

# NUCLEAR ENERGY IS ESSENTIAL TO EU LOW-CARBON FUTURE

In order to achieve a fully decarbonized electricity sector by 2050, the European Union needs an energy mix composed of at least one quarter nuclear.

## NUCLEAR



Is a low-carbon energy source



Ensures security of supply



Is environmentally, economically and socially sustainable

## NUCLEAR INDUSTRY IN NUMBERS



Accounts for  
**26%**  
of electricity in the EU



Almost  
**50%**  
of low-carbon electricity



Supports around  
**800.000**  
jobs



Turnover of  
**70bn**  
per year



## NUCLEAR ENERGY

### A key player in Europe’s long-term carbon free vision

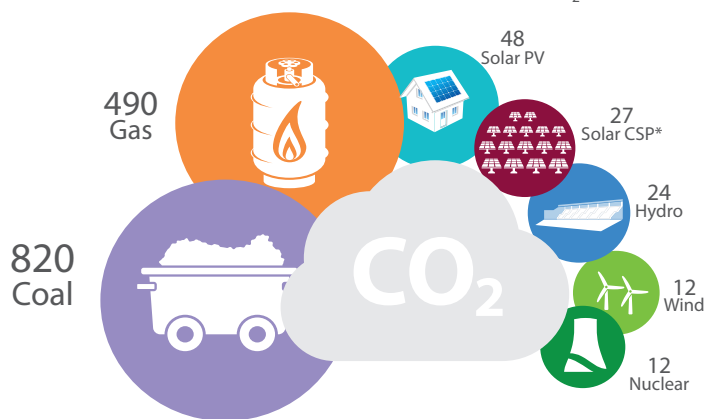
Nuclear energy plays an essential role in the European energy mix – particularly when it comes to complying with the COP21 Paris Agreement commitment of decarbonising the electricity system.

In its ‘A Clean Planet for all’ strategy, published on 28 November 2018, the European Commission confirmed that nuclear will form the backbone of a carbon-free European power system, together with renewables. This announcement came just after the publication of the latest Intergovernmental Panel on Climate Change (IPCC) report (Global Warming of 1.5°C) which also recognises that nuclear power is essential if the world is to keep global warming to below 1.5 degrees. According to one of the IPCC scenarios, a six-fold increase in global nuclear capacity is needed if we want to achieve our climate goals! Not only is nuclear low-carbon, it also has one of the lowest total energy costs and goes hand in hand with variable renewable sources (vRES) production.

Furthermore, it guarantees security of supply, thanks to:

- High availability
- Access to multiple sources of supply
- High energy density
- Requires only a small quantity of uranium
- Low sensitivity to uranium price variations
- The diversity and reliability it provides to the energy mix

Comparison of greenhouse gas emissions  
(grammes CO<sub>2</sub> eq/kWh)



Nuclear energy has one of the lowest climate impacts of any energy

\*Concentrated Solar Power  
© FORATOM - Source: IPCC 2014

Nuclear produces electricity at full power

**85 to >90%**

of the time thus enhancing security of supply



© FORATOM - Source: NEI 2012

# Nuclear is Environmentally Sustainable

## Climate Change

Based on the current climate change debate, it is important that nuclear energy capacity is maintained (and preferably increased) in order for the EU to achieve its targets. Nuclear energy will help the EU meet its 2050 objectives both in terms of ensuring security of supply and lower GHG emissions.

**In order to achieve a fully decarbonized electricity sector by 2050, the European Union needs an energy mix with at least one quarter nuclear<sup>1</sup>. This translates into a minimum of 150 GWe of installed nuclear capacity.**

## Air pollution & environmental protection

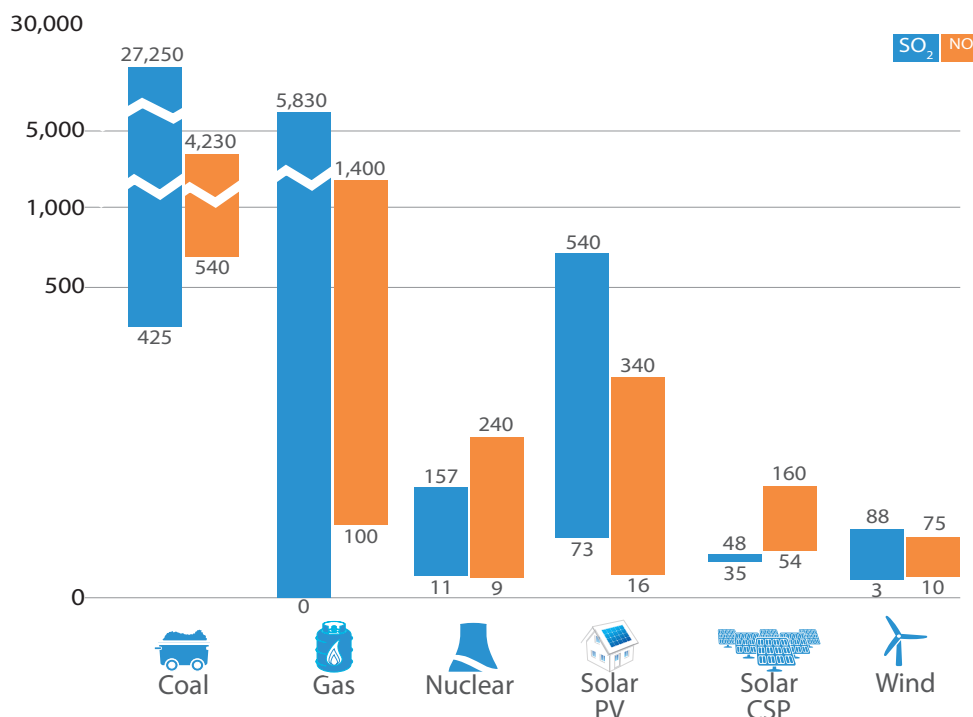
According to the International Energy Agency (IEA)<sup>2</sup>, the power sector is responsible for one-third of sulphur dioxide (SO<sub>2</sub>) emissions, which causes acid rain, 14% of nitrogen oxides (NO<sub>x</sub>) emissions, a precursor pollutant for particulate matter (PM) and ground-level ozone, and 5% of particulate matter (PM<sub>2.5</sub>). This is important when we consider estimates by the World Health Organisation which indicate that every year three million deaths globally are caused by ambient air pollution and by particulate matter released mainly through the burning of coal or biomass.

**Nuclear energy production complies with air quality standards given that it does not emit any air pollutants nor particulate matter.**

Furthermore, it also protects the environment by:

- Protecting water quality
- Preserving and improving habitats for plants and wildlife.

Lifecycle SO<sub>2</sub> and NO<sub>x</sub> emissions by different generation technologies (mg/kWh)



© FORATOM - Source: Masanet et al. 2013

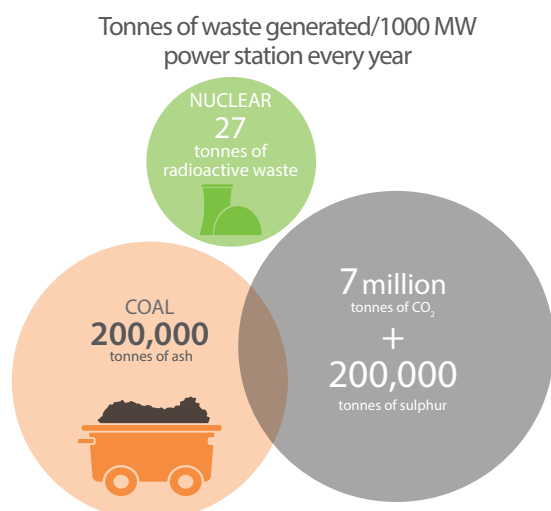
<sup>1</sup>[Pathways to 2050: role of nuclear in a low-carbon Europe](#)

<sup>2</sup>IEA World Energy Outlook (WEO) Special Report on Energy and Air Pollution

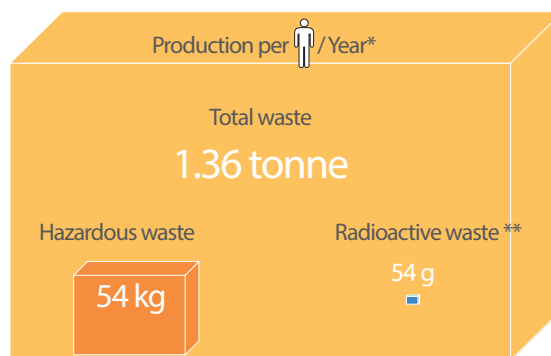
## Waste

When compared with other sectors, the nuclear industry generates a very limited amount of waste each year. It is estimated that each person generates 1.36 tonnes of waste per year, out of which hazardous waste accounts for 54kg. By comparison, only 54g of radioactive waste is generated per person, per year. Coal-fired power plants, for example, generate 200,000 tonnes of ash each year per 1,000 MWh of electricity produced. To put it into perspective, 133 billion tonnes of ash were generated in 2017 by coal-fired power plants located in the European Union – the equivalent of 261 tonnes of ash for each person living in the EU.

The nuclear industry not only produces lower amounts of waste compared to other electricity sectors, it also carefully handles the back end of the fuel cycle activities in a responsible manner by contributing to the funds that cover radioactive management (including spent fuel) and decommissioning expenses.



© FORATOM - Source: WNA 2012



\*These figures were calculated by dividing the total amount of waste produced globally by the world population (7.35 billion, July 2015, UN estimation).

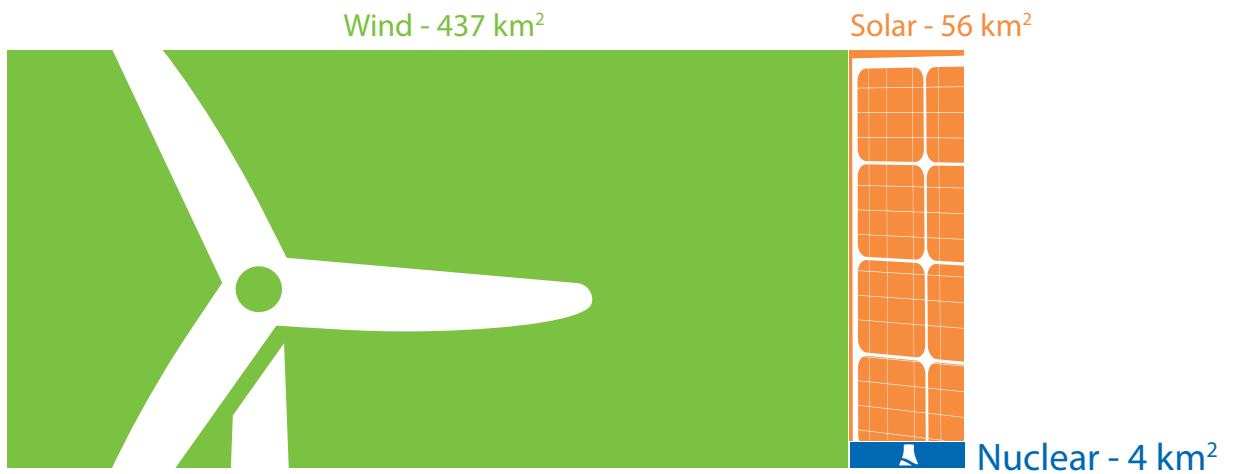
\*\*It only includes radioactive waste from nuclear power plants and their fuel cycle support facilities (excluding mining and extraction wastes).

© FORATOM - Source: OECD/NEA 2015

## Land use

When it comes to land use, the number of hectares needed to produce electricity from nuclear power plants is massively lower than, for example, wind farms. Not only does this reduce the visual impact of energy generation, it also limits land use change and the loss of biodiversity and natural habitats.

Land required by different energy sources to match the amount of electricity produced by a 1,800 MW nuclear power plant and having one of the lowest land footprints



© FORATOM - Source: Entergy Arkansas, Inc.



# Nuclear Ensures Security of Supply

## Energy independence

Today, the EU imports 54% of the energy it consumes, including:

- 90% of oil
- 69% of natural gas
- 42% of solid fuels

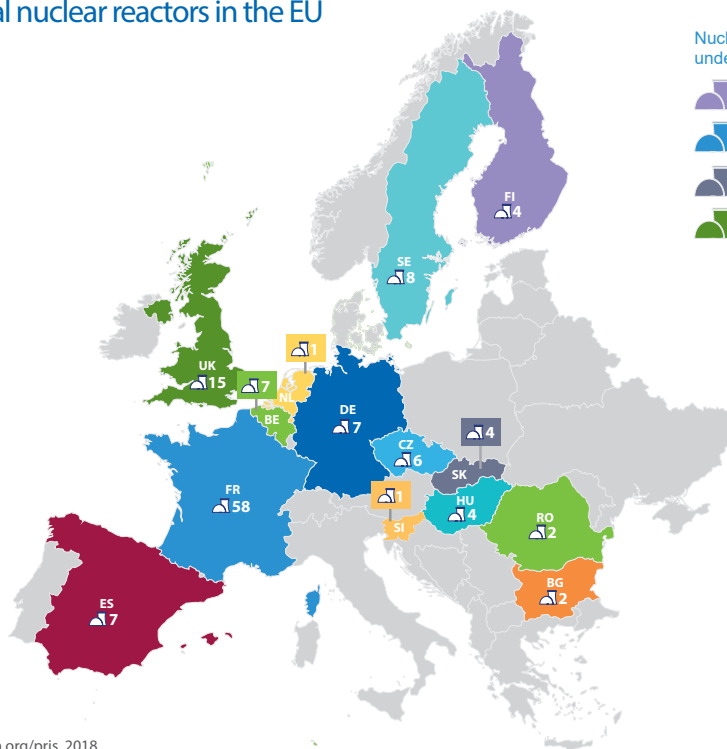
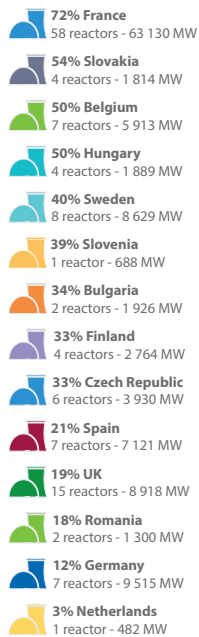
Furthermore, the EU's daily external energy bill accounts for €1 billion. Many EU Member States are often dependent on one single external supplier when it comes to – for example - natural gas supplies. All of this combined puts Europe at risk of energy supply interruptions.

Nuclear energy is a perfect tool for limiting such risks. There are currently 126 operational nuclear reactors in 14 Member States, providing more than one quarter of electricity production in the EU. One tiny uranium fuel pellet can produce as much energy as 3 barrels of oil, 1 tonne of coal or 500 cubic meters of gas. To put it into perspective: a 1000-megawatt PWR reactor consumes less than 30 tonnes of fuel a year while a coal plant with a similar capacity would consume around 4.3 million tonnes of coal.

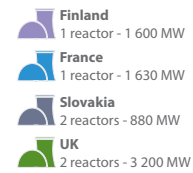
**Nuclear energy therefore contributes significantly to reducing dependence upon imported fossil fuels, and thus increases security of supply.**

## 126 Operational nuclear reactors in the EU

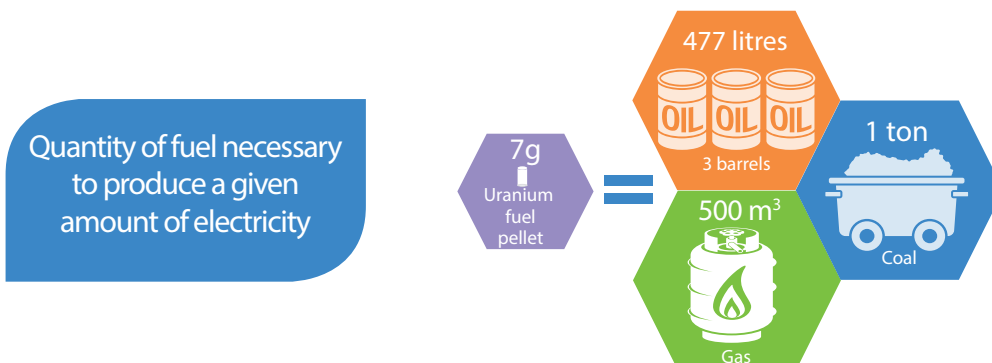
### Nuclear share of electricity



### Nuclear power plants under construction



© FORATOM - Source: www.iaea.org/pris, 2018

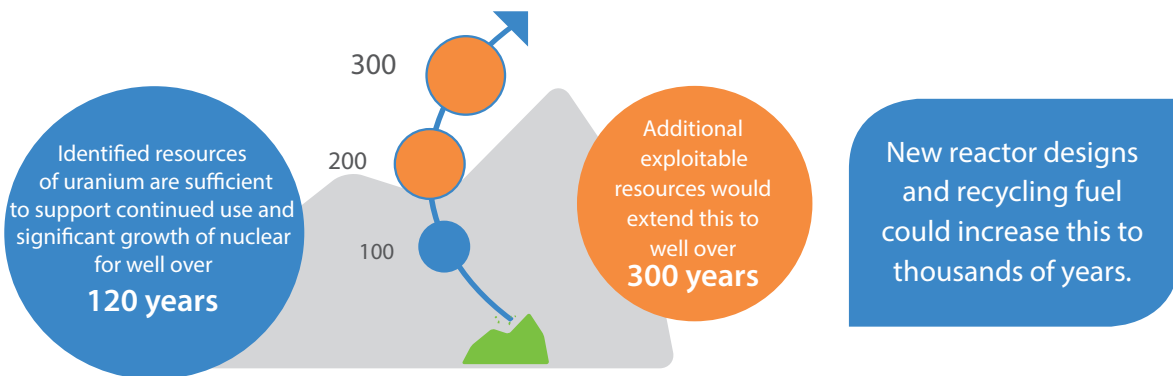


© FORATOM - Source: American Nuclear Society 2013

### Long term resource availability

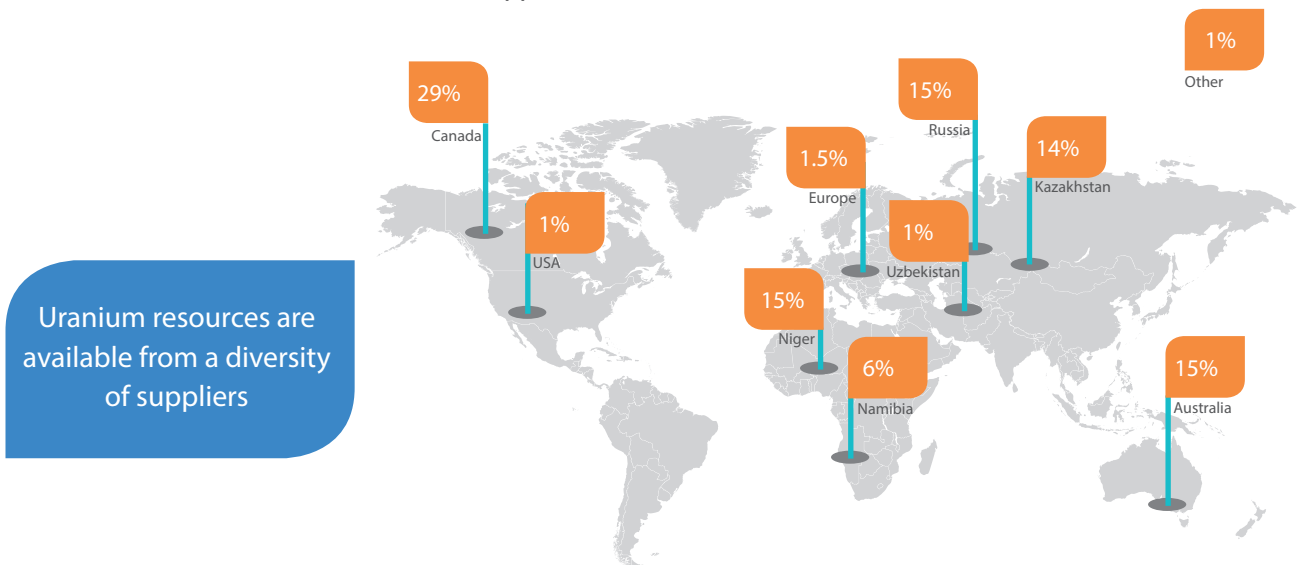
Both the transportation and storage of uranium is relatively straightforward and takes up little space. Given the small amount of uranium needed, many years of supply can be stored in a relatively small area. Contrary to other energy sources, it is common practice for nuclear operators to store sufficient fuel assemblies on-site for a number of years of operation (2-3 years), making it relatively impervious to supply constraints. In the face of geopolitical supply risks, nuclear energy also holds advantages that other fuels such as oil, coal and gas do not enjoy.

For oil and gas, new transport routes, improved port facilities and increased storage capacity within the EU will require enormous financing and long lead times. On top of that, extreme weather conditions can also affect transport and usage of fossil fuels (i.e. cold spells have an impact on both the coal and gas industries).



© FORATOM - Source: Uranium 2014: Resources, production and demand, IAEA 2014

### Who supplies uranium to the EU?

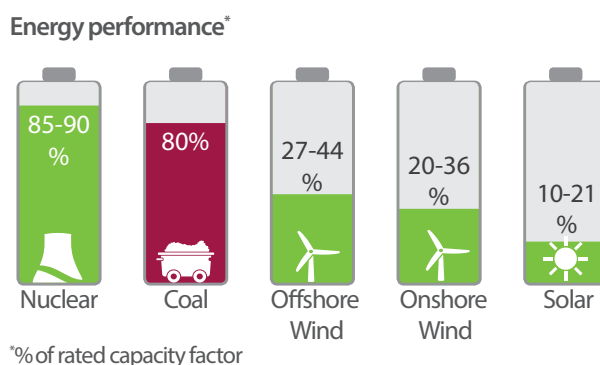


© FORATOM - Source: EURATOM Supply Agency 2018



## Reliability

An important factor in ensuring a reliable grid is a power plant’s ability to produce large amounts of “dispatchable” power. Compared to other energy sources, nuclear reactors operate at high capacity levels, with an availability of at least 90%, which means that nuclear energy can be considered as a reliable source of base-load electricity.



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Source: ASSET project, “Technology pathways in decarbonisation scenarios”, 2018

## Grid stability

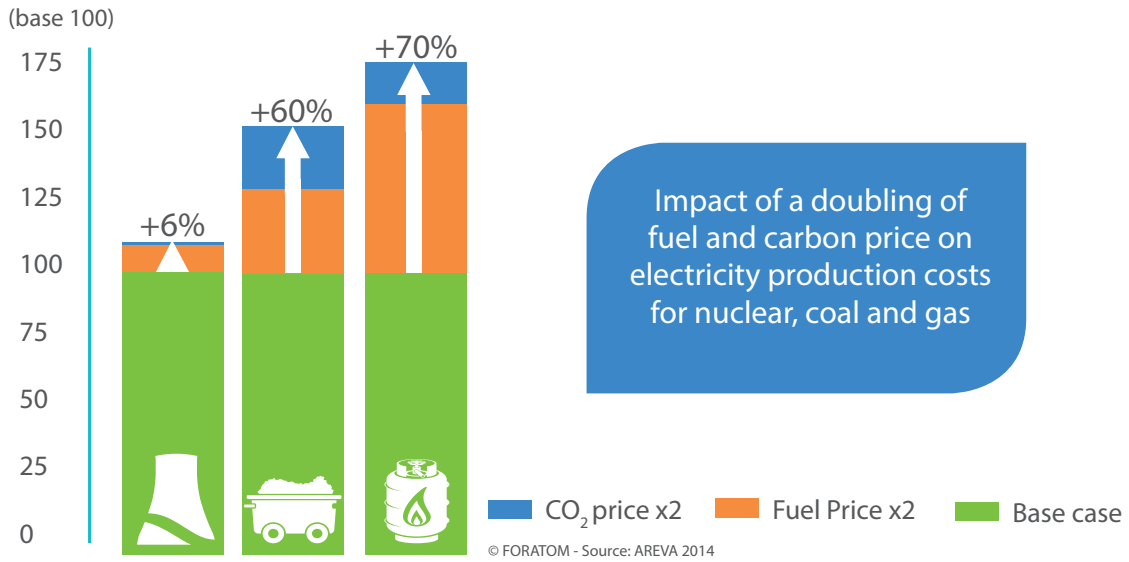
Nuclear power plants can also provide stability for the grid thanks to their flexible operation which accommodates for the increase in the installation of renewables. Whilst its technical capabilities are similar to those of gas, nuclear has the added advantage of being low carbon – a very important consideration if Europe wants to achieve a fully decarbonized electricity sector.



# Nuclear is Economically and Socially Sustainable

## Wholesale price stability

Nuclear is much less affected by potential fuel price spikes. This is because uranium costs are marginal in terms of the total cost of electricity and have little effect on production costs. The same cannot be said for fossil fuels, as their market prices are more volatile



## Competitive low-carbon energy sources

Based on the following comparison of LCOE (Levelized Cost of Electricity) for new build production facilities (2020 perspective) for different technologies in Europe (10% discount rate scenarios and 30 USD/t CO<sub>2</sub>) one can see that nuclear, together with on-shore wind, is the most competitive low-carbon source. Furthermore, the Long-Term Operation (LTO) of existing nuclear reactors – which requires much less investment than new nuclear capacity – has the lowest LCOE of all technologies. It should be noted that the LCOE is unable to capture the full system costs of all technologies, hindering a fair comparison between them.



<sup>3</sup>IEA and OECD-NEA - [Projected Costs of Generating Electricity - 2010 Edition](#)

<sup>4</sup>William D. D'haeseleer - Study for the European Commission, DG Energy - [Synthesis on the Economics of Nuclear Energy](#)

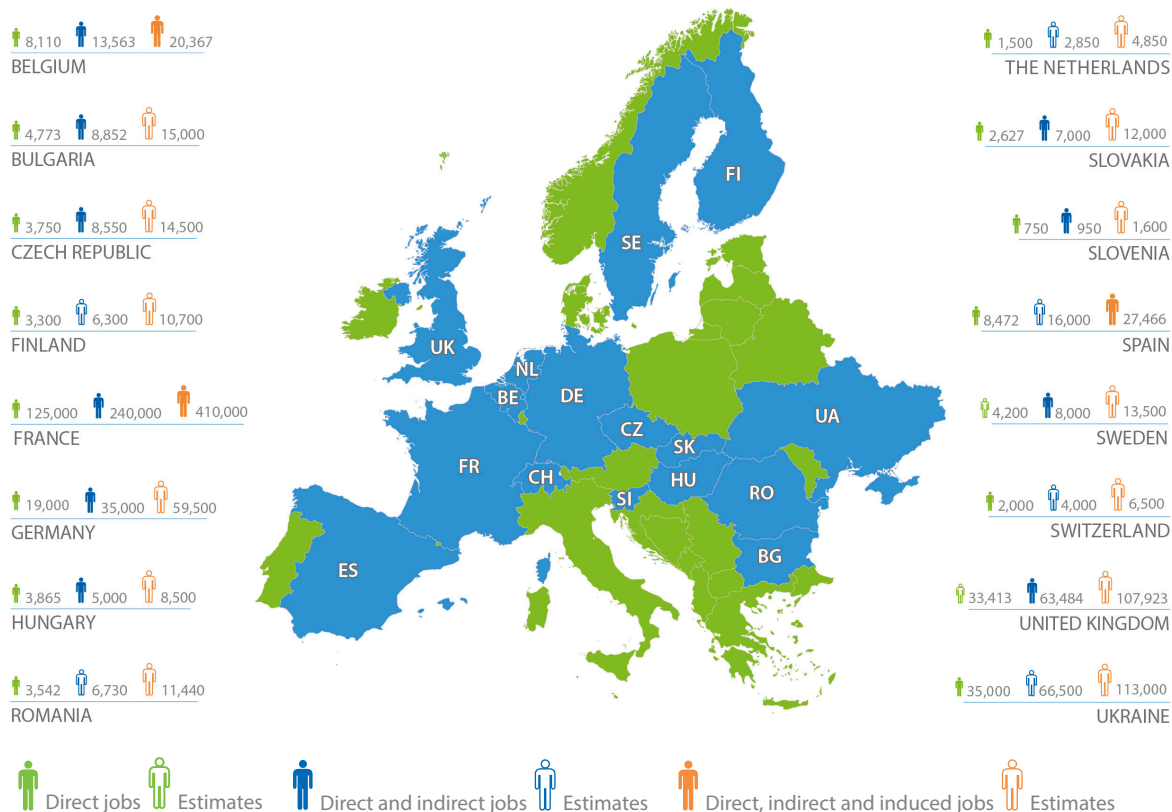
<sup>5</sup>IEA and OECD-NEA - [Projected Costs of Generating Electricity - 2015 Edition](#)

## Jobs

The nuclear sector offers a large amount of long-term highly skilled jobs. In Europe alone, around 800,000 jobs are supported by the nuclear industry. These jobs are linked to both the lifetime operation of the current fleet, but also temporary ones generated during the construction of new reactors.

# EUROPE-WIDE JOBS MAP

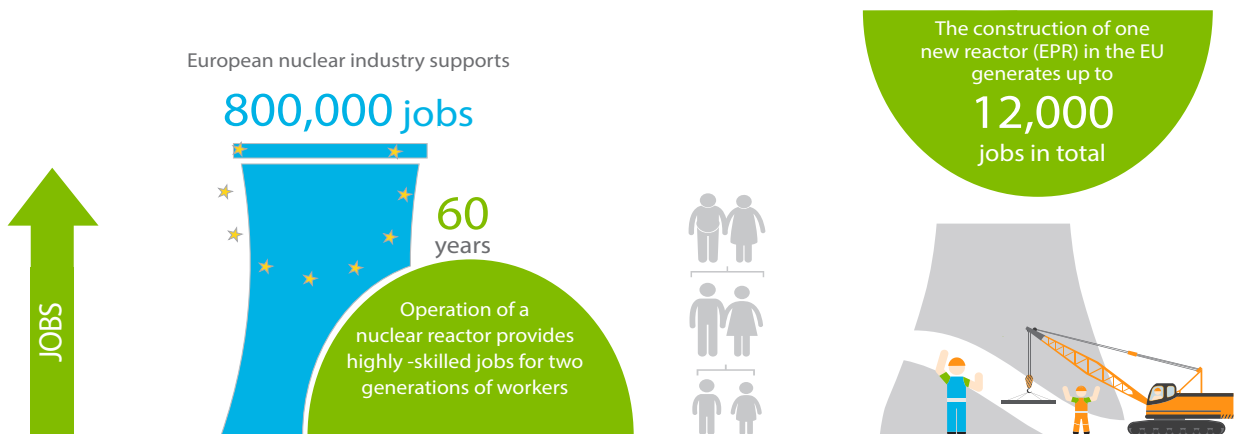
Civil nuclear industry supports around 800,000 jobs in Europe



EUROPE: **240,000** Direct jobs, **460,000** Direct and indirect jobs, **780,000** Direct, indirect and induced jobs. The figures only include the number of jobs in countries that operate nuclear reactors.

For more information on infographics, please consult our website: [www.foratom.org](http://www.foratom.org)

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## About us

The European Atomic Forum (FORATOM) is the Brussels-based trade association for the nuclear energy industry in Europe. The membership of FORATOM is made up of 15 national nuclear associations and through these associations, FORATOM represents nearly 3,000 European companies working in the industry and supporting around 800,000 jobs.



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