prevalence of import of primary energy resources from Russia, dependence of Lithuania's gas supply and electricity systems on Russia's energy systems as well as absence of interconnections with Western European energy systems;
- II. The decommissioning of the Ignalina NPP in 2009, which has a considerable detrimental effect on the structure of electricity sources, primary energy balance and electricity price in 2010-2015;
- III. The strict environmental requirements set forth to energy enterprises, including restrictions on carbon dioxide emissions.

Improving efficiency of energy generation and consumption and increasing usage of renewable energy sources could mitigate the negative impact of the above-mentioned factors.

### **Targeted towards Structural Fund Support**

The cornerstone of the E4C – strategy is to support the implementation of energy pilot actions in the selected region feasible for public financial support, with main focus on **European Structural and Cohesion Funds (SF and CF)** during the funding period from 2007-2013. E4C strives to overcome the various constraints which currently hinder the broader use of Structural Funds for innovative energy actions in less developed and rural regions of Europe.

### **Cooperative Approach**

In the region all main stakeholders were brought together for a successful and efficient definition of innovative energy actions in the respective region. The E4C actor cycle includes municipalities, households, media, capital provider and financial experts. Within this actor cycle Lithuanian project partner LEI was responsible for the coordination of the different actors, and the preparation of the regional Master Plan. Main focus was put to integrate suggestions and ideas existing in the region rather than exposing priorities from outside.

## 2. Master Plan Structure

Comprehensive investigations were undertaken, starting from an abstract and general view on the regions, leading to concrete innovative energy set-ups, consisting of a range of RE and EE projects. A comprehensive and detailed methodology was used, including 3 main elements:

1. **Target region portrait** – Within the first chapter, the target region portrait is presented, including a first overview of the region for what concerns the actual energy situation (current energy infrastructure, current energy supply and consumption). The statistical data needed for the target region portrait were collected specially for preparation of Kaunas Region Master Plan.
2. **Energy Vision of Kaunas Region** - The Energy vision chapter has two goals: The first one was to evaluate existing socio-economic situation in the target region and the real energy needs and based on this, define the renewable energy potential of the area. The second goal was to create selected renewable Energy Actions for implementation of more clean energy production and for efficient production and usage energy in the region. Investments into usage of renewable energy resources in the target region will enable to fulfill important obligations, stipulating that by 2010 renewable energy resources should take at least 12% in the total balance of primary energy. Development of the use of local renewable resources will have a very positive impact on local development and encourage people engaged in agriculture to partially re-organize their activities and start production and supply of local bio-fuel (wood, straw) to energy installations.

On the basis of **SWOT analysis** of Kaunas Region, 6 fields of priorities were selected to draw the region's Energy Vision:

1. Security of energy supply;
2. Increasing energy efficiency in existing buildings (renovation of buildings, modernization of heating systems);
3. Efficient production of heat and electricity (development of cogeneration);
4. Diversity of primary energy sources: increasing the contribution of renewable and local energy resources;
5. Education, research, promotion RES and RUE in the energy sector;
6. Cooperation of regional administration with municipalities and private sector.

**3. Identification of concrete actions or action bundles** – The prepared Energy Vision considers several adapted initiatives ('Energy Actions'). The most interesting Energy Actions feasible for Cohesion and Structural funding were selected. These are presented in chapter 4:

- I. Lapes city landfill gas utilization in CHP plant,
- II. Biogas utilization in CHP plant of JSC "Kauno vandenys";
- III. Renovation of District Heating network of city Birstonas.

### 3. Identified Energy Actions / Action Bundles for Kaunas Region

<b>Energy Action 1 - Lapes city landfill gas utilization in CHP plant.</b>
Proposal includes construction a landfill gas extraction system in the existing Lapes landfill for production electricity and heat in Combined Cycle.
<b>Current state</b>
<p>The objective of the project is to use landfill gas extracted from the Lapes landfill site for heat and power generation in a combined heat and power (CHP) plant to be constructed. This will significantly reduce methane emissions from the landfill. Substituting landfill gas for fossil fuels in heat and power generation will also reduce CO<sub>2</sub> emissions in the Lithuanian energy sector.</p> <p>Lapes landfill is located near the city of Kaunas in Lithuania. Its exploitation started in 1973 and the total area of the landfill is 38.7 ha. The annual waste volumes disposed in the landfill have been around 110–120 thousand tonnes over the past years.</p>
<b>Technological solution</b>
The project proponent is planning to build a landfill gas extraction system in the Lapes landfill. A combined heat and power (CHP) plant will also be constructed and connected to the gas extraction system. The CHP plant will provide electricity for the Lithuanian power grid and heat for the local district heating network. The CHP plant would have an electrical capacity of 1.1 MW <sub>el</sub> and a heating capacity of 1.4 MW <sub>th</sub> .
<b>Investors</b>
<p>Municipality of Kaunas District.</p> <p>Lithuanian Environmental Investment Fund (LEIF).</p>
<b>Benefiting groups</b>
<p><b>Municipality</b> – reduced costs for energy.</p> <p><b>Residents</b> – reduced costs on heating, creation new jobs, reduction of emissions to Lapes city and region.</p> <p>Expected reduction of pollutions:</p> <p>approximately 45-60% of the gas emitted to the air by the Lapes landfill site is methane, which is a potent greenhouse gas. By implementing the project, a significant portion of the landfill gas will be collected and either flared or used for energy generation in the Domeikava cogeneration plant.</p> <p>The EU landfill directive requires that the landfills receiving biodegradable waste must have a gas collection system. Existing landfill sites must comply with the requirements of the directive within 8 years from the date that the national legislation implementing the directive came into force.</p>
<b>Logistics</b>
Biogas will be produced from existing landfill of city Lapes. The total area of the landfill is 38.7 ha. The annual waste volumes disposed in the landfill have been around 110-120

thousand tonnes over the past years.
<b>Financing</b>
Municipality of Kaunas District has possibilities to receive grant from EU Structural Funds (80% of eligible costs on installation energy generation in combined cycle). 10% can be covered by own sources, 10% from Lithuanian Environmental Investment Fund.
<b>Expected implementation time</b>
2008-2009

<b>Energy Action 2 – Biogas utilisation in CHP plant of JSC “Kauno vandenys”</b>
<p>Proposal includes utilisation biogas from wastewater treatment plant JSC “Kauno vandenys” using biogas for combined heat and power production.</p>
<b>Current state</b>
<p>At present time part of biogas from wastewater treatment plant JSC “Kauno vandenys” is using in Noreikiskes city CHP plant. At present time in wastewater treatment plant is installed only mechanical water cleaning technology.</p> <p>After implementation biological water cleaning technology production of biogas significant will increase.</p> <p>Proposal includes usage biogas after biological water cleaning process.</p>
<b>Technological solution</b>
<p>This proposal corresponds to the strategic goals of the Lithuanian energy sector and facilitates to implement the requirements of Directive 2001/77/EC and White Paper – Energy for the future. Renewable sources of energy – in the year 2010 the part of energy produced from RES have to reach 12% in primary energy balance and “green” electricity have to make 7% from electricity consumption in the country.</p> <p>Proposal includes construction of 2 unit of CHP in JSC “Kauno vandenys”. Fuel – biogas after wastewater biological cleaning process.</p> <p>Installed capacity:</p> <p>2 CHP units x 300 kW<sub>el</sub>.</p> <p>Are planed CHP units Cento T 150 SP B10 produced by TEDOM company Czech Republic.</p> <p>The equipment of CHP plant will be connected to the 10 kV outlet to JSC “Vakaru skirstomieji tinklai” distributive channels by 10/04 kV transformer.</p> <p>Nominal electrical capacity of unit – 300 kW<sub>el</sub>.</p> <p>Nominal thermal capacity of unit – 420 kW<sub>th</sub>.</p> <p>Biogas consumption (it heating value is 20 MJ/kg) – 560 Nm<sup>3</sup>/h.</p> <p>Electrical efficiency of the CHP plant – 36.4%.</p> <p>Thermal efficiency of the CHP plant – 51.2%.</p> <p>Overall efficiency of the CHP plant – 87.6%.</p>
<b>Investors</b>
<p>Kaunas city Municipality.</p> <p>JSC “Kauno vandenys”.</p>
<b>Benefiting groups</b>
<p>JSC “Kauno vandenys” will receive money for electricity sold to the grid according to special high tariff (0.20 LTL/kWh) which is applied only for electricity, produced from RES. Using heat, produced by CHP, company significant will save money from heating.</p>

The biogas (which main component is methane – strong greenhouse gas effect increasing gas) produced in wastewater treatment process not will be exhausted into atmosphere, but will be used for production of electricity and heat.

Implementation of the project will increase local employment (preparation project, implementation project).

Implementation of the project will be very good example for usage of renewable energy sources for electricity and heat production and will contributes to the public awareness in the Kaunas region.

### **Logistics**

Biogas will be produced in JSC “Kauno vandenys” in wastewater cleaning process.

### **Financing**

Possible scheme of financing can be:

Kaunas city municipality will apply for grant from EU Structural funds (80% of eligible costs, 10% can be covered by municipality, 10% - own resources of JSC “Kauno vandenys”).

### **Expected implementation time**

Year 2008-2009.

### Energy Action 3 – Renovation of District Heating network of city Birstonas

Proposal includes renovation of district heating network of small city Birstonas for reduction heat losses in heat distribution system.

#### Current state

The objective of the project is to renovate the existing district heating network in small city Birstonas. The length of existing DH pipelines is about 18.0 km. Those pipes are connecting the boiler house with heat and hot water consumers. The boiler house capacity in 2005 was 22.0 MW (20 t/h steam). Boiler capacity according fuel used: 18.0 MW for natural gas and 4.0 MW for biofuel.

Building stock connected to DH (2005)

1. Amount of buildings – 102
2. Floor area ( $10^{-3} \text{ m}^2$ ) – 91.4

Dwelling houses:

- One/two storey – 36
- Amount of flats – 180
- Floor area ( $10^{-3} \text{ m}^2$ ) – 9.0
- Multi-storey – 43
- Amount of flats – 788
- Floor area ( $10^{-3} \text{ m}^2$ ) – 42.1

Other buildings:

- Amount of buildings – 23
- Floor area ( $10^{-3} \text{ m}^2$ ) – 40.3

Heat energy produced in 2005 – 22.8 thousand MWh. Technological losses – 4.8 thousand MWh (21.1%). Average technical losses in district heating network in Lithuania was ~ 17%.

#### Technological solution

The project proposal is to renovate the existing district heating network.

The length of existing DH pipelines is about 18,0 km. The pipelines installed in period 1970-1980 is in very bad conditions. Technological losses in network in 2005 was 21,1% (4.8 thous. MWh). After 1990, heat consumption in city Birstonas significant reduced and now existing dimension of pipes are to big. Insulation of pipes is in bad conditions. For minimization of heat supply losses will be changed 5.0 km existing pipelines (with conditioned diameter of pipes from 32 to 400 mm). Existing pipelines will be changed to new type preinsulated pipelines with polyurethane thermal insulation and an outer casing of high density polyethylene (referred as PE, HDPE or PEH).

In the project will be included optimization of the heat carrier velocity and pressure losses in heat supply network.

After renovation of existing DH network will be reduced heat losses, less strain on the environment, lower operational costs, will help to stabilize heat price.

#### Investors

<p>Municipality of city Birstonas. JSC "Birstono siluma".</p>
<p><b>Benefiting groups</b></p>
<p>Municipality of city Birstonas, JSC "Birstono siluma" – will reduce costs for energy. Residents – reduced costs on heating, new job for networks installation companies, reduced of emissions from existing boilers.</p>
<p><b>Financing</b></p>
<p>Municipality of city Birstonas has possibilities to receive grant from EU Structural Funds (50% of investment). 50% can be covered by loan from local banks.</p>
<p><b>Expected implementation time</b></p>
<p>Year 2007-2008.</p>

## 4. Conclusion and Outlook

The target region portrait of Kaunas is presented in the Master Plan. Actual energy situation (existing energy infrastructure, current energy production, supply and consumption) has been evaluated and is presented. The Energy Vision for Master Plan of region has been prepared.

One of the main tasks in Energy Vision was analysis of usage and existing potential of RES in the region. Results of analysis shows that biomass the main renewable energy sources in the region.

Total RES potential from biomass in Kaunas Region is equal to 1.115 GWh/year. An analysis of situation in the area of hydro energy shows that hydro energy resources in the region are fully exploited. Mini hydro power stations are erected on almost all ponds suitable for power production, Construction of new large capacity HPP on largest Lithuanian rivers Nemunas and Neris are impossible because of strict environmental requirements.

Utilization of wind and solar energy in greater scale in Kaunas Region is doubtful because of conditions for wind energy development are incomparable better in the Baltic sea coast region. Solar collectors are installed mostly in private houses and very seldom in public sector. So wind and solar energy applications will play minor role in the short-term future.

On the basis of analysis of Kaunas Region, 6 priorities in region were selected:

- Security of energy supply.
- Increasing energy efficiency in existing buildings (renovation of buildings, modernization of heating systems).
- Efficient production of heat and electricity (development of cogeneration).
- Diversity of primary energy sources: increasing the contribution of renewable and local energy resources.
- Education, research, promotion RES and RUE in the energy sector. Cooperation of regional administration with municipalities and private sector.

The most interesting and feasible for structural Funds Energy Action Bundles identified:

- Lapes city landfill gas utilization for energy generation.
- Biogas utilization in JSC "Kauno vandenys".
- Renovation of District Heating network of city Birstonas.

Total investments for identified Energy Actions – 4.60 mln. Euro.

Real (discounted) payback for 1 or 2 Energy Actions – 5.5-7.5 years. Payback for renovation of District Heating network (Energy Action 3) – 25 years.

Implementation of selected projects will have significant positive effects (economical, environmental, other) in view to overall energy vision of the Kaunas Region.

Implementation of the selected projects will be good example for usage of renewable energy sources for electricity and heat production; will contribute to the public awareness in this area. Implemented projects can be used as demonstrational objects for the other regions in Lithuania.

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