Promoting Low Carbon Development in Municipalities of Armenia

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Technical background elaborated in course UNDP-GEF projects

• Third National Communication to UNFCCC
• National GHG Inventory Report for 2012 and mitigation policies and measures analyzed in the course of preparation of the First Biennial Update Report,
• Standardized Baseline of National Electrical Grid Emission Factor developed and approved by CDM EB and posted on UNFCCC web-site (2015), valid for period 2015-2017
• NAMA on Energy Efficiency in Building Sector developed and posted in UNFCCC NAMA Registry –(2014)
Supportive National Context

• The energy security and reduction of dependence from imported fossil sources is stated as national priority
• Existing supportive legal framework promoting the energy efficiency and renewable energy
• IFIs and bilateral assistance programmes has on-going programmes supporting RES and EE
• 10 cities of Armenia joined the Covenant of Mayors
• Armenia submitted its INDC on 28 of September 2015, stating commitment for limiting GHG emissions
### GHG Emissions by Sectors as of 2012

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Emissions, Gg CO₂ eq.</th>
<th>Share in total emissions, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total emissions</td>
<td>9,423</td>
<td>100</td>
</tr>
<tr>
<td>Energy</td>
<td>6,913</td>
<td>73.4</td>
</tr>
<tr>
<td>Industrial processes and product use (IIPU)</td>
<td>662</td>
<td>7</td>
</tr>
<tr>
<td>Agriculture*</td>
<td>1,216</td>
<td>12.9</td>
</tr>
<tr>
<td>Waste</td>
<td>632</td>
<td>6.7</td>
</tr>
</tbody>
</table>

* Without Forestry and Other Land Use
### Projection of main indicators

<table>
<thead>
<tr>
<th>Parameters</th>
<th>2012</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, billion $US*</td>
<td>9958</td>
<td>11758</td>
<td>15509</td>
<td>20456</td>
<td>23708</td>
</tr>
<tr>
<td>Population, million person</td>
<td>3.027*</td>
<td>3.01</td>
<td>2.99</td>
<td>2.97</td>
<td>2.95</td>
</tr>
</tbody>
</table>

**Business as usual**

<table>
<thead>
<tr>
<th>GHG emissions, thous. tCO$_2$eq</th>
<th>9,424</th>
<th>9,940.8</th>
<th>13,802</th>
<th>15,798</th>
<th>18,301.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions per GDP unit</td>
<td>0.946</td>
<td>0.845</td>
<td>0.89</td>
<td>0.77</td>
<td>0.772</td>
</tr>
<tr>
<td>tCO$_2$eq/1000 $US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions per capita tCO$_2$eq/person</td>
<td>3.11</td>
<td>3.3</td>
<td>4.61</td>
<td>5.32</td>
<td>6.2</td>
</tr>
</tbody>
</table>

**Mitigation scenario with additional measures**

<table>
<thead>
<tr>
<th>GHG emissions, thous. tCO$_2$eq</th>
<th>9,424</th>
<th>9,048</th>
<th>12,439</th>
<th>13,546</th>
<th>12,045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions per GDP unit</td>
<td>0.946</td>
<td>0.769</td>
<td>0.8</td>
<td>0.66</td>
<td>0.508</td>
</tr>
<tr>
<td>tCO$_2$eq/1000 $US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions per capita tCO$_2$eq/person</td>
<td>3.11</td>
<td>3.0</td>
<td>4.16</td>
<td>4.56</td>
<td>4.02</td>
</tr>
</tbody>
</table>

In 1990

- GHG Emissions per unit of GDP, t CO2 eqv /$ 1000 2.9
- GHG emissions per capita, t CO2 eqv./person 7.0

*Source: NSS, WB*
GHG Emissions in “Energy” Sector

- Energy generation
- Industry and construction
- Transport
- Other sectors
- Fugitive emissions
GHG Emission Projections from Energy Sector

In 1990 was 21,382 Gg CO2
Four scenarios were considered:

1. **Business as Usual, BAU-1**: Growing demand will be met by the construction by TPPs. With no mitigation measures on the demand side.


3. **With Measures, WM**: includes measures on generation side and demand side with high probability of implementation and secured finance.

4. **With Additional Measures, WAM**: additional mitigation measures on generation side and demand side.
Energy efficiency on household, municipal, national level

Household level
- Standards and labelling
- Awareness raising
- EE retrofitting of buildings

Municipal level
- Street Lighting
- Cogeneration based centralized heating
- Boilers testing

National Level
- Building code, EE standards,
  Minimum performance standards
- Greenhouse gas mitigation
targets, INDC NAMAs
"Green Urban Lighting" UNDP-GEF/00074869 project
Green Urban Lighting Project

• Lighting is the second largest source of municipal greenhouse gas (GHG) emissions in Armenia (after heating), accounting for about one-third of municipalities’ GHG emissions and up to 50 percent of their electricity bill.

• Municipal lighting in the capital city of Yerevan accounts for the largest consumption in the country: 78 per cent of all urban lighting energy use nation wide;

• Considerable share of streets in urban communities and large rural communities in the regions are poorly illuminated;

• Technical potential for cost-effective efficiency improvements in public lighting is significant: average specific power consumption for street lighting in Yerevan is 1.3-1.5 times higher than that of European.
Identified Barriers

- **Insufficient public awareness** of modern energy efficient technologies and solutions in the lighting sector.

- **Lack of efficient market supervision**, consequently, prevalence of low quality lighting devices and those with discrepancy between the marked and actual technical indicators.

- **Limited** technical and financial **capacities** of local self-government bodies.

- **Limited funding** sources (lending options).

- **Negligence** towards energy efficiency and qualitative indicators of devices procured via the state procurement procedures.

- **Limited involvement** of the private sector.

- **Lack of favorable taxation**, including customs, for production and import of energy efficient devices.

- **Insufficient regulative framework** (standards, norms etc.)
Urban Lighting in Armenia

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Yerevan</th>
<th>Other cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total installed capacity, MW</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Number of illuminated objects</td>
<td>1 235</td>
<td>981</td>
</tr>
<tr>
<td>Number of street lights</td>
<td>54 880</td>
<td>16 234</td>
</tr>
<tr>
<td>Mercury lamps</td>
<td>2 700</td>
<td>6 474</td>
</tr>
<tr>
<td>Annual electricity cost for 2011, mln USD/year</td>
<td>2,0</td>
<td>0,6</td>
</tr>
<tr>
<td>Average daily length of operation of street</td>
<td>8</td>
<td>6,44</td>
</tr>
<tr>
<td>lighting, hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of not illuminated streets, side streets, alleys, yards.</td>
<td>507</td>
<td>400</td>
</tr>
</tbody>
</table>
## Process and results of EE luminaries installation in Yerevan

### Isakov avenue

**Energy Efficiency Revolving Fund established in Yerevan Municipality from savings of the demonstration project**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before</th>
<th>After</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total installed capacity, kW</td>
<td>215.5</td>
<td>79.0</td>
<td>Decrease: 136.5 kW</td>
</tr>
<tr>
<td>Annual energy consumption, MWh</td>
<td>794.5</td>
<td>291.2</td>
<td>Energy saving: 63%</td>
</tr>
<tr>
<td>Annual greenhouse gas emission, t CO₂</td>
<td>352.7</td>
<td>129.3</td>
<td>Reduction: 223.4 t</td>
</tr>
</tbody>
</table>
## Process and results of EE luminaries installation in Yerevan

### Yerevan zoo

<table>
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<th>Before</th>
<th>After</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total installed capacity, kW</td>
<td>19.04</td>
<td>4.37</td>
<td>Decrease: 14.67 kW</td>
</tr>
<tr>
<td>Annual energy consumption, MWh</td>
<td>27.80</td>
<td>6.38</td>
<td>Energy saving: 77 %</td>
</tr>
<tr>
<td>Annual greenhouse gas emission, t CO₂</td>
<td>12.35</td>
<td>2.84</td>
<td>Reduction: 9.5 t CO₂</td>
</tr>
</tbody>
</table>
## Street Light Retrofitting Demonstration Projects

<table>
<thead>
<tr>
<th>City</th>
<th>Object</th>
<th>Number existing fixtures</th>
<th>Number of LED fixtures</th>
<th>Reduction of system capacity (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yerevan</td>
<td>Isakov Avenue, Tairov Street 9 km</td>
<td>756</td>
<td>482</td>
<td>136.5</td>
</tr>
<tr>
<td>Yerevan</td>
<td>ZOO, 1.8km</td>
<td>112</td>
<td>112</td>
<td>14.67</td>
</tr>
<tr>
<td>Alaverdi</td>
<td>Z. Andranik, Sayat-Nova, Shahumyan, 1.8km</td>
<td>67</td>
<td>67</td>
<td>15.8</td>
</tr>
<tr>
<td>Spitak</td>
<td>Shahumyan and Manukyan 1.3 km</td>
<td>60</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Abovian</td>
<td>Yerevanyan 1.3 km</td>
<td>124</td>
<td>84</td>
<td>28.5</td>
</tr>
<tr>
<td>Sevan</td>
<td>Shahumyan 1.0 km</td>
<td>62</td>
<td>62</td>
<td>13.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>16.2 km</td>
<td>1181</td>
<td>867 (73%)</td>
<td>219</td>
</tr>
</tbody>
</table>

- **Energy saving** - 57 to 80%,
- **GHG emissions reduction** 285 ton CO2 eq./ annual
- **Illuminance improvement** to comply with the norms

"Green Urban Lighting" UNDP-GEF/00074869 project
THANKS