Global Perspectives on Nuclear Energy and Decarbonization

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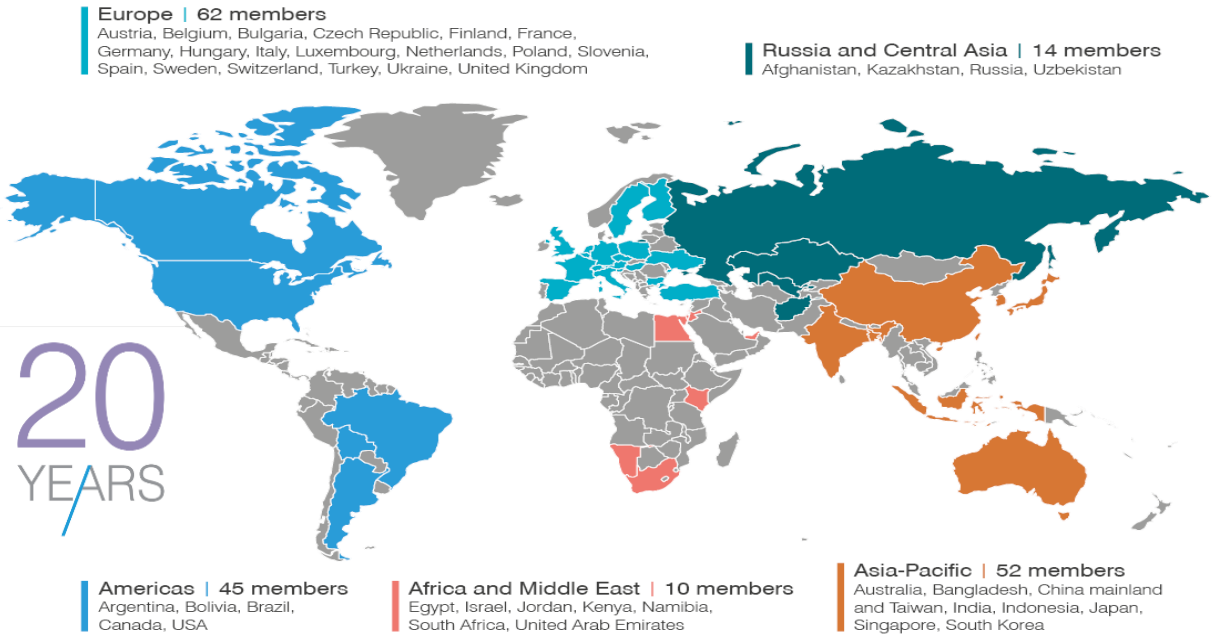
Virginia Nuclear Energy Consortium Authority
22 February 2022

We are the voice of the global nuclear industry

188 members

45 countries



Major reactor vendors - nuclear utility companies - uranium mining, conversion, enrichment, and fuel fabrication companies - nuclear engineering, construction and waste management companies – R&D organizations - transport, law, insurance and finance service companies

World Nuclear Association …

We work with, support and represent the industry

wnn world nuclear news

We inform and communicate on nuclear energy

WORLD NUCLEAR UNIVERSITY

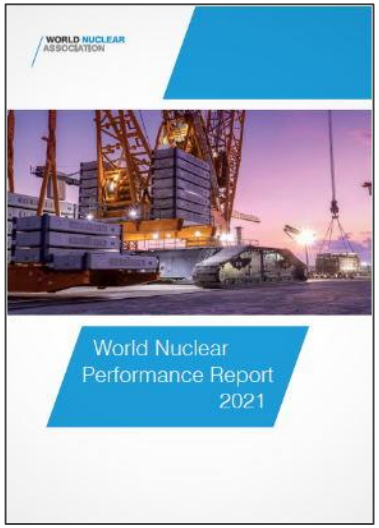
We train the nuclear leaders of tomorrow

HARMONY
What will power our electric future?

We are a thought leader for nuclear energy in the global energy debate

We provide authoritative information about nuclear

Nuclear Performance

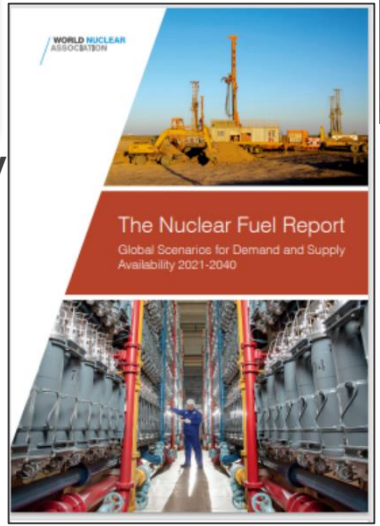


https://world-nuclear.org/our-association/publications/global-trends-reports/world-nuclear-performance-report.aspx

COVID-19 recovery

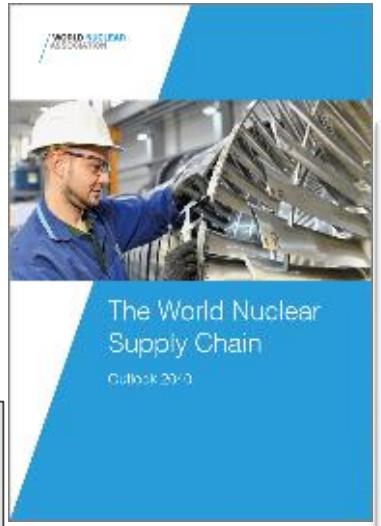
https://world-nuclear.org/our-association/publications/policy-papers/building-a-stronger-tomorrow.aspx

Nuclear Fuel



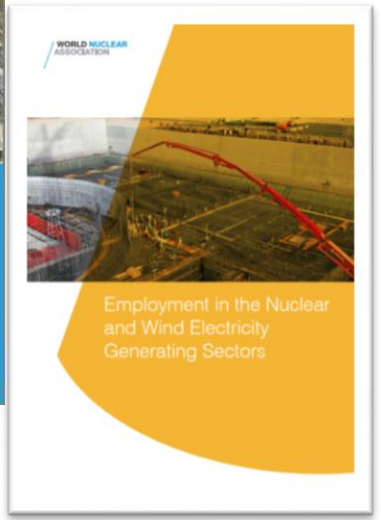
https://world-nuclear.org/shop/products/the-nuclear-fuel-report-global-scenarios-2021.aspx

Supply Chain



https://world-nuclear.org/shop/products/the-world-nuclear-supply-chain-outlook-2040.aspx

Nuclear jobs



https://www.world-nuclear.org/our-association/publications/technical-positions/employment-in-the-nuclear-and-wind-electricity-gen.aspx

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World Nuclear University Summer Institute 2022

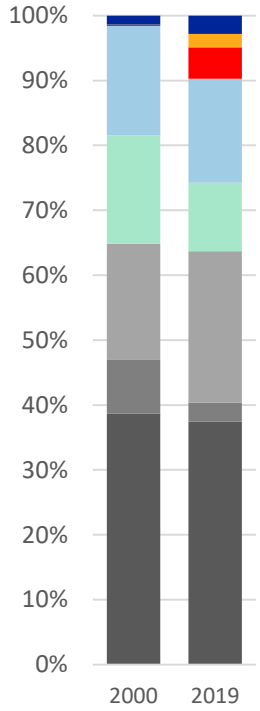
WNU's Flagship in-person leadership and professional development programme for future leaders

Hosted by Spain, in cooperation with SNE.

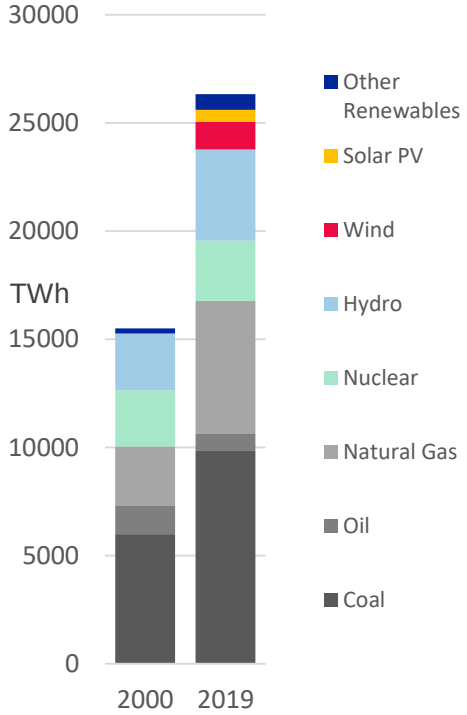
Dates:19 June- 23 July 2022
Duration: 5 weeks

Further information:
www.world-nuclear-university.org/programmes/summer-institute
wnu@world-nuclear.org

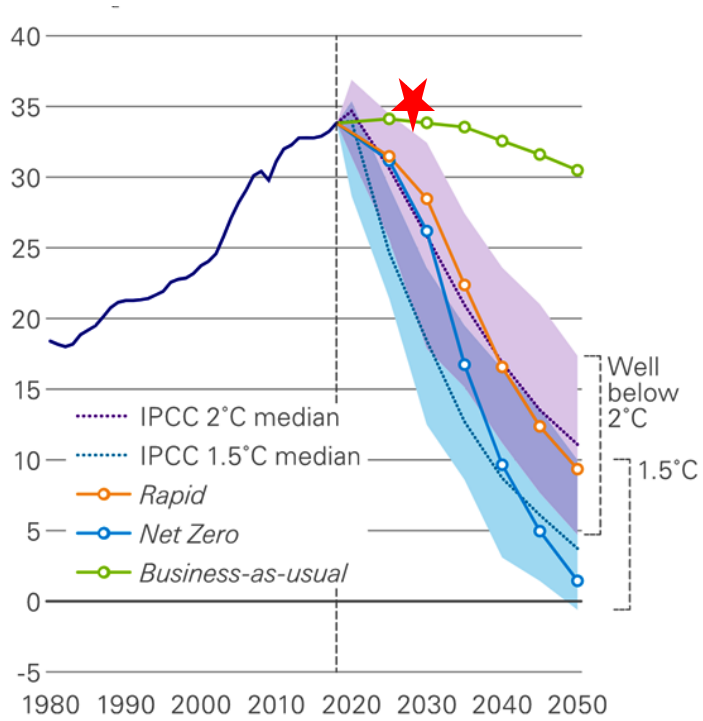
The enormity and the urgency of the climate change challenge are staggering



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



Electricity generation from fossil fuels in 2019 higher than total generation in 2000

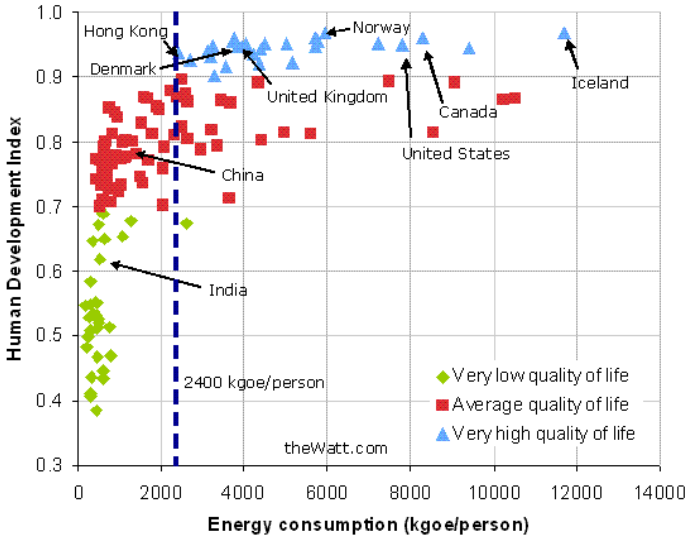


CO_2 emissions must decline over next 30 years.

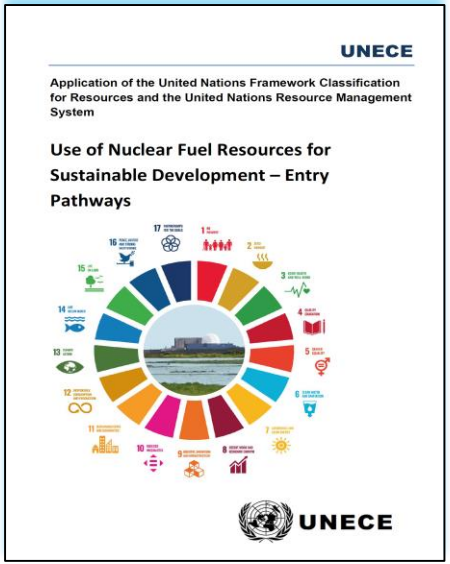
IEA: World Energy Outlook 2020

BP Energy Outlook 2020/IPCC

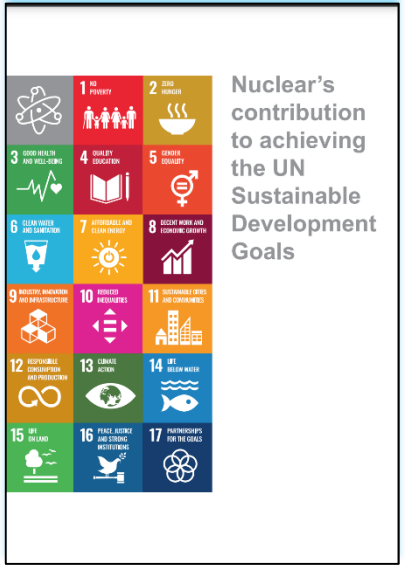
Less developed nations are focused on both clean energy and socio-economic development



Source: BP Energy Outlook 2019



Source: UNECE, 2021 https://unece.org/sustainable-energy/publications/nuclear-entry-pathways

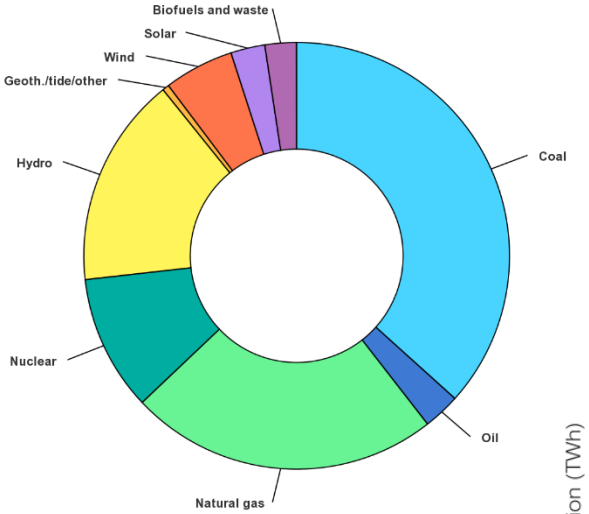


Source: WNA, 2021 https://www.world-nuclear.org/sustainable-development-goals-and-nuclear.aspx

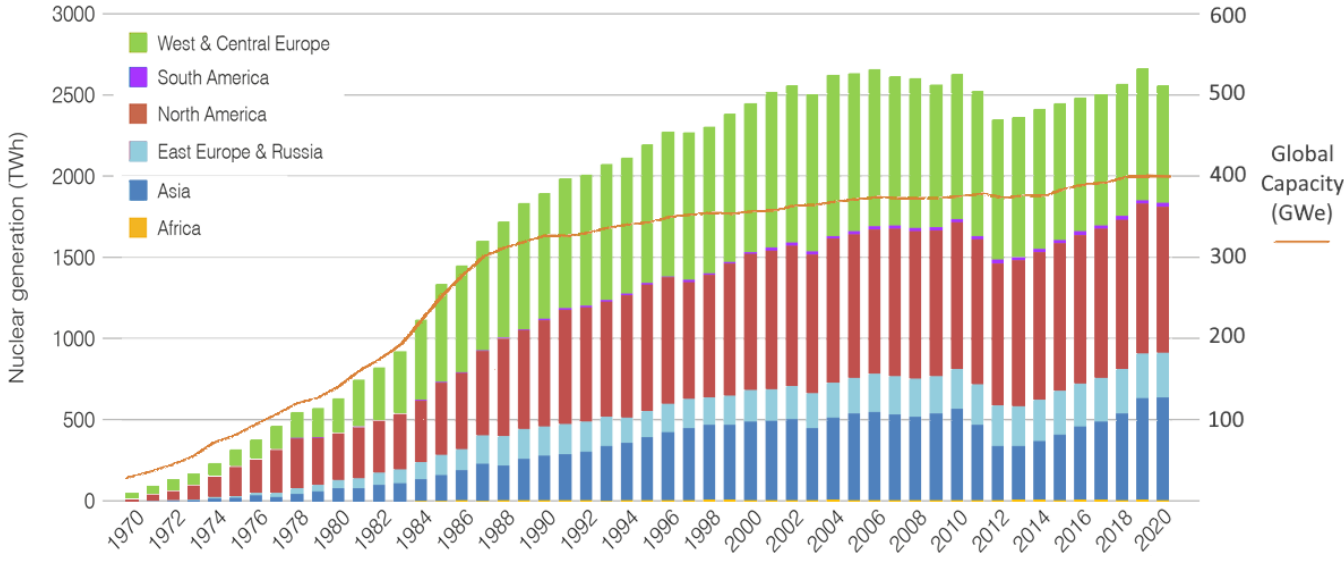
Around 80% of the world's population today have an average energy consumption of less than 100 GJ per head.

Nuclear energy is an indispensable tool for achieving the global sustainable development agenda.

Nuclear energy is the second largest source of low-carbon electricity – largest in OECD countries



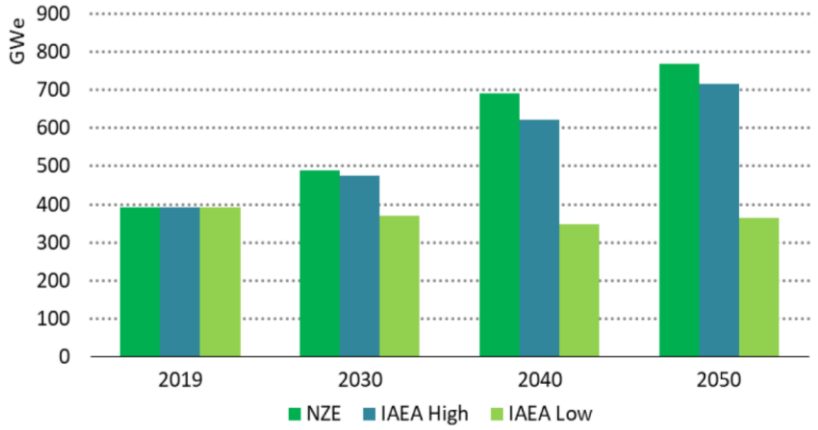
Over the past 50 years, the use of nuclear power has reduced CO2 emissions by over 60 gigatonnes – nearly two years' worth of global energy-related emissions



Source: World Nuclear Association and IAEA Power Reactor Information Service (PRIS)

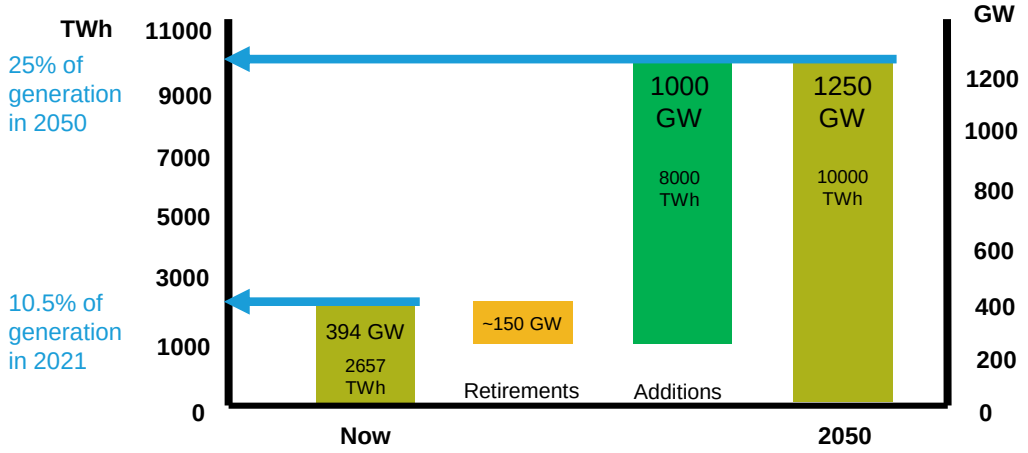
Nuclear energy needs to grow significantly for deep decarbonization

World nuclear installed capacity (net)



Source: IEA 2021

World nuclear installed capacity (net)



Source: WNA Harmony Program 2021

- Nuclear energy needs to grow rapidly if we are to satisfy energy demand, achieve climate targets and help the world meet the sustainable development goals.
- Increased ambition in the role of nuclear energy to reach Net-Zero Goals is needed

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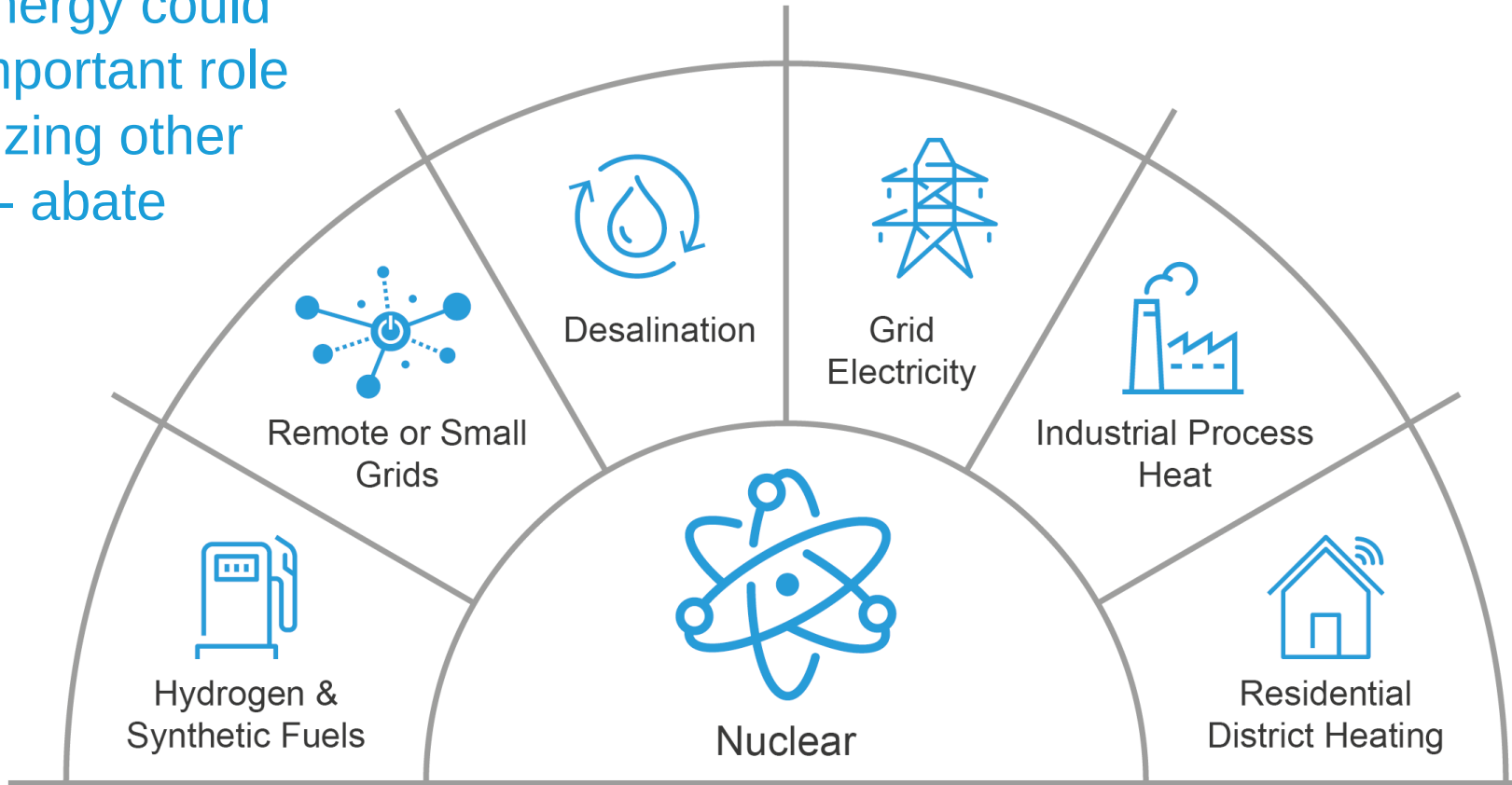
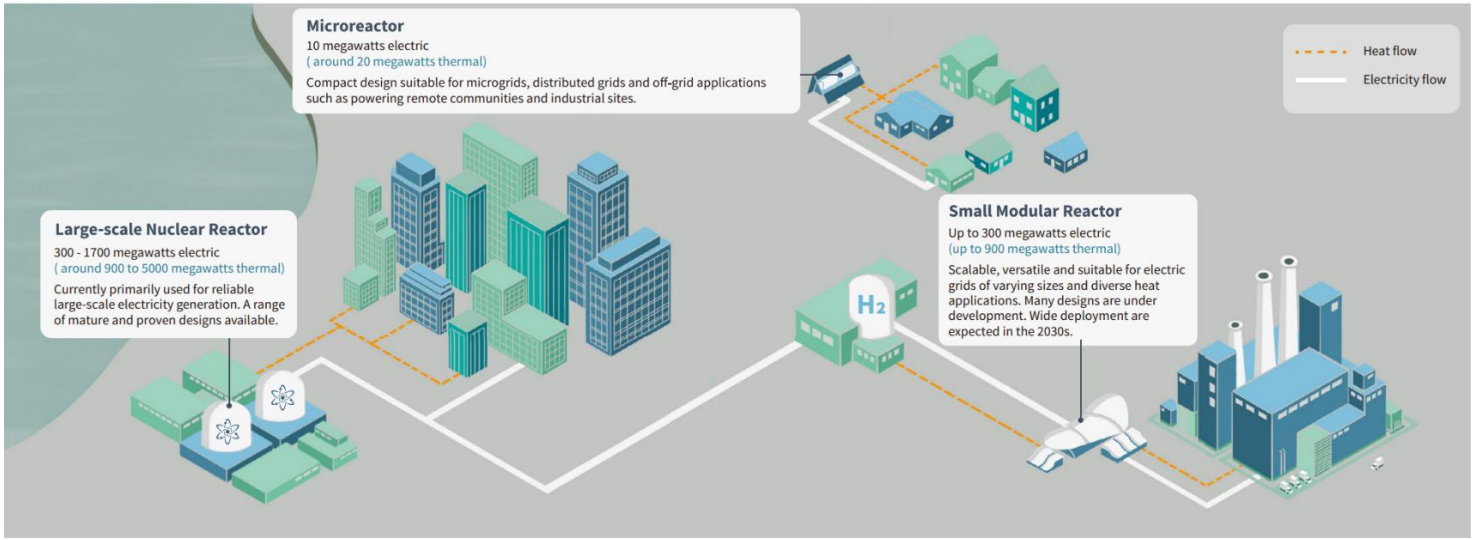
As the only low-carbon source that can produce electricity and heat, nuclear energy could play an important role decarbonizing other difficult-to- abate sectors



NUCLEAR POWER

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



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 C

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.

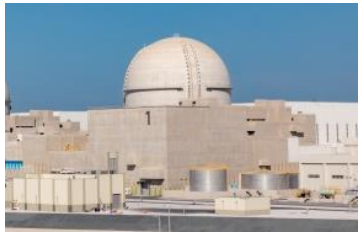
Raising Awareness
Recognise that nuclear power is a source of low-carbon energy and heat that can help decarbonise energy systems

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

Source: UNECE, 2021 https://unece.org/sites/default/files/2021-08/Nuclear%20power%20brief_EN_0.pdf

Lots of excitement about new nuclear projects, large and small

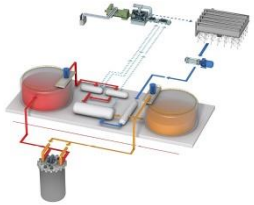


Barakah 1 - UAE
APR-1400
In operation

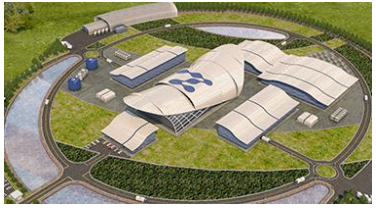
Fuqing 5 - China
Hualong One
In operation

Ostrovets 1 - Belarus
VVER V-491
In operation

Akademik Lomonosov
KLT-40S - Russia
In operation



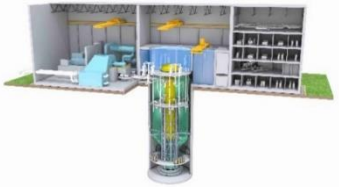
Natrium, US
345 MWe SFR
MS storage
Under Development



NuScale, US
77 MWe PWR
Design Licensed

HTR-PM, China
2x110 MWe HTGR
Under Commissioning

Terrestrial, Canada, US, UK
190 MWe IMSR
Under Development



BWRX300, US
300 MWe BWR
Under Review

Aurora/Oklo, US
1.5 MWe Heatpipe FNR
Under Review

COP26 marked a change of perception for nuclear

Energy

Macron says France will build new nuclear energy reactors

Reuters

Rolls-Royce secures funding for SMR deployment

British engineering group Rolls-Royce has announced the establishment of a new business - Rolls-Royce SMR Limited - for the deployment and commercialisation of its small modular reactor technology. The announcement follows the securing of GBP210 million (USD285 million) in funding from the UK government, matched by more than GBP250 million of private investment.

Teaming agreement signed for Romanian SMR deployment

NuScale Power and Romanian national nuclear company Nuclearelectrica yesterday signed a teaming agreement to advance the deployment of NuScale's small modular reactor technology in Romania. The signing came a day after plans for the cooperation were announced on the sidelines of the COP26 climate conference in Glasgow.

Birol calls for nuclear acceleration

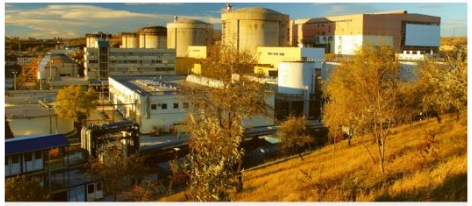
Countries have "re-appreciated" the value of nuclear power, International Energy Agency Director General Fatih Birol said at COP26 today. Birol, who called for new build in Europe, North America and Asia, also said that national commitments made at COP26 would put the world on track to limit global warming to 1.8°C.

Countries are looking at nuclear energy to meet net-zero goals

Nuclear makes a comeback in the Netherlands

Nuclear Policies 15 December 2021

The Netherlands' new coalition government has placed nuclear power at the heart of its climate and energy policy. Some EUR500 million (USD564 million) has been earmarked to support new nuclear build in the period to 2025.



First contract signed for Cernavoda completion

A year-long, CAD8.4 million (USD6.6 million) contract will see Canada's Candu Energy prepare the licensing basis for two new Candu pressurised heavy water reactors at Romania's Cernavoda nuclear power plant. The signing was celebrated by the governments of Romania and Canada, as well as the USA.

Polish joint venture to commercialise SMRs

07 December 2021

Share

Polish companies Synthos Green Energy and PKN Orlen have signed an investment agreement to establish a joint venture for the deployment of a small modular reactor (SMR) fleet in Poland. The Orlen Synthos Green Energy joint venture will commercialise micro modular reactor (MMR) and SMR technology, in particular GE Hitachi Nuclear Energy's BWRX-300.

Westinghouse signs initial contract for Ukrainian AP1000s

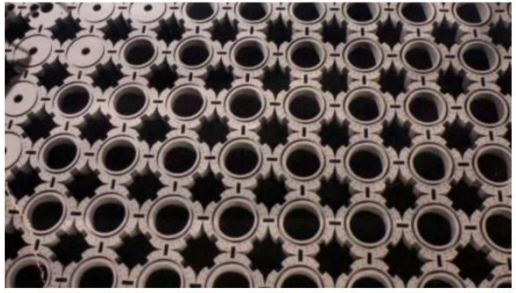
22 November 2021

Share

A contract signed by the Ukrainian nuclear operator Energoatom and US vendor Westinghouse will trigger the engineering and procurement of components for the first of several AP1000s planned for Ukraine. The country is planning as much as 11 GWe of new build by 2040.

Polish support for nuclear on a high

Support for nuclear energy in Poland is overwhelming with 78% of people supporting the technology as a response to climate change, according to opinion polling. It comes as the country experiences a series of developments towards nuclear deployment.



UK selects HTGR for advanced reactor demonstration

Lifetime extensions of the existing nuclear fleet are crucial in the near term

Bruce NPP, Canada (Source: Bruce Power)

- Most cost-effective decarbonisation tool
- Preserves know-how and supply chains in nuclear sector
- Shovel-ready jobs able to contribute to post-COVID economic recovery and beyond.
- Technology & socio-economic spill-overs in local and national economies.

New nuclear projects needed to maintain long term clean electricity goals and sustained economic development

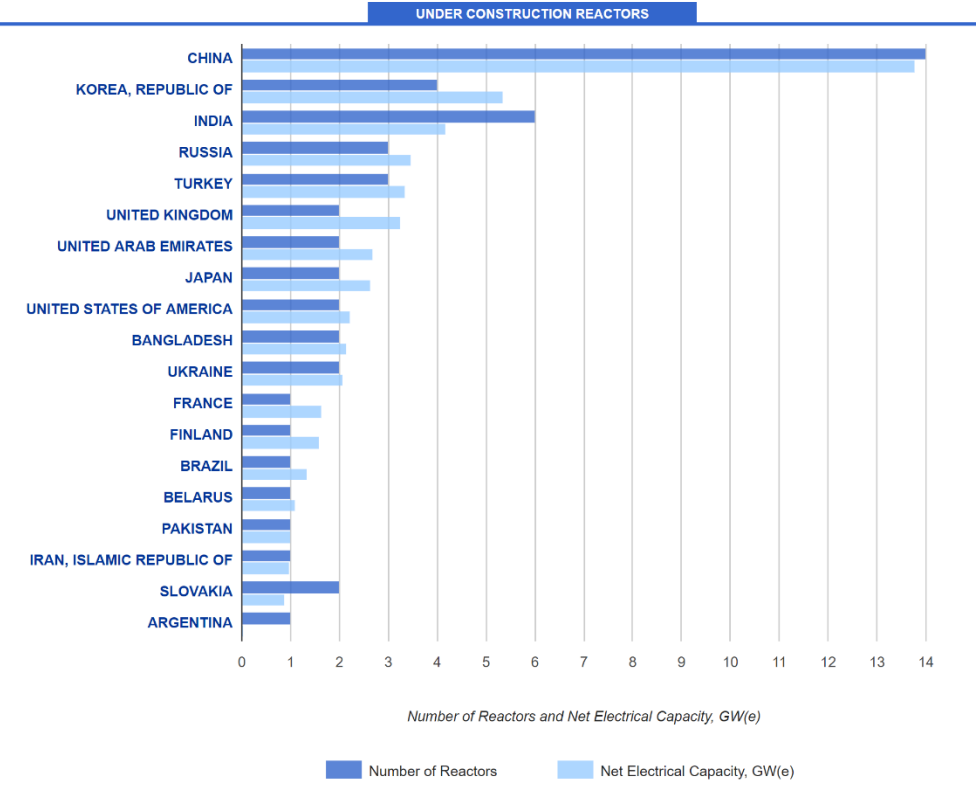
- Nuclear energy needed for clean energy transitions around the world
- New build economic multiplier effect brings enhanced benefits from initial investment.
- The development of nuclear power has historically proven to be a catalyst for industrial and economic growth and prosperity across the world.
- Promotes energy independence and security of supply, and builds resilience against geopolitical shocks.

IMF study found that nuclear energy investment spending has a large output economic multiplier, significant in the short run

Horizon	Nuclear Energy Investments Multiplier	Green Energy Investments Multiplier	Non-Eco-Friendly Energy Investments Multiplier
Impact	4.11*	1.19*	0.65*
1 Year	3.97*	1.20*	0.64*
2 Years	3.88	1.19*	0.62*
3 Years	3.83	1.17*	0.59*
4 Years	3.80	1.14*	0.55
5 Years	3.78	1.11	0.52

Source: IMF, 2021 https://www.elibrary.imf.org/view/journals/001/2021/087/001.2021.issue-087-en.x

Accelerating the deployment of new nuclear is key to achieve decarbonization goals



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.
- **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.

Essential for ESG and climate financing to recognize nuclear energy as a sustainable energy source

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NGFS
Central Banks and Supervisors Network for Greening the Financial System

WORLD ECONOMIC FORUM

IFRS
International Financial Reporting Standards

DFC U.S. International Development Finance Corporation

IOSCO
International Organization of Securities Commissions

Mixed role of nuclear in international taxonomies

- Over 20 national/regional sustainable finance taxonomies are active or under development.
- Taxonomies differ in scope and granularity. Most may not be as comprehensive as the EU taxonomy, or pose the same level of risk for excluded activities
- Nuclear is recognised as green/sustainable in some of the issued taxonomies. An economic activity can be included, excluded or simply not mentioned.
- For nuclear energy the different fuel cycle activities may be split out and assessed independently

Status of nuclear energy in some issued taxonomies

Region/ Country	Status	Nuclear status
ASEAN Taxonomy for Sustainable Finance	2021	Pending
Bangladesh -Sustainable Finance Policy for Banks and Financial Institutions	Issued 2017. Updated 2020	Excluded
China – Green Bonds endorsed project catalogue	Issued 2015. Last updated 2021.	Included
European Union – EU Taxonomy	First Delegated Act to enter into force by end of 2021. CDA published	Included subjected to vote of Council and Parliament
Malaysia Climate Change and Principle based Taxonomy	Issued April 2021 by Bank Negara Malaysia	Not mentioned – presumably not included.
Mongolia – Mongolia Green Taxonomy	Issued 2019	Not mentioned – presumably not included.
Russia – Russian Green Financing guidelines	Issued 2020, updated 2021	Included
Climate Bonds Initiative - Climate Bonds taxonomy - Green Bond Database	2021, initial 2013 2020	Included Assets need further review

Nuclear included in the EU Taxonomy

Having nuclear included is an enormous win!

But:

- Nuclear is treated as a transitional technology
- Separate disclosure requirements for nuclear have been introduced
- In order to be taxonomy compliant existing and new build projects must
  - Have plans for an operational final repository for HLW and spent fuel by 2050
  - Use Accident Tolerant Fuels by 2025
- The Commission grants itself extensive powers over the monitoring and assessment of projects in order to decide whether a project is taxonomy compliant or not
- The nuclear fuel cycle is currently not included in the CDA as an ‘enabling activity’
- Uncertainty regarding R&D activities
- Exclusion of non-EU investments

Lots of international initiatives in financing

There are numerous ongoing initiatives that aim to accelerate the mobilization of sustainable capital and to increase the international harmonization of ESG standards and reduce market fragmentation.

- Three broad themes:
  - Disclosure
  - Risk management
  - Mobilization of capital.

Some key global initiatives

- **Task Force on Climate-related Financial Disclosures** (TCFD) developed recommendations applicable to organizations across sectors and jurisdictions for the voluntary disclosure of climate-related financial risks
  - Being pushed as a model for harmonization of climate-related disclosures
- **International Financial Reporting Standards foundation** (IFRS) has started developing a global baseline for investor-oriented sustainability-related disclosure standards
  - new climate reporting standard could be ready as soon as July 2022. **Important for nuclear to be included**
- **G20 Green Finance Working Group** to identify institutional and market barriers to green finance as well as options to enhance the mobilization of private capital for green investment
  - Recommendations expected to be consistent with those produced by other organizations, such as the IFRS and NGFS
- COP26 - **Glasgow Financial Alliance for Net-Zero** (GFANZ) is a global coalition of leading financial institutions committed to accelerating the decarbonization of the economy. Members currently include over 450 financial firms across 45 countries responsible for assets of over $130 trillion.
  - Created 17 Investment Opportunity Roadmaps. **Nuclear is not currently among them**
  - GFANZ steering group and advisory panel includes several anti nuclear organisation
  - Very Important that nuclear energy is understood to be sustainable by GFANZ members

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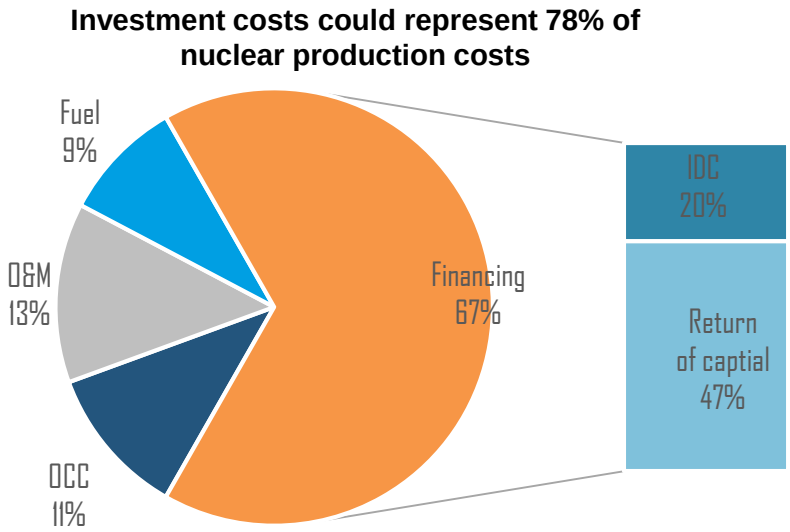
There is a window of opportunity for nuclear energy to deliver on promises

The nuclear sector must work together…

- to **sustain** and **enhance** global nuclear capabilities for nuclear R&D, operation, supply chain and regulation
- to accelerate the **cost-effective** deployment of nuclear projects
- to bring **disruptive technologies** to deployment on a **global** basis
- to transform **nuclear regulatory** frameworks

…. but cannot do it alone: government support is crucial

Government support needed to instil confidence and incentivise long term planning and investment



Source: NEA, 2020 https://www.oecd-nea.org/jcms/pl_30653
Note: Calculations based on OCC of USD 4 500 per kilowatt of electrical capacity (/kW_e), a load factor of 85%, 60-year lifetime and 7-year construction time at a real discount rate of 9%.

- Unlocking **low-cost finance** for nuclear projects
- Streamlining the **nuclear licensing and regulatory frameworks**
- **Level playing field (policies & markets)** with other low-carbon technologies

WORLD NUCLEAR ASSOCIATION

The Harmony programme is a global initiative of the nuclear industry coordinated by World Nuclear Association.

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Nuclear energy offers a golden opportunity to build a cleaner, more equitable world, in which everyone has access to clean, abundant, affordable energy and a high quality of life