Yves Desbazeille

Director General, nucleareurope, 13 June

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ABOUT nucleareurope

Who we are

We act as the voice of the European nuclear industry in energy policy discussions with EU Institutions and other key stakeholders

Membership

The membership of nucleareurope is made up of 15 national nuclear associations representing more than 3,000 companies.

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Corporate Members:

CEZ (Czech Republic),
Fermi Energia (Estonia),
Nuvia (France),
PGE EJ1 (Poland),
Rolls-Royce led SMR
Urenco (Global)

NUCLEAR ENERGY AT EU LEVEL

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What does nuclear contribute to the EU's economy?

104 Nuclear reactors in operation in the EU

1 million jobs

€ 100 billion/year

25% of the electricity production

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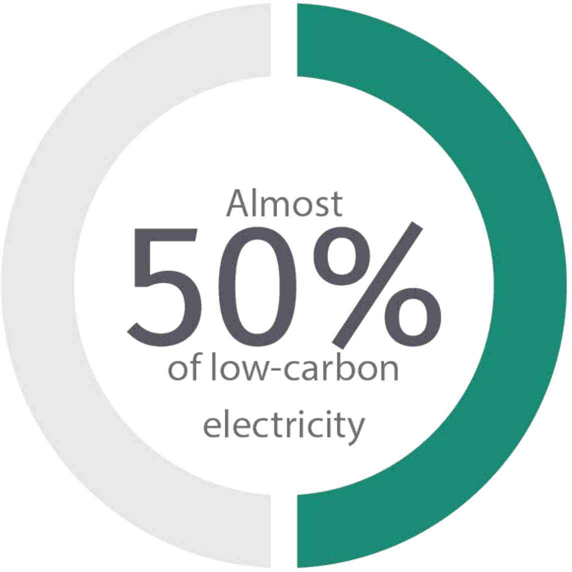
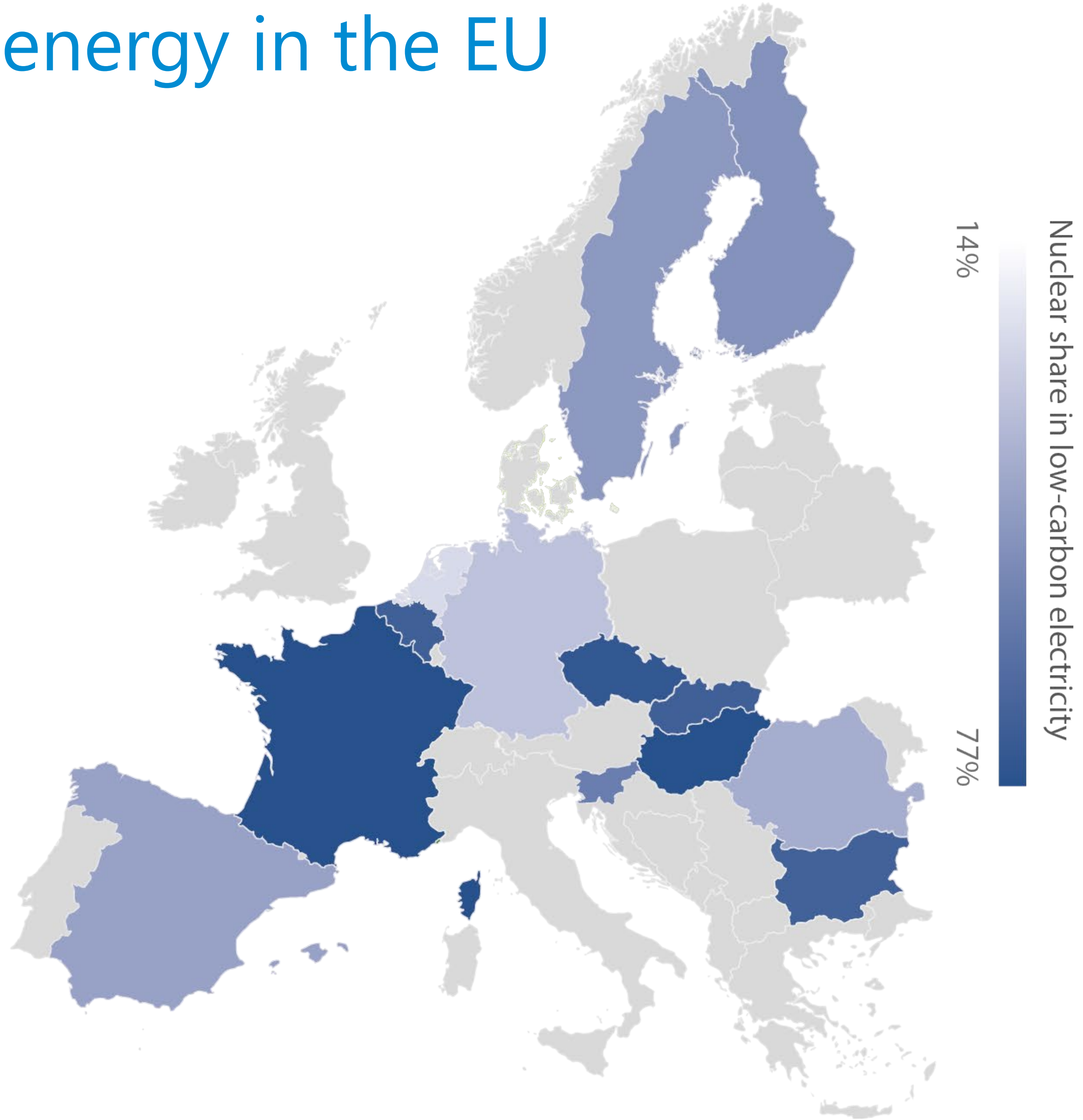
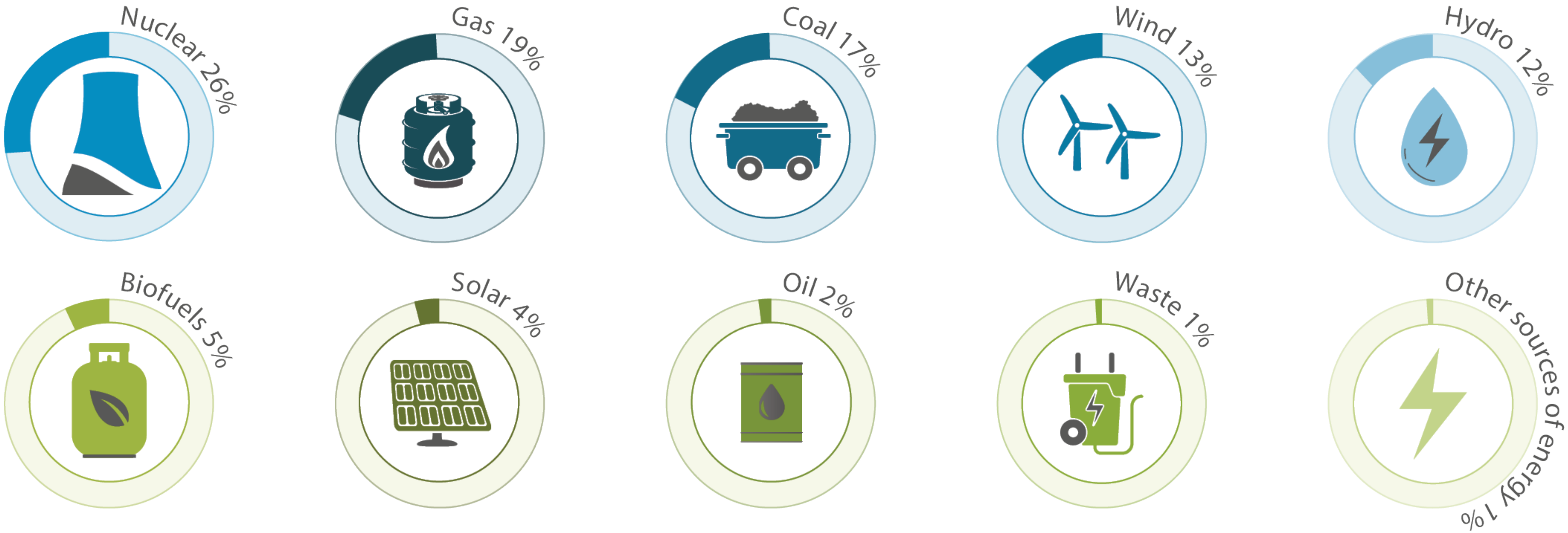
Nuclear energy in the EU



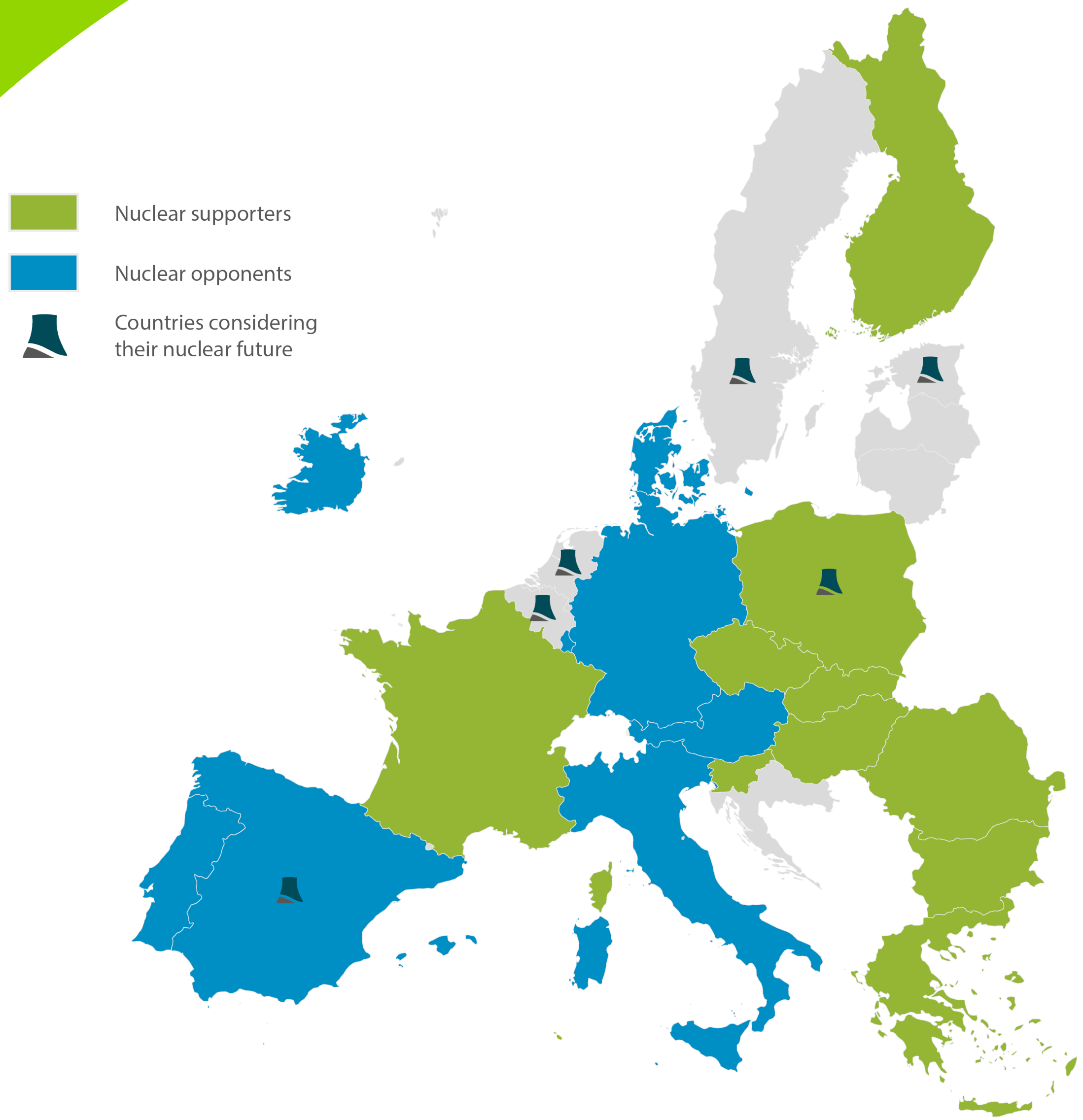


Status of EU's power sector

Electricity generation by technology (% in 2019)



EU balance of powers



Many EU states have announced their plans to invest in or continue using nuclear energy:

- Bulgaria
- Czech Republic
- Estonia
- Finland
- France
- Hungary
- Netherlands
- Poland
- Romania

All nuclear projects, examined by the EC, have been cleared and will be carried out.

Each MS has the right to choose nuclear as part of its energy mix in line with the objectives of the Euratom Treaty.

BENEFITS OF NUCLEAR

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Nuclear as an electricity provider

Carbon neutrality will require the increased electrification of industry

But this electricity will need to be clean, affordable & available 24/7

NUCLEAR IS

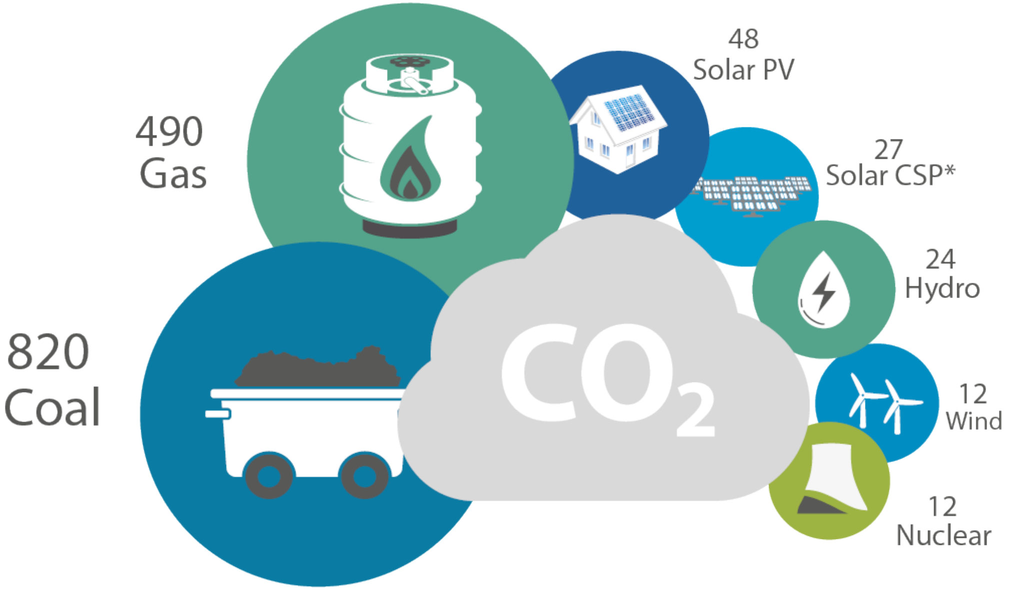
LOW CARBON
12 grammes CO2 eq. per kWh

AVAILABLE 24/7
Produces electricity at full power 90% of the time

AFFORDABLE
LTO of existing reactors has the lowest LCOE of all technologie

Nuclear is low-carbon and avoids SO_2 and NOx emissions

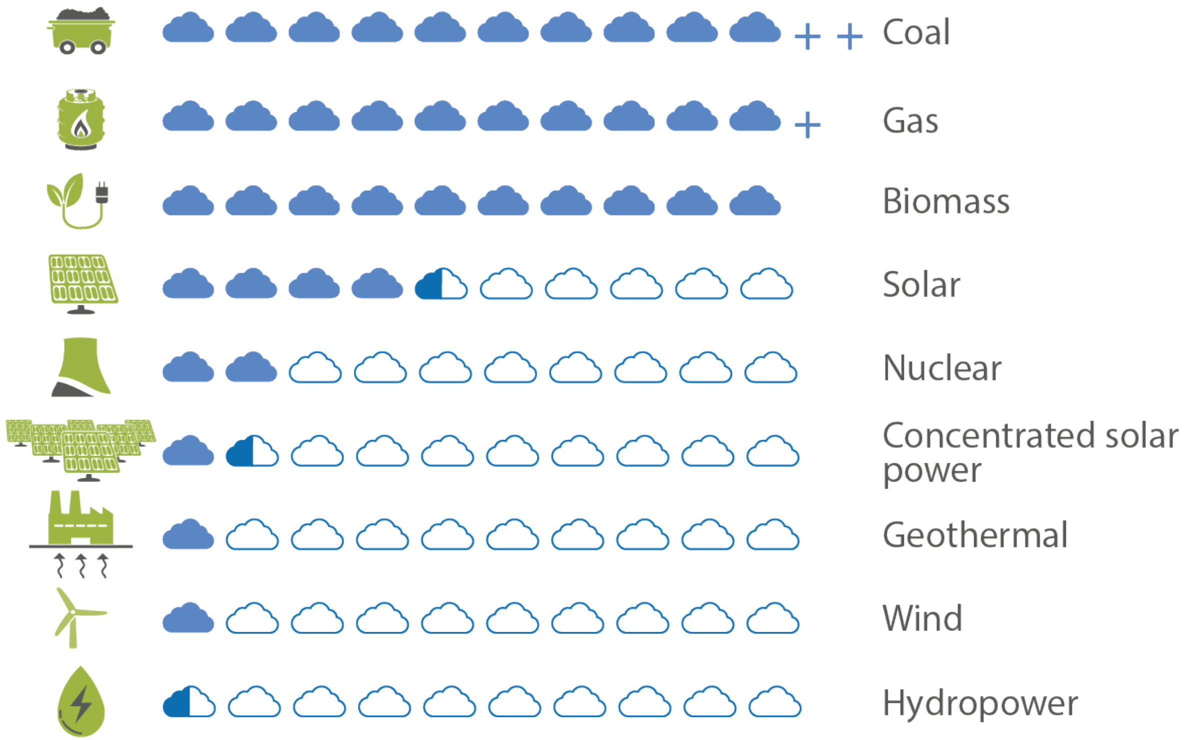
The amount of CO_2 emitted by nuclear energy is comparable to that of renewables.



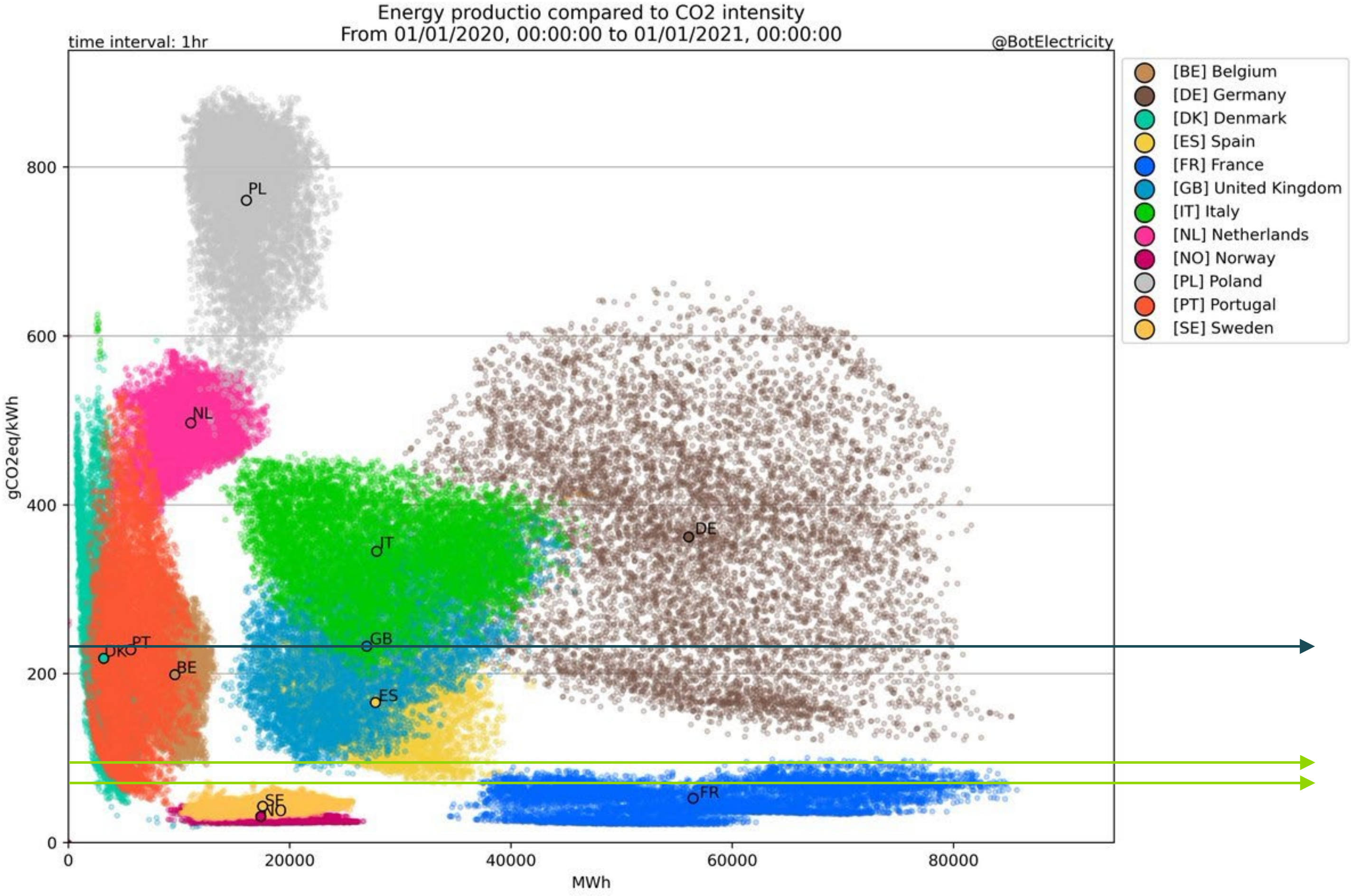
Comparison of average greenhouse gas emissions (grammes CO_2 eq/kWh)

*Concentrated Solar Power

Average lifecycle SO_2 and NOx emissions of different generation technologies



EU power production CO2 intensity – 2020

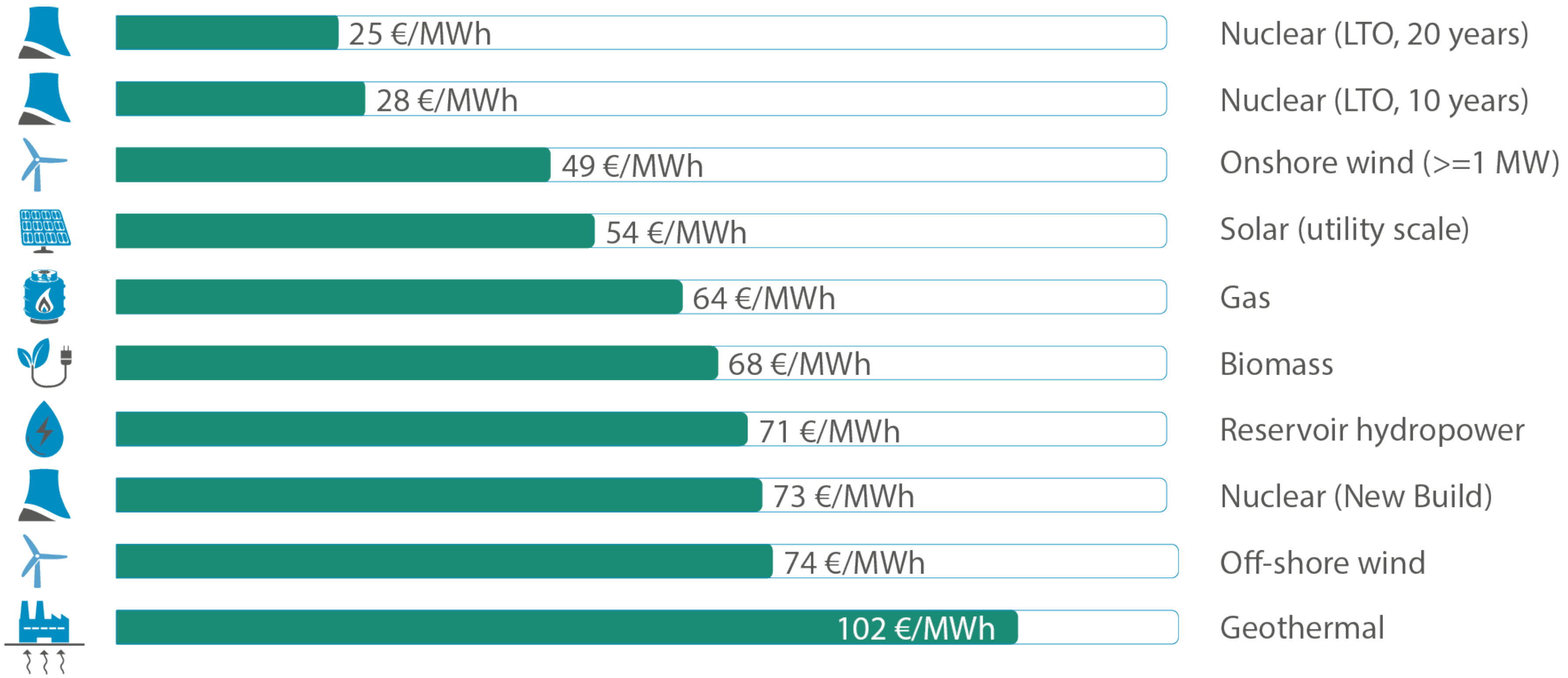


The EU power mix average carbon intensity in 2020 (230 gCO2eq/kWh)
Source: European Environment Agency

The EU power mix average carbon intensity 2030 target
(between 75 gCO2eq/kWh and 97 gCO2eq/kWh)
Source: European Environment Agency

Nuclear electricity is affordable

Comparison of LCOE (levelized cost of electricity) for different technologies in Europe (7% discount rate)



*LCOE metrics are not sufficient to characterize the competitiveness of different power generating technologies. A comparison should include system costs, i.e. networks and flexibility costs in addition to the sole production costs.

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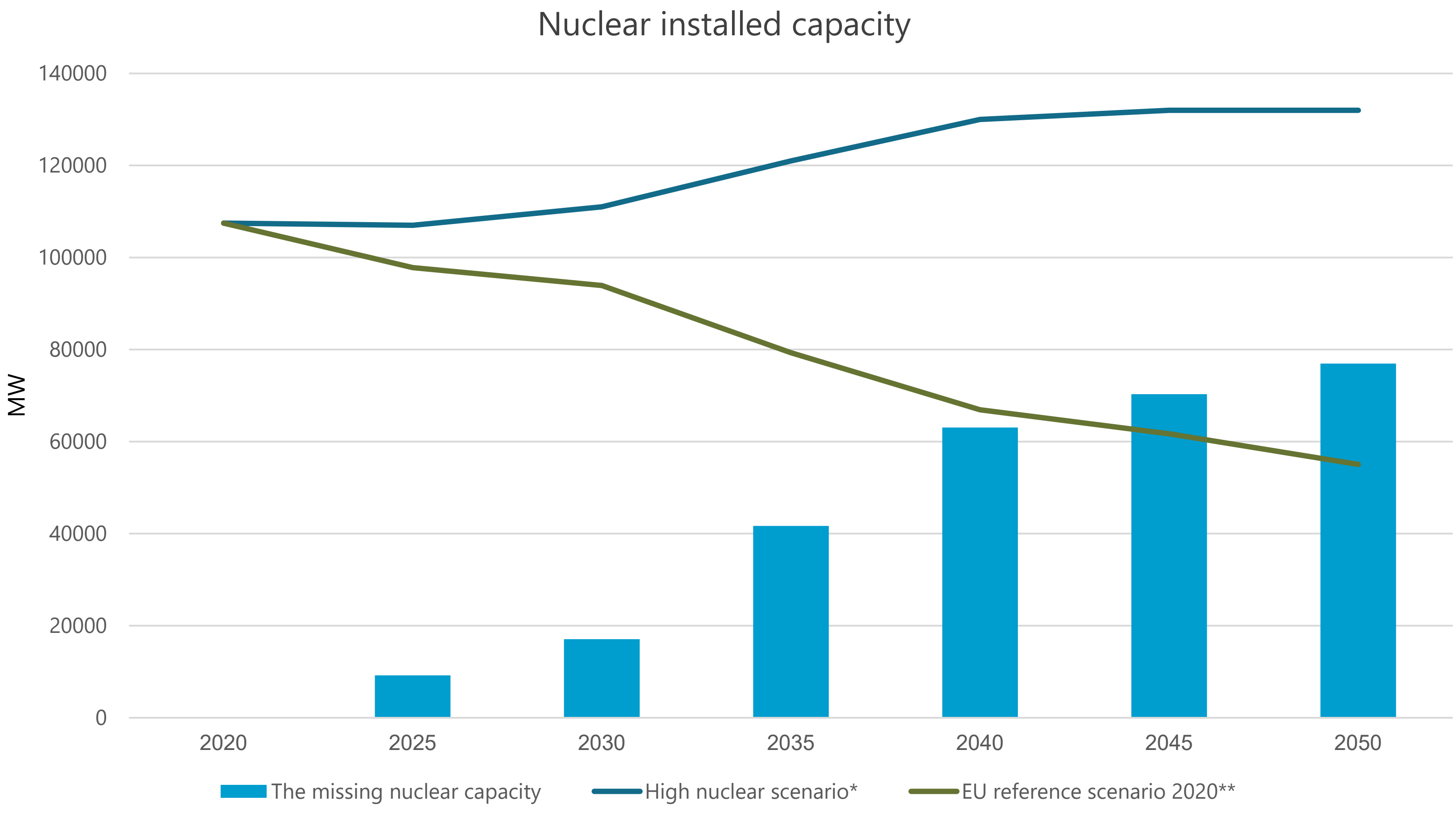
2050 Nuclear scenarios



* The updated "Pathways to 2050: Role of nuclear in a low-carbon Europe" report, Compass Lexecon, November 2021
** EU Reference scenario 2020, released in July 2021

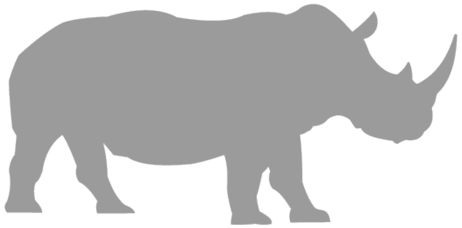
THE QUESTION OF NUCLEAR WASTE

Sources of radioactive waste

- Nuclear Power Plants
- Industry
- Hospitals
- Research centres
- Universities etc...

On average, each year one person generates:

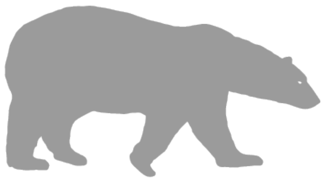
1.36 tonnes of total waste

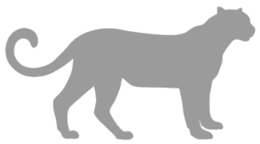


270 kg Municipal solid waste

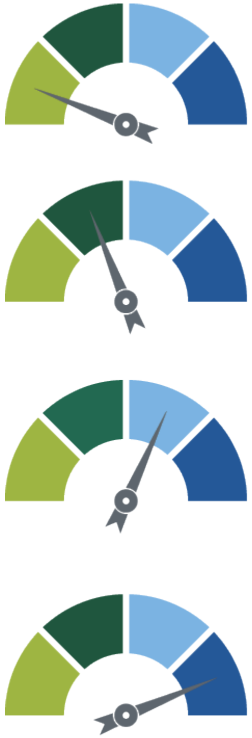
54 kg Hazardous waste

54 g Radioactive waste





Types of radioactive waste and their distribution per category (2016)

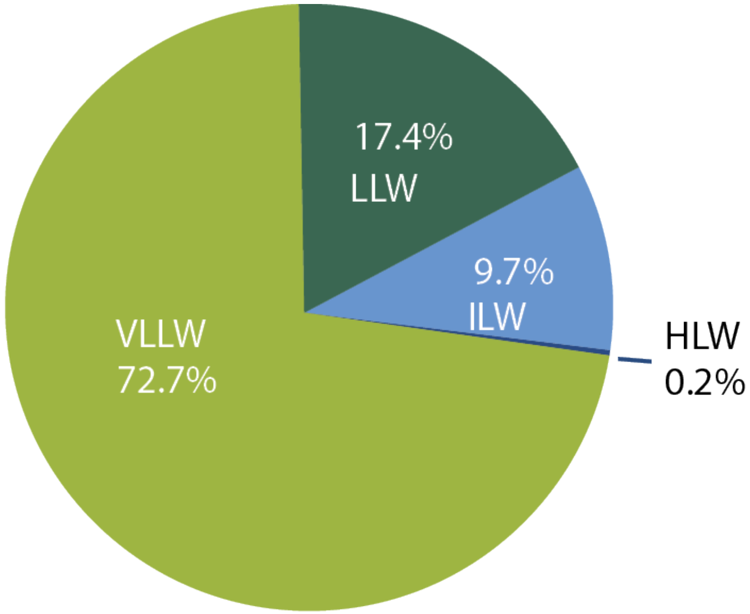


Very low level waste (VLLW)
E.g., concrete

Low level waste (LLW)
E.g., scrap metal

Intermediate level waste (ILW)
E.g., nuclear reactor components

High level waste (HLW)
E.g., by-product of fuel reprocessing

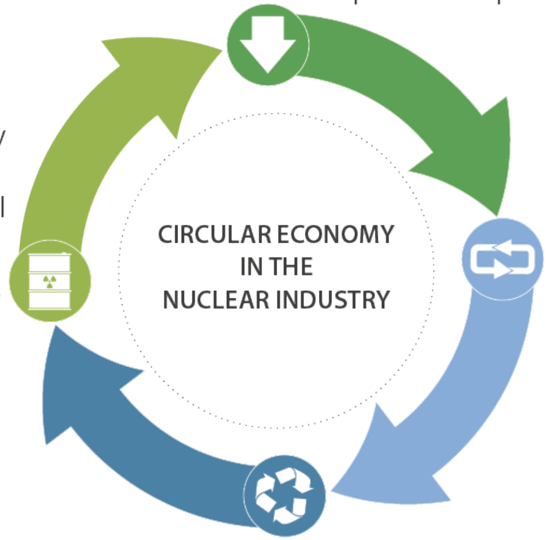


© nucleareurope - Source: 2016, *Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects*

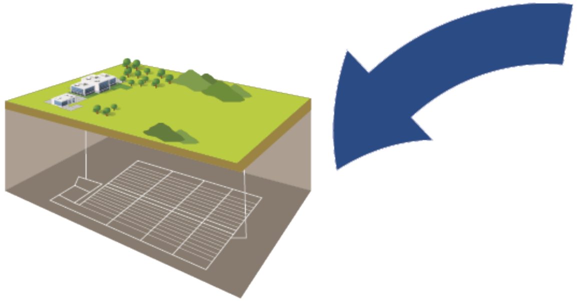
Applying a circular economy approach to radioactive waste

REDUCE
Reduction in the volumes of waste generated thanks to:
- Improved reactor design
- Improved reactor operation
- Improved fuel production

RESIDUAL
Temporary storage:
Some countries use temporary storage in order to enable the future retrieval and reprocessing of the spent fuel



REUSE
Several technologies exist which enable the reuse of spent fuel. This saves up to around 25% of natural uranium resources, cuts final waste volumes by a factor of 5 and its long-term radiotoxicity by a factor of 10



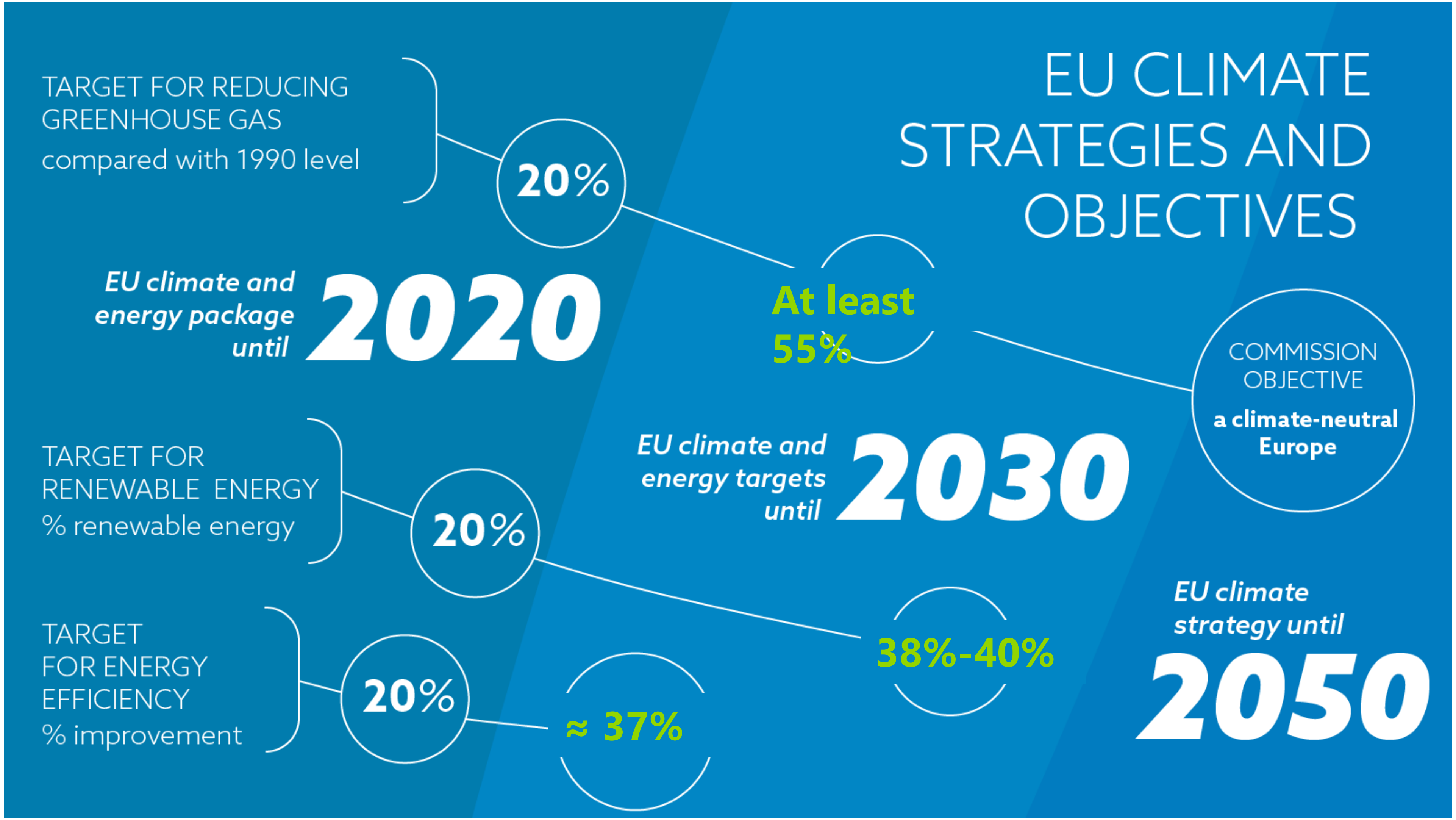
RECYCLE
Construction materials used in nuclear facilities can be fully recycled. Americium and plutonium can be recycled in space, medical and other applications

RESIDUAL
Long-term disposal:
The nuclear sector is a leading example when it comes to the long-term disposal of radioactive waste thanks to, for example, the Deep Geological Repositories currently under development.

DEVELOPMENTS AT EU LEVEL WITH AN IMPACT ON THE NUCLEAR SECTOR

European Green Deal – Fit for 55 Package

Decarbonisation of the EU's economy



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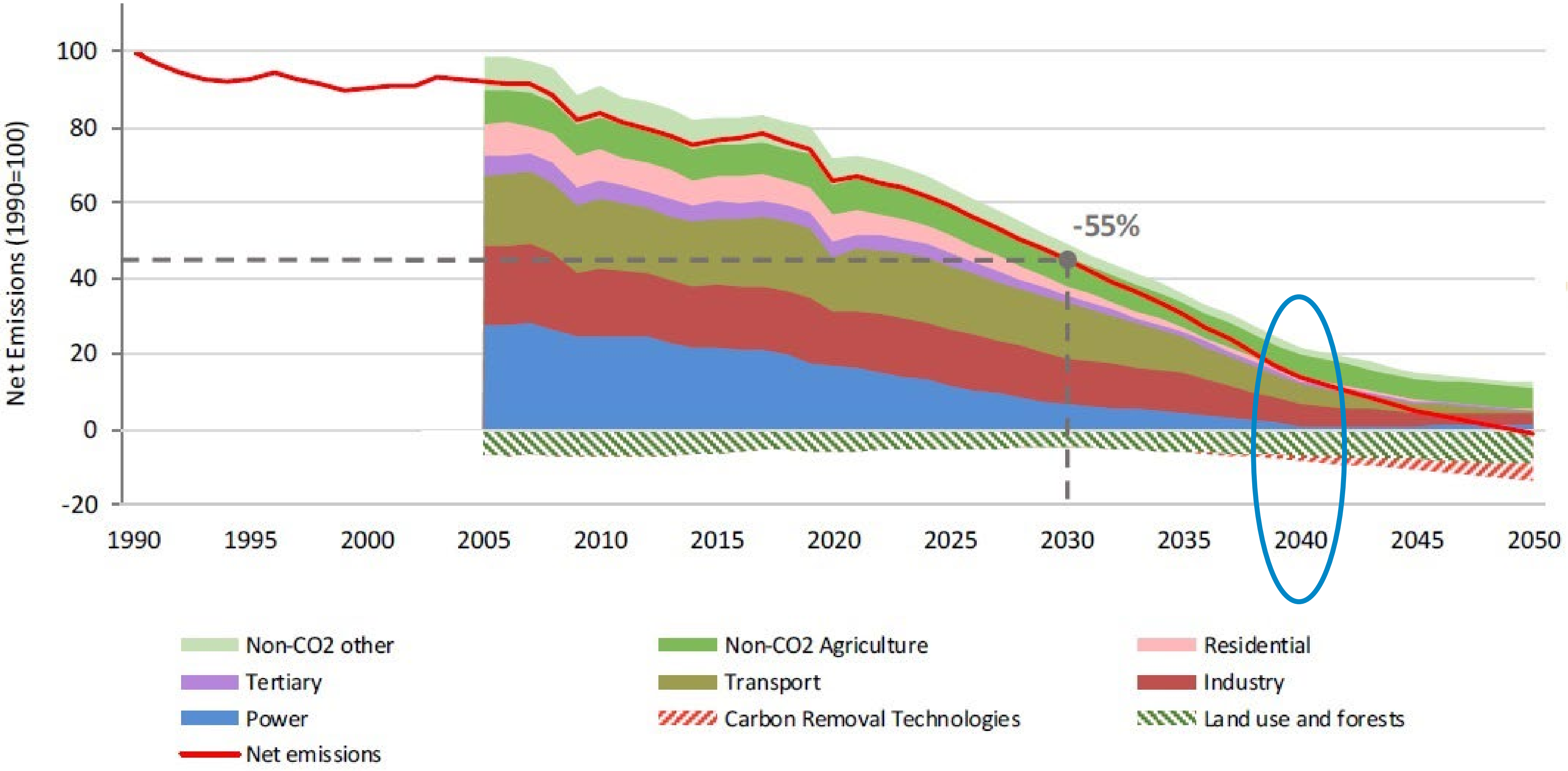
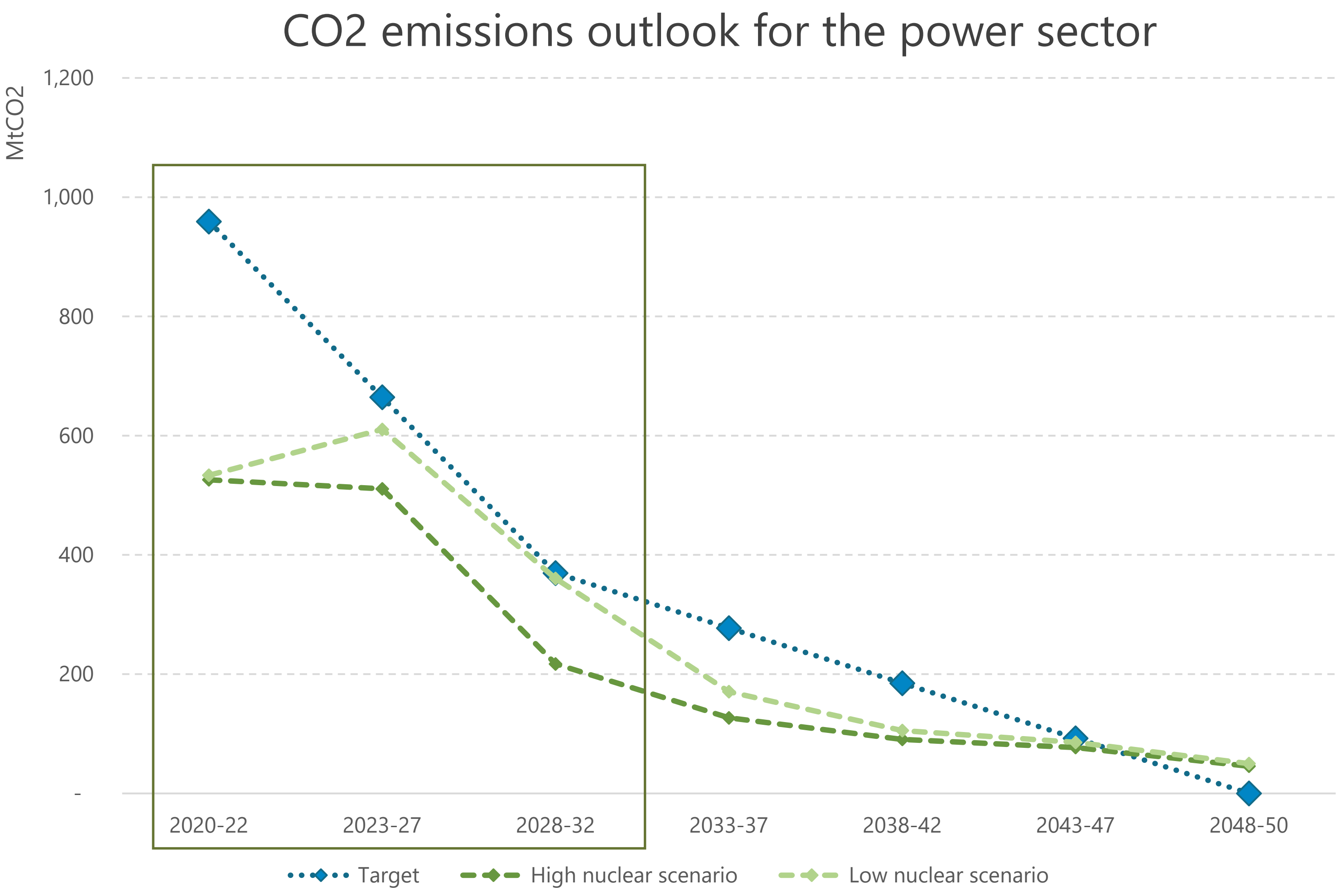
Decarbonisation of the EU economy



Source: Stepping up Europe's 2030 climate ambition - COM(2020) 562 final

The importance of LTO of the existing nuclear fleet



Source: The updated "Pathways to 2050: Role of nuclear in a low-carbon Europe" report, Compass Lexecon, November 2021

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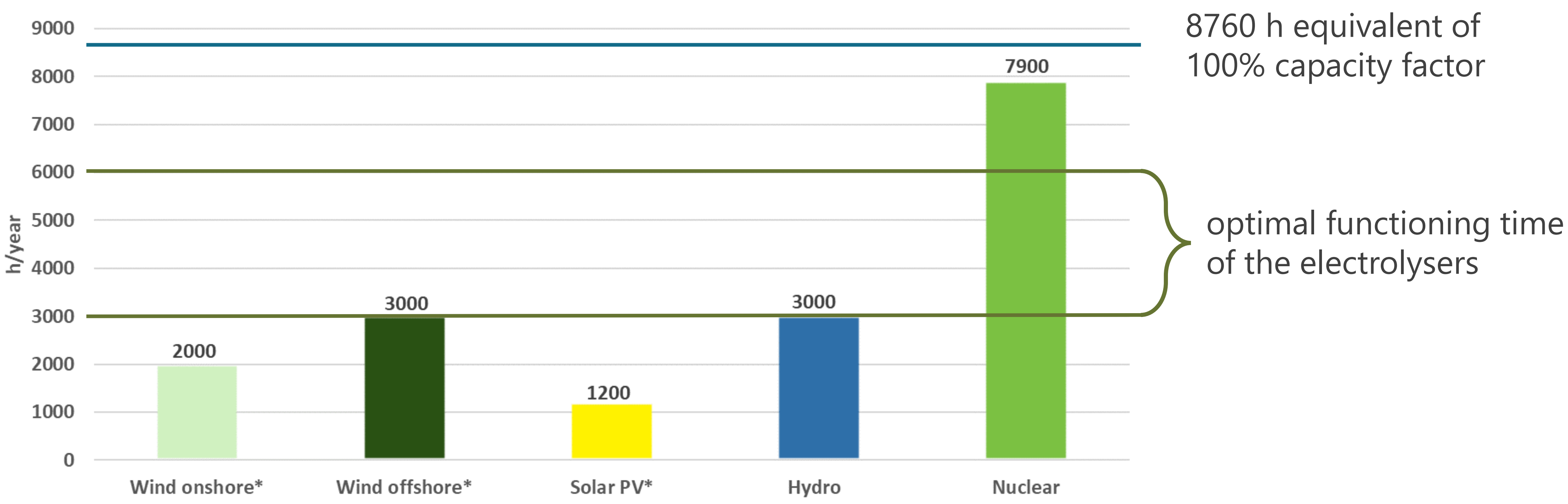
THE POTENTIAL OF NUCLEAR FOR HYDROGEN PRODUCTION

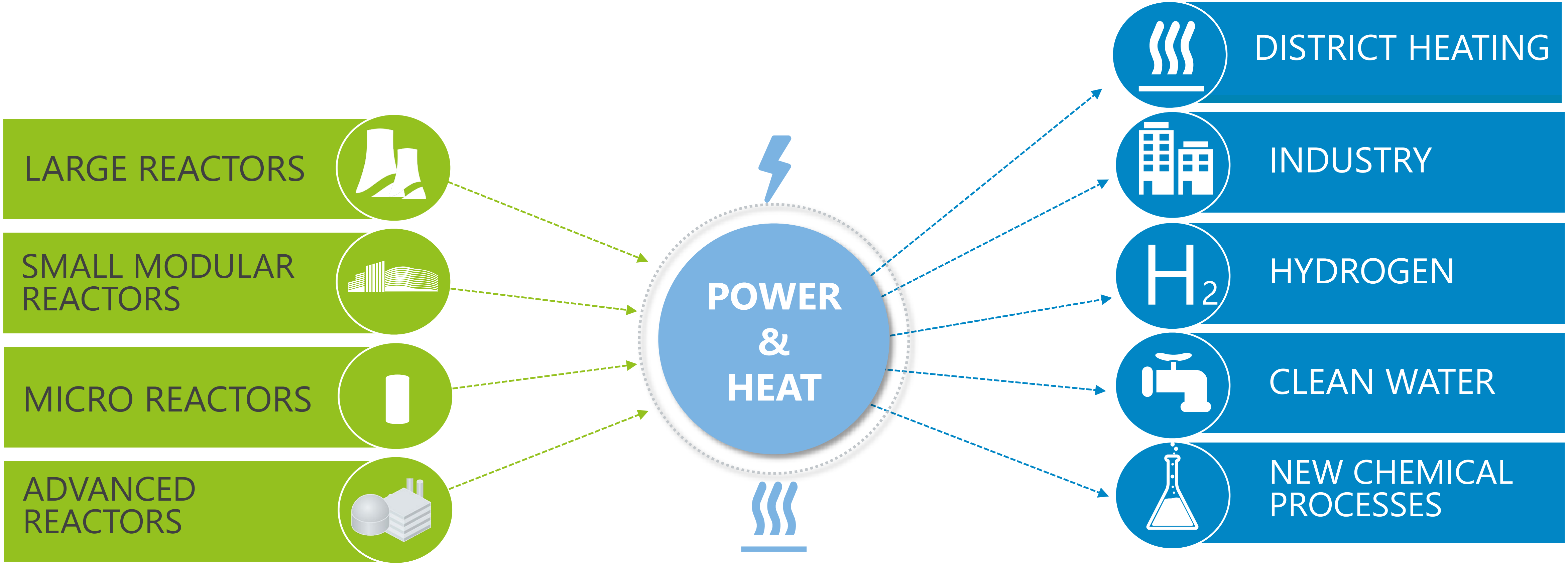
Low-carbon generations capacity factors



- With optimal economic functioning time of **3000h-6000h/year** resting only on renewable doesn't make sense
- The carbon intensity of H2 from grid can fulfil required thresholds only w/ support of nuclear (i.e. France, Sweden or Finland)

*ASSET report for EC on "Technology pathways in decarbonisation scenarios", July 2018
Note: medium capacity factors for 2030 has been considered for the selected technologies

Nuclear and energy sector integration



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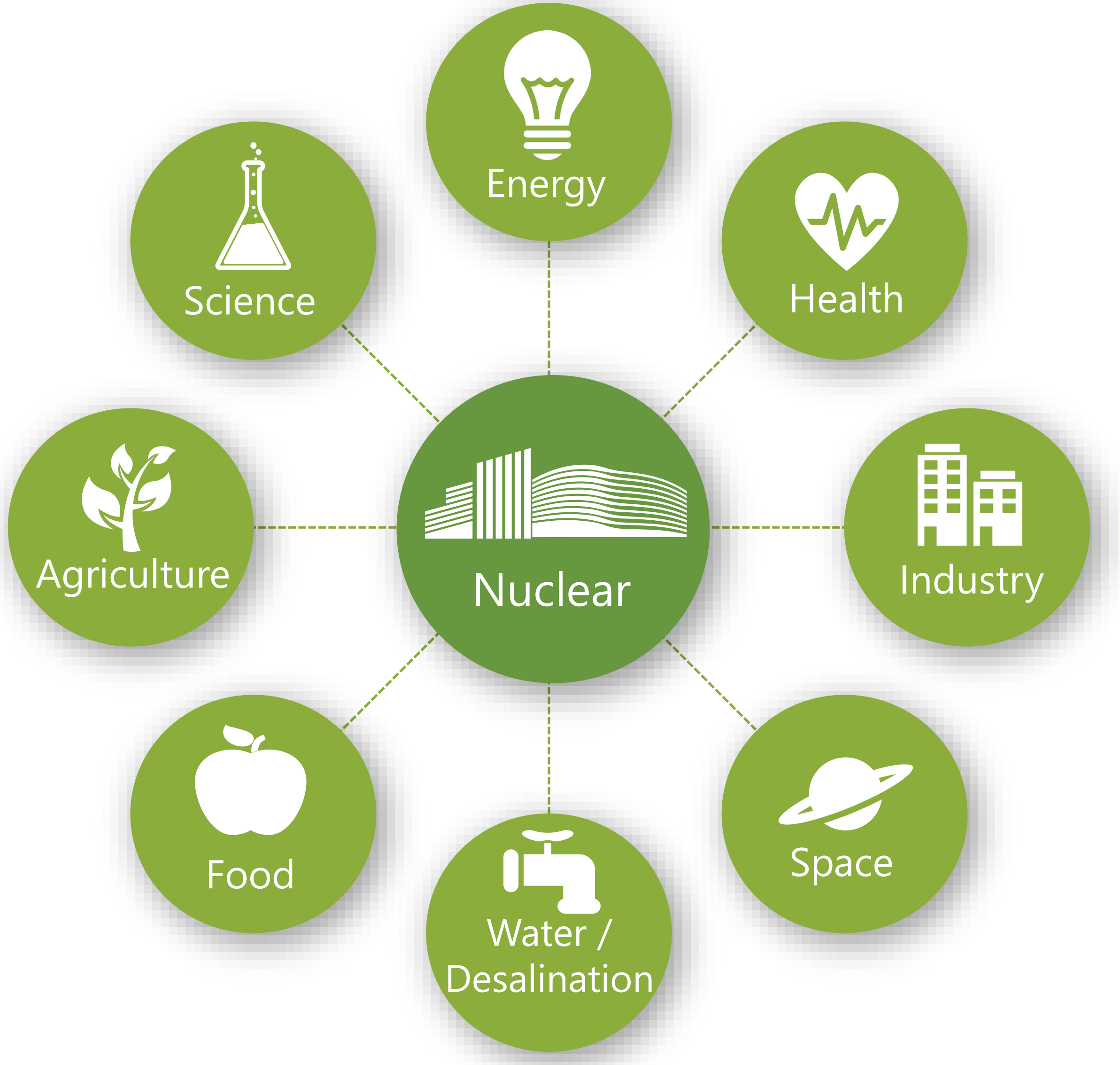
Nuclear: more than just power



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SECURITY OF ENERGY SUPPLY

Security of energy supply

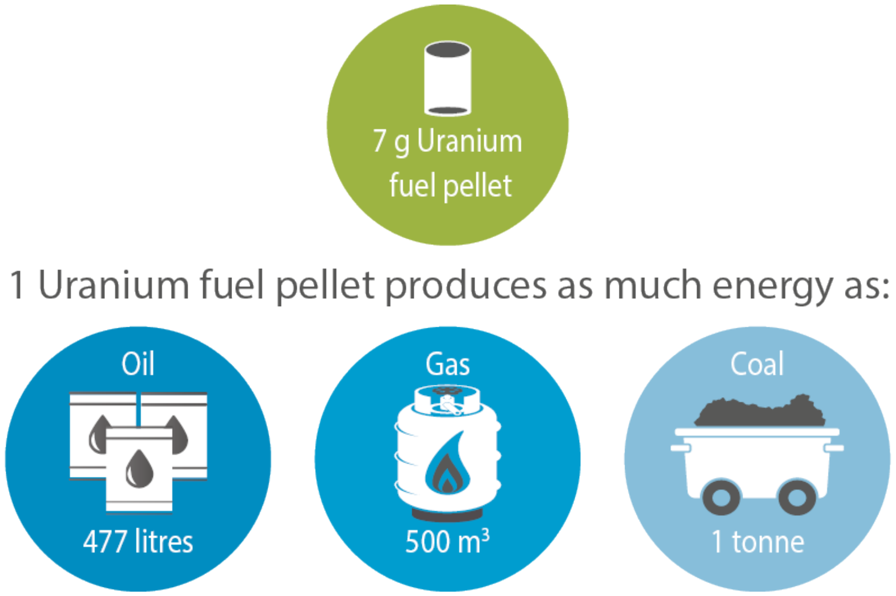
Nuclear technology advantages

- Nuclear fuel is high in energy density leading to advantages regarding transport and storage comparing with some other dispatchable power sources

  - No supply uranium shortages:

"ESA finds that most of the utility inventories are at a healthy level. [...]on average the inventory could fuel a utility for 2.75 years"

Euratom Supply Agency, 2020



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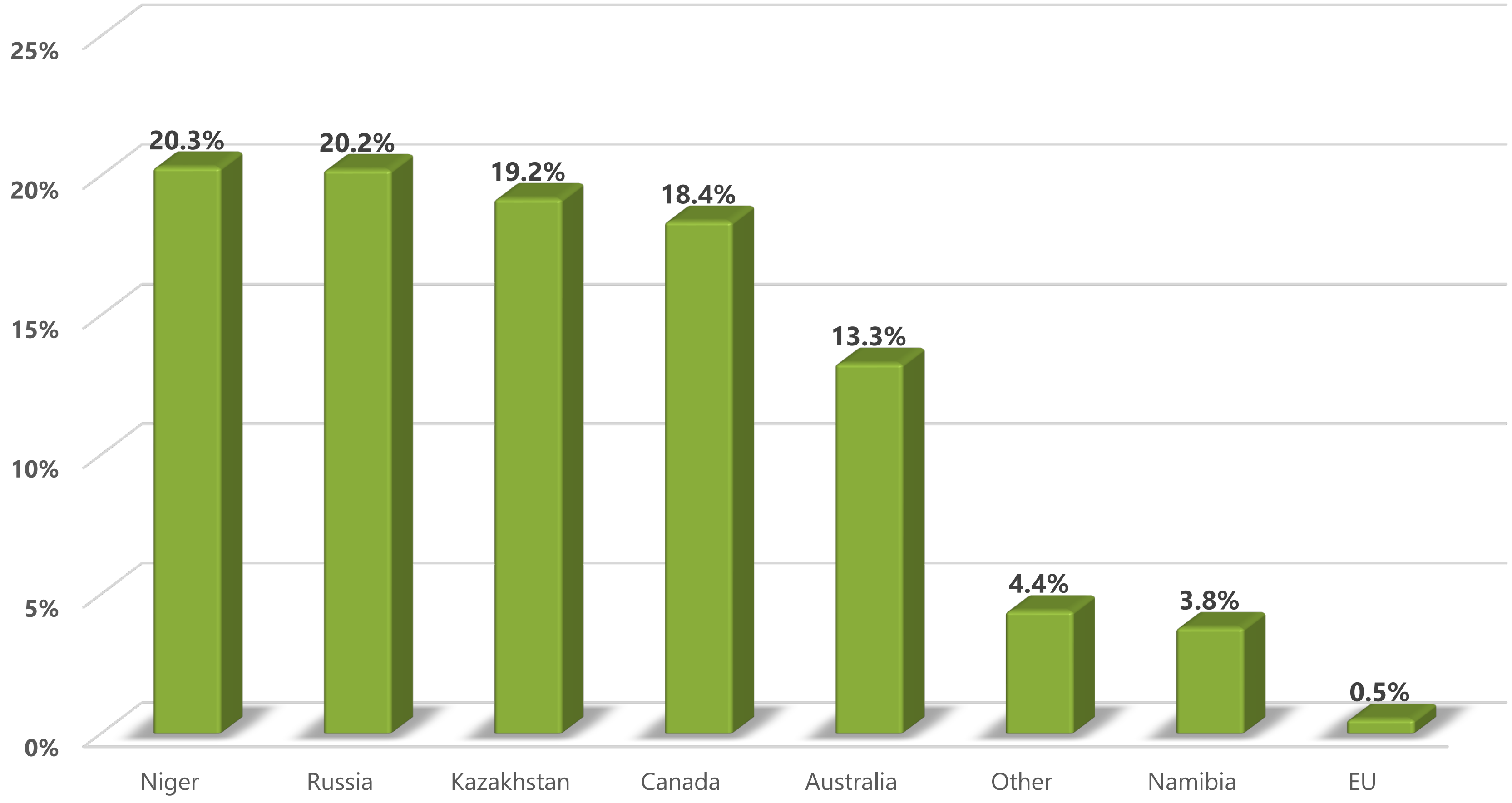
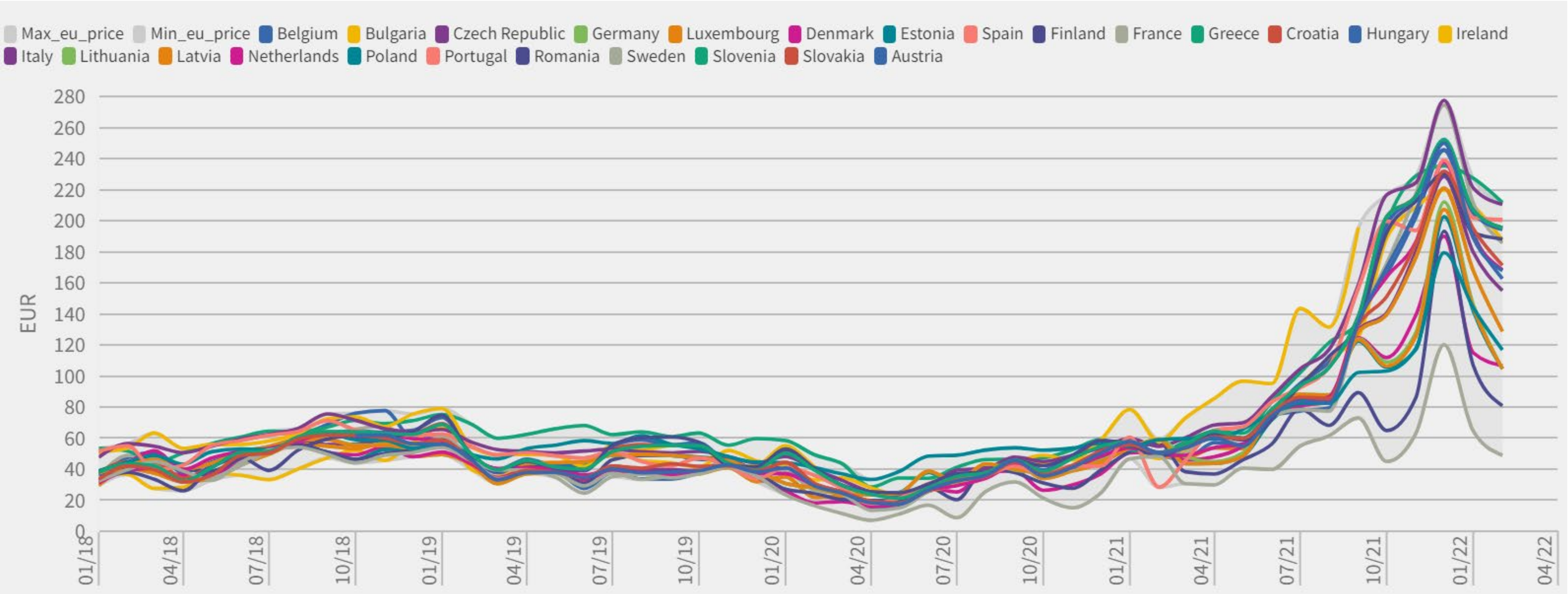
Security of energy supply

Origins of uranium delivered to EU utilities in 2020



Source: Euratom Supply Agency, 2020

Current situation of the power market

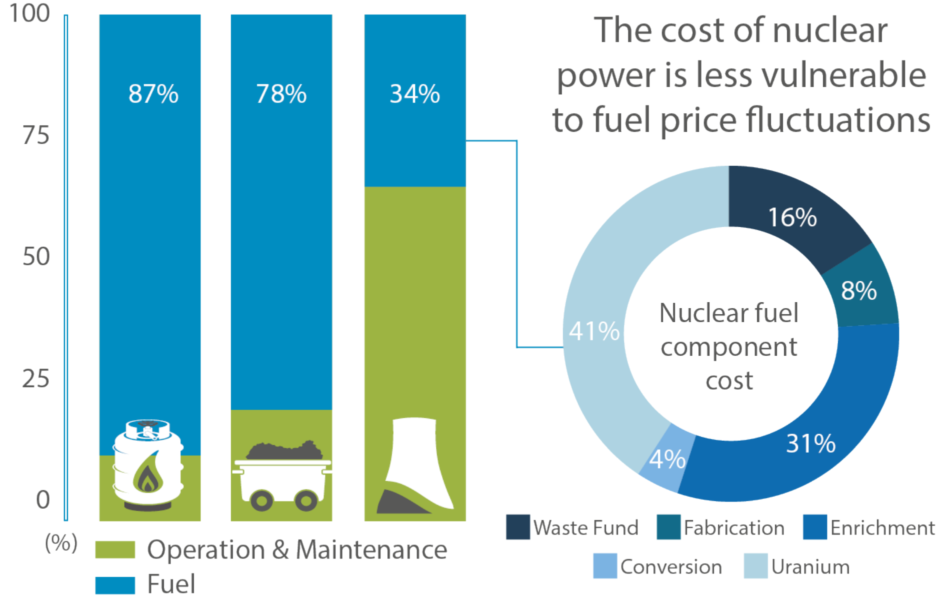


Source: EMBER

Measures to combat the energy prices increase

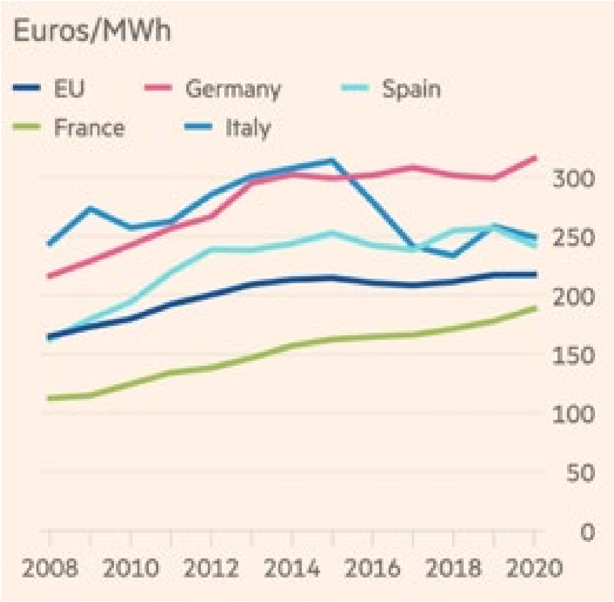
Short term measures - avoid any nuclear power plant closure. It is clear that nuclear can provide stability of the nuclear power price production
With uranium prices fluctuation having an marginal impact on the power production cost
is able to provide stability to final power prices

Breakdown of operating costs for nuclear, coal and gas generation



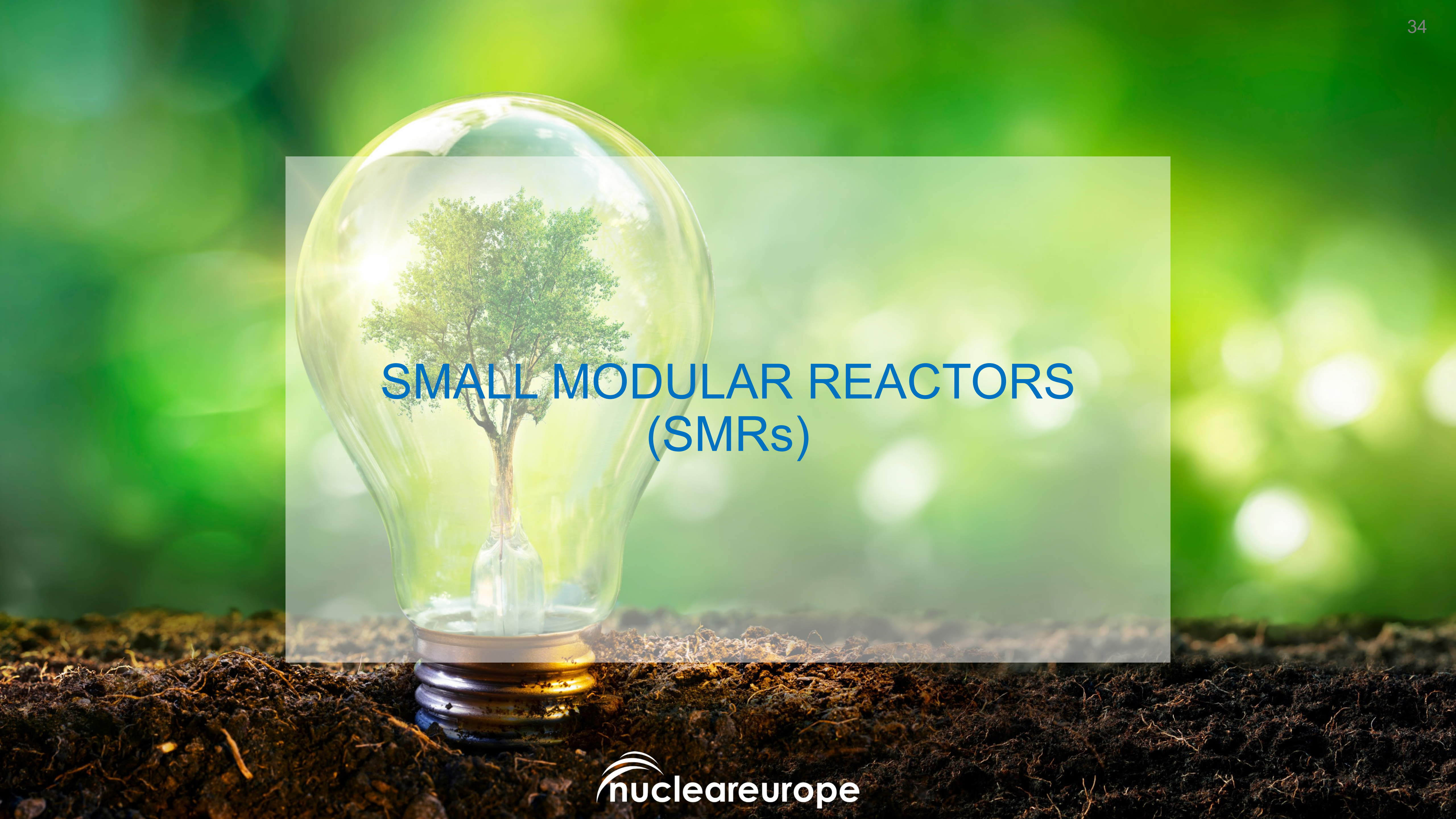
© nucleareurope - Source: World Nuclear Association 2017, Nuclear Energy Institute

Power prices for households



Power prices for businesses

FT - France bets on more nuclear power in face of Europe's energy crisis



SMALL MODULAR REACTORS (SMRs)

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SMR technology features

- **Nuclear Safety**

Enhanced levels of safety through the incorporation of lessons learned from major safety events in the SMR design under development should facilitate faster acceptance by the energy policy maker and stakeholder.

- **Funding and Financing**

Easier to finance due to a lower upfront capital cost; less interest during construction; phased financing; private sector interest; and potential for minimized investment risk.

- **Electrical Grid**

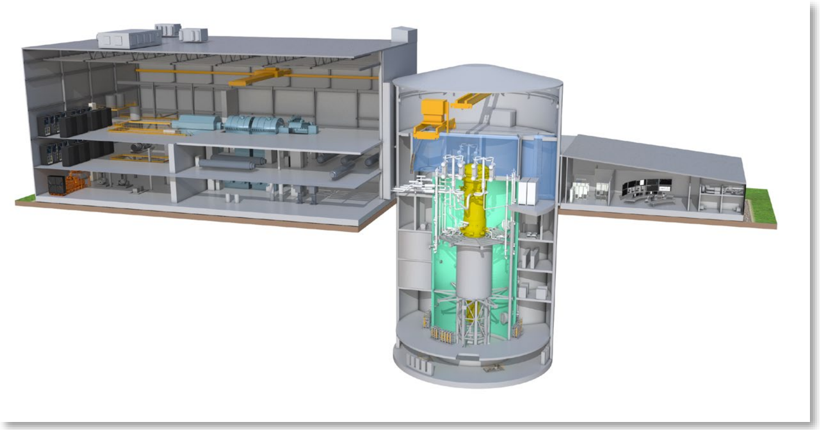
SMRs can be deployed on smaller grids that require less reserve capacity and be less dependent on off-site power for safety functions.

- **Human Resource Development**

A built-in factory setting and the use of modular construction technology can reduce the peak construction workforce and shorten the construction period;

SMR technology models

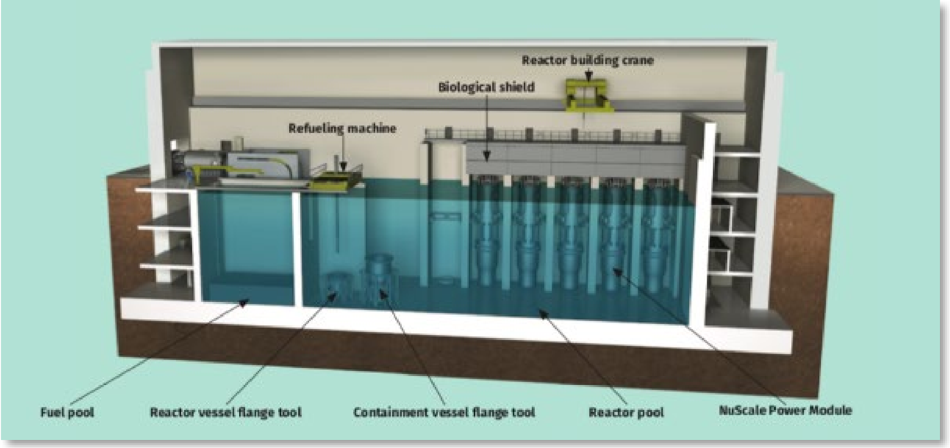
Single unit on the site



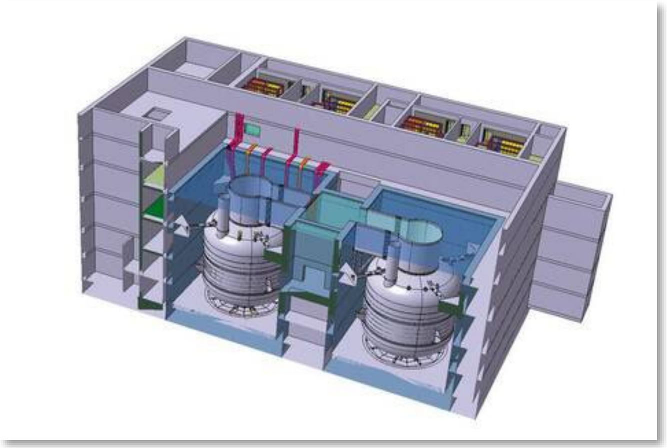
BWRX-300

Rolls-Royce SMR

Multiple units on-site



NuScale



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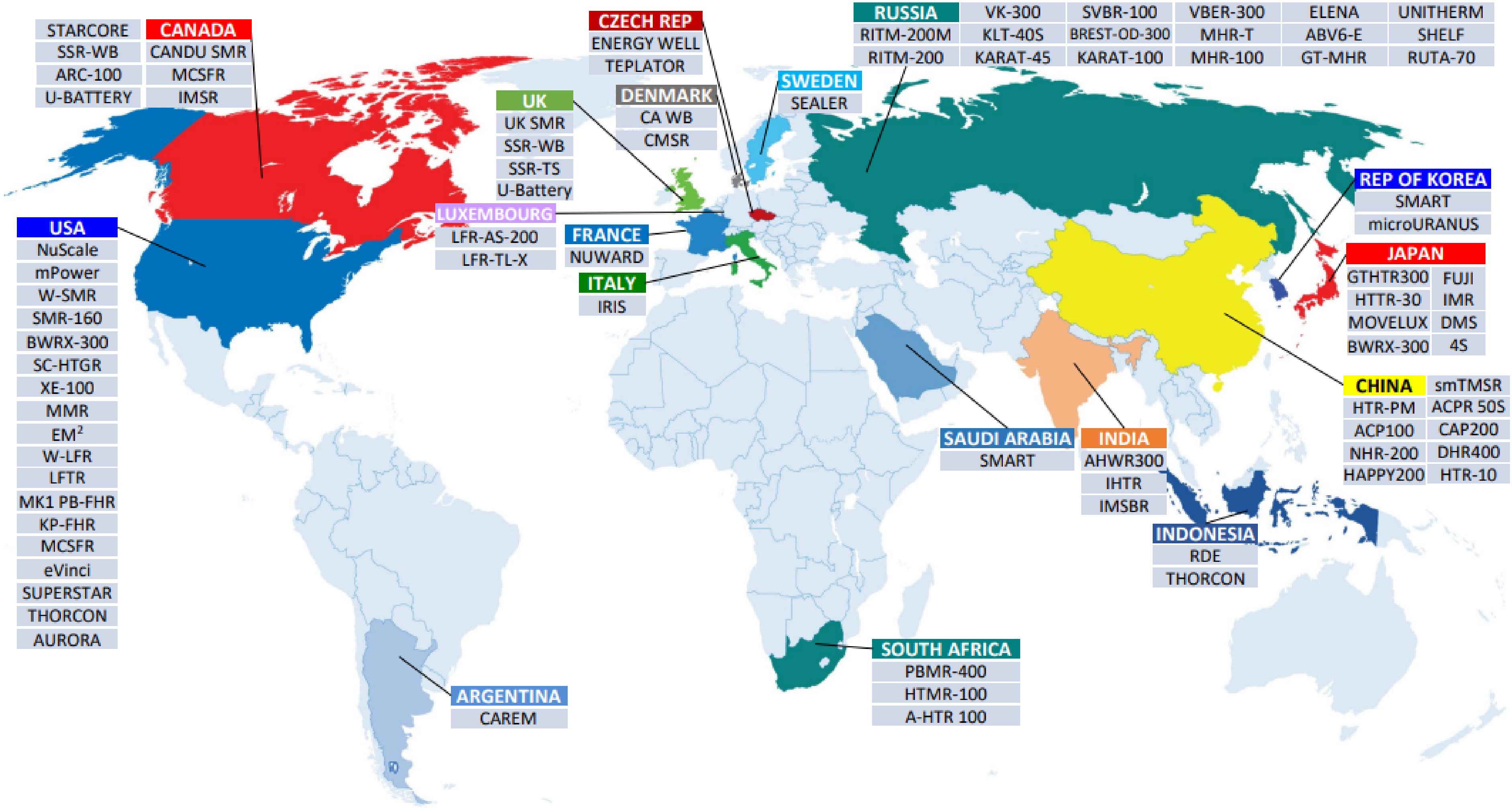
Global map of SMR technology development



Source: IAEA

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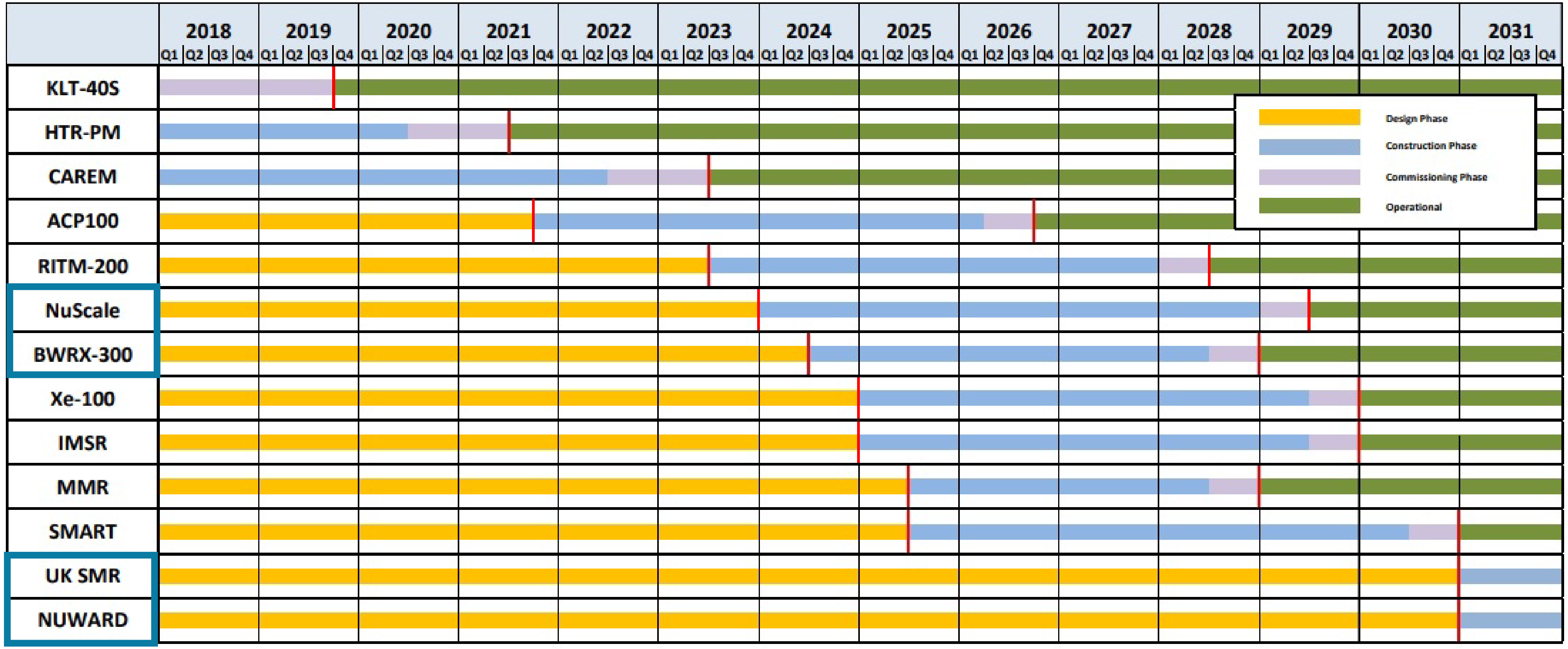
Timeline of deployment of SMR designs to 2030



Source: IAEA

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Thank you!

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