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A strategic policy framework for advancing U.S. civilian nuclear power as a national security imperative

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ABSTRACT

The U.S. is at an inflection point on nuclear power with much debate revolving around the extent to which markets or policy should be leveraged to sustain nuclear. This has generated concerns about costs, grid reliability and climate. However, the national security implications must also be accounted for. Here, a strategic policy framework is presented as a means for sustaining U.S. nuclear power domestically and expanding U.S. nuclear power abroad as a national security imperative.

1. Introduction

In the ongoing battle of ideas in its electric power sector, the U.S. has reached a familiar inflection point—it is in the throes of a debate on whether to retain civilian nuclear power in its energy portfolio, thus as a resource for the world's leading industrial economy.

Nuclear energy is a unique resource because of its unmatched energy density and dual-purpose utility for electric power generation and nuclear weaponry. Triple-purpose if applications in medicine are included. However, the U.S. made critical policy decisions in the past that have carried forward and compromised America's capacity to advance in the civilian nuclear power space.

In 1977 the U.S. made the policy decision to *"defer indefinitely the reprocessing of spent nuclear power reactor fuel"* in order to set an example for other nations to likewise not reprocess spent fuel, with the objective being to protect the world from the proliferation of nuclear weapons (Rossin, 1999). This expectation didn't transpire as France, the U.K., Russia, Japan and India currently have nuclear fuel reprocessing capacity (WNA, 2017a). Then, in 1993, another energy policy decision weakened the U.S. further in the advanced nuclear power technology space when President Clinton announced (Clinton Decision, 1993; Gattie, 2017a) the end of nuclear power research and development, characterizing it as a program no longer needed and effectively bringing to an end U.S. research on integral fast reactors. With respect to both fuel reprocessing and fast reactor research, the U.S. Senate held committee meetings in 2017 that addressed the need to look at fuel reprocessing and fast reactor technologies as necessary advances for America's nuclear power future (Senate EPW Hearing, 2017; Senate Appropriations Hearing, 2017, 2016). In all, America is facing stiff international competition, not only with respect to current light-water reactors, but also advanced reactors such as molten salt reactors, fast reactors and small modular reactors (Third Way, 2017). Moreover, several plants in the existing U.S. nuclear power fleet are facing challenges on a different front and are struggling to compete with natural gas and renewables (Proctor, 2017; Polson, 2017).

The issue of harnessing the energy of the atomic nucleus to generate electricity can be traced to the days of the Atomic Energy Commission in 1946, and it was controversial from the beginning (Oppenheimer, 1948; Rhodes, 1986). Some have argued that nuclear power isn't the right way forward or that it poses too great of a risk to the general public (Breyman, 2001; Lovins, 1976; Ehrlich, 1975), while others argue that nuclear power isn't necessary to meet electricity demands (Lovins, 2017; Jacobson et al., 2017a,b). Yet, others contend that nuclear power is needed in order to reduce global carbon emissions and meet climate goals (Begos, 2013; Kharecha and Hansen, 2013; Vine and Juliant, 2014; Shellenberger, 2017; Climate Scientists for Nuclear, 2017). Currently, much of the debate in the U.S. revolves around markets and the extent to which markets should determine the fate of nuclear power in the U.S. energy portfolio. One argument being that markets should be allowed to work and, by proxy, dictate the energy portfolio for the U.S. electric power sector (Lovins, 2017; Perry, 2017; Dyson, 2017; Green, 2017). This is in sharp contrast with efforts to employ subsidies and zero-emission credits to keep baseload nuclear plants in operation (State of New York Public Service Commission, 2017) or to explore mechanisms for assigning value to the reliability and resilience attributes provided by nuclear power (Dept. of Energy Grid Resiliency Pricing Rule, 2017). These issues of costs, climate, reliability and resilience are necessary in the discussion of nuclear power, but they don't sufficiently encompass all aspects of nuclear power in the U.S. One aspect, in particular, is the importance of civilian nuclear

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power to U.S. national security, which is the focus of this paper.

The objectives of this paper are to:

1. Provide rationale for expanding U.S. civilian nuclear power and its associated science, engineering and technology based on U.S. national security concerns, and
2. Present a strategic policy framework for sustaining domestic U.S. nuclear power and expanding the U.S. civilian nuclear power footprint abroad as a national security imperative.

Here, national security is broadly characterized as anything that constrains U.S. options or U.S. capacity to respond to a threat (military, economic, technological, environmental, climate, etc.). This includes, but isn't limited to, any policy or policy deficiency that is complicit in allowing the U.S. to fall behind other nations in a critical field of science, engineering or technology.

2. Nuclear and national security: a brief background

U.S. national security has been at the forefront of America's geopolitical interests since the founding of the country with one of the earliest examples being the Monroe Doctrine of 1823 (Office of the Historian, 2017a). However, since World War II (WWII) national security is more globally extensive and retains in its foundation concerns about nuclear energy—concerns articulated in 1946 by Caryl P. Haskins, then Deputy Executive Officer of the National Defense Research Committee:

> *We therefore cannot count on maintaining our security through a monopoly of fundamental knowledge in the atomic field […]. Further, our monopoly of technical information and facilities is limited and is diminishing. At present we do have a monopoly of stockpiles of raw materials and finished atomic bombs, and we are equipped with gigantic plants for producing these materials. Within something like ten years, however, our monopoly in technology may have disappeared completely, whatever the policy we now adopt with respect to international action.*
> (Haskins, 1946)

Haskins was clear in his concern regarding the possibility that the U.S. no longer had a monopoly on nuclear technology. This had been demonstrated throughout the preceding decades as scientists from across the world and from various nationalities probed the atom for its secrets. Hailing from countries such as New Zealand (Ernest Rutherford), Denmark (Neils Bohr), England (James Chadwick), Hungary (Leo Szilard), Italy (Enrico Fermi), Germany (Otto Hahn), Austria (Lise Meitner), and the United States (Robert Oppenheimer), these scientists did what scientists do—explored the unknown in order to understand the nature of things. In this case it was the mystery of the atom and the knowledge hidden within the atomic nucleus, and that knowledge was available to anyone or any country with the wherewithal and commitment to explore it. The secrets of the atom could not be reserved for U.S. interests only as scientific discovery cannot be contained by geographical boundaries nor is it a respecter of geopolitical intentions or ideologies—good or bad (Gattie, 2017b). This was true in 1946, it is true in 2017, and it will continue to be true in the future.

Haskins' warning proved true as the Soviet Union developed its own nuclear capabilities in pursuit of geopolitical dominance in Europe and Asia. This was followed by the enactment of the Truman Doctrine (Office of the Historian, 2017c) as the foundation to U.S. foreign policy, where America became committed to "*actively offering assistance to preserve the political integrity of democratic nations when such an offer was deemed to be in the best interest of the United States*" (Office of the Historian, 2017c). This was based on the geopolitical reality that U.S. national security "*depended on more than just the physical security of American territory*" (Office of the Historian, 2017c). Eventually, on July 26, 1947, the National Security Act (Office of the Historian, 2017b) was signed into law signifying that the U.S. had accepted its responsibility as the global leader in what was then the new international order.

In the ensuing years, America pursued primacy in nuclear science, engineering and technology in order to maintain a secure distance between itself and any proto-peer nation probing the power of the atom and pursuing nuclear capabilities in order to become a competitor with the U.S.; particularly with respect to military capabilities (Colucci, 2015; Mearsheimer, 2010). The pursuit of American primacy remains an issue of heated debate (Brands, 2016; Sapolsky, 2016).

3. America's role and responsibility in the global nuclear energy cycle

Since President Eisenhower's Atoms for Peace speech in 1953, the U.S. has been the world leader in establishing and maintaining global standards for the nuclear fuel cycle, with the primary objective being nonproliferation (IAEA, 2017; US House, 2017). At least one of the institutional foundations for the U.S. role has been Section 123 of the Atomic Energy Act, which establishes the conditions and outlines the process for major nuclear cooperation between the United States and other countries (National Nuclear Security Administration, 2017). In order for a country to enter into such an agreement with the United States, that country must commit to a set of nine nonproliferation criteria established in order to control the flow and exchange of nuclear material supplies and fuel throughout the world (U.S. Atomic Energy Act, 2017). Historically, the U.S. role as global leader in this critical nonproliferation agreement has been due to its technological capabilities and high standards of excellence in the nuclear supply chain. Nye has noted that American leadership in the global nuclear fuel chain slowed the growth in the number of nuclear weapons states from the twenty-five expected in the 1960s to the nine that exist today (Nye, 1981, 2015). However, of late, some countries have penetrated other regions, particularly emerging economies, with their own reactor designs, construction and services and, in doing so, are challenging U.S. leadership in the civilian nuclear field (Gil, 2017; Japan Times, 2017; Stratfor Worldview, 2017; Gattie, 2017d). In matters of nonproliferation, the standards, integrity and custody of nuclear materials and fuel are paramount issues as the U.S. provides leadership in collaborating with other nations toward global nuclear disarmament while maintaining its long-held stewardship over the global nuclear fuel cycle and the peaceful use of nuclear power to support economic development objectives worldwide.

4. Trends in nuclear power: U.S. and global

Nuclear power in the U.S. is facing challenging circumstances with respect to existing plants and new plant construction. For several years now, particularly since hydraulic fracturing unlocked abundant, inexpensive natural gas resources in the U.S., the electric power sector is trending away from coal and toward natural gas. One benefit of this innovation has been a decline in CO_2 emissions from the electric power sector (Fig. 1). At the same time, low natural gas prices are creating issues for existing nuclear plants, particularly in deregulated markets as markets pursue the next marginal investment, which currently is natural gas. Consequently, several nuclear power plants are scheduled for early closure (Larson, 2016; Plumer, 2016; Anderson, 2017) representing 15,285 MW of baseload capacity and 121,640,916 MWhrs of zero-carbon emissions (Table 1).

In addition, new nuclear projects in Georgia and South Carolina have been confronted by issues associated with reviving a U.S. industrial sector that, with respect to new construction, has been dormant for thirty years. Compounding these new construction efforts were the bankruptcy of Westinghouse and other financial problems with Toshiba, the parent company of Westinghouse (The Economist, 2017; Hals and Flitter, 2017). In the case of V.C. Summer in South Carolina, the project was canceled, leaving Plant Vogtle Units 3 & 4 in Georgia as