Main stages and Key Stakeholders in Preparation of Siting Decisions of Nuclear Power Plants, Regional Specifics for SMR

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ERI RAS – experience in system energy studies

Energy Research Institute of the Russian Academy of Sciences (ERI RAS) was established in 1985 for the fundamental studies in the area of national energy policy development and implementation:

✓ international level – scientific and analytical co-operation with leading institutions and research teams in the area of global energy and technological forecasting, transformation of energy systems and energy markets, participation in the EU-Russia Energy Dialogue, BRICS Economic Partnership, Global Energy Interconnection Development and Cooperation Organization (GEIDCO), etc.

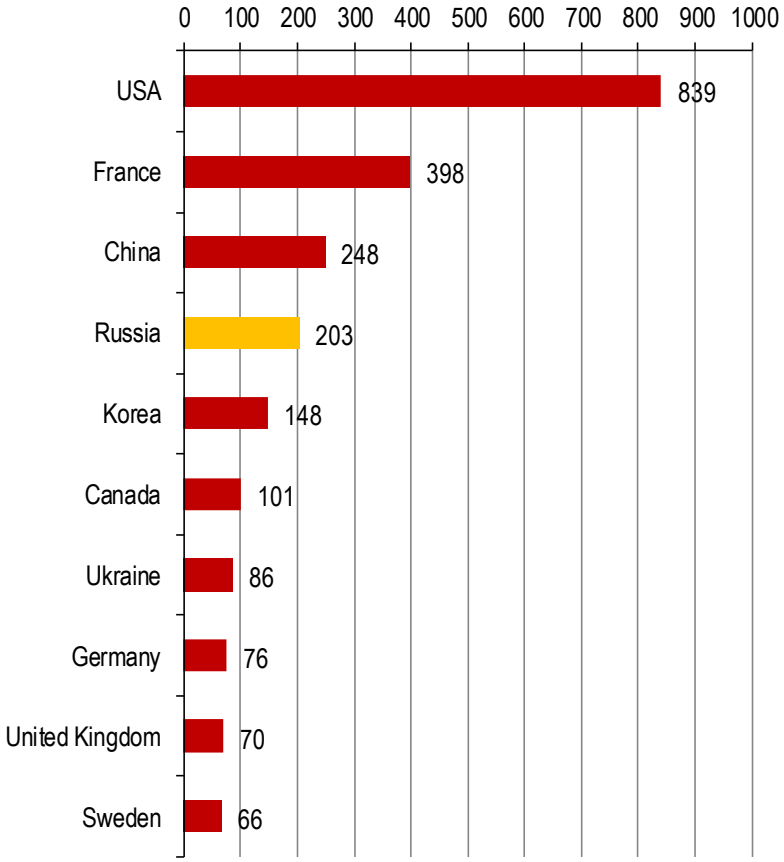
✓state level - methodological, modeling and analytical support for the energy policy priorities and implementation mechanisms (incl. macroeconomic, technological, pricing, environmental and other aspects), quantitative elaboration of the economy and energy sector scenarios, incl. decarbonisation options

- ***National Energy Strategy (multiple updates)***
- *Long-term Development Plan for the Gas Industry*
- *Long-term Development Plan for the Coal Industry*
- ***Long-term Development Plan for the Electric Power Sector (incl. nuclear power plants)***
- ***Energy Technologies Forecast to 2035***
- *Vision of the Smart Power System*
- *Vision, Scenarios and Roadmap of the Renewable Energy Sources Development*
- *Effects from digital transformation of Russian Energy Sector*

✓ corporate level – capacity building, modeling and information support of the strategic planning system of leading Russian and foreign energy companies, justification of investment and market policy (at the domestic and global markets) under the energy markets transformation processes

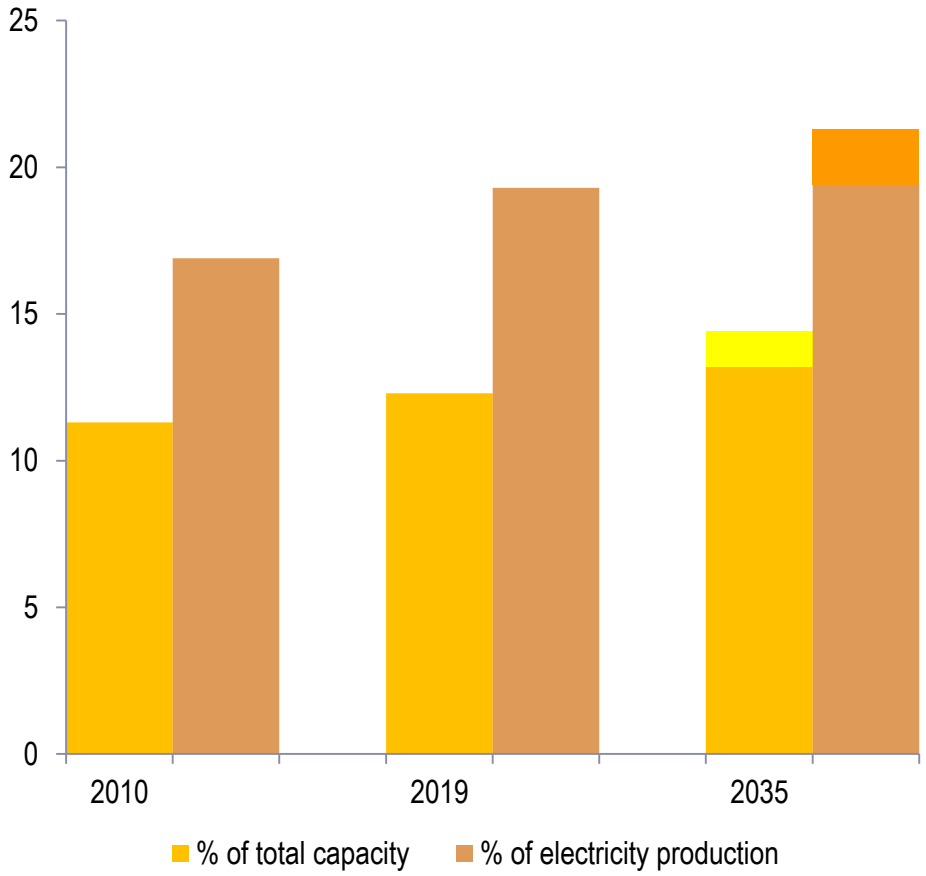
Nuclear power in Russia is…

TOP-10 electricity producers at NPPs in 2017, TWh



Source: IEA Keyword energy statistics (2019)

NPPs in the structure of national power system



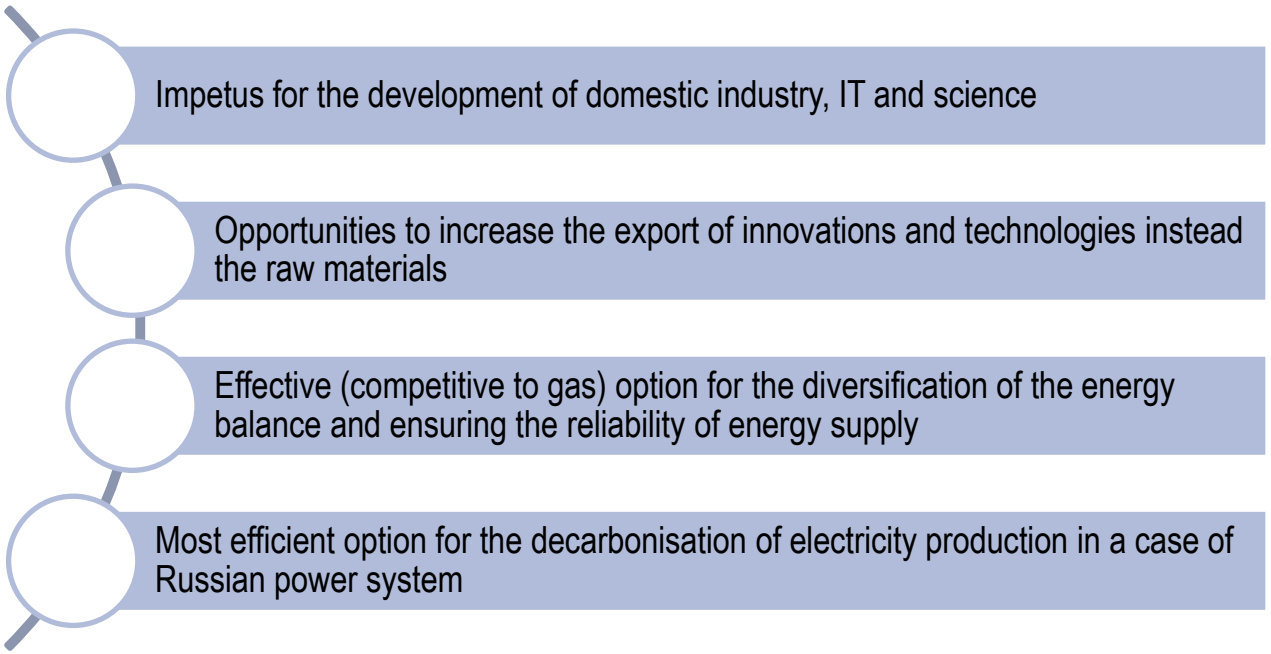
Source: System Operator, ERI RAS forecast

Support of the nuclear power at the federal level

National Energy Strategy - 2040 (approved in 2020)

"Russia is leading in the development of a new energy supply technology based on nuclear power, involving the parallel operation of thermal and fast neutron reactors, united by a common closed nuclear fuel cycle. Such a technology contributes to solving the problems of reproduction of nuclear fuel, minimization of radioactive waste and compliance with the regime of non-proliferation of nuclear materials"

Macroeconomic effects from the development of nuclear power generating technologies



Support of the nuclear power at the regional level

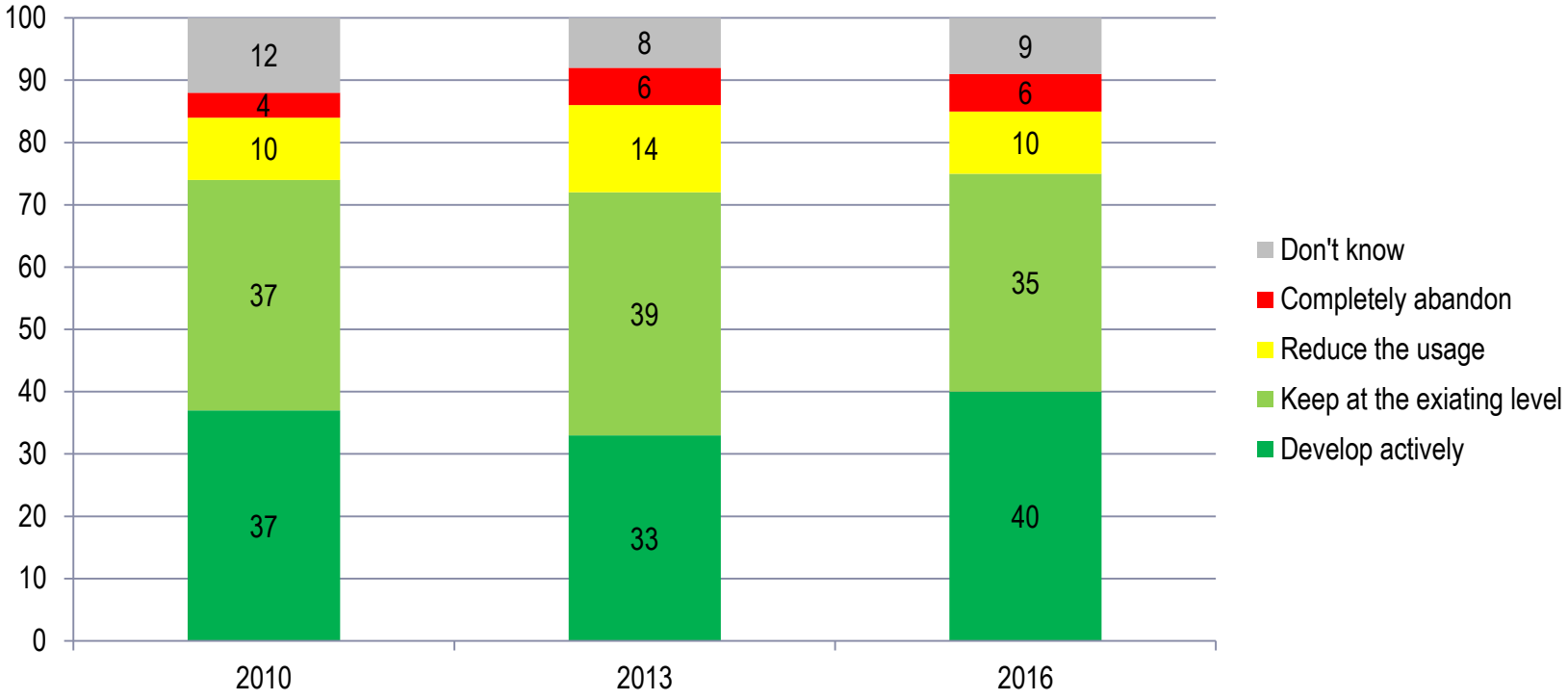
- NPP are located in 10 (of 85) administrative units of Russian Federation
  - Most new NPPs are constructed close to the sites of existing and decommissioning plants to maximize the effects from existing nuclear and power transmission infrastructure
    - Additional sites for new NPP are located in ~20 administrative units

Effects at the regional level

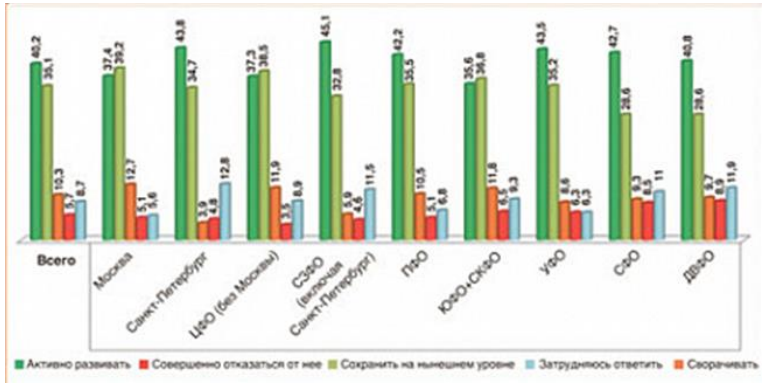
Investments as a driver of the local economic activity	New jobs and increased employment	Development of transport and social infrastructure
New large taxpayer	Average wage and population income growth	Region becomes an energy donor for its neighbors

There are strong interregional competition and intensive lobbying of the decisions about the siting of new NPPs

Public acceptance of nuclear power



Source: Sociological surveys of Levada Center



- 75% of people have a positive attitude towards nuclear energy
- a high level of support is observed in all parts of the country

Main stages for launching NPP projects

State level (federal and regional authorities)

Corporate level (Rosatom)

Approved at the federal level (RF Government)

General 15-year plan for the allocation of power generation and transmission assets

- Least cost generating capacity and electricity production structure
- Priority areas for new nuclear plants determined on a basis of the forecast capacity deficits and evaluation of investment alternatives (incl. related system integration costs)

Investment concept of the project

- Preliminary assessment of efficiency for nuclear project at the proposed area (still not at a specific site)
- Based on the typical cost and performance data of the nuclear plant and related grid facilities
- Based on the comparison with alternatives (fossil plants, grid expansion, development at the neighboring regions)

Approved at the regional level (Governor or regional Government)

Declaration of intent to invest in the NPP project

- Concept of project, technology and its parameters
- Alternative sites for the construction
- Required land, water, energy, labor resources
- Transport infrastructure requirements
- Social and environmental issues
- Industrial and radiation safety, waste management

Pre-feasibility study

- Selection of the site for the construction
- Based on the detailed site-specific cost and performance data of the nuclear plant and a required grid expansion
- All local factors are also taken into account (public acceptance, requests from regional authorities, impacts on local communities and ecosystems, multiplicative effects for the regional economy, etc.)

Appropriate regional and federal authorities

Pre-construction procedures

- Project is included in the spatial planning scheme of the region
- Site license
- Technical requirements for connecting the construction site to communications and other infrastructure
- License for construction of NPP

Strategic prospects for SMR development

National Energy Strategy - 2040 (approved in 2020)

"development of nuclear power plants on a basis of small modular reactors for power supply of remote and isolated territories"

Key features of power supply of remote and isolated territories:

- outdated equipment with low thermal efficiency
- expensive seasonal transportation of diesel fuel and coal for local plants and boilers
- unsecure supply due to the age of equipment
- highest electricity prices and permanent subsidies to the consumers

National Energy Strategy indicator

"the cost of electricity generation in the areas of decentralized power supply must be lower at 6% in 2024 and 17% in 2035"

Pilot land-based SMR project with RITM-200

Flexible, tailor-made small NPP solution based on RITM SMR is designed to address a wide range of customer demands

TECHNICAL PARAMETERS

Electrical capacity	>110 MW (2 x 55 MW)
Thermal capacity	380 MW (2 x 190 MW)
Refueling cycle	5-6 years
Design life	60 years
Availability factor	90%
Plant area	15 acres (0.06 km^2)
Construction period	3 - 4 years

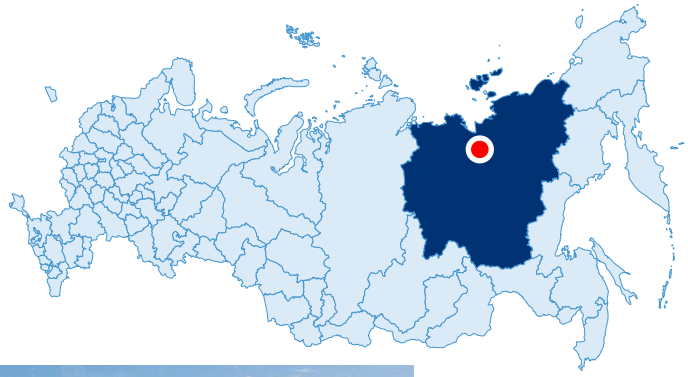
Key milestones of the pilot project

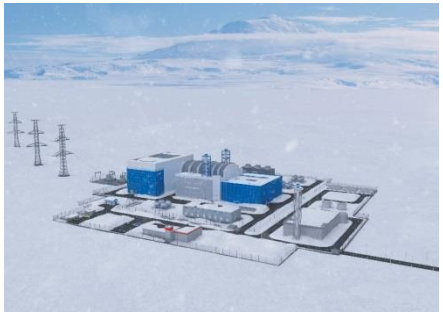
- **2018** Concept design developed
- **2019** FOAK site selection process started
- **2020** FOAK site in Russia selected
- **2023** Site license obtained
- **2024** License for construction obtained, start of construction
- **2027** Power start-up

Source: ROSATOM data

Pilot land-based SMR project with RITM-200

Yakutia is selected as a site for the deployment of SMR with RITM-200N reactor





Geographical location affects on the technical decisions:

- load-following mode operation in an isolated power system
- heat supply may be also required
- extremely low temperatures in winter and probable seismic activity

Pilot project will provide:

- Energy supply of new industrial load – new gold mining plant Kyuchus
  - Energy (and heat) supply of existing residual load – Ust'-Kuyga setlement
    - Substitution of existing 7 MW of diesel generation

Pilot project will result to:

- Decrease of electricity price at 50% and related budget subsidies to the consumers
  - Decrease CO2 emissions at 10000 tons per year
    - Formation of the energy supply infrastructure for the new regional economy growth point a
      - Up to 800 new jobs in the region

2019	Letter of intent between ROSATOM and the Government of Yakutia
2020	Tariff agreement between ROSATOM and the Government of Yakutia: • project tariff regulation • electricity sales guaranties up to 40-50 MW • assistance in obtaining the site license
2021-22	Declaration of intent to invest Pre-feasibility study

Source: ROSATOM data

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Thank you for attention!