Climate Change Targets: *The Role of Nuclear Energy*

- **The world's effort to decarbonise is one of the defining challenges for this generation and the window for action is rapidly narrowing**
- **Nuclear energy is playing an important role today and can do more to help meet decarbonisation targets**
- **Continued operation of the existing fleet, as well as new builds of large-scale and small modular reactors could avoid 87 gigatonnes of cumulative emissions between 2020 and 2050**
- **By 2050, nuclear energy could displace 5 gigatonnes of emissions per year, which is more than what the entire US economy emits annually today**
- **Energy policymakers have an important role to play to create the enabling conditions for success**

The world is not on track to meet the decarbonisation objectives of the Paris Agreement

As highlighted by the IPCC synthesis report (IPCC, 2018), the world is not on track. Rather than the steep reductions scientists had hoped for, global emissions are expected to rise by 16% by 2030. The window for action is rapidly narrowing. Even if carbon emissions were to remain constant, the entire carbon budget would be consumed within eight years.

Constrained by the world's carbon budget, carbon emissions must peak within the next few years and drop to zero by 2100 (or sooner). This will require policy changes around the world as well as massive investments in innovation, infrastructure, and the deployment of non-emitting energy resources. More specifically, electricity grids must be decarbonised; vehicle fleets must be electrified or transitioned to non-emitting fuels; and a range of industrial sectors (e.g. off-grid mining, buildings, chemicals, iron and steel, cement) must be transformed as well.

Current emissions are on a trajectory to far exceed the targets arising from the 1.5° scenario. It is clear that a major shift in direction will be required if countries are to meet their objectives.

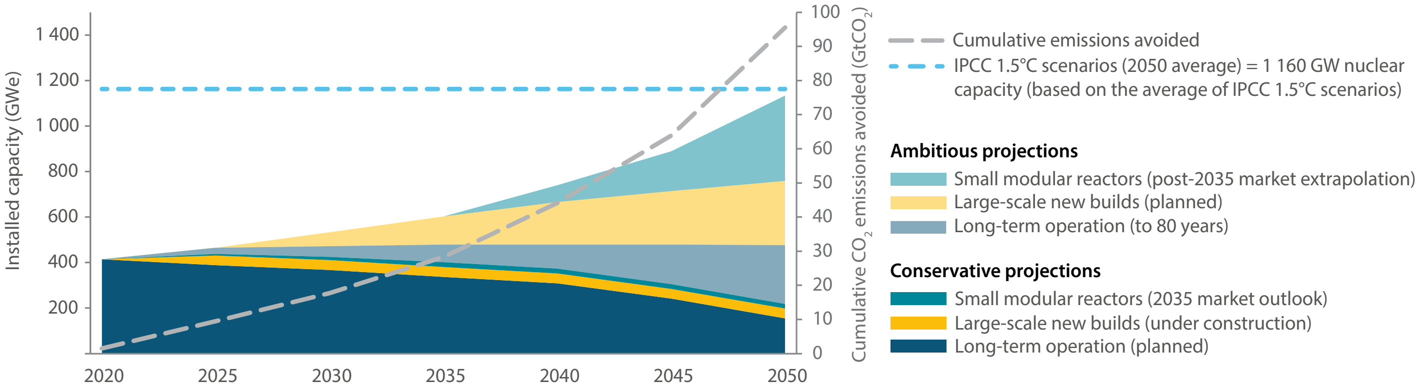
The IPCC 1.5°C scenario foresees, on average, 1 160 GW of operational nuclear energy by 2050, a three-fold increase compared to 2020

The 444 nuclear power reactors in operation worldwide today provide 394 gigawatts of electrical capacity that supplies approximately 10% of the world's electricity. Nuclear energy is the largest source of non-emitting electricity generation in OECD countries and the second largest source worldwide (after hydropower). There are approximately 50 more nuclear reactors under construction to provide an additional 55 gigawatts of capacity and more than 100 additional reactors are planned. Existing nuclear capacity displaces 1.6 gigatonnes of carbon dioxide emissions annually and has displaced 66 gigatonnes of carbon dioxide since 1971 – the equivalent of two years of global emissions (NEA, 2020).

The nuclear sector can support future climate change mitigation efforts in a variety of ways. Existing global installed nuclear capacity is already playing a role and long-term operation of the existing fleet can continue making a contribution for decades to come. There is also significant potential for large scale nuclear new builds to provide non-emitting electricity in existing and embarking nuclear power jurisdictions, and, in particular, replace coal. In addition, a wave of near-term and medium-term nuclear innovations have the potential to open up new opportunities with advanced and small modular reactors (SMRs), as well as nuclear hybrid energy systems, reaching into new markets and applications. These innovations include sector coupling, combined heat and power (cogeneration) for heavy industry and resource extraction, hydrogen and synthetic fuel production, desalination, and off-grid applications.

In a special report published in 2018 (IPCC, 2018), the IPCC considered 90 pathways consistent with a 1.5°C scenario – i.e. pathways with emissions reductions sufficient to limit average global warming to less than 1.5°C. The IPCC found that, on average, the pathways for the 1.5°C scenario require nuclear energy to reach 1 160 gigawatts of electricity by 2050, up from 394 gigawatts in 2020.

Figure 1: **Full potential of nuclear contributions to net-zero**



Source: NEA, Forthcoming.

Nuclear energy can displace 87 gigatonnes of cumulative emissions between 2020 and 2050

1 160 GW by 2050 is an ambitious target for nuclear energy, but it is not beyond reach. It can be achieved through a combination of long-term operations, large-scale new builds and small modular reactors, as shown in Figure 1.

New analysis by the NEA identifies the potential contribution of nuclear energy to clean energy capacity and emissions reductions between 2020 and 2050, taking into consideration the potential contributions from power and non-power applications of nuclear technologies (NEA, forthcoming).

Taken together, the contributions of long-term operation, large-scale new builds using existing nuclear technologies, small modular reactors, nuclear hybrid energy and hydrogen systems begin to reveal the full extent of the potential for nuclear energy and nuclear innovations to play a significant and growing role in pathways to net-zero by 2050.

Table 1. **Projected contributions of nuclear energy to cumulative emissions reductions (2020-2050)**

Cumulative emissions avoided from…*	*…electricity*	*…heat*	*…hydrogen*	*Totals*
…long term operation	38.3	6.7	4.3	49.2
…new builds of large Generation III reactors	16.2	4.2	2.4	22.8
…small modular reactors (SMRs)	9.7	3.6	1.8	15.1
Totals	64.1	14.5	8.5	87.1

* All cumulative emissions from 2020 to 2050 are shown in gigatonnes of carbon dioxide ($GtCO_2$).

Reaching the target of 1 160 gigawatts electrical capacity would avoid 87 gigatonnes of cumulative emissions between 2020 and 2050. By 2050, nuclear energy could displace 5 gigatonnes of emissions per year, which is more than what the entire US economy emits annually today.

Addressing the challenges faced by nuclear energy

While the potential exists for nuclear energy to play a much larger role in global climate change mitigation efforts, nuclear energy faces many challenges. The above estimates are not forecasts but represent what could be achieved with timely enabling decisions.

To seize the window of opportunity, the nuclear sector must move quickly to demonstrate and deploy near-term and medium-term innovations including advanced and small modular reactors, as well as nuclear hybrid energy systems using hydrogen.

Additionally, there are key enabling conditions for success that the nuclear sector and energy policymakers more broadly should address in the areas of system costs, project timelines, public confidence and clean energy financing.

A systems approach is required to understand the full costs of electricity provision, and to ensure that markets value desired outcomes: low-carbon baseload, dispatchability, and reliability.

Rapid build-out of new nuclear power is possible, but requires a clear vision and plan. Historical and recent experience show that under the right policy frameworks and a robust programmatic approach, nuclear power can be a low-carbon technology with rapid delivery times. This was the case historically for countries such as France and jurisdictions such as Ontario in Canada that have both decarbonised their electricity mix in less than two decades with nuclear energy and hydropower. Today, the Barakah project in the United Arab Emirates demonstrates that such a rate of deployment can be achieved even with existing nuclear reactor designs. In China and Korea, countries in more advanced stages of nuclear construction learning, construction lead-time for large existing nuclear reactor designs with increased safety are, on average, around 5-6 years – or even faster.

Building and maintaining public confidence is essential for all nuclear energy projects, from mining to research and development, operations, and waste management. Building trust is central to building public confidence and requires sustained investments in open and transparent engagement as well as science communication. A common mistake, however, is to assume that public confidence is primarily a communications issue, when in actuality, public confidence is much more complex, touching on issues of trust, values, culture, and benefits sharing, among others.

Governments have a role to play in all capital intensive infrastructure projects – including but not limited to nuclear energy projects. This role can include direct funding, but also by enabling policy frameworks that allow an efficient allocation of risks. Nuclear energy projects can then compete on their merits on an equal footing with other non-emitting energy projects.

Further reading

IPCC (2018), *Global Warming of 1.5°C*, IPCC, Geneva, www.ipcc.ch/sr15.

NEA (forthcoming), *Meeting Climate Change Targets: Projecting the Potential Role of Nuclear Energy*, OECD Publishing, Paris.

NEA (2020), *Unlocking Reductions in the Construction Costs of Nuclear A Practical Guide for Stakeholders*, OECD Publishing, Paris, www.oecd-nea.org/jcms/pl_30653/unlocking-reductions-in-the-construction-costs-of-nuclear.

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