# 1AC

## 1AC---Econ

#### Contention one is the economy.

#### The economy is poised to decline

Stephen S. Roach, 3-26-2025, "America has been an engine of global growth. Now it’s a source of stagflation.", MarketWatch, <https://www.marketwatch.com/story/america-has-been-an-engine-of-global-growth-now-its-a-source-of-stagflation-21bfd389> [Stephen S. Roach, former chairman of Morgan Stanley Asia and once the firm's chief economist, is a senior fellow at Yale University's Jackson Institute of Global Affairs and a senior lecturer at Yale's School of Management. He is the author of the new book "Unbalanced: The Codependency of America and China."] DOA: 3/27/2025 //RRM

The world’s major growth engines are about to run in reverse. The policies and uncertainties of President Donald Trump’s second administration have hit a sluggish global economy with a transformational exogenous shock. Risks are especially worrisome in both the U.S. and China, which have collectively accounted for a little more than 40% of cumulative global GDP growth since 2010. America is now the problem, not the solution. Long the anchor of the rules-based international order, the U.S. has turned protectionist, posing major risks to an already fragile global trade cycle. At the same time, Trump’s “Make America Great Again” movement has driven a powerful wedge between the U.S. and Europe and divided North America, with Canada’s very independence in Trump’s crosshairs. The central role of the U.S. in sustaining post-World War II geostrategic stability has been shattered. The U.S. will be unable to put the genie back in the bottle. Trump’s shocking actions have eroded the trust that has underpinned America’s global leadership, and the damage will be evident long after Trump has left the scene. With America having once abdicated its moral authority as the anchor of the free world, who is to say it can’t happen again? This breakdown in trust will cast a long and lasting shadow over economic performance, not least in the U.S. itself, where it is already affecting business decision-making, especially the costly long-term commitments associated with hiring and capital spending. Businesses need to scale their future operations relative to confident expectations of growth trajectories — now an increasingly uncertain proposition. Asset values and consumer confidence, too, have been shaken. Uncertainty, the enemy of decision-making, is likely to freeze the most dynamic segments of the U.S. economy. Trade wars have no winners The Trump shock is likely not only to exacerbate the Sino-American conflict but also to weaken both countries’ growth prospects significantly. For China, state-directed policy guidance might temper the initial blow of a Trump policy shock. But the pressures of Trump’s tariff escalation will undermine China’s export-led growth model, which is especially problematic for economic growth, given the lingering weakness of China’s domestic demand. The country’s long-promised consumer-led rebalancing of the economy remains more of a slogan than an actual shift in the sources of Chinese growth — especially with a deficient social safety net that continues to encourage fear-driven precautionary saving. China’s just-announced 30-point action plan to boost household demand draws much-needed attention to the seemingly chronic plight of the Chinese consumer. But it offers only modest support to an inadequate social safety net. The Trump shock is likely not only to exacerbate the Sino-American conflict but also to weaken both countries’ growth prospects significantly. Don’t count on other economies filling this void. Eventually, India might be able to take up some of the slack. But its relatively small share of world GDP — currently 8.5% (in purchasing-power-parity terms), compared with 34% for China and the U.S. combined — means that that day is in the distant future. The same is true of Europe. While the European Union’s 14% share of world GDP is nearly double that of India, Europe remains saddled with anemic growth, compounded by mounting trade pressures associated with an escalating global tariff war. If the apparent breakdown of the trans-Atlantic alliance has a silver lining, it is that the incentives for strategic cohesion should have an outsize impact on European military spending. But that will also take time. Meanwhile, Europe will be exposed equally to the adverse effects on business and consumer expectations and decision-making, comparable to those afflicting the U.S. Downside risks will progressively build. What does all this mean for global economic prospects in the coming years? The current baseline expectation of around 3.3% world GDP growth for 2025-26, as per recent forecasts by the International Monetary Fund, is far too sanguine. While there may be some front-loading of growth momentum in the early part of this year — exemplified by accelerated shipments of Chinese exports ahead of Trump’s tariff hikes — I suspect that the downside risks will progressively build. Don't miss out on this limited time offer! Don't fall behind this tax season. Subscribe to learn how today’s business practices, news, and tax policies impact the market and your money. Subscribe Now MarketWatch on Multiple devices That points to a fractional reduction of forecasts for global economic growth for 2025, with the slowdown becoming considerably more pronounced in 2026 and after. That could easily push an increasingly fragile world economy down to the 2.5% growth threshold, typically associated with outright global recession. Nor is this likely to be a standard shortfall of global growth. To the extent that the tariff war is aimed at promoting friendshoring and strengthening supply-chain resilience, the global economy’s supply side is likely to come under significant strain. A new layer of adjustment costs is being imposed on a once-globalized world. Reshoring to higher-cost local producers not only takes considerable time, but also erodes the efficiencies of production, assembly and delivery that have underpinned worldwide disinflation over the past three decades. Almost five years ago, in the depths of the COVID-19 shock, I warned that the onset of stagflation was only “a broken supply chain away.” Subsequent experience and research have borne that out, confirming that the supply-chain disruptions during the pandemic and its immediate aftermath generated significant upward pressure on prices. A global trade conflict implies a similar dynamic. The higher costs associated with Trump’s coming “reciprocal” escalation of multilateral tariffs, which are due to be announced on April 2, are especially problematic. In the face of a likely shortfall of economic growth, the added cost and price pressures are likely to tip the scales toward global stagflation. The Trump shock is the functional equivalent of a full-blown crisis. The Trump shock, in short, is the functional equivalent of a full-blown crisis. It is likely to have a lasting impact on the U.S. and Chinese economies, and the contagion is almost certain to spread throughout the world through cross-border trade and capital flows. Perhaps most importantly, this is a geostrategic crisis, reflecting a reversal of America’s global leadership role. In the space of little more than two months, Trump has turned the world inside out. If my assessment of this shock is anywhere close to the mark, concerns over the global economic forecast seem almost trivial.

#### Thankfully, affirming solves by attracting private sector investment

IEA, 1-16-2025, "A new era for nuclear energy beckons as projects, policies and investments increase", <https://www.iea.org/news/a-new-era-for-nuclear-energy-beckons-as-projects-policies-and-investments-increase> [The International Energy Agency was created in 1974 to help co-ordinate a collective response to major disruptions in the supply of oil. While oil security remains a key aspect of our work, the IEA has evolved and expanded significantly since its foundation. Taking an all-fuels, all-technology approach, the IEA recommends policies that enhance the reliability, affordability and sustainability of energy. It examines the full spectrum issues including renewables, oil, gas and coal supply and demand, energy efficiency, clean energy technologies, electricity systems and markets, access to energy, demand-side management, and much more. Since 2015, the IEA has opened its doors to major emerging countries to expand its global impact, and deepen cooperation in energy security, data and statistics, energy policy analysis, energy efficiency, and the growing use of clean energy technologies.] DOA: 3/10/2025 //RRM

Most of the existing nuclear power fleet today is in advanced economies, but many of those plants were built decades ago. Meanwhile, the global map for nuclear is changing, with the majority of projects under construction in China, which is on course to overtake both the United States and Europe in installed nuclear capacity by 2030. Russia is also a major player in the nuclear technology landscape. Of the 52 reactors that have started construction worldwide since 2017, 25 are of Chinese design and another 23 are of Russian design. Similarly, the report shows how the production and enrichment of uranium, the fuel that goes into nuclear reactors, are highly concentrated. “Today, more than 99% of the enrichment capacity takes place in four supplier countries, with Russia accounting for 40% of global capacity, the single largest share,” Dr Birol said. “Highly concentrated markets for nuclear technologies, as well as for uranium production and enrichment, represent a risk factor for the future and underscore the need for greater diversity in supply chains.” Innovations in nuclear technologies are helping to drive momentum behind new projects, the report finds. SMRs, a type of smaller scale nuclear power plants that are quicker to build with greater scope for cost reductions, are drawing increasing interest from the private sector. The report highlights how the introduction of SMRs could lead to lower financing costs. With the right support, SMR installations could reach 80 GW by 2040, accounting for 10% of overall nuclear capacity globally. However, the success of the technology and speed of adoption will hinge on the industry’s ability to bring down costs by 2040 to a similar level to those of large-scale hydropower and offshore wind projects. A new era for nuclear energy will require a lot of investment. In a rapid growth scenario for nuclear, annual investment would need to double to USD 120 billion already by 2030. Given the scale of the infrastructure investment required, the rollout of new nuclear projects cannot rely exclusively on public finances. IEA analysis shows that ensuring the predictability of future cash flows is key to bringing down financing costs and attracting private capital to the nuclear sector. The report highlights that the private sector is increasingly viewing nuclear energy as an investible energy source with the promise of firm, competitive, clean power that can serve energy-intensive operations 24/7. Notably, big names in the technology sector are signing power purchase agreements with developers to provide electricity for data centres and artificial intelligence. To take advantage of the opportunities that nuclear power offers, governments must be prepared to provide the strategic vision alongside stable regulatory frameworks that will give the private sector confidence to invest. The report details how incentives and public finance more broadly can unlock the investment needed to deliver greater clean and reliable power from nuclear.

#### Domestic action facilitates international projects and energy exports.

Maria Lorenzini, 3-7-2025, "The US can reduce Russia's nuclear energy—and geopolitical—influence", Atlantic Council, <https://www.atlanticcouncil.org/blogs/energysource/the-us-can-reduce-russias-nuclear-energy-and-geopolitical-influence/> [Marina Lorenzini is the research program coordinator at the Middle East Initiative at the Belfer Center for Science and International Affairs at Harvard University’s John F. Kennedy School of Government.] DOA: 3/10/2025 //RRM

* Consistency = credibility
* Also prob empiric to spike out of politics Das
* Doesn’t contradict energy independence b/c us becomes less dependent on imports not exports

In early February, the Bulgarian energy minister met with officials from the US Export-Import Bank (EXIM) to advance a $8.6 billion (more than 60 percent of the estimated cost) letter of interest for the two new reactors. For the remaining amount, the Bulgarian treasury or Kozloduy’s owner has several options. Bulgaria may also have access to debt or equity financing from the world’s largest multilateral development lender, the European Investment Bank. Additionally, as the World Bank considers how to incorporate nuclear power into their offerings, any steps toward engagement would encourage other lenders to do the same. If further capital is required, Bulgaria—with its relatively healthy domestic economy—could issue dollar-denominated bonds to raise funds, or the Kozloduy owner could issue green bonds similar to Canada’s Bruce Power. Bulgaria’s ability—and that of any potential lenders—to overcome financing hurdles will determine the success of such agreements. But if the agreement leads to new nuclear power generation, it bodes well for similar economies to undertake new reactor builds. Soviet reactor reaches end of life in Armenia Russia dominates Armenia’s energy system, but Armenian foreign policy has shifted dramatically away from Moscow in the past year, in part due to the lack of Russian military assistance to Armenia when Azerbaijan seized Nagorno-Karabakh. The policy change will not immediately impact Armenia’s Soviet-era VVER-440 nuclear reactor at Metsamor, which has received several upgrades and lifetime extensions—the latest, with Rosatom’s support, will sustain the remaining operational reactor until 2036. However, preparations must be made in the coming years to: extend the operational lifetime (a highly unlikely outcome due to the reactor’s age); build new light-water reactors (whether from China, Russia, South Korea, or the United States); or invest in small modular reactors (SMRs). Armenia may seek to build an SMR rather than a traditional reactor due to limited financing options and low power consumption. To build a new reactor, Armenia might want to follow Romania’s blended model for financing its SMR deal with NuScale. The EXIM and US International Development Finance Corporation offered Romania tentative financial support totaling $4 billion. Public and private partners then formed a coalition of stakeholders from Japan, South Korea, the United Arab Emirates, and the United States to finance the SMR project up to $275 million. If further capital is needed, private financial institutions have also recently announced their plans to support the nuclear industry. Whether and when construction begins for the reactor in Romania will demonstrate feasibility, but so far, the financial structure has shown promise. A great nuclear power balance In partnership with allies, the United States should advance financial and commercial solutions to help countries dependent on Russian nuclear energy diversify their domestic power programs. The United States is well positioned to do so. Trump, and Biden before him, have supported nuclear energy domestically, which, in turn, can result in the export of US technologies and expertise. Strong bipartisan appropriations from multiple administrations will reinforce Trump’s vision and the domestic nuclear energy industry. In 2019, during Trump’s first administration, the Nuclear Energy Innovation and Modernization Act became law, paving the way for a streamlined advanced reactor licensing process. Under the Biden administration, the multibillion-dollar appropriations from the Infrastructure Investment and Jobs Act and the Inflation Reduction Act bolstered the US nuclear energy industry. Further, the 2023 Nuclear Fuel Security Act and the 2024 ADVANCE Act enjoyed bipartisan support on Capitol Hill. Building on these domestic advances, Trump’s embrace of financial vehicles, such as the EXIM Bank or DFC, that bridge public and private sectors, will facilitate investments in multi-billion dollar infrastructure projects outside of the United States and bolster US energy-related exports, including from its domestic nuclear energy industry. These factors bode well for the United States to substantially weaken Russia’s share of global nuclear markets and its geopolitical influence.

#### Nuclear energy fosters economic resilience and empirically boosted GDP.

WNA, 05-01-2024, "Nuclear Energy and Sustainable Development", World Nuclear Association, <https://world-nuclear.org/information-library/energy-and-the-environment/nuclear-energy-and-sustainable-development> [World Nuclear Association’s mission is to facilitate the growth of the nuclear sector by connecting players across the value chain, representing the industry’s position in key world forums, and providing authoritative information and influencing key audiences.] DOA: 3/14/2025 //RRM

* spikes climate turns

The relationship between energy consumption and human development is clear. Up to about 100 GJ per capita consumption – a level yet to be reached by 80% of the world’s population – a country can fundamentally enhance the health, educational standards, and general wellbeing of its population by consuming more energy. Any transition towards a more equitable and sustainable future must therefore be predicated on delivering the benefits of access to modern, affordable and reliable energy services to all. But doing so will increase overall energy demand: at present, the world’s poorest 4 billion people consume just 5% of the amount of energy enjoyed by those living in developed economies. For that figure to rise to 15%, global energy consumption would increase by the equivalent of an additional United States’ worth of demand. The key question, therefore, is: how should that energy be supplied? At present, over 80% of primary energy consumption is from the burning of oil, gas and coal – unchanged since 1990. However, unregulated emissions from the combustion of fuels are causing climate change, environmental damage, and the premature death of an estimated 7 million people each year. The continued use of fossil fuels therefore has profound intra- and intergenerational social, economic and environmental implications. The resulting dual challenge – the need to reduce harmful emissions, whilst providing more energy to more people – positions the energy sector at the heart of achieving sustainable development. There is no technology that is fully without risk to people or the environment. For example, whilst low-carbon sources of energy do not emit carbon dioxide at the point of use, they are responsible for emissions and waste during construction, manufacturing and decommissioning. As such, any energy technology’s compatibility with sustainable development objectives must be assessed in relative terms – in the light of the alternatives. As the only proven, scalable and reliable low-carbon source of energy, nuclear power will be required to play a pivotal role if the world is to reduce its reliance on fossil fuels to address climate change and chronic air pollution. More broadly, however, the proposition of nuclear power as a sustainable energy source is fundamentally robust due to its innate energy density, and its internalization of health and environmental costs. Using nuclear energy has numerous sustainability advantages relative to alternative forms of generation. By expanding its use, modern and affordable energy can be provided to all who currently lack access, whilst reducing the human impact on the natural environment, and ensuring that the world’s ability to meet its other sustainable development goals is not curtailed. Defining Sustainable Development A number of definitions have been put forward for sustainable development, but the most widely quoted is from the 1987 Brundtland Report1: "Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” Sustainable development is therefore the pathway to sustainability. For an activity, product or entity to be truly sustainable, it must achieve environmental, economic and social sustainability in balance: the three 'pillars'. The three pillars of sustainability Figure 1: The three 'pillars' of sustainability In 2015, the 193 member states of the United Nations (UN) adopted the 2030 Agenda for Sustainable Development – a plan of action for people, planet and prosperity, aligned to the three pillars of sustainability. To disaggregate the bold ambitions of the 2030 Agenda, the UN agreed 17 Sustainable Development Goals (SDGs) to be used to guide and gauge progress. The United Nations 17 sustainable development goals Figure 2: The UN's Sustainable Development Goals More energy, lower emissions The 2030 Agenda for Sustainable Development recognized that by nature, the SDGs are “integrated and indivisible”. As such, achieving progress across any of the SDGs is contingent upon progress across the others. However the centrality of energy – and thus SDG 7 – is widely recognized: progress across all SDGs is contingent upon the provision of a sustainable supply of energy. Providing access to affordable, reliable and clean energy is pivotal for eradicating poverty, for improving population’s health and education, and for reducing greenhouse gases whilst continuing to support industrial development (see Figure 4). The link between the wellbeing of a population and energy consumption is well-established for developing countries. For those countries with an annual energy consumption below 100 GJ per capita – a level that 80% of the world’s population is yet to reach2, 3 – there is a clear correlation between their energy consumption and Human Development Index (HDI)a value, which is an indicator of a nation's health, education and living standards. Human Development Index and annual energy consumption per capita Figure 3: Human Development Index and annual energy consumption per capita, 2020 (source: BP) This relationship between human wellbeing and energy consumption explains the importance assigned to ensuring reliable access to affordable energy for all in SDG 7; reducing the share of the world’s population whose prospects are curtailed by lack of energy is essential for meeting the needs of the present. Achieving progress towards SDG 7 for the world’s growing population will require a significant increase in energy provision. The importance of clean energy for a sustainable future Figure 4: SDG 7 – key to all SDGs The key question, therefore, is how best to supply those growing energy needs. Our existing energy system is built on fossil fuels, but their combustion for energy generates carbon dioxide (CO2) emissions, a key contributor to climate change. The energy sector is responsible for about three-quarters of all greenhouse gas emissions, and as such, fundamentally transforming it is the single most important step towards combatting climate change. The UN has long-recognized climate change as the defining issue of our time. Despite this explicit acknowledgement, and spectacular recent investment in renewable energy, the world burned 66% more fossil fuels for energy in absolute terms in 2021 than it did in 1990. As a result, global energy-related CO2 emissions were 63% higher. Box 1: The importance of electricity At present, fossil fuels are used to meet our energy requirements for transport, residential applications (e.g. heating), and to power industrial processes. Fossil fuels are also the dominant means of generating electricity, but other sources, including hydro, nuclear, solar and wind, are used too. To transition to a sustainable energy system all energy sectors will need to be decarbonized. However, much of the focus to date has been on the electricity sector for several reasons: The electricity sector is the most readily-decarbonized, as it provides the means to use non-fossil low-carbon energy (e.g. hydro, nuclear, wind and solar). Electricity is clean at the point of final use. This has two main advantages: improving air quality in urban areas; and centralising energy-related emissions (i.e. at power stations), making emissions regulation more straightforward. About 20% of final energy consumption is in the form of electricity, but the generation of electricity is responsible for almost 50% of all energy-related emissions. Despite the focus on electricity, limited progress has been made to date. In 2021, worldwide, 133% more electricity was generated from fossil fuels than 30 years earlier. Can nuclear contribute to sustainable development goals? Despite the crucial role that nuclear will need to play if the UN’s SDGs are to be achieved, there remains some opposition to the growing recognition of the energy source’s credentials for contributing towards sustainable development. Fundamentally, nuclear energy’s competitive position from a sustainable development perspective is robust due to its energy density and internalization of health and environmental costs. Using nuclear energy brings multiple sustainability advantages over available alternatives, explaining its expanded role in almost all major studies that outline plausible pathways towards sustainable energy provision (see Box 2). An analysis of nuclear energy’s characteristics within a sustainable development framework shows that the approach adopted within the nuclear energy sector is consistent with a central goal of sustainable development of passing a range of assets to future generations while minimising environmental impacts and burdens. Box 2: Nuclear energy’s role in sustainable energy transitions Predicting the future of energy supply is complex, and uncertainties are high. However, it is striking that in almost all forward-looking normative scenarios, nuclear energy’s share in the mix grows substantially4. Generally, the more ambitious a scenario is in its aims for decarbonization and sustainability, the greater the role for nuclear. In the IPCC’s P3 'middle-of-the-road' scenario, for example, nuclear generation grows six-fold by 2050. Primary energy mix by 2040 and share of nuclear energy Primary energy mix by 2040 and share of nuclear energy (source: World Energy Council) The environmental pillar The environmental pillar of sustainable development encompasses issues including air and water pollution, waste management, ecosystem management, and protection of natural resources, wildlife and endangered species. Climate change The United Nations recognizes climate change as “the most systemic threat to humankind”. As such, addressing it is generally considered the most significant and urgent sustainability challenge. Climate change is resulting from increasing concentrations of CO2 in the Earth’s atmosphere. Given that three-quarters of anthropogenic CO2 emissions result from the burning of fossil fuels for energy, the main focus should be on deploying energy technologies that emit only small amounts of CO2 per unit of energy. On a life-cycle basis, nuclear power emits just a few grams of CO2 equivalent per kWh of electricity produced. A median value of 12g CO2 equivalent/kWh has been estimated for nuclear – similar to wind, and lower than all types of solar5. Average life-cycle CO2 equivalent emissions Figure 5: Average life-cycle CO2 equivalent emissions (source: IPCC) Ecosystem protection The main impacts of power production on ecosystems are eutrophication (i.e. increased concentrations of chemical nutrients, primarily nitrogen and phosphorus, that damage water quality by causing oxygen depletion) and acidification (i.e. increased concentrations of acidic chemicals – caused by the absorption of atmospheric CO2 – that damage water quality, harming shellfish and coral, and leading to excessive algal growth). Among power producing technologies, fossil fuels have by far the greatest potential to cause both acidification and eutrophication. CO2 released into the atmosphere during the combustion of fossil fuels dissolves into the oceans, increasing their acidity; and the mining, extraction, transport, waste treatment and emissions associated with fossil fuel use contribute to their high eutrophication potential. By contrast, both the acidification and eutrophication potential of nuclear power are estimated to be among the lowest of all available generation technologies6. Figure 6: Lifecycle eutrophying emissions for 2020, in grams of phosphorus equivalent per MWh (source: Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources, UNECE (March 2022) Land and water use Land and water usage are key criteria for assessing the sustainability of different power production technologies. The power sector competes for limited resources with other important sectors such as agriculture, industry and housing, and the emergence of a new concept known as the water-food-energy nexus reflects the growing appreciation of the interconnectedness of policy decisions in these three areas. Nuclear power plants produce huge amounts of low-carbon power and require less land to do so than any other energy source. The UN expects two-thirds of people to be living in urban areas by 2050 – an additional 2.5 billion individuals – where land is at a premium. Coupled with the need to preserve land to prevent loss of biodiversity, it is likely that nuclear energy’s unique land-use advantages will prove increasingly determinative in the future. Box 3: The water-food-energy nexus Demand for water, food and energy is increasing, driven by rising global population and prosperity, as well as urbanization, dietary changes and economic growth. More than one-quarter of the world’s energy is used for the production of food, and the agricultural sector is the largest single consumer of freshwater resources. The inextricable link between achieving water, energy and food security has driven recognition that policy decisions on each cannot be made effectively in isolation. The nexus approach is designed to integrate management across the three closely-related sectors. The water-food-energy nexus The water-food-energy nexus (source: International Water Association) A large two-unit nuclear power plant can provide electricity for 4-5 million people from a generating footprint of just 2 square kilometres. However, the land use of all energy-generating technologies extends beyond their generating footprint, and includes the required mining of raw materials and, for conventional sources of power, their fuel cycle. Taking this into account, the land use of biomass, hydro, wind and solar are between one and three orders of magnitude greater than nuclear7. Relative land useof electricity generation options per unit of electricity Figure 7: Relative land use (fuel mining and generating footprint) of electricity generation options per unit of electricity (source: Brook & Bradshaw, 2015) At some stage during supply, construction or operation, all electricity generating options consume water. Wind and solar energy have the smallest water 'footprints', whereas biomass and hydropower have the largest. Fossil fuels and nuclear consume significant quantities of water in the operational phase for cooling8. Fresh water is a valuable resource in most parts of the world. Apart from proximity to main load centres, there is no reason to site nuclear power plants away from a coast, where they can use once-through seawater cooling. The high energy density of uranium means that logistical requirements for fuel are modest (about 200 tonnes for a large reactor annually versus over 3,000,000 tonnes for an equivalent coal plant) allowing for flexible siting of nuclear power plants. In the event that water is so limited that it cannot be used for cooling, and a coastal location is not available, plants can be sited away from the load demand, but this will incur additional transmission costs. Whilst nuclear power plants require significant quantities of water for cooling, their ability to provide large amounts of power is increasingly being used to secure water supplies in areas of scarcity. Where potable water cannot be obtained from streams and aquifers, desalination of seawater, mineralized groundwater or urban waste water is required. Most desalination at present is powered by fossil fuels, but nuclear desalination has been used for many years in countries such as Japan, India and Kazakhstan. Water consumption per unit of electricity and heat produced Figure 8: Water consumption per unit of electricity and heat produced 2008-2012 (source: Mekonnen et al., 2015) Waste The careful management of waste streams is a key sustainability consideration in order to prevent short- or long-term harm to humans and the environment. All energy-producing technologies create waste, but the amount produced, the risk it poses, and the means of management vary widely. The energy density of fuel used for electricity generation is one key determinant of the magnitude and manageability of waste streams. Uranium’s exceptionally high energy density means a relatively small amount of fuel is required per unit of energy produced. Using less fuel reduces the scale of fuel extraction activities and transport requirements – in turn reducing the chance of unintended environmental releases – and results in the creation of less waste. Contrary to popular belief, therefore, one of the benefits of producing electricity from nuclear energy is that its waste streams are small, and therefore innately manageable. It is for this reason that nuclear energy is the only form of electricity generation to fully contain its emissions, effluents and waste. Unlike nuclear energy, some energy sources dispose of wastes to the environment, or have health effects which are not costed into the product. These implicit subsidies, or external costs as they are generally called, are nevertheless real and usually quantifiable, and are borne by society at large. Their quantification is necessary to enable rational choices between energy sources. Nuclear energy provides for waste management, disposal and decommissioning costs in the actual cost of electricity (i.e. it has internalized them), so that external costs are minimized. The social pillar Human health – air pollution Air pollution arising from the use of carbon-based fuels for energy is one of the biggest threats to human welfare. The World Health Organization estimates that about 7 million people die prematurely each year as a result of air pollution exposure. Nuclear power plants emit virtually no air pollutants during operation, and because they are reliable and can be deployed on a large scale, they can directly replace fossil fuel plant. NASA’s Goddard Institute for Space Studies and Columbia University’s Earth Institute estimated that the use of nuclear power prevented over 1.8 million air pollution-related deaths between 1971 and 2009. There are numerous non-power uses of nuclear technology that contribute to fulfilment of human 'needs'. For example: the provision of nuclear medicine; helping to control the spread of infectious diseases; and securing reliable supplies of clean water, sanitation and food (see Figure 9). Examples of the contribution of non-power nuclear technologies to the SDGs Figure 9: Examples of the contribution of non-power nuclear technologies to the SDGs Human health – radiation Radiation is a well-understood process, with natural sources accounting for most of the radiation people receive each year. Doses received average 2.4 mSv/yr, but vary widely by location, driven by factors such as underlying geology and altitude. The highest known level of background radiation affecting a substantial population is in the states of Kerala and Madras in India where some 140,000 people receive doses which average over 15 mSv/yr from gamma radiation, in addition to a similar dose from radon. Comparable levels occur in Brazil and Sudan, with average exposures up to about 40 mSv/yr to many people. Lifetime doses from natural radiation range up to several thousand millisieverts. However, there is no evidence of increased cancers or other health problems arising from these high natural levels. 20 mSv/yr is the current average allowed limit for nuclear industry employees and uranium miners during normal operation. The millions of nuclear workers that have been monitored closely for 50 years have no higher cancer mortality than the general population but have had up to ten times the average dose. Nuclear power is the only technology that systematically measures and accounts for radioactive emissions. However, exposure to above-background radiation is not exclusive to nuclear power-related activities. UNSCEAR has estimated that both occupational and public exposures from electricity generation are higher for workers in the coal industry, for example. Employment Nuclear power plants can operate for over 60 years, creating long-lasting, high-paying jobs for people from a range of fields and educational backgrounds. Undertaking a nuclear power programme therefore represents a long-term investment in human capital. Investment in capital-intensive projects tends to spill over into other industries and economic sectors. A modern gigawatt-scale nuclear power plant employs 500-1000 workers directly. But throughout both its construction and operation, it requires a complex supporting supply chain (e.g. construction, manufacturing and consultancy services), creating attractive indirect and induced employment opportunities. Hinkley point C unit 2 construction site During construction of a large, modern plant, thousands of workers may be onsite. At Hinkley Point C (pictured), over 8000 workers will be onsite during the peak of construction. A study of the European nuclear industry by Deloitte suggested that nuclear provides more jobs per TWh of electricity generated than any other clean energy source. According to the report, the nuclear industry sustains more than 1.1 million jobs in the European Union. In addition, each gigawatt of installed nuclear capacity generates €9.3 billion in annual investments in nuclear and related economic sectors, and provides permanent and local employment to nearly 10,000 people. For every €1 invested, the nuclear industry generates an indirect contribution of €4 in GDP, and every direct job creates 3.2 jobs in the EU as a whole. The economic pillar Resource adequacy, preservation & opportunity cost Uranium has no significant use other than nuclear energy production. Producing electricity with uranium extends the overall resource base available for human use, provides greater diversity of choice and allows the use of other resources, such as hydrocarbons, where they are most effective e.g. for transportation or petrochemicals. Uranium is plentiful and is distributed among a wide range of geopolitically diverse countries. The distribution of uranium reduces the risk of market disruptions of the nature experienced during historical oil and gas crises. Resource efficiency and material throughput The focus on power supply options defined as 'renewable' over the past several decades reflects the importance attached to the preservation of finite resources. Renewable sources of energy are those generated from natural processes that are continuously replenished. Renewable technologies, therefore, are defined as those that are not fuelled by a finite resource. Intergenerational equity is a key principle of sustainable development, and so the purported advantage of renewable energy options – that they do not diminish finite fuel resources for future generations – is valuable. However, fuel supply is just one aspect of the material requirements for power generation. All means of generating electricity require infrastructure that consumes finite resources, with the major material inputs by volume outside of fuel supply typically concrete and metals (e.g. aluminium, cooper, steel). Estimates for the use of key bulk materials and copper per TWh for different technologies have been produced by former environmental organization Bright New World9, based on a literature review of studies on this topic. Nuclear PWR Solar Wind Hydro Gas (load following) Gas (load following) + CCS Coal Coal + CCS Concrete 1060 1220 4470 15,320 390 820 450 520 Steel 130 940 1450 330 320 970 160 1170 Aluminium 0.3 287.5 17.4 8.7 5.7 21.4 1.6 37.4 Copper 2.5 68.0 39.1 4.8 5.4 8.8 3.0 11.8 Capacity f. 85% 28% 35% 50% 30% 30% 85% 85% Lifespan 60 30 30 100 60 60 60 60 Table 1 and Figure 10: Major materials for different generating technologies, tonnes per TWh (source: Bright New World) The aim of reducing material inputs is a central concept of sustainable development. Using material in the production, transport and implementation of power producing technologies will consume energy in the form of fossil fuels, and as such the metric of material throughput is important in consideration of energy efficiency as well as life-cycle carbon emissions. But more broadly, resource efficiency is a key aim in itself. Consumption of primary materials is expected to more than double by 2050. Using nuclear energy to generate electricity is one means by which resource demand can be reduced to more sustainable levels. Affordability Affordability is a key component of SDG 7. The benefits of access to modern energy are profound, but the aspiration of ensuring access for all can only be realized if it is affordable. The relative affordability of electricity supply options is a function of generation costs as well as the costs they impose on the system as a whole. Generation costs are typically reported using the levelized cost of electricity generation (LCOE) metric, which is a measure of the ratio of the total costs of a generic plant (capital and operating), to the total amount of electricity expected to be generated over that plant’s lifetime. LCOE as a metric is relatively simple and transparent, and so is widely referenced. However, its ability to assess overall costs to society are limited. In deregulated markets, revenues are uncertain over a generator’s lifetime making the metric less pertinent; and the metric does not attempt to capture the markedly different system costs of technologies. System costs have always existed, but the growth in variable renewable energy sources has promoted the topic in recent years. System costs include required outlays for distribution and transmission, and most importantly, backup for the inherent variability of some renewable energy. System costs are difficult to assess, as they depend on the characteristics of the system in question, the time frame considered, location and numerous other factors. Whilst there is uncertainty, estimates are consistent in that system costs for variable energy sources are significant, increase non-linearly with growing shares of electricity generation, and are an order of magnitude higher than for dispatchable technologies10. The costs of the system as a whole are ultimately borne by society, and so, given the increasing use of variable renewable energy, it is important that system costs are internalized to ensure that policy decisions can be properly directed towards maximizing affordability. Negative effects beyond the system itself (i.e. negative externalities) related to the provision of electricity are increasingly being recognized as significant and complicate the picture further. Negative externalities related to electricity generation – most notably the emissions of greenhouse gases and other pollutants – represent a social cost that may impact the true affordability of different electricity supply options. It is well documented that the social and economic costs of climate change and air pollution are significant. In order to better-understand the socially optimal level of externalities (relative to production) it is imperative that the relative costs of different supply options include a reasonable estimate of their impacts on emissions and the climate. Nuclear energy is cost-competitive based on a simple LCOE comparison, particularly at low discount rates. Its unique attributes of providing predictable, reliable supply that is low-carbon means that inclusion of system costs and negative externalities both markedly improve the relative affordability of nuclear energy. Grid-level system costs for dispatchable and renewable technologies Figure 11: Grid-level system costs for dispatchable and renewable technologies (source: OECD Nuclear Energy Agency, 2018) Notes & references Notes a. The Human Development Index (HDI) is a United Nations Development Programme statistical tool to measure a country's level of social and economic development. The social and economic dimensions of a country are based on the health of its people, their level of education attainment and their standard of living. A country scores a higher HDI when the lifespan of its people is longer, the education level is higher, and the gross national income per capita is higher. [Back] References 1. United Nations, Report of the World Commission on Environment and Development: Our Common Future ('Brundtland Report') (1987) [Back] 2. United Nations Development Programme, Human Development Reports [Back] 3. BP Energy Outlook: 2019 edition [Back] 4. World Energy Council, World Energy Scenarios 2019, The Future of Nuclear: Diverse Harmonies in the Energy Transition (2019) [Back] 5. Steffen Schlömer (ed.), Technology-specific Cost and Performance Parameters, Annex III of Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014) [Back] 6. United Nations Economic Commission for Europe, Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources (March 2022) [Back] 7. Barry W. Brook and Corey J. A. Bradshaw, Key role for nuclear energy in global biodiversity conservation, Conservation Biology, 29, 3 (2015) [Back] 8. Mesfin Mekonnen et al., The consumptive water footprint of electricity and heat: a global assessment, Environmental Science: Water Research & Technology (March 2015) [Back] 9. Bright New World, Materials use in a clean energy future (June 2021) [Back] 10. OECD Nuclear Energy Agency, The Full Costs of Electricity Provision (2018) [Back]

#### Otherwise, a recession would be devastating

Heidi Shierholz, 9-10-2009, "New 2008 poverty, income data reveal only tip of the recession iceberg", Economic Policy Institute, <https://www.epi.org/publication/income_picture_20090910/> [Heidi Shierholz (she/her) is the president of the Economic Policy Institute, a nonprofit, nonpartisan think tank that uses the power of its research on economic trends and on the impact of economic policies to advance reforms that serve working people, deliver racial justice, and guarantee gender equity. In 2021 she became the fourth president EPI has had since its founding in 1986.] DOA: 4/4/2025

The poverty rate increased from 12.5% to 13.2% between 2007 and 2008, representing an additional 2.6 million people living in poverty. The large increase in poverty suggests that as anti-poverty policies have come to depend more on paid work as the main pathway out of poverty, the safety net has become less effective in reducing economic hardship when the economy and job market are underperforming.

• The poverty rate for children was 19.0% in 2008, representing 14.1 million kids living in poverty. In 2008, over one-third (35.3%) of all people living in poverty were children.

• It is important to note that the federal poverty threshold as currently measured is widely understood by poverty researchers to be an inadequate measure of the income needed to make ends meet. Poverty experts often use twice the poverty line as a more accurate threshold for material deprivation. In 2008, 31.9% (96 million people) were living below twice the poverty threshold, up from 30.5% in 2007. The number was even higher for children, with 40.6% of children (30.1 million) living below “twice poverty,” up from 39.2% in 2007.

• Hispanics and Asians were particularly hard-hit by increases in poverty in 2008, increasing by 1.6 and 1.4 percentage points, respectively, from 2007 to 2008.

• In 2008, over one-third (33.9%) of all black children and nearly one-third (30.6%) of all Hispanic children were living in poverty (increases of 0.2 and 2.0 percentage points, respectively, since 2007).

## 1AC---Climate

#### Climate change is worsening – best, most recent studies confirm we’re on the brink of irreversibility and the next 20 years are key.

Martina Igini, 02-11-2025, "Breaching 1.5C Threshold Could Come 'Earlier Than Expected'", Earth.Org, <https://earth.org/paris-agreements-1-5c-threshold-breach-could-come-earlier-than-expected-scientists-warn/> [Martina holds two BA degrees - in Translation Studies and Journalism - and an MA in International Development from the University of Vienna.] DOA: 3/10/2025 //RRM

Two new studies indicate that we might have already crossed a key threshold to limit global warming in line with the Paris Agreement, after 2024 became the first calendar year where global temperatures surpassed 1.5C. — The planet might be on track to breach a key global warming threshold “earlier than expected,” two new papers warned on Monday. The studies, published in Nature Climate Change, follow the hottest year on record and the first in which global temperatures reached 1.5C for the entire year. This has left scientists wondering what this means for warming trends, as it puts us closer to a temperature limit we have pledged to do everything we can to avoid crossing. EO Movement Become an EO Member today and join a growing movement of people determined to make a change. JOIN EARTH.ORG Whether the planet has breached the Paris Agreement 1.5C warming target or not is measured over a 20-year retrospective average, meaning last year does not signal a permanent breach. What the new studies investigated, however, is whether we have already entered the 20-year period above 1.5C. Both concluded we have. One study, authored by Alex Cannon, a research scientist with Environment and Climate Change Canada, concluded that if 1.5C anomalies continue beyond 18 months, “breaching the Paris Agreement threshold is virtually certain.” Meanwhile, Emanuele Bevacqua, a climate scientist at the Helmholtz Centre for Environmental Research in Germany, and colleagues put the odds of 2024 being the first year of a 20-year period reaching the 1.5C warming level at “likely” to “virtually certain.” The Paris deal was drafted in 2015 to strengthen the global response to the growing threat of climate change. It set out a framework for limiting global warming to below 1.5C or “well below 2C” above pre-industrial levels by the end of the century. Beyond this limit, experts warn that critical tipping points will be breached, leading to devastating and potentially irreversible consequences for several vital Earth systems that sustain a hospitable planet. The United Nations had already estimated that current emissions reduction pledges put the planet on track for a temperature increase of 2.6-3.1C over the course of this century. The only way to avoid this is do drastically reduce greenhouse gas emissions, the primary driver of global warming as they trap heat in the atmosphere, raising Earth’s surface temperature. Scientists are not optimistic either. A survey of 380 IPCC scientists conducted by the Guardian last May revealed that 77% of them believe humanity is headed for at least 2.5C of warming. And on Monday, renowned climatologist James Hansen said even the 2C target “is dead” after his latest paper concluded that Earth’s climate is more sensitive to rising greenhouse gas emissions than previously thought. The former top NASA climate scientist famously announced to the US Congress in 1988 that global warming was underway.⁣ Warming Continues Hopes that the recent warming trend would subside with the arrival of a cooling weather pattern known as La Niña were dashed last month, as January turned out to be the hottest January ever recorded. Surface air temperature anomaly for January 2025 relative to the January average for the period 1991-2020. Data source: ERA5. Surface air temperature anomaly for January 2025 relative to the January average for the period 1991-2020. Image: C3S/ECMWF. “[M]any of us expect that 2025 will be cooler than both 2023 and 2024, and is unlikely to be the warmest year in the instrumental record,” climatologist Zeke Hausfather wrote in a blog post on Monday. Their expectations were not met, he went on to say, describing how last beat the prior record set in January 2024 “by a sizable margin.” “January 2025 stands out as anomalous even by the standards of the last two years,” Hausfather wrote. “[A]t least at the start of the year nature seems not to be following our expectations.”

#### Nuclear energy is key to climate solvency and is better than alternatives

WNA, 05-01-2024, "Nuclear Energy and Sustainable Development", World Nuclear Association, <https://world-nuclear.org/information-library/energy-and-the-environment/nuclear-energy-and-sustainable-development> [World Nuclear Association’s mission is to facilitate the growth of the nuclear sector by connecting players across the value chain, representing the industry’s position in key world forums, and providing authoritative information and influencing key audiences.] DOA: 3/14/2025 //RRM

* spikes climate turns

The relationship between energy consumption and human development is clear. Up to about 100 GJ per capita consumption – a level yet to be reached by 80% of the world’s population – a country can fundamentally enhance the health, educational standards, and general wellbeing of its population by consuming more energy. Any transition towards a more equitable and sustainable future must therefore be predicated on delivering the benefits of access to modern, affordable and reliable energy services to all. But doing so will increase overall energy demand: at present, the world’s poorest 4 billion people consume just 5% of the amount of energy enjoyed by those living in developed economies. For that figure to rise to 15%, global energy consumption would increase by the equivalent of an additional United States’ worth of demand. The key question, therefore, is: how should that energy be supplied? At present, over 80% of primary energy consumption is from the burning of oil, gas and coal – unchanged since 1990. However, unregulated emissions from the combustion of fuels are causing climate change, environmental damage, and the premature death of an estimated 7 million people each year. The continued use of fossil fuels therefore has profound intra- and intergenerational social, economic and environmental implications. The resulting dual challenge – the need to reduce harmful emissions, whilst providing more energy to more people – positions the energy sector at the heart of achieving sustainable development. There is no technology that is fully without risk to people or the environment. For example, whilst low-carbon sources of energy do not emit carbon dioxide at the point of use, they are responsible for emissions and waste during construction, manufacturing and decommissioning. As such, any energy technology’s compatibility with sustainable development objectives must be assessed in relative terms – in the light of the alternatives. As the only proven, scalable and reliable low-carbon source of energy, nuclear power will be required to play a pivotal role if the world is to reduce its reliance on fossil fuels to address climate change and chronic air pollution. More broadly, however, the proposition of nuclear power as a sustainable energy source is fundamentally robust due to its innate energy density, and its internalization of health and environmental costs. Using nuclear energy has numerous sustainability advantages relative to alternative forms of generation. By expanding its use, modern and affordable energy can be provided to all who currently lack access, whilst reducing the human impact on the natural environment, and ensuring that the world’s ability to meet its other sustainable development goals is not curtailed. Defining Sustainable Development A number of definitions have been put forward for sustainable development, but the most widely quoted is from the 1987 Brundtland Report1: "Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” Sustainable development is therefore the pathway to sustainability. For an activity, product or entity to be truly sustainable, it must achieve environmental, economic and social sustainability in balance: the three 'pillars'. The three pillars of sustainability Figure 1: The three 'pillars' of sustainability In 2015, the 193 member states of the United Nations (UN) adopted the 2030 Agenda for Sustainable Development – a plan of action for people, planet and prosperity, aligned to the three pillars of sustainability. To disaggregate the bold ambitions of the 2030 Agenda, the UN agreed 17 Sustainable Development Goals (SDGs) to be used to guide and gauge progress. The United Nations 17 sustainable development goals Figure 2: The UN's Sustainable Development Goals More energy, lower emissions The 2030 Agenda for Sustainable Development recognized that by nature, the SDGs are “integrated and indivisible”. As such, achieving progress across any of the SDGs is contingent upon progress across the others. However the centrality of energy – and thus SDG 7 – is widely recognized: progress across all SDGs is contingent upon the provision of a sustainable supply of energy. Providing access to affordable, reliable and clean energy is pivotal for eradicating poverty, for improving population’s health and education, and for reducing greenhouse gases whilst continuing to support industrial development (see Figure 4). The link between the wellbeing of a population and energy consumption is well-established for developing countries. For those countries with an annual energy consumption below 100 GJ per capita – a level that 80% of the world’s population is yet to reach2, 3 – there is a clear correlation between their energy consumption and Human Development Index (HDI)a value, which is an indicator of a nation's health, education and living standards. Human Development Index and annual energy consumption per capita Figure 3: Human Development Index and annual energy consumption per capita, 2020 (source: BP) This relationship between human wellbeing and energy consumption explains the importance assigned to ensuring reliable access to affordable energy for all in SDG 7; reducing the share of the world’s population whose prospects are curtailed by lack of energy is essential for meeting the needs of the present. Achieving progress towards SDG 7 for the world’s growing population will require a significant increase in energy provision. The importance of clean energy for a sustainable future Figure 4: SDG 7 – key to all SDGs The key question, therefore, is how best to supply those growing energy needs. Our existing energy system is built on fossil fuels, but their combustion for energy generates carbon dioxide (CO2) emissions, a key contributor to climate change. The energy sector is responsible for about three-quarters of all greenhouse gas emissions, and as such, fundamentally transforming it is the single most important step towards combatting climate change. The UN has long-recognized climate change as the defining issue of our time. Despite this explicit acknowledgement, and spectacular recent investment in renewable energy, the world burned 66% more fossil fuels for energy in absolute terms in 2021 than it did in 1990. As a result, global energy-related CO2 emissions were 63% higher. Box 1: The importance of electricity At present, fossil fuels are used to meet our energy requirements for transport, residential applications (e.g. heating), and to power industrial processes. Fossil fuels are also the dominant means of generating electricity, but other sources, including hydro, nuclear, solar and wind, are used too. To transition to a sustainable energy system all energy sectors will need to be decarbonized. However, much of the focus to date has been on the electricity sector for several reasons: The electricity sector is the most readily-decarbonized, as it provides the means to use non-fossil low-carbon energy (e.g. hydro, nuclear, wind and solar). Electricity is clean at the point of final use. This has two main advantages: improving air quality in urban areas; and centralising energy-related emissions (i.e. at power stations), making emissions regulation more straightforward. About 20% of final energy consumption is in the form of electricity, but the generation of electricity is responsible for almost 50% of all energy-related emissions. Despite the focus on electricity, limited progress has been made to date. In 2021, worldwide, 133% more electricity was generated from fossil fuels than 30 years earlier. Can nuclear contribute to sustainable development goals? Despite the crucial role that nuclear will need to play if the UN’s SDGs are to be achieved, there remains some opposition to the growing recognition of the energy source’s credentials for contributing towards sustainable development. Fundamentally, nuclear energy’s competitive position from a sustainable development perspective is robust due to its energy density and internalization of health and environmental costs. Using nuclear energy brings multiple sustainability advantages over available alternatives, explaining its expanded role in almost all major studies that outline plausible pathways towards sustainable energy provision (see Box 2). An analysis of nuclear energy’s characteristics within a sustainable development framework shows that the approach adopted within the nuclear energy sector is consistent with a central goal of sustainable development of passing a range of assets to future generations while minimising environmental impacts and burdens. Box 2: Nuclear energy’s role in sustainable energy transitions Predicting the future of energy supply is complex, and uncertainties are high. However, it is striking that in almost all forward-looking normative scenarios, nuclear energy’s share in the mix grows substantially4. Generally, the more ambitious a scenario is in its aims for decarbonization and sustainability, the greater the role for nuclear. In the IPCC’s P3 'middle-of-the-road' scenario, for example, nuclear generation grows six-fold by 2050. Primary energy mix by 2040 and share of nuclear energy Primary energy mix by 2040 and share of nuclear energy (source: World Energy Council) The environmental pillar The environmental pillar of sustainable development encompasses issues including air and water pollution, waste management, ecosystem management, and protection of natural resources, wildlife and endangered species. Climate change The United Nations recognizes climate change as “the most systemic threat to humankind”. As such, addressing it is generally considered the most significant and urgent sustainability challenge. Climate change is resulting from increasing concentrations of CO2 in the Earth’s atmosphere. Given that three-quarters of anthropogenic CO2 emissions result from the burning of fossil fuels for energy, the main focus should be on deploying energy technologies that emit only small amounts of CO2 per unit of energy. On a life-cycle basis, nuclear power emits just a few grams of CO2 equivalent per kWh of electricity produced. A median value of 12g CO2 equivalent/kWh has been estimated for nuclear – similar to wind, and lower than all types of solar5. Average life-cycle CO2 equivalent emissions Figure 5: Average life-cycle CO2 equivalent emissions (source: IPCC) Ecosystem protection The main impacts of power production on ecosystems are eutrophication (i.e. increased concentrations of chemical nutrients, primarily nitrogen and phosphorus, that damage water quality by causing oxygen depletion) and acidification (i.e. increased concentrations of acidic chemicals – caused by the absorption of atmospheric CO2 – that damage water quality, harming shellfish and coral, and leading to excessive algal growth). Among power producing technologies, fossil fuels have by far the greatest potential to cause both acidification and eutrophication. CO2 released into the atmosphere during the combustion of fossil fuels dissolves into the oceans, increasing their acidity; and the mining, extraction, transport, waste treatment and emissions associated with fossil fuel use contribute to their high eutrophication potential. By contrast, both the acidification and eutrophication potential of nuclear power are estimated to be among the lowest of all available generation technologies6. Figure 6: Lifecycle eutrophying emissions for 2020, in grams of phosphorus equivalent per MWh (source: Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources, UNECE (March 2022) Land and water use Land and water usage are key criteria for assessing the sustainability of different power production technologies. The power sector competes for limited resources with other important sectors such as agriculture, industry and housing, and the emergence of a new concept known as the water-food-energy nexus reflects the growing appreciation of the interconnectedness of policy decisions in these three areas. Nuclear power plants produce huge amounts of low-carbon power and require less land to do so than any other energy source. The UN expects two-thirds of people to be living in urban areas by 2050 – an additional 2.5 billion individuals – where land is at a premium. Coupled with the need to preserve land to prevent loss of biodiversity, it is likely that nuclear energy’s unique land-use advantages will prove increasingly determinative in the future. Box 3: The water-food-energy nexus Demand for water, food and energy is increasing, driven by rising global population and prosperity, as well as urbanization, dietary changes and economic growth. More than one-quarter of the world’s energy is used for the production of food, and the agricultural sector is the largest single consumer of freshwater resources. The inextricable link between achieving water, energy and food security has driven recognition that policy decisions on each cannot be made effectively in isolation. The nexus approach is designed to integrate management across the three closely-related sectors. The water-food-energy nexus The water-food-energy nexus (source: International Water Association) A large two-unit nuclear power plant can provide electricity for 4-5 million people from a generating footprint of just 2 square kilometres. However, the land use of all energy-generating technologies extends beyond their generating footprint, and includes the required mining of raw materials and, for conventional sources of power, their fuel cycle. Taking this into account, the land use of biomass, hydro, wind and solar are between one and three orders of magnitude greater than nuclear7. Relative land useof electricity generation options per unit of electricity Figure 7: Relative land use (fuel mining and generating footprint) of electricity generation options per unit of electricity (source: Brook & Bradshaw, 2015) At some stage during supply, construction or operation, all electricity generating options consume water. Wind and solar energy have the smallest water 'footprints', whereas biomass and hydropower have the largest. Fossil fuels and nuclear consume significant quantities of water in the operational phase for cooling8. Fresh water is a valuable resource in most parts of the world. Apart from proximity to main load centres, there is no reason to site nuclear power plants away from a coast, where they can use once-through seawater cooling. The high energy density of uranium means that logistical requirements for fuel are modest (about 200 tonnes for a large reactor annually versus over 3,000,000 tonnes for an equivalent coal plant) allowing for flexible siting of nuclear power plants. In the event that water is so limited that it cannot be used for cooling, and a coastal location is not available, plants can be sited away from the load demand, but this will incur additional transmission costs. Whilst nuclear power plants require significant quantities of water for cooling, their ability to provide large amounts of power is increasingly being used to secure water supplies in areas of scarcity. Where potable water cannot be obtained from streams and aquifers, desalination of seawater, mineralized groundwater or urban waste water is required. Most desalination at present is powered by fossil fuels, but nuclear desalination has been used for many years in countries such as Japan, India and Kazakhstan. Water consumption per unit of electricity and heat produced Figure 8: Water consumption per unit of electricity and heat produced 2008-2012 (source: Mekonnen et al., 2015) Waste The careful management of waste streams is a key sustainability consideration in order to prevent short- or long-term harm to humans and the environment. All energy-producing technologies create waste, but the amount produced, the risk it poses, and the means of management vary widely. The energy density of fuel used for electricity generation is one key determinant of the magnitude and manageability of waste streams. Uranium’s exceptionally high energy density means a relatively small amount of fuel is required per unit of energy produced. Using less fuel reduces the scale of fuel extraction activities and transport requirements – in turn reducing the chance of unintended environmental releases – and results in the creation of less waste. Contrary to popular belief, therefore, one of the benefits of producing electricity from nuclear energy is that its waste streams are small, and therefore innately manageable. It is for this reason that nuclear energy is the only form of electricity generation to fully contain its emissions, effluents and waste. Unlike nuclear energy, some energy sources dispose of wastes to the environment, or have health effects which are not costed into the product. These implicit subsidies, or external costs as they are generally called, are nevertheless real and usually quantifiable, and are borne by society at large. Their quantification is necessary to enable rational choices between energy sources. Nuclear energy provides for waste management, disposal and decommissioning costs in the actual cost of electricity (i.e. it has internalized them), so that external costs are minimized. The social pillar Human health – air pollution Air pollution arising from the use of carbon-based fuels for energy is one of the biggest threats to human welfare. The World Health Organization estimates that about 7 million people die prematurely each year as a result of air pollution exposure. Nuclear power plants emit virtually no air pollutants during operation, and because they are reliable and can be deployed on a large scale, they can directly replace fossil fuel plant. NASA’s Goddard Institute for Space Studies and Columbia University’s Earth Institute estimated that the use of nuclear power prevented over 1.8 million air pollution-related deaths between 1971 and 2009. There are numerous non-power uses of nuclear technology that contribute to fulfilment of human 'needs'. For example: the provision of nuclear medicine; helping to control the spread of infectious diseases; and securing reliable supplies of clean water, sanitation and food (see Figure 9). Examples of the contribution of non-power nuclear technologies to the SDGs Figure 9: Examples of the contribution of non-power nuclear technologies to the SDGs Human health – radiation Radiation is a well-understood process, with natural sources accounting for most of the radiation people receive each year. Doses received average 2.4 mSv/yr, but vary widely by location, driven by factors such as underlying geology and altitude. The highest known level of background radiation affecting a substantial population is in the states of Kerala and Madras in India where some 140,000 people receive doses which average over 15 mSv/yr from gamma radiation, in addition to a similar dose from radon. Comparable levels occur in Brazil and Sudan, with average exposures up to about 40 mSv/yr to many people. Lifetime doses from natural radiation range up to several thousand millisieverts. However, there is no evidence of increased cancers or other health problems arising from these high natural levels. 20 mSv/yr is the current average allowed limit for nuclear industry employees and uranium miners during normal operation. The millions of nuclear workers that have been monitored closely for 50 years have no higher cancer mortality than the general population but have had up to ten times the average dose. Nuclear power is the only technology that systematically measures and accounts for radioactive emissions. However, exposure to above-background radiation is not exclusive to nuclear power-related activities. UNSCEAR has estimated that both occupational and public exposures from electricity generation are higher for workers in the coal industry, for example. Employment Nuclear power plants can operate for over 60 years, creating long-lasting, high-paying jobs for people from a range of fields and educational backgrounds. Undertaking a nuclear power programme therefore represents a long-term investment in human capital. Investment in capital-intensive projects tends to spill over into other industries and economic sectors. A modern gigawatt-scale nuclear power plant employs 500-1000 workers directly. But throughout both its construction and operation, it requires a complex supporting supply chain (e.g. construction, manufacturing and consultancy services), creating attractive indirect and induced employment opportunities. Hinkley point C unit 2 construction site During construction of a large, modern plant, thousands of workers may be onsite. At Hinkley Point C (pictured), over 8000 workers will be onsite during the peak of construction. A study of the European nuclear industry by Deloitte suggested that nuclear provides more jobs per TWh of electricity generated than any other clean energy source. According to the report, the nuclear industry sustains more than 1.1 million jobs in the European Union. In addition, each gigawatt of installed nuclear capacity generates €9.3 billion in annual investments in nuclear and related economic sectors, and provides permanent and local employment to nearly 10,000 people. For every €1 invested, the nuclear industry generates an indirect contribution of €4 in GDP, and every direct job creates 3.2 jobs in the EU as a whole. The economic pillar Resource adequacy, preservation & opportunity cost Uranium has no significant use other than nuclear energy production. Producing electricity with uranium extends the overall resource base available for human use, provides greater diversity of choice and allows the use of other resources, such as hydrocarbons, where they are most effective e.g. for transportation or petrochemicals. Uranium is plentiful and is distributed among a wide range of geopolitically diverse countries. The distribution of uranium reduces the risk of market disruptions of the nature experienced during historical oil and gas crises. Resource efficiency and material throughput The focus on power supply options defined as 'renewable' over the past several decades reflects the importance attached to the preservation of finite resources. Renewable sources of energy are those generated from natural processes that are continuously replenished. Renewable technologies, therefore, are defined as those that are not fuelled by a finite resource. 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Nuclear PWR Solar Wind Hydro Gas (load following) Gas (load following) + CCS Coal Coal + CCS Concrete 1060 1220 4470 15,320 390 820 450 520 Steel 130 940 1450 330 320 970 160 1170 Aluminium 0.3 287.5 17.4 8.7 5.7 21.4 1.6 37.4 Copper 2.5 68.0 39.1 4.8 5.4 8.8 3.0 11.8 Capacity f. 85% 28% 35% 50% 30% 30% 85% 85% Lifespan 60 30 30 100 60 60 60 60 Table 1 and Figure 10: Major materials for different generating technologies, tonnes per TWh (source: Bright New World) The aim of reducing material inputs is a central concept of sustainable development. Using material in the production, transport and implementation of power producing technologies will consume energy in the form of fossil fuels, and as such the metric of material throughput is important in consideration of energy efficiency as well as life-cycle carbon emissions. But more broadly, resource efficiency is a key aim in itself. Consumption of primary materials is expected to more than double by 2050. Using nuclear energy to generate electricity is one means by which resource demand can be reduced to more sustainable levels. Affordability Affordability is a key component of SDG 7. The benefits of access to modern energy are profound, but the aspiration of ensuring access for all can only be realized if it is affordable. The relative affordability of electricity supply options is a function of generation costs as well as the costs they impose on the system as a whole. Generation costs are typically reported using the levelized cost of electricity generation (LCOE) metric, which is a measure of the ratio of the total costs of a generic plant (capital and operating), to the total amount of electricity expected to be generated over that plant’s lifetime. LCOE as a metric is relatively simple and transparent, and so is widely referenced. However, its ability to assess overall costs to society are limited. In deregulated markets, revenues are uncertain over a generator’s lifetime making the metric less pertinent; and the metric does not attempt to capture the markedly different system costs of technologies. System costs have always existed, but the growth in variable renewable energy sources has promoted the topic in recent years. System costs include required outlays for distribution and transmission, and most importantly, backup for the inherent variability of some renewable energy. System costs are difficult to assess, as they depend on the characteristics of the system in question, the time frame considered, location and numerous other factors. Whilst there is uncertainty, estimates are consistent in that system costs for variable energy sources are significant, increase non-linearly with growing shares of electricity generation, and are an order of magnitude higher than for dispatchable technologies10. The costs of the system as a whole are ultimately borne by society, and so, given the increasing use of variable renewable energy, it is important that system costs are internalized to ensure that policy decisions can be properly directed towards maximizing affordability. Negative effects beyond the system itself (i.e. negative externalities) related to the provision of electricity are increasingly being recognized as significant and complicate the picture further. Negative externalities related to electricity generation – most notably the emissions of greenhouse gases and other pollutants – represent a social cost that may impact the true affordability of different electricity supply options. It is well documented that the social and economic costs of climate change and air pollution are significant. In order to better-understand the socially optimal level of externalities (relative to production) it is imperative that the relative costs of different supply options include a reasonable estimate of their impacts on emissions and the climate. Nuclear energy is cost-competitive based on a simple LCOE comparison, particularly at low discount rates. Its unique attributes of providing predictable, reliable supply that is low-carbon means that inclusion of system costs and negative externalities both markedly improve the relative affordability of nuclear energy. Grid-level system costs for dispatchable and renewable technologies Figure 11: Grid-level system costs for dispatchable and renewable technologies (source: OECD Nuclear Energy Agency, 2018) Notes & references Notes a. The Human Development Index (HDI) is a United Nations Development Programme statistical tool to measure a country's level of social and economic development. The social and economic dimensions of a country are based on the health of its people, their level of education attainment and their standard of living. A country scores a higher HDI when the lifespan of its people is longer, the education level is higher, and the gross national income per capita is higher. [Back] References 1. United Nations, Report of the World Commission on Environment and Development: Our Common Future ('Brundtland Report') (1987) [Back] 2. United Nations Development Programme, Human Development Reports [Back] 3. BP Energy Outlook: 2019 edition [Back] 4. World Energy Council, World Energy Scenarios 2019, The Future of Nuclear: Diverse Harmonies in the Energy Transition (2019) [Back] 5. Steffen Schlömer (ed.), Technology-specific Cost and Performance Parameters, Annex III of Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014) [Back] 6. United Nations Economic Commission for Europe, Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources (March 2022) [Back] 7. Barry W. Brook and Corey J. A. Bradshaw, Key role for nuclear energy in global biodiversity conservation, Conservation Biology, 29, 3 (2015) [Back] 8. Mesfin Mekonnen et al., The consumptive water footprint of electricity and heat: a global assessment, Environmental Science: Water Research & Technology (March 2015) [Back] 9. Bright New World, Materials use in a clean energy future (June 2021) [Back] 10. OECD Nuclear Energy Agency, The Full Costs of Electricity Provision (2018) [Back]

#### The impact is scalar: each degree of warming matters and will reduce suffering for billions.

David **McKay 22**, Researcher in Earth System Resilience, Stockholm University, 10-18-2022, "Climate tipping points could lock in unstoppable changes to the planet – how close are they?," World Economic Forum, <https://www.weforum.org/agenda/2022/10/climate-tipping-points-could-lock-in-unstoppable-changes-to-earth> || DOA 9/6/2023 BRP

A new assessment of the past 15 years of research has found there is a risk of certain tipping points being triggered now when global warming stands at roughly 1.2°C. But the Paris agreement’s aim of halting warming at 1.5°C would reduce the chances of triggering multiple climate tipping points, the researchers say. **Continued greenhouse gas emissions risk triggering climate tipping points. These** are **self-sustaining shifts in the climate system that would lock-in devastating changes, like sea-level rise, even if all emissions ended.** The first major assessment in 2008 identified nine parts of the climate system that are sensitive to tipping, including ice sheets, ocean currents and major forests. Since then, huge advances in climate modelling and a flood of new observations and records of ancient climate change have given scientists a far better picture of these tipping elements. Extra ones have also been proposed, **like permafrost around the Arctic** (permanently frozen ground **that could unleash more carbon** if thawed). Estimates of the warming levels at which these elements could tip have fallen since 2008. The collapse of the west Antarctic ice sheet was once thought to be a risk when warming reached 3°C-5°C above Earth’s pre-industrial average temperature. Now it’s thought to be possible at current warming levels. In our new assessment of the past 15 years of research, myself and colleagues found that we can’t rule out five tipping points being triggered right now when global warming stands at roughly 1.2°C. Four of these five become more likely as global warming exceeds 1.5°C. These are sobering conclusions. Not all of the news coverage captured the nuance of our study, though. So here’s what our findings actually mean. Uncertain thresholds **We synthesised the results of more than 200 studies to estimate warming thresholds for each tipping element.** The best estimate was either one that multiple studies converged on or which a study judged to be particularly reliable reported. For example, records of when ice sheets had retreated in the past and modelling studies indicate the Greenland ice sheet is likely to collapse beyond 1.5°C. We also estimated the minimum and maximum thresholds at which collapse is possible: model estimates for Greenland range between 0.8°C and 3.0°C. Within this range, **tipping becomes more likely as warming increases.** We defined tipping as possible (but not yet likely) when warming is above the minimum but below the best estimate, and likely above the best estimate. We also judged how confident we are with each estimate. For example, we are more confident in our estimates for Greenland’s ice sheet collapse than those for abrupt permafrost thaw. **This uncertainty means that we do not expect four climate tipping points to be triggered the first year global temperatures reach 1.5°C** (which climate scientists suggest is possible in the next five years), or even when temperatures averaged over several years reach 1.5°C sometime in the next couple of decades. **Instead, every fraction of a degree makes tipping more likely, but we can’t be sure exactly when tipping becomes inevitable.** This is especially true for the Greenland and west Antarctic ice sheets. While our assessment suggests their collapse becomes likely beyond 1.5°C, ice sheets are so massive that they change very slowly. Collapse would take thousands of years, and the processes driving it require warming to remain beyond the threshold for several decades. If warming returned below the threshold before tipping kicked in, it may be possible for ice sheets to temporarily overshoot their thresholds without collapsing. For some other tipping points, change is likely to be more dispersed. We estimate that both tropical coral reef death and abrupt permafrost thaw are possible at the current warming level. But thresholds vary between reefs and patches of permafrost. Both are [already](https://www.nature.com/articles/d41586-019-01313-4) [happening](https://www.theguardian.com/environment/2022/mar/18/dead-coral-found-at-great-barrier-reef-as-widespread-bleaching-event-unfolds) in some places, but in our assessment, these changes become much more widespread at a similar time beyond 1.5°C. Elsewhere, small patches of the Amazon and northern forests might tip and transition to a savannah-like state [first](https://www.uu.nl/en/news/climate-change-tipping-points-back-to-the-drawing-table), bypassing a more catastrophic dieback across the whole forest. Model [results](https://egusphere.copernicus.org/preprints/2022/egusphere-2022-82/) that are yet to be published suggest that [Amazon tipping](https://climatetippingpoints.info/2021/07/18/amazon-dieback-explainer/) might occur in several regions at varying warming levels rather than as one big event. There may also be no well-defined threshold for some tipping elements. Ancient climate records suggest ocean currents in the North Atlantic can dramatically flip from being strong, as they are now, to weak as a result of both warming and melting freshwater from Greenland disrupting circulation. [Recent modelling](https://www.sciencealert.com/a-major-ocean-current-might-be-on-the-verge-of-a-climate-change-tipping-point) suggests that the threshold for the collapse of Atlantic circulation depends on how fast warming increases alongside other hard-to-measure factors, making it highly uncertain. Into the danger zone There are signs that some tipping points are already approaching. Degradation and drought have caused parts of the Amazon to become [less resilient](https://phys.org/news/2022-03-amazon-rainforest-loss-dieback.html) to disturbances like fire and [emit more carbon](https://www.nature.com/articles/d41586-021-01871-6) than they absorb. The front edge of some retreating west Antarctic glaciers are [only kilometres away](https://blogs.agu.org/geospace/2019/12/04/new-study-models-impact-of-calving-on-retreat-of-thwaites-glacier/) from the unstoppable retreat. Early warning signals in climate monitoring data (such as bigger and longer swings in how much glaciers melt each year) suggest that parts of the [Greenland ice sheet](https://physics.aps.org/articles/v14/80) and [Atlantic circulation](https://www.theguardian.com/environment/2021/aug/05/climate-crisis-scientists-spot-warning-signs-of-gulf-stream-collapse) are also destabilising. These signals can’t tell us exactly how close we are to tipping points, only that destabilisation is underway and a tipping point may be approaching. **The most we can be sure of is that every fraction of further warming will destabilise these tipping elements more and make the initiation of self-sustaining changes more likely. This strengthens the case for ambitious emissions cuts in line with the Paris agreement’s aim of halting warming at 1.5°C.** **This would reduce the chances of triggering multiple climate tipping points – even if we can’t rule out some being reached soon.**

#### To quantify, Shindell et al 18 empirically found that decreasing warming by just .5 degrees Celsius would:

**Shindell et al 18**, Shindell D, Faluvegi G, Seltzer K, Shindell C. Quantified, Researchers at Duke University, Localized Health Benefits of Accelerated Carbon Dioxide Emissions Reductions. Nat Clim Chang. 2018;8(4):291-295. doi: 10.1038/s41558-018-0108-y. Epub 2018 Mar 19. PMID: 29623109; PMCID: PMC5880221, accessed from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880221/> on 9/6/2023 BRP

Societal risks increase as Earth warms, but also for emissions trajectories accepting relatively high levels of near-term emissions while assuming future negative emissions will compensate even if they lead to identical warming [[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880221/#R1)]. **Accelerating carbon dioxide (CO2) emissions reductions, including as a substitute for negative emissions**, hence **reduces long-term risks** but requires dramatic near-term societal transformations [[2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880221/#R2)]. A major barrier to emissions reductions is the difficulty of reconciling immediate, localized costs with global, long-term benefits [[3](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880221/#R3), [4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880221/#R4)]. However, 2°C trajectories not relying on negative emissions or 1.5°C trajectories require elimination of most fossil fuel related emissions. This generally reduces co-emissions that cause ambient air pollution, resulting in near-term, localized health benefits. **We therefore examine the human health benefits of increasing ambition of 21st century CO2 reductions by 180 GtC; an amount that would shift a ‘standard’ 2°C scenario to 1.5°C or could achieve 2°C without negative emissions. The decreased air pollution leads to 153±43 million fewer premature deaths worldwide, with ~40% occurring during the next 40 years, and minimal climate disbenefits.** More than a million premature deaths would be prevented in many metropolitan areas in Asia and Africa, and >200,000 in individual urban areas on every inhabited continent except Austra

#### Climate change causes extinction---multiple internal links and no adaptability.

Dr. Yew-Kwang **Ng 19** [Winsemius Professor of Economics at Nanyang Technological University, Fellow of the Academy of Social Sciences in Australia and Member of Advisory Board at the Global Priorities Institute at Oxford University, PhD in Economics from Sydney University, “Keynote: Global Extinction and Animal Welfare: Two Priorities for Effective Altruism”, Global Policy, Volume 10, Number 2, May 2019, pp. 258–266, https://onlinelibrary.wiley.com/doi/10.1111/1758-5899.12647] Accessed 10/09/2024, DSL

Catastrophic **climate change** Though by no means certain, CCC causing **global extinction** is **possible** due to **interrelated factors** of **non-linearity**, **cascading effects**, **positive feedbacks**, **multiplicative factors**, **critical thresholds** and **tipping points** (e.g. Barnosky and Hadly, 2016; Belaia et al., 2017; Buldyrev et al., 2010; Grainger, 2017; Hansen and Sato, 2012; IPCC 2014; Kareiva and Carranza, 2018; Osmond and Klausmeier, 2017; Rothman, 2017; Schuur et al., 2015; Sims and Finnoff, 2016; Van Aalst, 2006).7 A possibly **imminent** tipping point could be in the form of ‘an **abrupt ice sheet collapse** [that] could cause a **rapid sea level rise’** (Baum et al., 2011, p. 399). There are **many avenues** for **positive feedback** in global warming, including: • the replacement of an **ice sea** by a **liquid ocean surface** from **melting** reduces the **reflection** and increases the **absorption of sunlight**, leading to faster warming; • the **drying of forests** from warming increases **forest fires** and the release of more **carbon**; and • higher **ocean** **temperatures** may lead to the **release of methane** trapped under the ocean floor, producing **runaway** global warming. Though there are also avenues for **negative** feedback, the **scientific consensus** is for an **overall net positive feedback** (Roe and Baker, 2007). Thus, the Global Challenges Foundation (2017, p. 25) concludes, ‘The world is currently **completely unprepared** to envisage, and even less **deal with**, the consequences of **CCC’**. The threat of sea-level rising from global warming is well known, but there are also other likely and more imminent threats to the survivability of mankind and other living things. For example, Sherwood and Huber (2010) emphasize the **adaptability limit** to climate change due to **heat stress** from high environmental wet-bulb temperature. They show that ‘even **modest** global **warming** could ... expose large fractions of the [world] population to **unprecedented heat stress’** p. 9552 and that with substantial global warming, ‘the area of land rendered **uninhabitable by heat stress** would **dwarf** that affected by rising **sea level’** p. 9555, making **extinction much more likely** and the relatively moderate damages estimated by most integrated assessment models unreliably low. While **imminent** extinction is very unlikely and may not come for a long time even under business as usual, the main point is that we **cannot rule it out**. Annan and Hargreaves (2011, pp. 434–435) may be right that there is ‘an upper 95 per cent probability limit for S [temperature increase] ... to lie close to 4°C, and certainly well below 6°C’. However, probabilities of 5 per cent, 0.5 per cent, 0.05 per cent or even 0.005 per cent of excessive warming and the resulting extinction probabilities cannot be ruled out and are unacceptable. Even if there is only a **1 per cent probability** that there is a time **bomb in the** air**plane**, you **probably want to change your flight**. **Extinction of the whole world is more important to avoid by literally a trillion times**.

# 2AC

## AT: C1

#### 1] 2025 will see global proliferation due to expiring agreements and Trump.

Dave Lawler 3-10, CEO of Kimmeridge Texas Gas (KTG) and a Director of Commonwealth LNG. KTG is a gulf coast exploration and production company currently producing 400 MMCFD, with growth plans to reach 1 BCFD by 2029. CEO of BPX Energy, 3-10-2025, "Trump's nuclear dilemma: "Greatest threat" is getting bigger", Axios, https://www.axios.com/2025/03/11/trump-nuclear-weapons-iran-russia-china, Accessed 3-12-2025, ARC

The flipside: Trump's [withdrawal of U.S. support for Kyiv](https://www.axios.com/2025/03/03/ukraine-military-aid-us-trump) has U.S. **allies** debating whether to **develop their own nukes**, rather than depend on Washington.

**Polish** Prime Minister Donald Tusk said Friday that his country would have to **explore** "opportunities related to **nuclear weapons**" due to the "profound change of **American geopolitics**."

**French** President Emmanuel Macron also said last week that he would consult with European allies like Germany about including them under the French nuclear umbrella.

Trump's ally-bashing has also turbocharged the debate in **South Korea** over whether a domestic nuclear program is needed to counter nuclear-armed [North Korea](https://www.axios.com/world/north-korea).

Some experts fear a new era of nuclearization.

"The belief that the United States has no interest in defending allies, which is the conclusion that allies are rapidly and rightly drawing, is very likely to cause proliferation," says James Acton, co-director of the Nuclear Policy Program at the Carnegie Endowment for International Peace.

"I think it's virtually **inevitable** they will **explore their options**, and there is a realistic prospect that some of those explorations turn into weapons programs," Acton says, emphasizing that likelihood for South Korea in particular.

Meanwhile, the **last major** U.S.-Russia **arms control agreement**, [New START](https://www.axios.com/2021/01/21/biden-russia-nuclear-treaty), is **less than a year from expiration**.

That treaty can't be extended, and any new agreement that constrains the U.S. but not China is unlikely to pass muster in Washington.

China, meanwhile, **rejects** arms control talks outright — at least until its rapidly advancing nuclear program reaches parity with the other major powers.

A former senior U.S. official conceded to Axios that it's "difficult to conceive of" a scenario where Beijing comes to the table for the sort of trilateral talks Trump envisions.

"There's not a lot of carrots. You mostly offer them the stick," the official said.

"The problem is that a lot of the available sticks they're already brandishing at the Chinese right now — **tariffs** and other things."

Key quote: "I think we're going into a period of time where we won't have any operative nuclear arms control agreements," the former official says.

A National Security Council spokesperson did not provide a comment for this story.

Flashback: Trump made two dramatic moves in the nuclear arena in his first term — [pulling out of the 2015 Iran deal](https://www.axios.com/2025/01/06/trump-iran-nuclear-deal), and holding two summits to try to convince North Korea's Kim Jong-un to denuclearize.

Both **Tehran** and **Pyongyang** have made significant nuclear advances since then.

What to watch: Trump's letter to Khamenei and early [comments](https://thediplomat.com/2025/02/will-kim-jong-un-meet-trump-again/) on Kim suggest leader-to-leader nuclear diplomacy is back on the menu.

But force of personality alone won't be enough to keep the world's "greatest threat" in check.

#### ] Turn: New tech advancements reduce prolif risks.

NIA, xx-xx-2025, "Global Security", Nuclear Innovation Alliance, <https://nuclearinnovationalliance.org/global-security> [The Nuclear Innovation Alliance (NIA) is a non-profit, non-partisan, “think-and-do” tank based out of Washington D.C. Through policy analysis, research, outreach, and education, we are catalyzing the next era of nuclear energy.] DOA: 4/1/2025

Nuclear Non-Proliferation

Nuclear non-proliferation principles form the core of the international governance framework for nuclear technology. With a basis in President Eisenhower’s “Atoms for Peace” initiative, international trade in nuclear technologies has supported the global economy and enhanced diplomatic relationships. With the oversight of the International Atomic Energy Agency, which has unique powers to impose safeguards for civil nuclear technology, the world has largely avoided proliferation from civilian nuclear sectors.

The next generation of nuclear power can continue to meet President Eisenhower’s mission by providing technologies that feature key non-proliferation features. Although new technologies can support this goal, preventing the proliferation of nuclear weapons requires strong global governance. Advanced reactors can help to reduce proliferation risk both through technological innovation and by restoring the U.S. role in international nuclear energy markets, serving as a foundation for an “Atoms for Peace 2.0” program.

Key technological innovations include:

Safeguards Compatibility: Safeguards measures help the International Atomic Energy Agency (IAEA) detect host state diversion and undeclared production of nuclear materials for weapons use. Advanced reactors can contribute to a more efficient use of safeguards resources by incorporating “safeguards-by-design” principles, enabling IAEA to maintain and improve safeguards even as nuclear energy scales to meet climate needs.

Advanced Fuels: Some advanced reactors use fuel forms that make separation of weapons material even more challenging than existing types. TRISO fuel, for example, used in some advanced reactors, is difficult to separate into its component parts and would not be a likely target for proliferation. Some reactors can even reduce government fissile material stockpiles by consuming plutonium or highly enriched uranium down-blended from weapons, similar to the Megatons to Megawatts program. Some reactor designs also reduce the fissile material available in spent fuels.

Reduced Fuel Access: Many advanced reactors have longer refueling cycles than today’s reactors, which are typically on 18-24 month cycles. Each time the reactor is refueled, there is some vulnerability to diversion of fuel, so fewer refueling outages (every seven to ten years, for example) provide fewer such opportunities. In some cases, reactor designs feature a ‘sealed core’ that is simply replaced every ten years; making it possible to avoid any fuel-handling in the host country.

Reduced Enrichment Requirements: Some advanced reactors reduce the need for uranium enrichment or reprocessing, which are the steps with the greatest proliferation risk, by using unenriched uranium, spent nuclear fuel, or thorium. Some are designed to require no reprocessing, rely primarily on depleted uranium for fuel (with some low enriched uranium for startup), and eliminate the need for enrichment entirely once the fleet is in operation.

Verification Innovations: Beyond nuclear technologies, new monitoring technologies offer enhanced methods to monitor and verify safeguards compliance. Satellite monitoring of facilities and artificial intelligence increase the capabilities of IAEA and national governments to detect any diversion of material.

All of these technological advances can be useful in the effort to reduce proliferation risk, but the benefits of creating robust international nuclear trade may yield much larger benefits. The United States and Europe were the great champions for the security architecture designed to prevent nuclear proliferation. Today however, both are waning forces in the global nuclear energy order.

#### 6] Turn: American reactor exports increase global adherence to nonprolif standards.

Amy Roma et. al, 07-30-2020, "Updating an Outdated National Security Framework", Nuclear Innovation Alliance, <https://nuclearinnovationalliance.org/updating-outdated-national-security-framework> [Amy has also led a number of high impact humanitarian initiatives, included leading the legal efforts to send the New England Patriots’ private team plane to China in March 2020 to pick up and donate nearly two million N95 masks, and spearheading a number of high-risk evacuations and resettlements from Afghanistan. In addition to her JD, Amy holds an MBA with a focus in finance and leadership from the University of Virginia. Before joining Helion, Sachin worked on nuclear regulatory matters and started his legal career at the U.S. Nuclear Regulatory Commission, and before that clerked at the U.S. Court of Federal Claims. While at Harvard Law School he was editor-in-chief of the Harvard Environmental Law Review. Before law school, Sachin was a consultant at Deloitte, a Henry Luce Scholar, and obtained a master’s degree in aerospace engineering from Cornell University. Alex is pursuing a PhD in Space Resources at the Colorado School of Mines, focusing on resource governance, environmental protection, and space nuclear power. He is also Adjunct Faculty at Johns Hopkins University, co-teaching a course on nuclear power technology and regulation.] DOA: 4/1/2025 //RRM

The nuclear energy industry and advocates need to break out of silos by engaging with¶ other clean energy industries, the financial community, labor, environmental advocates,¶ community leaders and energy stakeholders. As important as advanced nuclear technology is, it¶ will only succeed if it has broad support and buy-in from customer and host communities.¶ Broader support of nuclear energy is needed for advanced reactors to reach their full¶ decarbonization potential, and the industry needs to earn that support. Advanced nuclear energy¶ can help bring climate justice and environmental justice. Industry, advocates, and policymakers¶ should actively engage, listen to, and address social and other concerns.¶ Societal recommendations include:¶ • Efforts are needed to increase understanding of the benefits of nuclear energy¶ • A social science research agenda, led by government-funding and academia, is¶ important to build a basis for long-term commercialization that meets the real needs¶ of communities¶ • Address the negative impacts of uranium mining and nuclear waste on¶ disadvantaged communities by establishing and promoting ethical uranium¶ standards¶ • Local community engagement and buy-in is crucial for all future nuclear projects¶ and should begin as early in the project lifecycle as feasible¶ • Industry must create good jobs with high wages for construction, operations, and¶ supply chain, boosting workers and local communities¶ 17¶ 3. An Advanced Reactor Export Strategy for Global Leadership¶ Climate change and energy concerns are global issues and require international solutions.¶ Nuclear energy is a major energy source for many countries and, by providing ~10% of¶ electricity, is the #2 source of carbon-free energy worldwide, behind hydropower. American¶ leadership in commercializing advanced nuclear reactors can accelerate international reductions¶ in greenhouse gas emissions while also revitalizing U.S. exports and maintaining international¶ nonproliferation, security, and safety standards. The largest share of carbon emissions growth is¶ projected to occur in nations that do not currently use nuclear energy and suffer from energy¶ poverty and energy insecurity. Nuclear energy is an attractive option for its decarbonization,¶ energy supply, and energy security characteristics. The innovation and entrepreneurial culture of¶ the U.S. is uniquely suited to deliver commercial nuclear energy to new countries for clean¶ development.¶ While the U.S. has the most operating reactors of any nation, it has built few new¶ domestic reactors since the early 1990s, with some existing plants retiring. This stagnation has¶ reduced its international competitiveness and weakened its once robust supply chains. The U.S.¶ risks missing out on an emerging market for nuclear energy that could be worth $1.3-1.9 trillion¶ for electricity alone, with additional potential to provide zero-carbon heat, fuels, desalination,¶ and other capabilities. Beyond economic losses, falling behind as a commercial nuclear exporter¶ reduces the influence of the U.S. on global safety, security, and non-proliferation standards.¶ During this period of decades-long atrophy, new competitors have emerged and are¶ poised to dominate global nuclear energy markets. Russia has emerged as the dominant¶ international supplier of large reactors and their fuel. Russia is also the only country to have¶ deployed a small modular reactor and commercial fast reactor. In the past 30 years, China has¶ grown its domestic nuclear capability from zero to 49 nuclear reactors. It is looking abroad for¶ new nuclear export markets, including among strong U.S. allies, and pursuing western regulatory¶ approval for its technology to increase its export opportunities. In its pursuit of nuclear reactor¶ deployments, it is leveraging its financing capability to obtain new-build projects for its¶ indigenous design (the Hualong One) as well. China’s overall nuclear energy program is part of¶ its global economic and diplomatic strategy, including the Belt & Road Initiative (BRI).As a general prerequisite to global competitiveness, the U.S. government and industry¶ must actively decide to compete in global markets. Developing trade opportunities for nuclear¶ reactors takes time, close coordination between government, allies, and industry, and attractive¶ products built for foreign customers.¶ To develop global leadership in advanced reactor markets, priorities include:¶ • Strengthening the positioning of the U.S private industry to compete against SOEs¶ • Assessing the global marketplace for the technology and encouraging the¶ governance structure required for safe and secure export¶ • Elevating nuclear energy in U.S. foreign policy and clean energy diplomacy¶ • Developing a 21st century export control framework that enables American¶ competitiveness and ensures non-proliferation commitments

## AT: C2

#### 1] NU: Russia’s wartime economy ensures collapse, even if ceasefire – Russian experts agree

Tetiana Fedosiuk, 3-19-2025, "How to Break Russia’s Economic Back", ICDS, <https://icds.ee/en/how-to-break-russias-economic-back/> [Tetiana Fedosiuk is an editor, translator, and analyst. She speaks Ukrainian, Russian, English, Italian, and Polish. Tetiana specialises on Russia’s propaganda and disinformation in the US, Eastern European and post-Soviet nations, as well as on NATO related topics and defence policies in respective countries.] DOA: 3/23/2025

Emil Wannheden, economic analyst at the Swedish Defence Research Agency (Totalförsvarets forskningsinstitut, FOI): We need to realise that this war is an enormous economic effort for Russia. At the beginning, in 2022, they did not initially spend that much on the war because they hoped it would be short, quick, and easy. But as the war dragged on, they increased military spending. The latest estimate suggests that they will spend almost 9% of GDP on the military budget in 2025—this is a very heavy burden on the Russian economy. Emil Wannheden As to what has changed, there have been many effects, for example, on the labour force. People are being sent to the front and many have emigrated, which contributes to labour shortages in Russia. This, in turn, makes everything more expensive because one needs to pay more money to recruit workers. Thus, wages have gone up, especially in certain sectors connected to the war effort, but so has inflation. Whereas some have been receiving higher wages, others have not. Prices have also been rising, so people who rely on financial support from the government, like pensioners, have been struggling more. The war has changed the structure of the Russian economy, with the military sector becoming the most important, privileged sector because this is where most of the state investment goes to the military. TF: Can one separate Russia’s economy from the Russian war effort in 2025? EW: No, one cannot. They are interconnected. The Russian economy has been so militarised that it is becoming more and more difficult to separate the military part from the civilian part. The construction industry, for example, is helping with fortifications and building infrastructure in the occupied regions of Ukraine. Since the civilian part of the economy needs to support the military, the whole economic development of Russia has been very degraded. Russians are paying a very high price for this war, too. TF: For how much longer can the Kremlin afford to sustain its military campaign at a current pace without inflicting irreversible damage to the Russian economy? EW: It is less about economics and more about politics. A state can always choose where to put the money. Yet, in a democracy, it is difficult to invest more resources into the military because people may not accept it and vote the government out of office, whilst in Russia, the situation is different. However, financing the budget is becoming more and more difficult each year for them. Russia has been running out of its financial reserves, which means that it has to borrow more money to sustain military expenditures. That may also become difficult, so they may have to print money, essentially, to continue financing the war effort—one can find ways. Yet, the longer one does it, the more negative consequences it will have on the rest of the economy. Russia’s economic future is grim, given the decisions Russians have taken, and even more so with every passing month. From that point of view, it’s not sustainable. But from the other point of view, they might continue to prioritise military spending because they think it’s too important—and they can do that if they think it is worth it to pay this price. There’s already been irreversible damage in many ways. Every ruble that they spend on the military today is a ruble they can’t spend on infrastructure, education, healthcare, and so on. Even Russian demographers admit that demographic effects have been catastrophic: fewer children are being born, the school system is suffering, and health is declining. All of it is happening at a time when Russia not only needs to maintain the old degrading infrastructure but also to build new one in order to increase trade with China. The longer Russia continues down this path, the more negative irreversible changes there will be. TF: In the event of a ceasefire, what would happen to the Russian economy if Moscow deprioritises military spending and the defence industry? EW: If they deprioritised military spending, it would help to start an economic recovery, of course, which people in Russia admit is necessary. I think it is unlikely that it will happen because even if there is a ceasefire, Russia will probably need to maintain its military in occupied parts of Ukraine. Russians also want to reconstitute the armed forces and even have plans to expand them. I think our assumption should be that they will continue with higher military spending. There is another aspect to it: the defence industry is now so strong and so important for the economy that it is difficult to lower military expenditures and convert to civilian production. So, there is a lock-in-effect. It will continue to be militarised even if there is a ceasefire. We shouldn’t assume that just because there is a ceasefire or a pause in Ukraine, Russia will demilitarise. TF: How dependent has Russia become on China? Has the Russian economy pivoted to the east? EW: Russia is now entirely dependent on trading with China, whereas before it traded with the west. This dependence is two-fold. First, China buys Russian oil. Russia needs this source of revenue in order to finance the state budget. Second, Russia is reliant on Chinese imports: it imports more consumer goods that it does not produce, such as cars, while mostly exporting natural resources. This economic pivot to the East has happened to a certain degree. Yet bottlenecks persist, for example, in trade: most imported goods are transported from China via railways, while the rail infrastructure capacity in the area is not as big as Russia needs it to be. Then, there have been problems with payments and the financial system due to sanctions that the US has put in place. It is quite a precarious situation.

#### 2] Turn: Decreased oil demand jacks up oil price---solves their impact.

Bordoff ’20 [Jason; Dean, Columbia Climate School; October 5; Foreign Policy; “Everything You Think About the Geopolitics of Climate Change Is Wrong,” <https://foreignpolicy.com/2020/10/05/climate-geopolitics-petrostates-russia-china/#cookie_message_anchor>] ARC

Conventional wisdom also holds that shrinking demand for oil and gas will mean lower prices, implying that even if petrostates gain market share, they would still see revenues collapse. Here, too, the reality is more complicated. Absent continued investment, production from existing fields declines at a rate of roughly 8 percent per year. According to the International Energy Agency (IEA), demand won’t fall that quickly even if the Paris climate goals are met, meaning that additional investment is needed. But capital may well dry up once oil demand peaks and the sector continues to fall into disfavor among investors. They may no longer be willing to provide billions of dollars over many years to develop new resources in a sector seen to be in terminal decline. As a result, supply may very well decline faster than demand, leading to a shortage of oil. The resulting higher prices would actually boost petrostate revenues for a time, which may explain why Saudi Aramco still plans to spend tens of billions of dollars to grow its oil production capacity.

There could even be a paradox at play: Rising oil prices as supply shrinks faster than demand would improve the economics of alternative energy technologies such as electric vehicles. While many worry that petrostates will delay the energy transition and falter as a result of it, the opposite could happen: Petrostates could temporarily profit from the energy transition even as higher prices speed the switch to clean energy.