



PAKISTAN'S NUCLEAR ENERGY OUTLOOK

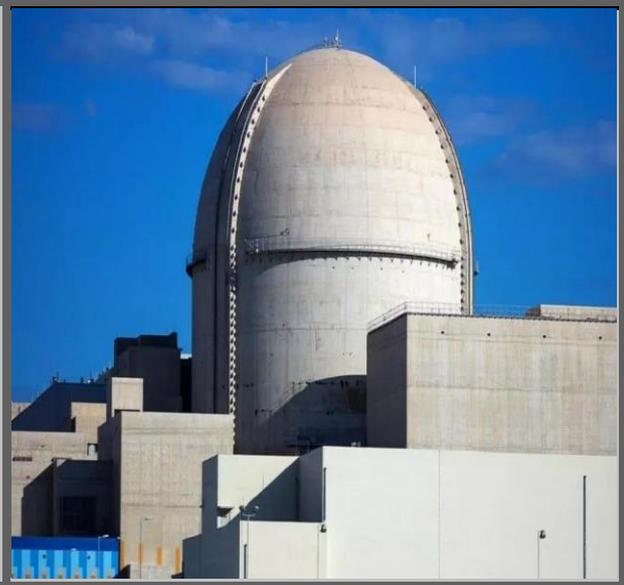
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April 29, 2021

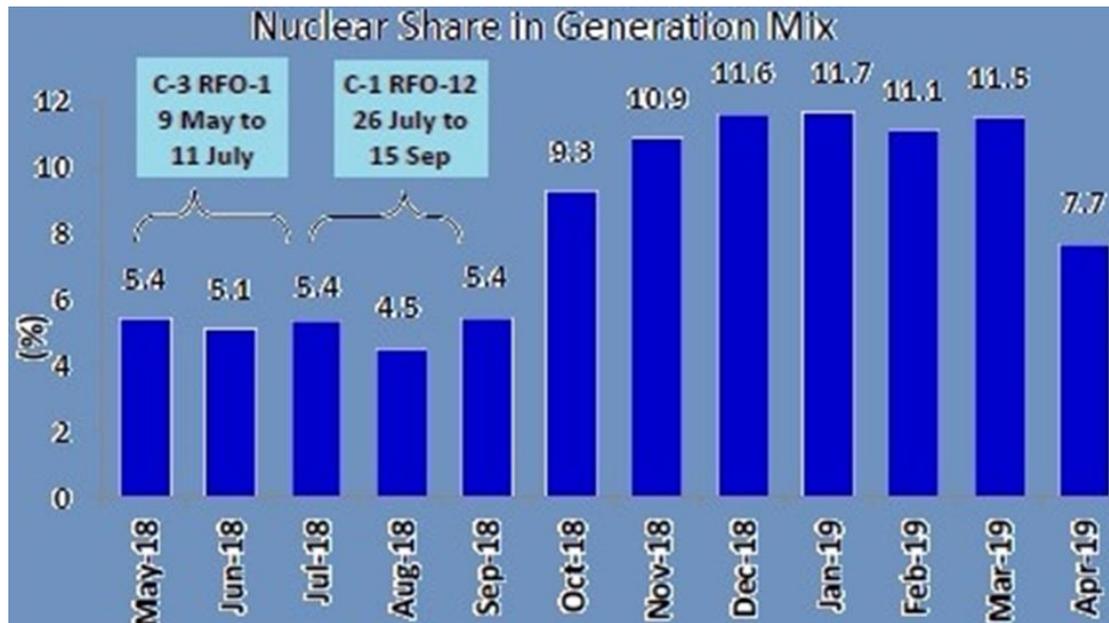
(Views expressed in the brief are those of the author, and do not represent those of ISSI)



In March 2021, the Pakistan Atomic Energy Commission (PAEC) announced that it had connected the Karachi Nuclear Power Plant KANUPP Unit-2 (K-2) with a 1,100MWe capacity to the national grid. The PAEC called it a 'Pakistan Day' gift to the nation. Pakistan Energy Minister, Omar Ayub Khan, said in a tweet that "By the Grace of Almighty Allah, Nuclear Power Plant K-2 synchronised successfully with the National Grid."¹ This is certainly a step in the right direction for a country like Pakistan that has chronic energy deficit issues. Power generation through nuclear energy is important for Pakistan. However, the percentage of nuclear power in the total energy mix remains very small. It was 8.2% for the year 2020.² Other power generation sources in Pakistan are hydro, thermal, natural gas, coal, wind and solar. Nuclear power has the potential to contribute more to the national grid if it is invested in. For now, it is important to assess how many nuclear power plants Pakistan operates and has under construction, as well as its nuclear energy outlook in the coming decades.

¹ "K-2 Nuclear Plant Successfully Synchronised with National Grid," *Business Recorder*, March 19, 2021, <https://www.brecorder.com/news/40075555>

² "Thermal has Largest Share in Pakistan's Energy Mix," *The Express Tribune*, June 12, 2020, <https://tribune.com.pk/story/2240789/2-thermal-largest-share-pakistans-energy-mix>



Source: “Nuclear Power Plant - Facts & Figure,” Pakistan Atomic Energy Commission(PAEC), <http://www.paec.gov.pk/Parameters/>

According to the PAEC statement, the K-2 nuclear power plant (NPP) had achieved criticality at the end of February 2021 and had been undergoing safety tests and procedures. The loading of nuclear fuel onto the plant was earlier done in December 2020, after clearance from the Pakistan Nuclear Regulatory Authority (PNRA). The PAEC further said that K-2 is a pressurised water reactor based on the Chinese ACP1000 technology and a third-generation plant with advanced safety features. The K-2 would be the NPP with the highest power generation capacity of 1,100MWe compared to just 1400MWe from the five PAEC operated nuclear plants combined. The PAEC stated that this addition would “help improve the economy of the country.”³ There is one more power plant under construction of the same series in Karachi known as K-3 that will be completed and become operational by the end of the year. This would further add to the national grid.

With the addition of K-2 the PAEC is now runs six NPPs in Pakistan. Two are located in Karachi and four at Chashma. Pakistan’s first nuclear power reactor, K1 or KANUPP 1, is a small 100MWe Canadian pressurised heavy water reactor (PHWR) that has been operational since 1971 and which is under the IAEA safeguards. The second unit is 325MWe capacity Chashma 1 (CHASNUPP 1) which is a pressurised water reactor (PWR) supplied by the China National Nuclear Corporation (CNNC) which is under safeguards.⁴ The Chashma 2 (CHASNUPP 2) project started in 2005 with the help of China at a cost of PKR 51.46 billion or \$ 490 million. China financed with \$20 million of the cost.

³ “K-2 Nuclear Power Plant Connected to Grid,” *Dawn*, March 19, 2021, <https://www.dawn.com/news/1613286>

⁴ “Country Nuclear Power Profiles: Pakistan” IAEA, Updated 2020, <https://cnpp.iaea.org/countryprofiles/Pakistan/Pakistan.htm>

Chashma 2 has been operational since 2011 and a safeguards agreement was signed with the IAEA in 2006.⁵ Pakistan signed the agreement to build Chashma 3 and 4 with 320MWe capacity each with China in 2008. These two power plants were also partially financed by China. Chashma 3 has been operational since 2011 and Chashma 4 since 2017. Pakistan signed the agreement to build K-2 and K-3 units with the CNNC in August 2013 with a total cost of Rs 959 billion (\$9.116 billion).⁶

PAEC Operated Reactors in Pakistan

Reactor Name	Alternative Name	Model	Reactor Type	Net Capacity (MWe)	Construction Start	First Grid Connection
CHASNUPP-1	Chashma Nuclear Power Plant 1	CNP-300	PWR	300	1993-08	2000-06
CHASNUPP-2	Chashma Nuclear Power Plant 2	CNP-300	PWR	300	2005-12	2011-03
Chashma Nuclear Power Plant Unit 3	Chashma Nuclear Power Plant 3	CNP-300	PWR	315	2011-05	2016-10
Chashma Nuclear Power Plant Unit 4	Chashma Nuclear Power Plant 4	CNP-300	PWR	313	2011-12	2017-06
K-2	Karachi 2	HPR1000	PWR	1,014	2015-08	2021-03
Karachi Nuclear Power Plant	Karachi 1	CANDU-137 MW	PHWR	90	1966-08	1971-10

Source: "Nuclear Power in Pakistan," Updated March 2021, <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx>

There are two more plants under construction. The K-3 with 1100MWe capacity is near completion and is expected to become operational within the year. In November 2017, Pakistan signed an agreement with the CNNC construction of Chashma 5 as a Hualong One unit.

Under its Nuclear Energy Vision 2050, Pakistan envisages a nuclear power generation capacity of 40,000MWe. The PAEC Chairman, Muhammad Naeem, said that Pakistan has plans to generate 8,000MWe of electricity through nuclear means in the coming year to overcome the country's

⁵ "Nuclear Power in Pakistan," Updated March 2021, <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx>

⁶ Ibid.

energy crisis.⁷ Pakistan has plans to select eight more sites with four nuclear power plants each, with a planned total of 32 NPPs that would provide a 25% of the country's energy requirements by 2050. Pakistan has plans to generate 8800MWe through nuclear power by 2030.⁸

However, one of the biggest challenges to developing nuclear power generation is that Pakistan is not part of the Nuclear Non-Proliferation Treaty (NPT). Thus, it is largely excluded from trade in nuclear plant or materials, which impedes the development of civil nuclear energy. The Nuclear Suppliers Group (NSG), a 48-member group of nuclear-supplying states, restrict trade in civil nuclear components to countries that are not a member and are outside the NPT. Membership to the NSG is important for Pakistan to broaden nuclear energy cooperation to meet its ever-growing energy needs. Pakistan applied for NSG membership in May 2016, as did India. The membership was denied. However, there have been double standards at play with India which at pressure from the US granted an NSG waiver to India that has allowed many states to do civil nuclear cooperation with New Delhi. Pakistan has pushed for a criteria-based approach to NSG membership.

Pakistan has the right credential to be an NSG member. Pakistan has proven itself to be a responsible nuclear state. Pakistan has all its nuclear power reactors and two research reactors (PARR 1&2) under the IAEA safeguards. In March 2017, the IAEA approved Pakistan's request to apply international safeguards to K-2 and K-3 and the agreement on this came into force in May the same year.⁹ Pakistan has a stringent export control regime and complies with most of the export control regime lists – like the Missile Technology Control Regime (MTCR), NSG and Australia Group. Moreover, it has a professional PNRA and a spotless nuclear safety and security record. With over 50 years of experience in generating nuclear power and not a single accident, Pakistan has proven its safety and security. Pakistan is also a party to the Convention on Nuclear Safety and two international conventions for early notification and assistance. Nuclear power in general is the need of the country to truly develop its economic potential. Membership to the NSG will go a long way towards achieving that goal.

The coming online of the KANUPP-2 or K-2 has nearly doubled the nuclear power generation capacity of Pakistan from 1400MWe to 2500MWe, which has substantially improved the overall share of nuclear power in the energy mix. Pakistan's economy has suffered due to energy shortages in the past. However, Chinese investment in form of loans and assistance in nuclear energy projects

⁷ "Pakistan Envisions 40,000MW of Nuclear Power Generation Capacity: PAEC," *Dawn*, September 27, 2015, <https://www.dawn.com/news/1207543>

⁸ "Pakistan Nuclear Power, Facts and Figures," Pakistan Atomic Energy Commission (PAEC), <http://www.paec.gov.pk/>

⁹ "Nuclear Power in Pakistan," Updated March 2021, <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx>

has helped it come out of the energy crisis. Pakistan's nuclear power vision 2030 and 2050 have put the country on the path of realising its potential. However, Pakistan can use civil nuclear cooperation from countries besides China. A membership to the NSG will go a long way in promoting Pakistan nuclear energy programme. It is perhaps time for the world to do away with double standards and follow a criteria-based approach to NSG membership so that countries like Pakistan can ride out the energy crunch.