

Shutdown this misguided energy policy

The vulnerabilities of reactors and their high costs are strong reasons why India must cancel its nuclear expansion plans



SUVRAT RAJU & M.V. RAMANA

Nuclear technology is hazardous. The world was reminded of this on March 3, when a fire broke out near the Zaporizhzhia nuclear plant in Ukraine (Europe's largest) during the course of a military battle. Had the fire affected the cooling system, the plant's power supply, or its spent fuel pool, a major disaster could have occurred. Luckily, this did not happen.

Eleven years ago, the people of Japan were not as fortunate. On March 11, 2011, multiple reactors at the Fukushima Daiichi nuclear plant suffered severe accidents after an earthquake and a tsunami. Those reactors were quickly "shut down" following the earthquake. But their radioactive cores continued producing heat and eventually melted down because the tsunami knocked out the cooling system.

The aftershocks of the Fukushima disaster were felt beyond Japan and led to a slump in nuclear energy in most of the world. Yet, some policymakers insist on expanding nuclear power, ostensibly in response to climate-change concerns.

On December 15, 2021, the Indian government informed Parliament that it plans to build "10 indigenous reactors... in fleet mode" and had granted "in principle approval" for 28 additional reactors, including 24 to be imported from France, the U.S. and Russia. Given the post-Fukushima global and national trends in the nuclear industry, such a policy seems misguided; nuclear power is neither an

economical source of electricity nor a viable route to meeting India's climate goals.

Nuclear power plants are capital intensive and recent nuclear builds have suffered major cost overruns. An illustrative example is the V.C. Summer nuclear project in South Carolina (U.S.) where costs rose so sharply that the project was abandoned – after an expenditure of over \$9 billion.

In contrast, renewable-energy technologies have become cheaper. The Wall Street company, Lazarus, estimated that the cost of electricity from solar photovoltaics and wind turbines in the U.S. declined by 90% and 72%, respectively, between 2009-21. In 2020, the International Energy Agency dubbed solar energy the "new king of electricity".

This contrast has stymied plans for expanding nuclear power. In 2008, the U.S. government projected an expansion of nuclear capacity to 114.9 gigawatts by 2030; in 2021, it predicted that capacity would contract to 83.3 gigawatts. This mirrors a global trend: in 1996, 17.5% of the world's electricity came from nuclear power plants; by 2020, this figure had declined to just around 10%.

India has also had to drastically cut its nuclear ambitions after Fukushima. In 2008, then chairman of the Atomic Energy Commission, Anil Kakodkar, projected that India would have 650GW of installed capacity by 2050; his successor, Srikumar Banerjee, predicted in 2010 that capacity would reach 35 gigawatts by 2020. Installed capacity today is only 6.78 GW.

Unviable imports

Such targets were based on the expectation that India would import many light-water reactors after the India-U.S. civil nuclear deal. But, the deal has not led to the esta-



blishment of a single new nuclear plant, over 13 years after it was concluded. The worrying part of the Government's recent parliamentary submission is that these plans for imports have not been cancelled, as is widely believed, and still remain on the books.

Of the 24 foreign reactors with "in principle" approval, six are of the VVER (water-water energetic reactor) design that has had multiple operational problems at Kudankulam in Tamil Nadu. The cumulative load factors for the Kudankulam-1 and two reactors in 2020 were just 53% and 52%, respectively.

Twelve reactors are proposed to be imported from the U.S., including at least six AP1000 reactors – the same design that was abandoned in South Carolina. Elsewhere in the U.S., the Vogtle project comprising two AP1000 reactors has escalated from an initial estimate of \$14 billion to over \$30 billion.

The remaining six are of the EPR design that France has been unable to successfully complete in its home country. The single EPR plant being constructed in Flamanville in France is now estimated to cost €12.4 billion, four times what was forecast when construction started in 2007.

We estimated in 2013 that had the six planned EPRs at Jaitapur in Maharashtra been constructed on schedule, electricity from these reactors would cost at least ₹ 15

per unit excluding transmission costs. Given recent cost escalations, this is most likely an underestimate. The figures from Vogtle suggest that the proposed AP1000 reactors would produce power that would similarly be costly.

Compare that figure with recent low bids of ₹2.14 per unit for solar power, and ₹2.34 for solar-wind hybrid projects; even in projects coupled with storage, bids are around ₹4.30 per unit. If nuclear electricity is to be sold at a competitive rate, it would have to be greatly subsidised by the Indian government, which operates all nuclear plants through the Nuclear Power Corporation of India.

Understanding risks

Safety concerns following the Fukushima accident have led to protests against each planned reactor. Vijay Rupani, then Chief Minister of Gujarat, admitted in the State Assembly in March 2018 that "locals turned against" the Mithivirdi nuclear project after the Fukushima disaster.

Contrary to the condescending opinion held by some nucleocrats, peoples' concerns are not based on an irrational fear of nuclear energy. In a densely populated country such as India, land is at a premium and emergency health care is far from uniformly available. Local citizens understand that a nuclear disaster might leave large swathes of land uninhabitable – as in Chernobyl – or require a prohibitively expensive clean-up – as in Fukushima, where the final costs may eventually exceed \$600 billion.

Concerns about safety have been accentuated by the insistence of multinational nuclear suppliers that they be indemnified of liability for the consequence of any accident in India. Under pressure from multinational manufac-

turers, India's liability law already largely protects them. But the industry objects to the small window of opportunity available for the Indian government to hold them to account.

The message to local citizens is simple: manufacturers do not really believe in their own claims about how safe their reactors are. If they did, they should have been willing to accept responsibility for any failure rather than insisting on special legal arrangements not available to any other industry.

Climate concerns

Climate change will increase the risk of nuclear reactor accidents. The day after the fire at the Zaporizhzhia nuclear plant, a wildfire approached the Hanul nuclear power plant in South Korea and President Moon Jae-in ordered "all-out efforts" to avoid an accident at the reactors there. In 2020, a windstorm caused the Duane Arnold nuclear plant in the U.S. to cease operations. The frequency of such extreme weather events is likely to increase in the future.

Therefore, nuclear power is not the right choice to "adapt" to climate change, which requires resilience in power systems. It is also not the appropriate choice for mitigating India's carbon emissions since it cannot be deployed at the necessary scale. The resources spent on nuclear plants will yield quicker results if they are redirected to renewables.

Given the inherent vulnerabilities of nuclear reactors and their high costs, it would be best for the government to unambiguously cancel its plans for a nuclear expansion.

Suvrat Raju and M.V. Ramana are physicists with the Coalition for Nuclear Disarmament and Peace. The views expressed are personal

World has witnessed multiple nuclear disasters and near-misses. Yet, some policymakers insist on expanding nuclear power, ostensibly in response to climate-change concerns.

Dec 2021 - Govt informed Parliament that it plans to build “10 indigenous reactors in fleet mode” and had granted “in principle approval” for 28 additional reactors, including 24 to be imported from France, the U.S. and Russia.

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V.C. Summer nuclear project in South Carolina- costs rose so sharply that the project was abandoned after an expenditure of over \$9 billion. Renewable-energy technologies have become cheaper. Cost of electricity from solar photovoltaics and wind turbines in the U.S. declined by 90% and 72%, respectively, between 2009-21. In 2020, the International Energy Agency dubbed solar energy the “new king of electricity”.

Global trend: in 1996, 17.5% of the world’s electricity came from nuclear power plants; by 2020, Declined to just around 10%. India has also had to drastically cut its nuclear ambitions after Fukushima. In 2008: AEC projected that India would have 650GW of installed capacity by 2050 and 35 gigawatts by 2020. Installed capacity today is only 6.78 GW.

India’s targets were based on the expectation that India would import many light-water reactors after the India-U.S. civil nuclear deal. But it has not led to the establishment of a single new nuclear plant, over 13 years after it was concluded. Of the 24 foreign reactors with “in principle” approval, six are of the VVER (water-water energetic reactor) design that has had multiple operational problems at Kudankulam in Tamil Nadu. Out of the 12 reactors to be imported from the U.S, 6 are AP1000 reactors — the same design that was abandoned in South Carolina. The remaining six are of the EPR design that France has been unable to successfully complete in its home country. The single EPR plant being constructed in Flamanville in France is now estimated to cost €12.4 billion, four times what was forecast when construction started in 2007. With these cost escalations, earlier estimate of this energy costing Rs. 15/unit is an underestimate. Solar power cost - ₹2.14 per unit, Solar-wind hybrid - ₹2.34, coupled with storage - around ₹4.30 per unit.

Security concerns after Fukushima disaster. Also, insistence of multinational nuclear suppliers that they be indemnified of liability for the consequence of any accident in India. Under pressure from multinational manufacturers, India’s liability law already largely protects them. Climate change will increase the risk of nuclear reactor accidents.

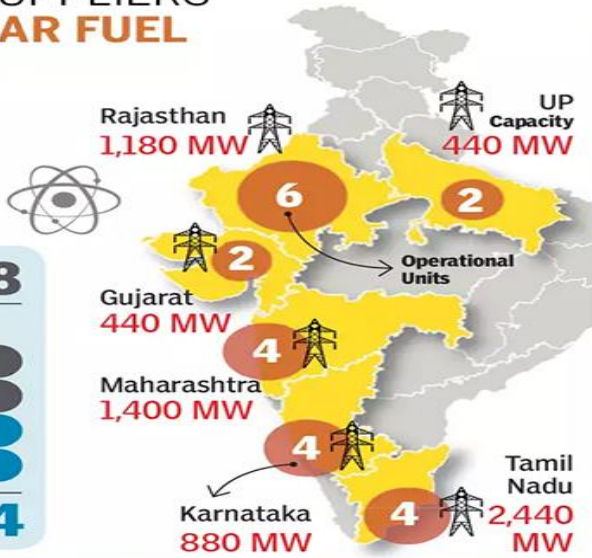
Beyond the Writeup: Nuclear energy in India

- Nuclear power is zero-emission. It has no greenhouse gases or air pollutants. According to US government data, a 1,000-megawatt nuclear plant requires 360 times less land than a similar-capacity wind farm and 75 times less land than solar plants.
- Renewables are Unstable Sources: Solar and wind energy are intermittent and unstable. The power from these sources can only be generated when the sun shines or wind blows. Even in the best case scenario, solar and wind farms do not and can never generate power round the clock, they require fossil-fuel back-up. Currently, 24% of Britain's power comes from wind. But the country saw an unexpected "windless summer" this year, which is one of the reasons for the UK power crisis.
- Ecological Damage from Renewables: Wind and solar projects can cause ecological damage to the relatively pristine areas where they are set up. It is conservatively estimated that 500,000 birds are being killed every year by collision with wind turbines in the US.
- Nuclear as an Alternative: In 2020, nuclear power made up 78% of the energy France generated, and renewables 19%. Fossil fuels accounted for only 3%. Only 3% of the power India generates is nuclear.

Issues Associated to Nuclear Energy: Lack of Public Funding, Factors Pulling Nuclear Out of Competition, Poor Financial Conditions of Investors like Toshiba-Westinghouse and Areva, Grassroots Resistance, Acquisition of Land.

BIGGEST SUPPLIERS OF NUCLEAR FUEL TO INDIA

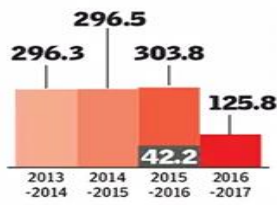
22 nuclear power plants can generate **6,780 MW**



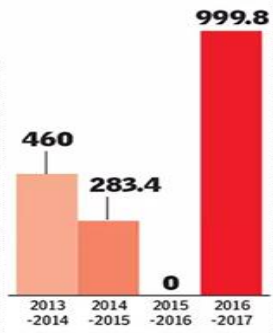
Kazakhstan and Canada are currently the biggest suppliers of uranium to India

Supply in metric tonnes

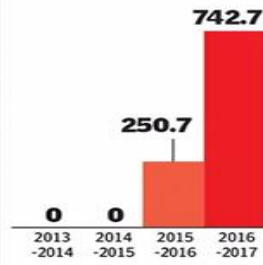
■ Enriched Uranium



RUSSIA



KAZAKHSTAN



CANADA

Pg 8. GS III (Economic Development)

Skies wide open

The resumption of regular international flights should help the travel and hospitality sectors

The Government's decision to allow scheduled commercial international flights to resume operations from later this month will come as a big relief to the travel, tourism and hospitality sectors, which have been among the hardest hit by the pandemic. The International Air Transport Association estimates that the global aviation industry suffered about \$201 billion in losses between 2020 and 2022 due to COVID-19 and the accompanying curbs on overseas travel and domestic mobility. The tourism and hospitality industry largely feeds off the aviation sector for its earnings and jobs growth, evident from estimates that in 2020 – the year of lockdowns – India's foreign exchange earnings from tourist arrivals from abroad plummeted 76% from the previous year, to ₹50,136 crore. Official data show that in just the nine months ended December 2020, 21.5 million jobs were lost in tourism. However, the decision to open up international travel has coincided with the intensification of sanctions on Russia in the wake of its invasion of Ukraine, which in turn has sent oil prices soaring on fears of disruptions to global energy supply chains. The price of crude oil has zoomed close to historical peaks. As a result, aviation turbine fuel (ATF) prices have also jumped by almost 60% year-on-year. This month, India's state-owned oil marketing companies raised ATF prices for the fifth time this year, and this was before crude soared to near record highs. Fuel costs typically constitute about one fifth of a global airline's operating expenditure and multiple price increases are certain to hurt airlines' margins and viability.

The conflict in Ukraine has also triggered a sharp jump in a wide range of commodity prices, that is potentially set to quicken inflation across the globe. This is bound to seep into the cost of overseas travel as well, with travellers needing to budget more for food and entertainment. Airlines will find it a challenge to fill seats profitably, given the combination of rising costs, economic uncertainty triggered by the conflict in Eastern Europe and the residual fear among travellers of new variants of the SARS-CoV-2 virus. Strict regulations as various parts of the world cautiously open their borders to visitors will only add to the burden of the aviation and the hospitality industries. And, with the pandemic and restricted mobility having steered corporates to conduct business online effectively, getting business-related travel back to pre-pandemic levels will be a tough ask. Restoring visitor confidence through enforcement of COVID-19 protocols and widening vaccination coverage alone may not be enough. Estimates show that indirect taxes take away 21% of airlines' revenue, hobbling the sector. Lowering ATF prices by cutting duties is an option the Government must weigh. Everything must be done to woo back more tourists.

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TOURISM AND HOSPITALITY



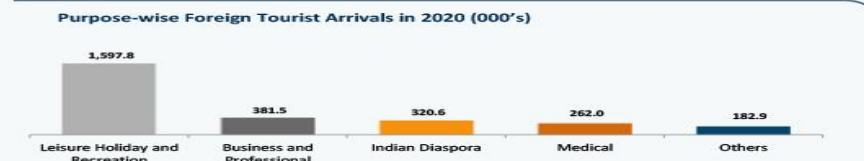
MARKET SIZE



Note: F - Forecast



SECTOR COMPOSITION



KEY TRENDS



Note: 2020* - Until March 2020



GOVERNMENT INITIATIVES



ADVANTAGE INDIA

- **Robust demand:** The travel market in India is projected to reach US\$ 125 billion by FY27 from an estimated US\$ 75 billion in FY20.
- **Diverse Attractions:** India offers geographical diversity, attractive beaches, 37 World Heritage sites and 10 bio-geographic zones.
- **Policy support:** In October 2021, the Government of India announced plan to resume inbound tourism from November 15, 2021, which is expected to lend a major boost to the tourism sector in India. The government introduced a scheme to boost the tourism sector by providing one-month free tourist visa to 5 lakh tourists until March 31, 2022.
- **Attractive opportunities:** Government is providing free loans to MSMEs to help them deal with the crisis and revive the economy, including the tourism sector.

Beyond the Writeup: Constraints in tourism sector

- **Infrastructure and Connectivity:** Deficiencies in infrastructure and inadequate connectivity hamper tourist visits to some heritage sites.
- **Promotion and Marketing:** Although it has been increasing, online marketing/branding remains limited and campaigns are not coordinated. Tourist information centers are poorly managed, making it difficult for domestic and foreign tourists to access information with ease.
- **Lack of Skills:** The number of adequately trained individuals for the tourism and hospitality sector is a key challenge to giving visitors a world-class experience. A limited number of multilingual trained guides, and the limited local awareness and understanding of the benefits and responsibilities associated with tourist growth act as constraints on the sector's growth.

Russia offers more oil to India

Call between Russian Deputy PM and Puri comes after U.S. banned oil imports

SUHASINI HAIDAR
NEW DELHI

Beleaguered by sanctions from the western countries and a ban on fuel exports to the United States, Russia is keen to increase its oil and petroleum product exports to India. Russian Deputy Prime Minister Alexander Novak conveyed to Petroleum Minister Hardeep Puri on Friday.

According to a statement issued by the Russian government, Mr. Puri spoke to Mr. Novak, who was also the former Energy Minister, about the possibilities of strengthening the India-Russia strategic partnership in the energy sector.

"Russia's oil and petroleum product exports to India have approached \$1 billion, and there are clear opportunities to increase this figure," said a statement issued in Moscow about the telephone call, which, it said, discussed "current and potential joint projects in the fuel and energy industry and



Fuelling worries: People queuing up in a petrol station to tank up, fearing a surge in prices. •PTI

noted that current projects continue to be steadily implemented."

"We are interested in further attracting Indian investment to the Russian oil and gas sector and expanding Russian companies' sales networks in India," Mr. Novak said, according to the statement. According to sources, the Ministers agreed to let the proposals be discussed by officials, including the possible modes of payment. The talks appear to confirm reports that

suggested India has received an offer of discounted crude oil from Russia, that has lost major buyers in the past two weeks, as the U.S., the European Union and other countries have slapped sanctions on Russia for its attacks on Ukraine.

While European countries have exempted Russian banks involved in energy trade from their sanctions due to a heavy dependence on Russian oil, the U.S. announced a complete ban on the import of all Russian pe-

troleum and petroleum products from March 8. The decision led to a sharp spike in oil prices, crossing \$139 per barrel at one point, and the prices remain over \$100 per barrel, causing a global scare over inflation.

Meanwhile Russia, that has lost the U.S. imports of about 7,00,000 barrels of oil per day, and could see a reduction over time of European current intakes of 4.5 million barrels a day, will be left with unsold stocks if it doesn't find new buyers.

A decision to purchase more oil from Russia would also have to be weighed against the adverse reaction from India's American and European partners who want to "isolate Russia" economically. External Affairs Minister S. Jaishankar had said last month that India does not follow "unilateral sanctions", however, in 2019, India did bow to the U.S. demands that it "zero out" all its oil imports from Iran.

"Russia's oil and petroleum product exports to India have approached \$1 billion, and there are clear opportunities to increase this figure," – Russia government.

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Beyond the Writeup: India Russia energy exchange

India imported 1.8 million tonnes of thermal coal from Russia in 2021, down from 2.5 million in 2020. Russia's share in India's thermal coal imports fell to 1.3% in 2021 from 1.6%. India imported 43,400 bpd oil from Russia in 2021, about 1% of overall its imports. India accounts for about 0.2% Russia's natural gas exports. GAIL (India) Ltd has a 20-year deal with to buy 2.5 million tonnes of LNG a year which started in 2018.

'A whole lot of factors' will decide on Russian oil import to India: Finance minister

Sandeep Moudgal / TNN / Mar 9, 2022, 15:32 IST



Govt weighing Russia's offer for discounted crude

TNN / Updated: Mar 10, 2022, 07:44 IST



Page 15. GS III (Science & Tech, Economic Development)

Ukraine's two leading suppliers of neon, which produce about half the world's supply of the key ingredient for making chips, have halted their operations. Some 45%-54% of the world's semiconductor grade neon, critical for the lasers used to make chips, comes from two Ukrainian companies, Ingas and Cryoin. Global neon consumption for chips reached about 540 metric tonnes last year.

Both firms have shuttered their operations. The stoppage casts a cloud over the worldwide output of chips, already in short supply after the pandemic drove up demand for cell phones, laptops and later cars, forcing some firms to scale back production. Before the invasion, Ingas produced 15,000 to 20,000 cubic metres of neon per month for customers in Taiwan, Korea, China, the U.S. and Germany, Cryoin produced about 10,000 to 15,000 cubic metres of neon per month.

Ukraine halts half of world's neon output for chips, clouding outlook

War hits production at Ingas, Cryoin

REUTERS
WASHINGTON

Ukraine's two leading suppliers of neon, which produce about half the world's supply of the key ingredient for making chips, have halted their operations as Moscow has sharpened its attack on the country, threatening to raise prices and aggravate the semiconductor shortage.

Some 45%-54% of the world's semiconductor grade neon, critical for the lasers used to make chips, comes from two Ukrainian companies, Ingas and Cryoin, according to Reuters calculations based on figures from the companies and market research firm Techcet. Global neon consumption for chips reached about 540 metric tonnes last year, Techcet estimates.

Both firms have shuttered their operations, according to company representatives contacted by Reuters, as Russian troops have escalated their attacks on cities throughout Ukraine.

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While estimates vary widely about the amount of neon stocks chipmakers keep on hand, production could take a hit if the conflict drags on, according to CFRA analyst Angelo Zino.

"If stockpiles are depleted by April and chipmakers don't have orders locked up in other regions... it likely means further constraints for the broader supply chain and inability to manufacture the end-product," Mr.



Zino said.

Before the invasion, Ingas produced 15,000 to 20,000 cubic metres of neon per month for customers in Taiwan, Korea, China, the U.S. and Germany, with about 75% going to the chip industry, Nikolay Avdzyi, the company's chief commercial officer, said in an email. The company is based in Mariupol, which has been besieged by Russian forces.

Cryoin, which produced about 10,000 to 15,000 cubic metres of neon per month, and is located in Odessa, halted operations on February 24 when the attacks began, to keep employees safe, according to business development director Larissa Bondarenko.

'Unable to fulfill orders' She said the firm would be unable to fill orders for 13,000 cubic metres of neon in March unless the violence stopped. She said the company could weather at least three months with the plant closed, but warned that if equipment were damaged, that would prove a bigger drag on company finances and make it harder to restart operations quickly.

Taiwan's Economy Ministry said Taiwanese firms had already made preparations and had "safety stocks" of neon, so it did not see any problems in the supply chain in the near term.

Beyond the Writeup: Semiconductor chip shortage & reasons

Russia supplies the global semiconductor industry with rare metals, and Ukraine supplies specialty gases required by the chipmaking industry. As the pandemic hit, people switched to work from home, children connected to schools through laptops, and get-togethers happened over video calls. This shift led to a surge in demand for laptops and tablets. The stay-at-home rules also made several people pick up console-based gaming.

Neon and helium are both gases critical to the production of chips, and Russia and Ukraine are both major players in the global supply chain—so much that neon prices went up more than 10 times following the Russian annexation of Crimea in 2014. **Ukraine supplies rare gases used to produce semiconductor fab lasers**, and Russia exports rare metals like palladium to make semiconductors. This combination is required to build chipsets that power a range of devices, from automobiles to smartphones. **Russia and South Africa are the two largest producers of palladium.** In 2021, Russia

supplied 2.35 million ounces (66 million grams) of palladium. **Palladium** is often used as an **alternative to gold in making various devices** as the metal is highly malleable and resistant to corrosion.

The U.S. government is looking to pass the **CHIPS Act**, a law that would provide semiconductor firms with \$52 billion in subsidies to advance chip making in the country. India recently cleared a Rs. 76,000-crore scheme to incentivise companies to design and make semiconductors.

Beyond the Writeup: Applications of Neon

- The reddish-orange coloured neon lights are used in making advertising signs. It's also utilized in these types of lights generally when many other gasses are needed to generate lights of different colours.
- Other uses of neon include lightning arrestors, high-voltage indicators, television tubes and meter tubes.
- Gas lasers are made with the help of neon and helium.
- The electronics industry uses neon singly or in mixtures with other gases in many types of gas-filled electron tubes.
- A mixture of helium and neon is used for respiration by marine divers in the sea since helium is less soluble in blood than nitrogen at high pressure.

Mains Practice Questions

1. Discuss the reasons given by some experts against the idea of expanding nuclear power generation in India. How do these cons measure against pros of nuclear energy? (250 words; 15 marks)[GS-3, Science]
2. Elaborate tourism sector's potential of being a mass job producer in India. What are some of the roadblocks being faced by this sector? (250 words; 15 marks)[GS-3, Economic Development]