Nuclear energy development in the UNECE region

ENERGY

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Vice-Chair of Group of Experts on Cleaner Electricity Systems

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Sustainable Energy – Key areas of work

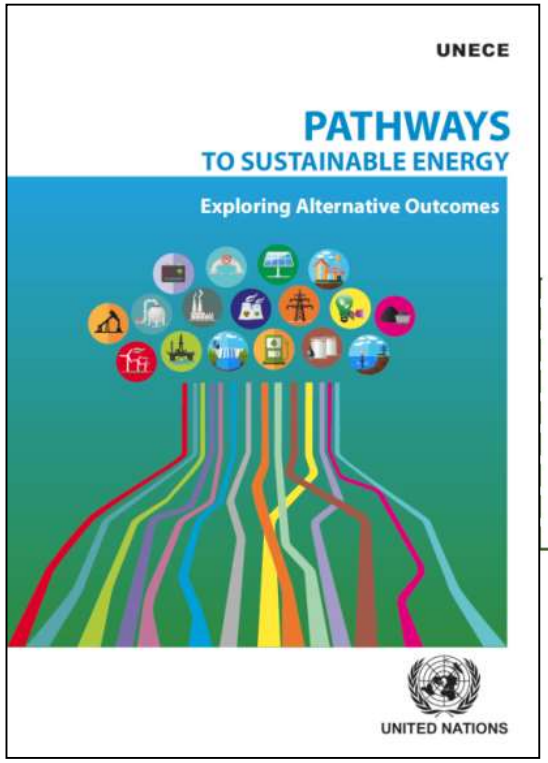
UNECE

Sustainable Resource Management

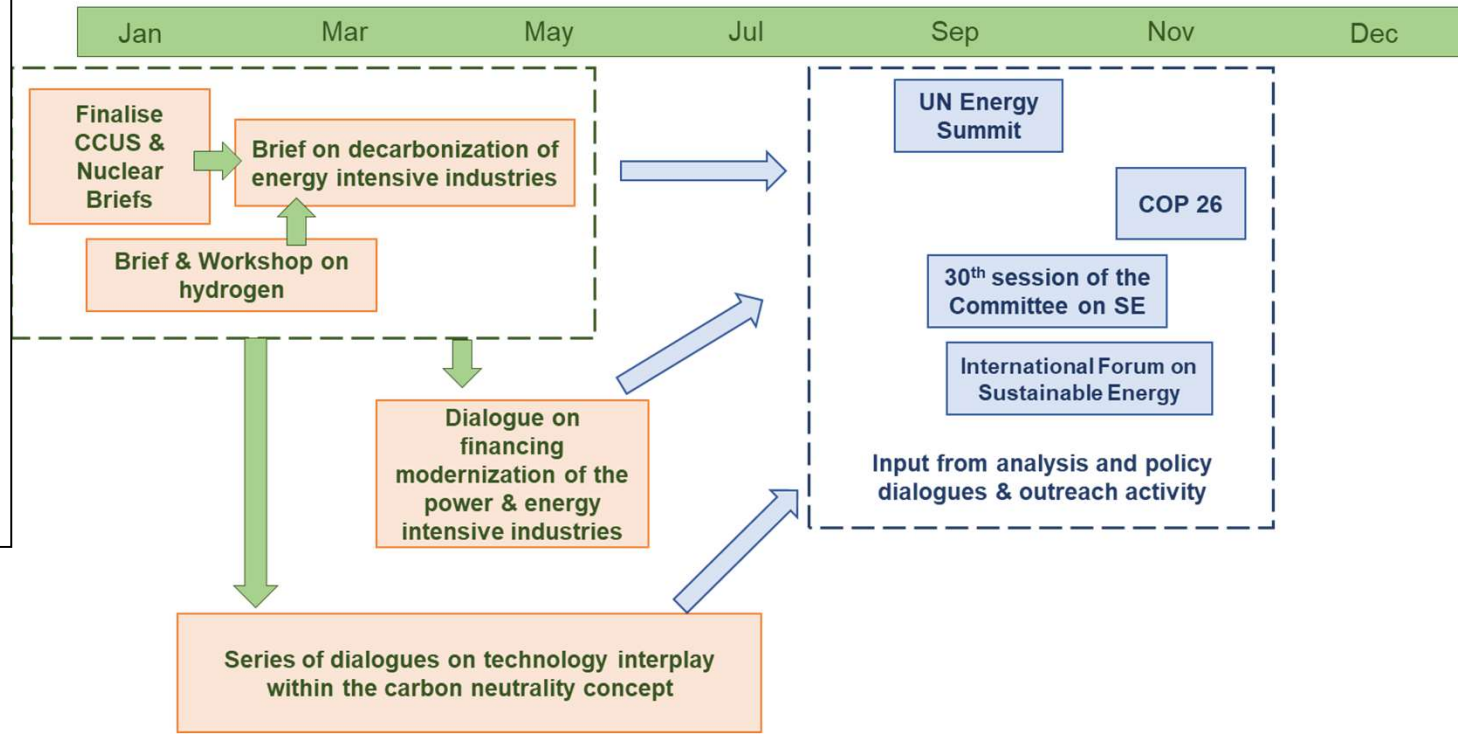
Deep Transformation of the Energy System

Reducing the Environmental Footprint of Fossil Fuels

Regional Cooperation, Projects and Partnerships



Carbon Neutrality Project



Climate change challenge is staggering

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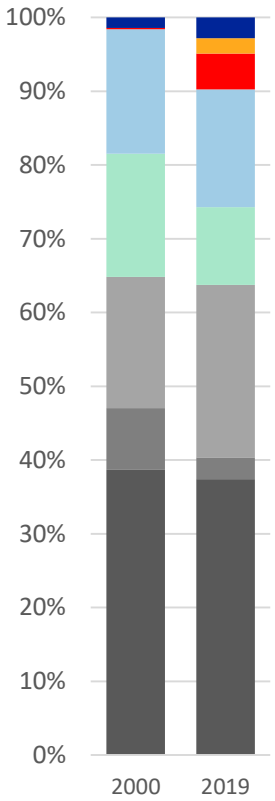
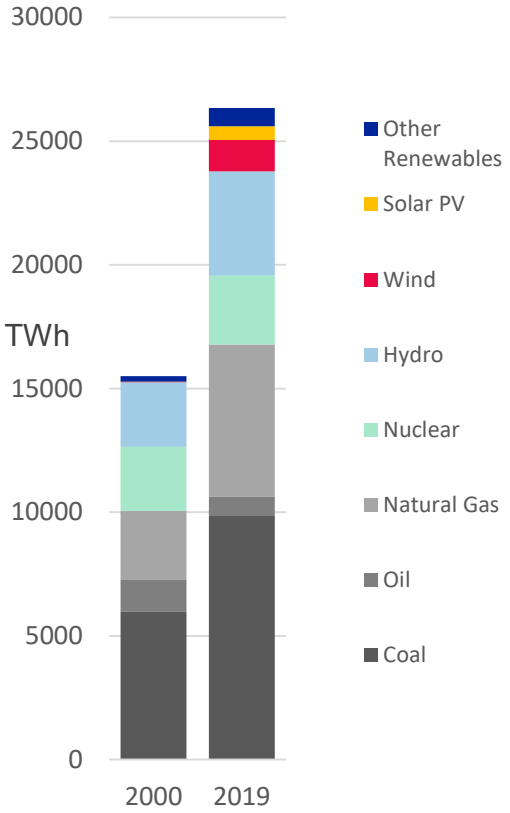
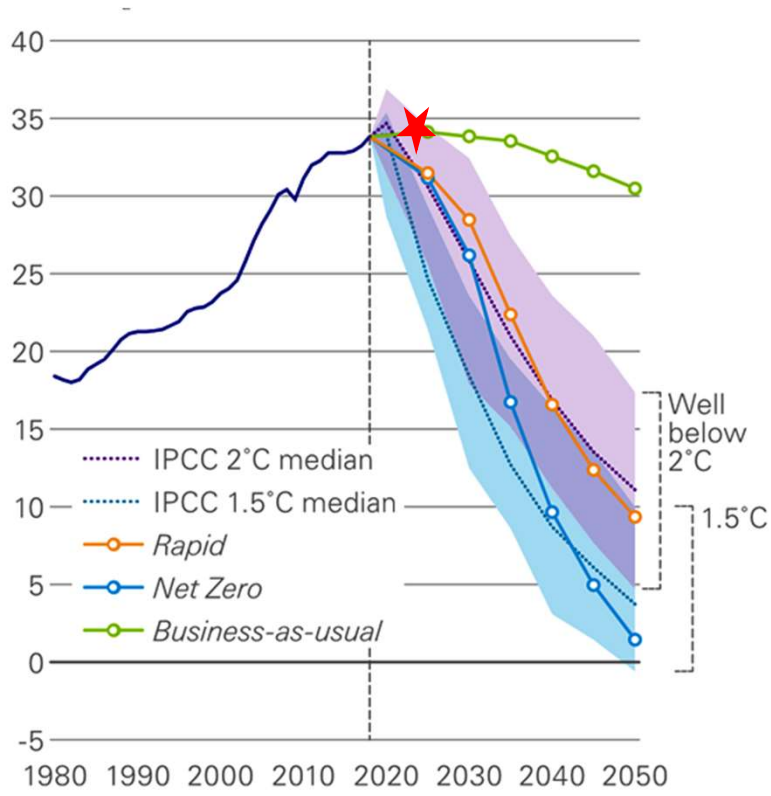


The share of fossil global electricity generation has not significantly reduced since 2000



Global electricity generation from fossil fuels in 2019 higher than total generation in 2000

IEA: World Energy Outlook 2020



- CO_2 emissions must decline over next 30 years.

BP Energy Outlook 2020/IPCC

Nuclear important part of future clean energy mix

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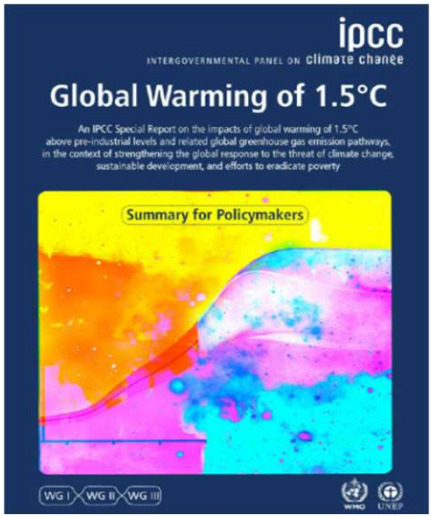
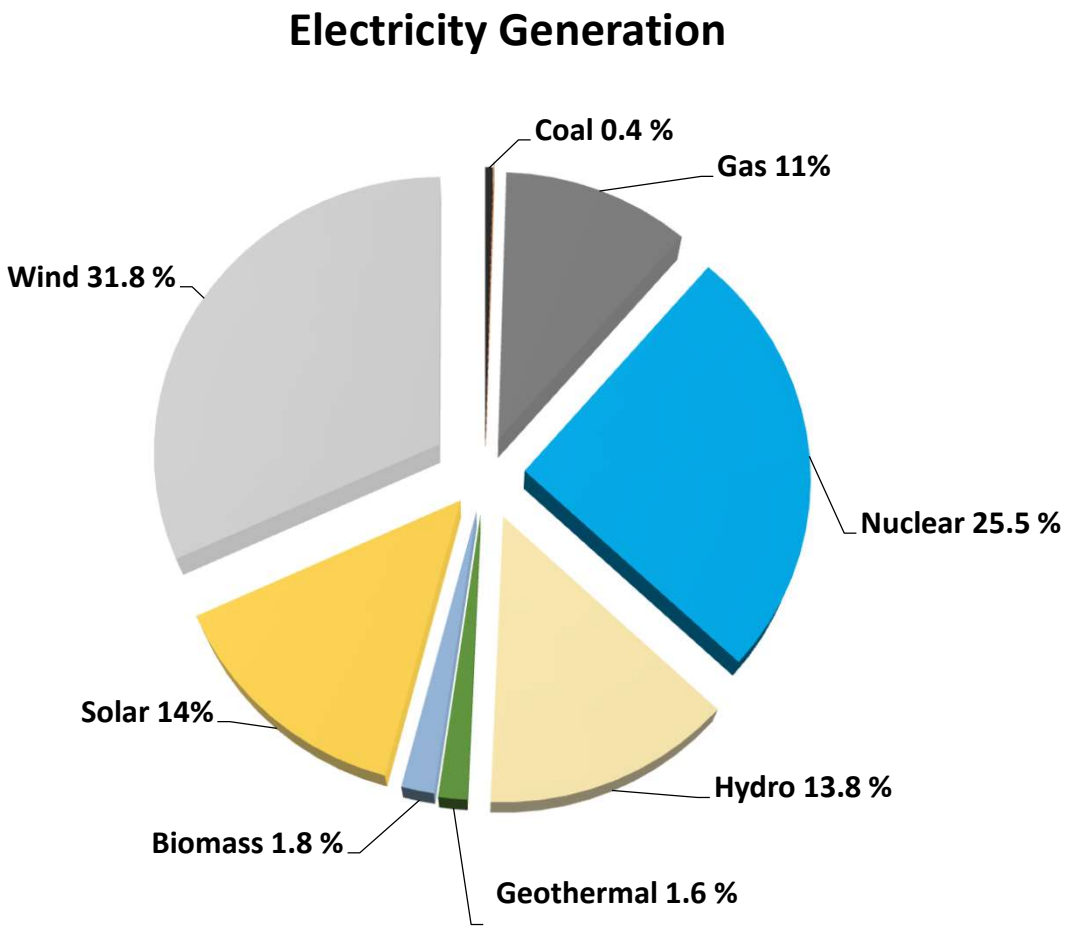
IPCC 1.5°C Report Middle of the road scenario see nuclear energy grow six-fold by 2050, with 2243 GWe capacity, representing 25% of global electricity generation.





Data Source: IPCC Special report on the impacts of global warming of 1.5 °C, 2018,

UNECE nuclear power brief

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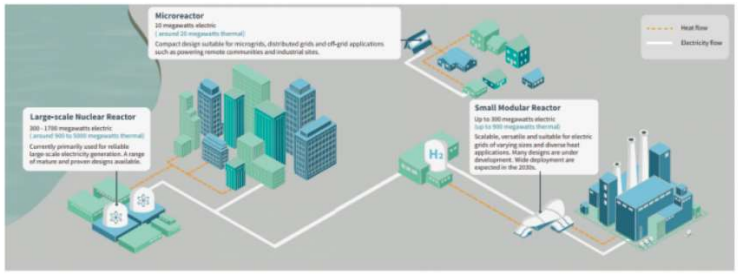
Nuclear Power



Nuclear power is an important **source of low-carbon electricity and heat** that contributes to attaining **carbon neutrality.**

Nuclear power use has avoided about 74Gt of CO_2 over the past 50 years, nearly two year's worth of total global energy-related emissions. In the UNECE region, it currently provides 20% of total generated electricity and 43% of low-carbon generation. In addition, it has the potential to increase its integration with other low-carbon energy sources in a future decarbonised energy mix.

In the UNECE region, nuclear power is an active part of the energy system, providing over 30% of electric generation in eleven countries (Belgium, Bulgaria, Czech Republic, Finland, France, Hungary, Slovakia, Slovenia, Sweden, Switzerland, Ukraine). Twenty countries currently operate nuclear power plants, and fifteen countries have new reactors under construction or under development. Seven UNECE member States are in the process of developing nuclear power programmes for the first time. However, some countries have chosen not to pursue nuclear power because they consider the risks of nuclear incidents and accidents to be unacceptable or because of issues linked to long-term disposal of radioactive wastes.

In many parts of the world, existing large scale nuclear power plants are a cost-competitive option for generating electricity. New innovations such as small modular reactors (SMRs) and

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https://unece.org/sustainable-energy/cleaner-electricity-systems/nuclear-power

Nuclear energy plays an essential role in the UNECE Region

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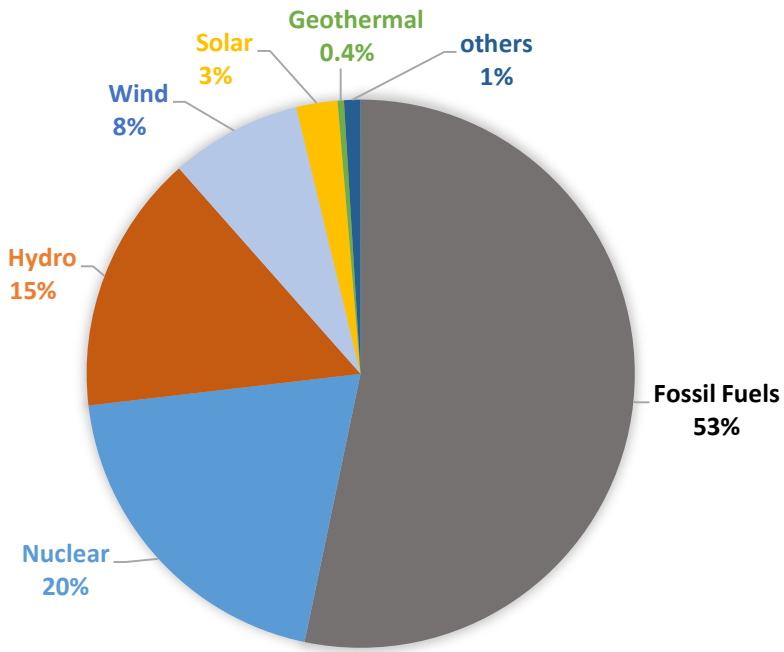
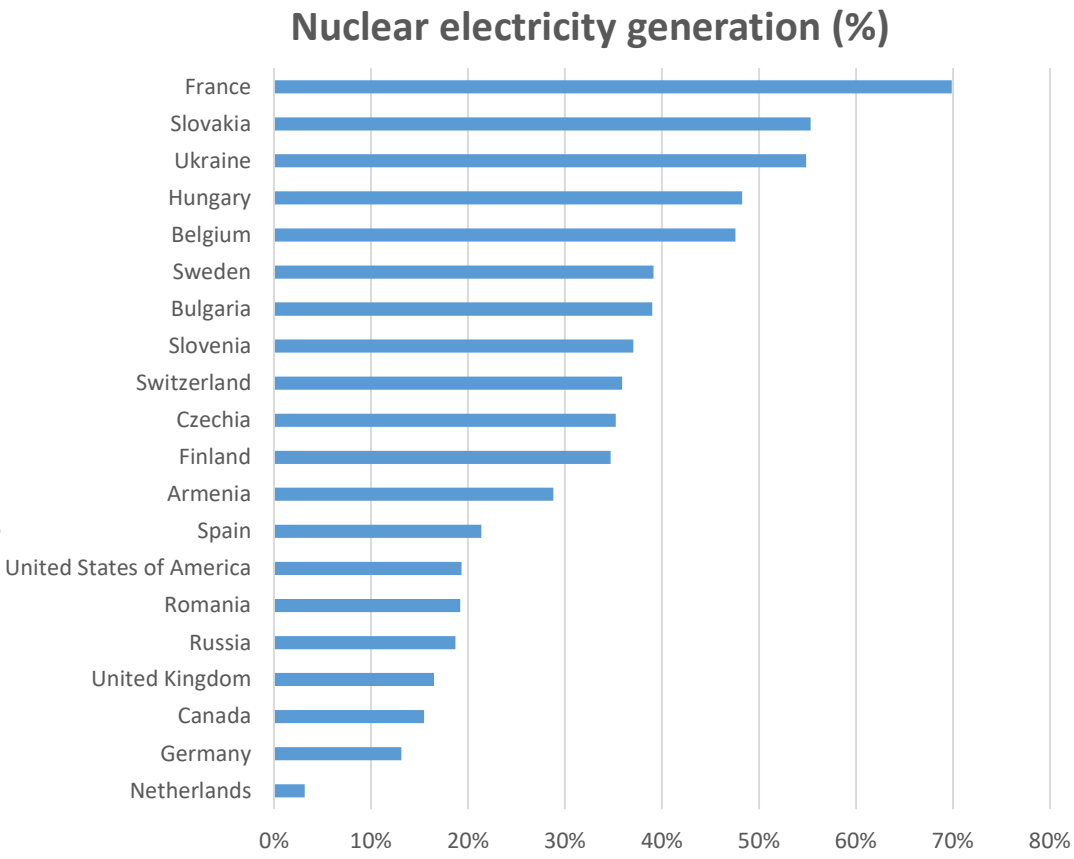
Electricity generation by source in the UNECE region for 2019





Nuclear energy provides the largest contribution of low carbon electricity in ECE region.

20 ECE Member States currently operate nuclear power plants. These nuclear countries produce 85% of ECE total electricity generation.

Current and proposed nuclear power development in UNECE countries

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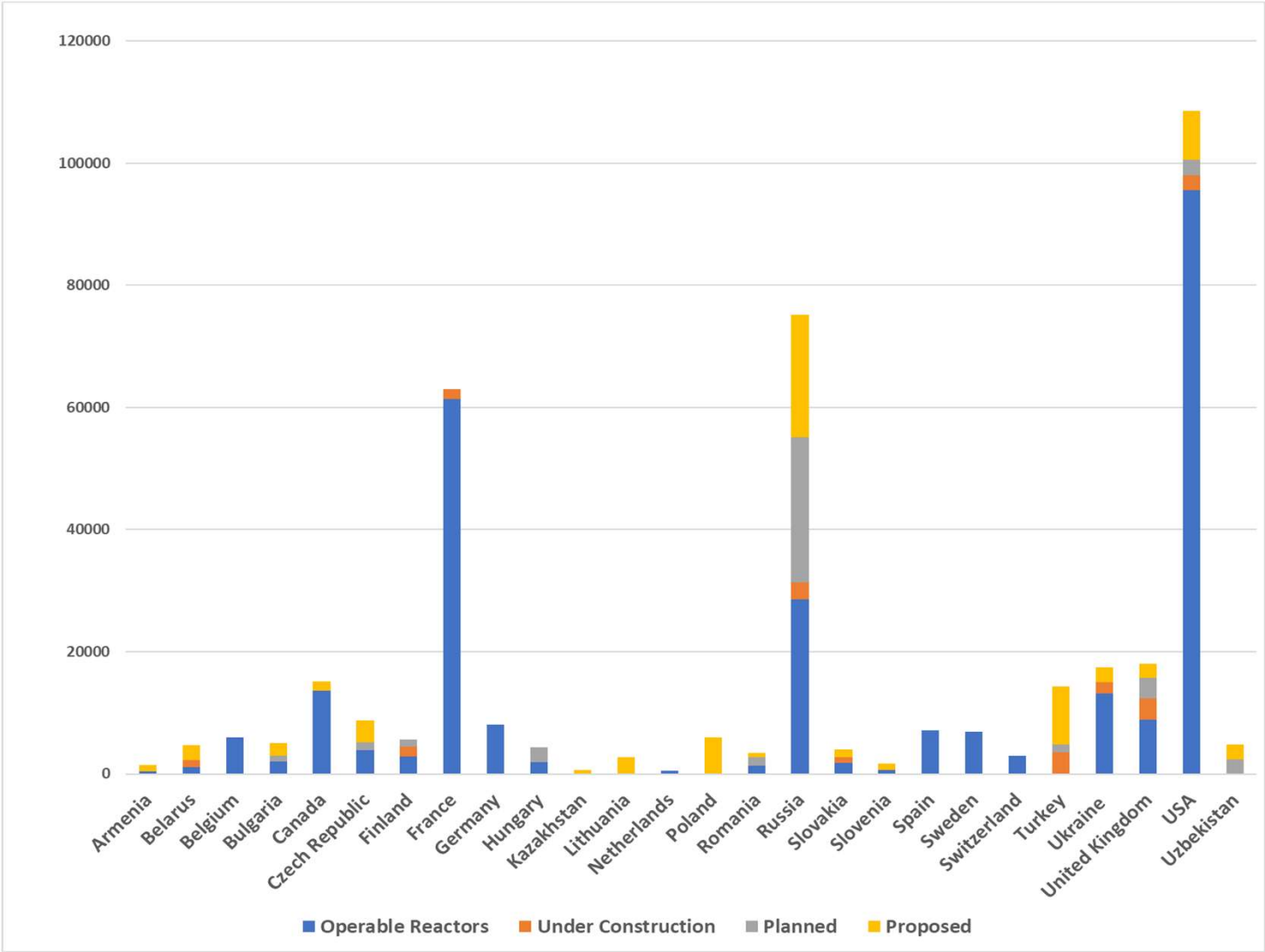
Currently there are 292 nuclear reactor units in operation in ECE countries.

17 reactor units (nearly 20 GWe) are currently under construction in 9 ECE countries.

A further 118 reactor units are planned or proposed, by 19 ECE countries.



Data Source: World Nuclear Association

Nuclear power applications

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NUCLEAR POWER

Nuclear power is an important source of low-carbon electricity and heat that contributes to attaining carbon neutrality

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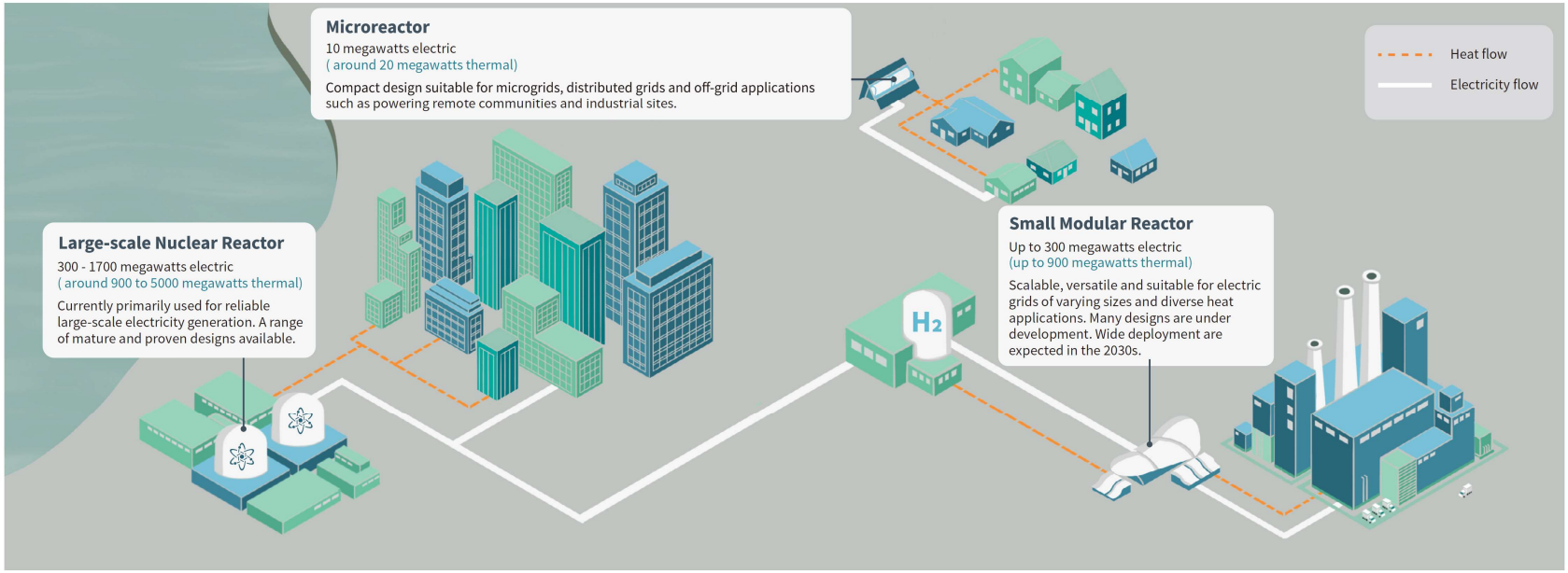

ELECTRICITY GENERATION

Nuclear power plants can produce reliable 24/7 electricity or operate flexibly as required. Dispatchable electricity sources are essential for keeping the costs of the overall system low.

HYDROGEN

Nuclear power can be used to produce low-carbon hydrogen via several process:

- Low-temperature electrolysis - using nuclear electricity
- Steam electrolysis - using nuclear heat and electricity
- Thermochemical process - using nuclear heat at above 600 ℃

PROCESS HEAT FOR INDUSTRY

High-temperature heat from nuclear plants can be transformative in decarbonising hard-to-abate sectors.

DISTRIC HEATING

Nuclear plants are a proven source of heat for urban district heating that have operated successfully in a number of countries.

Raising Awareness
Recognise that nuclear power is a source of low-carbon energy and heat that can help decarbonise energy systems

Promoting Acceptance
Develop policies that instil confidence and facilitate the wider application of nuclear power to decarbonise electricity and energy intensive industries

Incentivising Finance
Develop financing frameworks that instil confidence and incentivise affordable public and private investment in support of new nuclear power projects

Nuclear innovation – Small modular reactors

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Nuscale, USA
77 MWe PWR
Design Licensed

HTR-PM, China
2x110 MWe HTGR
Under Commissioning

Floating NPP, Russia
2x35 MWe PWR
In Operation

Nuward , France
300-400 MWe PWR
Under Development

SMART, South Korea
100 MWe PWR
Design Licensed

Rolls Royce, UK
220-440 MWe PWR
Under Development

Nuclear energy is cost competitive

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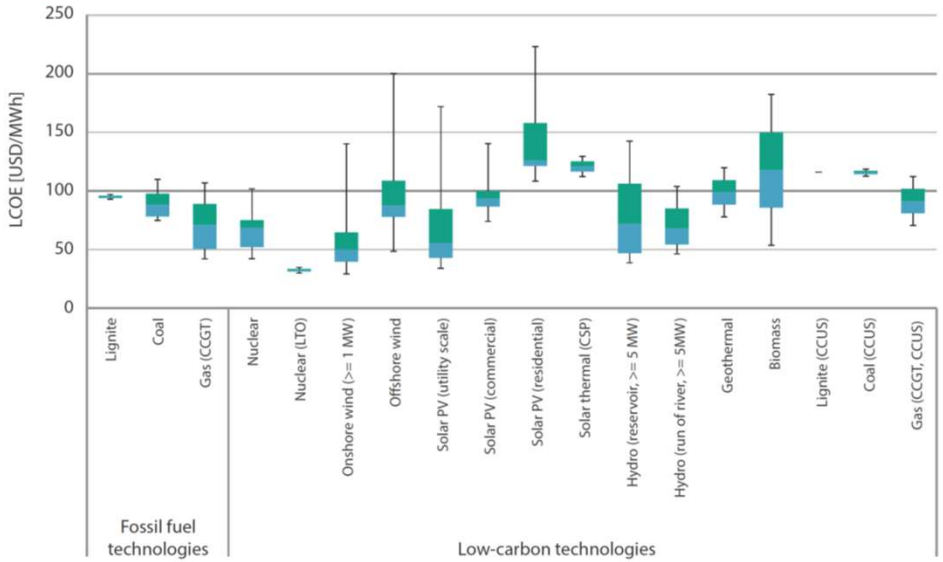
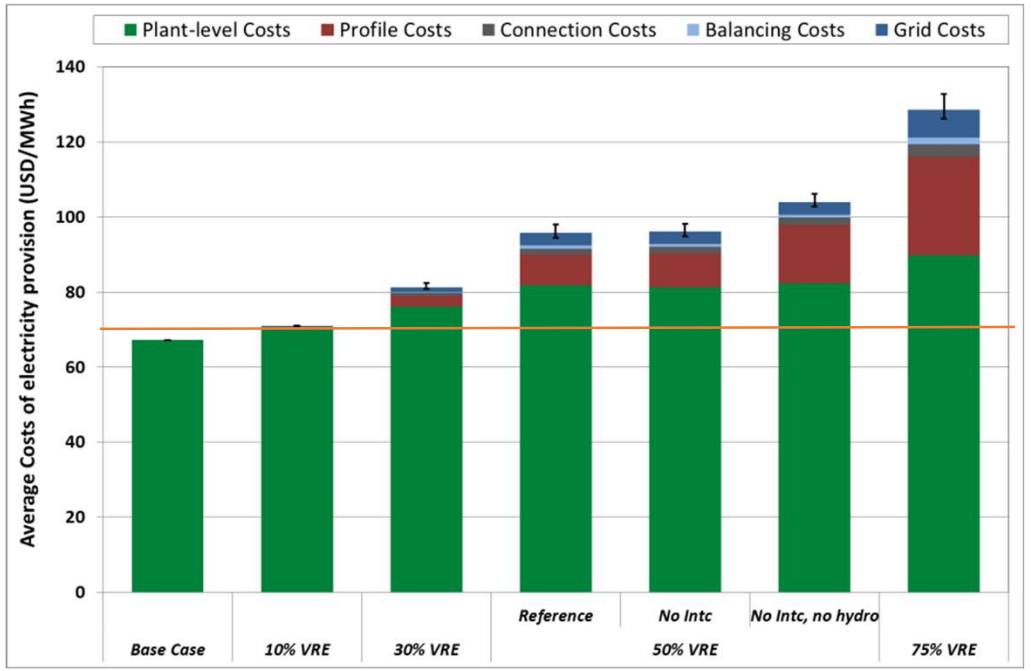
Levelized cost of electricity



Data source: IEA and OECD-NEA, 2020, Projected Costs of Generating Electricity 2020 edition

Total cost of electricity provision - system costs



Data source: OECD-NEA, 2019 , The Costs of Decarbonisation: System Costs with High Shares of Nuclear and Renewables

Nuclear energy sustainability: life cycle assessment

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All forms of energy production pose risks and cause environmental and health impacts.

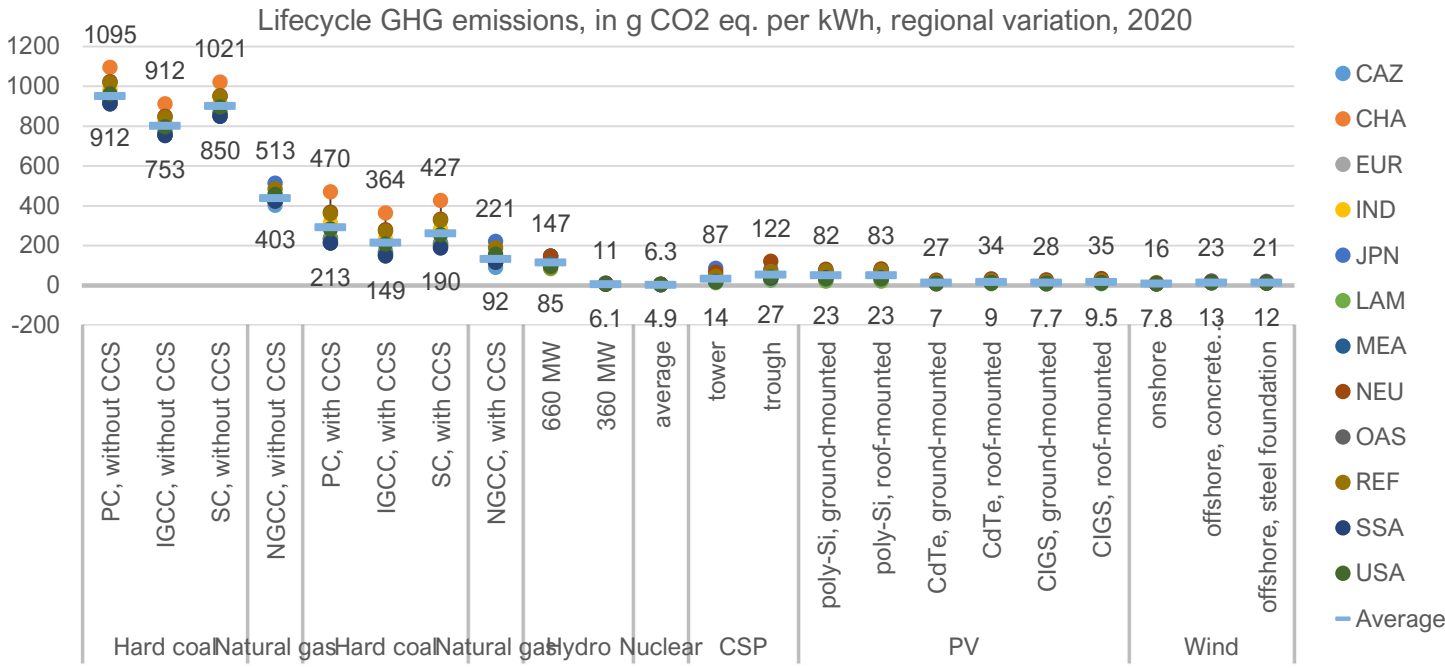
Nuclear power presents specific risks such as radiological accidents and radioactive waste management.

Need to assess and consider as on a scientific whole life cycle basis.

Nuclear power's lifecycle GHG emissions are estimated at 6.3 g CO2 eq./kWh, the lowest of all energy sources.

LCA OF ELECTRICITY GENERATION TECHNOLOGIES

UNECE modelling activities – Carbon neutrality project



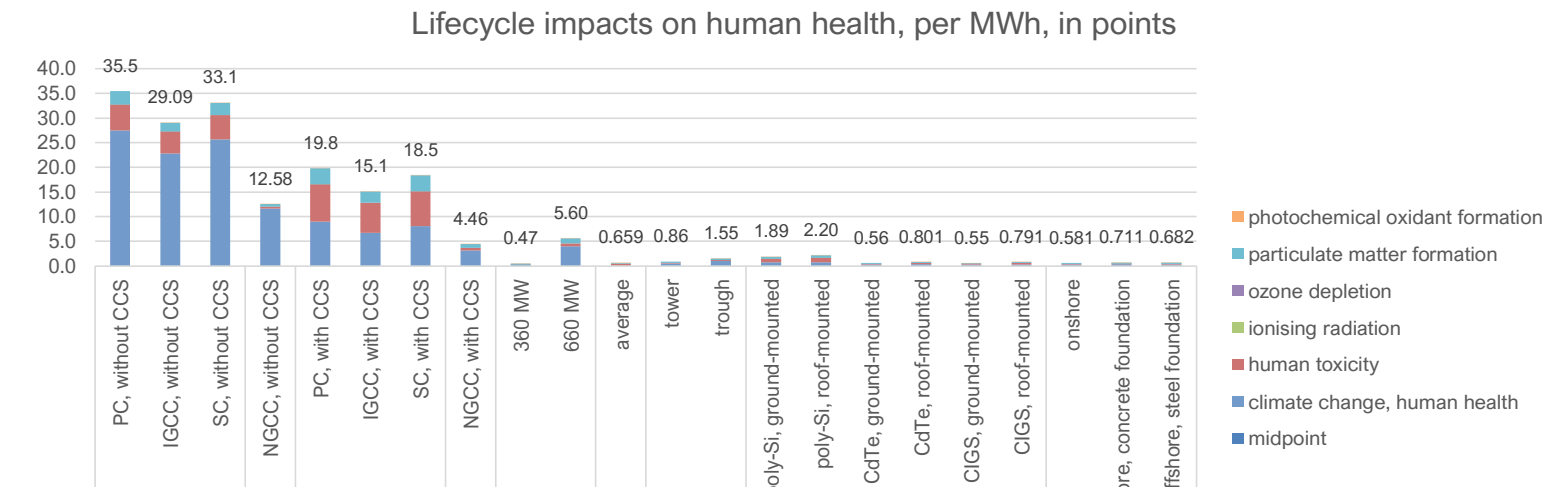
*Preliminary Results

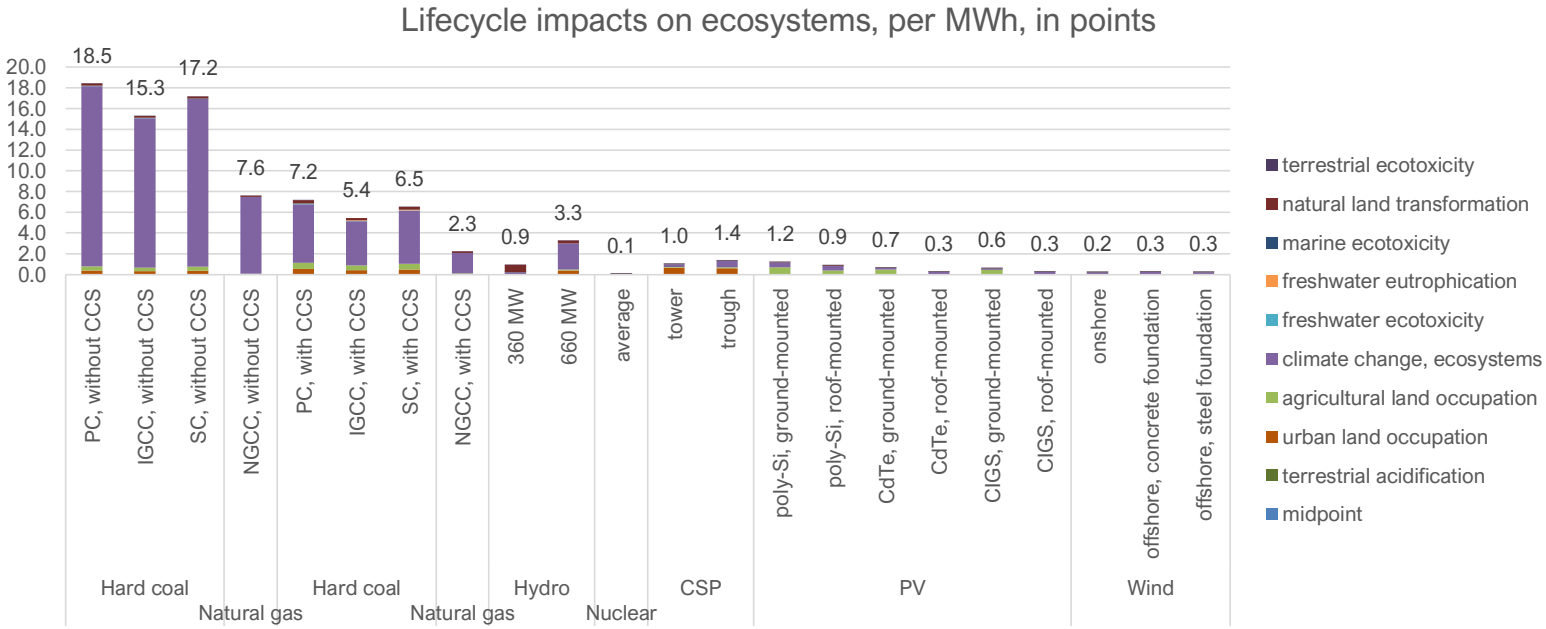
Nuclear energy sustainability: life cycle assessment

ENERGY

All forms of energy production pose risks and cause environmental and health impacts.

Nuclear power has much lower human health and environmental impacts than fossil fuel power generation and is comparable with renewable energy technologies.





***Preliminary Results**

Nuclear technologies to support sustainable development

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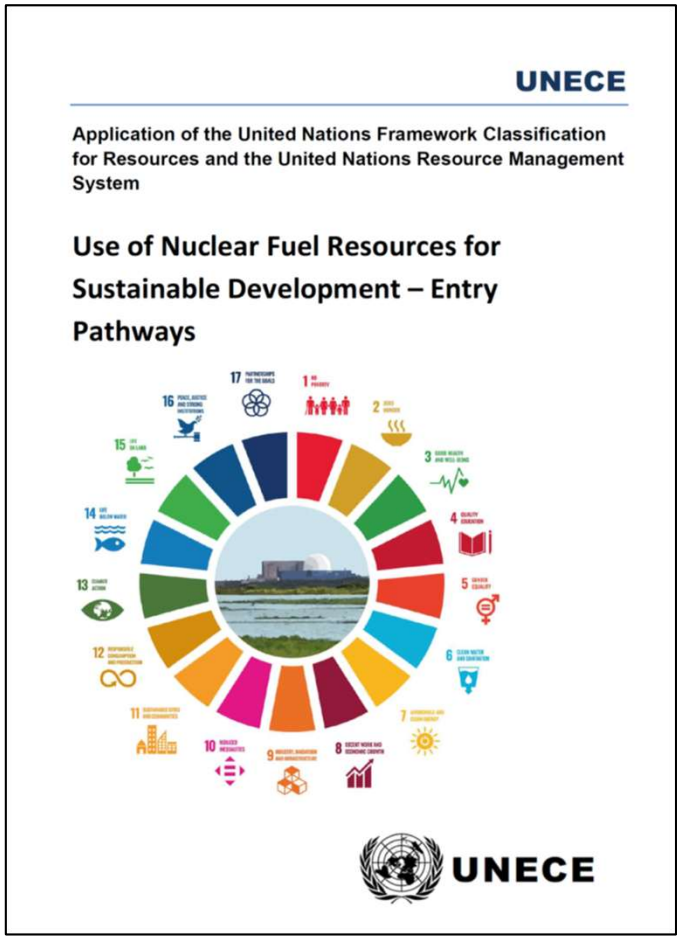
Nuclear energy is an ‘indispensable tool’ for achieving the sustainable development goals (SDGs). It has a crucial role in providing affordable energy and climate change mitigation, as well as eliminating poverty, achieving zero hunger, providing clean water, economic growth, and industry innovation.



Nuclear technologies to support sustainable development

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Food and Agriculture

Nuclear technologies help fight against pests, avoiding the need to resort to harmful pesticides.

Using nuclear techniques to develop new plant breeds means that farmers can grow crops that need less water and that are more resistant to the impacts of climate change.

Fresh food can last longer if irradiated, and this process also kills E. coli, listeria and salmonella.

Medical

40 million nuclear medicine procedures are performed each year.

Nuclear medicine is a critical component in diagnosing health problems related to the function of organs, tissues, or bones.

Radiotherapy helps treat and cure many kinds of cancer.

Nuclear technologies to support sustainable development

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Clean water

Desalination of seawater using heat generated by nuclear reactors produces pure, clean water, without the greenhouse gases emitted by the fossil fuel plants that power desalination units.

Isotope hydrology techniques help tracing and measurement of the extent of underground water resources to improve the management and conservation of existing supplies of water, and in the identification of new sources.

Sustainable Cities

Nuclear power plants prevented more than 1.8 million air pollution-related deaths between 1971 and 2009.

Nuclear energy assists in the electrification of public rail transport and electric vehicles.

Nuclear power plants can also be used for district heating, avoiding pollution from fossil fuels.

Nuclear projects result in significant socio-economic benefits

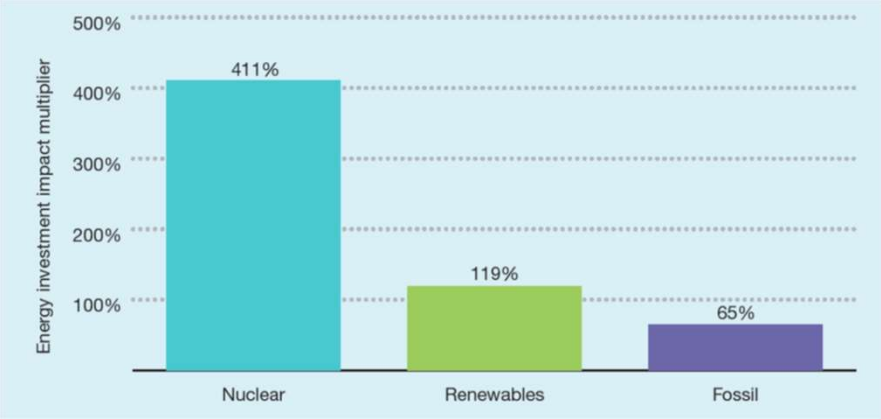
ENERGY

SDG 8 - Decent Work and Economic Growth

The nuclear industry provides well-paid, high-skill jobs and investment that supports local communities

Nuclear projects provide high spill-over investment into the local and regional economy.

IMF found nuclear energy investment spending has a large economic output multiplier effect, producing more growth.



Data source: IMF Working Papers 2021 Building Back Better: How Big Are Green Spending Multipliers?

For example the UK Hinkley Point C nuclear power plant project:

Jobs - 22,000 people in Britain currently working on the project, with a total 71,000 projected jobs to be supported by the project.

Skills – 800 apprentices trained on the project to date

Local and regional economic development – £3.2 Billion spent with local companies in the South West region.

Industrial development and supply chain 64% of the value of Hinkley Point C contracts has been awarded to UK-based companies to date. The total projected economic value to the UK of £18 Billion.

Hinkley Point C Socio-economic Impacts Report 2021

Key Takeaways

ENERGY

Nuclear energy is an important source of low-carbon electricity and heat that contributes to attaining carbon neutrality. It has played a major role in avoiding carbon dioxide (CO2) emissions to date.

All available low-carbon technologies are required to transition to a low carbon economy. Nuclear is an important part of future clean energy mix.

Nuclear innovations, small modular reactor (SMRs), will complement established large-scale reactors and open new applications for nuclear energy, including district heating, high temperature process heat and hydrogen production. SMRs could provide electricity for small grids or remote locations and will improve the integration of variable renewable energy sources.

Nuclear power has much lower human health and environmental impacts than fossil fuel power generation and is comparable with renewable energy technologies.

Nuclear energy is an 'indispensable tool' for achieving the sustainable development goals (SDGs). It has a crucial role in providing affordable energy and climate change mitigation, as well as eliminating poverty, achieving zero hunger, providing clean water, economic growth, and industry innovation.

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