The fastest path to Net Zero for a sustainable & energy secure future for all

Data has shown that Global Warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. Human activities are estimated to have caused approximately 1.0°C of the global temperature increase from pre-industrial levels.

Amongst the multiple consequences of Global Warming, even the most conservative models have identified increases in the mean temperature in most regions, rising ocean levels, weather extremes in most inhabited areas, heavy precipitation, and the probability of severe drought and precipitation deficits in other areas. The impacts of such consequences will be visible across regions and have the potential to intensify the existing inequalities humanity faces today.

On land, impacts on biodiversity and ecosystems, including species loss and extinction, are projected to be lower at 1.5°C of global warming compared to 2°C. Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans. In terms of the societal aspects, climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further to 2°C.

Models have also shown that by limiting the temperature rise to 1.5°C, limiting the overshoot, and reducing anthropogenic CO_2 emissions by around 45% from 2010 levels by 2030, it would be possible to reach Net Zero by 2050. However, if we fail to do so and temperatures continue to increase, getting and passing the 2 °C thresholds would push the achievement of Net Zero by 20+ years, and the consequences could be irreversible. Simply put, if we want to keep temperatures below 1.5C, we need to take action now and start working towards the fastest path to achieving Net Zero for a sustainable & energy secure future for all.

Reaching the Net Zero goal by 2050 - less than 30 years! - would require simultaneous, rapid, and far-reaching transitions in energy, land, urban and infrastructure, including transport, buildings - and industrial systems. These systemic transitions are unprecedented in terms of scale but not necessarily in terms of speed. To attain this, there is a need for: structural changes, deep emissions reductions in all sectors, a comprehensive portfolio of mitigation options and a significant upscaling of investments in sustainable infrastructure that allow attaining energy security for all.

This means providing a level playing field for all low-carbon solutions and facilitating investment in a wide range of technologies such as renewables, batteries, transmission and energy efficiency solutions, electric vehicles, clean synthetic fuels, hydrogen and nuclear power plants for both electricity and heat processes.

In addition to the emissions increase and rapid changes, decision-makers need to consider the demand increase for energy services, including marginalized populations. The grid will need to be at least 2 or 3 times larger to support climate goals while ending poverty and hunger, while ensuring public health and overall energy security. Energy poverty and access to clean water and sanitation are intimately linked with access to electricity, and the ability to provide economic growth, industry and infrastructure is supported by affordable and clean energy. Appropriate infrastructure and services are also related to quality education and gender equality. Energy access provides women and girls in

marginalised communities have access to essential services such as safety and education. It also improves their overall health and allows for less time to be employed gathering fuel and/or water.

Renewable energy is playing a key role in powering the future grid. However, it is necessary to consider a diversified energy portfolio capable of satisfying the needs of different stakeholders, including energy-intensive industries, and at different scales.

Net Zero Needs Nuclear

Nuclear for Climate is a **grassroots** initiative uniting nuclear professionals and scientists from over 150 associations worldwide. We aim to open a dialogue with policymakers, the public and other industries about the necessity of including **nuclear energy** among the carbon-free solutions to Climate Change. Our purpose is to accelerate the transition to an **abundant**, **clean**, **sustainable**, **just** and l**ow-carbon** future for all; by establishing meaningful partnerships to attain the UN Sustainable Development Goals (SDGs). Our goal is to decarbonize electricity and the broader economic systems, including transportation, industry, housing, and agriculture.

Our **vision** is to provide a clean, sustainable, 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 technologies. We pronounce that **Net Zero Needs Nuclear,** and these are the reasons why:

- **Nuclear is a clean, abundant, reliable, affordable, and clean energy source that complements variable renewables:** Nuclear power is a proven low carbon source of energy that reduces greenhouse gas emissions and can replace our current reliance on polluting fossil fuel sources. Its small land-use, material-dependency, reliability and abundance allow it to be integrated with an increasing supply of variable renewables to deliver efficient, secure, affordable clean energy systems.
- **Nuclear is available, scalable, and deployable across many sectors of the economy:** Nuclear technology is innovative and covers a broad range of needs. This includes the production of heat for industrial processes, water desalination, isotope production for medical purposes, electricity production, and clean hydrogen production. Technology also offers excellent scalability thanks to the wide range of reactors, ranging from microreactors of 10 MWe**,** Small Modular Reactors (SMRs) of 300 MWe, to Conventional reactors of 1000 MWe. New nuclear needs to be deployed at scale and urgently, along with renewables, for Net Zero targets to be achievable.
- **Nuclear supports inclusive and sustainable global development for all:** Nuclear promotes global socio-economic benefits and is strongly aligned to the UN Sustainable Development Goals.

Six years after the signing of the Paris Agreement, we are waking up to the enormity of the world's challenge in limiting global temperature rise to 1.5°C. The global climate is at a critical juncture; together, we must reach Net Zero carbon emissions no later than 2050 to protect our planet's future. But, currently, we are off track, and time is running out. We need to act now.

Decisions and policymakers need to create a level playing field for all low-carbon, sustainable technologies. It is imperative to create global energy portfolios that are capable of addressing the

current and growing needs for energy services, without compromising our and future generations' ability to sustainably meet their needs. This would entail complementing renewable sources such as solar and wind, which are intermittent, and other clean energy sources, with nuclear energy. Countries need to collectively consider nuclear power as part of their strategies for sustainable development. COP27 in Sharm El-Sheik 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.

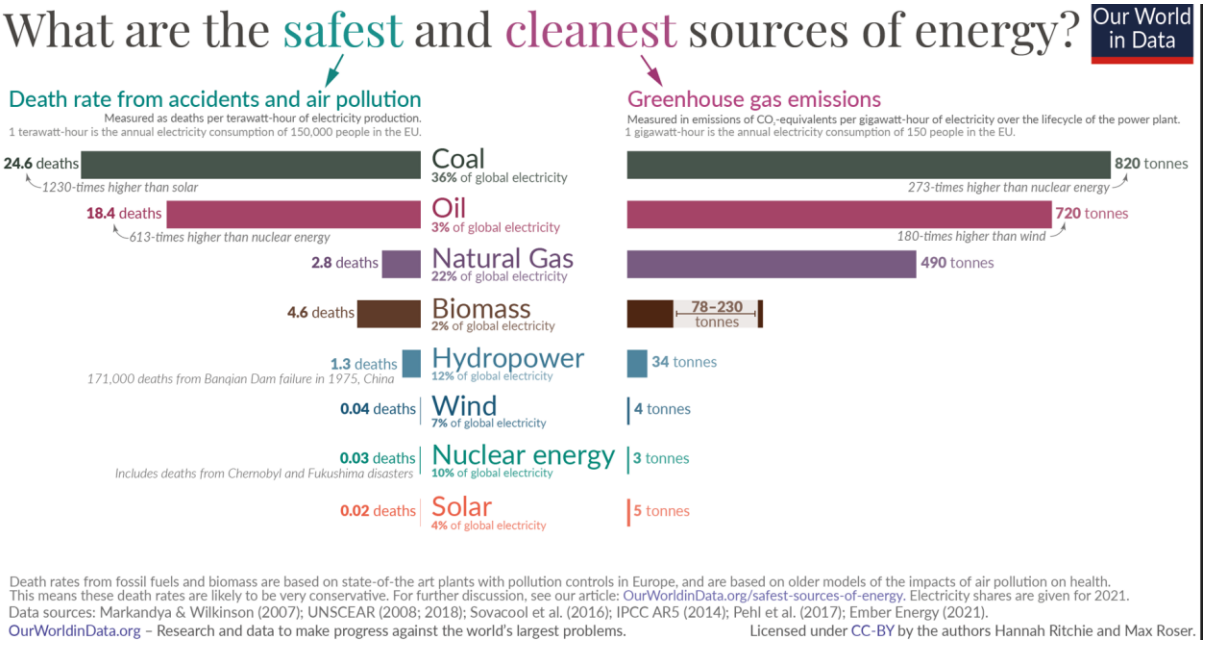
We are calling on all negotiators and policymakers involved at COP27 to take a scientific and technology-neutral approach to energy policy and financing that can promote sustainable collaboration between nuclear and renewables.

The reasoning behind our statement

Nuclear is a clean, abundant, reliable, affordable and clean energy source that complements variable renewables:

Nuclear has been a key low carbon energy source for over 60 years. With around 440 reactors in operation across 32 different countries plus Taiwan, nuclear accounted for 10% of global electricity production at the end of 2021[1]. Together with renewables and solar, 37% of electricity generation worldwide is low carbon, with the remaining 63% coming from fossil fuels.

- The lifetime CO_2 emissions of nuclear relative to the energy it provides, or 'carbon intensity', are very low, similar to that of wind, solar and hydropower[1]. Nuclear Power is also one of the safest forms of electricity generation on par with Wind and Solar. New nuclear, incorporating advances in fuel technology and passive safety systems, will improve nuclear's already excellent safety record.



- 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.
- 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[2] despite a massive investment in the growth of renewable sources (€178 Bn)[3]. Additionally to the dependency on fossil fuels, overall emissions have increased in the country and there has not been major benefits to vulnerable populations from the

[1] IPCC Wg3 Energy Systems (2018)

[2] IEA – World Energy Balances (2020) – Total Energy Supply (TES) by source - Germany

[3] German Federal Ministry for Economic Affairs and Energy (BMWi) "Renewable Energy Sources in Figures" (2020)

transition. The situation has also threatened the country's energy security. All of these have pushed for a reconsideration of their position towards nuclear.

- 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[4]. Nuclear power is a source of clean energy which is both dispatchable and flexible and can therefore replace fossil fuels and integrate with variable renewables.

- Recent research has shown that nuclear remains the cheapest dispatchable low-carbon technology[5] and the cost of decarbonising electricity is lowest when the mix includes optimal amounts of this type of clean and consistent generation capacity[6]. Another recent study finds thatnuclear power is the clean energy source with the highest system value for reducing carbon intensity[7]. System value is an important holistic measure which quantifies the total impact of each source upon the wider energy system.

- Rapid growth in renewables needs to continue, as does investment in transmission, storage, and innovation. But renewables alone won't support decarbonization at the speed we need, and over-reliance on natural gas as a transition fuel has been disastrous for many countries in 2022. Renewables and Nuclear need to grow together to meet our climate goals. In short, in short **Net Zero Needs Nuclear,**.

Nuclear is available, scalable and deployable across many sectors of the economy:

- The consensus across major international institutions (UN, OECD-IEA[8], EU[9]) is that all low carbon technologies, including nuclear power, will need to be deployed urgently and at scale in order to achieve Net Zero targets. This is reflected in the latest IPCC report [10] 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 has the highest energy density of any currently available fuel source, and the land use needs for nuclear are significantly lower than wind and solar. Thus making the pairing with more land intensive technologies is a great solution for more land deprived areas. It also allows for greater flexibility when deploying land intensive-technology as it provides for backup power .

- Nuclear requires fewer raw materials than any other energy source. Raw material availability may become a more serious issue as renewables continue to scale, and nations need to be prepared, with a diverse portfolio, for possible shortages and price increases.

[4] EC METIS studies S11 Effect of high shares of Renewables on power systems (2018)

[5] IEA & OECD-NEA "Projecting Costs of Generating Electricity" (2020)

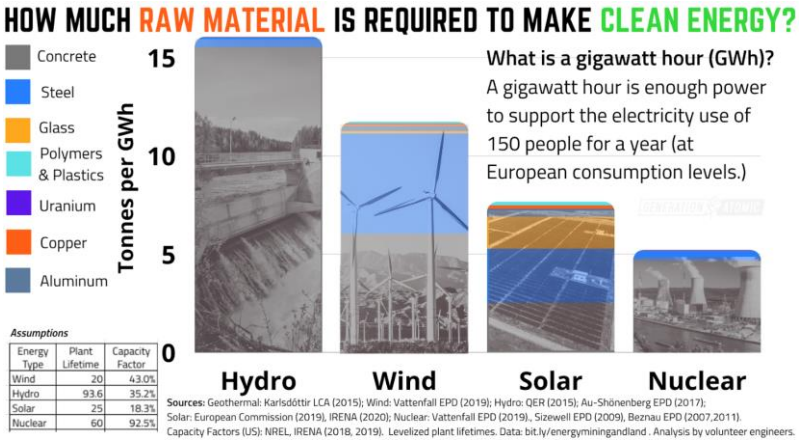
[6] MIT "The Future of Nuclear Energy in a Carbon-Constrained World" (2018)

[7] NNWI "The Failings of Levelised Cost and the Importance of System-level Analysis" (2020)

[8] IEA - World Energy Outlook (2020)

[9] EUCO3232.5 – Energy Efficiency Modelling (2019)

[10] IPCC - Global Warming of 1.5 ºC Report (2019)



- Nuclear is a readily 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 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[11]. Swedish CO_2 emissions per capita have decreased by 75% since 1970[12].

- There are ongoing developments to apply nuclear as a method of clean energy storage within hybrid systems by utilising nuclear-generated process heat or hydrogen as a form of storage[13].

- Global heat and electricity production, which is projected to increase significantly, currently accounts for over 40% of total greenhouse gas emissions and it is still dominated by fossil fuel sources (63% of total electricity production)[14]. Fossil fuels are also used extensively across other sectors, such as transport, heating and industrial processes.

- 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[15]. These wider 'cogeneration' applications can include, amongst others, district heating, industrial process heat and seawater desalination[16].

- While home heating and light duty transportation can be reasonably electrified to allow for renewable power generation, other industrial activities, particularly steel, cement, and chemical manufacturing, provide unique challenges for decarbonization. These applications either require very high heat or the manufacturing process itself directly emits GHG, and together, industrial applications emit ~20% of global GHG.

- Nuclear has the ability to produce hydrogen effectively, which can then be used as an alternative to fossil fuels to support wider decarbonisation[17,18]. Nuclear-produced hydrogen

[11] IAEA – PRIS Country Profiles - Sweden

[12] The World Bank – CO2 Emissions (metric tonnes per capita) Sweden 1960-2016

[13] NICE future "Flexible Nuclear Energy for Clean Energy Systems Report" (2020)

[14] IEA – Data and Statistics (2019)

[15] IEA – Innovation Gaps (2019)

[16] The Royal Society – Nuclear Cogeneration: Civil Nuclear Energy in a Low Carbon Future (2020)

[17] IAEA – Nuclear Hydrogen Production (2020)

[18] Lucid Catalyst – "How Hydrogen-Enabled Synthetic Fuels Can Help Deliver the Paris Goals" (2020)

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[19].

- 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[20].

Nuclear supports inclusive and sustainable global development

- 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[21].

- 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[22].

- Roughly 30 countries are currently considering, planning or establishing nuclear power programs, 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[23].

- Nuclear delivers skilled jobs and economic benefits. Recent studies 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[24].

- Nuclear technology is used to manufacture radio-isotopes that can be used for cancer diagnosis and treatment. Nuclear medicine is the latest technology in oncology that has revolutionised the way we diagnose and treat cancers. Breast cancer and cervical cancer are the leading causes of cancer deaths in the world today, and two thirds of these cases are from LLMICs. The UICC Global project on 'closing the care gap' aims to address the cancer inequalities in access to diagnostic and treatment resources. We need to protect our women and children by early diagnosis and treatment of women cancers (breast and cervical cancers).

- In 2019 there were 79 nuclear reactors used for desalination, district heating, or process heat, with 750 reactor-years of experience in these.

[19] IEA – The Future of Hydrogen (2019)

[20] IAEA Nuclear and Renewables: Playing Complementary Roles in Hybrid Energy Systems (2019)

[21] IAEA - Nuclear Power for Sustainable Development (2017)

[22] IEA – Nuclear Power (2020)

[23] World-Nuclear-News 'Nuclear Power can speed progress in the developing world' (2020)

[24] Foratom "Investing in low-carbon nuclear generates jobs and economic growth in Europe" (2019)

- 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[25] for all.

[25] NEA - Creating high-value jobs in the post-COVID-19 recovery with nuclear energy projects (2020)