ENERGY COOPERATION IN NORTH-EAST ASIA

Oleg Budargin, Member of the Global Energy Association Board of Trustees, Vice-Chairman of the World Energy Council

11 September 2018, EEF
07 September 2012, APEC-2012 Summit, Vladivostok. Russian President Vladimir Putin said: “Along with the development of the power industry in the Far East, we are going to connect it infrastructurally with the European Russia, so that we can easily transfer the necessary flows of raw materials and electricity from one part of the country to another and easily enter the markets of the European countries as well as those of the Asia Pacific countries”.

On 30 March 2016, a memorandum was signed in Beijing on the creation of a unified energy system of the countries of North-East Asia, between PJSC Rosseti, State Power Corporation of China, KEPCO (Republic of Korea) and Softbank (Japan).

02 and 03 September 2016, Eastern Economic Forum. Russian President Vladimir Putin said: “We support the initiative of the companies of Russia, Japan, Republic of Korea and China to create an energy super ring that will connect our countries”.

15 May 2017, Belt and Road Forum in Beijing. Russian President Vladimir Putin said: “We are talking about the energy development. You have probably heard about our initiative of the big Asian electric power ring, it can be interesting and very useful for us, because we have quite large and, shall we put it so, excess generating capacities, especially in the eastern part of the country. And certain projects, for example, in the field of energy are already being implemented by way of attracting large investments, including those from China".
RUSSIAN POWER INDUSTRY: OUR OPPORTUNITIES AND PROSPECTS

Export of electricity from the Russian Federation in 2017
(1.6% of electricity generation of the year 2017)

16,699 million kWh

CONVENTIONAL SYMBOLS
- Existing electric supply network
- Emerging electric supply network
15 May 2017, Belt and Road Forum in Beijing.

Russian President Vladimir Putin said: “We are talking about the energy development. You have probably heard about our initiative of the big Asian electric power ring, it can be interesting and very useful for us, because we have quite large and, shall we put it so, excess generating capacities, especially in the eastern part of the country. And certain projects, for example, in the field of energy are already being implemented by way of attracting large investments, including those from China”.

SPARE CAPACITY OF THE RUSSIAN POWER SUPPLY SYSTEM
## Convention Symbols

- **P_{inst}** - installed generator capacity
- **P_{max}** - maximum power consumption
- Existing interconnections: 500, 220 kW
- Non-implemented projects of interconnections: 500, 220 kW
- Maximum allowable power flow
- Annual volume of electricity exports

## Spare Capacity of the Russian Power Supply System

<table>
<thead>
<tr>
<th></th>
<th>I quarter</th>
<th>II quarter</th>
<th>III quarter</th>
<th>IV quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed generator capacity</td>
<td>235,4</td>
<td>235,3</td>
<td>237,8</td>
<td>238,0</td>
</tr>
<tr>
<td>Operating generator</td>
<td>196,9</td>
<td>172,2</td>
<td>172,8</td>
<td>201,2</td>
</tr>
<tr>
<td>Maximal usage capacity</td>
<td>149,2</td>
<td>124,6</td>
<td>122,9</td>
<td>151,1</td>
</tr>
<tr>
<td>Aggregate capacity</td>
<td>45,3</td>
<td>47,2</td>
<td>47,3</td>
<td>48,0</td>
</tr>
<tr>
<td>Released</td>
<td>31,9</td>
<td>34,0</td>
<td>28,3</td>
<td>32,1</td>
</tr>
<tr>
<td>Non-released</td>
<td>13,4</td>
<td>13,2</td>
<td>19</td>
<td>15,9</td>
</tr>
</tbody>
</table>

### Key Projects:

- **Vladivostok-Seoul**
- **Siberia-East**
- **Tomsk transit**
- **Gusinozerskaya GRES power plant - Darkhan**

### Export Information:

- **0.7 GW** to China
- **3.3 billion kWh**

### Spare Capacity:

- **47.0 GW** – Average annual capacity margin
- **31.6 GW** – Average annual output capacity margin
Comparison of Consumer Prices for Electricity

Ratio of Average Prices for Electricity in the World

<table>
<thead>
<tr>
<th>Country</th>
<th>USD/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>0.49</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.37</td>
</tr>
<tr>
<td>Jordan</td>
<td>0.35</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.34</td>
</tr>
<tr>
<td>Germany</td>
<td>0.33</td>
</tr>
<tr>
<td>Italy</td>
<td>0.31</td>
</tr>
<tr>
<td>Japan</td>
<td>0.28</td>
</tr>
<tr>
<td>Chile</td>
<td>0.25</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.21</td>
</tr>
<tr>
<td>France</td>
<td>0.21</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.20</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.19</td>
</tr>
<tr>
<td>USA</td>
<td>0.18</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.17</td>
</tr>
<tr>
<td>Canada</td>
<td>0.13</td>
</tr>
<tr>
<td>India</td>
<td>0.11</td>
</tr>
<tr>
<td>China</td>
<td>0.11</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.11</td>
</tr>
<tr>
<td>Mongolia</td>
<td>0.09</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.08</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Ratio of Average Prices for Electricity in North-East Asia Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>USD/kWh</th>
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</thead>
<tbody>
<tr>
<td>South Korea</td>
<td>0.08</td>
</tr>
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<td>Thailand</td>
<td>0.11</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Source: Statista US
24 660 billion kWh of electricity was produced in the world in 2016.

FORECAST OF WORLD ELECTRICITY DEVELOPMENT BY 2030

In the context of regions

- North America: 6 trillion kWh (13%)
- South and Central America: 1 trillion kWh (35%)
- Europe: 4 trillion kWh (22%)
- CIS: 1 trillion kWh (14%)
- Asia: 10 trillion kWh (56%)
- Near East: 1 trillion kWh (52%)
- Africa: 1 trillion kWh (65%)

In the context of the largest countries

- Russia: 1.1 trillion kWh (+14%)
- USA: 4.3 trillion kWh (+11%)
- China: 6.0 trillion kWh (+58%)
- India: 1.4 trillion kWh (+91%)
- Japan: 1.0 trillion kWh (+15%)

In the context of international associations

- EU-28: 3.24 trillion kWh
- OECD: 10.9 trillion kWh
- BRICS: 9.4 trillion kWh
- CSG-20: 22.4 trillion kWh

In the context of the structure of production by 2030

- Coal: 35%
- Atomic Energy: 12%
- Gas: 23%
- Hydropower: 16%
- Fuel oil: 2%
- RES: 2%
- Biofuel: 10%

2/3 growth is taking place in the Asian region.
LOADING PROFILES OF POWER SUPPLY SYSTEMS IN NORTH-EAST ASIA
The peak day load is shifted by 1-2 hours between the border areas, for example, the Far East of Russia and the Northeast of China.

Consumption in the evening decreases far more in Asia (Japan, China) than in Russia after the end of the working day.

Taking into account the fact that Russia is not a hot country, in summer Siberia and the Far East display a significant decrease in consumption reaching 60-70% in relation to the annual maximum.

In Japan, Korea and China, the summer peak consumption in the night and working hours is due to air conditioning.

Source: Melentiev Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences (ISEM SO RAN), Skolkovo, EN+
In summer, the power generating capacities function with 60% load in Siberia and the Russian Far East.

During the same period, Japan, Korea and Northern China have a peak of electricity consumption.

In spring, Asia shows a stronger decline in consumption than the regions of the Russian Federation, where spring usually begins later.

Source: Melentiev Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences (ISEM SO RAN), Skolkovo, EN+
ENERGY RING PROJECTS
THE GREAT CASPIAN ENERGY RING

CONVENTIONAL SYMBOLS
- future energy corridors
- existing energy corridors