Conventional and Unconventional Management Methods of Energy Efficiency for Peripheral Regions

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Abstract

The paper elucidates the role of the energy efficiency management methods on a regional level. In every EU country there are peripheral support regions. Complete and autonomous provision of renewable energy resources (RES) allows finding a solution for the supporting energy supply as well as energy efficiency problems. Such a pilot project in the Latvian conditions shows that it can be supported on the biomass basis.

1. Introduction

Energy efficiency deals with energetic, economic and environmental problems on a global, regional and national scale. The European Union (EU) makes much effort to raise the energy efficiency (EE) and to a greater extent. Much more innovative suggestions and directives are being developed to be observed by the new member states, too. The new member states have a great potential for raising the EE. However, in order to reach the level of the old European countries, this requires great efforts, and each country is looking for new ways how to raise the EE and the methods of their management. The EU Directive 2006/32/EC “On energy end-use efficiency and energy services” provides for all the EU member states to save 9% of the annual energy consumption in the year 2016. The North European countries consume much energy to produce heat for heating houses. In Latvia, more than 60% of the total consumption of energy resources is used to produce heat. The existing buildings have great losses of heat. In every EU country there are peripheral support regions. Complete and autonomous provision of renewable energy resources (RES) allows finding a solution for the supporting energy supply as well as energy efficiency problems. One of the peripheral support regions in Latvia is located in the eastern part of the country close to the border with the Russian Federation. Such a pilot project in the Latvian conditions shows that it can be supported on the biomass basis. The natural resources of the region are: wood, hydropower, peat, dolomite, limestone, gypsum and sapropel.

2. The Latvian pilot project

One of the peripheral support regions in Latvia is located in the eastern part of the country close to the border with the Russian Federation. This region is under discussion within a framework of the model of the sustainable energy community (SEC). For the main characteristics of the SEC see Fig. 1. Wood is the first form of energy ever known and used for cooking, heating and the production processes. Nowadays, interest in biomass is growing again as it is a renewable energy source, when
managed correctly; moreover, modern technologies enable an efficient conversion of biomass into heat, electricity or fuels for transport. It originates from the forest and agricultural waste and is transformed into various highly effective biofuels (see Fig. 2). The potential of electricity production depends on the SEC’s biofuel production and technology (see Fig. 3).

3. The SEC’s development methodology

The SEC’s methodology is adaptation of the EU project ASPIRE. The project has been developed from six Sustainable Energy Actions Plans (SEAPs) by applying a common methodology. The methodology was to be used by the partners to provide qualitative and quantitative information about each community from which opportunities and priorities for actions would emerge. Moreover, the common methodology was intended to assist the communities in the SEC project to adopt the Action Plans which would be:

- based on the analysis of energy data and other characteristics and on the identification of the strengths and weaknesses of the local community;
- endorsed by local Stakeholders Steering Boards (SSBs),
- aimed at the introducing actions and measures that are (likely) to be adopted and implemented in a 3-5 years’ horizon.

Furthermore, the SEC’s approach has constituted a solid basis for the development of a tool-kit for other communities that intend to develop a SEAP and become Sustainable Energy Communities (SECs).

The total SEC area is 2243 sq km - 3.5% from the entire area of Latvia. Its population - 25 086 people; density - 12 people /km². 57% of total area of the territory are covered with woodland, 30 % - with agricultural lands, 8% - with swamps and marshland, 3 % - with rivers and lakes (Lake Aluksne – 2540 hectares), 2% - the other useful land. The natural resources are: wood, hydropower, peat, dolomite, limestone, gypsum, and sapropel.

Figure 1. The natural resources of the SEC Aluksne.

Thus, through the experience gained from the SEC Project, the SEC approach has been enriched and turned into an operational tool-box supporting a step-by-step sustainable energy planning process.
This model is a tool for assisting in the creation of Sustainable Energy Communities (SEC). The process-like model gives strategic and operational guidance from the very first step to the continuous improvement stage. Sustainable Energy Communities are areas where the goals are rational use of energy and sustainable energy sources as well as energy saving. The structure of SEC methodology is reflected in Figs. 4 and 5.

The SEC Model follows the course of four phases. These phases are: Planning and creation of the SEC; a Capacity Building; a Sustainable Energy Actions Plan and the Impact Evaluation.

![Figure 2. RES transformation possibilities into bio fuel](image)

<table>
<thead>
<tr>
<th>Bio fuels</th>
<th>Specific production (depending on the site-specific conditions)</th>
<th>Specific yearly electricity production (the values depending on the technologies and way of production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas Wood Vegetable oil</td>
<td>1-1.5 m³/t live weight per day (pigs – cows) 1 – 4 t₃₅/ha per year 1 t/ha per year</td>
<td>700 – 1 100 kWh/t of live weight 350 – 2 000 kWh/ha 3 500 – 4 000 kWh/ha</td>
</tr>
</tbody>
</table>

*Figure 3. The potential of electricity production from bio fuels*
Figure 4. Structure of the SEC methodology

Figure 5. Structure of the TOOL-KIT methodology
4. The main SEC development phases

**Planning and Creation of the SEC** (the Sustainable Energy Community):
- The first phase of the Model is laying a solid foundation for the creation of a new SEC.
- Identification of important stakeholders and other actors and securing their commitment to the SEC processes as a key role within this initial phase. In addition, recruiting an organization creates its own key success factor.
- Knowledge of the regional characteristics of the SEC is of great importance especially for the fact that in this work task initial data are gathered.
- Finally, the last key success factor of the first phase is finding the demands and needs of the SEC.
- As a rule of thumb, the actions should always be demand-driven to enhance commitment and positive acceptance.

**Capacity Building**
The Capacity Building phase has a strong foundation for the demands and needs part of the first phase. Capacity Building can be seen as a continuous work that corresponds to the demands and needs arising in the area. These can be divided into two main categories:
1. Awareness
2. Capabilities
- The first category, Awareness, includes both general energy related matters but also the actions that are done in the SEC. These can be, for example, informing people about energy saving, holding a workshop or a seminar about new technologies for energy efficient houses, but also newspaper articles about energy-related matters.
- The Capabilities category is more related to enhancing the energy-related knowledge and know-how for defined groups of people. Usually these groups include planners, architects, development organizations and other authority actors.

**The Sustainable Energy Actions Plan (SEAP)**
- The phase of the Sustainable Energy Action Plan starts with the accumulation of different project ideas. This is crucial for the actual implementation of the Action Plan. Later, when suitable project ideas have been found, they are prioritized in the Action Plan to be carried out in the SEC.
- The next task is to ensure funding for the actions included in the Actions Plan. Finally, the last work in this phase is to implement individual projects and actions. This phase can include operational activities, for example, recruiting applicable experts, technicians and key persons and gathering data about energy consumption.

**The Impact Evaluation**
- Evaluation of the impacts produced through the creation of a SEC is of great importance. Individual financed projects have to be monitored to ensure their effectiveness.
- The initial data are collected already in the first phase under the topic of Knowledge of Regional Characteristics.
- Comparison of the data obtained in different stages of the SEC creation facilitates the monitoring of the progress.
- To the impacts of the SEC creation belong: variations in the energy self-sufficiency, the unemployment rate, the number of enterprises, the economical welfare and the decrease in the CO₂ emissions.

5. The first step towards energy efficiency

Investigations show that a very important energy efficiency measure is the improvement of the heat insulation properties of the envelope of dwelling houses. The North European countries consume much energy to produce heat for heating houses. In Latvia, more than 60% of the total consumption of energy resources is used to produce heat. Considering the fact that the existing buildings have great losses of heat, it is planned to economize heat mainly for heating houses. The annual specific heat consumption in kWh/m² for heating the heating areas is more than twice as high as in the Scandinavian countries with similar weather conditions. There are similar
conditions in all the Baltic States and the other new EU member states from the Central and East European countries. In order to reduce the heat consumption in the buildings by half after the oil crisis of the year 1973, the Scandinavian countries needed 20 – 25 years. This shows the importance of the national and the EU strategy of energy efficiency policy, so that energy economy could be reached still faster and to a greater extent, as it is provided by the Sustainable Energy Actions Plan of the SEC Aluksne.

Before creating an action plan several dwelling houses underwent a thermo audit using a thermograph (see Fig. 6, 7).

6. The second-generation RES

The conventional infrastructure and technology of extraction and use of fossil fuel developed more than 100 years ago, and it has been produced on a wide scale. Yet the infrastructure and technology for the RES developed not earlier than 50 year ago. A vision for the development of the RES in the future is shown in Figure 8.

In the future, the second-generation RES must be based on bio fuel produced mainly from the forest and timber industry waste. An important role in this area will be attached to development of the wood gasification technology. The second-generation biomass must be based mainly on the use of waste and residues from the field cultivation and cattle-breeding. Such a RES policy allows:

- to free soil for food production;
- to free environment from waste and residues;
- to produce advantage – addition of bio fuel to gasoline or the motor fuel.

![Figure 6. A thermograph of a house with small losses of heat](image-url)
**Figure 7. A thermograph of a house with big losses of heat**

<table>
<thead>
<tr>
<th>RES</th>
<th>Transformation (production)</th>
<th>The used technology</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio fuel (wood)</td>
<td>Chips, briquettes, pellets</td>
<td>Boiler house</td>
<td>Boilers produced in Latvia</td>
</tr>
<tr>
<td></td>
<td>Gasification</td>
<td>Research, experimental technology</td>
<td></td>
</tr>
<tr>
<td>Biomass, growing green mass</td>
<td>Biogas production technology</td>
<td>Boiler house, cogeneration</td>
<td>Development of cogeneration</td>
</tr>
<tr>
<td>2nd generation-biomass: waste and residues from field cultivation and cattle-breeding</td>
<td>Biogas production technology</td>
<td>Boiler house, cogeneration</td>
<td>To free soil for food production, To free environment from waste and residues, Production advantage of gas fuel</td>
</tr>
<tr>
<td>Bio gasoline: canola oil plants</td>
<td>Oil</td>
<td>Addition to diesel fuel</td>
<td></td>
</tr>
<tr>
<td>Bio gasoline: grain crops</td>
<td>Ethyl alcohol</td>
<td>Addition to gasoline</td>
<td></td>
</tr>
<tr>
<td>2nd generation-bio gasoline: waste and residues from field cultivation and cattle-breeding</td>
<td>Biogas production technology</td>
<td>Addition to diesel fuel</td>
<td>1. To free soil for food production, 2. To free environment from waste and residues, 3. Production advantage: addition to motor fuel</td>
</tr>
</tbody>
</table>

**Figure 8. A vision for the development of RES in the future.**
Conclusions

1. The research shows that the “Common methodology for SEC” can be used for the implementation of projects in peripheral regions with complete and autonomous RES provision.

2. The main energy policy instruments for the implementation methodology are:
   • creation of a SEC steering board.
   • a financial support.

3. The SEC model is based on the ideology of continuous, step-by-step improvement of the 2nd-generation RES technology.

References

- Technical elements for the assessment of energy planning actions // Project „Achieving Energy Sustainability in Peripheral Regions of Europe” Intelligent energy project 32 pp.