

# The Nuclear Belt and Road: A Boon or a Bust for the Environment?

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## Introduction

The Nuclear Belt and Road, China's ambitious plan for nuclear exports, is an important part of the Belt and Road Initiative (BRI). Though a late comer to the global nuclear market, China is rising as a competitive nuclear vendor based on its advanced nuclear technology, attractive prices based on its large domestic nuclear market, and lavish funding backed by China's state-owned banks. China has made some significant successes in the global nuclear market recently. In addition, two recent developments are creating more opportunities for the Nuclear Belt and Road. First, the global campaign to cut carbon emissions to zero, and in particular, China's pledge not to finance coal projects abroad, are opening more room for China's nuclear exports. Second, Russia's invasion of Ukraine undermines the attractiveness of Russia, the current leader of the nuclear market, making China the new presumptive leader. What does this all mean for the environment? The Nuclear Belt and Road could be a boon from an environmental perspective. Powering China's massive development and infrastructure building projects under the BRI with coal would be a disaster for the environment. While renewables are not yet reliable and affordable, nuclear energy is a clean alternative to fossil fuels. However, China's problematic industrial safety track record, its rampant corruption, and its lack of transparency generate concerns about nuclear accidents. The fact that many BRI countries mostly lack rigorous regulations and the necessary technology, know-how and personnel to handle the atoms safely adds to the concern.

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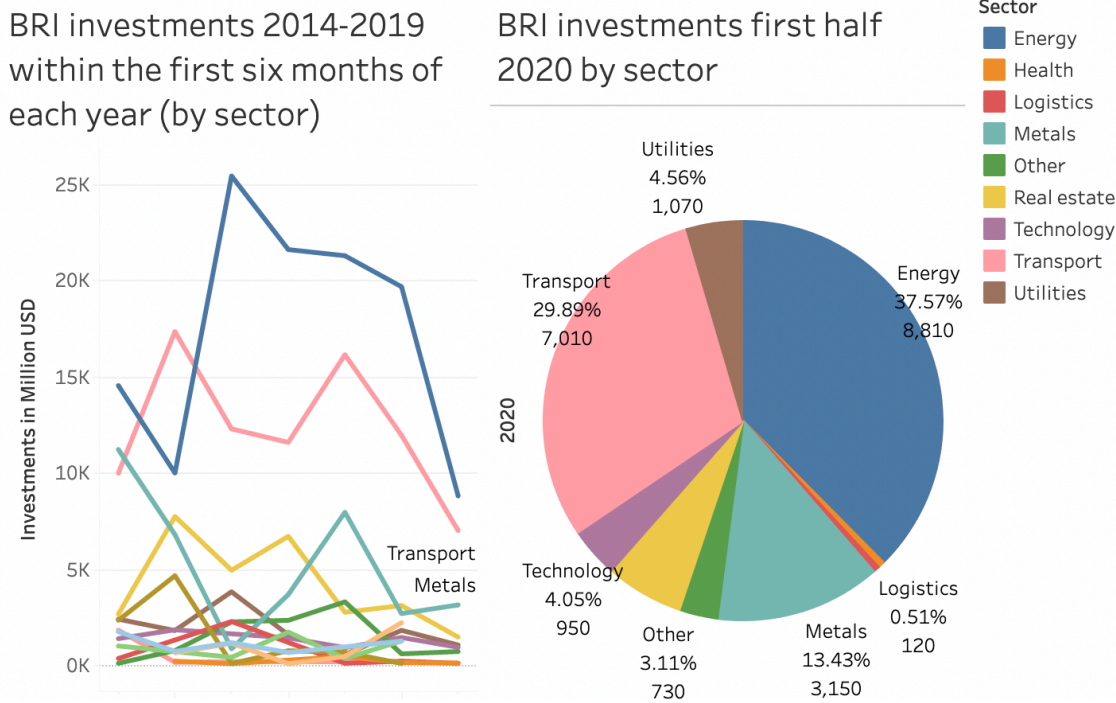
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This paper will first briefly introduce the Nuclear Belt and Road and evaluate its potential for success. Then it will discuss recent events that could contribute to the success of the Nuclear Belt and Road. Lastly, it will examine the Nuclear Belt and Road's implications from the environmental/nuclear safety perspective.

## The Nuclear Belt and Road

In October 2013, Beijing announced the BRI, China's ambitious infrastructure development and investment initiatives that stretch from Asia to Europe. The BRI is an over-trillion-dollar, long-term, umbrella project that encompasses various infrastructure and development projects aimed at enhancing China's connectivity to other regions and building a China-centric global economy. The BRI is not just about connectivity, as it is often described. A major part of the BRI is the energy sector, as energy generation is a critical precondition for economic development. In fact, the energy sector has received the largest amount of BRI investments, as the figures below show.

[Figure 1. BRI Investments by Sector]<sup>1</sup>



So far, the majority of BRI-investment in the energy sector has gone into coal projects, but China is seeking to increase the portion of nuclear energy. Under the banner of the Green BRI, China has pledged to build over 150 nuclear power plants abroad in the next fifteen years. However, China's ambition for nuclear exports goes way back. When China was just building its first nuclear power plants with foreign assistance in the 1970s and 1980s, it already had the ambition to develop homegrown technology based on foreign technology and become a nuclear exporter in the future, something China has now succeeded in doing.

China is increasingly competitive in the nuclear market based on its advanced nuclear technology, competitive prices and lavish financing. China has developed homegrown nuclear technologies with its own intellectual property rights. China's first nuclear reactor based on Hualong One technology, the No. 5 unit of the Fuqing Nuclear Power Plant in Fujian Province, went online in November 2020.<sup>2</sup> This reactor design is known to be simpler than its American and European counterparts, and thus is cheaper and faster to build. It has been certified as compliant with safety requirements by the European Utility Requirements, a technical advisory group that evaluates new nuclear power plants proposed for construction in Europe.<sup>3</sup> In February 2022, this design was approved for construction in the United Kingdom after five years of assessment. China has recently connected to grid the world's first fourth-generation nuclear reactor based on high-temperature gas-cooled reactor technology. China's "Linglong One" was the first small

<sup>1</sup> Christoph Nedopil Wang, "Brief: Investments in the Chinese Belt and Road Initiative (BRI) in 2020 during the Covid-19 Pandemic," *Green Finance and Development Center*, July 31, 2020, <https://greenfdc.org/investment-report-belt-and-road-initiative-bri-2020-covid19>.

<sup>2</sup> People's Daily, "First Nuclear Unit with Hualong One Reactor Connected to Grid," *People's Daily*, November 27, 2020, <http://en.people.cn/n3/2020/1127/c90000-9793505.html>.

<sup>3</sup> World Nuclear News, "CGN's Hualong One Design Certified for European Use," *World Nuclear News*, November 20, 2020, <https://world-nuclear-news.org/Articles/CGNs-Hualong-One-design-certified-for-European-use>.

modular reactor (SMR) to be approved by the International Atomic Energy Agency. SMR are smaller, and thus cheaper, quicker to build, safer, and mobile, and thus has huge potential as a next generation nuclear reactor. Lastly, China has developed sophisticated radioactive liquid waste disposal equipment, capable of melting waste into glass, and has also made breakthroughs in nuclear fusion technology, which is believed to be safer and cleaner than fission nuclear power.<sup>4</sup>

Another of China's strengths is its affordable prices based on its large domestic nuclear market. China is the second largest producer of nuclear power only after the United States. It is operating 50 out of the world's 443 nuclear reactors,<sup>5</sup> and constructing 11 out of the world's 52 new reactors in Chinese territory.<sup>6</sup> China is expected to overtake the United States as the largest nuclear energy generator sometime before 2030.<sup>7</sup> China is investing in nuclear power more than any other countries in the world—up to 440 billion dollars over the next 15 years. What this means for nuclear exports is that its large domestic market allows China to reach economies of scale and reduce the average costs of building nuclear reactors, which allows China to offer attractive prices to foreign countries.

On top of that, China is also willing to offer generous financing backed by China's state-owned banks to cover upfront costs. Nuclear power plants are relatively cheap to run, but expensive to build—they can cost billions of dollars. Thus, often financing is the most important consideration during nuclear cooperation negotiations with foreign countries. China covered about 80% of its nuclear projects in Pakistan, and has recently agreed to finance 85% of the two nuclear reactors it will build in Argentina. Only the Chinese and Russian nuclear industries, strongly backed by their governments, can offer such massive financing. This aspect is very attractive especially for developing countries.

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Based on these comparative advantages, China is rising as a competitive nuclear vendor. China has built four nuclear reactors and is currently building two more in Pakistan. China is financing a third of the construction of nuclear reactors at Hinkley Point C in the United Kingdom, which France is building. It has recently signed a contract to build two Hualong One reactors in Argentina. It is in negotiations with a number of other countries, such as Saudi Arabia, the Philippines, and Kazakhstan, among many others with the goal of exporting as many as 30 nuclear reactors by 2030.<sup>8</sup> A late comer to the nuclear market, China has not built many nuclear reactors abroad. However, with the decline of traditional vendors, such as the United States, France and Japan, China is a formidable contender. The only real rival is Russia, which is the dominant nuclear vendor today.<sup>9</sup>

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<sup>4</sup> Fan Anqi and Deng Xiaoci, "China Makes Breakthrough in High-level Radioactive Waste Disposal Technique, Achieves Milestone in Nuclear Industry Devt," *Global Times*, Sep 12, 2021, <https://www.globaltimes.cn/page/202109/1234033.shtml>

<sup>5</sup> International Atomic Energy Agency, "Operational & Long-Term Shutdown Reactors," *IAEA Power Reactor Information System (PRIS)*, last accessed on February 15, 2021, <https://www.iaea.org/PRIS/WorldStatistics/OperationalReactorsByCountry.aspx>.

<sup>6</sup> International Atomic Energy Agency, "Under Construction Reactors," *IAEA Power Reactor Information System (PRIS)*, last accessed on February 15, 2021, <https://www.iaea.org/PRIS/WorldStatistics/UnderConstructionReactorsByCountry.aspx>.

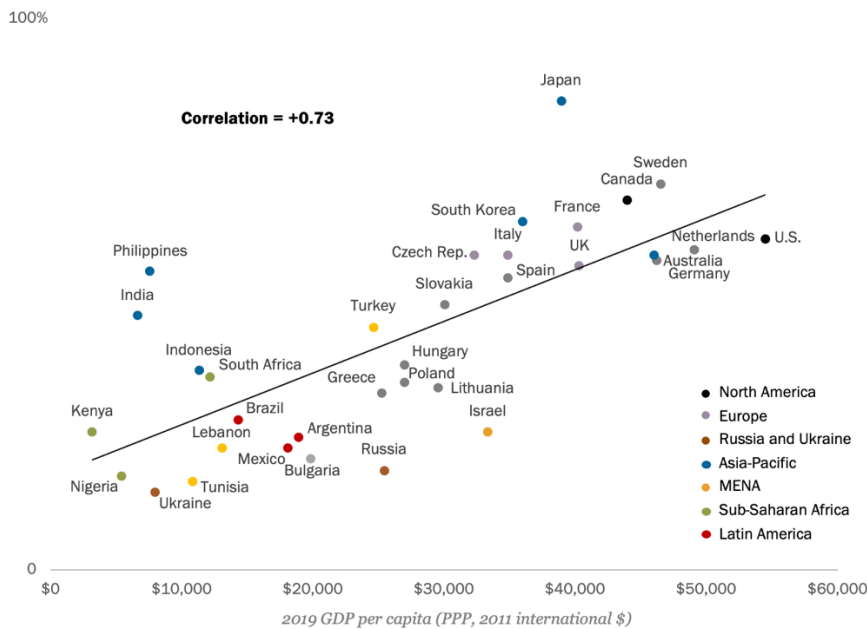
<sup>7</sup> Mark Hibbs, *The Future of Nuclear Power in China* (Washington, D.C.: Carnegie Endowment for International Peace, 2018): 5.

<sup>8</sup> For details of where China is exporting nuclear power plants, see Lami Kim, "Nuclear Belt and Road: China's Ambition for Nuclear Exports and Its Implications for World Politics," in *Essays on the Rise of China and Its Implications* (The Woodrow Wilson International Center for Scholars, 2021).

<sup>9</sup> Japan Times, "Russia Unrivaled in Nuclear Power Plant Exports," *Japan Times*, July 27, 2017, <https://www.japantimes.co.jp/opinion/2017/07/27/commentary/world-commentary/russia-unrivaled-nuclear-power-plant-exports>.

However, there are obstacles to China's ambitions for the Nuclear Belt and Road. The main obstacle is political rather than technological or financial. China's increasingly assertive behavior, and especially its economic coercion against Australia, Norway, South Korea, and many others, make countries nervous about letting China build critical energy infrastructure on their soil. For this reason, Romania canceled its nuclear deal with China. The British PM recently vowed to block China's development of its Bradwell B power plant, which has been planned since 2016. The Czech Republic also excluded China from its potential cooperator list. It is possible that some countries, in particular those in Europe, may think twice about working with the Chinese. That said, these negative reactions are mostly coming from European countries, and it is less clear if non-Western, developing countries may react in the same way. Surveys show that there is a correlation between economic wealth and attitude toward China. As the chart below shows, people in countries with higher per capita GDP tend to view China less favorably.<sup>10</sup> China is viewed quite positively in African, Middle Eastern and Latin America countries. In fact, China's economic coercion has not discouraged many developing countries from cooperating with China in other critical infrastructure, such as 5G infrastructure and highspeed trains, due to the benefits that China provides such as attractive prices and financing. Particularly for small developing countries that require huge amount of financing, China may be the only viable partner for nuclear energy cooperation. Beijing will likely focus on developing countries in Africa, the Middle East and Latin America, where it has a stronger chance to succeed.

[Figure 2. Relationship between Unfavorability and Per Capita GDP]



### Recent Developments

There are a couple of recent developments that are creating even more opportunities for China's nuclear exports: the global campaign to cut carbon emissions to zero and Russia's invasion of Ukraine.

<sup>10</sup> Laura Silver, kat Devlin, and Christine Huang, "China's Economic Growth Mostly Welcomed in Emerging Markets, But Neighbors Wary of Its Influence," December 5, 2019, <https://www.pewresearch.org/global/2019/12/05/attitudes-toward-china-2019>.

### *Carbon Neutrality*

In order to meet the 2015 Paris Accord's goal of keeping global temperature to below 1.5 degrees Celsius, greenhouse gas emissions must be cut by 45% by 2030 and reach "net zero" by 2050.<sup>11</sup> "Net zero" means achieving an overall balance between emissions produced and those removed from the atmosphere so that no more greenhouse gas will be added to the atmosphere. According to the United Nations, over 130 countries have already committed to or are now considering the goal of achieving net zero goal by 2050. In order to achieve this goal, it is critical for them to reduce the use of fossil fuels, which is the biggest culprit of carbon emissions, and secure clean alternative energy sources.

China, the largest carbon emitter, has also joined the global campaign to cut carbon emissions. In 2020, Beijing declared its commitment to have carbon emissions peak before 2030 and achieve carbon neutrality before 2060. At the UN General Assembly in September 2021, Chinese President Xi Jinping also pledged not to build more coal power plants abroad. This is a significant development, as China is the world's largest coal financier. In 2020, China commissioned 76% of the world's new coal power plants<sup>12</sup> in developing countries in Asia, Africa and Europe. However, Beijing's decision to stop building coal power plants abroad does not mean that China's BRI investment in energy will decrease. After all, in order for the Belt and Road Initiative to succeed, China will need to find a way to generate energy in BRI countries. In particular, Southeast Asia, where China's coal power plants were concentrated, needs an alternative energy source to meet the region's fast growing economic development. Then what will fill the gap? Renewables have become significantly cheaper and are expanding but not quickly enough to meet energy demand. They are not yet reliable, as their energy generation is intermittent depending on the availability of their fuels, such as wind and sunlight. As a result, there was a sharp increase in the use of coal in 2020. Natural gas is also quite dirty, because it emits methane, another type of greenhouse gas. Nuclear energy is a zero-emissions energy source, and so many countries are looking at nuclear energy. In particular, SMRs are suitable as a bridge energy source, as they are smaller, and thus quicker to build, and can be used alongside new renewable energy sources to compensate for the intermittency of renewable sources. As mentioned above, China seems to be most advanced in SMR technology. Although China is increasing its investment in renewables, in the medium term, China is seeking to utilize nuclear energy until the transition to renewables becomes viable.

### *Russia's invasion of Ukraine*

Another recent development is Russia's invasion of Ukraine. Broadly speaking, there are two major implications for nuclear energy. One is that it is driving up the demand for nuclear energy, as countries especially in Europe are seeking to reduce their reliance on Russian gas and oil. While demand for nuclear energy is rising, Russia, the leader in the nuclear market, and which makes up about 60% of global reactor sales and technical assistance, is being pushed out of the nuclear market. Until recently, Russia was a very attractive nuclear vendor as a one-stop shop that provides everything from construction with generous financing to fuel supply to spent fuel management. But now there are enormous risks in going into an 80 to 100 year nuclear deal with Russia. Massive sanctions against Russia will affect doing business with Russia although the nuclear sector is not directly sanctioned. Also, Russia may increasingly find it difficult to offer generous financing, as it faces its own financial turmoil. Russia's damaged reputation is yet another

<sup>11</sup> "For a Livable Climate: Net-zero Commitments Must Be Backed by Credible Action," *The United Nations*, <https://www.un.org/en/climatechange/net-zero-coalition>.

<sup>12</sup> Quirin Schiermeier, "China's Pledge on Overseas Coal—By the Numbers," *Nature*, September 29, 2021, <https://www.nature.com/articles/d41586-021-02645-w>.

factor.

Turkey's Akkuyu nuclear power plant being built by Russia's Rosatom, for example, is being delayed, because Rosatom is having difficulty in receiving parts and equipment from third parties, and it seems Russia won't be able to provide the financing as originally promised. Looking at this case, it is unlikely that many countries will be willing to go into a deal with Rosatom at least for the time being. I believe that China has a strong potential to fill this gap. So far, I have discussed the potential for China to become the leader in the nuclear market. If the Nuclear Belt and Road success, what would be some implications for the environment?

### Implications for the Environment/Nuclear Safety

The Nuclear Belt and Road, if successful, can be a boon for the environment. As BRI countries develop further, demand for energy in the countries will rise significantly. According to Beijing-based think tank Tsinghua Center for Finance and Development, if BRI countries follow the traditional, carbon-intensive growth paths, global temperature will rise almost 3 degrees C, even if the rest of the world meets their targets to reduce carbon emissions.<sup>13</sup> Beijing has promoted development projects based on renewable energy abroad under the banner of "Green Belt and Road," but as mentioned above, renewables are not yet as reliable of an alternative energy source to fossil fuels. China's construction and financing of nuclear power plants in BRI countries would help these countries grow economically without relying heavily on coal.

In particular, China's next generation nuclear technologies give hopes for sustainable development. Even though nuclear energy is carbon-free, many environmentalists are against it, because there is not a permanent solution to treat radioactive waste. A portion of spent fuels are reprocessed and reused as fuels for nuclear reactors, but there still remain radioactive materials that need to be contained. China is developing technologies that mitigate this problem. Its radioactive liquid waste disposal equipment turns radioactive waste into glass that they bury deep underground. It is also developing technology that reduces radioactive waste generation in the first place. Lastly, nuclear fusion technology, in which China is leading, leaves no waste. China's development and provision of these technologies at affordable prices would significantly contribute to the world's clean development.

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However, the Nuclear Belt and Road raises another kind of environmental concern, namely potential environmental hazards caused by radiological contamination. There have been concerns about nuclear safety in China. Admittedly, there has not been a major nuclear accident in China, and the China's National Nuclear Safety Administration has inspected nuclear power plants in China and has strengthened its nuclear safety regulations and emergency management since the 2011 Fukushima accident. However, there are ample reasons to worry about China's nuclear safety. One of them is rampant corruption and a poor track record in industrial safety. When accidents occur, often the main culprit is not the lack of sufficient regulations, but rather poor implementation of regulations. Chinese companies

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<sup>13</sup> Ma Jun and Simon Zadek, "Decarbonizing the Belt and Road: A Green Finance Roadmap," *Tsinghua Center for Finance and Development*, December 2019, <https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-Road-%E2%80%93Final-Report-English.pdf>.

often cut corners to meet deadlines and reduce costs, and Chinese officials often turn a blind eye to malpractice in return for bribes. It is particularly concerning, as people who have insider knowledge about the Chinese nuclear industry have raised the alarm about China's nuclear safety. A former vice-president of the Chinese National Nuclear Corporation, Li Yulun, stated that Chinese nuclear firms do not seem to share the Chinese government's priority on nuclear safety.<sup>14</sup> He Zuoxiu, a pro-Communist Party, Chinese nuclear expert called Beijing's ambitious nuclear plans "insane" due to safety concerns. Murong Xuecun wrote in the *New York Times* that "[f]rom everything we know of Chinese building and supervision practices, an accident in a Chinese nuclear power station is just a question of when and where."<sup>15</sup>

Another source of concern is China's lack of transparency. Beijing has a "history of withholding, manipulating, and falsifying data for its own purposes" to an alarming level.<sup>16</sup> This characteristic is particularly problematic in the nuclear sector. Chinese local governments may hide problems with nuclear power plants from Beijing in order to avoid humiliation and punishment. Beijing may also have incentives to hide problems from its citizens and foreign countries. Unlike China, other nuclear energy countries report safety issues to the International Atomic Energy Agency's "International Reporting System for Operating Experience," so that nuclear experts around the world learn from one another's experiences.<sup>17</sup> If necessary, they seek help from other countries. This is not the case when it comes to China. A case in point is how China dealt with the radiological threat that occurred in Taishan Nuclear Power Plant in Guangdong Province last year. French companies that were involved in the reactor reported an "imminent radiological threat" that appeared to be caused by a leak of gasses from fuel rods of one of the nuclear reactors and sought help from the United States. China did not reveal this accident and refused to comment on it, when asked. It is concerning that when there is a threat, Beijing may conceal it, or worse yet, not be aware of it because information was withheld. Also, it is highly unlikely that Beijing will seek help if it considers a call for assistance humiliating.

There are greater safety concerns for China's nuclear projects abroad. It is likely that Chinese nuclear firms will use more caution when building and maintaining domestic nuclear power plants, as a major nuclear accident would be highly damaging to Beijing's political standing. When it comes to overseas projects, there is even less accountability. Also, in order to make its deals more competitive, China does not demand rigorous safety mechanisms as a condition of supply, unlike other vendors like the United States. The fact that potential recipient countries are mostly developing countries and lack relevant experience, technology and personnel to maintain and operate nuclear reactors safety adds to the concern.

## Conclusion

With the global net zero movement and Russia's invasion of Ukraine, the demand for nuclear energy is growing. As a rising nuclear vendor with advanced technology, attractive prices and generous financing, China will likely seize this opportunity not only to increase its share in the nuclear market but also to enhance its economic and political influence around the world.

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<sup>14</sup> Eric Ng, "China Nuclear Plant Delay Raises Safety Concern," *South China Morning Post*, October 7, 2013, <https://www.scmp.com/business/china-business/article/1325973/china-nuclear-plant-delay-raises-safety-concern>.

<sup>15</sup> Murong Xuecun, "Inside a Beijing Interrogation Room," *The New York Times*, July 17, 2014, <https://www.nytimes.com/2014/07/18/opinion/murong-xuecun-inside-a-beijing-interrogation-room.html>.

<sup>16</sup> "China Transparency Project," *Heritage Foundation*, June 30, 2021, <https://www.heritage.org/CTP>.

<sup>17</sup> NEA/IAEA, *Nuclear Power Plant Operating Experiences from the IAEA/NEA Incident Reporting System 2015-2017* (Paris: OECD Publishing, 2020), <http://www.oecd.org/publications/nuclear-power-plant-operating-experience-from-the-iaea-nea-international-reporting-system-for-operating-experience-2015-2017-2bdd0383-en.htm>.

From an environmental standpoint, China's Nuclear Belt and Road can contribute to the international community's efforts to tackle climate change. China will require substantial energy resources to realize its massive development projects under the banner of the BRI. It would be beneficial for the world if China could utilize clean energy sources rather than fossil fuels. At this point, nuclear energy seems necessary for this endeavor. However, if it is true that China is bound to experience a major nuclear accident as some experts predict, the environmental damage of China's nuclear exports could potentially be enormous. Depending on the scale, location and nature of a potential accident, the damage may not be limited to its immediate location. Beijing's failure to acknowledge and announce its mistakes may make matters even worse. The world is still dealing with the negative consequences of the 2011 Fukushima incident. It has been an enormous challenge for Tokyo, which has a far longer experience with nuclear energy, and far safer standards and better governance in general than China. It wouldn't be unfair for the world to have concerns about China's handling of a potential nuclear disaster. This aspect has not been widely discussed when we consider China's nuclear exports.

The international community should raise awareness about the risk involved in China's nuclear exports. Also, it should put pressure on China to be transparent about its nuclear activities, report problems with its reactors, and seek help from others in event of an emergency. Also, China should pay greater attention to safety standards in its nuclear projects abroad. Responsible nuclear behavior will ultimately enhance the chances for success of the Nuclear Belt and Road.

*The views expressed are those of the author and do not necessarily reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.*

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