

## Exporting the Nuclear ‘China Model’: ‘Win-Win’ Radioactive Development and the Geopolitics of Nuclear Energy in Africa

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“Africa’s concerns are China’s concerns. Africa’s priorities are China’s priorities.”

–Chinese Foreign Minister Wang Yi, responding to Former U.S. Secretary of State Rex Tillerson’s warning that Chinese investments threaten the sovereignty of African States (March 8, 2018)

“Nuclear is like the ‘adult table’ [but for international relations] ... We have seen now how China rightly claimed its place there [as a nuclear power]. I think perhaps the time is here for Namibia to follow the lead of China.”

– SWAPO Party Youth League Leader (Interview)

### Introduction: Situating Nuclear Energy in Climate Necropolitics

Most discussions of China’s low-carbon energy transition focus on its world-leading implementation of wind, solar, and hydropower technologies. Yet China is also developing another low-carbon energy source faster than any other country: nuclear energy. At the 2014 Nuclear Security Summit, Chinese President Xi Jinping described nuclear energy as essential for both “ensuring energy security and tackling climate change. Like Prometheus who gave fire to humanity, the peaceful rise of nuclear energy has sparked a flame of hope and opened up a bright future for mankind.”<sup>1</sup> As Xi’s statement suggests, China’s pursuit of nuclear energy has implications well beyond China. In this paper, I extend discussions of the ‘China model’ to the nuclear realm by evaluating how and why African governments are pursuing nuclear energy and how their interpretations of the Chinese government’s nuclear strategy inform those pursuits.<sup>2</sup> I ground these interpretations in a case study of Namibia, the largest destination for Chinese foreign direct investments in uranium mining and a country whose leaders envision it as globally significant exporter of low-carbon energy—including nuclear energy.

This paper is part of a broader research project on ‘climate necropolitics.’<sup>3</sup> Drawing inspiration from Achille Mbembe’s

<sup>1</sup> Xi, J. 2014. “Statement by H.E. Xi Jinping, President of the People’s Republic of China, at the Nuclear Security Summit.” Ministry of Foreign Affairs of the People’s Republic of China, March 25.

[http://www.fmprc.gov.cn/mfa\\_eng/wjdt\\_665385/zyjh\\_665391/t1140583.shtml](http://www.fmprc.gov.cn/mfa_eng/wjdt_665385/zyjh_665391/t1140583.shtml).

<sup>2</sup> On the ‘China model’, see Benabdallah, L. 2020. *Shaping the Future of Power: Knowledge Production and Network-Building in China-Africa Relations*. Ann Arbor: University of Michigan Press; Corkin, L. 2013. *Uncovering African Agency: Angola’s Management of Chinese Credit Lines*. London: Ashgate; DeBoom, M.J. 2018. *Developmental Fusion: Chinese Investment, Resource Nationalism, and the Distributive Politics of Uranium Mining in Namibia*. PhD Dissertation, University of Colorado at Boulder; Driessen, M. 2019. *Tales of Hope, Tastes of Bitterness: Chinese Road Builders in Ethiopia*. Hong Kong: Hong Kong University Press; Lee, C.K. 2018. *The Specter of Global China: Politics, Labor, and Foreign Investment in Africa*. Chicago: University of Chicago Press; Ripa, A., and T. Oakes. 2023. “Infrastructural Thinking in China: A Research Agenda.” *The China Quarterly* 255: 547-559.

<sup>3</sup> DeBoom, M.J. 2020. “Sovereignty and Climate Necropolitics: The Tragedy of the State System Goes ‘Green.’” In Moisiu, Sami, Andrew E.G. Jonas, Natalie Koch, Christopher Lizotte, and Juho Luukkonen, (eds), *Handbook on the Changing Geographies of the State: New Spaces of Geopolitics*, p. 276–286. Northampton, UK: Edward Elgar; DeBoom, M.J. 2021. “Climate Necropolitics: Ecological Civilization and the Distributive Geographies of Extractive Violence in the Anthropocene.” *Annals of the American*

theory of necropower,<sup>4</sup> climate necropolitics is a framework to analyze the processes, practices, discourses, imaginaries, and logics through which violence against marginalized populations is rendered legitimate in the name of climate change response. Recognizing that state and non-state actors can use geo-imaginaries of climate change (e.g., the Chinese Communist Party's 'Ecological Civilization') to justify both unequally distributed extractive violence and concentrated economic and geopolitical benefits (e.g., for foreign investors and governments), my research sheds light on how and through the actions of whom these justifications affect material outcomes in particular places. The infrastructures of low-carbon energy transitions, for example, often rely on 'open' land and 'abundant' raw materials in the global South. Intensified extraction in these contexts risks deepening socio-environmental, political, and economic violence against communities already suffering from some of the worst consequences of climate change itself. My prior research analyzed the role of climate necropolitics in intensified uranium mining in Namibia. This paper analyzes the nuclear ambitions of Namibia and other African states and the role of China as a 'model' in those pursuits. I consider not only 'why' African leaders want to go nuclear, but *how* and *with what effects*. What imaginaries and logics do African leaders use to frame nuclear energy as in 'Africa's interests,' for example? What effects are these nuclear strategies likely to have, and for whom and where?

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*China has become the world's second largest producer of nuclear energy. It accounted for over 65 percent of nuclear reactors constructed between 2009 and 2018. China's nuclear capacity has already surpassed France, and it is expected to surpass the U.S. by 2030. If the Chinese government achieves its nuclear ambitions, China will account for one third of global nuclear energy capacity by 2040*

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The paper begins with a brief overview of China's nuclear rise. I then evaluate China's nuclear technology exports as simultaneously a soft power and commercial strategy, highlighting how geopolitical imaginaries of nuclear energy intersect with Chinese diplomatic rhetoric on south-south solidarity and win-win development. After a brief discussion of my methods, I examine how African leaders interpret China's nuclear model and its relevance to their own countries. Finally, I turn to a case study of Namibia to explain why Namibian leaders are pursuing nuclear energy and how their interpretations of China's nuclear model inform those pursuits. I conclude by considering the implications of the 'nuclear China model' and its diffusion.

### **Background: China's Nuclear Rise**

It is difficult to overstate how quickly the Chinese government has transformed China from a minor nuclear power into a global nuclear leader. In 2010, *Foreign Affairs* described China's nuclear capabilities as "forgotten," overlooked in the

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*Association of Geographers* 111, no. 3: 900-912.

<sup>4</sup> Mbembe, A. 2003. "Necropolitics" *Public Culture* 15, no. 1: 11-40; Mbembe, A. 2019. *Necropolitics*. Durham: Duke University Press.

context of Americans' "lingering bipolar mindset."<sup>5</sup> Today, China's nuclear profile is impossible to ignore—and increasingly interpreted through a 'second Cold War' bipolar mindset that centers on perceptions of China as a threat to Western geopolitical hegemony.<sup>6</sup> Since connecting its first reactor to the grid in 1991—a year in which the number of operating U.S. nuclear reactors peaked at 112—China has become the world's second largest producer of nuclear energy. It accounted for over 65 percent of nuclear reactors constructed between 2009 and 2018.<sup>7</sup> China's nuclear capacity has already surpassed France, and it is expected to surpass the U.S. by 2030. If the Chinese government achieves its nuclear ambitions, China will account for one third of global nuclear energy capacity by 2040.<sup>8</sup>

Chinese President Xi Jinping has framed nuclear energy as key to accomplishing the CCP's goals of peaking carbon emissions by 2030 and achieving carbon neutrality by 2060, but the (geo)political importance of China's nuclear strategy extends beyond carbon emissions. I will highlight three key factors here. First, replacing coal with nuclear and renewables supports Xi's pursuit of "Ecological Civilization," a state-led eco-modernization strategy that aims to reconcile economic development with sustainability.<sup>9</sup> China's reliance on coal, which accounted for roughly 60 percent of its energy generation in 2022, has had devastating human and environmental consequences in China's domestic context, with implications for political legitimacy. Replacing coal with nuclear energy promises to clean the air of China's cities: a visible indicator of the success of Ecological Civilization. Second, nuclear energy advances the Chinese government's energy security strategy by reducing China's reliance on imported oil. The efficiency of uranium as a raw material for energy generation means that far less uranium is needed to produce a similar amount of energy vis-à-vis fossil fuel-based energy generation. Even better, China has significant domestic uranium reserves. Although these reserves are inadequate to meet the uranium needs associated with China's long-term plans for nuclear energy development, the governments of several countries with significant uranium reserves, including Namibia, have strong geopolitical ties with the CCP and welcome Chinese foreign direct investments in uranium. Finally, nuclear technology is a geopolitically prestigious *and* profitable export industry with a growing international market. Nuclear technology exports are a way to strengthen China's existing commercial and diplomatic links to energy-hungry states in the global South while also opening new markets and opportunities for China's prominent nuclear state-owned enterprises (SOEs).

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<sup>5</sup> Roberts, B., R.A. Manning, and R.N. Montaperto. 2000. "China: The Forgotten Nuclear Power." *Foreign Affairs*, July/August.

<sup>6</sup> Schindler, S., I. Alami, J. DiCarlo, N. Jepson, et al. 2023. "The Second Cold War: US-China Competition for Centrality in Infrastructure, Digital, Production, and Finance Networks." *Geopolitics*. <https://doi.org/10.1080/14650045.2023.2253432>.

<sup>7</sup> World Nuclear Association (WNA). 2019. "Nuclear Power in the World Today." <http://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx>.

<sup>8</sup> International Atomic Energy Agency (IAEA). 2018. *Country Nuclear Power Profiles*. <https://cnpp.iaea.org/pages/index.htm>; U.S. EIA. 2023. *International Energy Outlook 2023*. <https://www.eia.gov/outlooks/ieo/>.

<sup>9</sup> DeBoom, 2020 and 2021; Geall, S., and A. Ely. 2018. "Narratives and Pathways Towards an Ecological Civilization in Contemporary China." *The China Quarterly* 236:1175–96; Hansen, M.H., H. Li, and R. Svarverud. 2018. "'Ecological Civilization': Interpreting the Chinese Past, Projecting the Global Future." *Global Environmental Change* 53:195–203; Pow, C.P. 2018. "Building a Harmonious Society through Greening: Ecological Civilization and Aesthetic Governmentality in China." *Annals of the American Association of Geographers* 103, no. 3: 864-883; Rodenbiker, J. 2023. *Ecological States: Politics of Science and Nature in Urbanizing China*. Ithaca: Cornell University Press. Yeh, E. 2023. "The Making of Natural Infrastructure in China's Era of Ecological Civilization." *The China Quarterly* 255: 611-627.

African countries represent one potential export market for Chinese nuclear technologies. Foreign investors often treat African countries as merely a source of raw materials. Africa accounts for over 15 percent of global uranium production. The continent is a hotspot for the extraction of critical raw materials (CRM) necessary for low-carbon energy transitions.<sup>10</sup> African governments are also pursuing opportunities to develop their own low-carbon grids though—including through nuclear energy. These ambitions challenge the nuclearity binary described by Gabrielle Hecht, according to which Africa is treated as a source of uranium but not a ‘nuclear’ continent.<sup>11</sup> The lower cost and smaller scale nuclear technologies being developed by Chinese SOEs are particularly appealing to African governments, which face simultaneous energy, environmental, and socio-political challenges. These challenges include rapid urbanization, air pollution, energy security, citizen demands for development and electrification, and climate change mitigation—challenges that are familiar to Chinese leaders and have shaped their own nuclear ambitions.

### Going Out, Going Nuclear: Chinese Commercial Strategy and Radioactive Soft Power

Nuclear energy is a controversial energy source in much of the global North, but it retains persistent and potent associations with geopolitical prestige, futurity, and modernity.<sup>12</sup> Even in its pessimistic assessment of the future of nuclear energy following the Fukushima disaster, *The Economist* concluded that nuclear countries remained the “technological premier league.”<sup>13</sup> I opened this paper with a quote from a leader in Namibia’s SWAPO Party Youth League (the youth branch of Namibia’s ruling party) who described nuclear power as the “adult table” of international relations, a status to which they thought Namibia should aspire. These associations make China’s nuclear rise a potent ‘soft power’ geopolitical asset, particularly among nuclear aspirants in the global South.<sup>14</sup>

Chinese leaders have doubled down on the soft power potential of nuclear energy by framing it as a ‘green’ technology to facilitate Ecological Civilization and climate change mitigation.<sup>15</sup> Ecological Civilization was formally introduced at the same 17<sup>th</sup> National Congress of the Communist Party of China at which former President Hu Jintao advocated for

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<sup>10</sup> Deberdt, R. and P. Le Billon. 2024. “Green Transition’s Necropolitics: Inequalities, Climate Extractivism, and Carbon Classes.” *Antipode*. <https://doi.org/10.1111/anti.13032>.

<sup>11</sup> Hecht, G. 2012. *Being Nuclear: Africans and the Global Uranium Trade*. Cambridge, MA: MIT Press, p. 897.

<sup>12</sup> Hecht, G. 1998. *The Radiance of France: Nuclear Power and National Identity After World War II*. Cambridge, MA: MIT Press; Hecht, 2012; Puig, A.P.I. 2005. “Science on the Periphery. The Spanish Reception of Nuclear Energy: An Attempt at Modernity?” *Minerva* 43, no. 2: 197-218; Sagan, S.D. 1996. “Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb.” *International Security* 21, no. 3: 54-86; Sovacool, B.K. and S.V. Valentine. 2010. “The Socio-Political Economy of Nuclear Energy in China.” *Energy* 35: 3803-3813.

<sup>13</sup> *The Economist*. 2012. “Nuclear Power: The Dream That Failed.” <https://www.economist.com/node/21549936>.

<sup>14</sup> For a range of analyses of the Chinese government’s pursuits of soft power, see Benabdallah 2020; Gill, B., and Y. Huang. 2006. “Sources and Limits of Chinese ‘Soft Power.’” *Survival* 48, no. 2: 17-36; Kurlantzick, J. 2007. *Charm Offensive: How China’s Soft Power is Transforming the World*. New Haven, CT: Yale University Press; Paradise, J.F. 2009. “China and International Harmony: The Role of Confucius Institutes in Bolstering Beijing’s Soft Power.” *Asian Survey* 49, no. 4: 647-669; Repnikova, M. 2022. *Chinese Soft Power*. Cambridge: Cambridge University Press; Wang, Y. 2008. “Public Diplomacy and the Rise of Chinese Soft Power.” *The Annals of the American Academy of Political and Social Sciences* 616, no. 1: 257-273.

<sup>15</sup> DeBoom 2021.

renewed efforts to build China's soft power. President Xi has characterized Ecological Civilization as a "global endeavor" that "will benefit generations to come" through the implementation of a "new model of modernization with humans developing in harmony with nature."<sup>16</sup> Nuclear energy—and the uranium mining on which it relies—is far from a 'green' industry; indeed, the use of imaginaries like Ecological Civilization to justify intensified uranium mining in Africa is an example of climate necropolitics. Yet the conflation of nuclear energy's low carbon profile with 'green' energy persists in the rhetoric of Chinese and African officials. This rhetorical conflation is a powerful tool in rendering state-led pursuits of both nuclear energy and intensified uranium mining legitimate.

The Chinese government's 'Going Out' commercial strategy for nuclear technologies complements its soft power ambitions. China aims to become the world's leading supplier of nuclear components and reactors.<sup>17</sup> In developing its nuclear industry, the Chinese government has pursued an "indigenization" strategy to develop "national champions" in strategic industries (e.g., high-speed rail). China's two primary state-owned enterprises (SOEs), China National Nuclear Corporation (CNNC) and China General Nuclear Power Corporation (CGN), are key actors in this realm. Drawing on the successful nuclear standardization strategies of South Korea and France, both SOEs have developed Chinese-built versions of standard reactor designs, such as a CGN-built CPR-1000 based on Électricité de France's 900Mwe model.<sup>18</sup> More CPR-1000 components are now built in China than in France, and the first nuclear reactor based on China's domestic Hualong One technology, housed at the Fuqing Nuclear Power plant, became operational in 2020.

China's nuclear SOEs have also prioritized developing technologies that promise to reduce the notoriously long nuclear plant construction process.<sup>19</sup> These include small modular reactors (SMRs) and advanced operating systems. Compared to larger reactors, SMR components are easier to pre-build in factories for on-site assembly, with safety and speed benefits. Furthermore, SMRs can be used for purposes beyond electricity (e.g., transportation, desalination, military uses) or underground. Reflecting both domestic imperatives and the post-Fukushima global context, Chinese SOEs are also working to develop new operating systems. These include 'Generation IV' techniques such as gas and molten salt-cooled reactors (fail-safes in the event of catastrophic loss of power and back-up generation capabilities), sodium-cooled fast reactors able to consume spent fuel from conventional reactors (closed-loop technology), and reactors powered by thorium instead of enriched uranium.<sup>20</sup>

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<sup>16</sup> Xi, J. 2017. "Secure a Decisive Victory in Building a Moderately Prosperous Society." [http://www.xinhuanet.com/english/download/Xi\\_Jinping's\\_report\\_at\\_19th\\_CPC\\_National\\_Congress.pdf](http://www.xinhuanet.com/english/download/Xi_Jinping's_report_at_19th_CPC_National_Congress.pdf).

<sup>17</sup> Hinze, J. and Y. Zhou. 2012. "China's Commercial Reactors." *Nuclear Engineering International*, February. China Supplement. <https://www.belfercenter.org/sites/default/files/legacy/files/chinas-commercial-reactors-proof.pdf>; Martin, R. 2016. "Fail-Safe Nuclear Power." *MIT Technology Review*, August 2. <https://www.vox.com/2016/2/29/11132930/nuclear-power-costs-us-france-korea>.

<sup>18</sup> Hinze and Zhou, 2012.

<sup>19</sup> Most currently operating reactors were completed in six to eight years. Construction times for nuclear plants opened in 2010 ranged from four to twenty years.

<sup>20</sup> The Chinese Academy of Sciences secured an operating license for an experimental thorium-powered, molten salt reactor in 2023. Thorium reserves are largely estimated rather than proven due to low commercial demand, but China is ranked 11<sup>th</sup> in the world in terms of estimated reserves. Oak Ridge National Laboratory in the U.S. operated a liquid-fluoride thorium reactor in the 1960s, but it

China is not alone in its attention to the nuclear export market. Russia's Rosatom has hosted a series of nuclear events and trainings around the world, including in Africa, and the U.S. Department of Energy hosted a nuclear summit in Ghana in fall 2023. A mid-level Department of Energy employee I interviewed interpreted the Department of Energy's decision to allocate \$60 million for 13 advanced nuclear technology projects (including NuScale's small modular reactor)—investments that contributed to the 2023 introduction of the Westinghouse SMR AP300—as a response to concerns that the U.S. nuclear industry is ceding commercial and geopolitical ground to China. Despite not formally appearing on the agenda, Chinese technology was a prevalent topic of discussion in industry presentations and hallway conversations at the 2023 Atlanta SMR and Advanced Reactors conference. Western actors, however, appear to be more constrained by the nuclearity binary in their assessments of potential export markets than the governments of China or Russia. U.S. think tanks like the Center for Strategic and International Studies and the Council on Foreign Relations, for example, frame China's nuclear exports to the global South primarily through the lens of a threat to U.S. national security rather than a threat to potential U.S. export markets.<sup>21</sup> At the SMR conference mentioned above, hallway discussions centered on Chinese technologies as a threat to U.S. dominance, not on the nuclear desires of global South governments or the potential role of Western exports in facilitating them.

The soft power and commercial benefits of China's nuclear geopolitical strategy are likely to reinforce one another in several ways. First, the low-cost technologies (e.g., SMRs) that Chinese SOEs have prioritized promise to make nuclear energy more accessible to global South governments. This outcome is in keeping with China's historical and contemporary geopolitical emphasis on mutual benefit and win-win development.<sup>22</sup> Whereas the nuclear slogan of the Cold War U.S. was the disingenuous "atoms for peace," the nuclear slogan of contemporary China may be "atoms for win-win development"—though the degree to which this 'win-win development' will benefit ordinary Africans is far from certain. Second, China's nuclear rise signals its ability to chart its own geopolitical destiny, a status to which many governments in the global South aspire. China's transformation from a 'developing country' to a 'nuclear leader' in only a few decades is particularly inspirational for many African leaders. Finally, there is likely to be a synergistic relationship between Chinese lending and nuclear exports. With the exception of some oil-exporting states, few global South governments with nuclear ambitions are likely to be able to fully fund their own reactors. Chinese lending could play a key role in facilitating such exports. This is perhaps nowhere truer than in Africa, a massive potential export market for Chinese nuclear technology—and a continent whose leaders have a growing interest in 'going nuclear.'

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was defunded.

<sup>21</sup> Liu, Z.Z. 2022. "Renewing America's Leadership in the Global Civil Nuclear Energy Market." *Council on Foreign Relations*, June 22. <https://www.cfr.org/blog/renewing-americas-leadership-global-civil-nuclear-energy-market>.

<sup>22</sup> Strauss, J.C. 2009. "The Past in the Present: Historical and Rhetorical Lineages in China's Relations with Africa." *The China Quarterly* 199: 777–795.

### A Note on Methods and Interpretation

The following sections draw on interpretations of China's nuclear 'model' and its relevance for African contexts as they emerged in interviews and focus groups and through participant observation in events and media/textual analysis during research in southern Africa since 2014. My data collection on China's nuclear 'model' during this time occurred as part of a broader research project on the geopolitics and political ecologies of Chinese investments in uranium mining. Much of this research occurred in southern Africa, particularly Namibia, but I also conducted research at several continental-scale China-Africa events (e.g., the Forum on China-Africa Cooperation) and at nuclear energy events in Africa and beyond. My participation in these events enabled me to hear the perspectives of government and private sector officials representing a wide range of geographic locales and nuclear ambitions.

The discussion of the nuclear 'China model' that follows—including decisions about which elements of that 'model' to focus on—builds directly on the interpretations of my interlocutors during this research. As such, I do not aim to identify a singular or definitive nuclear 'China model.' Instead, I synthesize African interpretations of the 'China model' and perspectives on its relevant elements as they emerged through my research. As a result, my description of the nuclear 'China model' may differ from other discussions of China's nuclear model, including Chinese government narratives and descriptions offered by scholars of China and nuclear energy.

### The Appeal of the Nuclear 'China Model' in Africa

Viewed from the perspective of 2023, China's emergence as a 'green' energy 'model' in Africa is possible to take for granted. Less than a decade ago, however, African leaders were far more likely to view China's environmental and energy strategies as *anti*-models than as models. In 2015—just over two years after Beijing's "airpocalypse," during which hazardous particles reached concentrations over forty times higher than the World Health Organization's safety maximum—I attended the Forum on China-Africa Cooperation (FOCAC) in Johannesburg. During the FOCAC and its associated diplomatic and public side events, leaders of the 43 African governments in attendance often praised China's development 'success story' with one notable caveat: its environmental management. A lower-ranking South African government delegate, for example, told me that their government would "take China's success in pulling its people out of poverty" but "here...we must value our environment more so than they have done." A Zambian journalist expressed similar sentiments. "While we in Zambia want growth, we need growth," they said, "we must breathe the air." An official representing Namibia, which includes environmental protection in its constitution, noted that the Namibian government appreciates Chinese investments but "at times, we are concerned about its own commitment to the values that guide our country." Debates over whether the Chinese government was taking adequate steps to address its environmental degradation and carbon emissions also overshadowed a pre-FOCAC event sponsored by the World Wildlife Fund's China office, which was ostensibly focused on poaching and wildlife protection.

Given the concentration of critical raw materials (CRM) necessary for low-carbon energy transitions across the continent, African countries will almost certainly play a growing role in energy geopolitics in the context of climate change response. Uranium mining for nuclear energy is part of that story. African leaders are not content to be merely a source of raw materials for other countries' energy transitions though. They aspire to be energy producers and consumers in their own right—and, in a domestic context, they *need* to be.

Although dwarfed by attention to other forms of low-carbon energy (e.g., hydropower) and critical raw materials (CRM), nuclear energy development in Africa, sometimes referred to as “atoms for Africa,” has begun to attract modest attention among development practitioners and academics.<sup>23</sup> This shift signals a break with historical patterns. Excluding the “uranium from Africa” argument that falsely foregrounded the U.S. invasion of Iraq and the apartheid South African government's pursuit of nuclear weapons, Africa has rarely been associated with nuclear energy. Popular understandings of Africa and Africans as separate from nuclear geopolitics reflect the nuclearity binary described by Hecht, according to which Africa is a site of uranium extraction but not *nuclear* activity.<sup>24</sup>

Attention to nuclear energy is far less modest among African politicians. In 2015, ten African countries (Egypt, Ghana, Kenya, Morocco, Niger, Nigeria, South Africa, Sudan, Tunisia, and Uganda) established the African Network for Enhancing Nuclear Power Program Development (ANENP) in association with the International Atomic Energy Agency (IAEA). More recently, in October 2023, the African Commission on Nuclear Energy (AFCON), an autonomous Pan-African organization established in 2010 as part of the Treaty of Pelindaba (African Nuclear Weapon Free Zone Treaty), signed a memorandum of understanding with the World Nuclear Association to support civilian nuclear energy development across the continent. Although the continent has only two active reactors as of late 2023 (both at Koeberg in South Africa), four additional reactors are under construction at El Dabaa in Egypt. South Africa, Ghana, Kenya, and Nigeria also plan to initiate or complete construction on new nuclear plants in the next decade. Twelve additional countries—Algeria, Ethiopia, Morocco, Niger, Namibia, Rwanda, Senegal, Sudan, Tanzania, Tunisia, Uganda, and Zambia—have expressed desires to generate nuclear energy by 2050. In keeping with the Chinese government's own nuclear strategy, most of these governments plan to develop their nuclear energy capabilities under the direction of new or existing nuclear SOEs

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<sup>23</sup> Ansah, M.N.S., E.B. Agekum, P.A. Ameoah, and B.K. Afornu. 2021. “Atoms for Electricity Generation in Africa: Analysis of Factors Affecting the Continent's Readiness.” *Progress in Nuclear Energy* 141: 103938; Campbell, K. 2017. “Interest in Nuclear Energy Said to Be Rising Across Sub-Saharan Africa.” *Engineering News*, April 21. <http://www.engineeringnews.co.za/article/interest-in-nuclear-energy-said-to-be-rising-across-sub-saharan-africa-2017-04-21>; DeBoom, 2018; International Energy Agency (IEA). 2014. *Africa Energy Outlook: A Focus on Prospects in Sub-Saharan Africa*. [https://www.iea.org/publications/freepublications/publication/WEO2014\\_AfricaEnergyOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2014_AfricaEnergyOutlook.pdf); Jewell, J. 2011. “A Nuclear-Powered North Africa: Just a Desert Mirage or Is There Something on the Horizon?” *Energy Policy* 39, no. 8: 4445-4457; Kessides, I.N., and V. Kuznetsov. 2012. “Small Modular Reactors for Enhancing Energy Security in Developing Countries.” *Sustainability* 4, no. 8: 1-27; Marktanner, M., and L. Salman. 2011. “Economic and Geopolitical Dimensions of Renewable Vs. Nuclear Energy in North Africa.” *Energy Policy* 39, no. 8: 4479-4489.

<sup>24</sup> Hecht, 2012.

Why are African leaders interested in nuclear energy? My research suggests that geopolitical prestige is a significant factor, but there are also practical concerns at play. First, African officials face rapidly increasing electricity demands associated with rising living standards, urbanization, and population growth—challenges that resonate with the experiences of Chinese leaders. Sub-Saharan Africa’s population is projected to reach 2.8 billion people by 2060 (~30 percent of the projected global population), compared to 1 billion in 2010.<sup>25</sup> Nigeria is expected to become the third most-populous country that year, trailing only India and China. Urbanization, which is associated with rising living standards and electricity usage, will further increase electricity demand. Between 2010 and 2015, eight of the ten fastest-urbanizing countries were in Africa.<sup>26</sup> By 2030, nearly 60 percent of Africans are expected to live in urban areas, up from 36 percent in 2010. As in China, urbanization in Africa will significantly increase baseload electricity demand, much of which is currently provided by fossil fuels (e.g., coal in South Africa, natural gas in Nigeria, oil and natural gas in Egypt). Nuclear energy’s high construction costs but low marginal costs make it most efficient in contexts with high baseload electricity demand that is anticipated to remain consistent (or grow) for decades. African governments have taken note of this ‘sweet spot’ for nuclear energy development. During the October 2023 event marking the signing of the MOU between AFCONE and the World Nuclear Association, for example, AFCONE Executive Secretary Anobot Agboraw identified four advantages of nuclear energy for African countries: “its ability to provide base load, its long-term cost effectiveness, its environmental resilience, and the long operational lifespan of nuclear power plants.”

Second, the scale of nuclear energy generation in the context of existing electricity supply on the African continent means that even one reactor can have a significant economic and political impact. More than 625 million people in Africa (including North Africa)—roughly 45 percent of the continent’s population—lacked electricity access in 2022.<sup>27</sup> Although roughly 40 percent of infrastructure projects under construction in Africa are related to electricity provision, the continent’s high rate of population growth means that demand will almost surely continue to outpace supply. African officials anticipate that rising electricity demand will compound existing electricity shortages. Electricity shortages have significant economic effects, costing African countries up to 2 percent of their GDPs each year and contributing to political economic frustrations among citizens.<sup>28</sup> Loadshedding (power shortages leading to blackouts) in South Africa alone is expected to result in a \$13 billion economic loss in 2023.<sup>29</sup> My research suggests that many African political leaders view these shortages as not just an economic problem but a *political* one; African governments who fail to meet rising electricity demands risk losing support from key constituencies. For concerned leaders, nuclear energy represents

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<sup>25</sup> United Nations (UN). 2018. *World Population Prospects: Key Findings & Advance Tables (2018 Revision)*. Department of Economic and Social Affairs, Population Division. New York: United Nations.

<sup>26</sup> UN, 2018.

<sup>27</sup> IEA, 2023.

<sup>28</sup> Okwatch, D. 2022. “Energy: Africa’s Stand at COP27.” *African Renewal Magazine*, produced by the United Nations, 1 November. <https://www.un.org/africarenewal/magazine/november-2022/energy-africas-stand-cop27>.

<sup>29</sup> Ferragamo, M. 2023. “Will South Africa’s Power Crisis Sink its Green Ambitions?” *Council on Foreign Relations*, July 20. <https://www.cfr.org/in-brief/will-south-africas-power-crisis-sink-its-green-ambitions>.

a strategy for responding to rapidly rising citizen demands for electricity at scale and in a highly visible way.

Third, as noted by AFCONE Executive Secretary Anobot above, many African officials see nuclear energy as a strategy for addressing rising energy demand while also transitioning to low-carbon energy production. Like their Chinese counterparts, most African officials with whom I spoke downplayed the environmental risks and costs of nuclear energy, focusing instead on its potential to reduce air pollution and carbon emissions. Urban air pollution in Africa causes an estimated 3.6 million premature deaths per year, making it the top environmental cause of mortality on the continent, ahead of inadequate clean water and sanitation. As in China, many African ruling parties have political legitimacy strategies that rely on citizen perceptions of the state (and party) as facilitating development.<sup>30</sup> Rising pollution associated with fossil fuel-based electricity generation threatens to undermine the legitimacy of these governments, particularly when combined with growing youth populations.

Finally, many African leaders interpret nuclear energy as offering unique spatial benefits in the context of Africa. In countries with land shortages and/or political tensions involving land allocation and distribution—as is the case across much of the continent—nuclear energy is often viewed as a space-efficient energy option.<sup>31</sup> The possibility of siting nuclear power plants near growing urban areas without air pollution consequences (as is the case with coal) appeals to some African leaders, particularly given the substantial transmission costs in many African countries. Renewable energy, by contrast, is often space intensive. In high-wind regions (assuming 20 percent capacity), 200-250 square miles of windmills may be required to produce roughly 1 GW of electricity.<sup>32</sup> Solar power (again in favorable conditions, assuming 17 percent capacity) can require roughly 50 square miles of cleared land to produce 1 GW of electricity.<sup>33</sup> The reactor for a 1 GW nuclear power plant, by contrast, is roughly the size of a bedroom (diameter = 15 feet), with a containment room the size of a large industrial building. The small modular reactors (SMRs) under development in China are roughly the size of a trash can. SMRs are particularly appealing to countries with lower initial electricity demands due to their lower costs and more modest scale (~100MWe versus roughly 600 MWe for the smallest typical reactor plants). African officials with whom I spoke were almost universally enthusiastic about these technologies and their potential alignment with their own domestic contexts.

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<sup>30</sup> Cooper, F. 2002. *Africa Since 1940: New Approaches to African History*. Cambridge, UK: Cambridge University Press.

<sup>31</sup> It is important to note, however, that living and working near a nuclear power plant is rarely popular. The long-term space requirements associated with nuclear energy disasters and waste storage are also substantial. African government officials with whom I spoke rarely mentioned such concerns, but these factors may affect popular support for nuclear energy in Africa. It is unclear to what degree these perceptions exist or predominate given the relative lack of research examining Africans' views on nuclear issues—though see Ewim, D.R.E., S.S. Oyewobi, M.O. Dioha, et al. 2021. "Exploring the Perception of Nigerians Towards Nuclear Power Generation." *African Journal of Science, Technology, Innovation, and Development* 14(4): 1059-1070; Odonkor, S.T. and S. Adams. 2020. "An Assessment of Public Knowledge, Perception, and Acceptance of Nuclear Energy in Ghana." *Journal of Cleaner Production* 269: 122279; and Nikosi, N.P. and J. Dikgang. 2021. "South African Attitudes About Nuclear Power: The Case of the Nuclear Energy Expansion." *International Journal of Energy Economics and Policy* 11(5): 138-146.

<sup>32</sup> *The Economist*, 2012.

<sup>33</sup> *Ibid.*

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The positive perceptions detailed above do not imply that African leaders are unaware of the challenges associated with nuclear energy development. African officials acknowledge that construction costs present a substantial hurdle to the development of nuclear energy in their countries. Small nuclear reactors (not SMRs—merely smaller reactors than average) in China often cost \$1-2 billion. Several leaders told me that these costs were not necessarily prohibitive though, thanks in part to the availability of low-interest lending options (particularly via the Chinese government). Chinese SOEs have signed formal nuclear agreements with Kenya (CGN), Sudan (CNNC), South Africa (CNNC), and Uganda (CNNC) to date, with further agreements anticipated. Several of my interlocuters also argued that it is important to consider the costs of nuclear energy in comparative terms. Other energy sources are also costly in urban Africa. Nigeria, for example, spends roughly \$14 billion annually in off-grid diesel generation. By 2035, Nigeria aims for 80 percent of its population to have grid-connected electricity, compared to 50 percent today.<sup>34</sup> The long-term cost of achieving this goal through an energy source with high marginal costs, like diesel, could approach or rival the cost of nuclear energy. African leaders—particularly in southern Africa—were also quick to note that first-moving nuclear producers will likely have lucrative opportunities to export electricity to their neighbors. In pursuing this option, they would aim to improve upon the model of South Africa’s Eskom, which exports electricity to Botswana, Lesotho, Mozambique, Namibia, eSwatini, and Zimbabwe. It is to one of these countries—Namibia—that I now turn.

### **Going Nuclear for Whom? Placing the Nuclear ‘China Model’ in Namibia**

Over the past decade, no country has increased its uranium exports—in absolute or relative terms—more than Namibia. Namibia’s rise to become the world’s third largest uranium exporter (trailing only Kazakhstan and Canada) is intimately intertwined with China’s nuclear energy strategy. Namibian people and places have long been rendered sacrificial in the name of nuclear pursuits by external actors, including those of the U.S., the U.K., and Japan during the Cold War and South Africa during apartheid.<sup>35</sup> Uranium mining in Namibia began in 1976, when Rio Tinto opened the Rössing mine. In geologic terms, the Rössing uranium deposit—like most of Namibia’s uranium deposits—was unspectacular. Uranium mines are described in terms of “grades,” which refer to the percentage of the orebody that is composed of uranium. Rössing has an average grade of 0.02 percent, versus more than 20 percent at Canada’s McArthur River mine. Rio Tinto could operate the mine profitably thanks in no small part to the apartheid labor system, which ensured low labor

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<sup>34</sup> IAEA, 2014.

<sup>35</sup> DeBoom, M.J. 2020. “Toward a More Sustainable Energy Transition: Lessons from Chinese Investments in Namibian Uranium.” *Environment: Science and Policy for Sustainable Development* 62, no. 1, 2-31; DeBoom, M.J. 2022. “Radioactive Strategies: Geopolitical Rivalries, African Agency, and the Longue Durée of Nuclear Infrastructures in Namibia.” In Seth Schindler and Jessica DiCarlo (eds), *The Rise of the Infrastructure State: How US-China Rivalry Shapes Politics and Place Worldwide*, p. 137-152. Bristol, UK: Policy Press; Hecht, 2012.

costs at a time of tightened mining regulations elsewhere.<sup>36</sup> Rössing remained the only uranium mine in Namibia for more than 30 years, beyond Namibia's independence in 1990. Commercial interest in Namibian uranium increased only after the precipitous rise in uranium prices in the 2000s, which was catalyzed in part by China's nuclear ambitions. In 2006, Namibia's first conventional uranium mine in 30 years opened. China's two major nuclear SOEs, General Nuclear Power Corp (CGN) and China National Nuclear Corporation (CNNC), began to purchase shares in foreign uranium mines that same year. As of late 2023, Chinese SOEs have majority ownership stakes all of Namibia's operating uranium mines, including Rössing. Namibia also accounts for more than half of the total estimated production of Chinese SOE-owned uranium mines overseas.

With a largely rural population of 2.5 million and a capital city with fewer than one million residents, Namibia is an inconspicuous candidate for nuclear energy. Yet in April 2011, the Namibian government's ruling SWAPO political party announced plans to construct its own nuclear reactor. In 2014, longtime SWAPO leader and subsequent President of Namibia Hage Geingob expressed his support for a Namibian nuclear plant in association with a tour of China's CGN-managed Dayawan Nuclear Plant. During a subsequent nuclear energy conference in 2014, then-Namibian Minister of Mines and Energy Isak Katali stated that, "[i]t is the expressed decision of the Namibian government to seriously consider the development of nuclear power in order to complete the national energy mix and provide sufficient energy for our development." A Chinese-Namibian joint venture submitted plans for a nuclear plant to the Ministry of Mines and Energy in 2017. Those plans have not come to fruition, but nuclear energy remains a hot topic in some political circles.

As is the case elsewhere on the continent, rising demand for electricity and rapid urbanization (albeit with a small starting population) have influenced Namibian leaders' nuclear goals. Desires for energy security and prestige have also played a significant role though. When I asked Namibian officials to describe the biggest development challenges facing Namibia in the next 15 years, they often highlighted energy security challenges. These concerns have only grown in recent years. Namibia imports over half of its electricity from South Africa, Zambia, and Zimbabwe, at a cost of \$238 million in 2021 (compared to \$9.9 million in 2016). One official with NamPower, Namibia's electricity SOE, indicated that options for renewing these import contracts are uncertain beyond their upcoming expirations. Although Namibia has one of the most reliable electricity grids in Africa, its reliance on exports from countries with their own energy shortages increases the risk of blackouts that could negatively affect commerce and fuel public discontent. Making matters worse, recurrent droughts have hampered electricity generation at Namibia's sole hydroelectric plant on the Angolan border, and the country's primary coal power station near Windhoek has been downgraded for age-related reasons. Given Namibia's substantial uranium resources, some Namibian officials view nuclear energy as a way to alleviate domestic energy shortfalls 'in house'—and transform Namibia from a net electricity importer to a net exporter in the process. The latter goal is a commercially appealing prospect given the much larger populations of neighboring countries like the

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<sup>36</sup> Hecht, 2012.

Democratic Republic of Congo, South Africa, and Zambia, all of which are experiencing electricity shortages.

In the context of Namibia, China's nuclear rise is often interpreted through the lens of its technological and geopolitical status. Many of the Namibian officials I interviewed equated nuclear energy with technological mastery and future-oriented thinking. Officials associated with Namibia's ruling SWAPO party regularly cited China's nuclear energy pursuits when characterizing it as a "pilot," "innovator," "leader," or "standard-bearer" in my interviews, during public forums, and in the media. They were not alone in expressing these sentiments. A young Namibian made a similar argument in a focus group (held during the Trump administration in the U.S.), noting that U.S. leaders were talking about "coal...that is energy from the 1800s! They would have us turn around. China says wind, nuclear, solar. These are the energies of the future." Despite Fukushima, for many (though not all) Namibians, nuclear energy represents the possibility of limitless economic development through seemingly endless energy. It is perceived as more futuristic and 'green' than coal or oil, but it also signifies state power (domestically and geopolitically) in a way that few renewables do.<sup>37</sup>

Some Namibian officials and ordinary citizens also interpret nuclear energy as an opportunity to remedy a situation in which Namibians are, in the words of a NamPower representative at a 2016 mining conference, "giving away our comparative advantage [uranium]." This is particularly true within SWAPO. Namibia's uranium exports since 1976 have facilitated the nuclear development and geopolitical prestige of countries like the U.K., the U.S., and South Africa, but they have done little, in the eyes of many of my informants, to enhance Namibia's development or geopolitical status. Many in SWAPO regard this situation with a sense of injustice. During a 2016 state visit to India, for example, then-Namibian President Hage Geingob characterized the control of nuclear technology by only a few countries as "nuclear apartheid." Plans are underway to increase Namibia's use of renewable energy by 2030, but most of these projects lack the geopolitical prestige and political appeal of nuclear energy or even fossil fuel-based electricity generation (e.g., the proposed gas-fired power plant associated with the Kudu offshore gas field). Many Namibians share the view that using Namibia's uranium to produce the country's own nuclear energy is a matter of justice. "Selling the uranium is selling out our country," one young Namibian uranium mine employee told me during a focus group. His fellow focus group participants agreed. These sentiments were particularly common in communities hosting large numbers of uranium mine employees.

Not everyone is convinced though. SWAPO leaders' calls for nuclear energy parallel their arguments for increased uranium mining in Namibia. In both cases, SWAPO leaders deploy arguments about the necessity of radioactive development and associated imaginaries of modernity and prestige to consolidate and legitimize the party's position as

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<sup>37</sup> Hydropower, which is associated with a degree of prestige due to its "megaproject" scale, is a possible exception. Nuclear energy retains a mystique that hydropower lacks though. I have met few Namibians who view the country's Ruacana dam in terms of geopolitical prestige, yet many Namibians think of the country's uranium mines and nuclear ambitions in those terms.

the trustee and arbitrator of development and to discipline dissent (e.g., to argue for political unity as essential to development). This is another connection to the 'China model'. Uranium mining-proximate minority communities are particularly skeptical of SWAPO's nuclear ambitions. For them, radioactive development through intensified uranium mining has meant dried out aquifers, dust pollution, threatened livelihoods, and embodied radioactive violence. As I have written about elsewhere, many residents of these communities view SWAPO's pursuit of radioactive 'development' and 'modernity' as antithetical to their own conceptions of development and the good life.<sup>38</sup> The push for a nuclear Namibia promises more of the same—only now under the banner of 'green' energy instead of 'green' extractivism. Going nuclear, for these communities, means investing in a symbol of SWAPO's achievements—and thus the consolidation of SWAPO's power as ruling party *and* its power over the rural minority communities who resist its authority. Namibian leaders see their nuclear ambitions as challenging the geopolitical injustices of nuclearity, which have long rendered their country merely a source of uranium. For those living on the frontlines of radioactive development, however, radioactive injustices appear likely to continue.

## Conclusion

This paper discussed African perceptions of China's nuclear 'model' and its relevance to their energy, environmental, and (geo)political goals. Drawing on data from interviews, focus groups, and participant observation, I provided insights into how and why African governments, including that of Namibia, are pursuing nuclear energy and what role China's 'model' of radioactive development is playing in those pursuits. By exporting nuclear technologies to African countries like Namibia, the Chinese government and its nuclear SOEs stand to reap significant soft power and commercial benefits. In keeping with Chinese geopolitical rhetoric of 'south-south solidarity,' such exports challenge the binary of nuclearity, or, in the words of Gabrielle Hecht, the "apparently immutable ontology [that] has long distinguished nuclear things from non-nuclear things" and has thus marginalized Africans in the nuclear realm.<sup>39</sup> The diffusion of China's nuclear model may also, however, serve to consolidate the developmental authority of African governments and, in so doing, make it more difficult for those living near uranium mining sites—or potential nuclear facilities—to contest the logics of radioactive development. In the case of Namibia, government officials frame their nuclear ambitions as challenging the geopolitics of "nuclear apartheid" that have long rendered their country merely a source of uranium exports. For those living on the frontlines of radioactive development, however, nuclear energy is likely to further entrench the climate necropolitics that have long rendered their lives disposable.

## References

Ansah, M.N.S., E.B. Agekum, P.A. Ameoah, and B.K. Afornu. 2021. "Atoms for Electricity Generation in Africa: Analysis of Factors Affecting the Continent's Readiness." *Progress in Nuclear Energy* 141: 103938.

Benabdallah, L. 2020. *Shaping the Future of Power: Knowledge Production and Network-Building in China-Africa*

<sup>38</sup> DeBoom, 2020a; DeBoom, 2021.

<sup>39</sup> Hecht, 2012, p. 897.

*Relations*. Ann Arbor: University of Michigan Press.

Campbell, K. 2017. "Interest in Nuclear Energy Said to Be Rising Across Sub-Saharan Africa." *Engineering News*, April 21. <http://www.engineeringnews.co.za/article/interest-in-nuclear-energy-said-to-be-rising-across-sub-saharan-africa-2017-04-21>.

Cooper, F. 2002. *Africa Since 1940: New Approaches to African History*. Cambridge, UK: Cambridge University Press.

Corkin, L. 2013. *Uncovering African Agency: Angola's Management of Chinese Credit Lines*. London: Ashgate.

Deberdt, R. and P. Le Billon. 2024. "Green Transition's Necropolitics: Inequalities, Climate Extractivism, and Carbon Classes." *Antipode*. <https://doi.org/10.1111/anti.13032>.

DeBoom, M.J. 2018. *Developmental Fusion: Chinese Investment, Resource Nationalism, and the Distributive Politics of Uranium Mining in Namibia*. PhD Dissertation, University of Colorado at Boulder.

DeBoom, M.J. 2020a. "Sovereignty and Climate Necropolitics: The Tragedy of the State System Goes 'Green'." In Moisiu, Sami, Andrew E.G. Jonas, Natalie Koch, Christopher Lizotte, and Juho Luukkonen, (eds), *Handbook on the Changing Geographies of the State: New Spaces of Geopolitics*, p. 276–286.

DeBoom, M.J. 2020b. "Toward a More Sustainable Energy Transition: Lessons from Chinese Investments in Namibian Uranium." *Environment: Science and Policy for Sustainable Development* 62, no. 1, 2-31.

DeBoom, M.J. 2021. "Climate Necropolitics: Ecological Civilization and the Distributive Geographies of Extractive Violence in the Anthropocene." *Annals of the American Association of Geographers* 111, no. 3: 900-912.

Driessen, M. 2019. *Tales of Hope, Tastes of Bitterness: Chinese Road Builders in Ethiopia*. Hong Kong: Hong Kong University Press.

Ewim, D.R.E., S.S. Oyewobi, M.O. Dioha, et al. 2021. "Exploring the Perception of Nigerians Towards Nuclear Power Generation." *African Journal of Science, Technology, Innovation, and Development* 14(4): 1059-1070.

Ferragamo, M. 2023. "Will South Africa's Power Crisis Sink its Green Ambitions?" *Council on Foreign Relations*, July 20. <https://www.cfr.org/in-brief/will-south-africas-power-crisis-sink-its-green-ambitions>.

Geall, S., and A. Ely. 2018. "Narratives and Pathways Towards an Ecological Civilization in Contemporary China." *The China Quarterly* 236:1175–96.

Gill, B., and Y. Huang. 2006. "Sources and Limits of Chinese 'Soft Power.'" *Survival* 48, no. 2: 17-36.

Hansen, M.H., H. Li, and R. Svarverud. 2018. "'Ecological Civilization': Interpreting the Chinese Past, Projecting the Global Future." *Global Environmental Change* 53:195–203.

Hecht, G. 1998. *The Radiance of France: Nuclear Power and National Identity After World War II*. Cambridge, MA: MIT Press.

Hecht, G. 2012. *Being Nuclear: Africans and the Global Uranium Trade*. Cambridge, MA: MIT Press.

Hinze, J. and Y. Zhou. 2012. "China's Commercial Reactors." *Nuclear Engineering International*, February. China Supplement. <https://www.belfercenter.org/sites/default/files/legacy/files/chinas-commercial-reactors-proof.pdf>.

International Atomic Energy Agency (IAEA). 2018. *Country Nuclear Power Profiles*.

<https://cnpp.iaea.org/pages/index.htm>; U.S. EIA. 2023. *International Energy Outlook 2023*.  
<https://www.eia.gov/outlooks/ieo/>.

International Energy Agency (IEA). 2014. *Africa Energy Outlook: A Focus on Prospects in Sub-Saharan Africa*.  
[https://www.iea.org/publications/freepublications/publication/WEO2014\\_AfricaEnergyOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2014_AfricaEnergyOutlook.pdf).

Jewell, J. 2011. "A Nuclear-Powered North Africa: Just a Desert Mirage or Is There Something on the Horizon?" *Energy Policy* 39, no. 8: 4445-4457.

Kessides, I.N., and V. Kuznetsov. 2012. "Small Modular Reactors for Enhancing Energy Security in Developing Countries." *Sustainability* 4, no. 8: 1-27.

Kurlantzick, J. 2007. *Charm Offensive: How China's Soft Power is Transforming the World*. New Haven, CT: Yale University Press.

Lee, C.K. 2018. *The Specter of Global China: Politics, Labor, and Foreign Investment in Africa*. Chicago: University of Chicago Press.

Liu, Z.Z. 2022. "Renewing America's Leadership in the Global Civil Nuclear Energy Market." *Council on Foreign Relations*, June 22. <https://www.cfr.org/blog/renewing-americas-leadership-global-civil-nuclear-energy-market>.

Marktanner, M., and L. Salman. 2011. "Economic and Geopolitical Dimensions of Renewable Vs. Nuclear Energy in North Africa." *Energy Policy* 39, no. 8: 4479-4489.

Martin, R. 2016. "Fail-Safe Nuclear Power." *MIT Technology Review*, August 2.  
<https://www.vox.com/2016/2/29/11132930/nuclear-power-costs-us-france-korea>.

Mbembe, A. 2003. "Necropolitics" *Public Culture* 15, no. 1: 11-40; Mbembe, A. 2019. *Necropolitics*. Durham: Duke University Press.

Mbembe, A. 2019. *Necropolitics*. Durham: Duke University Press.

Nikosi, N.P. and J. Dikgang. 2021. "South African Attitudes About Nuclear Power: The Case of the Nuclear Energy Expansion." *International Journal of Energy Economics and Policy* 11(5): 138-146.

Odonkor, S.T. and S. Adams. 2020. "An Assessment of Public Knowledge, Perception, and Acceptance of Nuclear Energy in Ghana." *Journal of Cleaner Production* 269: 122279.

Okwatch, D. 2022. "Energy: Africa's Stand at COP27." *African Renewal Magazine*, produced by the United Nations, 1 November. <https://www.un.org/africarenewal/magazine/november-2022/energy-africas-stand-cop27>.

Paradise, J.F. 2009. "China and International Harmony: The Role of Confucius Institutes in Bolstering Beijing's Soft Power." *Asian Survey* 49, no. 4: 647-669.

Pow, C.P. 2018. "Building a Harmonious Society through Greening: Ecological Civilization and Aesthetic Governmentality in China." *Annals of the American Association of Geographers* 103, no. 3: 864-883.

Puig, A.P.I. 2005. "Science on the Periphery. The Spanish Reception of Nuclear Energy: An Attempt at Modernity?" *Minerva* 43, no. 2: 197-218.

Repnikova, M. 2022. *Chinese Soft Power*. Cambridge: Cambridge University Press.

- Rippa, A., and T. Oakes. 2023. "Infrastructural Thinking in China: A Research Agenda." *The China Quarterly* 255: 547-559.
- Roberts, B., R.A. Manning, and R.N. Montaperto. 2000. "China: The Forgotten Nuclear Power." *Foreign Affairs*, July/August.
- Rodenbiker, J. 2023. *Ecological States: Politics of Science and Nature in Urbanizing China*. Ithaca: Cornell University Press.
- Sagan, S.D. 1996. "Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb." *International Security* 21, no. 3: 54-86.
- Schindler, S., I. Alami, J. DiCarlo, N. Jepson, et al. 2023. "The Second Cold War: US-China Competition for Centrality in Infrastructure, Digital, Production, and Finance Networks." *Geopolitics*. <https://doi.org/10.1080/14650045.2023.2253432>.
- Sovacool, B.K. and S.V. Valentine. 2010. "The Socio-Political Economy of Nuclear Energy in China." *Energy* 35: 3803-3813.
- Strauss, J.C. 2009. "The Past in the Present: Historical and Rhetorical Lineages in China's Relations with Africa." *The China Quarterly* 199: 777-795.
- The Economist*. 2012. "Nuclear Power: The Dream That Failed." <https://www.economist.com/node/21549936>.
- United Nations (UN). 2018. *World Population Prospects: Key Findings & Advance Tables (2018 Revision)*. Department of Economic and Social Affairs, Population Division. New York: United Nations.
- Xi, J. 2014. "Statement by H.E. Xi Jinping, President of the People's Republic of China, at the Nuclear Security Summit." Ministry of Foreign Affairs of the People's Republic of China, March 25. [http://www.fmprc.gov.cn/mfa\\_eng/wjdt\\_665385/zyjh\\_665391/t1140583.shtml](http://www.fmprc.gov.cn/mfa_eng/wjdt_665385/zyjh_665391/t1140583.shtml).
- Xi, J. 2017. "Secure a Decisive Victory in Building a Moderately Prosperous Society." [http://www.xinhuanet.com/english/download/Xi\\_Jinping's\\_report\\_at\\_19th\\_CPC\\_National\\_Congress.pdf](http://www.xinhuanet.com/english/download/Xi_Jinping's_report_at_19th_CPC_National_Congress.pdf).
- Wang, Y. 2008. "Public Diplomacy and the Rise of Chinese Soft Power." *The Annals of the American Academy of Political and Social Sciences* 616, no. 1: 257-273.
- World Nuclear Association (WNA). 2019. "Nuclear Power in the World Today." <http://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx>.
- Yeh, E. 2023. "The Making of Natural Infrastructure in China's Era of Ecological Civilization." *The China Quarterly* 255: 611-627.