

Exporting Nuclear Norms

Japan and South Korea in the International Nuclear Market

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Introduction

Nuclear energy has been connected to notions of national security since the advent of nuclear reactor technology during the Manhattan Project in the early 1940s. Countries have taken different views of nuclear energy's connections to national security, but these views can be broadly placed into two themes. First, nuclear energy can significantly contribute to energy security, due to the relatively small amount of fuel required for commercial power reactors, the inherent ability for nuclear fuel to breed more fuel during use, and the stability of many nuclear fuel supplier countries. Second, nuclear materials and technologies can also have strategic military applications, such as nuclear weapons and nuclear propulsion for naval vessels, which has led to national and international efforts to control the spread and use of nuclear energy.

Cases for both views have been made in the United States, but arguably the prevailing stance has been that a strong nuclear power industry, both in the domestic and export markets, gives the United States the ability to enforce nuclear nonproliferation, safety, and security norms worldwide. The United States has used various policy tools to enforce these norms, and US export partners are expected to abide by these norms in their domestic nuclear industries. However, the domestic US nuclear industry has struggled in recent years due to poor economics for some existing nuclear plants, particularly those in deregulated state markets, cost overruns on new nuclear plant construction, and strong competition from cheap natural gas, and US dominance in the global nuclear energy market also has waned. This has led to worries that China and Russia would supplant the United States and that Washington would no longer be able to enforce its nuclear norms around the world, which is particularly concerning when considering that much of the anticipated growth for nuclear power could occur in developing countries with little or no experience operating commercial nuclear power plants.

Russia currently is the leading nuclear reactor exporter in the world, with seven reactors under construction and 22 more reactor exports either contracted or ordered.¹ China entered the export market more recently, and only Pakistan has imported Chinese nuclear reactors, including four operational units and two units under construction.² Yet, like Russia, China is aggressively pursuing other reactor export projects around the world, and Russian and Chinese bids are bolstered by

strong domestic industries and a variety of state-backed financing options for importers, both of which are key factors that can give China and Russia an edge over bids from private US nuclear vendors. Beijing and Moscow also place strategic and political importance on nuclear reactor exports (e.g., Beijing's inclusion of nuclear technology in the Belt and Road Initiative), making export projects not just a matter of economics for their state-owned nuclear enterprises. Beyond economics and geopolitics, some experts cite lax safety and security standards in China and Russia as reason for concern about what types of norms they would impart to their export partners, particularly to potential export partners in Africa, the Middle East, and Southeast Asia.³

With the US position in the international nuclear energy market falling, could like-minded US allies and partners step up and enforce similar nuclear nonproliferation, safety, and security norms? In particular, could Japan or South Korea become leaders in enforcing nuclear norms in the export market? Japan and South Korea have been major US trade partners in nuclear energy, as both countries imported and indigenized US nuclear reactor technology early in the development of their nuclear industries. Both countries also have been subject to US policies enforcing nuclear norms, and at times, the terms of nuclear cooperation have been the subject of contentious debate, despite being close US allies. Many Japanese and South Korean nuclear firms maintain close ties or partnerships with US nuclear firms, but Japanese and South Korean firms may play more leading roles in future export projects. In addition to being close US allies, Japan and South Korea can be viewed as middle powers with the ability to influence the international system and spread norms to other countries.

Building from US views on the connections between nuclear power and national security, this article will explore how Japan and South Korea have received and interpreted nuclear norms from the United States and how they have or could enforce norms with export partners. Concepts of middle-power diplomacy will be used as a theoretical base to analyze Japanese and South Korean views of their role in enforcing nuclear norms and to project future behavior.

This article will proceed as follows. The second section will summarize US views on nuclear power and national security, along with the history of US efforts to enforce nuclear nonproliferation, safety, and security norms around the world. Next, section three will provide an overview of the nuclear power sectors in Japan and South Korea and how those countries view the nuclear export market. Section four will introduce concepts of middle-power diplomacy and use those concepts to analyze Japan and South Korea's role in enforcing nuclear norms internationally. The article then will conclude with policy implications for the United

States, Japan, and South Korea on enforcing nuclear norms and competing with China and Russia in the global nuclear marketplace.

Nuclear Power, National Security, and Enforcing US Nuclear Norms

Since the beginning of the nuclear age, the United States has sought to control the international flow and use of nuclear technology, and Washington has especially focused on limiting the proliferation of nuclear materials and technology that could be used in a nuclear weapons program. Starting with the Acheson–Lilienthal report and the Baruch plan that the United States presented to the United Nations in 1946, the US government has led numerous bilateral and multilateral initiatives to enforce nuclear norms around the world.⁴ One of the most prominent initiatives was President Dwight Eisenhower’s Atoms for Peace program that led to the creation of the International Atomic Energy Agency (IAEA) in the 1950s.

In the Atoms for Peace program, the United States supplied nuclear materials and technology to recipient countries, with the aim of both spreading the benefits of civilian nuclear technology and restricting the military applications of nuclear technology. The United States was the clear world leader in nuclear technology at the time and, thus, could effectively employ such supply-side tools to enforce nuclear nonproliferation. Supplying US nuclear technology and training to recipients also meant that US norms on nuclear safety and security could be spread around the world, but again, the ability to do this was based on the dominant US position in the global nuclear market.

The United States initially wanted to give responsibility for safeguarding nuclear materials worldwide to the IAEA, but while the IAEA built its system, the United States proceeded with signing bilateral agreements for cooperation in the civil uses of nuclear energy (so-called 123 Agreements). These bilateral cooperation agreements included provisions for safeguards, and 35 bilateral agreements were in effect by the mid-1960s.⁵ But as IAEA capabilities grew, the United States worked to transfer responsibilities for safeguards to the IAEA. In this way, Washington institutionalized its norms on nuclear nonproliferation in the international system.

As the United States transferred safeguards responsibilities to the IAEA, US companies dominated the international nuclear market, providing over 90 percent of the world reactor export market through the early 1970s.⁶ This market position allowed the United States to dictate the terms of other countries’ nuclear energy programs, but even at that time, this level of influence appeared time-limited. Most countries starting nuclear energy programs at the time planned to use US

vendors for their first reactors, indigenize the technology, and then transfer production for future reactors to domestic companies.⁷ License transfer agreements from US nuclear vendors to export partners helped facilitate the transfer of US nuclear technology and know-how, but such agreements also helped other countries develop their own nuclear reactor design and production capabilities.⁸

In addition to exporting its reactor technologies around the world, the United States was the primary supplier of uranium enrichment and nuclear fuel fabrication services to its export partners. But the 1973 oil embargo and 1974 Indian nuclear explosive test heightened US concerns about energy supplies and nuclear weapons proliferation, respectively. The US government responded to these pressures by announcing that it could not accept new contacts for enrichment services, pushing to stop any further spread of enrichment or reprocessing technology, and suspending domestic reprocessing and breeder reactor development.⁹ While Pres. Jimmy Carter later sought to increase US enrichment capacity to lock in foreign supply contracts and enforce nonproliferation norms, US nuclear export partners saw the economic and political risks of excessive reliance on the United States for nuclear materials and technology. Some US partners, such as France, Germany, and Japan, responded by increasing their domestic capacity, seeking export contracts, and further internationalizing the global nuclear market.

This impending relative decline in US market position made the role of the IAEA and of IAEA member states even more important, something an official from the US Arms Control and Disarmament Agency noted in the mid-1960s: “Whether the IAEA will be able to act as an international instrument for regulating the peaceful uses of atomic energy will depend for the foreseeable future on the national policies of the Member States.”¹⁰ In addition to the IAEA itself, the continued enforcement of US nuclear norms is dependent on IAEA member states remaining committed to the norms that Washington transferred to the IAEA.

The US domestic nuclear market experienced a major shock with the partial meltdown at the Three Mile Island (TMI) nuclear power plant in 1979, which remains the most serious accident in the history of the US commercial nuclear industry. Nuclear power in the United States already was experiencing increasing reactor construction costs in the late 1970s, and the TMI accident thrust nuclear reactor safety to the top of the public consciousness. The US nuclear industry struggled in the face of economic and public acceptance challenges, and more than 30 years passed between new reactors construction starts, from 1977 to 2013.¹¹ Construction on four reactors at two nuclear power plants in Georgia and South Carolina began in 2013, but none of those reactors has entered operation yet. Construction on the two reactors in South Carolina was ceased in 2017, and the construction projects in Georgia face economic difficulties, cost overruns, and delays.

The domestic US nuclear industry faces other challenges in addition to the lack of new construction starts over the past 40 years. Several reactors have shut down in recent years, leading to a slow decline in the number of operating reactors in the United States. There currently are 97 operable nuclear reactors, down from a peak of 112 in the 1990s. Research and development on new reactor technology continues, but “on a smaller scale and less relevant for substantial improvements in power production or sophistication.”¹² The United States lacks significant nuclear fuel cycle capabilities, including inadequate uranium enrichment capacity, no commercial spent nuclear fuel reprocessing, and no permanent repository for spent nuclear fuel. The commercial nuclear industry also faces significant economic competition from natural gas and renewable energy sources.

In the export market, US nuclear vendor Westinghouse completed four AP1000 reactors, the same type that are being built in the US state of Georgia, in China in 2018 and 2019. These marked the first reactors built abroad by a US company since the 1990s.¹³ However, there are no other US-led nuclear reactor projects in the world, bringing the US share of global nuclear reactor exports to zero.

The struggles of the domestic US nuclear industry and declining export market position has led to a robust debate in recent years about restoring US leadership in the global nuclear market. In a 2018 article in *The Washington Quarterly*, Laura Holgate and Sagatom Saha succinctly state the prevailing view on the need for US leadership: “The United States must participate in the commercial export market so it can insist on strict protocols that promote nuclear security, deter nuclear theft, and prevent weapons development.”¹⁴ Moreover, they argue that “exporting nuclear reactors helped the United States develop critical diplomatic and economic links throughout Europe and the Asia-Pacific . . . and design international standards for nonproliferation and security.”¹⁵

On nuclear safety, Michael Wallace, Amy Roma, and Sachin Desai claim that being a leading exporter of nuclear reactor technology meant that the United States “was able to promote reactor designs and standards that favored nuclear safety . . . which has made nuclear power the safest of all energy sources around the world.”¹⁶ Related to these commercial ties, the US Nuclear Regulatory Commission (NRC) has worked with partners around the world “to develop codes and standards worldwide to ensure that regulatory environments are based on sound approaches.”¹⁷ Proponents of the US nuclear industry argue that the United States must remain involved in the global nuclear market to instill robust safety culture principles in other countries’ nuclear operators and regulators, particularly important for influencing countries with new nuclear programs.¹⁸

Holgate and Saha also clearly identify what they view as the risks if the United States loses its ability to set global nuclear norms and cedes leadership in the in-

ternational nuclear export market to China and Russia: “Both China and Russia are known for lax standards on nuclear security and poor track records on nuclear safety.”¹⁹ They add that these risks “would inevitably worsen as nuclear reactors are sited in countries with fragile institutions, weak regulatory environments, and unstable security situations.”²⁰ The Middle East and Southeast Asia are cited as two regions with strong potential for nuclear growth, but most of the countries in those regions have no experience with commercial nuclear power and face some of the problems stated by Holgate and Saha.

Yet, the United States must not necessarily regain its position of preeminence in the global nuclear market. The United States worked to build an international architecture for spreading nuclear norms, principally through the IAEA, and worked closely with export partners to instill US norms in them. Given the problems in the US domestic nuclear industry, it would be prudent to consider whether close US partners, particularly Japan and South Korea, could continue to uphold the nuclear norms that the United States has worked to spread and enforce. The next section will examine the nuclear industries of Japan and South Korea and how they view nuclear exports.

Nuclear Power in Japan and South Korea

Following Eisenhower’s Atoms for Peace speech, Japan and South Korea were early adopters of US nuclear technology. Both countries lack significant domestic energy resources and viewed nuclear energy as a way to relieve their dependence on energy imports, especially fossil fuel imports. Seoul and Tokyo also believed that developing domestic nuclear industries would grow their countries’ science and engineering workforce and bring international prestige.

Despite being close US allies, turbulent politics and concerning regional security developments in the 1960s and 1970s prompted Japan and South Korea to consider their options for nuclear weapons development. Tokyo studied the matter internally in the late 1960s and determined that developing nuclear weapons would be too costly.²¹ Seoul initiated a clandestine program to develop nuclear weapons in the 1970s but abandoned the program by the early 1980s.²² Preserving close, positive relations with the United States was a key factor in both countries’ decisions to not develop nuclear weapons. While speculation lingers regarding nuclear hedging or latent nuclear weapons capabilities, energy security has remained the primary impetus for their nuclear programs and connection between nuclear power and national security.

Japan and South Korea joined the IAEA in 1957, but Tokyo started its civilian nuclear power program a few years earlier in 1954. Japan imported its first commercial nuclear power reactor, a gas-cooled reactor, from the United Kingdom,

and that reactor began operating in 1966. Every reactor constructed in Japan after that first reactor has been based on US light-water reactor (LWR) technology.²³ Starting in the early 1970s, Japan aggressively expanded its fleet of commercial nuclear power reactors and had 54 operable reactors in 2010, with plans to keep growing. The Fukushima nuclear disaster of 2011 halted Japan's nuclear growth.

All Japan's nuclear reactors shut down after the disaster, and the process of re-starting reactors after new safety reviews has been long and difficult. In addition to the four reactors destroyed by the earthquake and tsunami in March 2011, utilities decided to decommission some reactors instead of going through upgrades and safety checks, and Japan has only 38 operable nuclear reactors today.²⁴ Since the first reactors restarted in 2015, the nuclear share of electricity generation in Japan has only been a few percent, down from around 30 percent before 2011.

Japan also is pursuing a closed nuclear fuel cycle, including indigenous uranium enrichment, spent nuclear fuel reprocessing, and fast breeder reactor (FBR) capabilities. Japan has an operating uranium enrichment facility at Rokkasho in northern Japan, but the reprocessing plant at Rokkasho has faced a series of delays and has yet to enter operation. FBR development has suffered similar delays, and there currently is no operating FBR in Japan. Japan's closed fuel cycle development has been controversial at times in the United States, but Tokyo received consent from Washington to develop these technologies in the 1980s—the only nonnuclear weapons state outside of Europe to receive such consent. This consent is granted in the 123 Agreement governing bilateral civil nuclear cooperation between Japan and the United States, which was extended indefinitely in 2018.²⁵

South Korea began its civil nuclear program in the late 1950s, soon after Japan did. Construction on South Korea's first commercial nuclear reactor, a turnkey plant imported from Westinghouse, began in 1972 and finished in 1977. South Korea also imported Canadian and French reactor technology in the 1970s and 1980s, but in 1987, the Korea Electric Power Company (KEPCO) selected an LWR design from US-based Combustion Engineering as the basis for developing an indigenous South Korean reactor design. By the early 2000s, South Korean firms were responsible for all major aspects of nuclear reactor design, supply, construction, and operation.²⁶

South Korea now has 25 operable commercial nuclear reactors, with four reactors under construction, and nuclear power provides nearly 25 percent of the country's electricity.²⁷ However, the South Korean nuclear industry faces an uncertain future, as current Republic of Korea (ROK) president Moon Jae-in announced a policy in 2017 to phase out nuclear power over the next 40 years.²⁸ The phase-out plan allows current reactor construction projects to finish but does not allow new reactors to be planned. The plan also does not allow existing reactors to operate

beyond 40 years. South Korea's reactor fleet is relatively young, so the phase-out plan will not have a large, immediate impact on electricity generation. Moon cannot be reelected after his presidential term ends in 2022, and it is uncertain if the next South Korean president would continue with this phase-out plan.

Unlike Japan, South Korea has an open nuclear fuel cycle, and the 123 Agreement between South Korea and the United States does not give Seoul advanced consent to develop enrichment or reprocessing technologies. The US–South Korea 123 Agreement was renewed in 2015, and Seoul pushed for advanced consent in the renewal negotiations. While Washington did not accede to Seoul's request, the two countries are conducting a joint fuel cycle study in the United States, and the new 123 Agreement formed a High Level Bilateral Commission to discuss nuclear cooperation issues in the future.²⁹

Despite the challenges facing both countries' nuclear industries, Japan and South Korea possess robust nuclear sectors, developed with close US cooperation. Their nuclear related firms, including Hitachi, Toshiba, KEPCO, and Doosan, are among the leading firms in the world, and both countries' governments and private firms are active in the global nuclear market. Yet, neither country is truly a great power with the ability to unilaterally set global norms. The next section will explore Japan and South Korea's nuclear exports and their role as middle powers in spreading nuclear norms.

Middle-Power Diplomacy and Exporting Nuclear Norms

To analyze the roles for Japan and South Korea as middle powers exporting nuclear norms, middle-power diplomacy and the roles that middle powers can play in international affairs must be defined. John Ikenberry and Jongryn Mo simply defined a *middle power* as “neither super power nor small power.”³⁰ Then–South Korean president Lee Myung-bak also offered a simple definition in 2010 by saying that the “world can be split into two groups: One group sets global rules, the other follows. South Korea has successfully transformed itself from a passive follower into an active agenda-setter.”³¹

With the third-largest economy in the world, it may seem debatable to term Japan as a middle power, but based on these definitions, Japan should be considered a middle power that can participate in setting global rules and agendas. Ikenberry and Mo also state that “traditional middle powers are fully developed countries” and that “many new middle powers are emerging as new developed powers.”³² Japan could be placed in the traditional middle-power category, and South Korea is a new middle power.

Importantly for the context of this article, the United States views itself, China, and Russia as the world's great powers, which would place Japan and South Korea

in the next tier of middle powers. As US allies, Washington should expect Seoul and Tokyo to uphold norms on issue areas, such as nuclear exports and the liberal international order. Ikenberry and Mo argue that “[m]iddle powers, both traditional and emerging, can help the international system stay liberal because it is in their interests to support liberal international order.”³³

A 2015 report from the East Asia Institute (EAI) describes how middle powers can support the liberal international order and uphold nuclear norms. The EAI argues that middle powers “derive their status from being a part of a network” and “function as a collective.”³⁴ Acting as a bridge or connector in the network, middle-power diplomacy “aligns great powers and smaller powers together, and as long as a middle power keeps genuine its intentions of contributing to the greater international good, they cannot be accused of harboring hegemonic intentions . . . a middle power acts as ‘norm diffuser.’”³⁵ In addition, a middle power “needs to possess material capability that places it in a position that is measured as relatively influential enough to attract and establish itself within a wider network or community of like-minded nations.”³⁶ The EAI then describes four identities that middle powers can adopt in pursuing this type of diplomacy:

1. Early mover: elevating their respective statures in the international society by adopting the “me first” approach and leading by example;
2. Bridge: mediating between opposing groups and seeking measures that would satisfy all parties involved;
3. Coalition coordinator: building coalitions of like-minded states to advance shared interests and address common concerns; and
4. Norm diffuser: contributing to the global diffusion of norms and standards.³⁷

In the global nuclear market, Japan or South Korea could possibly take on any of these four identities individually or in combination. Both countries were early movers in adopting nuclear power and US norms, and other developing countries, in particular, could learn from the example set by the commercial nuclear industries in Japan and South Korea. Seoul or Tokyo could operate as bridges or coalition coordinators between the United States and other nuclear exporters or countries looking to start a nuclear energy program. Finally, arguably the most important role that Japan or South Korea could play in the nuclear export market is that of a norm diffuser, spreading US and IAEA norms on nuclear nonproliferation, safety, and security.

However, Japan and South Korea face limitations in their conduct of middle-power diplomacy on nuclear energy issues. Writing on South Korea as a middle

power promoting international cooperation on nuclear security, Scott Snyder states that Seoul's "efforts on nuclear security came about primarily in the context of the US-ROK alliance."³⁸ Snyder also added that South Korea's contributions to international governance and to forming global networks occurred primarily outside of Northeast Asia. Snyder argues that Seoul faces these limitations due to its relatively smaller economy and military compared to other regional powers and to its reliance on the US alliance for security.³⁹ Snyder writes that Seoul is now able to "pursue greater autonomy through self-help but within the context of the country's continued need for the alliance as a bulwark against threats from major powers."⁴⁰ He adds that South Korea is "able to act more autonomously when its policy preferences align with those of the United States and when Seoul has Washington's backing."⁴¹

While Snyder wrote about South Korea, much of the preceding also could apply to Japan's conduct of middle-power diplomacy. Japan's economy is larger than South Korea's economy, but the two countries' defense expenditures are similar. According to the Stockholm International Peace Research Institute (SIPRI), Tokyo's defense budget in 2018 was \$46.6 billion USD, and Seoul spent \$43.1 billion USD on defense in 2018.⁴² Those numbers also do not account for the legal and social restrictions on offensive capabilities for Japan's Self-Defense Forces, which do not constrain South Korea's military. Similar to South Korea, Japan remains relatively weaker than its chief regional rival, China, and relies on the US alliance for security.

Another limitation on Seoul and Tokyo acting as middle powers on nuclear energy issues is the poor state of their bilateral relationship. Lingering tension and disputes related to the legacy of Japan's colonization of Korea in the first half of the twentieth century have persistently plagued bilateral relations. The latest flaring of tensions in 2019 resulted in both countries removing the other from white lists of preferred trade partners, complicating the trade of sensitive technologies between the two countries. While Japan and South Korea hold similar views on nuclear norms and work together in some multilateral forums, bilateral diplomatic and trade tensions and the strategic nature of nuclear technology would make closer cooperation in the nuclear export market more difficult. This would mean that Seoul or Tokyo likely would act individually as a coordinator or bridge, rather than forming a bilateral partnership to act in these roles together.

Overall, Japan and South Korea are each in a strong position to act as a middle power in spreading and enforcing nuclear norms with their export partners, even if they do not explicitly partner with each other to spread and enforce nuclear norms. Either country can act as coordinators in bringing together like-minded partners to work in concert on enforcing robust norms in nuclear exports, and

they can diffuse nuclear norms to their export partners. However, given US sensitivities toward nuclear proliferation and Tokyo’s and Seoul’s reliance on their alliances with the United States, the two countries would likely need to closely coordinate nuclear export activities with the United States and would have to remain aligned with US nuclear norms. As Snyder argued, middle powers like Japan and South Korea also have benefited from the US-led liberal international order and have incentive to perpetuate this order, including enforcing US nuclear norms rather than allowing China and Russia to revise existing international norms.

Demonstrating their standing to act as responsible, effective middle powers in spreading existing nuclear norms to export partners, Japan and South Korea are parties to the major international instruments related to nuclear nonproliferation, safety, and security. These multilateral commitments are in addition to the bilateral 123 Agreements with the United States that hold Seoul and Tokyo to strict nonproliferation standards. Table 1 summarizes the international instruments that Japan and South Korea are parties to.

Table 1. Japanese and South Korean members in international instruments on nuclear norms. Data compiled from individual country matrices at “Committee Approved Matrices,” 1540 Committee, 23 December 2015, <https://www.un.org/>.

Nuclear Norms	Major International Instruments
Nonproliferation	<ul style="list-style-type: none"> • Nonproliferation Treaty • Comprehensive Safeguards Agreement with the IAEA • Additional Protocol • Nuclear Suppliers Group • Zangger Committee • Missile Technology Control Regime • Hague Code of Conduct • Australia Group • Wassenaar Arrangement • Proliferation Security Initiative
Safety	<ul style="list-style-type: none"> • IAEA Code of Conduct on Safety and Security of Radioactive Sources • Convention on Nuclear Safety • Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management • Convention on Early Notification of a Nuclear Accident • Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
Security	<ul style="list-style-type: none"> • Convention for the Suppression of Acts of Nuclear Terrorism • Convention on Physical Protection of Nuclear Material

Among instruments listed in table 1, China is not party to the Missile Technology Control Regime, Hague Code of Conduct, Australia Group, Wassenaar Ar-

rangement, and the Proliferation Security Initiative, and Russia is not party to the Australia Group or the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.⁴³

In addition, Japanese and South Korean firms have worked with the NRC on reactor design certifications. Even though NRC certification is not required for Japanese or South Korean firms to export reactors to third-party recipients, such importers view NRC design certification as a gold-standard stamp of approval for the highest standards of safety, security, and performance. In 2019, the South Korean-designed APR1400 became the first non-US reactor design to receive standard design approval from the NRC.⁴⁴ GE-Hitachi Nuclear Energy received NRC certification for its Economic Simplified Boiling-Water Reactor in 2014, and General Electric received NRC certification for the Advanced Boiling-Water Reactor (ABWR), which is similar to the international version operating in Japan, in 1997. Mitsubishi also has a design under review for NRC certification.⁴⁵

In interviews that the author conducted in Japan and South Korea in July and August 2019, representatives from government and private sector all expressed their desire to continue partnering with US firms on nuclear export projects, even if Japanese or South Korean firms lead reactor design or construction. A South Korean government official said that Seoul closely follows US government policy and intentions in nuclear exports, and Seoul requires export partners to meet and adhere to IAEA standards on safeguards, safety, and security.⁴⁶ Japanese government and private-sector officials said they want to partner with US firms on nuclear export projects to bolster Japanese firms' competitiveness.⁴⁷

While Japan and South Korea sign bilateral cooperation agreements with their nuclear export partners that have similarities to 123 Agreements, partnering with US firms would require that those export partners sign 123 Agreements with the United States. As Seoul and Tokyo still look to the United States for leadership on nonproliferation, requiring a 123 Agreement with the United States would impose strict nonproliferation requirements on recipient countries.⁴⁸ Norms on safety and security would then be transferred and enforced through cooperation with the IAEA, NRC, and private-sector firms and government organizations from Japan, South Korea, and the United States.

This model of cooperation with the United States was used for South Korea's export of four nuclear reactors to the United Arab Emirates (UAE), which was Seoul's first reactor export project. The UAE selected a KEPCO-led consortium in 2009 to build four APR1400 reactors at the Barakah nuclear power plant. KEPCO's proposal was selected over proposals from Areva and GE-Hitachi, with the lower cost offered by KEPCO being a major factor for securing the bid.⁴⁹



(Photo courtesy of Emirates Nuclear Energy Corporation)

Figure 1. The UAE’s Barakah Nuclear Energy Plant

In addition to KEPCO and several other South Korean companies, the consortium included Westinghouse and other US companies providing engineering services and supplying components. Westinghouse’s participation was required because Westinghouse still considers South Korean reactors to be Westinghouse-licensed products, which then necessitated the UAE to sign a 123 Agreement with the US government and subjected the project to US export control requirements.⁵⁰ Toshiba also was originally involved in the consortium as the majority owner of Westinghouse, but Westinghouse’s bankruptcy in 2017 forced Toshiba to sell their ownership of Westinghouse.

The UAE also signed a bilateral cooperation agreement with Seoul that included provisions restricting the UAE from enriching uranium above 20 percent or reprocessing any nuclear material transferred through the deal. It prohibits the UAE from using materials or technology transferred through the agreement for military purposes. The agreement also requires the UAE to have a comprehensive safeguards agreement with the IAEA but does not require the Additional Protocol, although the UAE signed the Additional Protocol in 2009.⁵¹ On security, the agreement requires INFCIRC/225/Revision 5, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, and it calls for consultation and cooperation on safety issues.⁵²

No Japanese firm has led a nuclear reactor export project yet, but Japan has been involved in the nuclear export market in other ways. As mentioned above, Toshiba was originally involved with the Barakah project due to its then-ownership of Westinghouse, and Hitachi has worked with General Electric due to their joint venture (Hitachi-GE Nuclear Energy in Japan and GE-Hitachi Nuclear Energy in the United States). Mitsubishi Heavy Industries cooperated with Areva in the past and is now partnered with French nuclear companies Framatome and

EDF.⁵³ Japanese nuclear firms also are pursuing nuclear projects in Europe and Asia, with the intention of partnering with US firms and government agencies on such projects, and Japan would use the IAEA Milestones Approach to ensure that a recipient country is adhering to international nuclear norms.⁵⁴ Japan also has worked with the IAEA to promote nuclear nonproliferation, safety, and security norms and capacity building.

Employing middle-power diplomacy, Seoul or Tokyo can work to diffuse US nuclear norms on their own, but as discussed above, each country also prefers to work as a bridge or coordinator to keep the United States involved in setting global nuclear norms. Given bilateral tensions between Seoul and Tokyo, this likely would take the form of separate Seoul–Washington and Tokyo–Washington partnerships, but Japan and South Korea can work with the United States to maintain international norms on nuclear nonproliferation, safety, and security and counter the rising influence of China and Russia. The next section will go into more detail on the policy implications of this middle-power diplomacy in the global nuclear market.

Conclusion and Policy Implications

The international nuclear power industry is in a much different state today than it was when Washington launched the Atoms for Peace program in the 1950s. At that time, the United States was the global leader in nuclear technology and the most dominant actor in setting international nuclear norms. Washington used bilateral agreements, namely 123 Agreements, and multilateral instruments, mainly the IAEA, to set and enforce nuclear norms with export partners, and US nuclear firms sold their reactor technologies around the world. But as the domestic US nuclear industry declined over the last few decades, other countries have risen to prominence in the global nuclear market, primarily Russia and an ascendant China.

US partners, like Japan and South Korea, also have risen in prominence since indigenizing US reactor technology and now may be in a position to use middle-power diplomacy to continue spreading and enforcing international nuclear norms. Yet, Japan and South Korea also face uncertainties in their domestic nuclear markets, and as middle powers, they still prefer to partner with the United States to set agendas and enforce norms. They also must overcome formidable competition from China and Russia to secure reactor contracts. In this context, this article offers the following policy implications for the United States, Japan, and South Korea to consider when operating in the nuclear export market.

- Japan and South Korea can be effective nuclear norms diffusers.

- Seoul and Tokyo used nuclear power to fuel their economic growth and transition into developed economies, and they adopted US-origin nuclear technology and norms at the start of their programs. As middle powers, they are committed to preserving the existing system of nuclear norms espoused by the United States and the IAEA. They can spread these norms by building on their existing export practices that stipulate adherence to IAEA norms, establish education and training programs for other countries' nuclear programs, and providing world-class nuclear technologies. Their ability to diffuse norms will be especially important when working with countries starting a nuclear energy program and when exporting new reactor technologies.
- The United States can still lead from a supporting position.
- While Japan and South Korea can effectively diffuse norms, they are not able to unilaterally set or revise the international system, which is one of the reasons that they still prefer to partner with the United States in nuclear export projects. The domestic US commercial nuclear industry likely will continue to struggle for the foreseeable future, which will make it even harder for US nuclear firms to win future reactor export contracts. But with Seoul or Tokyo acting as a coordinator, Washington can still provide leadership on enforcing strict safety, security, and nonproliferation norms around the world. South Korea's reactor export project with the UAE provides a model for how Washington can work with newcomer nuclear countries, even when US firms do not lead the project. There are legal concerns that still tie Westinghouse with KEPCO, but more importantly, the policy preference for Japan and South Korea is to partner with the United States on their reactor export projects.
- The United States also could explore using nuclear norms as an issue of mutual concern and interest to promote Japan–South Korea cooperation. Seoul and Tokyo prefer working with the United States on nuclear exports, and all three countries seek to counter the growing influence of Russia and China. Past efforts to use nuclear energy as an issue on which to improve Japan–South Korea cooperation have not been as successful as hoped, but it is worth continuing such efforts.
- Japan or South Korea could be a bridge to nuclear cooperation with Saudi Arabia.
- While regions like Southeast Asia and Europe contain the potential for nuclear growth, the strongest and most contentious future reactor importer is Saudi Arabia. A tender for bids for exporting reactors to Saudi Arabia is expected in 2020, and US, South Korean, Russian, Chinese, and French firms

are involved in preliminary talks with Riyadh.⁵⁵ Despite the project's projected lucrative nature, the idea of exporting nuclear reactors to Saudi Arabia is controversial due to statements from Saudi officials about wanting to acquire enrichment technology, nuclear hedging against Iran, and the Saudi government's lack of transparency. These concerns have prevented Washington from concluding a 123 Agreement with Riyadh, which has balked at US demands that Saudi Arabia sign the Additional Protocol.⁵⁶ However, Japan or South Korea could act as a bridge between Washington and Riyadh to come up with an agreement that meets the needs of all parties. Seoul, in particular, could build on its experience with the UAE and bring together a coalition to work with Riyadh's nuclear ambitions while still enforcing US and IAEA nuclear norms.

- Spreading nuclear norms is only possible with export contracts.
- The biggest challenge facing Japan, South Korea, and the United States in the nuclear export market is becoming more competitive with Chinese and Russian state-owned nuclear firms. A 2019 study on nuclear reactor export competitiveness found that the most important criteria for importing countries are the financing package, an existing reference reactor, total capital investment costs, the economic package, and sustainability of the exporter's domestic nuclear industry.⁵⁷ On an individual head-to-head basis, Seoul, Tokyo, or Washington would have a difficult time competing with Beijing or Moscow on those categories, mainly due to the robust financing that the Chinese or Russian government can provide. But working as middle-power coalition coordinators, Japan or South Korea could increase competitiveness by assembling consortia with the United States and other like-minded countries, such as Canada, to make stronger, more cost-competitive supply chains to back reactor export proposals.
- French economist Francois Leveque writes that such consortia also could offer other goods and services, such as arms sales or infrastructure development projects, to bolster their reactor export bids. Leveque further argues that the nuclear industry has traditionally been dominated by vertically integrated companies operating under one flag, but firms operating in stagnant domestic markets would be more able to break free from this structure and form multinational consortia, which would more resemble the oil and gas supplies and service industry.⁵⁸
- Competitiveness could be increased further by marketing reactor designs that Japan and South Korea have recent experience building, namely the ABWR or APR1400. Two separate studies by French and Japanese scholars

both show that design and component standardization and recent construction experience can decrease costs for subsequent construction projects.⁵⁹ For all these reasons, forming consortia led by Seoul or Tokyo would improve competitiveness with China and Russia and help further strengthen international nuclear norms. ✪

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