



РОСЭНЕРГОАТОМ

ЭЛЕКТРОЭНЕРГЕТИЧЕСКИЙ ДИВИЗИОН РОСАТОМА



MHTK-2018

Role and place of the operating organization in implementation of the development strategy of Russian nuclear power industry

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1. Rosenergoatom today

Operating organization Rosenergoatom (REA) is as follows:

1 2 3 4 5 6 7
^

35 operating NPP units at 10 NPP sites

27 890 MW of installed capacity

18 VVER NPP units

15 channel-type NPP units

2 units with fast reactors

2 units at the stage of pilot operation (Rostov NPP unit No.4 with VVER-1000 and Leningrad NPP unit No.5 with VVER-1200 (AES 2006))



6 units under construction (design capacity more than **7** GW)

1 floating nuclear power plant under construction (FNPP **70** MW)



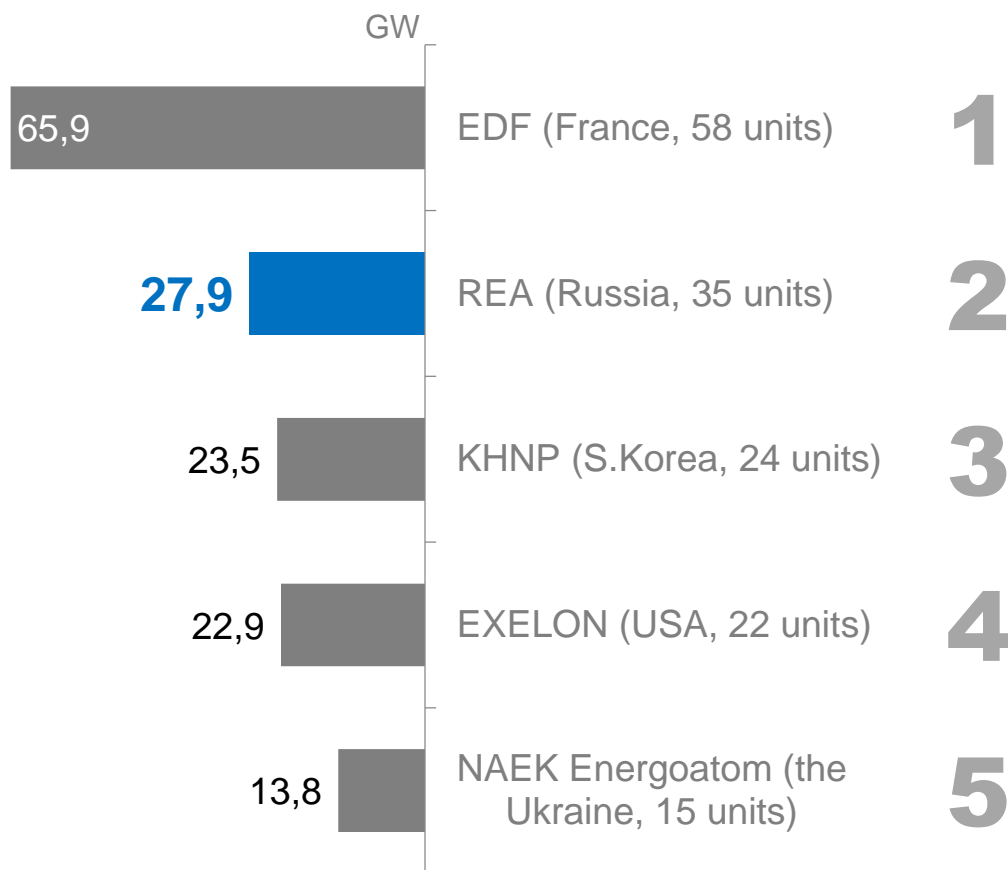
3 units in preparation for decommissioning

2 units at the stage of decommissioning:

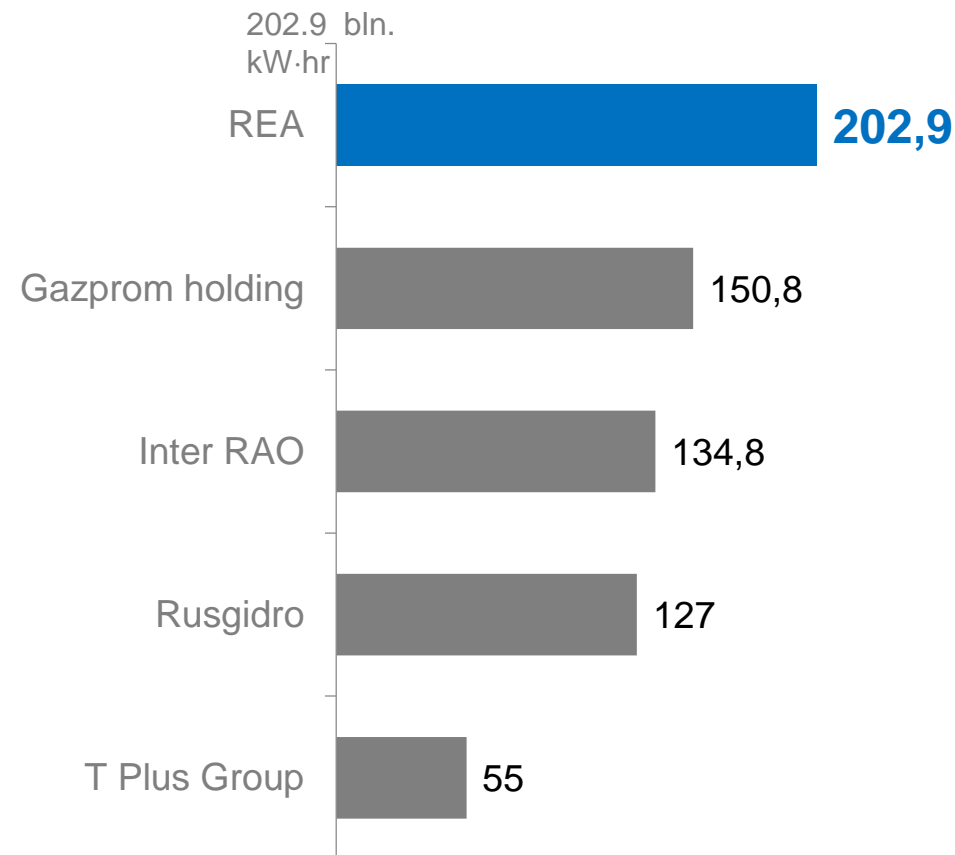
REA is one of the largest electric utilities

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in terms of installed capacity
over the world



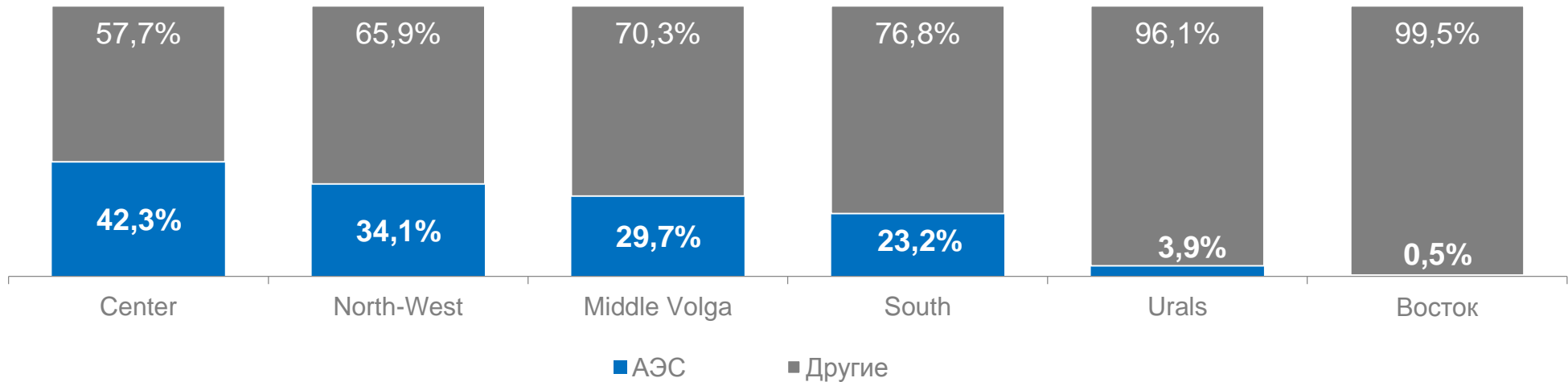
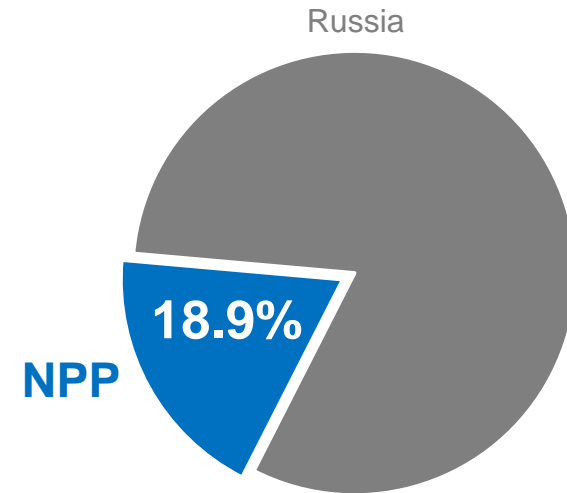
in electricity production
in Russia



The share of electricity production by REA in Russia in 2017 attained 18,9%

1 2 3 4 5 6 7
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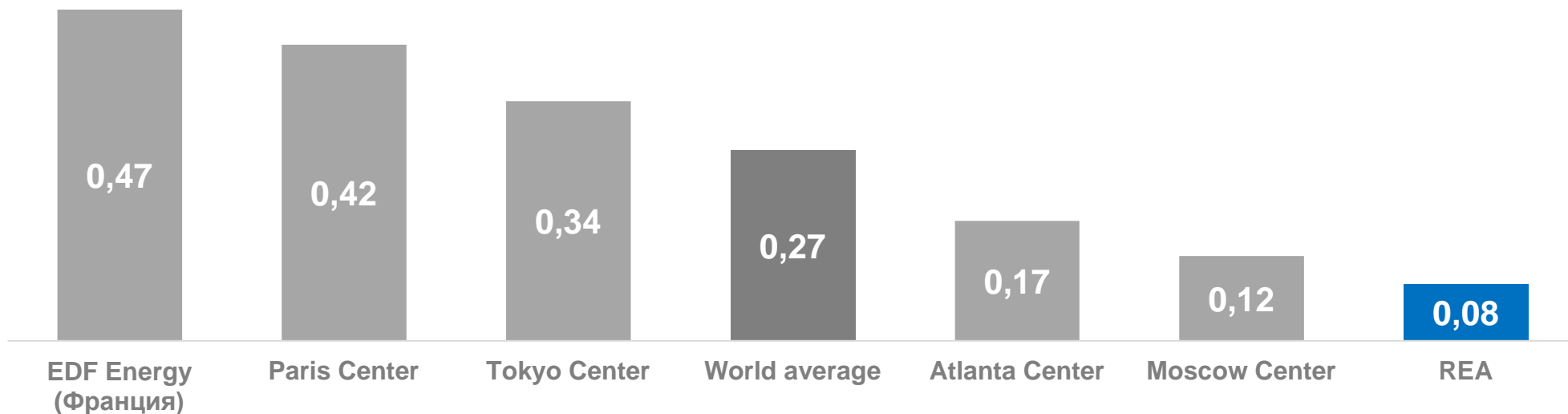
202,9 bln. kW·hr was generated at Russian NPPs in 2017



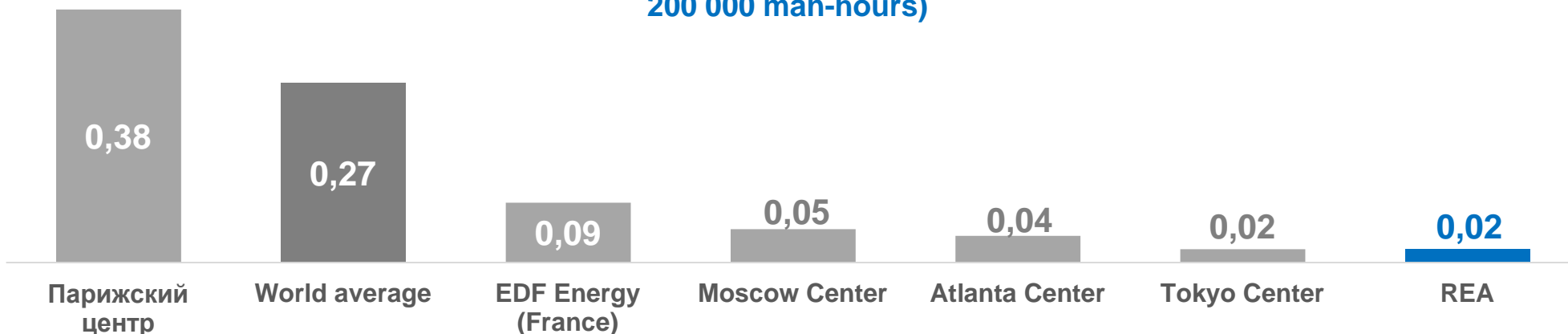
In comparison with indicators of WANO regional centers the indicators of sustainability of operation of REA NPP units and personnel injuries are at good level

1 2 3 4 5 6 7
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The indicator of scram actuation per 7000 hours of operation (WANO data) in 2017



Industrial Safety Accident Rate and Contractor Industrial Safety Accident Rate that resulted in personnel injuries (per 200 000 man-hours)



Four new NPP units were started up from 2016 to 2018

1 2 3 4 5 6 7
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Beloyarsk NPP Unit No. 4

NPP unit with fast reactor BN-800 was commissioned in 2016

Novovoronezh NPP-2 unit № 1

Innovative unit of Generation 3+ per design AES-2006 was commissioned in 2017

Rostov NPP Unit No. 4

Serial VVER-1000 NPP unit is at the stage of pilot operation

Leningrad NPP-2 unit № 1

Innovative unit of Generation 3+ per design AES-2006 is at the stage of pilot operation

International component is an integral part of REA activities

1 2 3 4 5 6 7
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IAEA

- Convention on Nuclear Safety
- Peer reviews (OSART missions)
- Exchange of experience (improvement of the NPP safety and reliability, technological development and new projects)
- IAEA safety standards

WANO

- Technical support and exchange of technical information
- Performance of peer reviews
- Exchange of operating experience
- Regional crisis centre of WANO Moscow Centre

OECD NEA

- OECD NEA projects and programs (International Information System on Occupational Exposure (ISOE), Multi-national design examination program (MDEP)
- Technical committees and Working groups of OECD NEA (operating experience, decommissioning, economy of nuclear power industry etc.)
- Work of REA experts in the Secretariat of OECD NEA

EDF, JNPC, IBERDROLA...

- Bilateral collaboration with leading energy companies of the world

2. Near-future strategy (10-15 years)

In the framework of implementation of the strategy for development of nuclear power industry in Russia to 2030 REA will be transformed from an operating organization into a global energy business company

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POCATOM



РОСЭНЕРГОАТОМ
ЭЛЕКТРОЭНЕРГЕТИЧЕСКИЙ ДИВИЗИОН РОСАТОМА

INCREASING THE SHARE
at international markets

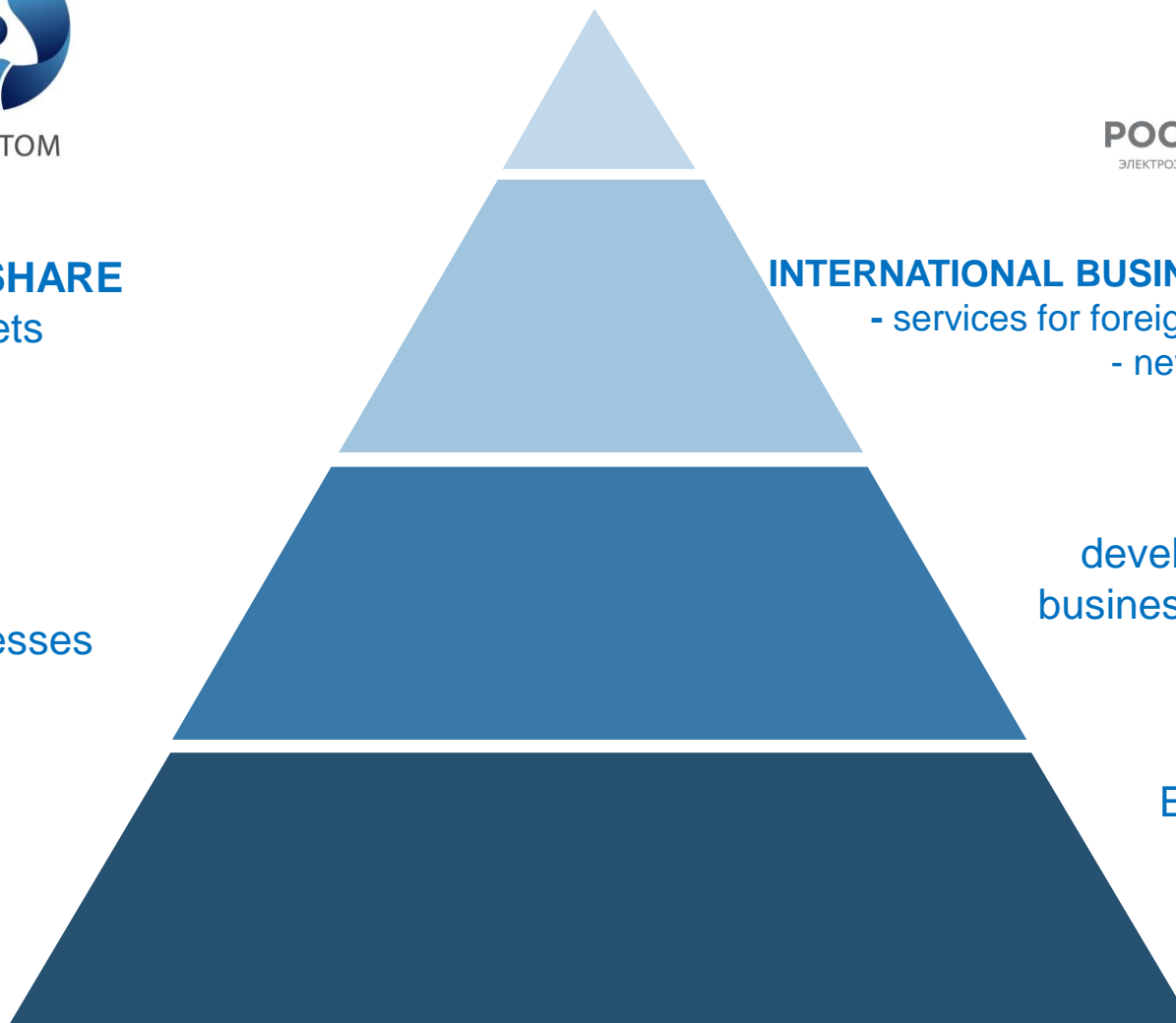
INTERNATIONAL BUSINESS DEVELOPMENT:
- services for foreign nuclear power plants,
- new products and projects

COST REDUCTION
products and timing
performance of processes

development of traditional
business **GENERATION OF
ELECTRICITY**

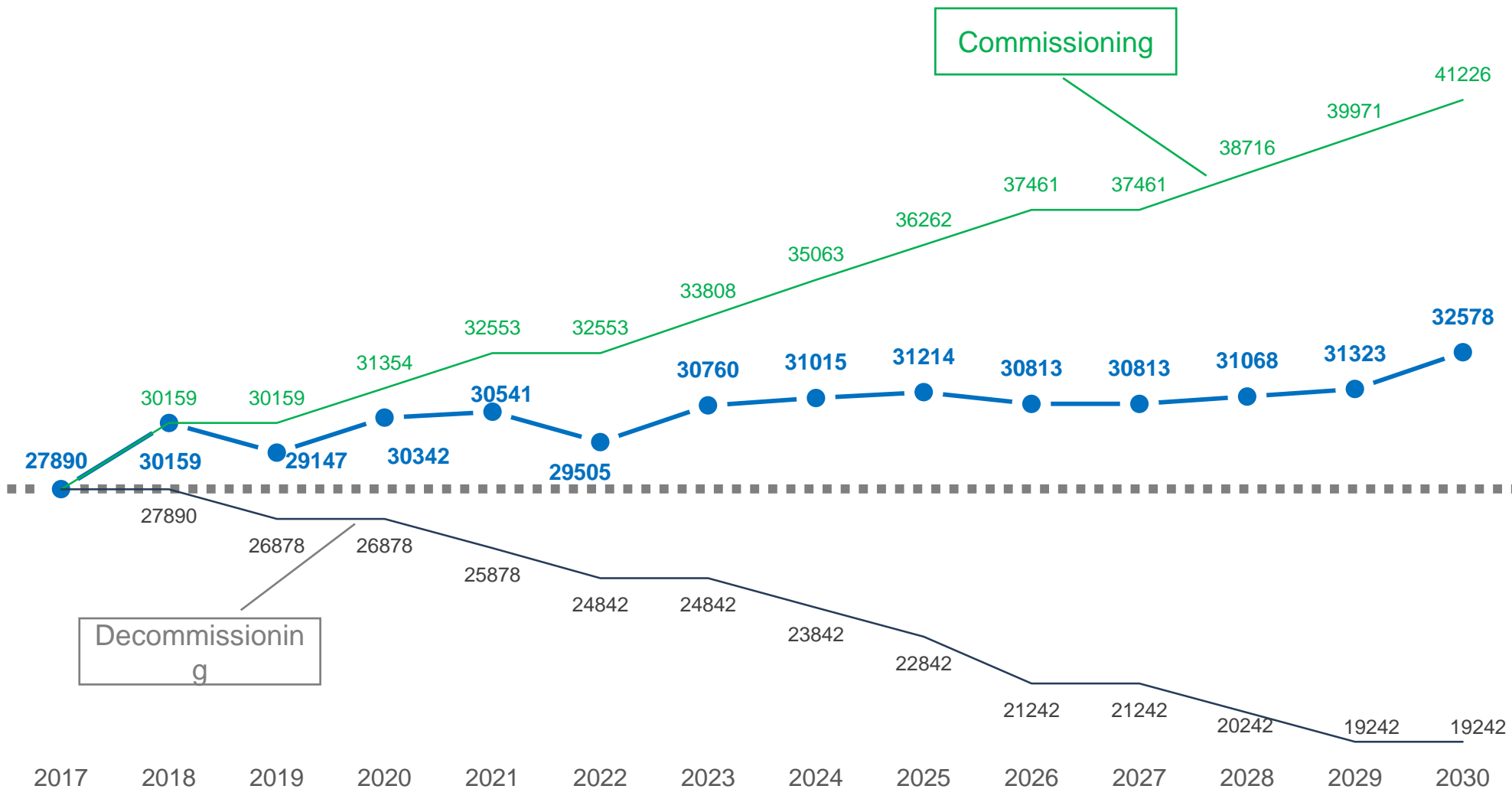
NEW PRODUCTS
for Russian and
international
markets

Entry to the market of
**NON-NUCLEAR
FACILITIES**



Development and preservation of the generating capacities (MW) to 2030

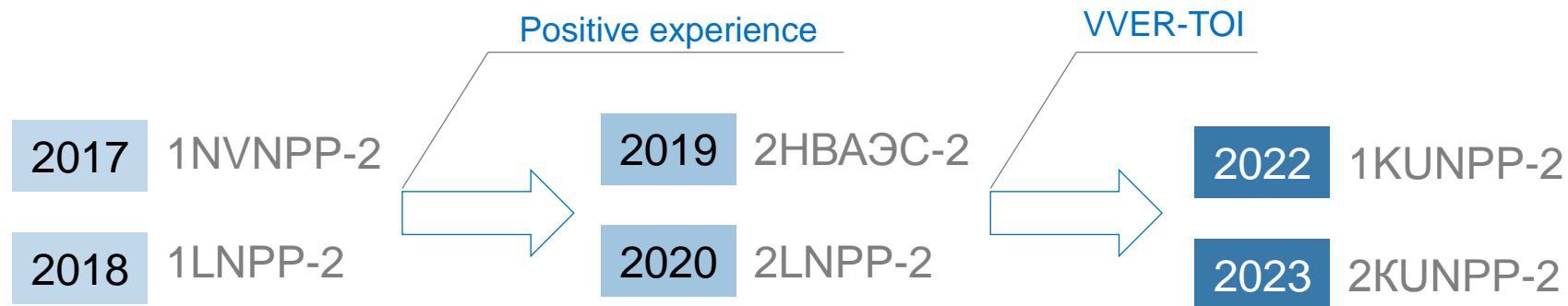
1 2 3 4 5 6 7



VVER technology development:

AES-2006 - an innovative project with VVER-1200 reactor of Generation 3+

Designed life time	LTE	Number of personnel	Peculiar features
60 years	20 years	30-40% less than (VVER-1000)	A unique combination of active and passive safety systems that makes the plant resistant to the maximum extent to the external and internal impacts



Enhancement of VVER-TOI project:

1. Improvement of competitiveness
2. Removal of conservatism in terms of safety
3. Operation in dual-component nuclear power system with BNs

REA is the customer, developer and the operating organization of FNPP with KLT-40S reactor



Characteristics of FNPU

2x35	Electric capacity, MW
50	Thermal capacity, Gcal / h
0.75	LF
3	Periodicity of nuclear refuelling, years
12	Periodicity of manufacturer overhaul, years
40	Design lifetime, years

Completion of FNPU from St.-Petersburg to Murmansk

Start of integrated mooring tests

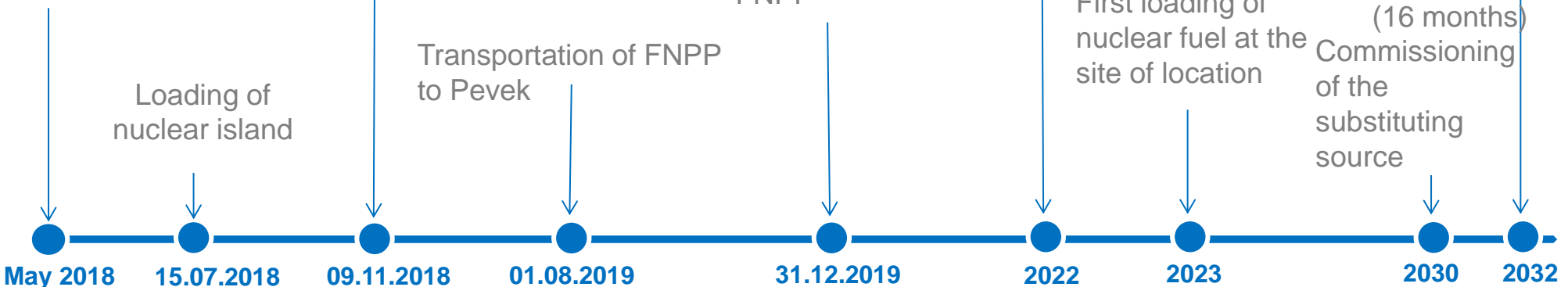
Decision-making on the FNPP replacement

Medium maintenance of FNPU at the manufacturer premises (16 months)
Commissioning of the substituting source

Commissioning of FNPP

First loading of nuclear fuel at the site of location

Transportation of FNPP to Pevek



Development of technologies for dual-component nuclear power system (NPS)

1 2 3 4 5 6 7

2034

2024

2020

Current status of Nuclear power industry (NPI)

Optimization systematic research that identify the structure of the dual component nuclear power industry and requirements for the components.

Development of the requirements for the components. VVER, RBN and CNFC

Upgrading of the design of the NPP unit with VVER-TOI reactor for work in closed nuclear fuel cycle

Development of the Improved NPP unit With BN-1200M reactor (BREAKTHROUGH)

Development of CNFC production: fabrication and reprocessing (BREAKTHROUGH)

Construction of the pilot unit for dual-component NPS for UOX and MOX (MNUP)

Construction of the pilot unit

Construction pilot production facility of U-Pu fuel

Elaboration of reactor technologies and CNFC

2035 - commercial operation:

Pilot NPP unit with BN-1200M reactor

Pilot NPP unit with VVER-TOI reactor

Plant for fabrication of MOX-fuel for BN-1200M

Design of reprocessing module for spent BN-1200M MOX fuel in CNFC

Abbreviations used: CNFC - closed nuclear fuel cycle, RBN - fast reactor, NPS - nuclear power system, UOX - uranium fuel, MNUP - mixed nitride uranium-plutonium

Decommissioning of NPP units in Russia and abroad

NUCLEAR POWER PLANTS IN RUSSIA

	Shutdown	Decommissioning	NPP units
2018	6	2	NVNPP № 1,2
2030	19	8	NVNPP №1,2, LNPP №1,2, KUNPP №1,2, BELNPP №1,2

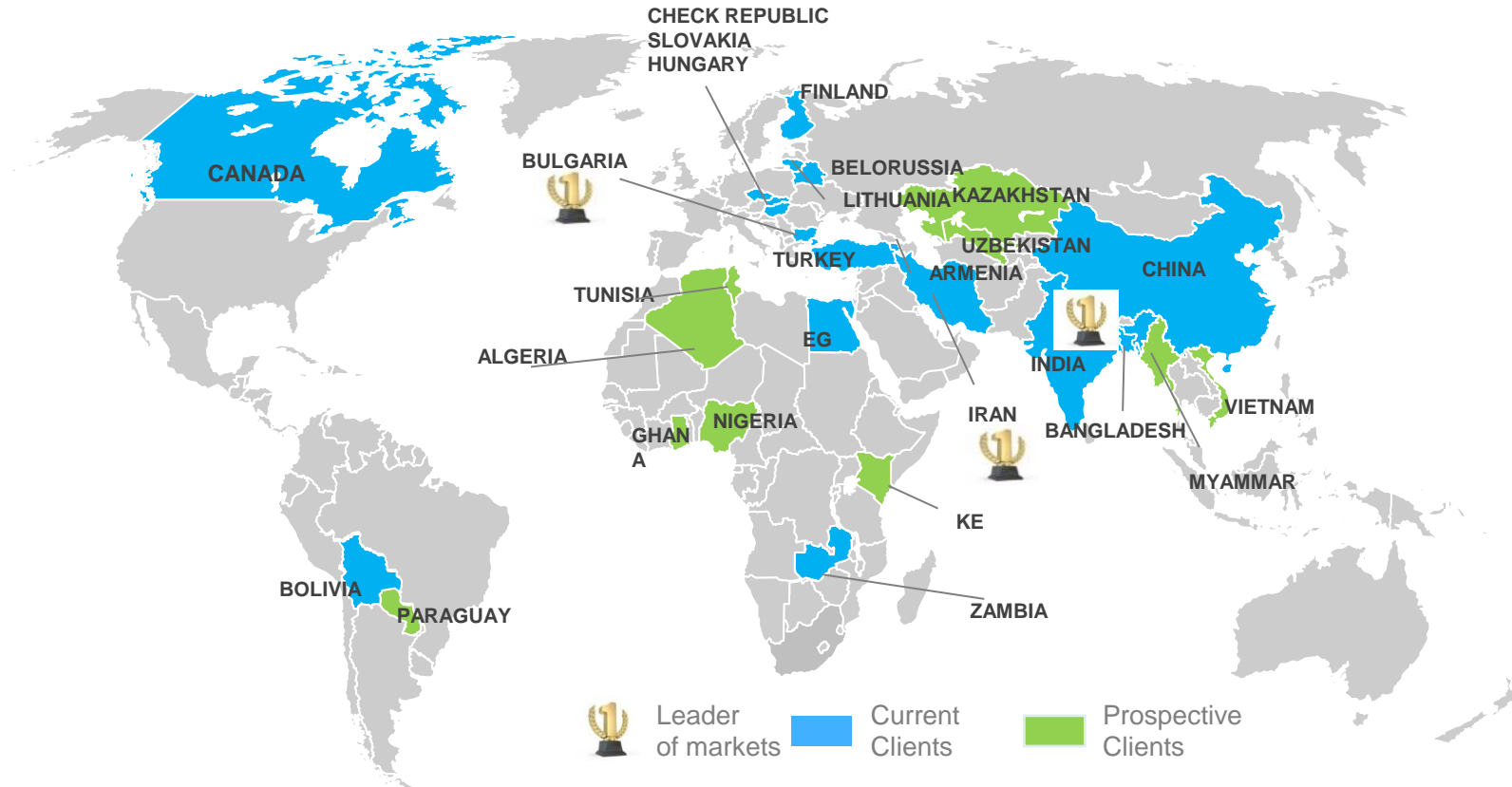
- Pilot project: decommissioning of Novovoronezh NPP units Nos. 1-2 with completion in 2035;
- The proven experience will be replicated at other nuclear power plants

TO OBTAIN A REFERENCE OF EXPERIENCE AND ENTRY TO THE INTERNATIONAL MARKET:

- Performance of the decommissioning activities at the first stage of Beloyarsk and Leningrad NPPs (by individual decisions from the time of shutdown);
- Establishment within the perimeter of State Corporation Rosatom of a new model of the decommissioning that allows to concentrate the obtained reference experience for entering to the international market.

New businesses of Electric power division Product and geographic diversification

-  Nuclear infrastructure
-  Sales of electricity
-  Personnel training
-  Production of isotopes
-  Technical customer services
-  Support to Conduct of operations
-  Commissioning activities
-  Decommissioning and radioactive waste management
-  Service, LTE, Upgrading



In 17 countries

Contracts signed

In 3 countries

Leaders of the service market

> 200 bln. roubles

Portfolio of new products for the period of 10 years outside the corporation Rosatom

One of strategic development directions is the personnel training

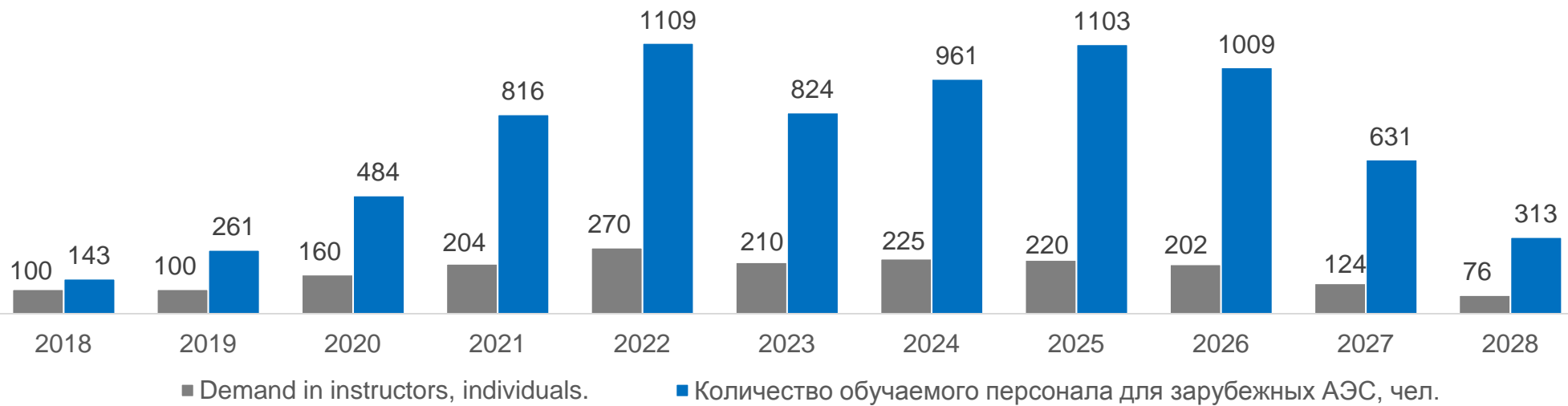
1. Recruitment of young, qualified personnel to the industry

Annual demand for young specialists at the NPPs of REA is **360** individuals.

NRNU MEPhI	Ivanovo State Energy University	Tomsk State Polytechnic Institute	Ural Physical University in Ekaterinburg
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Establishment of Technical Academy Rosatom (in 2017), an autonomous non-profit organization of vocational professional training:

2. Training of personnel for foreign NPPs



3. Continuous training and qualification improvement of the specialists from REA and foreign customers

Strategic business indicators on the horizon until 2030

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Current level

Share in the electricity market of the Russian Federation

+10%

Electricity generation

13

Commissioning of new NPP units

11

Lifetime extension of the NPP units

↑ in 3 times

Revenue from new businesses

↑ in 3 times

Foreign revenues (services of the NPPs abroad)

↑ in 2 times minimum

Growth of the revenues

3. Mid-term strategy (15-30 years)

Reactor VVER-S

- Reduction of natural uranium consumption;
- Reduction of capital costs;
- Full refusal from liquid boron control;
- Operation in dual-component nuclear power system with BNs

Commercial RBN

- Development of commercial RBN units for optimization of the dual-component NPS within a united CNFC;
- Optimization of the technologies of Pu application produced from VVER and uranium-238;
- Testing of technologies of application of nuclear fuel cycle with minor actinides for its burn-out in RBNs

Nuclear hydrogen energy

- Large-scale hydrogen production based on technologies of high-temperature gas-cooled reactors (HTGCR);
- Improvement of the technologies;
- Hydrogen energy infrastructure development

Small and mid capacity NPPs

- Development of reference competitive nuclear plants of small and mid capacity (ASMM and ASSM) and testing of key technologies

Role of REA in implementation of the nuclear energy development strategy of State Corporation Rosatom

1 2 **3** 4 5 6 7
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Current state

Operator of nuclear power plants in the Russian Federation and the head organization of the developing Electric power division

Near-future strategy (to 2034)

Operator of nuclear power plants in the Russian Federation and global energy market company with a significant share of revenues from the sale of new products and businesses in the foreign markets

Mid-term strategy (to 2045)

Global energy market company and a potential customer for strategic and cost effective projects in the mid-term stage of the nuclear energy development strategy in Russia