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ISSUE BRIEF

International Co-financing of Nuclear Reactors Between the United States and its Allies

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Introduction: International cooperation and the co-financing of nuclear reactors

It is critically important for global safety standards, nonproliferation agreements, and geopolitics that the United States play a leading role in the export of nuclear energy technologies. However, the domestic reactor fleet has struggled due to the deregulated US electricity market, inexpensive gas, and subsidies for renewables, which—in turn—has hampered US nuclear exports, since it is challenging to export a product that lacks a domestic market. However, building new reactors and bringing first-of-a-kind reactors to demonstration involve high capital costs and financial risk, for the purchasing party as well as the vendor. If the United States is to play a role at all in building new nuclear plants, it must address the challenges inherent in financing new nuclear builds; one mechanism to do this is through partnering with close US allies to co-finance new nuclear projects. If the United States and its allies fail to make their nuclear exports competitive, they will likely cede the mantle of global leadership in that area to Russia and China, where nuclear companies are state owned, easily able to finance nuclear exports, and already exploring emerging markets for nuclear exports.

A 2017 policy paper by US think tank Third Way argued, “France, the UK, Korea, Japan and Canada are all nuclear exporters who share [US] safety, security and democratic values. While individually we will all struggle to compete with Russia and China, we can cooperate to put together appeal-

The Global Energy Center promotes energy security by working alongside government, industry, civil society, and public stakeholders to devise pragmatic solutions to the geopolitical, sustainability, and economic challenges of the changing global energy landscape.

ing financing deals."[1] It is critical that the United States work to co-finance nuclear exports with allies, since US suppliers "can only sell nuclear power fuel or equipment abroad subject to a civil nuclear cooperation agreement," known as a Section 123 agreement.[2] Furthermore, since nuclear agreements establish decades-long diplomatic relationships, diplomatic stability is key. It should ideally not be subject to policy changes, like the 2018 restrictions on civil nuclear technology exports to China.[3] An international co-financing scheme between the United States and its allies is one way of competing with state-owned nuclear enterprises in Russia and China. The financial aspect is merely one component of international cooperation that fits into a broader framework that includes regulatory harmonization, diplomatic agreements, standards for safety and nonproliferation, research and development (R&D), and reactor demonstration. However, this issue brief focuses specifically on international co-financing as a way of bringing down transaction costs for the United States and its allies, even if the allies in question ultimately become market competitors.

As of October 2019, thirty countries were "considering, planning or starting" nuclear power programs.[4] Many of these are not members of the Organisation for Economic Co-operation and Development (OECD), and they are interested in acquiring civil nuclear capabilities, in large measure, to meet their anticipated increase in electricity demand.[5] Advanced nuclear technologies, like small modular reactors (SMRs) with capacities up to 300 megawatts (MW), are often especially appealing in emerging markets where the need for reliable zero-carbon energy is pronounced, but current grid structures cannot support large light-water reactors (LWRs).[6] Growing demand in traditional and emerging markets for advanced reactors represents an opportunity for the United States to export new nuclear technologies and regain a global leadership position. Russia and, to a lesser extent, China have identified these emerging nuclear markets, in OECD countries and especially in non-OECD countries, as opportunities not just to sell their technologies, but to enter into long-term diplomatic and financial agreements.

This issue brief examines the nature of cooperation between the United States and its allies to finance nuclear reactors, and it also looks at how international governing bodies like the International Atomic Energy Agency (IAEA) have facilitated co-financing efforts. This issue brief argues for the importance of US involvement in nuclear exports, with co-financing as a key method for lowering the costs associated with being a vendor of nuclear technologies, especially in markets where Russia and China are working to build nuclear reactors. Finally, this brief makes recommendations for ways in which the United States can streamline its export-financing mechanisms and reclaim its authority as a global leader in exporting nuclear technologies.

I. Challenges and considerations of international co-financing for nuclear reactor projects

How international co-financing works

The IAEA sets "the global framework of every nuclear project" to ensure that countries seeking nuclear technologies adhere to nonproliferation standards, which it does by coordinating between the political and regulatory regimes of each country in question.[7] Due to the challenges of coordinating between countries, a "set of treaties and conventions, rules and principles of regional institutions and professional associations such as the World Association of Nuclear Operators (WANO), in addition to national regula-

1 Suzanne Hobbs Baker, Ryan Fitzpatrick, and Matt Goldberg, *Getting Back in the Game: A Strategy to Boost American Nuclear Exports*, Third Way, January 10, 2017, https://www.thirdway.org/report/getting-back-in-the-game-a-strategy-to-boost-american-nuclear-exports.

2 Christopher Ashley Ford, "A New Approach to Civil Nuclear Cooperation Policy," (remarks given at the Hudson Institute, Washington, DC, February 26, 2019), https://www.state.gov/a-new-approach-to-civil-nuclear-cooperation-policy/.

3 Névine Schepers, *Too restrictive? US constrains civil nuclear technology exports to China*, The International Institute for Strategic Studies, October 18, 2018, https://www.iiss.org/blogs/analysis/2018/10/us-restricts-nuclear-exports-china.

4 "Emerging Nuclear Energy Countries," World Nuclear Association, last updated October 2019, https://www.world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.aspx.

5 "Emerging Nuclear Energy Countries."

6 Jessica Lovering and Kenton De Kirby, "Why the United States Should Partner With Africa to Deploy Advanced Reactors," *Issues in Science and Technology*, Vol. 35, No. 2, Winter 2019, https://issues.org/why-the-united-states-should-partner-with-africa-to-deploy-advanced-reactors/.

7 Fabienne Pehuet Lucet, "Financing Nuclear Power Plant Projects: A New Paradigm?," *IFRI Centre Énergie* May 2015, http://large.stanford.edu/courses/2017/ph241/zau1/docs/ifri-may15.pdf.

Workers are seen at Hinkley Point C nuclear power station site, near Bridgwater, Britain, September 12, 2019. *REUTERS/Peter Nicholls*

tions, complement the IAEA rules and contribute to regulating and controlling nuclear activities."[8] The International Framework for Nuclear Energy Cooperation (IFNEC), which was formerly the Global Nuclear Energy Partnership (GNEP), is an IAEA partner that deals specifically with co-financing questions.[9] While the IAEA helps coordinate between the relevant entities of countries that wish to co-finance nuclear reactor projects, the co-financing itself is generally left up to the governments in question, or to the owner and operator of the nuclear plant.[10]

In international nuclear co-financing—whether the relevant cooperating entities are government to government, business to business, or business to government—it is necessary to determine how to fund the capital costs of new builds, how to handle debt, and who assumes risk.

8 Lucet, "Financing Nuclear Power Plant Projects."

9 "International Framework for Nuclear Energy Cooperation," World Nuclear Association, last updated November 2016, https://www.world-nuclear.org/information-library/current-and-future-generation/international-framework-for-nuclear-energy-coopera.aspx.

10 *Funding and Finance*, International Atomic Energy Agency, accessed November 2019, https://www.iaea.org/topics/funding-and-finance.

In a 2008 paper on finance for new nuclear projects, the IAEA wrote that "governments have the power to establish general economic and institutional conditions conducive to external or commercial financing … they also have control over regulatory practices and policies."[11] At the same time, financing through private capital still relies on government support.[12] Ultimately, successful co-financing schemes will likely require a hybrid model of government funds and guarantees, along with robust vendor financing.[13]

Who assumes financial risk?

Several risks contribute to the costs of nuclear plants, including: insurance, construction and supply chain risks, plant operating performance (whether a plant has to shut down, and thereby loses revenue), fuel costs (including used fuel and waste), and the decommissioning of power plants.[14] Costs associated with nuclear projects can be financed through debt, equity, or some type of hybrid between the two.[15] Debt entails a loan, most often by a bank or international lending institution, which is then repaid with interest, while equity financing involves an investor who receives an ownership share after providing initial capital.[16]

One of the key questions in financing new nuclear builds is determining which entity (or entities) must carry the financial risk. Options range from the construction company to the client (or operator) to the government.[17] In some instances, governments (be they the purchaser or the technology provider for a state-owned enterprise) assume the financial risks associated with building new nuclear power plants; in others, corporations assume the full risk, or risk can often be shared between governments and corporations. For example, the financing of Hinkley Point C in the United Kingdom (UK) has primarily relied on France's Électricité de France (EDF); however, as of October 2013, EDF held 45–50 percent of the project, while Chinese companies China General Nuclear Power Group (CGN) and China National Nuclear Corporation (CNNC) held 30–40 percent, and French company Areva held 10 percent.[18] Importantly, EDF and Areva are, respectively, 85-percent and 80-percent owned by the French government, while the Chinese government owns the Chinese nuclear companies entirely.[19] However, even government involvement has not prevented financial challenges, as Areva experienced financial trouble by 2015 that precluded its continued involvement. To facilitate business-to-government co-financing for the project, EDF negotiated with the UK government throughout 2012 and 2013.[20] Although construction had been expected to start by the middle of 2019, the UK government postponed its decision until September, after which it reached a new agreement with EDF and Areva.[21]

In government-to-government financing, the vendor generally holds a portion of a state-run nuclear project, the purchasing country attracts foreign funds—as well as the nuclear expertise of the vendor—and both countries have the opportunity to build a bilateral relationship that will last, in all likelihood, for decades.[22] Given the large number of stakeholders that any new nuclear reactor build would entail, it is likely that many financing scenarios would look like

11 *Financing of New Nuclear Power Plants*, International Atomic Energy Agency, accessed November 2019, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1345_web.pdf.

12 Ibid.

13 "Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing," International Framework for Nuclear Energy Cooperation, (conference proceedings, May 11–12, 2016, Paris, France), https://www.ifnec.org/ifnec/upload/docs/application/pdf/2018-02/2016_ifnec_nea_nuclear_energys_role_in_the_21st_century_addressing_the_challenge_of_financing.pdf.

14 *The Financing of Nuclear Power Plants*, Nuclear Energy Agency, 2009, https://www.oecd-nea.org/ndd/reports/2009/financing-plants.pdf.

15 Ibid, 40.

16 Ibid, 40-41.

17 Jan Haverkamp, "Financing Models for Nuclear Power Plants," *Nuclear Monitor*, Issue #851 No. 4680, September 20, 2017, https://www.wiseinternational.org/nuclear-monitor/851/financing-models-nuclear power-plants. Haverkamp argues that "in a turn-key contract, the risks for time overdraws, budget overdraws and mistakes is carried by the construction company … The client—the operator—only carries the risk of lost income due to potentially late delivery."

18 Kukil Bora, "Consortium Led By France's EDF, And Including 2 Chinese Companies, To Build UK's First Nuclear Plant Since 1995, Will Create 25K Jobs," *International Business Times*, October 21, 2013, https://www.ibtimes.com/consortium-led-frances-edf-including-2-chinese-companies-build-uks-first-nuclear-1433326.

19 "Nuclear Power in the United Kingdom," World Nuclear Association, last updated October 2019, https://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-kingdom.aspx.

20 Ibid.

21 Ibid.

22 *Financing Nuclear Power in Evolving Electricity Markets*, International Atomic Energy Agency, April 2018, https://www.iaea.org/sites/default/files/18/07/financing-np-0418.pdf.

public-private partnerships—at least to some degree, and depending on local regulatory and market conditions—and that a combination of entities is likely to carry any financial risk involved.

Market forces make conditions in third-party countries appropriate for nuclear power

A Nuclear Energy Agency (NEA) report points out the impacts of "changes in the structure of the electricity markets in many OECD countries" that have increased the competitiveness of electricity markets and made it more difficult for utilities to recoup the upfront costs of nuclear power plant builds from electricity consumers.[23] Without a guarantee of return on initial investment, private utilities—the "traditional investors in power plants of any kind"—have struggled to finance nuclear power plants.[24] The IAEA notes that "where there is significant state ownership of nuclear utilities (such as in China, France, India, the Republic of Korea and the Russian Federation), the distinction between government and corporate financing is blurred."[25] Utility ownership (whether by government or the private sector) can add another dimension to questions of who assumes risk and which entities are likely to recover the costs of new nuclear builds.[26]

It is difficult to finance nuclear power in liberalized electricity markets due, in part, to the high capital expenses that are often passed to the consumer.[27] Additionally, liberalized markets do not account for negative externalities or value benefits, like low-carbon or baseload energy.[28] Where electricity markets are deregulated, "investors and lenders require more and more securities to enter nuclear projects."[29] Hungary, Slovakia, Belarus, Bangladesh, India, China, and the United Arab Emirates (UAE) are examples of countries with regulated electricity markets that are building new reactors, while countries like the UK and Finland have "reintroduced regulation instruments," and are, thus, also able to build new nuclear plants.[30] The IAEA's *Financing Nuclear Power in Evolving Electricity Markets* report notes that reactors in the United States "are in operation and planned in both regulated and unregulated markets," but that liberalization in electricity markets can lead to price instability, which creates "a challenging environment for new investment in capital intensive projects, such as nuclear power."[31] Given the challenges to new nuclear builds in liberalized electricity markets, nuclear reactors co-financed among the United States and its allies are likely to be built in third-party countries—some, but not most, of which may belong to the OECD.

New reactor designs face expenses due to lack of standardization

The costs of building new LWRs are well known, and—along with increasing security and fuel efficiency—bringing down expenses is one of the many goals of new or Generation IV reactors. Although advanced reactors ultimately aim to be more cost-effective than LWRs, there are potentially significant costs associated with demonstrating and commercializing first-of-a-kind technology. For example, an advanced reactor model must go through the process of licensing and permitting in each country where it seeks to build, dramatically multiplying the capital costs that it pays for upfront siting, licensing, and permitting. However, US Nuclear Regulatory Commission (NRC) Chairman Kristine Svinicki and Canadian Nuclear Safety Commission (CNSC) President and Chief Executive Officer (CEO) Rumina Velshi recently signed a memorandum of understanding (MOU), with the aim of harmonizing the regulatory process and technical reviews, especially for advanced reactors and SMRs.[32]

The Bulletin of the Atomic Scientists has argued, "in the United States, new nuclear plants varied significantly in design, due to the continual incorporation of new technological advancements—and also because of differences

23 *The Financing of Nuclear Power Plants*, Nuclear Energy Agency, 14.

24 Ibid, 45.

25 *Financing Nuclear Power in Evolving Electricity Markets*, International Atomic Energy Agency.

26 *The Financing of Nuclear Power Plants*, Nuclear Energy Agency, 12.

27 Haverkamp, "Financing Models for Nuclear Power Plants."

28 Charles Bayless, "Electricity Externalities and Regulation," *Public Utilities Fortnightly*, June 2018, https://www.fortnightly.com/fortnightly/2018/06/electricity-externalities-and-regulation?authkey=d94f4bea1fdf9dc191da6e6c11c6c11949011ea31d1f4de8ebe101cbb72e7b84.

29 Lucet, "Financing Nuclear Power Plant Projects."

30 Haverkamp, "Financing Models for Nuclear Power Plants."

31 *Financing Nuclear Power in Evolving Electricity Markets*, International Atomic Energy Agency.

32 James Conca, "The World Begins to Slowly Cooperate on New Nuclear Energy," *Forbes*, September 30, 2019, https://www.forbes.com/sites/jamesconca/2019/09/30/the-world-begins-to-slowly-cooperate-on-new-nuclear-energy/#647333c93e9e.

in location, layout, climate conditions, and cooling methods."[33] It is likely that, as advanced reactor companies establish agreements with the US Department of Energy and utilities—and especially as these companies bring their reactors to demonstration and commercialization—there will be an increase in standardization or, at the very least, fewer reactor types to license and site.

II. International co-financing examples

As the examples below will illustrate, the United States and its allies have faced a number of challenges—at both the government and private sector levels—in co-financing their nuclear energy programs. Although some nuclear energy partnerships, especially US-Japan and US-Republic of Korea (ROK), have experienced successes in the past, the countries in question can do more to bolster their efforts to be effective in their financial cooperation. This section provides a brief overview of cooperation efforts between the United States and, respectively, Japan and the ROK, and it also highlights new US diplomatic efforts to sign MOUs with Canada and other countries. Finally, this section looks at co-financing relationships in the UK and France, and at some of the challenges that those two countries have encountered.

US and Japan civil nuclear cooperation

In the realm of bilateral relationships, the United States and Japan signed the US-Japan Nuclear Research Agreement in 1955, making them the first two countries to have a civil nuclear accord.[34] Following that agreement, US companies sold equipment, technology, and fuel to Japan; in turn, Japan spent at least $150 million on US license fees and nuclear fuel services.[35] The two governments collaborate on a range of civil nuclear issues that go beyond financing, including R&D efforts through the Civil Nuclear Energy R&D Working Group established in 2012.[36] However, private sector cooperation on nuclear energy between the two countries has faced financial challenges in recent years.

The Atlantic Council Task Force on US Nuclear Energy Leadership noted that a number of private US companies, including Westinghouse Electric Company and General Electric Company, "helped Japan, South Korea, and Western European countries to develop their first reactors, which began operating in the early 1960s. Toshiba acquired Westinghouse Electric Company in 2006 and, in 2007, GE and Hitachi formed a joint venture, GE Hitachi Nuclear Energy (GEH), which is based in the United States and in which GE holds a 60 percent stake."[37] Although GEH has fared better, Toshiba and Westinghouse faced major restructuring challenges in 2017, which led to severe financial losses and an end to Westinghouse taking on "reactor construction contracts such as the AP1000 projects that have led it to seek bankruptcy protection."[38]

A boom followed Toshiba's acquisition of Westinghouse in 2006, including a series of agreements between Westinghouse and China's State Nuclear Power Technology Corporation (SNPTC).[39] Westinghouse agreed to provide SNPTC with R&D services to build a CAP1400 nuclear power plant, and also held contracts for the construction of four AP1000s—two at Sanmen owned by CNNC, and two at Haiyang operated by Shandong Nuclear Power Company, a subsidiary of the State Power Investment Corporation.[40] Additionally, Westinghouse acquired several other companies in the nuclear energy industry. However, by 2012, Westinghouse faced financial difficulties due to factors including the 2011 Fukushima Daiichi disaster and low natural

33 Daria Iurshina, Nikita Karpov, Marie Kirkegaard, Evgeny Semenov, "Why nuclear power plants cost so much—and what can be done about it," Bulletin of the Atomic Scientists, June 20, 2019, https://thebulletin.org/2019/06/why-nuclear power-plants-cost-so-much-and-what-can-be-done-about-it/.

34 Phyllis Yoshida, *U.S.-Japan Nuclear Cooperation: The Significance of July 2018*, Sasakawa Peace Foundation USA, March 26, 2018, https://spfusa.org/wp-content/uploads/2018/03/123-Agreement-Yoshida-032618.Final_.pdf.

35 Yoshida, *U.S.-Japan Nuclear Cooperation*.

36 "Bilateral Cooperation," US Department of Energy Office of Nuclear Energy, accessed November 2019, https://www.energy.gov/ne/nuclear reactor-technologies/international-nuclear-energy-policy-and-cooperation/bilateral.

37 Atlantic Council Task Force on US Nuclear Energy Leadership, US Nuclear Energy Leadership: Innovation and the Strategic Global Challenge, Atlantic Council, May 2019, https://www.atlanticcouncil.org/in-depth-research-reports/report/us-nuclear-energy-leadership-innovation-and-the-strategic-global-challenge-2/.

38 Jim Green, "Update on the Toshiba /Westinghouse Crisis," *World Information Service on Energy*, Issue: #843 No. 4642, August 6 2017, https://www.wiseinternational.org/nuclear-monitor/843/update-toshiba-westinghouse-crisis.

39 "China signs first engineering contracts for Westinghouse AP1000-derived CAP1400 reactor," *Power Engineering*, November 29, 2010, https://www.power-eng.com/2010/11/29/china-signs-first/#gref.

40 "Sanmen 2 AP1000 enters commercial operation," *World Nuclear News*, November 6, 2018, http://www.world-nuclear-news.org/Articles/Sanmen-2-AP1000-enters-commercial-operation; "Top ten biggest nuclear power plants in China," *Power Technology*, September 10, 2019, https://www.power-technology.com/features/top-ten-biggest-nuclear power-plants-in-china/.

gas prices. By 2017, Westinghouse had filed for bankruptcy, and Toshiba was facing twenty lawsuits in Japan "filed by banks, individuals, overseas investors and other parties seeking damages totaling ¥50 billion (US $455 million)."[41] Westinghouse was ultimately acquired by Brookfield Business Partners in 2018, out of a bankruptcy proceeding.

US and the Republic of Korea (ROK) civil nuclear cooperation

The United States and the ROK have cooperated on civil nuclear energy since 1956. In 1958, General Atomics agreed, through the Atoms for Peace Program, to work with the ROK on a research reactor. As a result, the ROK purchased a TRIGA Mark II research reactor, which came online in 1962, using US-origin fuel.[42] The United States and the ROK collaborate on R&D through the International Nuclear Energy Research Initiative (I-NERI) at the US Department of Energy.[43] Like Japan, the ROK worked with US companies Westinghouse, Combustion Engineering, and General Electric to build its early reactors. The ROK has invested heavily in its own civil nuclear program, and—with its win of the 2009 UAE nuclear contract for reactors to be built by Doosan, Korea Electric Power Corporation (KEPCO), Hyundai, Samsung, and Westinghouse—has become a significant nuclear vendor in its own right.[44]

The agreement announced in July 2019 between the Utah Associated Municipal Power Systems (UAMPS) and NuScale—a private sector, US-based company that is developing a modular light-water reactor that will generate 60 MW of electricity—for the purchase of 150 MW of power, also included international investment.[45] In July 2019, Doosan Heavy Industries & Construction Company and NuScale agreed to a $1.2-billion collaboration, in which Doosan would provide parts and equipment for NuScale's SMR project in Idaho, where NuScale plans to build and commercialize the first SMR in the United States.[46] An American Council for Capital Formation report recommended that the United States and the ROK continue to identify opportunities for nuclear business partnerships, especially in third-party countries.[47] The advances of Russia and China into emerging nuclear markets since 2016 have made those recommendations even more imperative.

US and Canada civil nuclear cooperation

In March 2019, the US Department of State announced a new initiative to facilitate the signing of MOUs with other countries that would "help American companies compete in the race to build the next generation of nuclear power plants around the world."[48] These MOUs are intended to bolster the activities of the US Departments of Energy and Commerce, but the involvement of the State Department is expected to elevate international cooperation efforts on civil nuclear power. The MOU between the US NRC and the CNSC is primarily structured around regulatory cooperation, especially on technical reviews for new technologies, like advanced reactors and SMRs.[49]

US cooperation with Canada in the field of nuclear energy dates back to 1955, and the two countries currently work together on a range of civil nuclear issues. Much like the United States and the ROK, the United States and Canada collaborate through I-NERI at the US Department of Energy.[50] Within the current field of private sector nuclear-energy start-ups, there is crossover between US and Canadian companies and their funders. For example, GEH

41 Green, "Update on the Toshiba /Westinghouse Crisis."

42 Jeffrey C. Crater and George David Banks, *The U.S.-Republic of Korea Nuclear Relationship – An Indispensable Alliance*, American Council for Capital Formation, December 2016, http://accf.org/wp-content/uploads/2017/04/ACCF-U.S.-ROK-Report-FINAL.pdf.

43 "BilateralCooperation."

44 Crater and Banks, *The U.S.-Republic of Korea Nuclear Relationship*.

45 Nathan Brown, "UAMPS announces 150 megawatts of buy-in for reactor project," *Post Register*, July 18, 2019, https://www.postregister.com/news/government/uamps-announces-megawatts-of-buy-in-for-reactor-project/article_4fa16981-17e1-51bf-af84-db31943a776e.html.

46 Matt Bowen, Stephen Brick, and Max Luke, *U.S.-ROK Cooperation on Nuclear Energy to Address Climate Change*, Nuclear Innovation Alliance, November 2019, http://www.nuclearinnovationalliance.org/us-rok-cooperation-nuclear-energy-address-climate-change; "UAMPS at vanguard of NuScale's relentless march towards commercialization," *NuCleus*, 2018, accessed November 2019, https://www.nuscalepower.com/newsletter/nucleus-fall-2018/uamps-update.

47 Crater and Banks, *The U.S.-Republic of Korea Nuclear Relationship*.

48 Tom DiChristopher, "The US is losing the nuclear energy export race to China and Russia. Here's the Trump team's plan to turn the tide," *CNBC*, April 4, 2019, https://www.cnbc.com/2019/03/21/trump-aims-to-beat-china-and-russia-in-nuclear-energy-export-race.html.

49 James Conca, "The World Begins to Slowly Cooperate on New Nuclear Energy."

50 "Bilateral Cooperation."

is funding ARC Nuclear Canada, and Jeff Bezos has provided funds to Canada's General Fusion.[51]

Co-financing could allow US nuclear exports to compete with Russian and Chinese state-owned enterprises

The World Nuclear Association has identified thirty countries as emerging markets for nuclear energy technologies, and most of the countries in question are not members of the OECD. The regions focused on acquiring civil nuclear capabilities include: Eastern Europe; the Middle East and North Africa; Western, Central, and Southern Africa; Central and South America; and East and Southeast Asia.[52] Russia and China have identified these new markets as opportunities to expand their spheres of influence by forging diplomatic and economic relationships. However, nuclear commitments between Russia or China and third-party countries may lack the safety guarantees and nonproliferation standards that are integral to nuclear-export agreements made by the United States or its allies.

Russia is playing an increasingly dominant role in exporting nuclear technologies around the world. In the early fall of 2019, Russia announced that it would build nuclear reactors in India and Rwanda, and a second reactor in Turkey.[53] Russia's ability to finance new nuclear projects through its state-owned enterprises allows it to offer attractive financial terms to countries that are newcomers to the civil nuclear energy sector. However, many purchasing countries choose their civil nuclear vendors based on geopolitical considerations, economics, and preferences for a particular nuclear technology. While financing from Russia and China may be more advantageous now, many countries still wish to build diplomatic ties with the United States, and would opt for nuclear partnerships with the United States and its allies.[54]

NuScale has signed agreements with Canada, Romania, and Jordan to "explore deploying its small modular reactors" in those countries, and other US nuclear companies are in various stages of negotiations with third-party countries.[55] Poland and the United States also signed an MOU on civilian nuclear energy cooperation in June 2019.[56] And, in October 2019, GEH announced that it had signed an agreement with Polish billionaire Michał Sołowow's company, Synthos SA, to build a 300-MW SMR in Poland, based on the premise that GE would license its SMR design in North America by 2024 and be able to build the unit in Poland in 2027.[57] Additionally, GEH and Fermi Energia OÜ have recently announced cooperation in Estonia on GEH's BWRX-300 SMR, and X-Energy and Jordan have signed a letter of intent to build four high temperature gas cooled 75-Megawatt electric (MWe) nuclear reactors.[58]

Less threatening than Russian and Chinese state-owned enterprises from a geopolitical standpoint, but just as illustrative of the advantages of state-owned enterprises, Finland as of 2019 had four nuclear reactors that provide 30 percent of its electricity, with a fifth reactor under construction and a sixth reactor planned.[59] Involvement in Finland's nuclear construction from France's EDF and Areva is not

51 Mark Halper, "Green, Nuclear, and Crowdfunded: One Startup's Unconventional Route to Building a Novel Reactor," *Fortune*, October 18, 2019, https://fortune.com/2019/10/18/nuclear power-crowdfunding-moltex/.

52 "Emerging Nuclear Energy Countries," World Nuclear Association.

53 "Russia plans to set up above 20 nuclear power units in India in next 20 years," *Livemint*, September 4, 2019, https://www.livemint.com/news/india/russia-plans-to-set-up-above-20-nuclear power-units-in-india-in-next-20-years-1567600889899.html; "Russia and India increase nuclear cooperation," *Nuclear Engineering International*, September 5, 2019, https://www.neimagazine.com/news/newsrussia-and-india-increase-nuclear-cooperation-7400438; Ivan R. Mugisha, "Rwanda Approves Nuclear Power Deal With Russia," *All Africa*, October 20, 2019, https://allafrica.com/stories/201910200091.html; "Rosatom wins license to build second nuclear reactor in Turkey – deputy CEO," Reuters, September 6, 2019, https://www.reuters.com/article/rosatom-nuclearpower-turkey/rosatom-wins-licence-to-build-second-nuclear reactor-in-turkey-deputy-ceo-idUSL5N25X40O.

54 Katherine Smith and Reto Gieré, *Why Some Nations Choose Nuclear Power*, Kleinman Center for Energy Policy, June 23, 2017, https://kleinmanenergy.upenn.edu/policy-digests/why-some-nations-choose-nuclear power.

55 DiChristopher, "The US is losing the nuclear energy export race."

56 "Poland, US sign MOU on nuclear energy cooperation," *Polandin*, June 12, 2019, https://polandin.com/43058326/poland-us-sign-mou-on-nuclear-energy-cooperation.

57 Maciej Martewicz and Konrad Krasuski, "As Poland Exits Coal, a Billionaire Offers First Nuclear Plant," *Bloomberg*, October 22, 2019, https://www.bloomberg.com/news/articles/2019-10-22/as-poland-exits-coal-a-billionaire-offers-first-nuclear-plant.

58 "GE Hitachi Nuclear Energy Announces New Reactor Technology Collaboration in Estonia," *GE Reports*, October 2, 2019, https://www.genewsroom.com/press-releases/ge-hitachi-nuclear-energy-announces-new-reactor-technology-collaboration-estonia; "X-Energy Signs on with Jordan for Four 75 MWe HTGR," *Energy Central*, November 15, 2019, https://www.energycentral.com/c/ec/x-energy-signs-jordan-four-75-mwe-htgr.

59 "Nuclear Power in Finland," World Nuclear Association, last updated July 2019, https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/finland.aspx.

The very first Belarusian nuclear power plant, which will have two power-generating units and is financed by Russia, is seen during emergency services drills, near the town of Ostrovets, Belarus, October 11, 2019. *REUTERS/Vasily Fedosenko*

without financial difficulties, but nationalized companies and regulated utilities are generally better equipped to handle financial challenges.[60]

National financing institutions: Overcoming past challenges

The ability of the United States to export its nuclear energy technologies is integral to maintaining safety and nonproliferation standards. Additionally, nuclear energy should be recognized and valued as a source of clean and reliable energy, which will likely become increasingly important in global efforts to mitigate climate change and reduce carbon emissions. In the October 2018 Intergovernmental Panel on Climate Change (IPCC) report, each of the four model pathways that limited global warming to 1.5 degrees Celsius over pre-industrial levels included nuclear power generation increases ranging from 59–501 percent.[61] The United States has a number of federal institutions that are intended to provide financial support to new international nuclear exports, and which will need to be strengthened in order to cooperate fully with US allies on co-financing schemes. These include the Export-Import Bank, the Overseas Private Investment Corporation (OPIC)—now reorganized into the US International Development Finance Corporation (USDFC)—and a whole-of-government approach that has been termed "Team USA." However, many of these institutions have suffered in recent years, and whether the United States can become a competitive exporter of nuclear technologies depends, in large part, on whether these institutions can be empowered and made more effective.

Furthermore, domestic nuclear technology—even if encouraged through legislation like the Nuclear Energy Innovation and Modernization Act (NEIMA), the Nuclear Energy Innovation Capabilities Act (NEICA), and the Nuclear

60 Haverkamp, "Financing Models for Nuclear Power Plants."

61 Jeffrey Donovan, "IPCC Head to Speak at International Conference on Climate Change and the Role of Nuclear Power," International Atomic Energy Agency, August 29, 2019, https://www.iaea.org/newscenter/news/ipcc-head-to-speak-at-international-conference-on-climate-change-and-the-role-of-nuclear power.

Energy Leadership Act (NELA)—will be stymied on the international stage without support from financial institutions like the US Export-Import Bank.[62] There are strong links between domestic progress in nuclear energy technologies and the ability of the United States to conduct a robust nuclear energy export program. The importance of streamlining domestic policy toward nuclear innovation and foreign policy toward nuclear exports cannot be overstated.

Empowering the Export-Import Bank

The anticipated nuclear renaissance in the first decade of the twenty-first century is a documented phenomenon, with agencies like the US NRC having prepared for it by hiring staff and building new facilities to house them. However, hopes for a renaissance ended due to a confluence of factors, which—when combined—brought the burgeoning field of additional nuclear energy to a halt by the end of that decade. Cheap natural gas prices starting in 2008 undercut the price of nuclear energy, and the global financial crisis of 2008, which resulted in a severe shortage of capital and stringent limits on financing, played a secondary role in curtailing the nuclear renaissance.[63] In 2010, speaking at the Emerging Issues Policy Forum, NRC Commissioner William C. Ostendorff said that "despite the global financial crisis over the last two years, there still appears to be great interest in nuclear power worldwide."[64] That interest—by and large—continued, but with the United States taking an increasingly diminished role.

The US Export-Import Bank was reauthorized in 2012 for a three-year term, but authorization lapsed in July 2015. The bank, which provides "loans, guarantees, and other modes of financial assistance to help facilitate the export of American goods and services," was caught up in congressional debates between the "Tea Party" movement of the Republican Party and Republican and Democratic proponents of free trade.[65] Although Congress in 2015 ultimately voted to reauthorize it, the bank lacked a quorum on its board of directors from July 2015 until May 2019, which meant that it was unable to consider loans larger than $10 million. This had major implications for the nuclear energy industry, in which $10 million is a relatively small sum.

With a quorum for the first time in four years—and with the possibility of congressional reauthorization by the end of 2019—the Export-Import Bank could be restored to its full capacity, which would help facilitate United States-led international nuclear reactor projects. Prior to its struggles in the mid-2010s, the bank was able to authorize major international loans, such as the $2-billion loan in 2012 to the Barakah One Company in the UAE, which supported the "export of American equipment and service-expertise for the construction of a four-unit nuclear power plant in the Emirate of Abu Dhabi."[66]

Including nuclear energy in USDFC loans and loan guarantees

In 2019, OPIC combined with the Trade and Development Agency to form the US International Development Finance Corporation (USDFC), following the passage of the Better Utilization of Investments Leading to Development (BUILD) Act in 2018.[67] However, the Atlantic Council Task Force on US Nuclear Energy Leadership noted that "in order to facilitate nuclear exports, the USDFC will need to modify the OPIC Environment and Social Policy Statement that prohibits funds from being used for new nuclear projects."[68] As with the Export-Import Bank, it is possible that the tide

62 The Nuclear Energy Innovation Capabilities Act (NEICA) was signed into law in 2018, and the Nuclear Energy Innovation and Modernization Act (NEIMA) was signed into law in January 2019. Along with the Nuclear Energy Leadership Act (NELA)—which has not yet passed— NEICA and NEIMA constitute an effort to encourage US nuclear innovation, especially in the field of advanced nuclear reactors. Mike Crapo, "A new era in nuclear energy," *Magic Valley*, May 12, 2019, https://magicvalley.com/opinion/columnists/reader-comment-a-new-era-in-nuclear-energy/article_e638a4bb-b390-546a-a6da-096934389999.html.

63 Lucet, "Financing Nuclear Power Plant Projects."

64 William C. Ostendorff, "Nuclear Regulation and the Nuclear Renaissance," *NRC News*, October 4, 2010, https://www.nrc.gov/docs/ML1027/ML102790151.pdf.

65 Thomas Wade, "Four Years On – Reauthorizing the Export-Import Bank: A Policy Evaluation," *American Action Forum: Insight*, January 15, 2019, https://www.americanactionforum.org/insight/four-years-on-reauthorizing-the-export-import-bank-a-policy-evaluation/; Kevin Cirilli, "Tea Party starts to circle Export-Import Bank," *The Hill*, May 5, 2015, https://thehill.com/policy/finance/241129-tea-party-starts-to-circle-ex-im-bank.

66 "Ex-Im Approves $2 Billion in Financing for Nuclear Power Plant in U.A.E.; Project will Support 5,000 U.S. Jobs in 17 States," *PR Newswire*, September 7, 2012, https://www.prnewswire.com/news-releases/ex-im-approves-2-billion-in-financing-for-nuclear power-plant-in-uae-project-will-support-5000-us-jobs-in-17-states-168953426.html.

67 Atlantic Council Task Force on US Nuclear Energy Leadership, *US Nuclear Energy Leadership*, 26.

68 Atlantic Council Task Force on US Nuclear Energy Leadership, *US Nuclear Energy Leadership*, 26.

of opinion—in policy circles, if not also in the general public—is turning to favor nuclear energy as a national security asset and a key tool in global decarbonization.

Like the OPIC, the World Bank has effectively placed a ban on financing new nuclear projects. The chance that the USDFC would lift its ban has galvanized the nuclear energy industry in the United States to put pressure on the World Bank to rescind its ban, since "when an organization such as OPIC or the World Bank is involved in other kinds of projects, it can help aggregate additional financing for the deal."[69] Although a whole-of-government, or "Team USA," approach would not guarantee that an international institution like the World Bank ends its ban on nuclear financing, a cohesive US policy on nuclear energy exports might be able to exert more pressure in the international sphere.

Taking a "Team USA" approach

In 2013, Rose Gottemoeller, who was then acting under secretary for arms control and international security at the US Department of State, gave a speech at the Nuclear Energy Institute outlining the Obama Administration's views on nuclear energy. After explaining why the Obama Administration was committed to nuclear energy, Gottemoeller explained that "we are developing what we call a 'Team USA' approach to civil nuclear engagement abroad. In January 2012, the White House created a new position, director of nuclear energy policy, to lead this effort. Going forward, this will help us present a unified US message on these issues and increase our presence in the civil nuclear commercial spaces."[70]

Joyce Connery served as director of nuclear energy policy within the Office of International Economics at the National Security Council (NSC) from 2012 to 2015. The advocacy role was intended to "ensure interagency coordination on cross-cutting issues between the Departments of Commerce, State, Energy, and Treasury, the US Trade Representative and the Export-Import Bank," according to a letter addressed to Susan Rice in 2016, which expressed concern over the possible elimination of the position.[71] Under the Trump Administration, Aaron Weston served as director of nuclear energy policy while detailed from his position at the Idaho National Laboratory. Weston left the NSC in July 2019 and returned to the Department of Energy, and Francis Brooke is fulfilling the same role, as a special assistant to the president in the National Economic Council's Office of Energy and Environmental Policy.[72] However, the role of the interagency coordinator for nuclear energy appears less empowered under the Trump Administration than it had been during Connery's tenure.[73] Even with a reauthorized Export-Import Bank and a USDFC that is not restricted in its lending to nuclear energy projects, the role of a coordinator will be critical to reinvigorating US nuclear energy exports.

III. Opportunities and recommendations

This issue brief makes the following recommendations, which will allow the United States to participate with allies in crafting co-financing agreements for nuclear energy projects.

- *Ensure that demand from local electricity utilities and other sectors exists.* Utilities that provide electricity are as important a piece of the nuclear financing puzzle as governments, and it is vital to look at local electricity market conditions in identifying co-financing partners for nuclear energy projects. Additionally, demand for nuclear energy can derive from nontraditional uses, which may include process heat for manufacturing, mining, smelting, and other purposes.

- *Craft a cohesive government strategy that will interface effectively with foreign governments and with international lending institutions like the World Bank*. There are a number of different entities in the United States that deal with financing nuclear energy projects, and which then must work with international entities on co-fi-

69 Jacqueline Toth, "Nuclear Industry Renews Pressure on OPIC to Allow Financing for Foreign Projects," *Morning Consult*, March 1, 2019, https://morningconsult.com/2019/03/01/nuclear-industry-renews-pressure-opic-allow-financing-foreign-projects/.

70 Rose Gottemoeller, "Geopolitics and Nuclear Energy: The View from the State Department," May 15, 2013, https://2009-2017.state.gov/t/us/209768.htm.

71 In Gottemoeller's 2013 remarks, she explained that the "Team USA" approach could "engage in generic advocacy, expressing to the host government its support for a US firm winning the [nuclear] contract." John Daly, "Team USA Determined to Boost Nuke Energy Exports," *Real Clear Energy*, April 6, 2014, https://www.realclearenergy.org/articles/2014/04/07/team_usa_determined_to_boost_nuke_energy_exports_107668.html; Letter to National Security Advisor Susan Rice, US Nuclear Infrastructure Council, American Nuclear Society, Third Way, and the Nuclear Energy Institute, May 3, 2016, http://cdn.ans.org/pi/ps/docs/support/director-nuclear-energy-policy-letter.pdf.

72 Jeremy Dillon and Kelsey Brugger, "Top aide tasked with boosting nuclear program set to leave," *E&E News*, July 29, 2019, https://www.eenews.net/stories/1060807085.

73 Expert interview with author, November 2019.

Rumina Velshi (left) and Christine Svinicki at the signing of a first-of-a-kind Memorandum of Cooperation (MoC) that will see Canadian and US nuclear regulators collaborate on the technical reviews of advanced reactor and small modular reactor (SMR) technologies. *Photo courtesy of the Canadian Nuclear Safety Commission*

nancing. A single coordinating office or position in the US government is necessary to ensure that the United States presents a coherent strategy to international allies and potential co-financers of nuclear builds.

- *Enable significant loans and loan guarantees*. Reauthorization of the Export-Import Bank and lifting the OPIC/USDFC and World Bank bans on nuclear financing will mitigate financing challenges. Given the high capital costs of nuclear projects, allowing loans in large sums—and providing loan guarantees to minimize risks associated with new nuclear power plants—is necessary to ensure that the United States can play an international role in nuclear energy.

- *Recognize and account for the value of low-carbon energy, as well as for the national security benefits of a robust nuclear export program*. The federal government should provide financial support to US nuclear energy exports, and bolster financing institutions like the Export-Import Bank, based on the inherent value of a nuclear energy program to US climate security and national security goals.

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