2021 Position Paper

Net Zero Needs Nuclear

Nuclear for Climate is a grassroots initiative gathering nuclear professionals and scientists from over 150 associations with the goal of opening a dialogue with policymakers and the public about the necessity of including nuclear energy among the carbon-free solutions to climate change.

We have a **vision** of a clean, sustainable and abundant low-carbon future for all. Our **mission** is to accelerate the ability of the world to achieve Net Zero by 2050, by driving collaboration between nuclear and renewable technology. We believe that **Net Zero Needs Nuclear** and these are the reasons why:

- **Nuclear is a proven and effective low carbon energy source:** Nuclear is a proven low carbon source of energy which reduces greenhouse gas emissions and can replace our current reliance on polluting fossil fuel sources.
- **Nuclear is available, scalable and deployable:** New nuclear needs to be deployed at scale and urgently, along with renewables, in order for Net Zero targets to be achievable.
- **Nuclear is a flexible and affordable source of clean energy:** Nuclear can integrate with an increasing supply of variable renewables to deliver efficient and affordable clean energy systems.
- **Nuclear can deliver more than just low carbon electricity:** Nuclear is also capable of supporting the decarbonisation of other sectors, such as heating and transport.
- **Nuclear supports inclusive and sustainable global development:** Nuclear promotes global socio-economic benefits and is strongly aligned to the UN Sustainable Development Goals.

Five years on from the signing of the Paris Agreement, we are waking up to the enormity of the challenge that the world faces in limiting global temperature rise to 1.5°C. The global climate is at a critical juncture and together, we need to reach Net Zero carbon emissions by no later than 2050 if we are to have a chance of achieving this and protecting our planet's future. But we are off track, and time is running out. So we need to act now.

COP26 in Glasgow represents a critical opportunity for our nations to come together and take action, collectively changing the way we think about climate and setting us on the path towards achieving Net Zero.

We are calling on all negotiators and policy makers who are involved at COP26 to take a scientific and technology neutral approach to energy policy and financing that can promote sustainable collaboration between nuclear and renewables.

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Nuclear is a proven and effective low carbon energy source: Nuclear is a proven low carbon source of energy which reduces greenhouse gas emissions and can replace our current reliance on polluting fossil fuel sources.

- Nuclear has been a key low carbon energy source for over 60 years. With around 440 reactors in operation across 30 different countries[1], nuclear accounted for 10% of global electricity production at the end of 2019[2]. It is the second largest global source of low carbon energy, behind hydropower.

- The lifetime CO_2 emissions of nuclear relative to the energy it provides, or 'carbon intensity', are very low, similar to that of wind and hydropower[3]. The countries which have the lowest carbon intensity are those with a large component of nuclear and hydropower. France, which produces approximately three quarters of its electricity from nuclear, has the lowest per capita emissions of the seven largest industrialised countries (G7).

- As a direct result of nuclear replacing fossil fuel sources, more than 60Gt[4] of CO_2 equivalent greenhouse gas emissions have been avoided globally since 1970. Using nuclear instead of fossil fuels has also prevented an estimated 1.84 million air pollution related deaths and it is estimated that a further 7 million deaths could be avoided by 2050 if nuclear replaced fossil fuel sources on a large scale[5].

- Despite the impressive global (5x) growth of solar and wind between 2000 and 2018, the use of fossil fuels has remained constant, representing roughly 80% of the total global energy supply. This correlates with a decline in the share of nuclear generation over this time period[6], even though nuclear generation in absolute terms has increased.

- Countries which have shut down their nuclear plants over recent years have struggled to reduce their reliance on polluting fossil fuels. Following a planned nuclear phaseout in Germany, their percentage share of fossil fuels as a primary energy source has dropped by less than 1% since 2010[7] despite a massive investment in the growth of renewable sources (€178 Bn)[8].

Nuclear is available, scalable and deployable: New nuclear needs to be deployed at scale and urgently, along with renewables, in order for Net Zero targets to be achievable.

- The consensus across major international institutions (UN, OECD-IEA[9], EU[10]) is that all low carbon technologies, including nuclear, will need to be deployed urgently and at scale in order to achieve Net Zero targets. This is reflected in the latest IPCC report [11] which shows a median projection of more than double the current primary energy supply from Nuclear being required by 2050 in order to limit global temperature rise to 1.5°C.

- Nuclear is an available and scalable technology, with a limited footprint, which has been deployed rapidly to positive effect in the past. Over the past 50 years, new nuclear projects

[1] IAEA Nuclear Power Plant data (2019)
[2] IEA - Electricity Information Overview (2020)
[3] IPCC Wg3 Energy Systems (2018)
[4] IEA – Data and Statistics (2020)
[5] Environmental Science and Technology "Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power" (2013)
[6] IEA – Nuclear Power in a Clean Energy System (2019)
[7] IEA – World Energy Balances (2020) – Total Energy Supply (TES) by source - Germany
[8] German Federal Ministry for Economic Affairs and Energy (BMWi) "Renewable Energy Sources in Figures" (2020)
[9] IEA - World Energy Outlook (2020)
[10] EUCO3232.5 – Energy Efficiency Modelling (2019)
[11] IPCC - Global Warming of 1.5 ºC Report (2019)

have represented the fastest method of achieving decarbonisation in terms of clean energy added per capita annually. This is reflected by the Swedish nuclear program where, from 1970, 10.9 GWe of new nuclear capacity was added in less than 15 years[12]. Swedish CO_2 emissions per capita have decreased by 75% since 1970[13].

- Small Modular Reactors (SMRs) have the potential to bolster new large nuclear projects. With the promise of reducing on-site construction time through modular manufacture of components, SMRs offer the possibility of increased scalability of deployment as well as reduced capital costs and associated financial risk, once established. Certain leading nuclear nations project that both small and large nuclear projects can contribute towards achieving Net Zero[14,15].

Nuclear is a flexible and affordable source of clean energy: Nuclear can integrate with an increasing supply of variable renewables to deliver efficient and affordable clean energy systems.

- Deployment of renewables has risen rapidly and must continue to do so. However, this increases the volatility of energy systems and introduces a greater requirement for grid flexibility[16]. Nuclear is a source of clean energy which is both dispatchable and flexible and can therefore replace fossil fuels and integrate with variable renewables.

- There are ongoing developments to further improve the operational flexibility and efficiency of nuclear reactors through design, as well as through more diverse application. This includes applying nuclear as a method of clean energy storage within hybrid systems by utilising nuclear-generated process heat or hydrogen as a form of storage[17].

- New technologies, including SMRs, offer the potential for more widespread and dispersed integration with renewables and other clean energy sources, supporting a more decentralised system where required, and bringing supply closer to points of demand.

- Recent research has shown that nuclear remains the cheapest dispatchable low-carbon technology[18] and the cost of decarbonising electricity is lowest when the mix includes optimal amounts of this type of clean and consistent generation capacity[19]. Another recent study finds that nuclear is the clean energy source with the highest system value for reducing carbon intensity[20]. System value is an important holistic measure which quantifies the total impact of each source upon the wider energy system.

Nuclear can deliver more than just low carbon electricity: Nuclear is also capable of supporting the decarbonisation of other sectors, such as heating and transport.

- Global electricity production, which is projected to increase significantly, currently accounts for 40% of total greenhouse gas emissions and it is still dominated by fossil fuel sources (64% of total electricity production)[21]. Fossil fuels are also used extensively across other sectors such as transport, heating and industrial processes.

[12] IAEA – PRIS Country Profiles - Sweden
[13] The World Bank – CO2 Emissions (metric tonnes per capita) Sweden 1960-2016
[14] The Climate Change Committee (CCC) UK Net Zero technical report (2019)
[15] CER-REC "Canada's Energy Future – Towards Achieving Net Zero 2050"
[16] EC METIS studies S11 Effect of high shares of Renewables on power systems (2018)
[17] NICE future "Flexible Nuclear Energy for Clean Energy Systems Report" (2020)
[18] IEA & OECD-NEA "Projecting Costs of Generating Electricity" (2020)
[19] MIT "The Future of Nuclear Energy in a Carbon-Constrained World" (2018)
[20] NNWI "The Failings of Levelised Cost and the Importance of System-level Analysis" (2020)
[21] IEA – Data and Statistics (2018)

- Nuclear has the ability to produce hydrogen effectively, which can then be used as an alternative to fossil fuels to support wider decarbonisation[22,23]. Nuclear-produced hydrogen can also be used in clean energy systems to add further grid flexibility. The concept of a clean hydrogen economy is receiving political and business momentum, with the number of associated policies and projects around the world expanding rapidly[24].

- Nuclear reactors also have the ability to supply heat to support more diverse non-electric applications that would provide economic, environmental and efficiency-related benefits[25]. These wider 'cogeneration' applications can include, amongst others, district heating, industrial process heat and seawater desalination[26].

- New advanced reactors being developed with higher operating temperatures also have the potential to provide further clean alternatives to other non-electric, energy-intensive applications including: polymer and plastic production, blast furnacing, agriculture fertilizer production as well as more efficient hydrogen production from high temperature electrolysis or thermochemical methods[27].

Nuclear supports inclusive and sustainable global development: Nuclear promotes global socio-economic benefits and is strongly aligned to the UN Sustainable Development Goals.

- Nuclear is strongly aligned to the UN Sustainable Development Goals (SDGs) and can be used to address energy poverty by delivering clean energy globally, supporting high living standards, good health, a clean environment and a sustainable economy[28].

- According to the IEA, new nuclear capacity of 15 GWe is required on average every year between 2020 and 2040 in order to meet their projected, SDG aligned, Sustainable Development Scenario (SDS). This will be critical for securing a cleaner and more inclusive energy future[29].

- Roughly 30 countries are currently considering, planning or establishing nuclear power programmes, ranging from sophisticated and advanced economies to developing nations. Bangladesh, Belarus, the UAE and Turkey are in the process of building, or have recently begun operating their first reactors and several countries in Africa are considering nuclear development as a clean energy solution[30].

- Nuclear delivers skilled jobs and economic benefits. A recent study on the European economy found that every Euro spent on nuclear generates an additional 5 Euros in EU GDP, and every direct job created in the nuclear industry creates 3.2 jobs in the EU economy as a whole[31].

- For these reasons, new nuclear can directly facilitate the global post COVID-19 recovery process: creating long term jobs and promoting sustainable economic development whilst increasing energy resilience and driving forward the clean energy transition[32].

[22] IAEA – Nuclear Hydrogen Production (2020)
[23] Lucid Catalyst – "How Hydrogen-Enabled Synthetic Fuels Can Help Deliver the Paris Goals" (2020)
[24] IEA – The Future of Hydrogen (2019)
[25] IEA – Innovation Gaps (2019)
[26] The Royal Society – Nuclear Cogeneration: Civil Nuclear Energy in a Low Carbon Future (2020)
[27] IAEA Nuclear and Renewables: Playing Complementary Roles in Hybrid Energy Systems (2019)
[28] IAEA - Nuclear Power for Sustainable Development (2017)
[29] IEA – Nuclear Power (2020)
[30] World-Nuclear-News 'Nuclear Power can speed progress in the developing world' (2020)
[31] Foratom "Investing in low-carbon nuclear generates jobs and economic growth in Europe" (2019)
[32] NEA - Creating high-value jobs in the post-COVID-19 recovery with nuclear energy projects (2020)