Local power industry development in the Sakha Republic (Yakutia), Russia

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Sakha Republic (Yakutia), Russia

- Territory – 3,1 mln. sq. km or 1/5 of Russian Federation territory;
- Population – 950,000, including about 470,000 Native population;
- Capital – Yakutsk;
- 35 different republican districts;
- The International Pole of Cold with the lowest winter temperature -70C;
- Big Natural Recources potential: diamonds, gold, coal, oil, natural gas, antimony, uranium, metals and etc.;
- Population density – 0,33 people per sq. km with average Russian rate 2,2;
- Density of roads with hard surface – 2,4 km per 1000 km with average Russian rate 13,6 km per 1000 km.
Population of Service Area – 150,000
Square kilometers of Service – 2,200,000
Number of villages - 175
Number of Diesel plants – 161 (289.4 MW)
Heating Generators units – 365 (2860 Gcal/h)
Overhead lines density – 1,85 m/sq.km
Generation output – 420,000 MWh
Total Annual Sales – 320,000 MWh
Annual diesel fuel consumption – 118,000 tn
Cost of electricity per kWh – $0.48

Local power industry – small capacity generating units (diesel generators), not connected with National electrical network, providing power by low voltage distribution lines to the isolated customers. The Yakutskenergo subsidiary Sakhaenergo providing service for local power industry.
Diesel generation problems in the Sakha Republic (Yakutia)

- Significant diesel fuel cost increase according to world oil price growth
- Complicated and multistage transportation scheme and seasonal dependence of duel shipment
- Aging the power equipment and high fuel consumption
- 60% of fuel share from total expenses for local power industry
- High cost price of electricity production – 48 cent/kWh (2007) in comparison with average National rate - 4 cent/kWh
Customers structure in area of local power industry

- Residential: 36%
- Housing Utility: 26%
- State Agencies: 21%
- Industrial: 13%
- Others: 4.3%
<table>
<thead>
<tr>
<th>Centralized power supply area</th>
<th>De-centralized power supply area</th>
<th>Unified principle of rate establishment on all Sakha Republic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total cost, $ mln</strong></td>
<td><strong>Total sales, mln kWh</strong></td>
<td><strong>Rate, $</strong></td>
</tr>
<tr>
<td>$356.5 mln</td>
<td>4,343 mln kWh</td>
<td><strong>$0.48</strong></td>
</tr>
<tr>
<td>$218.4 mln</td>
<td>320 mln kWh</td>
<td></td>
</tr>
<tr>
<td>$0.05</td>
<td>20.7 mln. $</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>$151 mln</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>$130 mln</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Additional cost for the industrial customers - $130 mln**
Diesel generation influence on the investment solutions

Subsidizing of diesel generation rates per kWh:
- providing a wrong signal to the big industrial customers about additional investment necessity for the own generation development;
- become a one of the reason for investors not allowing to have appropriate projects returns or IRR on the natural resources development or production lines.
During the 2001 – 2005 years main focus was put on the fuel saving programs by using of new modern diesel generators
Fuel consumption for the power and heat production in JSC “Sakhaenergo” during 2001-2006

During 2001-2006 total fuel consumption decrease is about 36 tones or 23%
Main threats of diesel generation

Who will guarantee that this trend will not continue during next 10 years?

World crude oil prices in 1997-2007

All Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel)

During last 10 years oil price increase more than 5 times

$70 for 1 barrel

$100 or $130 for 1 barrel

All Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel)
Main decision of this problem – change of power production technology by means of replacing of diesel fuel on other not-expensive type of fuel !!!

Program of local power industry optimization in the Sakha Republic (Yakutia)
Program of local power industry optimization directions

New transmission lines construction 996 km from Yakutsk Plant and Vilyusk Hydro Plants to the off-grid area replacing 19 Diesel Power Plants (81 MW) and construction of new Yakutsk Thermal Power Plant - 2
$392.4 mln

Construction of new 20 Power Heating Plants small capacity (94.5 MW, 445 Gcal/h) using local coal, replacing 20 Diesel Power Plants (129 MW) and 114 Heating Boiler Units (684 Gcal/h)
$484 mln

Local power saving program
$37.8 mln

Environmental conservation program
$2.4 mln

Technological

- In 2015 rate per kWh will be 11 cent/kWh with average Russian rate 11 cent/kWh
- Additional value added cost will be 1,700 mln $ or 7.04% from GDP of the Sakha Republic (Yakutia)
- Production and Service IRR will increase on 2.7%

Economical
### Project realization with public and private partnership…

#### Financing sources, mln. $ (no VAT)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Federal Budget</th>
<th>RAO “UES Russia”</th>
<th>Sakha Republic (Yakutia) Budjet</th>
<th>AK “Yakutskenergo”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>913</td>
<td>456</td>
<td>273</td>
<td>18</td>
<td>165</td>
</tr>
<tr>
<td><strong>2008</strong></td>
<td>188</td>
<td>94</td>
<td>75</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td><strong>2009</strong></td>
<td>114</td>
<td>57</td>
<td>49</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>2010</strong></td>
<td>141</td>
<td>70</td>
<td>46</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td><strong>2011-2013</strong></td>
<td>471</td>
<td>235</td>
<td>103</td>
<td></td>
<td>133</td>
</tr>
</tbody>
</table>
## Program realization parameters

<table>
<thead>
<tr>
<th>Paramenters</th>
<th>2007</th>
<th>2015 With Program realization</th>
<th>2015 Without Program realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average rate per kWh, $</td>
<td>0.08</td>
<td>0.11</td>
<td>0.15</td>
</tr>
<tr>
<td>Average Russian rate per kWh, $</td>
<td>0.04</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Diesel Fuel share in Fuel Balance of local power industry, %</td>
<td>98</td>
<td>15</td>
<td>98</td>
</tr>
<tr>
<td>Prognosis dynamics of local power industry subsidizing change, mln. $</td>
<td>129.7</td>
<td>117.8</td>
<td>249.9</td>
</tr>
<tr>
<td>Average rate for decentralized zone of power supply</td>
<td>0.49</td>
<td>0.78</td>
<td>1.05</td>
</tr>
<tr>
<td>Additional value added cost from rate decreasing in the Sakha Republic (Yakutia), $ mln</td>
<td>-</td>
<td>1.660.9</td>
<td>-</td>
</tr>
</tbody>
</table>
Technological Results

Fuel balance structure change in de-centralized zone with program realization

Dynamics of nominal capacity of local power industry

<table>
<thead>
<tr>
<th>Year</th>
<th>Diesel Plants (MВт)</th>
<th>Small Heating Plants (MВт)</th>
<th>Nominal capacity usage rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>288 (161)</td>
<td>94,5 (20)</td>
<td>16,5%</td>
</tr>
<tr>
<td>2008</td>
<td>238 (154)</td>
<td>94,0 (12)</td>
<td>18,9%</td>
</tr>
<tr>
<td>2009</td>
<td>193 (150)</td>
<td>58,5 (8)</td>
<td>18,3%</td>
</tr>
<tr>
<td>2010</td>
<td>157 (140)</td>
<td>46,5 (7)</td>
<td>22,5%</td>
</tr>
<tr>
<td>2011</td>
<td>148 (137)</td>
<td>32,6 (17)</td>
<td>24,7%</td>
</tr>
<tr>
<td>2012</td>
<td>132 (131)</td>
<td></td>
<td>27,4%</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td>76 (118)</td>
<td>39,6%</td>
</tr>
</tbody>
</table>
Environmental effects

Before

30,800

Value of pollution, tones

After

14,300
We need to combine our efforts on following directions:

- Adaptation of new technologies for local power industry: hydrogen power systems, mini-nuclear power generation, diesel gen’s;
- Development of technologies related with renewable natural resources: wind, solar, power batteries, biomass, mini-hydro plants and other;
- Ecological cooperation;
- Exchange of experts for learning the experience in management of rural area power supply, fuel logistics and materials.
Thank you for your attention!