Experience Sharing: Renewable Energy Services: Hydropower Generation in Russia

Submitted by: Russia
Renewable energy services: Hydropower generation in Russia

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QUESTION:

Having the largest gas reserves in the world and very rich oil and coal reserves will Russia ever seriously consider exploiting its diverse renewable energy potential?
The range of geographic zones, geological formations and climates provides for a potential to develop several renewable energy sectors:

- **Solar energy**: South-West region, Southern Siberia, and the Far East,
- **Wind energy**: coastal areas in the north, low and middle Volga regions, and the Urals,
- **Hydro energy**: Central and Eastern Siberia and the Far East,
- **Biomass**: Siberia, the Far East,
- **Geothermal**: the Far East, Northern Caucasus, and Southern region.

**Economic potential**

Geothermal energy 40% of overall renewable energy potential, small hydro reaching 24%, biomass accounting for 13%

Overall Russia’s the renewable energy potential - 260-300 million tons of coal equivalent per year.

- enough to supply 1/3 of Russia’s energy needs

Potential is largely underutilized with less than 1% of “green” electricity and less than 5% of “green” heat in total annual power and heat output.
**Energy Strategy of Russia 2020**

**Target:** creation of conditions for the expansion of production of electricity and heat from renewable energy sources

**Main tasks:**
- Ensure the production of energy from renewable sources of at least 80-100 kWh per year by 2030

**The Long-Term Concept of Socio-Economic Development 2020**

**Target:** attaining leading positions in the development of renewable energy and the introduction of eco-friendly energy technologies on industrial scale.

**Main tasks:**
- expansion of electricity production from renewable sources, excluding large and medium hydropower plants from 8 bln kWh in 2007 to 80 bln kWh in 2020;
- increase the installed capacity of renewable sources to 22 GW by 2020, excluding hydro power plants with installed capacity greater than 25 MW;
- Increase the installed capacity of large and medium hydropower plants (over 25 MW) to 25.1 GW by 2020.

**Main areas of public policy in the field of increasing the energy efficiency of electric power on the basis of renewable energy in 2020**

**Target:** Improving the energy efficiency of by increasing production of electric power from renewable energy sources

**Main tasks:**
- increasing production and consumption of electricity from renewable energy sources (excluding hydro power plants with installed capacity greater than 25 MW) to 2.5 per cent in 2015 (compared with 0.5 per cent in 2009) and to 4.5 per cent in 2020
RusHydro: the leading Russian utilities and renewables company

- **Russia’s largest genco** and one of the world’s largest publicly-traded predominantly hydro generation companies, with 70 hydropower stations and capacity of ca. 35 GW (ca. 16% of the Russian total)

- **The biggest winner from electricity market liberalization in Russia** due to extensive exposure to low-cost hydro generation (ca. 60% of Russian hydropower fleet)

- **A developing dividend story:** 3 consecutive years of dividend payments since 2010; government enforcing 25% payout for state-owned companies as of 2012

- **Focus on the Russian market:** extension of life-time and improving efficiency of existing hydro assets, timely commissioning of ongoing projects

- **Successful implementation of cost-cutting program**

- **One of the most liquid generation companies of the Russian stock market:** local shares in A1 on MOEX, GDRs listed on the LSE, ADRs trading OTC and OTC QX in New York

- **Green utility** – world’s 5th largest renewable player

- **RusHydro is due for partial privatization until 2016** (50%+1 should remain state-owned)

- **New Energy Fund to implement National Programme for Small Hydro Sector Development**

- **Start of construction of all 3 thermal projects in the Far East**
RusHydro: global scale, national focus

Key facts

- **Installed electric capacity 36.5 GW**: 28.1 GW – hydro, 8.4 GW – fossil-fuel generation (ca. 70% coal)
- **RusHydro (previously HydroOGK) was created in 2008**, spun-off from vertically-integrated RAO UES, consolidating mostly hydropower assets
- The Group operates over 70 hydropower stations and over 30 mid- and large-size thermal plants
- The Group’s operations include power and heat generation, power retail, R&D, construction engineering

Strong state ownership, yet significant free-float

### Top Russian genco

![Chart showing top Russian generating companies by installed capacity](chart)

- **#2 in Russia by installed capacity, GW**
- **% of Russian total installed capacity**
- **Notes**: as at 01.01.2012. **Source**: Annual Reports, Company

### One of the top international gencos

![Chart showing top international generating companies by hydro capacity](chart)

- **#4 globally by hydro capacity, GW**
- **Notes**: as at 01.01.2012. **Source**: Annual Reports
Global “green energy” player

Commitment to sustainable energy production

- **RusHydro:**
  - One of Russia’s largest energy holdings, a leader in the production of energy from renewable energy sources
  - Installed electric capacity 36.5 GW: 77% - hydro & renewable, 23% – fossil-fuel generation (ca. 70% coal)
  - # 5 global player by hydro & renewable capacity, # 4 by purely hydro capacity
- **Mission & strategy:** provide society with basically "clean" energy, paying adequate attention to environmental preservation
- The Group takes active measures to increase energy efficiency and energy savings


- The number of the plants that have implemented Environmental Management System ISO 14000 has increased from 3 in 2010 to 6 in 2013
- RusHydro is active participant in the UNDP-GEF-Ministry of Natural Resources Project on the biodiversity conservation
- “RusHydro Red Book” project is underway, includes the interaction with the 11 local reserves in regions of the Company’s presence

One of the top international green energy producers

#7 globally by total installed “green” (hydro/renewable/nuclear) capacity, # 5 by hydro & renewable capacity, # 4 by hydro capacity, GW**

<table>
<thead>
<tr>
<th>Company</th>
<th>Other renewables</th>
<th>Nuclear</th>
<th>Thermal</th>
<th>% of hydroelectric and renewable capacity in total installed capacity</th>
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</thead>
<tbody>
<tr>
<td>EDF</td>
<td></td>
<td>98%</td>
<td></td>
<td>Hydro</td>
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<tr>
<td>Enel</td>
<td></td>
<td></td>
<td>37%</td>
<td>Other renewables</td>
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<tr>
<td>EON</td>
<td></td>
<td></td>
<td></td>
<td>Nuclear</td>
</tr>
<tr>
<td>Iberdrola</td>
<td>46</td>
<td>52%</td>
<td></td>
<td>Thermal</td>
</tr>
<tr>
<td>Eletrobras</td>
<td>42</td>
<td>85%</td>
<td></td>
<td>% of hydroelectric and renewable capacity in total installed capacity</td>
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<tr>
<td>Vattenfall*</td>
<td>37</td>
<td>35%</td>
<td></td>
<td></td>
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<tr>
<td>Hydro Quebec*</td>
<td>36</td>
<td>77%</td>
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<tr>
<td>China Yangtze Power</td>
<td>36</td>
<td>98%</td>
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<tr>
<td>Eurosibenergo*</td>
<td>28</td>
<td>95%</td>
<td></td>
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<td></td>
<td>19</td>
<td>77%</td>
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* Unlisted
** Purely nuclear generators are not included

New hydro units commissioning will increase share of renewable capacity while Far East projects completion will reduce CO₂ emissions

Emissions in line with global peers, poised to further decline

- Emissions in line with global peers, poised to further decline
- New hydro units commissioning will increase share of renewable capacity while Far East projects completion will reduce CO₂ emissions
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- #7 globally by total installed “green” (hydro/renewable/nuclear) capacity, # 5 by hydro & renewable capacity, # 4 by hydro capacity, GW**

* 2012 data. Size of bubble represents volume of hydroelectric and renewable capacity in GW
Operating expenses

Third-party services 11%

- Employee benefit expenses 21%
- Fuel expenses 21%
- Purchased electricity and capacity 20%
- Electricity distribution expenses 16%
- Other expenses 4%
- Depreciation 7%
- Third-party services 11%
ENGINEERING SERVICES
Design engineering following concept through to detailed design
Draughting of new designs and modification to existing drawings
CPEng accredited engineers for the design and review of design solutions (review and recommendation service available for third party designs)
Feasibility studies and detailed recommendation/design reports
Engineering support for major turbine-generator overhauls and upgrades
Workshop QA on components under refurbishment or manufacture
Site presence for major overhauls and QA on installations
Production, review and compilation of inspection and test records for major and minor projects
Auxiliary system design solutions including screen cleaners, pumps
Alignment procedures and reporting for both large and small pieces of rotating equipment
Civil engineering capability for investigations, feasibility studies and design solutions
Inspection of all major hydro machinery components including, bearings, generators, turbines, penstocks and gates

PROJECT MANAGEMENT SERVICES
providing a safe and healthy workplace that protects employees, clients, suppliers, communities and the environment
Scheduling advice and risk assessment for major projects
Early cost advice, financial management and contractual control of construction projects
Subcontractor management and QA, with an emphasis on clear lines of communication back to the client
Management of inspection and test plans in line with client requirements

PROCUREMENT & SUPPLY
Turbine runners and all associated equipment
Governor systems including servomotors and wicket gates
Generator rotors, stators and related equipment
Associated design services

MECHANICAL SERVICES
To complement our engineering and project management service we also offer a dedicated team of experienced tradesmen to carry out including:
Full inspection and overhaul of hydro turbine-generator units
Modification and upgrade of hydro turbine-generator units
Modification and refurbishment of sluice gates, head gates and auxiliary equipment
Fabrication of replacement and new pipe-work within hydro power stations
On and off site sandblasting and painting services
Alignment of both major and minor rotating equipment
Access to NDT services

HYDRO EXPERIENCE/MAINTENANCE SERVICES
Procedures/methodologies and plans for the disassembly of turbine-generator units
Design of critical mechanical components such as greaseless bushing systems for wicket gates and linkages
Commissioning activities including on site and planning support for load rejection and over-speed testing
Orifice plate design to reduce
Wicket gate closing rate during trip conditions
Erosion protection for turbine components using Urethanes and other trial materials
Design of kidney loop filtration systems for bearings, governors and head gates
Machine alignment correction recommendations based on ‘as-found’ data.
Welding procedures for repairs to worn or fatigued components
Alternative repair design solutions such as metal spray shafts & metal stitch on bottom ring
Installation of new turbines
Design of air admission systems to enhance load rejection capabilities
Noise reducing enclosures to minimise harmful operating noise
First article inspection on turbines and components
Wicket gate leakage efficiency enhancement
Screen cleaner tine enhancement to maximise grab efficiency
Removal of redundant excitation equipment and shortening of the associated shaft
The Russian Federation operates one of the largest and at the same time one of oldest hydropower generation fleets; Underinvestment in the 1990s and 2000s negatively impacted reliability and safety of generating facilities and the equipment; Technical reconstruction and modernization of hydropower allows to extend the operation period of the equipment by an average of 30-40 years.
The abnormal floods in the Far East of Russia in 2013 revealed an unresolved problem of unregulated rivers. RusHydro has been commissioned to develop the feasibility studies of storage-based hydropower plants in order to prevent future abnormal floods in the region.

Construction of flood control HPPs could result in:

- control of over 90% of water flow into the creek of the Zeya river;
- territories of over 80,000 ha are safe from floods;
- more than 350,000 people are protected from floods.

The following conditions are required to make an investment decision on projects:

- Guaranteed sale of electricity produced by HPPs:
  - technical ability to supply power to deficient regions of the Russian Far East (the South of Primorye)
  - exploring potential and taking essential actions to provide export of power to China
- Determine funding sources and securing economic efficiency of projects (implementation of public private partnership mechanism, strategic partners’ participation)
- Alternative technical solutions (construction of flood control hydro technical facilities without power generation capacity) should be sufficiently explored and ruled out

- a program aimed at the implementation of projects of renewable energy sources in Russia’s Far East
- based on the successful operations of a range of trial facilities generating renewable energy in isolated settlements, far from infrastructure
- in isolated areas renewable energy sources become economically viable.
- proper environment for market of renewable energy sources projects in the isolated zones of Russia’s Far East and Far North has been provided.
- clear economic criteria for the future projects
ANSWER:

Having the largest gas reserves in the world and very rich oil and coal reserves Russia seriously considers exploiting its diverse renewable energy potential.
RusHydro

http://www.rushydro.ru