IDENTIFICATION OF POTENTIAL FOR ENERGY SAVINGS IN THE HOUSEHOLDS OF DRAGASH MUNICIPALITY

Conservation of Biodiversity and sustainable land use management in Municipality of Dragash

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June 2012
Identification the energy savings potential in the private houses of Dragash municipality

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1 INTRODUCTION

Revised Energy Strategy of Kosovo (ESK) 2009-2018 sets out the medium and long term frame of energy sector development in Kosovo, and highlights the need for a more rational use of local energy sources, including renewable sources and increase of energy efficiency as a mean of considerable savings source that reduces demand for generation capacity.

Reliability of supply, promotion of investments in the sector, environmental preservation and further development of the energy market are the main strategic goals of the new European strategy for energy sector in the EU. A number of important objectives derive from these goals, including the so-called 20% - 20% - 20%. This means: (1) 20% reduction of gas emissions that create the 'greenhouse' effect, (2) 20% increase of the participation of renewable sources in energy consumption, and (3) 20% improvement of energy efficiency.

Kosovo is a signatory of the Energy Community Treaty for South Eastern Europe with equal rights and obligations. Under this treaty, Kosovo is obliged to increase the energy efficiency at 9% until 2018, based on consumption during 2006/2007. Achievements on this goal will be reported every three (3) years and increased efficiency should be 1% per year or 3% in 3 years. The first report will be done in 2012.

Based on indicative targets for increasing energy efficiency, which Kosovo has approved in line with the obligations under the Energy Community Treaty, a Kosovo Energy Efficiency Plan (KEEP) for the period 2010 - 2018 has been drafted.

Energy Community Secretariat has requested the signatories of the treaty to adopt the harmonized methodology of the European Commission (EC) for evaluation of the energy savings and use it for evaluation and verification of energy savings in their countries. The methodology adopted in 2011 by the signatories of the Energy Community Treaty, as part of measures to implement energy efficiency, provides for the installation of sanitary hot water solar systems.

The “Republic of Kosovo Heating Strategy 2011 – 2018“ is aiming at “...effective management of existing energy resources and preservation of the environment. This strategy is focused on the improvement of security of heating supply, in accordance with European standards, and on the diversification of energy resources utilized. Other significant purposes of this strategy include: stimulation of rational use of energy, promotion of energy efficiency, promotion of renewable energy sources and introduction of new technologies that do not cause irreparable environmental damage, while respecting the application of environmental standards“.

This document is focusing on potential savings in the private housing sector by means of energy auditing and in consequence analyzing

- Potential of energy savings by EE improvement of construction parameters
Identification the energy savings potential in the private houses of Dragash municipality

- Potential savings by introducing EE appliances in households
- Potential savings by technology switch for heat generation (space heating)

In summary, saving potentials in the range of nearly 72% in the heating sector and 10% in the lighting sector of Dragash could be identified in the private household sector.

2 CURRENT SITUATION OF THE HOUSES IN DRAGASH MUNICIPALITY

2.1 SITUATION FOR THE BUILDING MATERIAL OF HOUSES

For analyzing the current situation of the houses in Dragash there are used data from the Energy Baseline done in 2011 by Energy Advisory Team of the UNDP Project in Dragash. Based on the results of the Energy Baseline, the building envelope was analyzed separately based on the different parts of the building envelope:

- Building material of outer walls, (figure 1)
- Insulation of outer walls, (figure 2)
- Insulation of the roofs, (figure 3)
- Types of the windows, (figure 4)
- Material of the windows rams, (figure 5)
- Material of the doors, (figure 6)

![Building material of walls](image)

Figure 1. Material of the outer walls of the existed houses in Dragash municipality

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1 Source: Naumann E., Pireci M. "Energy Baseline for Municipality Dragash", 2011
Identification the energy savings potential in the private houses of Dragash municipality.

Figure 2. Current situation of the houses in terms of insulation of the outer walls

Figure 3. Current situation of the houses in terms of insulation of the roofs

Figure 4. Types of current installed windows

Figure 5. Material of the rams of current installed windows


2.2 SITUATION FOR THE HOME LIGHTING

Current situation of the home lighting was done based on the results of the Energy Baseline. The main data that came as a result of the Energy Baseline and which are relevant for calculation the potential for energy savings are:
- Average number of the lamps used in Dragash municipality is: **15 lamps** per household,
- Average size of the lamps is: **100 [W]**
- In terms of efficiency: incandescent lamps (not efficient) are used in **56.55 %** of cases, while the CFL (efficient lamps) are used in **43.45 %** of cases, (Figure 7).

3 CALCULATION OF ENERGY SAVINGS

3.1 CALCULATION OF ENERGY SAVINGS FOR HEATING OF THE HOUSES

3.1.1 MODEL HOUSE FOR CALCULATION PURPOSES

Calculation of the savings potential for the heating has started from the current situation of the houses. For this purpose it was created the model house for calculation. Data used for creation the model house and for the calculations are shown below:

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Identification the energy savings potential in the private houses of Dragash municipality

**Building material of outer walls**

From the Energy Baseline outer walls of the houses in Dragash municipality are built from these materials, in percentage:

- Brick block with holes - 36.00 %
- Concrete block with holes - 31.50 %
- Brick and concrete block with holes - 7.00 %
- Stone and full brick - 2.00 %
- Full brick - 3.00 %
- Stone - 14.00 %
- Stone and concrete block with holes - 5.00 %
- Syporex block - 1.50 %

For simple calculation the similar types of the walls are grouped, (table 1).

<table>
<thead>
<tr>
<th>Before grouping</th>
<th>Group name</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick block with holes + Brick and concrete block with holes</td>
<td>Brick wall</td>
<td>43 %</td>
</tr>
<tr>
<td>Concrete block with holes + Stone and concrete block with holes</td>
<td>Concrete block wall</td>
<td>36.5 %</td>
</tr>
<tr>
<td>Stone</td>
<td>Stone wall</td>
<td>14 %</td>
</tr>
<tr>
<td>Full brick + Stone and full brick</td>
<td>Full brick wall</td>
<td>5 %</td>
</tr>
<tr>
<td>Syporex wall</td>
<td>Syporex wall</td>
<td>1.5 %</td>
</tr>
</tbody>
</table>

From the results of the Energy Baseline the average surface of the house in Dragash is 136.55 m\(^2\). Based on this the model of the house created for calculation purposes was taken with gross surface of 140 m\(^2\). Other data of the model house are shown in table 2.

<table>
<thead>
<tr>
<th>Data of the calculated building model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross surface of house</td>
</tr>
<tr>
<td>Used surface of house</td>
</tr>
<tr>
<td>Volume of the building</td>
</tr>
<tr>
<td>Surface of the outer walls</td>
</tr>
<tr>
<td>Windows surface</td>
</tr>
<tr>
<td>Doors surface</td>
</tr>
<tr>
<td>Floor used surface</td>
</tr>
<tr>
<td>Attic gross surface (flat ceiling surface)</td>
</tr>
<tr>
<td>Number of the floors</td>
</tr>
<tr>
<td>Total surface of building envelope</td>
</tr>
</tbody>
</table>

Based on the findings from Energy Baseline results the existing situation of the buildings in Dragash, in regard of Energy Efficiency, is not zero because there is a number of houses which are insulated and a number of houses which have installed appropriate doors and windows. So, the baseline of the model house for calculation is created based on the existed situation of the buildings, which is shown in table 3.
Technical data for calculation the heat losses and heating load are shown in table 4.

<table>
<thead>
<tr>
<th>Current condition of the model building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated walls</td>
</tr>
<tr>
<td>Un insulated walls</td>
</tr>
<tr>
<td>Insulated roofs</td>
</tr>
<tr>
<td>Un insulated roofs</td>
</tr>
</tbody>
</table>

Heat transmission coefficient for the types of the walls, floor and the roof (attic), was calculated separately for each type of the wall for two conditions: uninsulated walls and for the insulated walls (value of the coefficient after the EE measures). Heat transmission coefficient for windows and doors is taken from the literary. The calculated heat transmission coefficient is shown in table 5.

<table>
<thead>
<tr>
<th>Heat transmission coefficient before and after the EE measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat transmission coefficient - U [W/m²K]</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td><strong>Walls</strong></td>
</tr>
<tr>
<td>Brick wall</td>
</tr>
<tr>
<td>Concrete block wall</td>
</tr>
<tr>
<td>Stone wall</td>
</tr>
<tr>
<td>Full brick wall</td>
</tr>
<tr>
<td>Syporex wall</td>
</tr>
<tr>
<td><strong>Floor</strong></td>
</tr>
<tr>
<td>Floor</td>
</tr>
<tr>
<td><strong>Attic</strong></td>
</tr>
<tr>
<td>Attic</td>
</tr>
<tr>
<td><strong>Windows &amp; Doors</strong></td>
</tr>
<tr>
<td>Windows single glass</td>
</tr>
<tr>
<td>Windows double glass</td>
</tr>
</tbody>
</table>
3.2 RESULTS OF THE CALCULATIONS

For calculation the heat savings for model house it was used the energy audit methodology taking into the considerations the Heating Degree Days (HDD) for Dragash with proposed heating season from 15 October to the end of April.

The amount of energy that needed to heat the house for all the season in equal to the calculated heating load expressed in [kWh/a]. Calculation was done for three situations, by using the same technical data.

1. Heating load for non insulated house, with no any EE measures implemented,
2. Heating load for the house in the existed condition for Dragash, which means that there are some EE measures implemented (based on the table 3), and
3. Heating load after implementation of EE measures in all building envelope.

3.2.1 HEATING LOAD FOR UNINSULATED HOUSE, WITH NO ANY EE MEASURES IMPLEMENTED

For calculation are used data from tables 1, 2, 4 and 5. From table 5 are used data of the column named “Value for non insulated object”.

Calculated heating load is: 42851.65 [kWh/a], or 42.85 [MWh/a]
Specific heating demand: 346.98 [kWh/m²/a]

3.2.2 HEATING LOAD FOR THE HOUSE IN THE EXISTED CONDITION FOR DRAGASH

For calculation are used data from tables 1, 2, 3, 4 and 5. From table 5 depends of the current situation of the houses are used both heat losses coefficients taken from the column named “Value for non insulated object” and column named “U – Value after EE measures”.

Calculated heating load is: 34134.63 [kWh/a], or 34.13 [MWh/a]
Specific heating demand: 276.39 [kWh/m²/a]

3.2.3 HEATING LOAD AFTER IMPLEMENTATION OF EE MEASURES IN ALL BUILDING ENVELOPE

For calculation are used data from tables 1, 2, 4 and 5. From table 5 are used data of the column named “U – Value after EE measures”.

The implemented EE measure shows the ratio between the heat that is needed for heating the non insulated object, and heating the same object after the insulation of the certain parts of the object.

For the same model house located in Dragash area there is calculated the heating load after EE measures are implemented. The heat needed for the house could be saved by insulating all envelope of the object or by insulating certain parts of the object.

Heating savings are calculated in comparison with existed situation of the houses in Dragash.

3.2.3.1 Insulation of the outer walls of the building

In case if there will be insulation of the outer walls with Styrofoam thick of 10 cm and if other parts of the building will be unchanged, in this case will have:

Existed situation in Dragash:
Calculated heating load is: 34134.63 [kWh/a], or 34.13 [MWh/a]
Identification the energy savings potential in the private houses of Dragash municipality

Specific heating demand: 276.39 [kWh/m²/a]

After the insulation of outside walls:
Calculated heating load is: 21642.59 [kWh/a], or 21.64 [MWh/a]
Specific heating demand: 175.24 [kWh/m²/a]
Savings in percentage: 36.6 %

3.2.3.2 Insulation of the roof of the building
In case if there will be insulation of the horizontal plate in the last floor of the building (basement of the roof) with Styrofoam thick of 10 cm and if other parts of the building will be unchanged, in this case will have:

Existed situation in Dragash:
Calculated heating load is: 34134.63 [kWh/a], or 34,13 [MWh/a]
Specific heating demand: 276.39 [kWh/m²/a]

After the insulation of the roof:
Calculated heating load is: 27466.9 [kWh/a], or 27.46 [MWh/a]
Specific heating demand: 222.4 [kWh/m²/a]
Savings in percentage: 19.5 %

3.2.3.3 Changing the remaining not efficient windows and doors
In case if there will be changed all remaining old not efficient (single glass) windows and doors and if other parts of the building will be unchanged, in this case will have:

Existed situation in Dragash:
Calculated heating load is: 34134.63 [kWh/a], or 34,13 [MWh/a]
Specific heating demand: 276.39 [kWh/m²/a]

After changed the remained not efficient windows and doors:
Calculated heating load is: 31123.99 [kWh/a], or 31.12 [MWh/a]
Specific heating demand: 252.02 [kWh/m²/a]
Savings in percentage: 8.8 %

3.2.3.4 Insulation of the ground floor of the building
In case if there will be insulation of the ground floor of the building with Styrofoam thick of 5 cm and if other parts of the building will be unchanged, in this case will have:

Existed situation in Dragash:
Calculated heating load is: 34134.63 [kWh/a], or 34,13 [MWh/a]
Specific heating demand: 276.39 [kWh/m²/a]

After the insulation of the ground floor:
Calculated heating load is: 31876.76 [kWh/a], or 31.87 [MWh/a]
Specific heating demand: 258.11 [kWh/m²/a]
Savings in percentage: 6.6 %
3.2.3.5 **Implementation of the EE measures in all building envelope**

In case if there will be implemented all EE measured mentioned above in all envelope of the building, in that case the amount of the energy for heating the model house located in Dragash will be:

### Existed situation in Dragash:
- Calculated heating load: 34134.63 [kWh/a], or 34.13 [MWh/a]
- Specific heating demand: 276.39 [kWh/m²/a]

### After the implementation of EE measures in all building envelope:
- Calculated heating load: 9749.38 [kWh/a], or 9.75 [MWh/a]
- Specific heating demand: 78.94 [kWh/m²/a]
- Savings in percentage: **71.4 %**

In the figure 8 are compared the results of the EE measures in different part of the model house located in Dragash area.

![Specific heating demand before and after the EE measures](image)

**Figure 8. Comparison of the specific heating demand before and after EE measures in different parts of the object**

### RECOMENDATION

After the analyzing of the results, there is very clear that most savings are gained after the insulation of the outside walls and the insulation of the roof.

### Existed situation in Dragash:
- Calculated heating load: 34134.63 [kWh/a], or 34.13 [MWh/a]
- Specific heating demand: 276.39 [kWh/m²/a]

### After the insulation of the outside walls and roof:
- Calculated heating load: 14974.86 [kWh/a], or 14.97 [MWh/a]
- Specific heating demand: 121.25 [kWh/m²/a]
- Savings in percentage: **56.1 %**
For avoiding too much expenses for investment, the recommendation is to be more focused on implementation of the EE measures in the outside walls and insulation of the roofs of the buildings in Dragash area. This is also easy for implementation. The energy savings are 56.1% of the total energy there is needed for heating the house for the heating season.

4 CALCULATION OF ENERGY SAVINGS FOR LIGHTING IN THE HOUSEHOLDS OF DRAGASH

Data that were used for calculations for potential of energy savings for home lighting are:

- Average yearly electricity consumption of the household in Dragash, which is 534.29 [kWh/a]³.
- Average number of lighting lamps installed in the household is: 15 lamps⁴
- Average size of the lamps installed is: 100 [W]⁵
- Number of working hours per day for each lamp: 2.5 [h]⁶
- Currently incandescent lamps installed: 56.55 %⁷
- Currently CFL (efficient lamps) lamps installed: 43.45 %⁸

After calculation, the results are shown below:

Current electricity consumption for home lighting
- Average monthly electricity consumption for lighting for each household in Dragash is: **114.37 [kWh/month]**, (incandescent lamps take 56.55% or 64.67 [kWh/month] and CFL lamps take 43.45% or 49.69 [kWh/month]).
- Calculated yearly electricity consumption for home lighting for Dragash is: **8.17 [GWh/a]**,
- Percentage of electricity consumption by home lighting comparing to the total electricity consumption of the household is: **21.41 %**,

Savings
- Possible monthly energy to be saved by replacing all existed incandescent lamps with CFL (efficient lamps) in the household is: **51.74 [kWh/month]**,
- Possible yearly energy to be saved by replacing all existed incandescent lamps with CFL (efficient lamps) in the household is: **620.87 [kWh/a]**,
- Possible yearly energy saved by replacing the existing incandescent lamps with CFL lamps for all Dragash: **3.7 [GWh/a]**, or 45.24 % of the electricity used for home lighting,
- Potential of electricity savings in comparison to the total electricity consumption for households in Dragash, expressed in percentage is: **9.68 %**

³ Source: Kosovo Energetic Corporation - KEK and “Energy Baseline for Municipality Dragash”, 2011
⁶ Is taken approximately
According to our own calculations, the potential CO$_2$ abatement by replacing all existed incandescent lamps with CFL lamps amounts to about 4,805 t CO$_2$ per year.

5 CONCLUSION

The existing situation with regard of energy efficiency in the households of Dragash shows that there is a huge potential for saving the energy with different EE measures.

Since the situation of private households in Dragash might not be very different to those in other municipalities, the overall energy saving potential in all over Kosovo would contribute remarkably to the achievements of the political commitments with regard to improvement of Energy Efficiency in the country.

Most energy savings in private houses, according to the results of this study, obviously would be gained by insulation of the outside walls and the insulation of the roof.

Second most important intervention for energy savings in private households would be replacement of incandescent lamps with energy efficient CFL lamps. It should be noted, that the next generation of EE lamps, namely LED lamps, are not considered in this study because they are not well introduced in the Kosovo market and need an high amount of upfront investment. However, energy savings could be nearly doubled by introducing LED lamps rather than CFL lamps.

Based on the calculations the saving potential expressed in percentage for both energy consumption:

- energy used for heating: 71.4 %
- energy used for home lighting in comparison with total electricity consumption for household is: 9.68 %

Reduction of CO$_2$ could be calculated reliably only for home lighting, because this is based on electricity, and the respective energy mix of electricity generation and thus the CO$_2$ abatement by savings is known. CO$_2$ abatement by replacement of incandescent lamps with energy efficient CFL lamps would amount to about 4,805 t CO$_2$ per year.

The energy mix for heating is not as clear in private village households of Dragash, and partly based an biomass (firewood) which is replaced by annually growth of the same source of biomass. Therefore reliable figures for CO$_2$ abatement by exhaustion of the energy saving potential for heat generation in private households could not be obtained from the existing available information.