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# The Contemporary Buzz Around Nuclear Energy

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Like the tides of the ocean, nuclear energy too has seen its highs and lows from the time that commercial generation of electricity from nuclear reactors started in the mid-1950s. The last ebb came after the accident at Fukushima in 2011 whereafter a phase of scepticism about nuclear safety led many countries to pause or slowdown their nuclear power plans. The mood, however, seems to be changing, largely owing to the recognition of the urgent need for energy transition to low-carbon sources as a way of addressing climate change concerns. Three recent developments indicate this trend.

The first of these was the last UN Climate Change Conference, called the Conference of Parties (COP), that took place in Dubai in November 2023. At this meeting, the 28th since the first COP took place in 1995, nations took the first-ever pledge to phase down fossil fuel use. Towards this objective, more than one hundred countries pledged to triple renewable energy capacity by 2030. But, it is even more interesting that 22 countries<sup>1</sup> signed a declaration<sup>2</sup> to triple global nuclear energy capacity over the next 25 years to meet climate goals to reach net zero emissions by 2050. The International Atomic Energy Agency (IAEA) effectively used the COP to press its idea of 'Atoms4NetZero' in support of nuclear energy for climate mitigation. For the first time, the COP-28 final document included support for investments in nuclear energy amongst other low-emission technologies, a privilege earlier offered only to renewable energy technologies.

A second event where the spotlight shone on nuclear energy was the World Economic Forum (WEF) at Davos that took place from January 15-19, 2024. An annual assembly of global thought leaders, the forum provides a platform to discuss pressing global issues. Climate, energy and nature were one of the main themes

at this year's meeting which included a discussion on technologies to ensure clean energy transition. In an attempt to broaden the energy focus at WEF, the IAEA director general drew attention to the role that nuclear energy could play in combatting climate crises while ensuring energy security. A lunch session on January 16, 2024, was devoted to the topic of new nuclear technologies, such as small modular reactors and fusion technology, and the conditions necessary to make them realise their potential. Drawing the attention of the business leaders to these developments can help channel the flow of investments into the nuclear sector. To further this cause, the IAEA has also teamed up with the government of Belgium to hold a World Nuclear Energy conference in March 2024, particularly to call for providing a level playing field for nuclear energy alongside other low-carbon sources of electricity production.

A third topical development that has raised the buzz around nuclear energy is the release of '*Electricity 2024*' by the International Energy Agency in January 2024. This annual publication forecasts electricity demand and supply, and CO2 emissions. This year's edition provides a forecast up to 2026. It estimates that global electricity demand would grow at a faster rate over the next three years as compared to the reduced electricity demand in 2023 due to falling electricity consumption in advanced economies. Over the next three years, it is expected that electricity demand would jump from 2.2 per cent in 2023 to an average of 3.4 per cent during 2024-2026. China, India and countries in Southeast Asia are expected to lead this demand. In fact, India's demand for electricity is galloping. It grew by 7 per cent in 2023 and is expected to continue to grow at 6 per cent for the next three years.<sup>3</sup>

It is also anticipated that as these nations prioritise the transition to clean energy, their additional electricity demand would be covered by technologies that produce low emissions. While renewables are expected to make up more than a third of total generation by 2025, nuclear energy too is expected to grow from 40% of global electricity generation in 2023 to 50% by 2026.<sup>4</sup> In fact, nuclear power generation is forecast to reach an all-time high globally by 2025, "as output from France climbs, several plants in Japan are restarted, and new reactors begin commercial operations in many markets, including in China, India, South Korea and Europe. In fact, the share of Asia's nuclear generation is expected to reach 30% of global generation in 2026."<sup>5</sup>

### **The Urgent Necessity for Low-carbon Electricity Generation**

The surge in nuclear electricity generation is expected to come from the compulsion to meet the hunger for electricity through low-carbon sources. In fact, unless this is ensured, the world has no chance of meeting the climate change goals that it has set for itself. It may be recalled that in 2015, the international community

adopted the Paris Agreement on climate change, pledging to hold the increase in global average temperature to less than 2°C above pre-industrial levels, and if possible, to limit it to 1.5°C. Sadly, this objective appears shaky since the Earth's global average surface temperature was reported to be more than 2°C higher than pre-industrial levels in November 2023 for the first time, making it the hottest year on record.<sup>6</sup> Global and North Atlantic sea-surface temperatures too broke records, and Antarctic sea ice reached its lowest daily extent since the advent of satellite data. Interestingly, this news came when COP 28 was in session!

As is evident from the statistics that is pouring in, climate change is here and now. It is a major threat to humanity and the experience of the severity and frequency of adverse natural disasters has made nations sufficiently cognisant of the fact to be persuaded to make ambitious commitments. But, insufficient implementation of commitments owing to geopolitical or economic reasons remains a major hurdle. For instance, the world invested a record-breaking US\$1.7 trillion in clean energy in 2023. But, this was offset by nearly US\$1 trillion investment in fossil fuel which countries were unable to avoid for political and economic reasons. In short, current efforts to reduce greenhouse gas (GHG) emissions remain less than sufficient to arrest climate change. More efforts will have to be devoted towards refashioning activities that are emitting the largest amount of greenhouse gases. And, electricity generation tops this list.

Electricity generation is responsible for close to 40% of the global CO<sub>2</sub> emissions produced by the energy sector, the other 60% or so is generated primarily through the use of fossil fuels in industry, heating in buildings and transport.<sup>7</sup> Hence the urgent need for moving away from fossil fuel sources, which are the biggest culprits on this front. In fact, not only is electricity generation from fossil fuels amongst one of the highest contributors to GHG emissions, it is also one factor whose transformation could have a bearing on all other activities. Since modern-day economic growth and development are so tightly coupled with electricity, it becomes imperative that electricity generation takes place not just through safe and secure sources, but also from those that best sustain the environment. This requires ambitious efforts to transform the energy sector from fossil fuel production and use, which is the main source of carbon dioxide (CO<sub>2</sub>), to carbon-neutral sources.

## Renewables and Nuclear

Renewables (particularly hydro, solar, wind) and nuclear fission are amongst the low-carbon sources available for electricity generation. While hydroelectricity has been generated for a long time, it suffers from the handicap of being available only in specific locations. Also, the appetite for large hydro projects has significantly reduced owing to problems of displacement and rehabilitation that have lingered over decades.

Meanwhile, solar and wind energy have emerged as the new favourites and the last decade has seen a phenomenal jump in electricity produced using these sources. Heavily subsidised and incentivised by governments, the cost of this electricity too has fallen over the years. However, their biggest drawback is that they are unable to provide electricity grids with stable, resilient and dispatchable power to maintain a non-stop flow of energy. It has, therefore, been necessary to support fossil fuel plants with backup options to provide this stability. These have mostly been coal, oil or gas-fired plants. Given that they emit GHG emissions, it reduces the possibility of solar and wind energy being able to contribute towards achieving net zero emissions by themselves, even though they would make a substantial contribution.

It is in this context that the importance of nuclear energy as a baseload source of electricity that can effectively meet clean energy transition goals stands out. When comparing the cradle-to-grave journey of sources of electricity, nuclear energy has the lowest carbon footprint,<sup>8</sup> and uses fewer materials and land. To illustrate, solar power needs more than 17 times as much material and 46 times as much land to produce one unit of energy. The power density of nuclear energy beats all other renewables. According to one estimate, “A solar farm needs between 5 and 50 times more land to generate as much electricity as an equivalent coal-powered plant, and a wind farm needs ten times more than solar.”<sup>9</sup> Put another way, nuclear plants can generate 500-1000 watts per sq meter while solar is at 5-20 and wind at 1-2 watts per sq meter.<sup>10</sup> Bill Gates emphasises that nuclear plants rank the highest in efficiently using materials like cement, steel and glass, which are electricity guzzlers themselves in their manufacturing processes. Nuclear plants use much less material per unit of electricity generated compared to others.<sup>11</sup> In fact, solar photovoltaics are the least efficient followed by hydropower and wind. This is an important consideration when accounting for the GHG emissions produced in the manufacture of this material. As aptly put by Rafael Grossi, Director General of IAEA, “To be pro-nuclear is to take our long-term responsibility to this planet and its future generations seriously.”<sup>12</sup>

Besides decarbonising electricity production, the use of nuclear power can also decarbonise two other processes that use energy: heating in industry and of buildings through direct utilisation of steam, and producing low-carbon hydrogen for transportation. Thus, it is anticipated that nuclear energy can be used to produce hydrogen on a massive scale and at an increasingly competitive cost, which would be a clean heat and transportation source of the future. The potential of nuclear energy for these applications would also be crucial for reaching net zero through the development and deployment of low-carbon options.

In fact, enhancing energy production and sustaining the environment is not an either/or choice. The world needs both. Governments owe it to their citizens to provide them with electricity while also ensuring

the best quality of life from their health and environmental perspective. If economic development and decarbonisation have to be simultaneously pursued, nuclear power can offer a viable alternative to fossil fuels that must be prudently built and safely operated.

But, will nuclear energy be able to realise its perceived potential in the coming years? What are the head and tailwinds that it is likely to face? Where is it likely to grow? Which technologies are likely to reach fruition? How can one address public perceptions on nuclear safety? Where does India see nuclear energy in its own energy mix? The forthcoming monthly issues of 'NuClearly Put' in the year 2024 will examine these questions one by one to offer some clarity.

***(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])***

#### Notes:

<sup>1</sup> Endorsing countries include Armenia, Bulgaria, Canada, Croatia, Czech Republic, Finland, France, Ghana, Hungary, Jamaica, Japan, Republic of Korea, Moldova, Mongolia, Morocco, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, Ukraine, UAE, UK, and USA.

<sup>2</sup> Department of Energy, "At COP28, Countries Launch Declaration to Triple Nuclear Energy Capacity by 2050, Recognizing the Key Role of Nuclear Energy in Reaching Net Zero," December 1, 2023, <https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key#:~:text=Framework%20Convention%20on%20Climate%20Change,1.5%2Ddegree%20goal%20within%20reach>.

<sup>3</sup> David Dodwell, "On the climate change front, its not all 'gloom and doom'", *South China Morning Post*, January 28, 2024, <https://www.scmp.com/comment/opinion/article/3250045/climate-change-front-its-not-all-doom-and-gloom>. Accessed on January 16, 2024.

<sup>4</sup> "Nuclear output to reach new record by 2025, says IEA," *World Nuclear News*, January 24, 2024, Nuclear output to reach new record by 2025, says IEA: Energy & Environment - World Nuclear News (world-nuclear-news.org). Accessed on January 17, 2024.

<sup>5</sup> Rachel Millard, "Nuclear power generation to reach record high next year, IEA forecasts," *Financial Times*, January 24, 2024, Nuclear power generation to reach record high next year, IEA forecasts (ft.com). Accessed on January 17, 2024.

<sup>6</sup> John Mecklin, Ed., "A moment of historic danger: It is *still* 90 seconds to midnight," 2024 Doomsday Clock Statement, Science and Security Board, Bulletin of Atomic Scientists, January 23, 2024, <https://thebulletin.org/wp-content/uploads/2024/01/2024-Doomsday-Clock-Statement.pdf>. Accessed on January 18, 2024.

<sup>7</sup> IAEA, Nuclear Energy for a Net Zero World, September 2021, <https://www.iaea.org/sites/default/files/21/10/nuclear-energy-for-a-net-zero-world.pdf>.

<sup>8</sup> "Life-cycle Assessments of Electricity Generation Options," Report by UN Economic Commission for Europe Sustainable Development Goals, March 2022, <https://unece.org/sed/documents/2021/10/reports/life-cycle-assessment-electricity-generation-options>.

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<sup>9</sup> Bill Gates, *How to Avoid a Climate Disaster: The solutions We Have and the Breakthroughs We Need* (UK: Penguin Random House, 2021), p. 96.

<sup>10</sup> Ibid., p. 58

<sup>11</sup> Ibid., p. 85

<sup>12</sup> Rafael Grossi, "Time to Level the Playing Field and Work Together Towards Net Zero," speech delivered at the Second International Conference on Climate Change and the Role of Nuclear Power 2023: Atoms4NetZero, October 9, 2023, <https://www.iaea.org/newscenter/statements/time-to-level-the-playing-field-and-work-together-towards-net-zero>.

