



Role of Nuclear in a Changing World – European Perspective

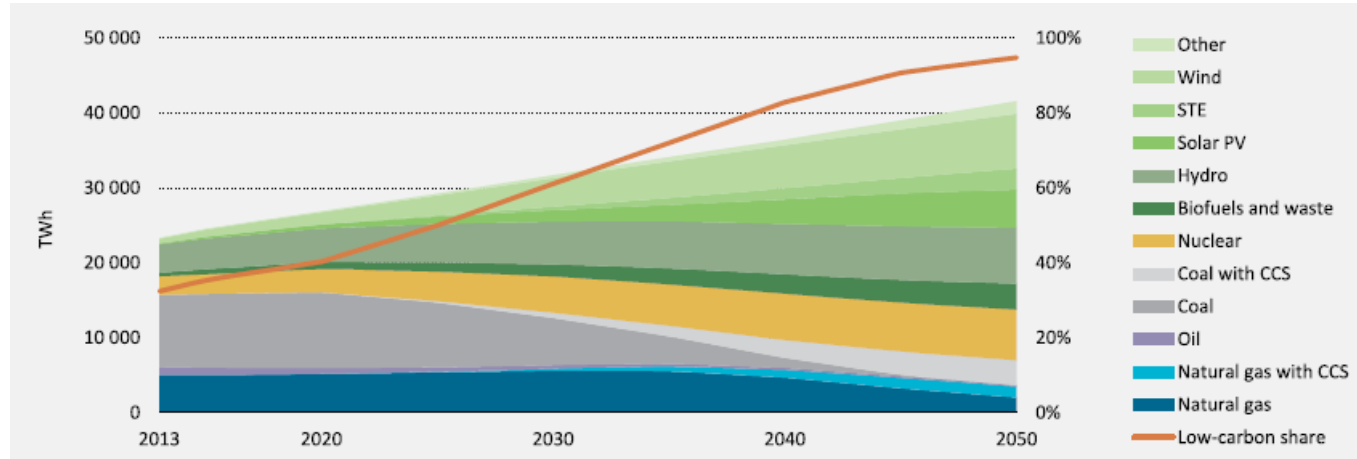
Yves Desbazeille

FORATOM Director General

What the World has to achieve to save the climate...



Global electricity production and technology shares in the IEA 2DS



Source: IEA, ETP2016, OECD/NEA 2018

533 gCO₂/kWh

{ 68% fossil fuels
22% renewables
11% nuclear

40 gCO₂/kWh

{ 17% fossil fuels
67% renewables
16% nuclear

- A **complete reconfiguration** of the electricity generation system is needed by 2050.
- Rise of nuclear is accompanied by a *complete phase-out* of coal and oil, a drastic decrease of gas, development of CCS and a massive increase of renewable energies.
- Colossal investments for the energy sector: 40 trillion USD + 35 in energy efficiency.

Key messages on nuclear



*Nuclear energy
contributes to all the
Energy Union's key
energy objectives*



Environmental:

- Low-carbon energy source
- Low environmental impact (land & resource use)



Economic:

- €70Bn turnover/year in Europe
- 3000+ companies
- 800,000+ jobs in Europe



Security of energy supply:

- Reliable baseload electricity at affordable cost
- Flexibility of dispatch required to balance renewables



NUCLEAR IN THE EU

Membership



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

Belgium

Bulgaria

Finland

France

Hungary

Italy

Netherlands

Romania



Slovakia

Slovenia

Spain

Sweden

Switzerland

Ukraine

United Kingdom

CEZ (Czech Republic) and PGE EJ 1 (Poland) are Corporate Members

What does nuclear contribute to Europe's economy?



126

NUCLEAR REACTORS
IN OPERATION IN THE EU



70

€ BILLION/YEAR



800,000

JOBS



26%

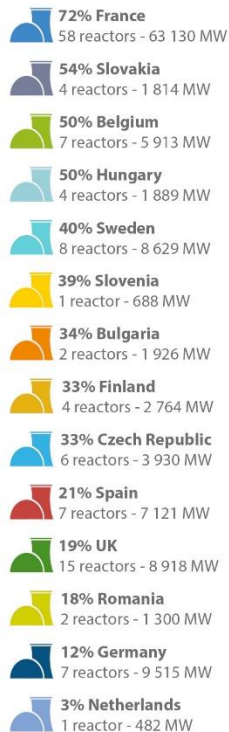
ELECTRICITY PRODUCTION



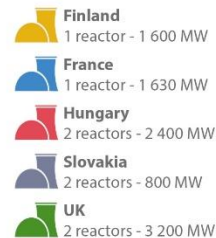
Nuclear energy in the EU

126 Operational nuclear reactors in the EU

Nuclear share of electricity



Nuclear power plants under construction



ELECTRICITY PRODUCTION

26%

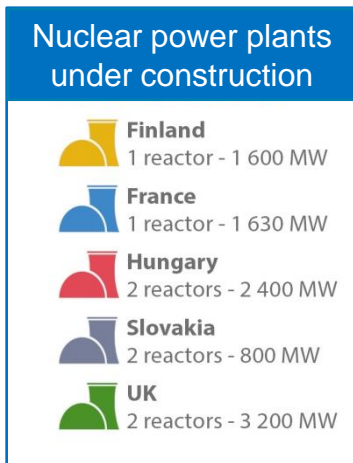


LOW-CARBON ELECTRICITY

50%

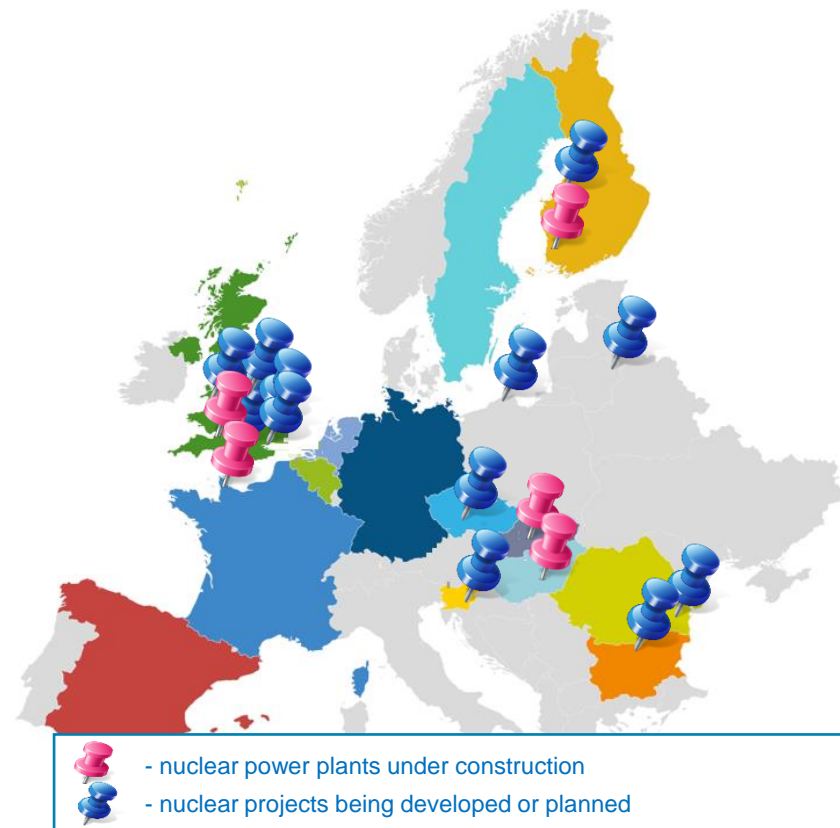


New build in the EU – construction & plans



Countries preparing or considering new build

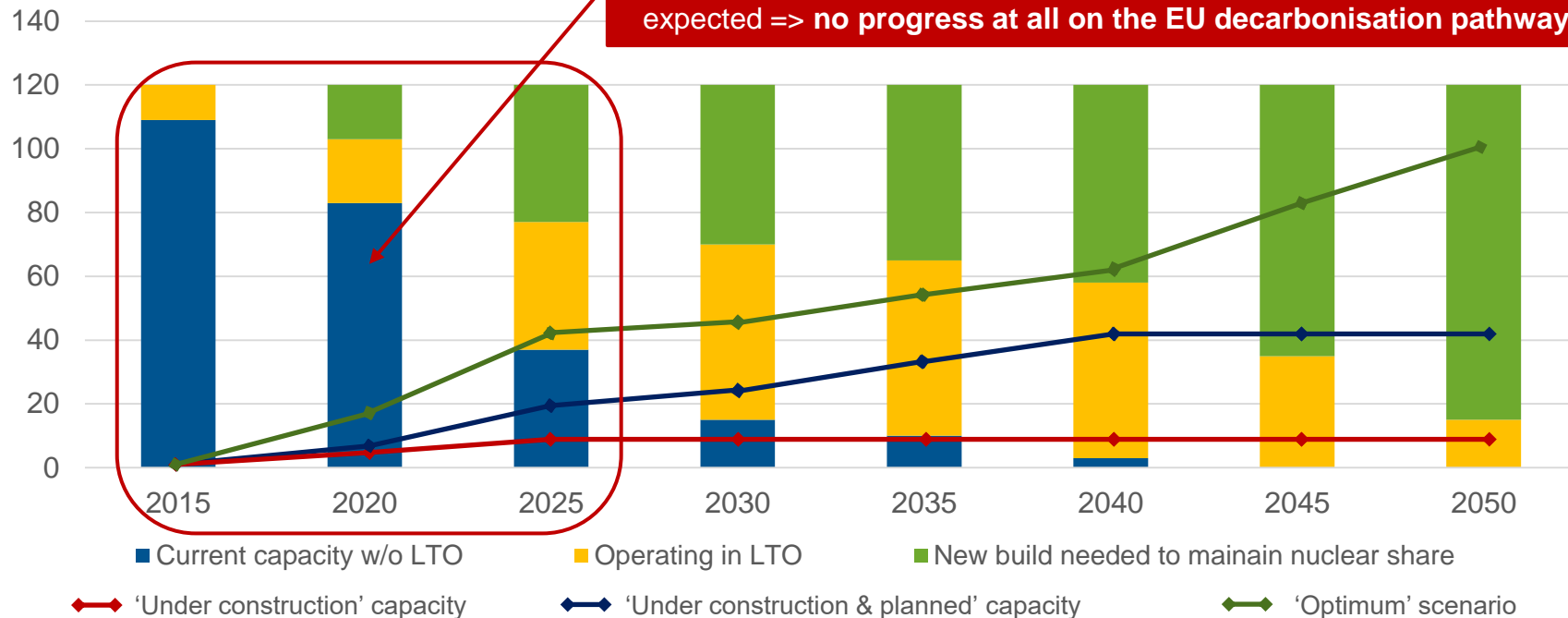
- ✓ Bulgaria
- ✓ Czech Republic
- ✓ Finland
- ✓ France
- ✓ Lithuania
- ✓ Poland
- ✓ Romania
- ✓ Slovenia
- ✓ UK



Future of nuclear in the EU

● ● ●

In the 2015-2025 period, more than 50 GW of nuclear capacity is at risk of early closure - equivalent to the new RES production expected => **no progress at all on the EU decarbonisation pathway**



*Source: PINC, European Commission, 2017
Estimated investment needs in LTO (until 2050): EUR 46,9 billion

EU Political Landscape



Political landscape

- Elections to the European Parliament – 23-26 May 2019
- New European Commission – late 2019



Presidencies of the Council of the EU

- Austria – July – December 2019
- Romania – January – June 2020
- Finland – July – December 2020
- *Croatia, Germany, Portugal, etc.*

Key challenges at EU level



**EU energy & climate goals:
CO₂ emissions goals vs. RES goals**



**Clean Energy Package & other energy files
(role of nuclear)**



**Balance of power
pronuclear vs. antinuclear countries**



**New build projects facing opposition
by selected EU members**



**Future of the Euratom Treaty
(EC's 2018 Work Programme)**



SECURITY OF ENERGY SUPPLY

Current state of play



Import of energy:

- EU imports **54%** of energy
- oil - **90%**, gas - **69%**, solid fuels - **42%**

Key challenges:

- External suppliers - **mostly gas**
- New projects - **Nord Stream II**

Costs:

- **€1 billion per day**
– EU external energy bill
- **€300 billion** – import of crude oil & oil products to EU

Affected countries:

- Every **Member State** - in particular the **Baltics** & **Eastern Europe**

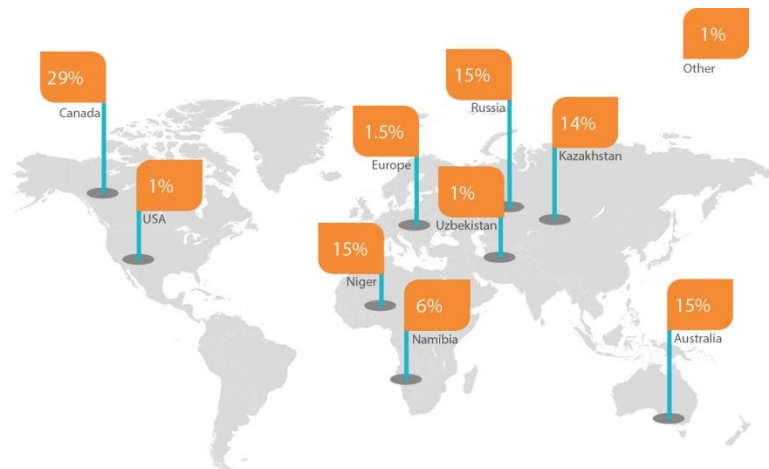
Examples:

- **6 MSs** depend from Russia (gas supply)
- Russia & Norway supply: **+50%** of gas & **+40%** of oil
- **Algeria** is the EU's third-largest energy supplier

Additional challenges:

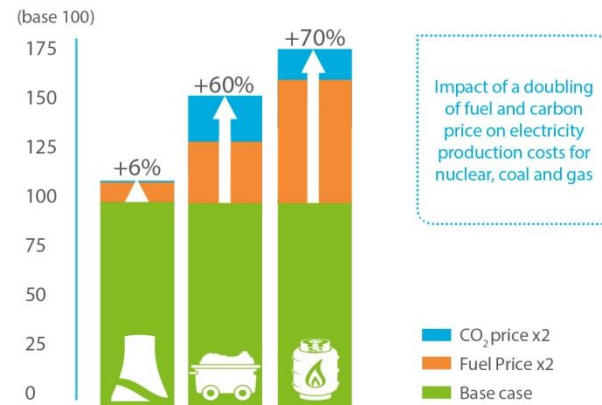
- Energy demand worldwide - increase by **27%** by **2030**

Security of energy supply – mining



Source: EURATOM Supply Agency 2018

The cost of nuclear power is less vulnerable to fuel price fluctuations



Source: AREVA 2014

“The aggregate stock level at the end of 2016 could fuel EU utilities’ nuclear power reactors – on average – for 3 years”

Euratom Supply Agency, 2016

EU external energy bill represents more than

€1 billion
per day

Total value of imported uranium to the EU

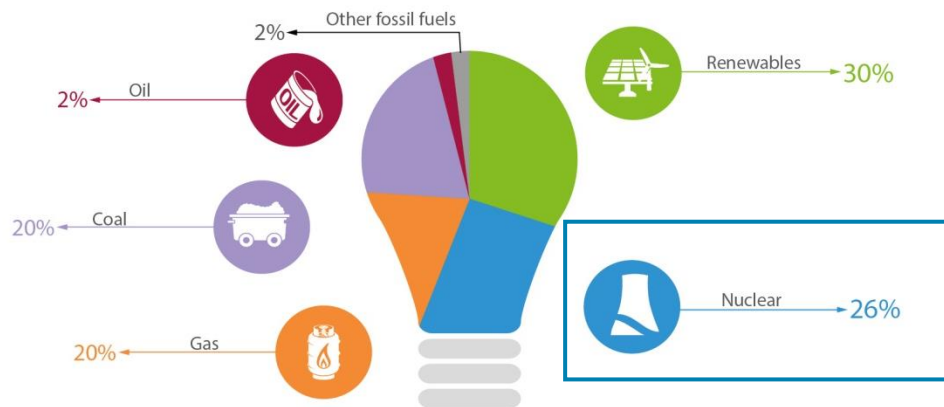
€2 billion
per year

Security of energy supply – power generation

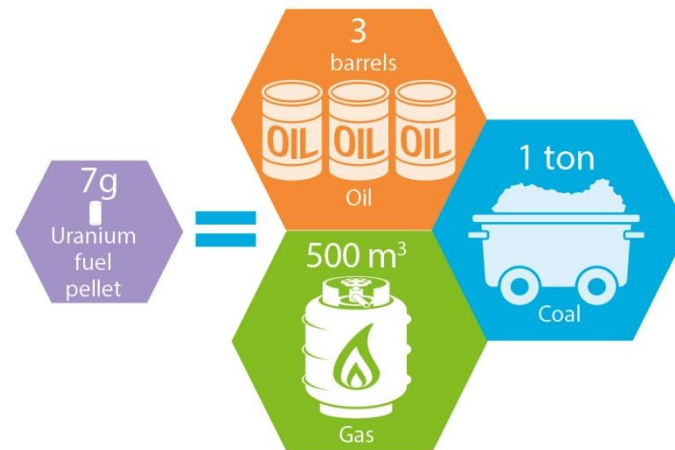
EU electricity mix

Fossil fuels

Low-carbon energy



Quantity of fuel necessary to produce a given amount of electricity





Long-Term Energy & Climate Strategy for Europe

FORATOM “Vision 2050” study



I.

- The EU ratification of the Paris agreement on 5 October 2016 reaffirmed the commitment to decarbonise its economy.

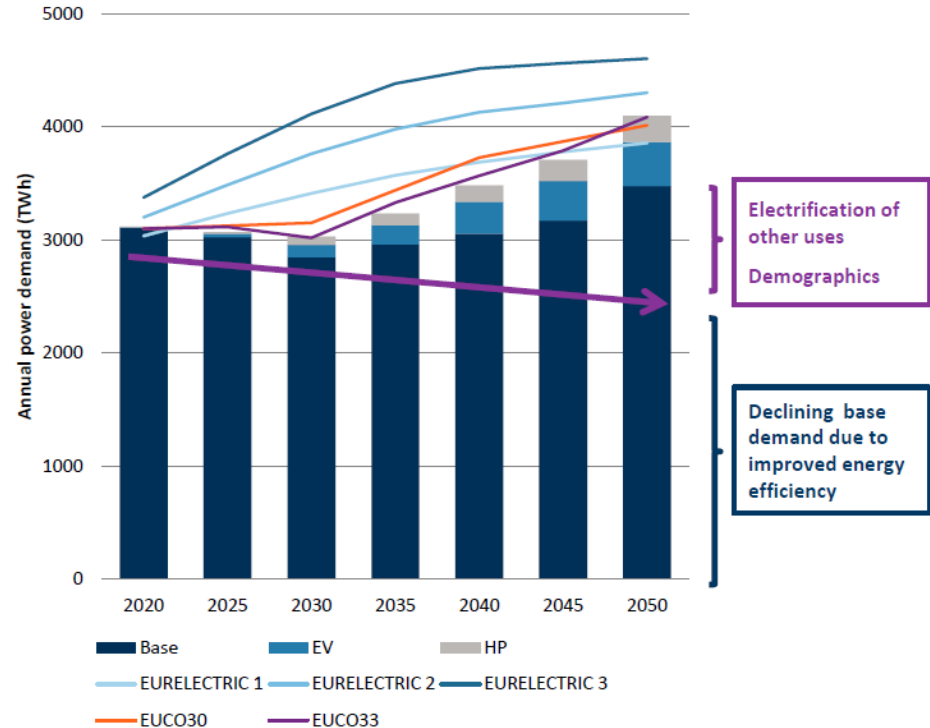
II.

- The Commission is currently working on a “**Strategy for long-term EU greenhouse gas emissions reductions**”.

III.

- Such ambitious decarbonisation pathway would require a growing role of electricity from 20% of the EU final energy consumption in 2015 to **more than 40% by 2050**.

In this context, FORATOM scenario is looking at the role of nuclear as a **low carbon, flexible, and baseload source of power** to address the long run expected electricity demand growth.



FORATOM “Vision 2050” study

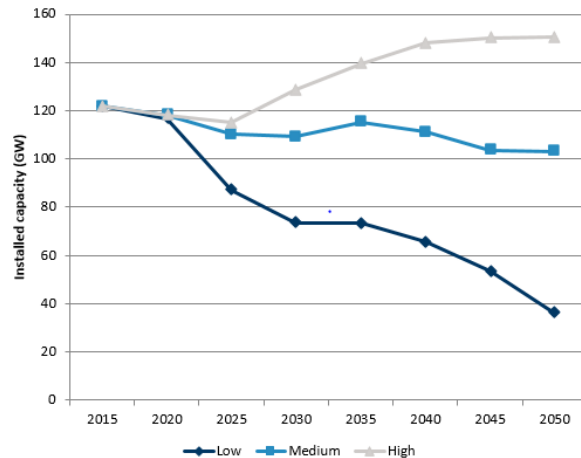
Comparison of existing scenarios and modelling of 3 scenarios

➤ Collect an extensive list of the available EU energy scenarios

Apply the exclusion criteria (Decarbonisation trajectory 95% / Penetration of electrification) and test scenarios' robustness and credibility

Design **three nuclear installed capacity scenarios (Low / Medium / High)** reflecting different degrees of ambition for the role of nuclear in decarbonising the EU power sector

EU-28 nuclear installed capacity outlooks (GW)



Source: FTI-CL Energy analysis based on FORATOM inputs

FORATOM foresees the need to increase the total installed capacity from **120 GW** today to around **140-150 GW** by 2050.

FORATOM “Vision 2050” study



Overall, a number of key questions emerge regarding the role of nuclear in the Europe future energy trajectories



Security of supply

- Can a EU scenario with fully decarbonized electricity mix be credible, secure and cost efficient without a significant share of nuclear?



Economics

- How to manage nuclear plant closures and new build in different countries to avoid locking in inefficient fossil fuel technologies and emissions in transition to a decarbonised power sector?

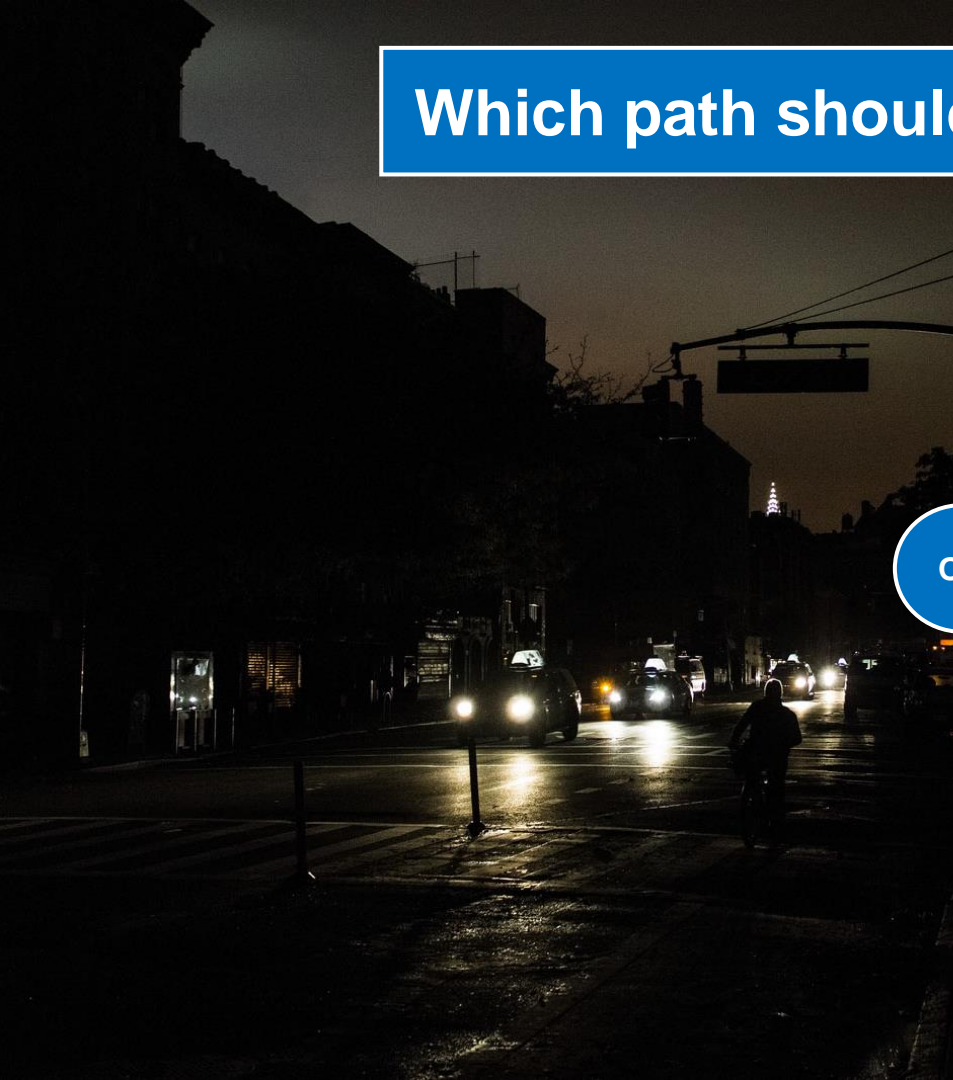


Sustainability

- What is the role that nuclear can play in a EU decarbonisation scenario with growing power demand driven by strong electrification of the economy?

The “Vision 2050” study elaborated by **FTI-CL** aims at **delivering fact-based evidence in response to these key questions** by analysing the contribution of the European nuclear sector to achieving European energy policy objectives of reliability, decarbonisation and cost efficiency.

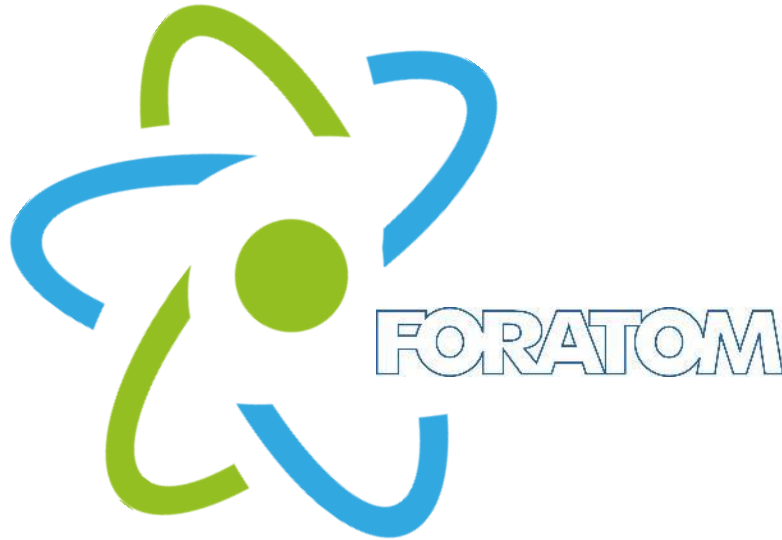
Which path should Europe choose?



OR



Thank you





Brexit



Brexit & its consequences for nuclear

FORATOM's PP on the "Brexit impact on nuclear energy" highlights key issues

1. Safeguards

NCAs

Validity of contracts

Free movement

R&D

Policy & regulation

FORATOM
THE VOICE OF THE EUROPEAN NUCLEAR INDUSTRY

THE BREXIT IMPACT ON NUCLEAR ENERGY

To avoid disruption across the whole nuclear fuel cycle, the EU should work closely with the UK Government to



Establish a new Nuclear Agreement with the UK as soon as possible, and arrangements for free trade in the nuclear sector.



Continue co-operation and collaboration on nuclear policy and regulation (including safety)



Implement a transition period to minimise any disruption to the civil nuclear sector activities across the EU



Allow for the free movement of nuclear skills to and from the UK



Negotiate a new agreement that would allow the UK to continue to be involved in the Euratom R&D programmes



Confirm validity of contracts already approved by the EC and the Euratom Supply Agency for the supply of nuclear materials between EU suppliers and the UK.

NUCLEAR INDUSTRY IN NUMBERS



Accounts for 27% of electricity in the EU



Almost 50% of low-carbon electricity



Supports around 800,000 jobs



Turnover of 70bn per year

<https://www.foratom.org/publications/>



www.foratom.org | foratom@foratom.org |

Euratom/UK - NCA

Key Principles for a Euratom/UK agreement:

1. • Free trade in nuclear/non-nuclear materials
2. • Free movement of nuclear workers
3. • Approval of EU/UK fuel contracts/movements
4. • EU/UK export control licence regime
5. • International collaboration in nuclear R&D



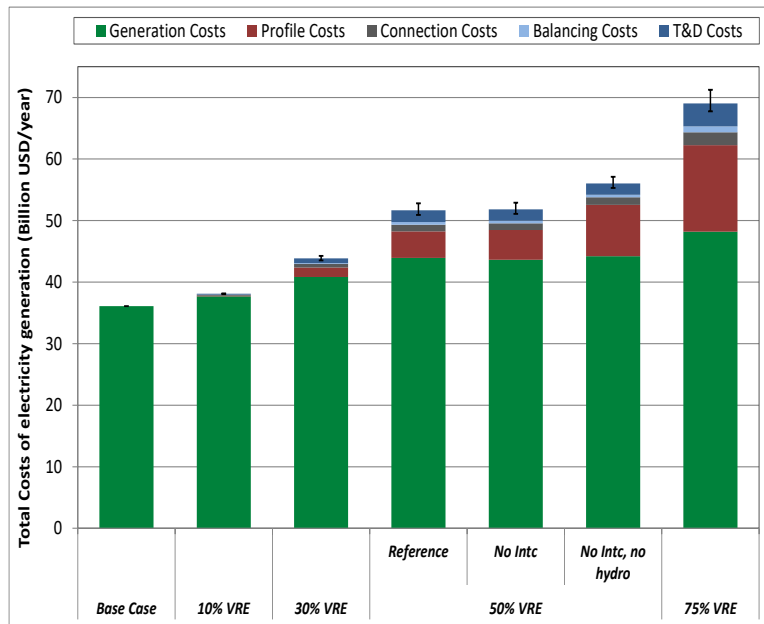


Costs of electricity generation

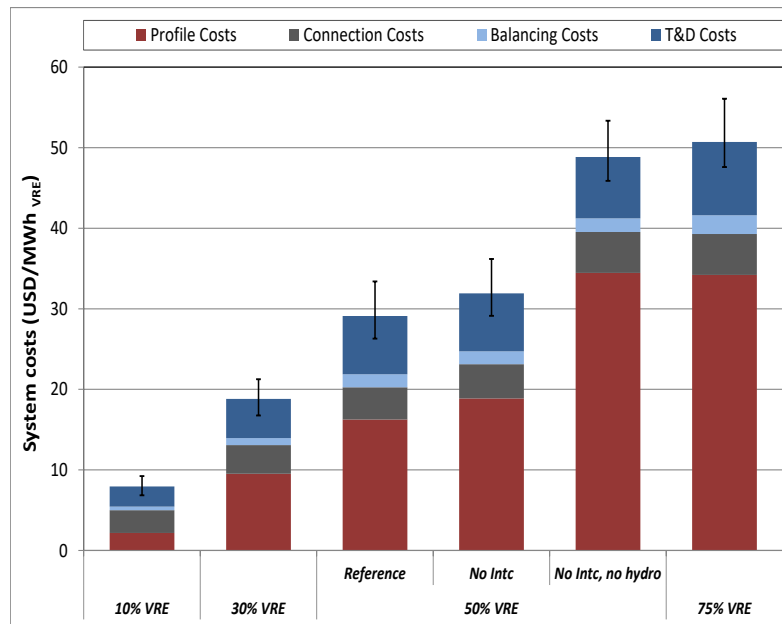
Total costs of generation including all system costs



Estimate of total cost of electricity provision, including other components of system costs from literature (T&D, connection and balancing).



Total costs of electricity provision
(billion USD/year)

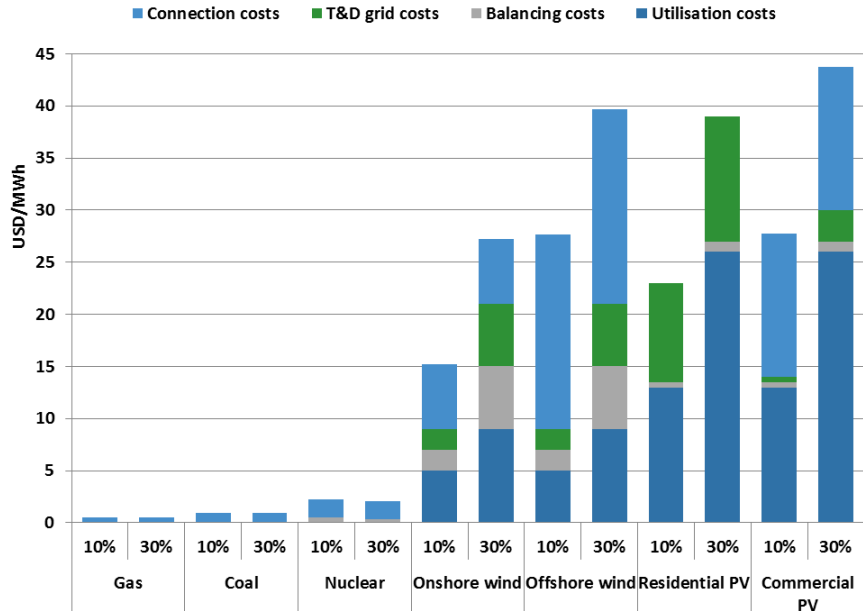


System costs calculated per unit of electricity generated by VRE (profile costs dominate at high VRE generation shares)

Grid-level System Costs



Grid-level System Costs of Selected Generation Technologies



Source: NEA (2012)

- Topic of system effect has moved into focus in the last years, due to the large deployment of VRE resources, but quantification remains challenging.
- System costs of VRE are large and cannot be neglected.
- Government have mechanisms to effectively internalise them.