SMALL-SCALE ENERGY SUPPLY SYSTEMS IN EASTERN RUSSIA: CURRENT STATUS, DEVELOPMENT STRATEGY, INTERNATIONAL COOPERATION

B. Saneev, I. Ivanova, T. Tuguzova
Energy Systems Institute SB RAS, Russia, Irkutsk

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BASIC STUDIES ON EASTERN ENERGY POLICY OF RUSSIA, CONDUCTED BY ENERGY SYSTEMS INSTITUTE, SB RAS

In the framework of the Energy Strategy of Russia 2030

- The strategy for energy development in East Siberia and the Far East until 2030

Ordered by the regional authorities

- The concept of providing stable operation of energy facilities and energy security of *Sakhalin region* until 2020 – ordered by Administration of Sakhalin region
- The strategy for energy development in *Amur region* until 2010 and for the time horizon until 2030 – ordered by Administration of Amur region
- The strategy for electric power industry development in *Chukot Autonomous Area* until 2020 – ordered by Administration of Chukot AA and JSC “Chukotenergo”
- The strategy for energy development in *Irkutsk region* until 2010 and for the time horizon until 2030 – ordered by Administration of Irkutsk region
- The energy strategy of *Sakha Republic (Yakutia)* until 2020 and for the time horizon until 2030 – ordered by the Government of Sakha Republic (Yakutia)
PLAN OF PRESENTATION

1. Energy supply to consumers in Russia’s East: current state and problems

2. Efficiency estimation of small-scale energy development options

3. Prospects and barriers in implementation of projects for construction of renewable energy sources

4. Directions of international cooperation in the field of small-scale energy supply systems
6.7 mln. km² (62%) is situated in the North, The population is 2 mln. people (14% of the population in East Siberia and the Far East)

**Autonomous and backup energy sources**
Number of power plants – 3960
Capacity – 1,7 thous. MW
Electricity output – 2,1 bln. kWh

**Renewable energy sources**
Number of power plants – 13
Capacity – 0.12 thous. MW
Electricity output – 0.5 bln. kWh

**Isolated power systems**
Number of power plants – 34
Capacity – 4,6 thous. MW
Electricity output – 12,1 bln. kWh

**Interconnected power systems**
Number of power plants – 90
Capacity – 45,8 thous. MW
Electricity output – 180 bln. kWh

The capacity of small-scale energy sources makes up 3,3% of the total capacity of power plants
LOCATION OF RENEWABLE ENERGY SOURCES IN THE EASTERN REGIONS (CURRENT STATE)

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PRICES AND TARIFFS FOR CONSUMERS IN DECENTRALIZED ELECTRICITY SUPPLY ZONES

- Price of diesel fuel – 32-38 thous. rub./t
- Price of fossil fuel – 3-6 thous. rub./tce

- Cost price of:
  - electricity production – 18-25 rub./kW·h
  - heat production – 4-5 thous. rub./Gcal

- Tariff for population:
  - electricity – 2.5-3.5 rub./kW·h
  - heat – 1-2 thous. rub./Gcal

For information:
- Average wholesale price of diesel fuel in Russia - 27 thous. rub./t
- Average tariff for population in Russia:
  - electricity – 1.2 rub./kW·h
  - heat – 430 rub./Gcal

Subventions for levelling tariffs (delivery of commodities to the North) 50 bil. rub
RATIONAL DIRECTIONS IN DEVELOPMENT OF SMALL-SCALE ENERGY SUPPLY SYSTEMS

- reconstruction and upgrading of existing energy sources;
- connection to electric power system;
- construction of mini cogeneration plants on local fuels (coal and hydrocarbons from local deposits);
- involvement of renewable energy sources;
- construction of low-capacity nuclear power plants.
2.1 Connection to centralized electricity supply

With rise in loads the economically efficient distances for connection to power systems increase.

Connection to centralized electricity supply is efficient for consumers located at a 75-90 km distance from supply centers.

In the eastern interconnected power systems up to 30-90 km.

In isolated power systems in the northeast up to 25-75 km.

Electricity tariff, cent/kWh

Diesel fuel tariff – 800 USD/t

Consumer load, MW

Length of transmission lines, km

Zone of autonomous electricity supply

Zone of centralized electricity supply

In isolated power systems in the northeast up to 25-75 km

In the eastern interconnected power systems up to 30-90 km

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2.2 Construction of mini cogeneration plants on local fuels

- Allocation of mini cogeneration plants is efficient near coal deposits and natural gas fields or in the buffer area of gas pipeline routes.

- Electricity production cost at cogeneration decreases two-fold against diesel power plant.

- Construction of mini cogeneration plants on local fuels

- Electric capacity of coal-fired mini cogeneration plants, MW:
  - 8
  - 4
  - 1.5

- Payback period, years

- Gas prices, USD / thous. m³

- Electricity tariff, cent/kWh

- Conversion to gas is efficient

- Diesel fuel price, USD/t

- Diesel power plant capacity, MW:
  - 0.4
  - 1
  - 2
  - 3

- Allocation of mini cogeneration plants is efficient near coal deposits and natural gas fields or in the buffer area of gas pipeline routes.
### 2.3 Construction of low-capacity nuclear power plants

**Graph:**
- **X-axis:** Specific capital investment in low-capacity NPP, thous. USD/kW
- **Y-axis:** Diesel fuel price, USD/t
- **Graph Trends:**
  - Low-capacity NPP
  - DPP + boiler plant

**Map:**
- **Locations:**
  - Sakha Republic (Yakutia)
  - Tomtor rare-earth metal (niobium) deposit
  - Restoration of Northern sea route
  - Kyuchus gold deposit
  - Copper ore deposit

**Table:**

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<th>Consumer</th>
<th>Electric capacity, MW</th>
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**Text:**
- **Low-capacity nuclear power plants** are competitive as compared to diesel power plants + boiler plants at capital investment of no more than 9 thousand USD/kW.
- **Allocation of low-capacity nuclear power plants** is efficient for energy supply to new industrial sites located in the hard-to-access areas.
Solar energy (annual total solar radiation > 1200 kWh/m²)
- - - 2000 – duration of solar radiance, h/year

Wind energy (mid-annual speed > 5 m/s)

Small-scale hydro energy

Geothermal energy

Wood resources

High potential resources

Federal Okrugs of RF
1 – Central
2 – Northwestern
3 – Volga
4 – Southern
5 – Urals
6 – Siberian
7 – Far-Eastern

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An aim of the **Russian Energy Strategy until 2030**:  
– increase in RES share in total electricity production **from 0.5% to 4.5%**  
– total capacity to be commissioned – **25 th.MW**

An indicator of the **General Scheme for Placement of Electric Power Industry Facilities in Russia until 2020 with prospects to 2030**:

– total renewable generating capacities to be commissioned - **6-14 th. MW**  
– in the eastern regions - **2 - 3.5 th. MW**

**Structure of capacities to be commissioned in Russia in 2030 by RES type, %**
An aim of the **Scenario conditions of electric power development until 2030:**
- total renewable generating capacities to be commissioned - **5 th. MW**
- in the eastern regions - **1 th. MW**

**FORECAST OF ESI FOR EASTERN REGIONS**

**Total capacity to be commissioned - 300-320 MW**

- Geo power plants in Kamchatka Krai and on the Kuril islands
- Wind power plants in Primorie, Khabarovsk and Kamchatka Krais
- Small hydropower plants in Buryat Republic, Kamchatka Krai and Irkutsk Oblast
Placement of renewable energy sources is efficient in the hard-to-access areas in which the indices of renewable energy potential are the highest.
BARRIERS TO DEVELOPMENT OF RENEWABLE ENERGY SOURCES IN RUSSIA

■ **Institutional:**
- insufficient legislative basis in the sphere of RES;
- ineffective system of measures intended to meet environmental constraints;
- unwillingness of authorities to participate in funding the investment projects

■ **Financial:**
- absence of federal financing mechanisms;
- insufficient internal and foreign investment capital;
- high cost of special equipment;
- lack of long-term loans on acceptable terms.

■ **Informational:**
- insufficient information about technologies and possibilities of their application;
- lack of reliable data on the indices of renewable energy resources;
- negative experience of RES operation.
RATIONAL PLACEMENT OF LOW-CAPACITY ENERGY SOURCES OF DIFFERENT TYPES

Total capacity to be commissioned by 2030

- Connection to centralized electricity supply
- Mini cogeneration plant - 70 MW
- Conversion of DPP to gas
- Low-capacity nuclear power plant – 108 MW
- Small HPP – 126 MW
- WPP – 123 MW
- Geo TPP – 76 MW

TOTAL – 503 MW
DIRECTIONS OF INTERNATIONAL COOPERATION IN THE FIELD OF SMALL-SCALE ENERGY SUPPLY SYSTEMS

- Legislative framework
- System of state stimulation
- System of preferential taxes and crediting
- Mutually beneficial deliveries of equipment
- Joint investment in projects
- Information exchange
Thank you for your attention