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Closed NFC *as a Way to Securing a Green Nuclear Power System*

The IFNEC Reliable Nuclear Fuel Services Working Group

THE FUTURE OF SPENT FUEL MANAGEMENT

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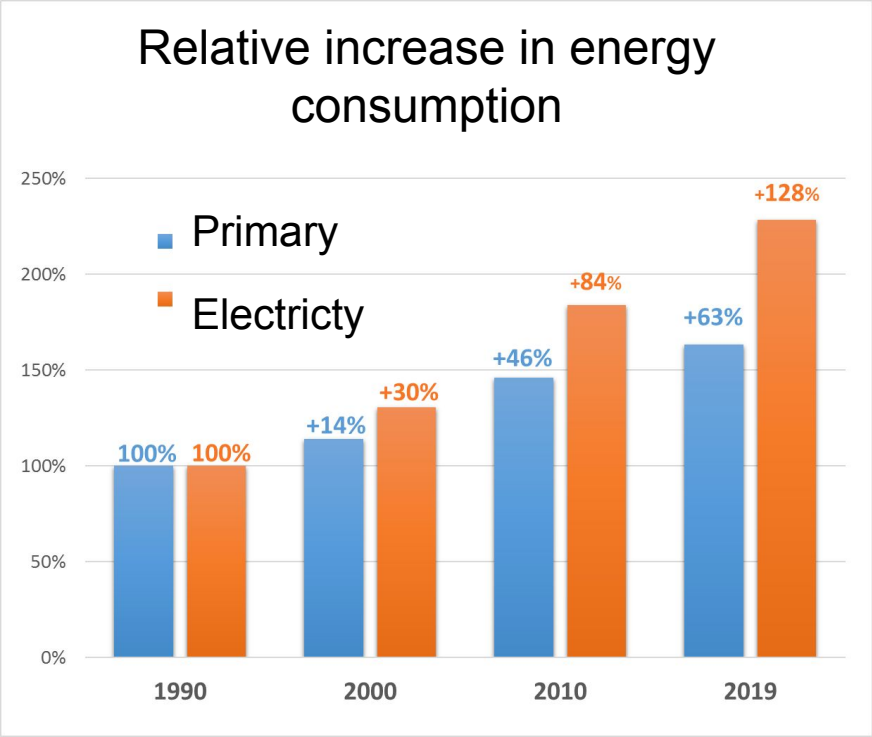
Electrical energy industry is a key segment of energy consumption growth in the XXI century



- Data from yearbook.enerdata.ru

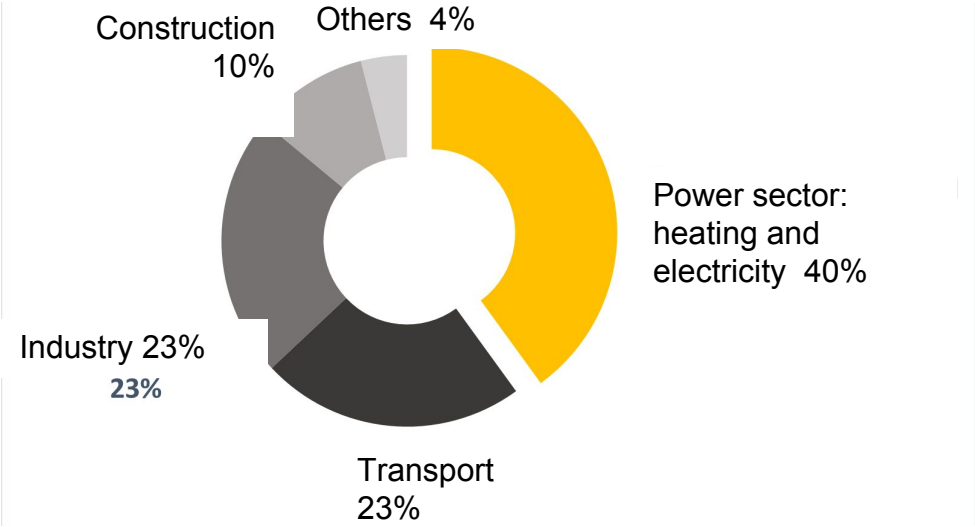
Key figures:

~ 85% 85% of global primary energy consumption was provided through coal, oil and gas

~ 50% of the global increase in electricity generation in 2010-2018, despite the rapid growth of renewable energy, is accounted for coal, oil and gas

Contribution of the electric power industry to CO2 emissions

Structure of CO2 emissions by sectors



The largest emitters of CO2 are China, USA, India, Russia, Japan, Germany

- Data from IEA 2021

Generation structure, emissions, cost

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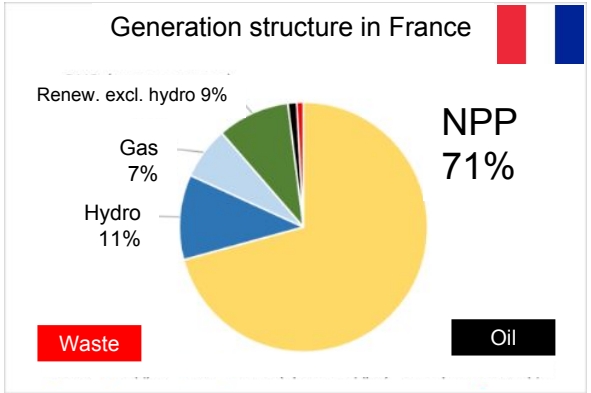
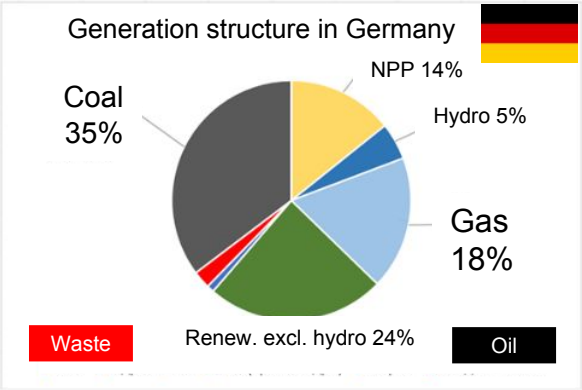
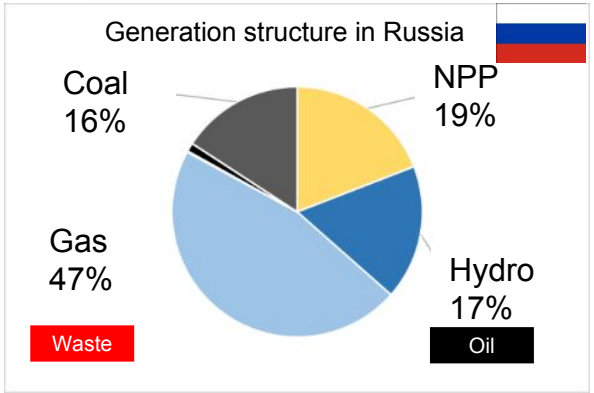


39 g CO_2 eq./kWh
0,18 €/kWh*



380 g CO_2 eq./kWh

0,31 €/ kWh*



325 g CO_2 eq./kWh

0,05 €/kWh

IEA, COUNTRY SPECIFIC ELECTRICITY GRID GREENHOUSE GAS EMISSION FACTORS 2020

* Eurostat – 1st quarter of 2019, tariffs for the population

Global demand for a "green" source of electricity

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Clean

- Low-carbon
- Environmentally friendly
- Waste-free

Inexpensive

- Guaranteed cost of electricity over the long term

Unlimited

- Sufficient resources
- Independence from weather conditions
- Compactness

Nuclear power is a reliable and affordable source of "green" electricity

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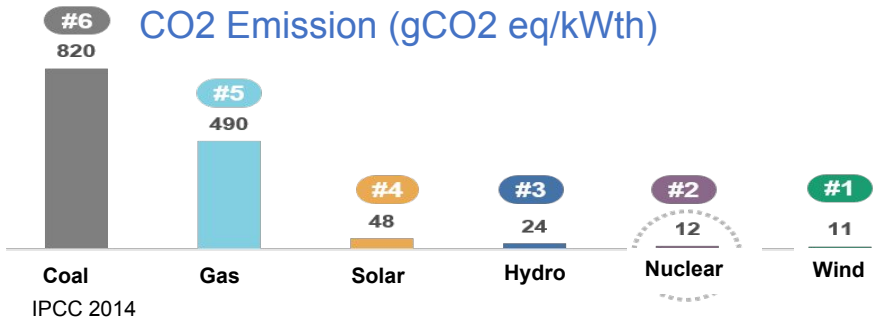
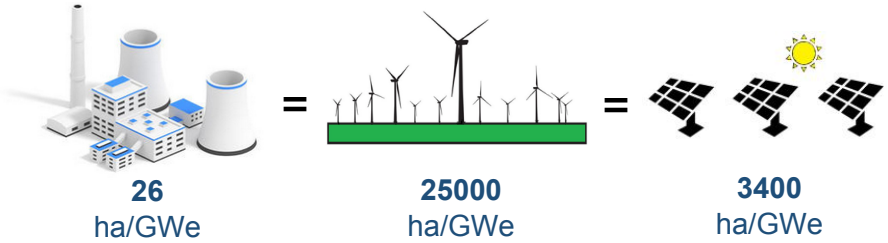
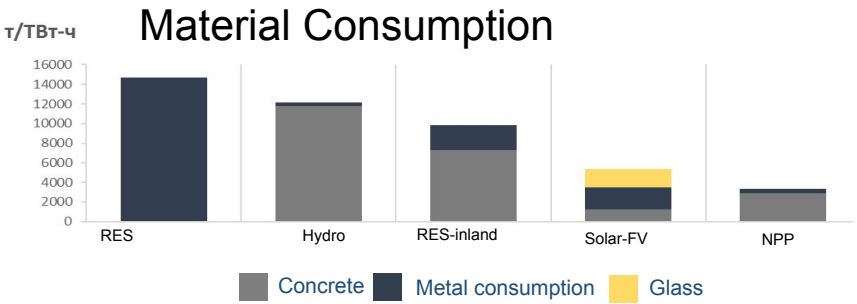
Minimum CO2 emissions



The smallest territory, the independence of the production from weather conditions



Low specific consumption of materials



Conditions for the large-scale development of nuclear energy

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Sufficient resources

No restrictions on the raw material resources

Environmental safety

Waste-free

Radiological equivalence of radioactive waste and raw uranium materials

Solving the legacy problem

Closed Nuclear Fuel Cycle: Expanding the resource base

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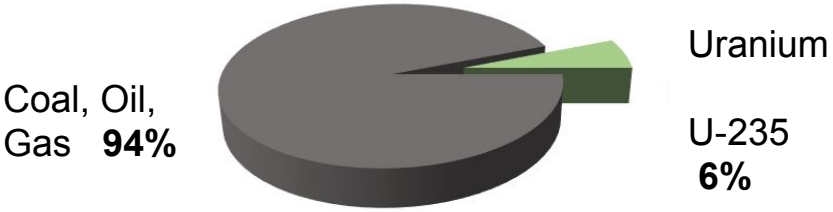
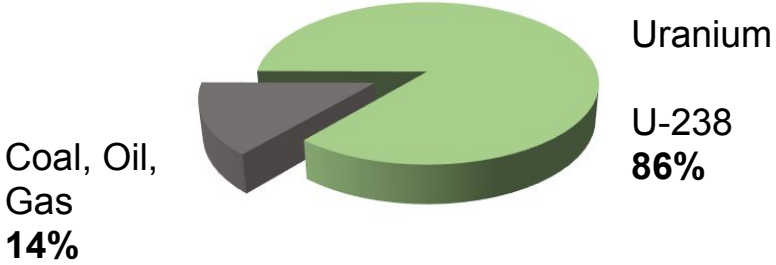
Relative energy potential of various natural energy resources





Open Nuclear Fuel Cycle:

limited by the resource base of natural uranium

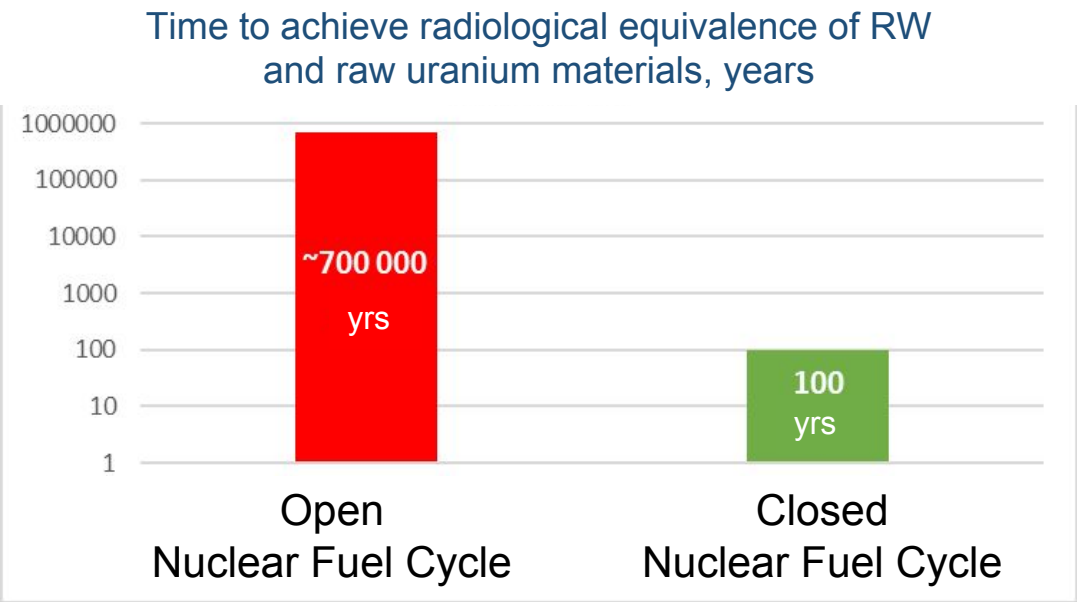
Closed Nuclear Fuel Cycle:

on the basis of fast reactors, due to the use of ^{238}U the problem of nuclear power plant fuel resources is fundamentally eliminated

Radiological equivalence of radioactive waste (RW) and uranium ore

Radiological equivalence is the equalization of lifelong radiation-related risks of cancer.

Radiation equivalence is the equalization of effective radiation doses from radioactive waste and natural uranium.



Solving the legacy problem

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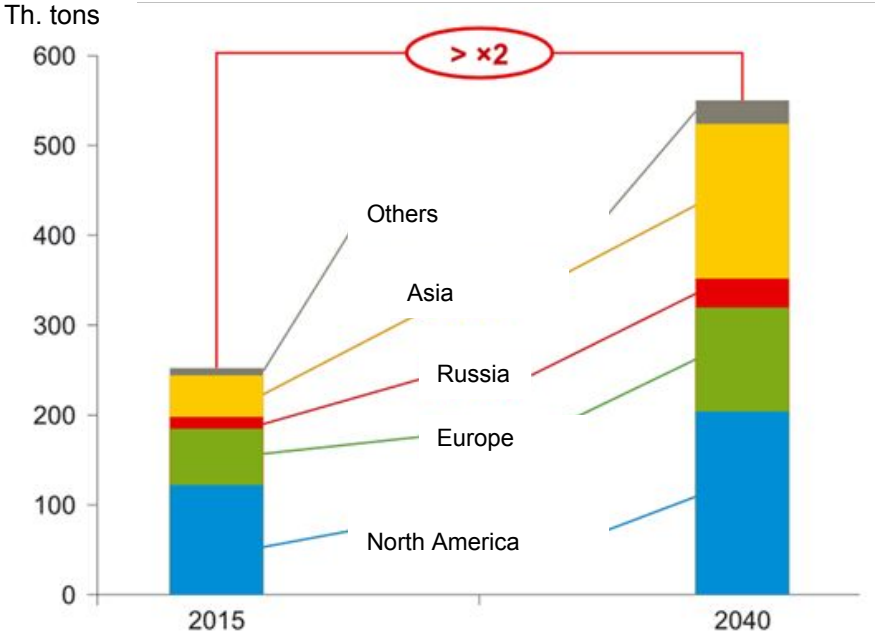
Open NFC

SNF accumulation forecast



Closed NFC

SNF is a source of raw materials (plutonium, regenerated uranium) for the development of a new generation NPP fleet

Fast neutron reactors – afterburning of minor actinides and the absence of the need for deep geological burial of RW

Closed NFC – meeting the conditions for large-scale development of nuclear energy

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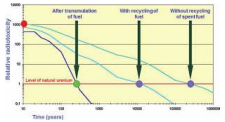
The use of fast reactors for the reproduction of the fuel base

Ecological safety



Closed NFC:
“Breakthrough”
Project

Waste-free

Sufficient resources for large-scale development

Justification of the closed NFC on PDEC

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2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030

Construction and commissioning
PDEC Fuel Fabrication Module

Equipment manufacturing, construction
Power-generating unit with BREST-OD-300

Construction and commissioning
PDEC Reprocessing Module

The “Proryv" project is a practical demonstration of all the elements of the closed NFC at the PDEC and the development of commercial FR

Development of the Russian nuclear power industry on a new technological platform

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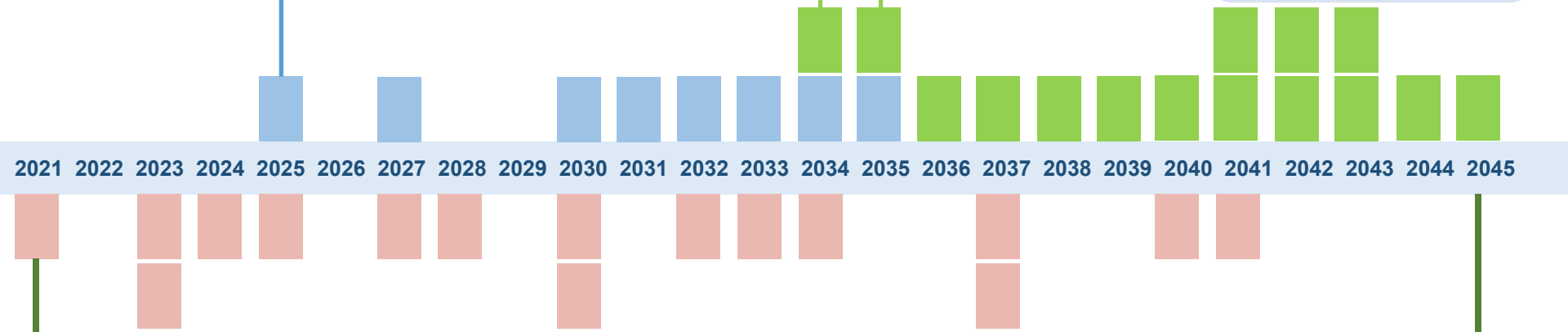
2025
Kursk NPP
VVER-TOI

2034
Kola NPP
VVER-C

2035
Beloyarsk NPP
BR-1200

during the period 2036 – 2045, **13** blocks need to be built



20%
of power balance in 2020

25%
of power balance in 2045

commissioning of serial power units

decommissioning of power units

commissioning of serial power units of a new technological platform

Nuclear Power System with closed NFC is a key to Sustainable Development and Entering to Taxonomy

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Addressing the issues of combating climate change and protecting the environment:

Reducing CO2 emissions

Guaranteed safety

No restrictions on the resource base

Minimizing waste requiring disposal and solving “legacy problems”

“Breakthrough” Comes True

Closed NFC – way to Green Energy Status for Nuclear Power

Thank you
for your attention