



ROSATOM

State atomic energy corporation "Rosatom"

Peak-loads – driving New energy challenge

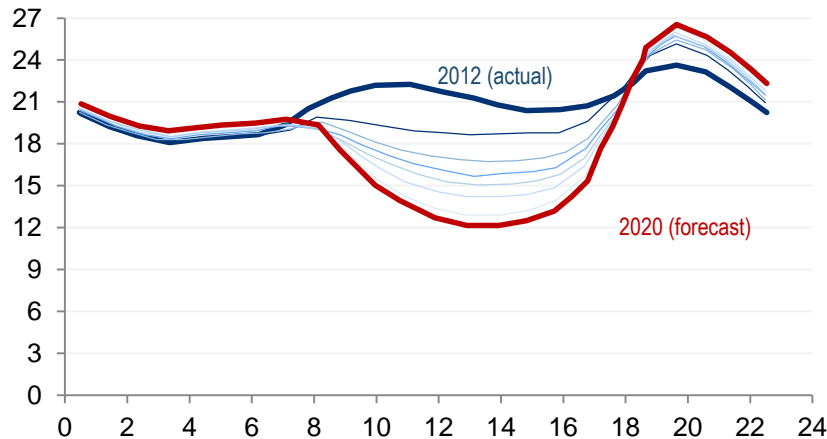
Sochi

May 15th, 2018

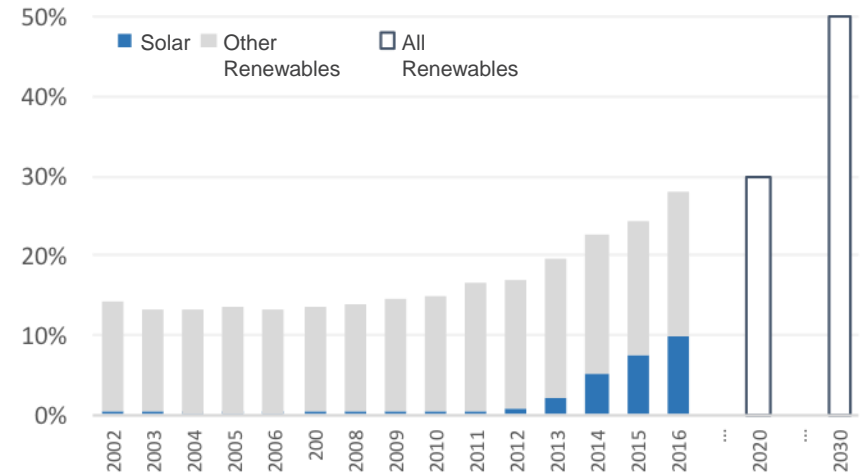
Rapid deployment of renewables increases peak loads in energy systems



The Californian “Duck” – the share of renewables doubled in 2008-2016. Maximum load at 11:00 fell by 7 GW, but grew at 21:00 by 3 GW



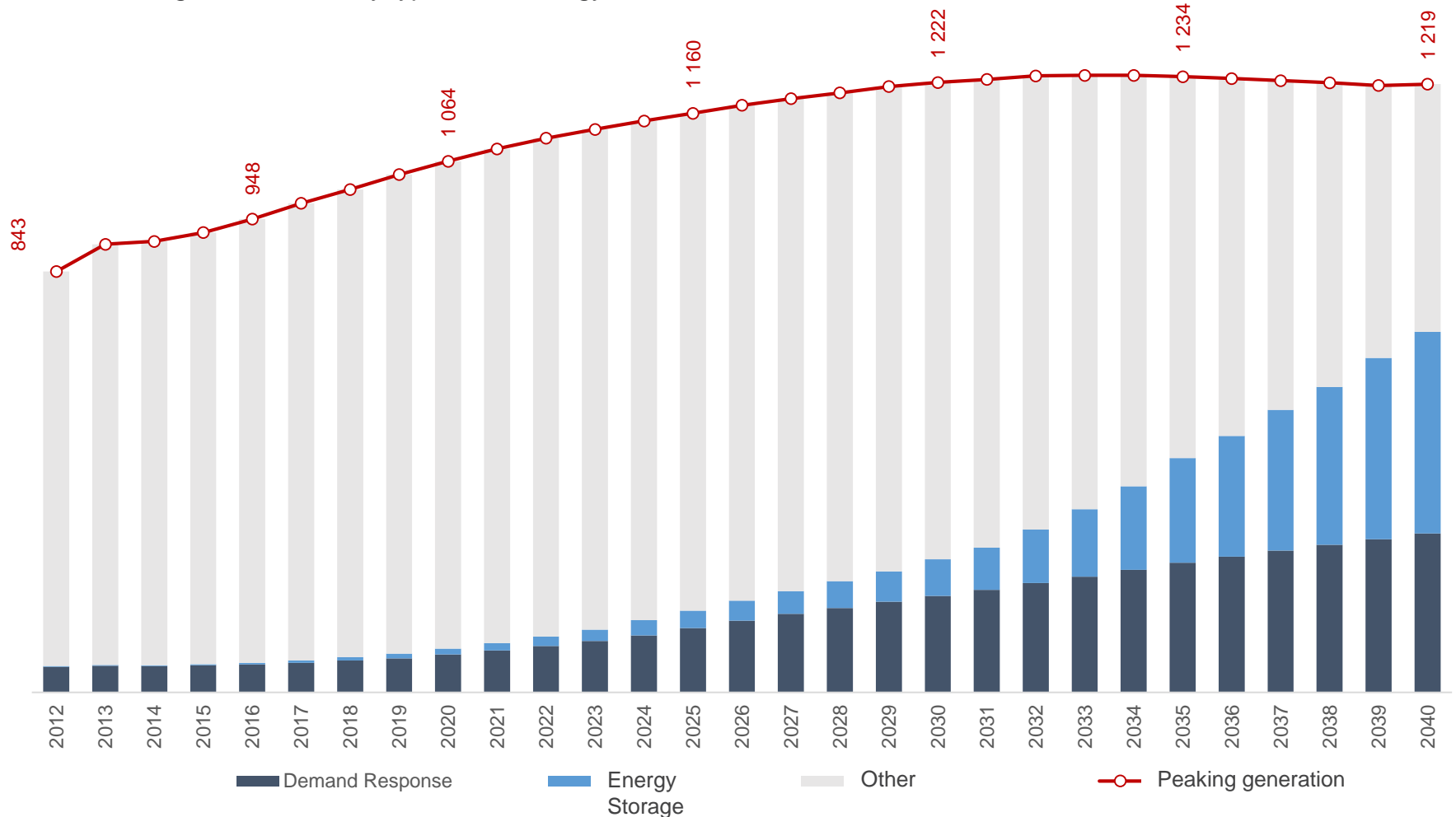
By 2030 renewables should generate more than half of all energy in California. This will increase peak coefficients even further



In 2040 energy storage and Demand Response (DR) services will provide for half of total peak-load market



Peak-load management market by type of technology, GW

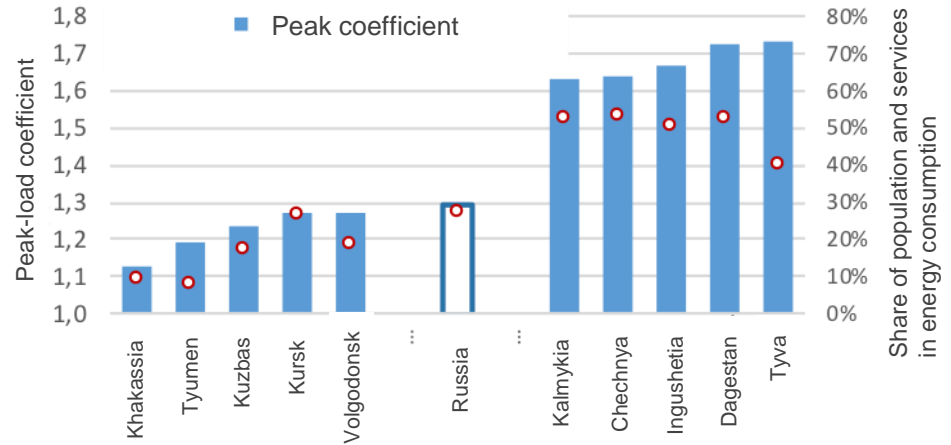


Source: Bloomberg New Energy Finance, "New Energy Outlook 2017"

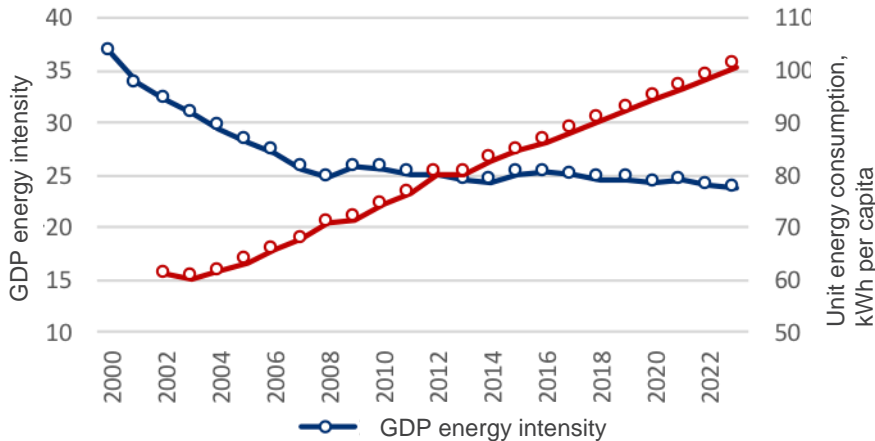
Causes of growth in peak-loads :

- Growth in households energy consumption about 10% p.a.
- Reduction of manufacturing energy propensity by third in last decade
- Growth of distributed generation by about 1 GW p.a.
- Growth in renewable energy

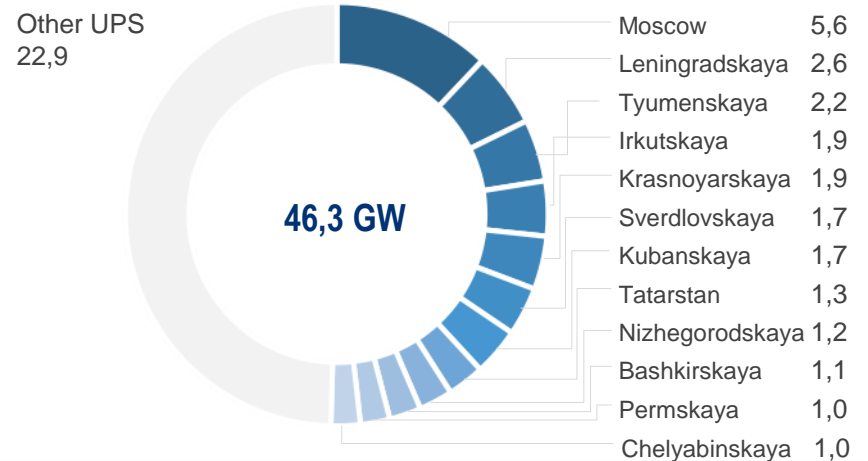
Peak-load coefficient for selected Russian regions



GDP energy intensity and unit energy consumption by population in 2000-2016 with forecast till 2023



Peak-loads in Russian regions GW 2016

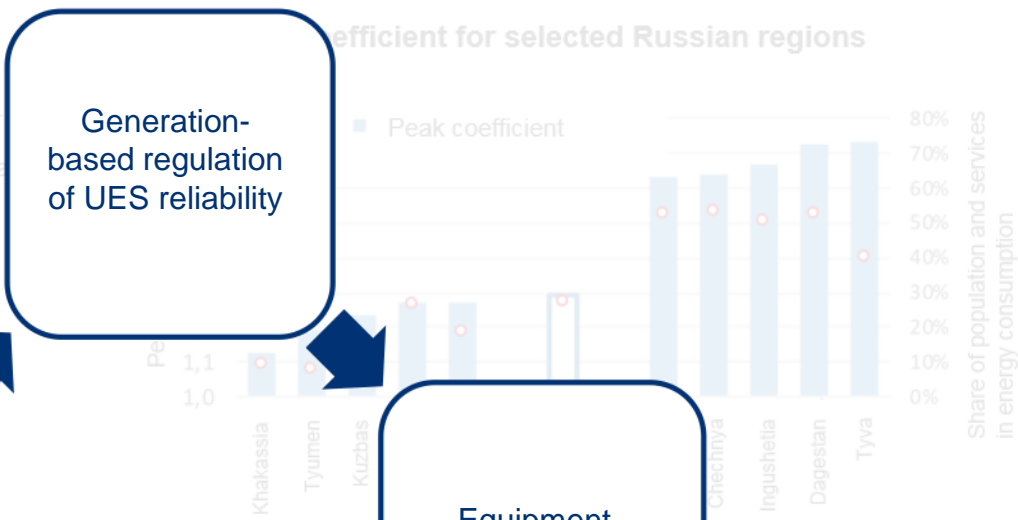


Factors impacting on peak energy consumption profile sharpness increase in Russia

Causes of growth in peak-loads :

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Peak coefficient for selected Russian regions



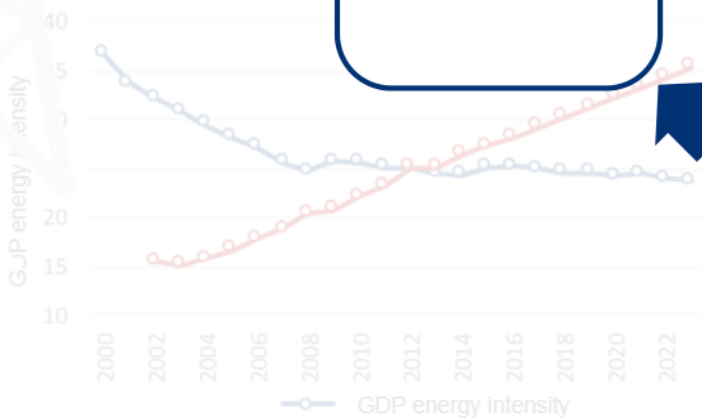
Distributed generation development

Generation-based regulation of UES reliability

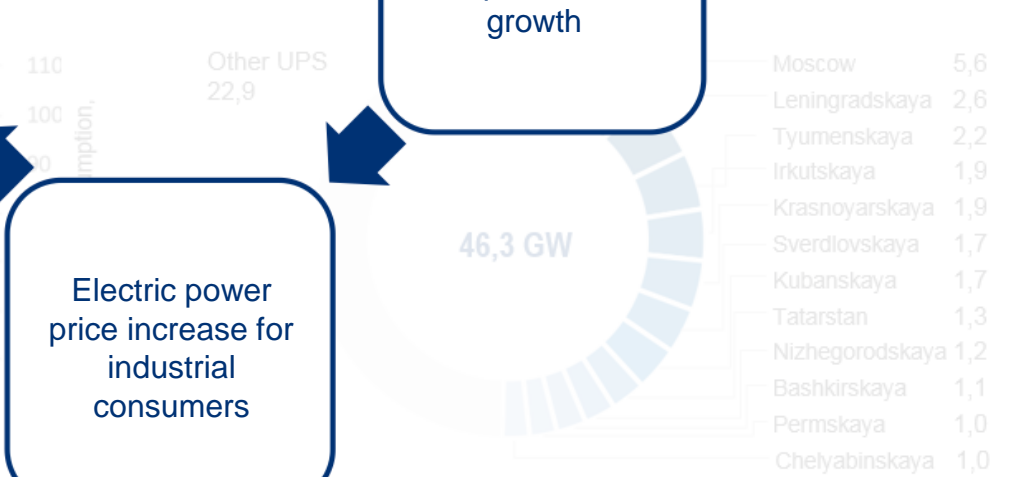
Equipment depreciation growth

Electric power price increase for industrial consumers

GDP energy intensity and population in 2000-2022



Peak-loads in Russia

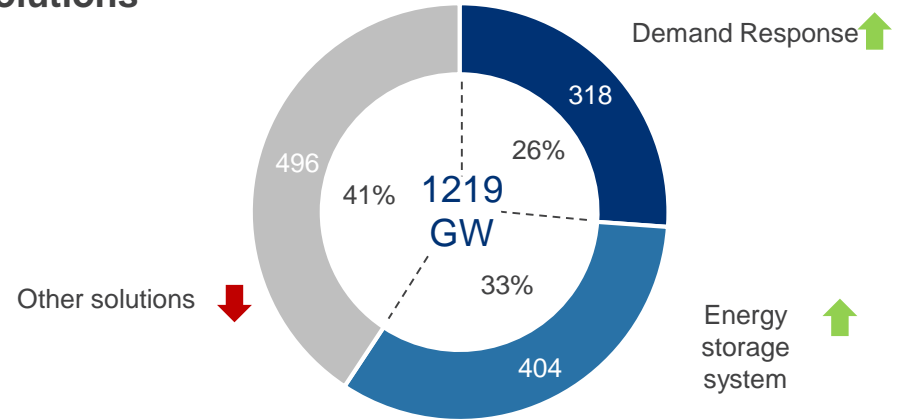
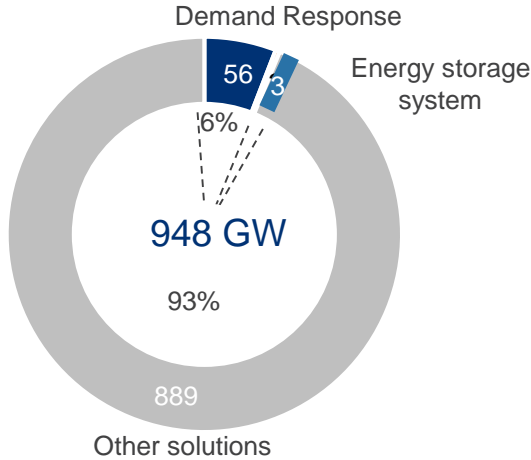


Peak generation dynamics

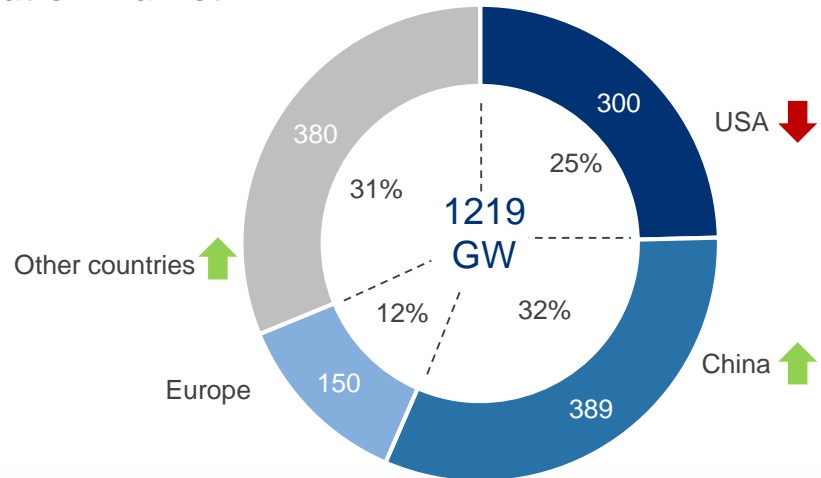
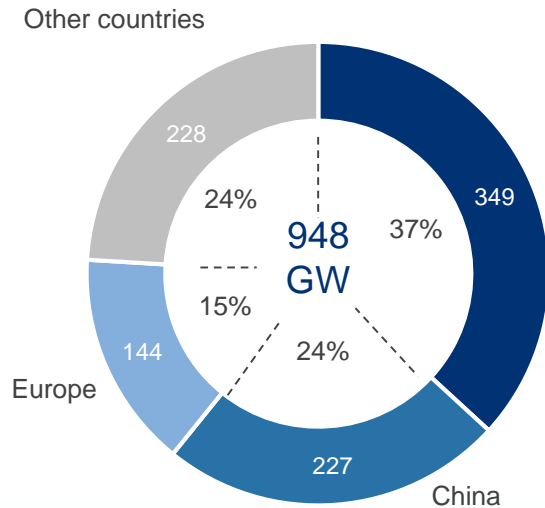
2016

Peak generation market structure by applied solutions

2040



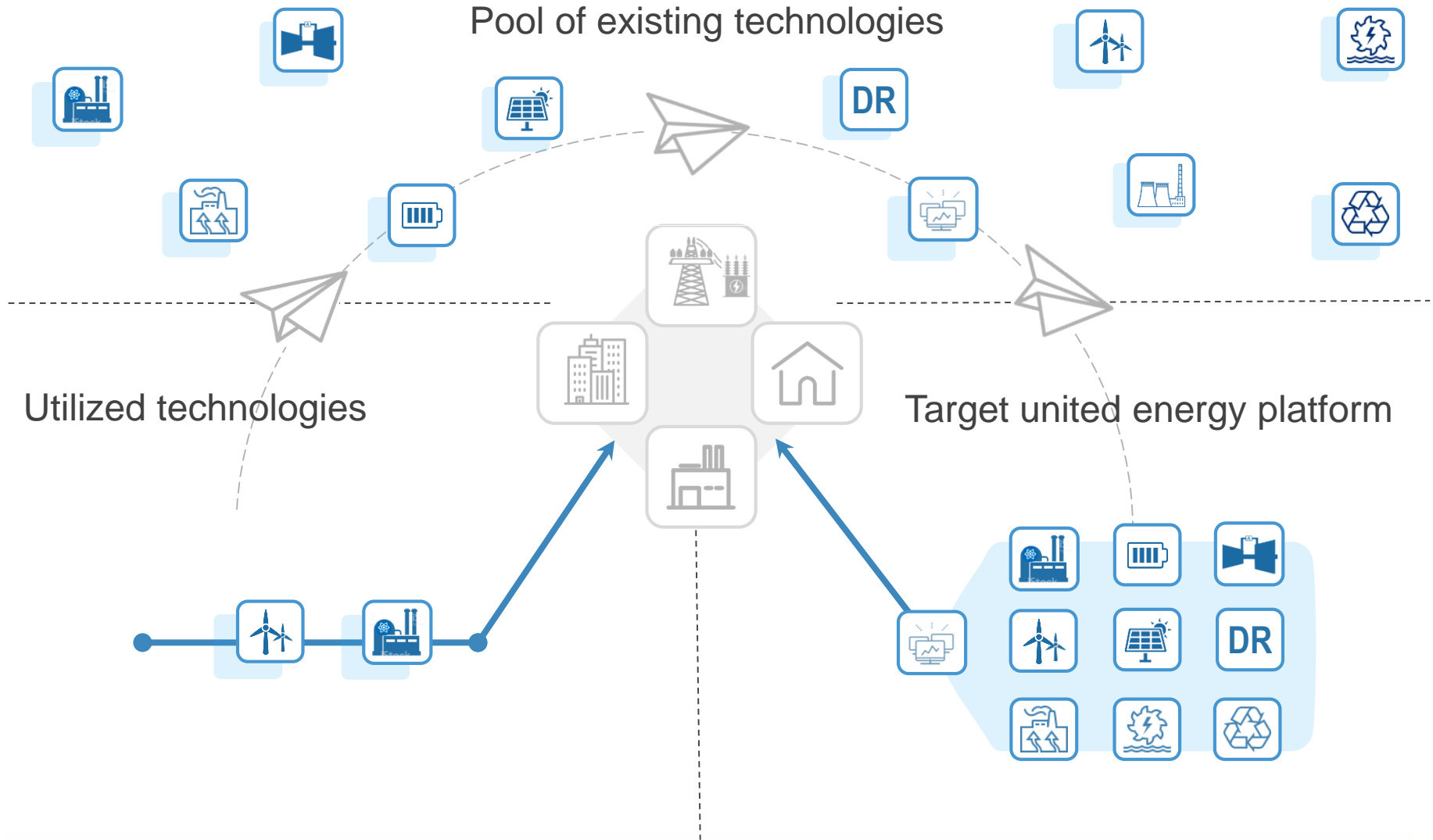
Geographic distribution of peak generation market



Strategic goal – to become **technologic and commercial leader** on peak generation market by 2040

- To anticipate the upcoming changes and to begin formation of product portfolio and **market launch of developed product line** in advance allowing for achievement of the strategic goal
- To realize global presence of Rosatom for scaling up of successful products leading to cost reduction
- To achieve synergy with other business directions in new energy by integrating peak generation product line into wind power, commercial dispatch and smart solutions for communities

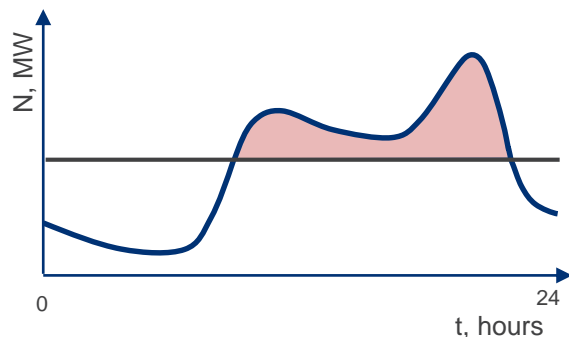
New products development is a way of united energy platform shaping within Rosatom



Product portfolio of «Peak generation» product strategy



Product 1
«Gas-turbine system»



Provision of cheaper generation during peak loads in the system/ at the customer level

Technology:

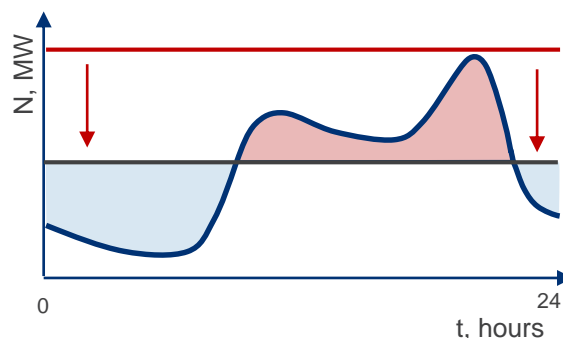
Flexible generation (gas-turbine system)

Target market:

- Substitution of generation working in forced regime on electric power and capacity with expensive additional charge
- Provision of industrial consumers with flexible capacity
- Provision of balance capacity during heat production restructuring between generators (shift of thermal load and generation roll-out)



Product 2
«Energy storage»



Shift in base load graph in accordance with consumption

Technology:

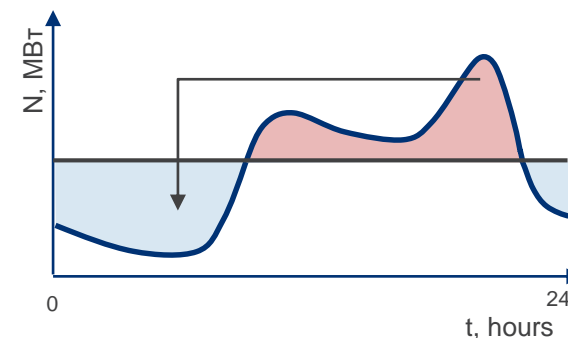
Electrochemical and hydrogenic energy storage devices

Target market:

- Rendering of system services for generators with base load (NPP, TPP) for provision of competitive advantage during formation of adjustment range limit on day-ahead market
- Provision for seasonal capacity deficit in periods of power transmission lines maintenance (securing reliability of power supply to load centers with weak connection)



Product 3
«Demand Response»



Redistribution of peak loads to the zone of minimum load

Technology:

Demand response, incl. application of energy storage devices

Target market:

- Industrial consumers
- Households

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