

RELIABLE ENERGY SUPPLY AND NONPROLIFERATION

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The phenomenon of global warming has led to a revival of the prospects for increased nuclear energy production worldwide, yet such increased production carries with it the increased risk of proliferation. To mitigate this risk, various multinational arrangements have been proposed to provide reliable supply of nuclear fuel while at the same time discouraging the construction of national plants for nuclear enrichment and reprocessing. This article provides a brief history of some of these proposals and concludes that the likelihood of success for such schemes as effective tools for nonproliferation is not high at this time. A proposal from the World Council on Renewable Energy to expand the understanding of supplier obligations under Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to include the development of non-nuclear energy technologies for NPT parties in good standing is potentially a much better nonproliferation tool. Such an approach tracks the ideas contained in Title V of the Nuclear Non-Proliferation Act of 1978, which has recently received revived congressional interest.

KEYWORDS: Nuclear power; proliferation; renewable energy; international fuel bank

The emergence of global warming as a threat to sustainable economic growth, development, and stability is spurring increased examination of energy policies around the world for ways to mitigate this phenomenon. The developed world has a special responsibility for reducing its contribution to global warming because its past and present use of fossil fuels is the major cause of the problem. But still-developing countries such as China and India, with large populations and high economic growth rates, are expected to surpass the developed world in emissions of greenhouse gases in the relatively near term. There is no evidence suggesting that any country is prepared to voluntarily slow down its growth in order to deal with this problem.

As a result, the main policy focus is on the promotion and development of alternative energy sources that can replace fossil fuels without impeding growth. Nuclear power, which does not produce large amounts of greenhouse gases but which has been in disfavor in the United States for more than thirty years, is being increasingly proposed as part of an energy strategy for global warming mitigation. Some estimates suggest that if nuclear is to make serious inroads into the global warming problem over the next 100 years, there would have to be at least 5,000 new reactors built worldwide during that period.¹ This is unlikely to happen, but any increase in the number of reactors above that being currently planned would require an increase in uranium mining, which itself results in significant greenhouse gas emissions, and the production of other supplies to keep those nuclear plants in operation.

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Countries pursuing nuclear power programs want assurances that nuclear fuel will be available over the lifetime of their reactors. One way of realizing such assurances is by building an indigenous fuel production enterprise. But such autarky would also allow a country to obtain easily the materials needed to proceed with a nuclear weapon program; any country even remotely considering a nuclear weapon option would want a national fuel production facility. Unfortunately, the international nuclear culture and infrastructure allows for indigenous nuclear power facilities to act as a cover for weapon ambitions.

Thus, the expansion of nuclear power to meet global warming mitigation goals carries with it an increased risk of nuclear weapon proliferation. In an attempt to reduce such risk, a number of proposals and strategies for internationalizing energy supply have been proposed to increase security and to enhance nonproliferation. But the history of such proposals suggests that their realization faces great difficulty and may be unable to overcome entrenched ideas of national sovereignty. The purpose of this article is to examine that history and describe other (non-nuclear) avenues of international cooperation on energy supply and security that are more likely to succeed in providing energy security without increasing the risk of proliferation.

Early Nuclear Supply Assurance Proposals

The notion of internationalizing nuclear activities goes back at least to the 1946 Acheson-Lilienthal Report, which proposed an international agency dubbed the Atomic Development Authority (ADA) that would have “the authority to own and lease property, and to carry on mining, manufacturing, research, licensing, inspecting, selling, or any other necessary operations.”² The agency would conduct “all intrinsically dangerous operations in the nuclear field,” including “all activities relating to raw materials, the construction and operation of production plants, and the conduct of research on explosives.” Nuclear activities deemed “non-dangerous” would be left under national control. Examples of the latter included nuclear research (except on explosives) and power reactors, although the ADA would continuously monitor the boundary between “dangerous” and “non-dangerous” activities and shift the boundary as appropriate in accordance with some kind of consensus. The ADA would own all raw materials, all enrichment and reprocessing plants, and all production reactors. It would lease nuclear materials as needed for “non-dangerous” research and power reactors, and would carry out inspections to ensure no diversion of materials for weapon purposes. Since the fuel would be owned internationally, it was deemed that all reactor spent fuel and byproducts would also be the property (and responsibility) of the international community. Any seizure by a country of the fuel or materials processed from it would be illegal and subject to whatever action the international community was prepared to take. But as long as a country’s behavior was proper, it was tacitly assumed that the international community would ensure that reactors in that country would receive the needed fuel supplies.

The sweep of the Acheson-Lilienthal proposals, mainly the product of scientists not notably constrained in their thinking by ideology or politics, was unsustainable in the

cultural, economic, and political climate of post-World War II America. The Cold War had already begun, and the American power elite, surveying the opportunities for economic and political domination presented by an impoverished world, and challenged only by the Soviet Union, was not about to voluntarily turn over the technological base for its nuclear weapon monopoly to an international body that it might not be able to control. So the Acheson-Lilienthal proposals were redrafted under the leadership of a Wall Street financier, Bernard Baruch, appointed by President Harry Truman to present the U.S. proposals to the United Nations. Those proposals became the Baruch Plan, which scrapped the notion of international ownership of nuclear materials and facilities in favor of the idea of inspections of national facilities with sanctions ("war," according to Baruch) in the event of weapon development.³

The Baruch Plan would have required the Soviet Union to forego weapon development, while the United States would keep its weapon monopoly until a sufficiently tight international system of inspections and sanctions was in place. It was no more acceptable to the Soviet Union than the Acheson-Lilienthal proposals were to Baruch. In any event, the U.S. Congress had already enacted the Atomic Energy Act of 1946, which gave the U.S. government exclusive authority to own nuclear materials, placed all nuclear activities under strict classification rules, and created the U.S. Atomic Energy Commission to oversee all nuclear research and development, whether for peaceful or military purposes.

If the idea of nuclear internationalization was dead, so was the idea of commercialization of nuclear technology, as long as the U.S. government maintained an exclusive right to own nuclear materials and facilities. The Soviet nuclear test of a fission device in 1949 and of a thermonuclear device in 1953 established and underscored the fact that nuclear technology could not remain the exclusive province of any one country. Thus, if the United States was going to transform its nuclear advantage into a leading commercial enterprise, it would have to create a market and exploit its advantage before other countries could compete successfully.

The opportunity to do this came at the very beginning of the Eisenhower administration. President Dwight Eisenhower was presented with a stark report by a panel chaired by J. Robert Oppenheimer urging that the American people be told the truth about the dangers presented by the nuclear weaponry already possessed by both the United States and the Soviet Union.⁴ Eisenhower had no intention of revealing the size of the U.S. stockpile and planned a massive buildup of U.S. nuclear weapons. In a propaganda move, he decided to make a speech on December 8, 1953, coupling the need to counter the Soviet nuclear threat with a proposal to advance the development of nuclear energy for peaceful purposes. Eisenhower laid out a vision of nuclear energy as a benign tool for producing new technological wonders that would transform people's lives. Nuclear energy would light people's homes (at a price, according to a later statement by the chairman of the Atomic Energy Commission, that would be "too cheap to meter"), would power the transportation system, and would transform agriculture.⁵

To bring these wonders to the world (and, not incidentally, to foster a Cold War sub-competition that Eisenhower was confident the United States would win), Eisenhower proposed the idea of an international fuel bank administered by an International Atomic Energy Agency (IAEA). The bank would begin with donations of nuclear fuel from the United

States and the Soviet Union, and the international agency would establish rules of procedure under which countries would receive shipments of fuel for their reactors. This proposal, while international in scope, was not a reincarnation of the ideas in the Acheson-Lilienthal Report; it did not provide for ownership of the materials (or anything else) by the IAEA—indeed, it rested on the principle of national ownership and development, which was precisely the opposite of what Acheson-Lilienthal said was needed to prevent weapons proliferation. A few years after Eisenhower's speech, the IAEA became a reality, but the fuel bank idea was never realized, partly because it was not popular, even within the Eisenhower administration, and, contrary to Eisenhower's initial belief, the Soviet Union could match any U.S. contribution without jeopardizing its weapon production rate, thereby negating any real or propaganda advantage to the United States via its contributions to the bank. Nonetheless, the proposed bank did foster competition to build and sell reactors.

For U.S. companies to enter commercial nuclear competition, the 1946 law had to be changed. So, a few months after the delivery of his "Atoms for Peace" speech (a name not given to it by Eisenhower), the U.S. Congress passed the Atomic Energy Act of 1954, which significantly reduced nuclear secrecy and made private ownership of nuclear materials legal. Few countries at the time had any nuclear facilities or experience, so both the United States and Soviet Union built research reactors that were virtually given away for the purpose of providing such experience. Exporting such reactors was a good marketing tool. The United States ultimately provided about forty countries with such reactors, most of which are still operating. Little thought was given to the fact that the fuel cores for these reactors were fashioned from highly enriched uranium (HEU), a weapon-grade fissile material; for more than twenty years now the United States has been trying to persuade its previous reactor customers to convert their reactor cores to operate on low-enriched uranium (LEU), which is not a weapon material (though it can be turned into one using enrichment facilities).

As nuclear power began to grow and reactors began to come on-line both in the United States and abroad, the United States began devoting more enrichment capacity to the civilian sector from its plants in Paducah, Kentucky and Portsmouth, Ohio. In essence, because of its weapon program, the United States had a ready-made monopoly on enrichment services for pressurized water reactors. The ability to guarantee fuel supplies, in turn, enabled more sales of U.S. reactors.

The rapid spread of nuclear technology alarmed many who thought that nuclear weapons might become ubiquitous. President John F. Kennedy speculated at a news conference in 1963 that the world might contain ten nuclear weapon states by 1970 and fifteen to twenty by 1975. Despite that stark prediction (which did not materialize), the major nuclear fear among most people was the possibility of nuclear war between the United States and Soviet Union. But it was understood that encouraging nuclear disarmament would be difficult, if not impossible, in a proliferated world. Accordingly, a drive was begun within the United Nations for a treaty to prevent the spread of nuclear weapons. After years of negotiation, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was drafted and went into effect on January 1, 1970.

The NPT says nothing directly about fuel assurances, but its Article IV provides that every party to the treaty has the right "to participate in the fullest possible exchange of

equipment, materials, and scientific and technical information for the peaceful uses of nuclear energy." In addition, Article IV provides that "nothing in this Treaty shall be interpreted as affecting the inalienable right of all parties to the Treaty to develop research, production, and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II." Article IV has been the subject of much discussion and concern because of claims by some member states, including Iran, that they have the right to build enrichment and reprocessing facilities without interference and to receive assistance in so doing in order to ensure that they will have adequate fuel supplies for reactors they are building or planning.⁶ Iran's violations of IAEA safeguards have raised grave suspicions about its plans to build an enrichment facility, especially since Iran has rejected other means to guarantee future nuclear fuel supplies.⁷ However, Article IV has been taken advantage of by Japan and Brazil to build reprocessing and enrichment facilities, respectively, and other countries, including Australia, are considering doing the same. Assurance of supply and the promise of profitable fuel sales have become standard justifications cited by countries explaining their investments in such facilities.

Anxieties over Nuclear Fuel Supply

Concerns by other countries about independence and assurance of supply date back to the 1960s, when the United States had its nuclear monopoly. Some American conservatives with an ideological commitment to the free market had been uncomfortable with the government's near-monopoly and control over civilian nuclear activities. When the 1946 law was passed establishing the government's authority in all matters nuclear, Representative Clare Booth Luce (Republican of Connecticut) pronounced the law as something that "would gladden the heart of any commissar."⁸ Thus, when Richard Nixon was elected president in 1968, conservatives and the fledgling nuclear industry combined to press for privatization of nuclear enrichment services and facilities. Congressional support was lacking, however, particularly within the powerful Joint Committee on Atomic Energy.

After Nixon won reelection in 1972 by a large margin, he decided to bring the issue to a head by closing the enrichment service's order books in the hope that this would spur Congress to authorize construction of a privately owned enrichment plant. It did not happen, partly because the private sector had little interest in investing in a new plant. But it did spur the Europeans, via a new consortium called Urenco, to build an enrichment plant based on centrifuge technology that would make them less dependent on U.S. enrichment services. The consortium, consisting of German, Dutch, and British companies, later became notorious as the company that hired Pakistani metallurgist A.Q. Khan, who stole plans that enabled Pakistan to build its own enrichment facility at Kahuta. Khan's work was indispensable to the Pakistani bomb program, and he became the head of a network of illicit nuclear suppliers that helped spread bomb technology to a number of countries, including Libya, North Korea, and Iran.⁹

The founding of Urenco was followed by the creation of Eurodif, a European consortium led by France that offered enrichment services using the older gaseous

diffusion technology. France, Belgium, Italy, Spain, and Iran all had shares, but Iran was barred from having access to the technology; later its partners bought out Iran's shares.

The desire of European countries to control all aspects of the fuel cycle began with the construction of a pilot-scale reprocessing facility at Mol in Belgium. Eurochemic, a company involving a consortium of thirteen countries, carried out the project. The consortium eventually grew into the current Nuclear Energy Agency of the Organization for Economic Cooperation and Development. The Eurochemic plant—the forerunner to reprocessing activities in France and other European countries—was shut down in 1975 and decommissioned in 1990.

Reprocessing for the extraction of plutonium was viewed at the time as a necessary element in the evolution of nuclear power. The U.S. view, adopted by others, was that there was insufficient uranium in the earth for nuclear power based on the once-through fuel cycle to last for more than a few decades. This view was later recognized as incorrect, as uranium turned out to be a relatively common mineral; indeed, virtually unlimited amounts are contained in seawater (though this is expensive to extract).

Nonetheless, reprocessing activities were burgeoning in the 1970s, and many countries sought to establish national plants with the assistance of nuclear weapon states. France entered into discussions with South Korea and Pakistan for building reprocessing facilities in those countries. But both deals fell through as a result of U.S. pressure stemming from proliferation concerns. India's 1974 nuclear test, plus growing tensions between nations' desires for fuel assurances and the need to protect against the spread of nuclear weapons, began producing ancillary efforts by nuclear suppliers, led by the United States, to codify nonproliferation protections beyond those stipulated by the NPT. This culminated in the formation of the Nuclear Suppliers Group in 1974—a development viewed with concern by potential recipients of nuclear technology, who began wondering if a cartel was forming under the guise of nonproliferation.

Such concerns increased following passage of the Symington and Glenn amendments to the Foreign Assistance Act of 1961. The Symington Amendment (1976) and the Glenn Amendment (1977) represented the first real interference with the nuclear trade culture established by Atoms for Peace. The Symington Amendment stipulated that any import or export of unsafeguarded nuclear enrichment or reprocessing technology would result in specified sanctions against the importer and exporter. The Glenn Amendment provided for similar sanctions for reprocessing transfers, regardless of whether they were safeguarded or not.

The following year, Congress raised the bar on nuclear trade still further by enacting the Nuclear Non-Proliferation Act (NNPA) of 1978, a law motivated by the 1974 Indian nuclear test. To some observers, the NNPA underlined the question of whether the United States could be a reliable supplier to countries that disagreed with U.S. policy. In particular, the law required the renegotiation, under threat of cutoff, of the then-current agreement for cooperation with the European Atomic Energy Community (Euratom) in order to give the U.S. consent rights over the reprocessing of U.S.-origin spent fuel. Also, all new agreements with non-weapon states were to contain such consent rights. The law did give the president some flexibility in dealing with this issue, so in the end there was no cutoff of nuclear fuel to Euratom while the old agreement was in force, and, after the old

agreement expired, the new agreement was written to give Euratom programmatic consent by the United States for reprocessing. The result was both heightened sensitivity by the Europeans to U.S. nonproliferation concerns over reprocessing and heightened sensitivity by the United States to European concerns about the reliability of supply.

In fact the law (of which this author was the chief architect) was drafted to address the concerns of both its nonproliferation audience and its nuclear utility audience, though this is rarely recognized. Title I of the NNPA is specifically directed toward fuel assurances or, in the vernacular of the time, strengthening the perception of the United States as a “reliable supplier.” Among other things, the act borrowed and elaborated on a number of ideas suggested by Nixon’s successor, Gerald Ford. Ford’s ideas were laid out in a policy statement dated October 28, 1976, five days before the presidential election that Ford lost to Jimmy Carter.¹⁰

To be sure, Ford was responding to campaign statements by Carter that raised the visibility of nonproliferation as an issue. But the cogency and relevance of Ford’s policy plan, which suggested a new approach to closure of the fuel cycle, is still remarkable after the passage of more than thirty years. Most references to Ford’s statement stress his conclusion that “The reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risk of proliferation . . . that the U.S. should no longer regard reprocessing of used nuclear fuel to produce plutonium as a necessary and inevitable step in the nuclear fuel cycle, and that we should pursue reprocessing and recycling in the future only if they are found to be consistent with our international objectives.” Although Ford made clear that his recommendations in this area did not preclude future reprocessing, pending further study, nonproliferation advocates nonetheless applauded his ancillary decision to defer the commercialization of plutonium extraction via chemical reprocessing and the associated suspension of work on such a facility being built at Barnwell, South Carolina.

But Ford’s strong support for nuclear energy, particularly his support for enhancing the U.S. role as a reliable supplier of nuclear fuel services, is generally forgotten. Ford endorsed the idea that “nuclear supplier nations have a special obligation to assure that customer nations have an adequate supply of fuel for their nuclear power plants, if those customer nations forego the acquisition of reprocessing and uranium enrichment capabilities and accept effective nonproliferation controls.” It is unsurprising that getting nations to give up what they view as an inalienable right is difficult, and it raises the question whether the security issues surrounding nuclear energy are inherently intractable in the absence of world government. The events involving Iran are illustrative.

The Iran Situation

In 2002, a U.S.-headquartered Iranian exile group with good connections to intelligence operations in Iran revealed the existence of a clandestine uranium enrichment operation in Iran. For nearly two decades, Iran had been building and experimenting with centrifuges with the aim of constructing a commercial-scale enrichment facility. Under its safeguards agreement with the IAEA, Iran was obligated to inform the agency of its effort but did not.

The Iranian attempt to hide this project is at least a technical violation of its safeguards obligations and has prompted suspicions regarding its ultimate aim. Without doubt, Iran's enrichment activities will bring it much closer to a nuclear weapons capability. Iran is believed to have received considerable help from the A.Q. Khan operation centered in Pakistan, and the IAEA is engaged in an ongoing investigation of Iran's nuclear activities. Iran, which did have reason to fear an attack by Israel similar to Israel's action against Iraq's Osirak nuclear reactor in 1981, evidently hoped to present the world with a nuclear *fait accompli* upon the completion of its centrifuge enrichment facility at Natanz. Iran has pledged to cooperate in providing the IAEA information on the history of its enrichment activities. But the discovery of the partially completed underground facility and separate pilot plant raised alarms, especially considering that Iran did not have a single operating nuclear power reactor (two are under construction) and therefore had no need for an enrichment plant to meet fuel requirements. Several rounds of intense negotiations followed, with Germany, the United Kingdom, and France—the European-3 (EU-3)—and later Russia, with the goal of halting and dismantling Iran's enrichment program in return for a package of incentives, including nuclear fuel assurances. Russia offered to provide enrichment services to Iran as a substitute for the Iranian facility.

Despite the application of great diplomatic pressure by the EU-3, backed up by thinly veiled (and sometimes not so veiled) threats of military attack by the United States, Iran stood its ground, insisting that its intent is to build a plant for peaceful purposes under safeguards in accordance with its obligations as a non-nuclear weapon state under the NPT. Although Iran is hard pressed to justify economically its enrichment plant, it claims that its political history, and that of the Middle East generally, requires that its energy production be kept in its own hands as much as possible.¹¹ Accordingly, Iran is proceeding and has announced the placement into operation of at least 4,000 centrifuges at Natanz, though its goal is to operate thousands more. Although Iran insists that it is interested only in producing LEU for pressurized water reactors, any centrifuge facility that can produce LEU can also be reconfigured to produce fissile material in the form of HEU.

The continuing Iranian saga has revived discussion of ways to induce countries that are operating or bent on establishing nuclear power programs to forego building domestic enrichment or reprocessing plants. The question remains of whether this has become an instance of proposing what should have been done thirty years ago, and whether it is now too late. Indeed, Iran has publicly announced that it will not suspend its enrichment activities even if offered nuclear fuel supply guarantees.¹² Whether additional guarantees combined with a program of targeted sanctions that do not include regime change can persuade Iran to alter its current nuclear course is under consideration by the Obama administration.

Proposals for Reliable Nuclear Supply

The notion of tying fuel assurances for countries with good nonproliferation records to specific restraints on national fuel cycle facilities was contained in a bill introduced by

Senator John Glenn (Democrat of Ohio) in 1976 and was incorporated into the 1978 NNPA as Title I. Under the NNPA, fuel guarantees were to be administered by an International Nuclear Fuel Authority (INFA) working with the IAEA and nuclear supplier nations. The president was tasked with negotiating the establishment of INFA, which would entail not only the provision of fuel supply assurances for countries satisfying appropriate nonproliferation standards, but also standards for the siting, development, and management of both enrichment facilities and spent fuel repositories under international auspices and inspection.

The president was also tasked with submitting to Congress within six months of enactment of the law proposals for initial fuel assurances, including creation of an interim stockpile of uranium enriched to less than 20 percent (i.e., LEU) to be available for transfer pursuant to an appropriate sales arrangement in order to ensure continuity of supply to nations with good nonproliferation credentials. The initial stockpile was suggested as being up to the amount sufficient to produce 100,000 megawatt-electric (MWe) years of power from light water reactors.

The key element regarding the INFA proposal was contained in an instruction to the president for negotiations on INFA's establishment: "The President shall, in particular, seek to ensure that the benefits of [fuel assurances] are available to non-nuclear weapon states only if such states accept IAEA safeguards on all their peaceful nuclear activities, do not manufacture or otherwise acquire any nuclear explosive device, do not establish any new enrichment or reprocessing facilities under their de facto or de jure control, and place any such existing facilities under effective international auspices and inspection." This was meant to be the starting point for the establishment of an integrated international fuel agency with comprehensive control over nuclear facilities and materials. Over time, it was thought that the activities of such an agency would expand and become the norm for nuclear operations in every country, thus bringing the world closer to the vision originally proposed in the Acheson-Lilienthal Report.

Unfortunately, the INFA proposal was too far ahead of its time. There was no interest on the part of suppliers to join the effort to create a fuel assurance regime that was based on restrictions on national sovereignty with respect to the building of new facilities. It took more than thirty years for the idea to gain traction with nuclear supplier nations (more on this in the next section). Although it did not attract much support at the time of its passage, the INFA idea is enshrined in U.S. law and can be revived at any time. Indeed, that time may be at hand since there have been recent congressional proposals to study INFA's implementation.¹³ And President Barack Obama, in a speech on the future of nuclear weapons given in Prague on April 5, 2009, endorsed the notion of an international nuclear fuel bank.¹⁴ In addition, a number of recent independent proposals for ensuring reliable nuclear fuel supply are quite close in concept to the INFA.

Proposals by IAEA and Nuclear Suppliers¹⁵

In a 2003 *Economist* article, IAEA Director General Mohamed ElBaradei expressed concern about the nonproliferation implications of national fuel cycle plants.¹⁶ He offered a number

of ideas on multinational approaches to the fuel cycle that included a call for a moratorium on the construction of new nationally owned enrichment and reprocessing plants as a way of strengthening the nonproliferation regime. To further develop ElBaradei's ideas, the IAEA convened an expert group that produced a report, INFCIRC/640, dated February 2005. The basic premise of the IAEA report is that nuclear fuel cycle problems are best solved on a cooperative regional basis, through the formation of regional nuclear fuel cycle centers.¹⁷ The report suggested five steps toward the formation of such centers, namely:

- reinforcing existing commercial market mechanisms through long-term contracting, initiation of fuel lease-take-back mechanisms, offers to store and dispose of spent fuel, and commercial fuel banks;
- developing international nuclear fuel supply guarantees with active IAEA participation;
- promoting voluntary conversion of existing fuel cycle facilities to multilateral centers as regional confidence-building measures;
- creating new regional multinational fuel cycle centers based on jointly owned new facilities dedicated to spent fuel disposal or fresh fuel supplies as appropriate; and
- broad global cooperation in developing nuclear energy based on integrating functions of the various regional nuclear energy centers.

Several other multilateral approaches to fuel cycle issues and for ensuring reliable fuel supply and spent fuel management have been proposed in recent years. These include a Russian proposal for an International Uranium Enrichment Center; a World Nuclear Association proposal for a three-tiered nuclear supply regime administered by current suppliers; a similar but simplified proposal by the six countries that operate commercial enrichment plants for the civilian market; the U.S. Global Nuclear Energy Partnership proposal; and proposals by the United Kingdom, Germany, and Japan. The details of these proposals are beyond the scope of this paper, but they all present formidable barriers to implementation. One proposal that has received not only significant attention in print but pledged financial contributions is that proposed by the Nuclear Threat Initiative (NTI), a nonprofit organization with an influential, international board that promotes nonproliferation and global security.

The NTI Proposal and Internationalization of the Nuclear Fuel Cycle

In September 2006, former Senator Sam Nunn (Democrat of Georgia), speaking for NTI, of which he is co-chair, proposed the formation of a nuclear fuel bank to be administered by the IAEA as a means of providing fuel supply guarantees to recipient countries in good standing with their NPT obligations who pledge not to build their own enrichment and reprocessing facilities. In that respect, the proposal is in keeping with the idea of INFA in the NNPA. The NTI fuel bank concept was established with a donation of \$50 million from financier Warren Buffet, who conditioned his contribution with the requirement of two

other similar contributions (or contributions in kind) to be obtained over a two-year period. In August 2008, then-Secretary of Energy Samuel Bodman notified the IAEA that the United States would make a matching contribution of \$50 million to this fuel bank concept. Additional contributions have been pledged by the United Arab Emirates (\$10 million), Norway (\$5 million), the European Union (up to 25 million euros), and Kuwait (\$10 million). This means that this fuel bank has reached its initial funding goals.¹⁸ In addition, the U.S. Department of Energy (DOE) has promised to provide 17 metric tons (MT) of HEU to be downblended for the purpose of contributing to a fuel bank as proposed by NTI; this could be designated as a contribution in kind.

The financial resources of the NTI fuel bank would be used to purchase a supply of 4.9 percent-enriched LEU to be administered by the IAEA and sold to qualified recipients. Some of the promised funds, as well as the proceeds from the sale of LEU, would be used to replenish the LEU stockpile under the bank's control. It is estimated that \$150 million committed to the fuel bank could purchase 60–100 MT of LEU, depending on the future prices of uranium oxide and enrichment services. The amount of LEU thus obtained would suffice for one full core load of a 1,500-MWe large advanced light water reactor and possibly one annual fuel reload, or alternately for about four fuel reloads.

Various issues related to the management of the fuel bank concept have yet to be worked out. One issue, the physical location of the LEU stockpile, may have been resolved, as Kazakhstan has reportedly indicated its willingness to act as host. The establishment of the bank is meant to be a catalyst for a much larger international effort. President Obama's endorsement notwithstanding, the prospects for the success of such an effort will depend on additional financial commitments. Such commitments may be difficult to obtain as long as the current worldwide climate of economic uncertainty and distress endures. There is also the basic question as to the effectiveness of the fuel bank idea as a nonproliferation tool at this time in history.

Part of the problem is that its value as a nonproliferation tool was at its height at the beginning of the nuclear age, when few countries were in a position to achieve nuclear autarky. The probability of consensus on establishing a worldwide regime in which there are fuel guarantees and no nationally owned fuel cycle facilities has been on a decreasing slope. Technology denial has become a less effective tool, thanks especially to A.Q. Khan and others. The spread of fuel cycle technologies has perhaps reached a tipping point in which the technology is, if not widely available, then sufficiently available to any determined party. Hence, the argument made by proponents of internationalization that giving up national nuclear development in favor of more restrictive international efforts will result in much greater security for all does not have the power it may once have had.

There is a basic unwillingness of sovereign countries to give up control over their fuel supply to regional or international organizations. The sole (limited-function) exception to this is the European nuclear fuel supply agency Euratom. Nuclear fuel supplies are national concerns of sufficient sensitivity to prevent most countries from turning over production and delivery responsibilities to multilateral organizations. Further, even in relatively similar regions the differences in national culture, outlook, and policies still limit the opportunities for regional collaboration on sensitive national issues. The Iran situation is what motivated the recent progress in this area, but the failure to stop the Iranian

program will not bode well for achieving agreement with other countries on limiting their options for advanced nuclear development. It is therefore difficult to see what transforming event might occur that would push the idea of internationalization still further. In the meantime, the spread of nuclear technology and facilities continues apace, as does the threat of proliferation to countries and subnational groups. What alternatives are there?

Renewable Energy, Not Just Atoms, for Peace

As indicated earlier, NPT Article IV has been problematic from a nonproliferation perspective by virtue of its providing the “inalienable” right of a non-nuclear weapon state in good standing with the NPT to pursue fuel cycle technologies that could provide nuclear weapon materials to that state. In attempting to mitigate this risk, various additional comprehensive and intrusive safeguards obligations have been developed and implemented where possible, including the Additional Protocol of the IAEA. Outright denial of transfers of fuel cycle technology to non-nuclear weapon states have also become the norm for nuclear suppliers, leading to complaints that one of the grand bargains upon which the NPT was founded has been reneged on. Nuclear fuel assurances via international arrangements are a way of addressing these complaints.

The problem with all the proposals for fuel assurances is that they attempt to fix a fundamental problem inherent in the nuclear enterprise that can be alleviated but not eliminated. Peaceful nuclear technology and nuclear weapons are two sides of the same technological coin. Accordingly, a nonproliferation policy worthy of the name should seek to avoid not just the spread of fuel cycle facilities, but also the promotion and use of nuclear power unless consistent with a clear advantage over alternatives in economic and social viability (including the economic and social costs of mitigating security concerns) and environmental protection.

Unfortunately, the NPT addresses only nuclear assistance, but the energy needs of any given country cannot be satisfied with nuclear power alone. Indeed, nuclear power is still economically uncompetitive in most countries compared with alternative sources of energy, including increases in end-use efficiency, gas turbines, and distributed combined heat/power installations. New nuclear energy installations are particularly unsuitable economically in countries where an existing mature nuclear infrastructure is not already in place, with an accompanying safety and quality assurance culture on an industrial scale.

Pushing nuclear power without such elements in place could mean enhanced risk of accidents with attendant reduction in the viability of nuclear energy programs elsewhere. Moreover, any significant increase in nuclear energy activity, even under the best circumstances, cannot avoid raising the risk of proliferation, theft of nuclear materials, and even nuclear terrorism.

We are thus faced with a serious dilemma: global warming and increased energy demands require increased non-carbon-emitting energy supplies, but one source of such increased supply, nuclear power, carries with it enhanced risk of nuclear detonations,

which would be environmentally destructive. Thus, in the reduction of greenhouse gases, the security externalities of nuclear energy should place it among the least desirable alternatives for mitigation, especially in cases where a prior commitment to nuclear power has not already been established and implemented.

It was in this spirit that Title V of the NNPA was drafted. Title V was meant to balance the tilt toward nuclear technology created by the atoms-for-peace philosophy and NPT Article IV by encouraging developing countries to meet their energy needs through alternatives to both fossil and nuclear fuels consistent with economic factors, material resources, and environmental protection. Title V authorized the creation of a program of cooperation involving the United States and other countries to evaluate the energy alternatives available to developing countries, to facilitate international trade in energy commodities, and to develop and apply suitable energy technologies in such countries. The program called for general and country-specific energy assessments, along with cooperative projects in resource exploration, training, research, and development. Scientific and technological exchanges between the United States and developing countries on energy development was mandated, and the president was to report on the feasibility of establishing a scientific peace corps designed to encourage technically trained volunteers to live and work in developing countries to assist them in meeting their energy research and development needs under this program.

Unfortunately, the program's funding had to be authorized via the annual DOE authorization bill, which was under the control of the energy committees in the House and Senate. Both committees were skeptical at the time of the economic viability of renewable energy resources; indeed, the Senate Energy Committee attempted, unsuccessfully, to remove the provision during markup of the NNPA. In addition, the Carter administration had become intimidated by other countries' criticism of its nuclear policy and did not want to push a program that might further reduce the administration's already low standing with the nuclear industry or potentially weaken the nuclear market at a time when the industry had entered a downturn in new orders. This downturn was exacerbated by the Three Mile Island accident that occurred fewer than three weeks after the enactment of the NNPA. Thus, the Title V program languished but is still part of U.S. law. It is a nonproliferation tool waiting to be picked up. In recent years, the rediscovery of Title V by nonproliferation activists has revived interest in the program by Congress.¹⁹ The congressional WMD Commission also specifically recommended implementation of Title V.²⁰ This suggests growing recognition that national security concerns must play an important role in establishing priorities for energy development both in the United States and abroad. The next section describes a way to revive and incorporate the Title V idea within the context of a reinterpretation of Article IV of the NPT.

Reviving Title V via Article IV

The World Council on Renewable Energy (WCRE), an organization founded in 2001 dedicated to promoting renewable energy, has produced an "Action Plan for the Global

Proliferation of Renewable Energy.”²¹ This plan contains twelve recommendations for transforming the world’s energy systems to a renewable resource base. Among other things, these recommendations address research and development expenditures and subsidies, national targets and the setting of global goals, industrial norms and standards (including in the use of energy statistics), ending trade barriers in renewable technologies, international financing for renewable energy projects, integrating the promotion of renewable energy into the missions of the UN agencies concerned with environmental protection and health, and conversion strategies to aid fossil fuel-exporting countries to transition their economies to alternative bases of wealth.

But perhaps the most striking idea in the WCRE plan is the call for a “Renewable Energy Proliferation Treaty” and the establishment of a “Renewable Energy Agency.” It is here that the nexus occurs between Title V of the NNPA and the WCRE plan. The treaty proposed by the WCRE is actually a supplemental protocol amending the NPT in which a state party’s supply responsibilities under Article IV could be satisfied by the supply of renewable energy technologies rather than just nuclear, with renewables given preference whenever feasible. International assistance and transfers in renewable energy technologies would be provided via a new international body called the International Renewable Energy Agency, whose membership would be open to all NPT state parties in good standing.

Title V of the NNPA called on the president to lead an international effort to encourage renewable energy technologies, particularly for developing countries, as a nonproliferation tool. The WCRE has made the connection between renewables and nonproliferation more direct by its call for a formal reinterpretation of NPT Article IV. NNPA Title V envisioned the IAEA as the agency tasked with handling the organizational aspects of renewable energy cooperation, but it may be that the culture of the IAEA is so pro-nuclear as to render a more neutral stance by the agency toward technical energy assistance problematic. Hence, the call for a separate agency to handle renewables may be more appropriate at this time.

Conclusion

The problem of global warming has fostered much talk of a “nuclear renaissance” as a response to the need to reduce carbon emissions. But it is a virtual certainty that increasing the spread of nuclear energy technology will result in an increased risk of nuclear weapons proliferation and nuclear terrorism. Schemes to mitigate this increased risk include internationalized nuclear fuel assurances for countries that forego national fuel cycle facilities, but fears of cartelization as well as states’ natural desire to control their energy destiny have made proposals such as those of Acheson-Lilienthal, INFA in the NNPA, and the more recent ones from ElBaradei and NTI—even with President Obama’s endorsement—difficult to implement and perhaps ineffective if implemented. Thus, NPT Article IV remains a problem and a vehicle for raising the risk of proliferation as long as it is cast as giving the right of full access to nuclear technologies to NPT state parties. That is

not to say that nuclear fuel assurances cannot be successful under certain special conditions and circumstances. But the acceptability of these conditions is problematic for any country sensitive to its sovereignty or for any potential proliferators. Any system creating tiers of limited suppliers and recipients is likely to engender complaints of discrimination and a class system for recipients that will be resented.

International cooperation on the development of renewable energy does not carry any such baggage and can succeed, provided it receives adequate political and financial support. The establishment of the WCRE and the proposal to enlarge the meaning of NPT Article IV to include renewables is an indicator that the debate over energy choices will not be settled by the proponents of any one source of supply. Logic, economics, and the market will ultimately prevail. While nuclear energy has a place in the mix, we must ensure that concerns over energy supplies and global warming do not cause a rush to expand and adopt technologies that are not only more expensive than renewable alternatives, but will also put the tools of nuclear war in more hands.

NOTES

1. Matthew Wald, "Experts See Nuclear Energy as Cure for Global Warming," *New York Times*, September 25, 1989, p. D2.
2. *A Report on the International Control of Atomic Energy* (Washington, DC: U.S. Government Printing Office, March 16, 1946), available as Department of State Publication 2498, <www.learnworld.com/ZNW/LWText.Acheson-Lilienthal.html>.
3. James Chace, *Acheson: The Secretary of State Who Created the American World* (New York: Simon and Schuster, 1998), p. 127.
4. Ira Chernus, *Eisenhower's Atoms for Peace* (Bryan, TX: Texas A&M Press, 2002), pp. 27–28.
5. For the "too cheap to meter" quote, see Lewis L. Strauss, "Speech to the National Association of Science Writers," New York City, September 16, 1954, as printed in *New York Times*, September 17, 1954.
6. Many papers over the years have cogently argued that NPT Article IV does not give a country *per se* an inalienable right to develop nuclear technology simply because that country declares its facilities and allows IAEA inspections. Unfortunately, these arguments have not resonated sufficiently with the world's nuclear community for any official change to occur in the interpretation of Article IV. See Robert Zarate, "The NPT, IAEA Safeguards, and Peaceful Nuclear Energy: An 'Inalienable Right', but Precisely to What?" in Henry Sokolski, ed., *Falling Behind: International Scrutiny of the Peaceful Atom* (Carlisle, PA: Strategic Studies Institute, 2008), pp. 221–90.
7. See Jacqueline Shire and David Albright, "Iran's NPT Violations—Numerous and Possibly On-going?" Institute for Science and International Security, September 29, 2006, <www.isis-online.org/publications/iran/irannptviolations.pdf>.
8. William Lanouette, "Atomic Energy 1945–1985," *Wilson Quarterly* 9 (Winter 1985), p. 100.
9. See Douglas Frantz and Catherine Collins, *The Nuclear Jihadist: The True Story of The Man Who Sold the World's Most Dangerous Secrets* (Hachette Book Group, 2007).
10. Gerald R. Ford Presidential Documents, vol. 12, no. 44, pp. 1626–27, 1976.
11. Thomas W. Wood, Matthew D. Milazzo, Barbara A. Reichmuth, and Jeffrey Bedell, "The Economics of Energy Independence for Iran," *Nonproliferation Review* 14 (March 2007), pp. 89–112.
12. "US-India Nuclear Deal Violates NPT: Iranian Official," Islamic Republic News Agency, October 6, 2008, <www.payvand.com/news/08/oct/1042.html>.
13. In the 110th Congress, on September 11, 2007, the Senate Foreign Relations Committee reported a bill introduced by Senator Richard Lugar (Republican of Indiana) and Senator Evan Bayh (Democrat of Indiana) calling for a study of the feasibility of establishing INFA as described in the NNPA.
14. "Remarks by President Barack Obama," Prague, Czech Republic, April 5, 2009.

15. The author acknowledges useful discussions of the material in this section with Chaim Braun of Stanford University.
16. Mohamed ElBaradei, "Towards a Safer World," *Economist*, October 16, 2003.
17. IAEA, "Multilateral Approaches to the Nuclear Fuel Cycle: Expert Group Report Submitted to the Director General of the International Atomic Energy Agency," INFCIRC/640, February 22, 2005.
18. "IAEA Nuclear Fuel Bank Reaches Funding Target," *Global Security Newswire*, March 9, 2009.
19. See prepared statement of Henry Sokolski, "Keeping Nuclear Energy Peaceful: Why We Must Review the NPT," testimony before the House Committee on International Relations, Subcommittee on International Terrorism and Nonproliferation Hearing, "Previewing the Nuclear Non-Proliferation Treaty Review Conference," 109-47, 109th Cong., 1st sess., April 28, 2005.
20. See Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism, *World at Risk: The Report of the Commission on the Prevention of WMD Proliferation and Terrorism* (New York: Vintage Books, December, 2008).
21. World Council on Renewable Energy, "Action Plan for the Global Proliferation of Renewable Energy," presented at the First World Renewable Energy Policy and Strategy Forum, Berlin, 2002, <www.wcre.de/en/images/downloads/actionplan_en.pdf>.