Washington Monthly, January/February 2009

Bad Reactors

Rethinking your opposition to nuclear power? Rethink again.

By Mariah Blake

Mariah Blake is an editor of the *Washington Monthly*. Research support for this article was provided by the Investigative Fund of the Nation Institute.

Seven years ago, Finland was faced with a daunting energy dilemma. To keep its domestic industries up and running, it needed to double its electricity supply by 2025. At the same time, it had to cut carbon emissions by fourteen million tons a year to comply with its obligations under the Kyoto Protocol. The question was how to fill the gap without stifling its flourishing economy or increasing dependence on costly imports.

As it hunted for solutions, the Finnish government decided to consider a controversial option: building another nuclear power plant. It was not a new idea; in fact, the Finns had weighed and rejected it nine years earlier. But since then, officials reasoned, the situation had changed. Besides a new imperative to reduce carbon emissions, a new generation of nuclear reactors had recently come onto the market. None had been built, but the industry claimed that their simple, standardized designs and modular components would make them far easier and less expensive to assemble than their predecessors. In fact, a study by the Lappeenranta University of Technology, which used figures on par with industry estimates for capital costs, found that a new atomic plant could deliver electricity more affordably than any other large-scale energy option. A group of lawmakers appointed by Prime Minister Paavo Lipponen to study the issue also concluded that a single reactor could create a much greater drop in greenhouse gas emissions than the next cheapest option, building more gas-fired plants. This meant there would be less pressure on the government to enact other mechanisms, such as a gasoline tax, that might put a dent in consumer spending and hamper economic growth.

Based on these findings, in May 2002 the Finnish parliament voted to approve the construction of a new nuclear power plant, something no Western nation had done in more than a decade. In industry circles, the decision was heralded as a breakthrough. Areva, the French company selected to build the reactor, touted the project as "historic" and promised that it would open the door to a global nuclear renaissance. In the United States, the Heritage Foundation issued a white paper commending Finland's "rational approach to nuclear power," and the New York Times ran a story calling the nation's choice "prescient." Tens of thousands of lawmakers and energy buffs from around the globe descended on Olkiluoto, where the reactor is being built, to witness the bold experiment taking shape.

A craggy peninsula, which sits at the end of a two-lane road lined with sagging barns, rusty tractors, and thick birch and pine groves, Olkiluoto is being transformed into a thriving showcase for the promise of clean, abundant nuclear power. Not far from the construction site is an airy 10,000-square-foot visitor's center with a glass wall overlooking the cool blue waters of the Bothnian Sea. In addition to a restaurant and an auditorium, the center features an elaborate interactive exhibit on the merits of smashing atoms. There are imitation caves full of real yellowcake uranium and a life-size mock-up of the new reactor's core, complete with hundreds of aluminum rods and the cobalt glow of Cerenkov radiation. All around, images of mossy forests paper the walls, and birds chirp over the speakers.

But the building site is far less serene. When I visited in November, it was teeming with lumbering backhoes, churning cranes, and workers doubled under sacks of concrete. Hundreds of metal shipping containers and canvas tents were scattered around a fifteen-acre hole blasted into the granite bedrock. Rising from one end of the pit was the containment building, a ninety-foot-tall tower with its top wrapped in scaffolding, which houses the reactor. From afar it looked like a solid pillar of concrete, but as I picked my way through stacks of rusty I beams and giant spools of cable, I noticed Bondo-colored patches scattered across its face. Eventually, I looped around back and crossed a rickety plywood bridge that led inside. The interior of the containment building was lined with a solid layer of steel that was crisscrossed with ropy welds. On this surface someone had scrawled the word "Titanic."

These marks are the last remaining hints of the problems that have plagued this thick outer shell, the last line of defense in case of a meltdown. The steel liner was hand forged using outdated plans by a Polish subcontractor, which had no prior nuclear experience. As a result, the holes for piping were cut in the wrong spots, and the gaps along the weld joints were too wide. Entire sections had to be ripped apart and rebuilt. And the containment liner is not unique. Virtually every stage of the construction process has been dogged by similar woes, from the nine-foot-thick foundation slab (the concrete was mixed with too much water, making it weaker than had been called for in the plans) to the stainless steel pipes that feed water through the reactor core (they had to be recast because the metal was the wrong consistency). To date, more than 2,200 "quality deficiencies" have been detected, according to the Finnish nuclear authority, STUK. Largely as a result, the project, which was supposed to be completed in 2009, is three years behind schedule and is expected to cost $6.2 billion, 50 percent more than the original estimate. And the numbers could keep climbing. "There are still some very challenging phases ahead," says Petteri Tiippana, STUK's assistant director for projects and operational safety. "Things will have to go extremely well if those responsible for building the project are to hit the new targets."

These complications have already erased the cost savings nuclear power was supposed to deliver compared to other energy sources, such as natural gas. What's more, the reactor won't be completed before 2012, when the Kyoto treaty expires. To meet its targets, between now and then Finland will have to buy hundreds of millions of dollars' worth of credits through the European Union's emissions trading scheme. In the meantime, because the country expected the reactor to deliver a bounty of energy and didn't pursue other options, it's facing a severe electricity shortage and will have to import even more from abroad, which will drive up power bills. Elfi, a consortium of Finnish heavy industries, has calculated that the project delays will create $4 billion in indirect costs for electricity users.

The implications of Finland's ordeal reach far beyond its borders. After three decades of struggling to gain traction through an aggressive lobbying and PR campaign, the nuclear power industry is on the verge of global resurgence. More than 100 new nuclear plants are being built or planned around the world. In the United States, there are thirty-five reactors on the drawing board, with licensing applications for twenty-six of them already under review by the Nuclear Regulatory Commission (NRC)—the first batch the agency has seen since 1978. These projects enjoy a broad public backing that would have been unthinkable a decade ago: a recent poll by Zogby Interactive found that two-thirds of all Americans support the construction of new reactors on U.S. soil. And this support cuts across political lines, with half of all Democrats favoring more nuclear power. Liberal opinion makers, such as New York Times columnist Thomas Friedman, have also endorsed the nuclear option. Wired magazine has repeatedly urged readers to "Go Nuclear." Even a few longtime foes of atomic energy, like House Speaker Nancy Pelosi, now argue it "has to be on the table." As for President Barack Obama, both he and his energy secretary, the Nobel Prize–winning physicist Steven Chu, have offered at least qualified support for expanding the use of nuclear power in the United States.

What's behind this dramatic reversal? The short answer is that climate change has shuffled priorities. Nuclear power may have some unsavory side effects, like radioactive waste and the risk of meltdowns. But no other energy source can deliver vast quantities of low- or zero-carbon energy at a price that rivals natural gas and coal, as the industry has promised the new breed of reactors will do. With this in mind, many people who once dismissed atomic power out of hand have come to view it as a vital, if imperfect, tool in the struggle to salvage our warming planet.

But as Finland's experience shows, the reality may be far messier than the industry lets on: a growing body of evidence suggests that new nuclear construction projects are prone to the same setbacks as those undertaken a generation ago, when lengthy delays and multibillion-dollar cost overruns were commonplace. This raises serious questions about the potential of nuclear power as a front-line solution in the battle against climate change.

In the early days of the Atomic Era, nuclear power was heralded as a panacea—a cheap, abundant energy source that would spur economic growth, cut dependence on foreign oil, and enable every imaginable human endeavor. President Dwight Eisenhower gave voice to this sentiment in 1954, when the United States broke ground on its first commercial reactor in Shippingport, Pennsylvania—part of an ambitious, government-funded program to develop a viable nuclear energy sector. "In thus advancing toward the economic production of electricity by atomic power," the president enthused, "mankind comes closer to fulfillment of the ancient dream of a new and better earth." He then kicked off the ground-breaking celebration with space-age flair by waving a "neutron wand" over a special neutron detector, signaling a robotic bulldozer to scoop up a pile of dirt. Days later, Lewis Strauss, chairman of the Atomic Energy Commission, declared that future generations would enjoy electricity "too cheap to meter."

By December 1957, residents of western Pennsylvania were brewing coffee and vacuuming carpets with power from the Shippingport plant. The project's success set off a chain reaction. Beginning in the early 1960s, utilities—lured by promises of cheap electricity and growing concerns about air pollution—were lining up to purchase new reactors, a phenomenon historians have dubbed the "great bandwagon market" for nuclear power. Between 1965 and 1967, sixty plants with 40,000 megawatts of generating capacity were ordered.

Sub-prime Nuclear Loans

In July 2007, Baltimore-based UniStar Nuclear Energy made history by applying for a permit to build a new 1,600-megawatt reactor on Maryland's Chesapeake Bay—the first application the Nuclear Regulatory Commission had seen in nearly three decades. It has since sought approval for an additional three plants in Missouri, New York, and Pennsylvania.

Behind these bold plans is a rare and complicated business model. UniStar, a limited liability corporation, is a joint venture of two major utilities: EDF of France and Constellation Energy, a Fortune 125 company and America's largest supplier of wholesale electricity. UniStar has also spun off a subsidiary, Calvert Cliffs 3 Nuclear Project, LLC, to build the Maryland project—a structure that gives its corporate parents two layers of protection against financial meltdown.

In its promotional materials, UniStar touts this arrangement, saying it is "powering the nuclear renaissance" through "effective risk management." But its approach carries substantial risks for the American public. According to UniStar estimates, the reactors will cost between $4,000 and $6,000 per kilowatt capacity to build, for a total of up to $38 billion. (Projections from Moody's Investment Services put the costs closer to $48 billion, roughly the same amount the United States spent on the Iraq War in 2006.) Yet UniStar's parents have only provided it with about $400 million in assets and capital, not nearly enough to tackle a project of this size. And there is a reason for this: its plan for financing these projects rests entirely on government-backed loans.

According to testimony UniStar executives gave before the Maryland Public Service Commission, the U.S. Treasury is expected to backstop 80 percent of the total costs through the Department of Energy loan guarantee program (designed largely to encourage the building of new nuclear power plants) and possibly to put up funds via its Federal Finance Bank arm. To cover the remainder, UniStar plans to seek loans from the French import/export bank COFACE. (Both Japan and France—the two countries with the capacity to manufacture new reactors—are expected to offer guaranteed loans to companies that build nuclear plants using suppliers in their countries, so other U.S. utilities will likely be eligible for this kind of support, too.) Under no circumstances do Constellation or EDF intend to dip into their own coffers to fund the project. "Without the federal loan guarantees, this whole thing will come to a stop," UniStar CEO George Vanderheyden told reporters before a community meeting about the Calvert Cliffs plant.

The Department of Energy is still weighing UniStar's loan guarantee applications, but if all goes as planned, the firm's corporate parents will have little or nothing at stake, while taxpayers are on the hook for tens of billions of dollars. And UniStar is not alone in its ambitions. Most, if not all, of the seventeen companies with applications for new reactors before the NRC are counting on federal loan guarantees—an unsettling scenario given that the Congressional Budget Office has found the risk of default on guaranteed loans for reactors to be "very high—well above 50 percent."

—M.B.

By the mid-1970s, more than 100 nuclear power stations were being planned or built. But the manic enthusiasm was fading as reactor projects ran aground amid soaring inflation, shrinking energy demand, bungled construction, and regulatory delays. Perhaps the most infamous boondoggle was the Shoreham Nuclear Power Plant on the Long Island Sound. The Long Island Lighting Company spent twenty-five years and $6 billion—eighty times the original estimate—trying to get it up and running. But it was never licensed to operate. The debacle saddled Long Island residents with some of the nation's highest electricity rates and pushed the regional economy to the brink of ruin.

As problems piled up, the market for new reactors collapsed. Between 1973 and 1978 the number of annual orders dwindled from thirty-eight to two. Some utilities began canceling reactor plans or abandoning half-built projects. In the mid-1980s, the Washington Public Power Supply System walked away from two unfinished reactors and $2.25 billion in bonds, the largest municipal bond default on the books. Another major utility was forced into bankruptcy. In 1985, Forbes magazine surveyed the wreckage of the nuclear power industry and described it as "the greatest managerial disaster in business history."

Although public opposition and safety concerns played a role in the industry's undoing—especially after the partial meltdown at Pennsylvania's Three Mile Island plant in 1979—the primary stumbling blocks were economics and an unworkable business model. Most first-generation plants were custom designed and built, and in many cases design plans weren't finished before construction began. This opened the door to construction errors and endless regulatory delays. In the hopes of rescuing the industry, in 1985 the Electric Power Research Institute, an industry-funded think tank, aided by executives from nuclear utilities and Nuclear Regulatory Commission officials, came up with a set of principles for next-generation reactors with simpler, standardized designs, fewer moving parts, and more modular components. The goal was to make them not only safer than their predecessors, but also faster and less expensive to build than coal-fired power plants. Four years later, the NRC overhauled its regulatory process to help this effort along. Reactor vendors were invited to submit a limited number of designs for precertification, so utilities could simply pick one and apply for a permit to build it as a specific site. "The idea was to commit to just a few designs, and set those designs in stone to create a more efficient process," explains NRC spokesman Scott Burnell.

The first two standardized designs were rolled out in 1997, but they were never built in the United States. After the fiascoes of the previous decade, banks and investors were simply too shell-shocked to risk financing new reactors, despite promises about the new streamlined plans. Hoping to overcome this barrier, the nuclear industry turned its attention to Capitol Hill, where it found that its concerns dovetailed with those of another interest group, which happened to have a powerful patron.

Around the time the first standardized reactor designs hit the market, veteran New Mexico Senator Pete Domenici was approached by two aides: Alex Flint, a savvy twentysomething operative who had worked his way up from the mail room, and Pete Lyons, a physicist whose salary was paid by the Los Alamos National Laboratories in Domenici's home state. Nearly a decade after the fall of the Berlin Wall, Los Alamos—the storied nuclear weapons lab that gave birth to the atom bomb—was fighting to defend its billion-dollar budget from congressional proposals to privatize or scale back weapons research. In America's stalled nuclear power industry, Flint and Lyons saw a potential second act for the lab's scientists and the rest of the nuclear weapons sector. Domenici, a technology buff and tireless advocate of New Mexico's labs (the largest employer in northern New Mexico, and the destination for 20 percent of the state's federal funding), embraced the idea. In June 1998, he convened a gathering of nuclear energy lobbyists and senior officials from industry, government, and the national labs. After six hours of brainstorming, the group hashed out a plan to put nuclear energy back on the nation's agenda. Among the key steps were reframing the debate to position nuclear power as an abundant, carbon-free energy source; creating "a broad-based nuclear mission that advocates a viable commercial sector" within the Department of Energy; and persuading Congress to "legislate a level playing field" for nuclear power by creating large-scale subsidies and tax credits.

Over the next few years, the forum participants and their political allies got to work. In 2001, the Bush administration took office and began working to overhaul government agencies to make them friendlier to the industry. Layers of NRC regulation were stripped away. At the DOE, the top position in the Office of Nuclear Energy was promoted to an assistant-secretary-level appointment, and a host of new programs were added to promote the resurgence of atomic energy—among them Nuclear Power 2010, under which the government pays half the cost of site selection, planning, and licensing for new nuclear reactors. The industry, meanwhile, worked to shift public perception, through an aggressive PR campaign that involved, among other things, planting ghostwritten op-eds advocating nuclear energy in local newspapers under the names of prominent local personalities, and setting up front groups that appeared to be independent environmental organizations, such as the New Jersey Affordable, Clean, Reliable Energy Coalition. It also began pressing Congress for subsidies and, starting in 2001, federal loan guarantees. But nuclear advocates made little headway on this front until 2003, when Republicans regained control of the Senate and Domenici was appointed chairman of the Energy Committee. He rehired Alex Flint, who had gone on to work as a nuclear power lobbyist, to direct the committee's work. Flint spent the next two years wrangling with politicians, often in secret, over a new energy bill.

On August 8, 2005, President George W. Bush's motorcade arrived at Sandia National Laboratories, in Albuquerque, New Mexico. The president toured the lab's Solar Tower Facility, a field of solar collectors pieced together from giant mirrors, which sits in the hilly scrubland surrounding the Sandia compound. Then he walked into the lab's auditorium. Seated beneath a giant banner with an image of clear blue sky, he signed the Domenici-sponsored Energy Policy Act of 2005 into law. The act fulfilled many of the industry's key legislative ambitions. Most importantly, it provided

unlimited federal loan guarantees to cover up to 80 percent of project costs for next-generation nuclear plants and other "innovative technologies" to reduce greenhouse gas emissions. It also included a twenty-year extension of the Price-Anderson Act, which limits the liability of nuclear power plant operators in case of accidents, and $13 billion in direct subsidies for nuclear power, including $2 billion in "risk insurance" to pay extra costs caused by delays in construction and licensing for the first six new reactors. Bush touted these measures as a boon for the environment. "Of all our nation's energy sources, only nuclear power plants can generate massive amounts of electricity without emitting an ounce of air pollution or greenhouse gases," he said, to a burst of applause.

The Energy Policy Act's passage signaled a seismic shift: in less than a decade, the nuclear power industry had gone from energy pariah to political heavyweight. Its lobbying operation was now among the most formidable on Capitol Hill, thanks to a generous infusion of cash. (Since the mid-1990s, the energy and nuclear power sector has spent at least $953 million lobbying Congress and the executive branch, according to the Center for Responsive Politics—more than any group except the pharmaceutical and insurance industries.) That money helped the industry to meet most of the goals laid out at the 1998 forum and win tens of billions of dollars in new subsidies. All told, the nuclear power sector has secured more than $100 billion in federal support, at least $25 billion of it in the last four years alone, according to the nonpartisan group Taxpayers for Common Sense. That's far more than renewable energy sources.

While Republicans—especially those with links to energy interests and the national labs—played a key role in the industry's resurgence, this stunning second act would not have been possible without the growing support of Democratic lawmakers. By 2005, it was becoming clear that the dangers of climate change were real, and politicians saw few solutions. Renewable energy was still viewed as an expensive niche market that was decades away from providing power on a large scale (though, in reality, some renewables—wind, most notably—were becoming financially competitive with coal). As a result, many Democrats were rethinking their reservations about atomic energy, including longtime foes like Senate Majority Leader Harry Reid, who was once "totally opposed to nuclear power." One sign of this newfound support was the broad backing for the Energy Policy Act, which passed the House by a margin of 275 to 156 and the Senate by 74 to 26. Four out of ten Democrats voted for it, including then Senator Barack Obama, who declared that the bill took "significant steps in the right direction on energy policy."

But this emerging bipartisan consensus did not extend to Wall Street, where the new package of giveaways did little to ease doubts about the viability of new nuclear power. Months after the 2005 bill passed, the rating agency Standard & Poor's issued a report saying that the generous new subsidies "may not be enough to mitigate the risks associated with operating issues and high capital costs" of new nuclear plants, and that companies that built or financed them would see their credit ratings slide. This was a blow to the industry; at the time, the Nuclear Energy Institute was claiming that the overnight building costs (meaning inflation isn't factored in) for next-generation reactors would be between $1,100 and $1,500 per kilowatt capacity—roughly on par with natural gas plants and cheaper than coal. In June 2007, the Keystone Center, a Colorado-based energy think tank, published another report, funded in part by the industry, which cast fresh doubt on NEI estimates. The study (which, unlike the NEI figures, used actual hard data from reactors built in Asia in the 1980s and '90s) projected that the overnight costs for new nuclear plants would be about $3,000 per kilowatt, or up to $4,000 per kilowatt including inflation—at least double the NEI's estimate. The following month, the managing directors of six major financial firms—among them Lehman Brothers, Merrill Lynch, and Morgan Stanley—wrote a letter to the DOE, saying, "We believe many new nuclear construction projects will have difficulty accessing the capital markets" because lenders feared getting mired in "another Shoreham." They concluded that raising the loan guarantee ceiling to cover 100 percent of project debt was one of the "minimum conditions necessary to secure project financing." In other words, the only way to unlock capital was for taxpayers to take on all of the risk.

In October 2007, Moody's Investor Services piled on with a report projecting that new reactors would cost $5,000 to $6,000 per kilowatt to build, or up to $12 billion per unit. This figure, which was based on actual bids for new reactors in the United States, caused considerable sticker shock. The trade magazine Nuclear Engineering International ran an article questioning whether utilities would shelve their plans for new reactors amid revelations about "prohibitively high" costs. In January 2008, Warren Buffett's MidAmerican Energy Holdings Co. scrapped plans to build a new reactor because it found the "economics of building the next generation of nuclear power plants" were "not in our customers' best interests." But as staggering as their estimates were at the time, those who did the calculations for

Keystone and Moody's have concluded, based on newer data, that they were not high enough. "The numbers have simply gone flying past our highest 2007 estimates," says Jim Hempstead, a senior vice president at Moody's, which now predicts new nuclear power plants will cost $7,500 per kilowatt to build. That's more than double the capital costs for solar power and three and a half times the cost for wind. Nuclear's high building costs are offset somewhat by low operating expenses and high operating efficiency, which in recent years has climbed from about 60 percent to more than 90 percent on average in the United States. But even taking into account these factors, according to Moody's forecasts, the production costs for nuclear power are higher than for most large-scale renewable energy sources (though not for solar power). And Moody's analysis was based on preliminary industry estimates—on average, first-generation nuclear plants in the United States cost three times initial projections.

How is it that new reactors make so little economic sense, even with massive government support? Part of the answer is that the industry still hasn't solved the problems that led to its initial collapse. A decade on, the standardized plant designs, on which nuclear advocates pinned their hopes of lower costs and greater reliability, have yet to materialize. This is not to say that no one has built a uniform fleet: some countries—most notably France, where the government holds a controlling stake in the main electricity-generating company—have managed to created a degree of standardization among their own reactors. But spreading the idea to countries with different regulatory agencies and requirements, to say nothing of the patchwork American utility market, is easier said than done. Nowhere are the hurdles more evident than in the new NRC licensing process and its supposedly set-in-stone designs. Initially, the industry had hoped to limit the number of reactor models to two or three. Instead, there are eight on offer, half of them certified, the rest awaiting approval (a process that takes years). What's more, all but one of the seventeen companies that are planning to build new reactors have chosen designs that are either not yet certified or that will need to be recertified because they have been substantially redesigned. Even the one company that has picked a fully certified model, NRG of New Jersey, isn't sticking to the original blueprints.

Rather than working with ready-made plans and a series of simple, modular components, engineers and designers working on Finland's new reactor are scrambling to finish plans even as construction is under way. During my visit to Olkiluoto, I met Jouni Silvennoinen, the construction manager on the plant for the Finnish utility TVO. He told me that, in his view, projects as large and complex as reactors simply don't lend themselves to cookie-cutter solutions. "The basic design can be planned in advance," he explained. "But you still have to do the detailed design. Where exactly is the rebar? How thick are the walls? Where is the pinning for pipes? Those details have to be tailored to the individual project, and it takes a tremendous amount of work."

Another reason estimates for new reactors have been both high and unpredictable is the atrophy of nuclear expertise and the dwindling number of suppliers, which has led to labor shortages and supply bottlenecks. Today, there is only one company in the world that can produce the heavy steel forgings for a reactor core—Japan Steel Works Ltd., in Osaka—and it has a two- to three-year backlog. In the United States, once the primary source of reactor components, the number of suppliers has dropped from 400 to eighty, while the number of accredited nuclear engineers has dwindled from 900 to 200. And the worst is yet to come. Half of all employees in the nuclear energy sector are older than forty-seven, and more than a quarter will be eligible for retirement in the next four years, according to NEI research. NRC Chairman Dale E. Klein summed up the gravity of the situation in remarks before the American Nuclear Society last year, saying, "The global supply chain is stretched, if not to the breaking point, at least to the tipping point."

Rather than backing away from its plans in the face of these daunting challenges, the industry and its allies have scrambled to shift even more of the financial risks to taxpayers. Before retiring in January, Domenici tried multiple times to quietly hand the DOE the authority to issue unlimited loan guarantees for "clean" power plants without congressional approval. (Under current law, Congress has the authority to set a cap on DOE loan guarantees, and so far it has only approved $18.5 billion in loans, far less than the industry needs.) Others have also taken up the cause. In August 2008, a bipartisan group of senators introduced a bill to open coastal areas to offshore drilling. Buried in it were billions of dollars in subsidies for nuclear power and language exempting DOE loan guarantees from congressional oversight. Though this bill was tabled after the financial crisis struck, it had broad bipartisan backing: half of the twenty sponsors were Democrats.

In a bid to consolidate its gains among liberal lawmakers and expand access to Treasury-backed loans, the industry has also doubled down on lobbying. The ten companies most likely to benefit from the loan guarantee program

poured more than $25 million into lobbying in the first three quarters of 2008. The NEI spent $1.9 million during the same period, 40 percent more than in all of 2007. It has also forged alliances with organized labor, hiring former Teamsters lobbyists and wooing the AFL-CIO. In a speech at the NEI annual conference last May, Mark H. Ayers, the AFL-CIO's president of Building and Construction Trades, spelled out the agreement between the two groups: in exchange for the industry's commitment to use union labor, the union would flex its own muscle to "persuade the new majority in Congress about the need for extending and increasing the loan guarantee program."

There is a reason for the nuclear industry's dogged pursuit of generous guaranteed loans: without them, or a similar public financing scheme, it doesn't have much of a future. Even before the financial meltdown, Wall Street wasn't willing to sink money into new reactors. Squeezing private capital from today's ravaged markets will be nothing short of impossible, which means the only way most utilities will be able to build new nuclear plants is if taxpayers shoulder the risk. On this front, the industry has proven remarkably resourceful. UniStar, a consortium of French and American utilities, was formed for the purpose of building four new reactors in the United States, a venture it expects to cost up to $38 billion. But it doesn't intend to sink any of its own money into construction. Instead, its plan for financing the project hinges entirely on guaranteed loans from the DOE and the French export bank, which is offering financial support to spur investment in French nuclear technology (see "Sub-prime Nuclear Loans").

Though the financial plans for most reactor projects have yet to become public, it appears that all but a few contenders are banking on similar schemes. Right now the DOE is weighing the first batch of loan guarantee applications, submitted in October. It includes twenty-one reactors, with an estimated total cost of $188 billion. The requested loan guarantee total is $122 billion, a hefty sum considering that the Congressional Budget Office has found the chance of default on guaranteed loans for new reactors is "well above 50 percent." And it will take roughly three times as much new nuclear capacity as those twenty-one reactors will provide just to keep a stable supply of nuclear power over the next few decades, as the aging plants that provide a fifth of our electricity are decommissioned. For nuclear power to make a meaningful contribution to the fight against climate change in the United States, the Keystone report concluded we will need to add 238 gigawatts of new capacity, or at least 140 of the most powerful reactors on the market. The cost, according to Harold A. Feiveson, a senior research policy scientist at Princeton University and a member of the Keystone panel: between $1 trillion and $1.8 trillion (an estimate that assumes capital costs of $4,000 to $7,500 per kilowatt).

The question is whether the new Democratic majority in Congress and the Obama administration will agree to anything approaching such a sweeping expansion of support for nuclear power. On the campaign trail, John McCain tried to gain advantage by painting Obama as a nuclear naysayer. In one particularly memorable instance, the Republican candidate visited the Enrico Fermi nuclear plant near Detroit, where he donned a gleaming white hard hat and toured the reactor building, then held a press conference in front of its cooling towers. "Senator Obama has said that expanding our nuclear power plants doesn't make sense," he argued. "I could not disagree more." Obama was forced to repeatedly reaffirm his support for nuclear power as part of the energy mix. In fact, rhetoric aside, Obama was actually the candidate with the closest ties to the industry; his chief political adviser, David Axelrod, runs a political consulting firm that has lobbied on behalf of Exelon, the nation's largest operator of nuclear plants. Exelon and its employees contributed around $250,000 to Obama's Senate and presidential races, more than to any other candidate. In 2006, it came to light that Exelon had failed to disclose low-level nuclear leaks at an Illinois plant. Initially, Obama introduced a Senate bill that would have required nuclear utilities to notify state authorities as soon as leaks were detected. But according to the New York Times, he later stripped out the reporting requirements, as requested by Senate Republicans and Exelon lobbyists.

In his climate plan, Obama makes the case for expanding nuclear energy, saying, "It is unlikely that we can meet our aggressive climate goals if we eliminate nuclear power as an option," though he also calls for nailing down secure storage for radioactive materials before new reactors are built. Steven Chu, Obama's secretary of energy, also advocates boosting America's atomic energy supply. Last August, he signed onto "A Sustainable Energy Future: The Essential Role of Nuclear Energy," a DOE manifesto, which argues that "nuclear energy must play a significant and growing role in our nation's—and the world's—energy portfolio" if we are to stave off catastrophic climate change. When asked by the San Jose Mercury News in June 2007 whether it was possible to tackle global warming without pursuing the nuclear option, Chu said, "If you start thinking like that, then you doom yourself." This was not a slap at other carbon-free technologies. Unlike most Bush appointees, Chu is a champion of renewable energy. He simply

believes we will have to deploy every weapon in our arsenal, including nuclear fission, in our urgent struggle against climate change—a position embraced by a growing majority of politicians and pundits.

This all-of-the-above approach is smart in theory, but in practice it has two glaring flaws. One is the long, uncertain construction schedule for building new reactors. To avoid the worst effects of global warming—rapidly rising sea levels, rampant famine, severe storms, and widespread drought—we will need to reverse the growth of greenhouse gas emissions by 2015, according to the UN's Intergovernmental Panel on Climate Change. The designs for most of the reactors on the drawing board in the United States won't be certified until 2011 or 2012. Only then can the NRC approve individual licenses—after which the plants still need to be built. Last time around, construction took an average of twelve years.

The other key problem is that, given the enormous expense and the industry's hunger for subsidies, pursuing the nuclear path can crowd out investment in green energy. Over the last decade, federal funding for renewable energy and efficiency research has essentially remained flat, even as concerns about global warming have mushroomed. Support for nuclear power, on the other hand, has soared from zero in the late 1990s to $438 million a year in 2008. The DOE's fiscal year 2009 budget request (which has yet to be approved) includes $630 million for nuclear energy research, a 44 percent increase from the previous year, while the request for renewable energy and efficiency R&D programs has dipped slightly to around $535 million.

Bills to foster renewable energy or rein in carbon emissions also tend to get bogged down in debate over attaching perks for nuclear power. In some cases, this struggle has derailed meaningful climate-change legislation. The bipartisan coalition backing the Lieberman-McCain Climate Stewardship Act—Congress's first serious attempt to cap greenhouses gases—fell apart in 2005 after McCain added $3.7 billion in subsidies for nuclear power. The push for nuclear subsidies was also a key sticking point during last year's floor debate over the Warner-Lieberman carbon cap-and-trade bill.

Elsewhere in the world, there are also signs that nuclear power and renewables aren't as compatible as policymakers tend to believe. In 2000, Germany became the first major industrialized nation to commit to phasing out atomic power. To fill the gap, it has introduced incentives to foster investment in renewables, ushering in a green-energy boom. Despite its damp, cloudy weather, the nation now has more than half the world's solar power generating capacity and is the leading producer of wind energy. All told, roughly 15 percent of German electricity comes from renewable sources, more than any other nation except China, which relies on hydroelectric dams for much of its power. By 2020, Germany aims to increase the share of renewables to 30 percent, roughly the same percentage nuclear supplied at its peak.

On the other end of the spectrum is Finland. Because residents believed the new reactor in Olkiluoto would drastically cut emissions, there was little effort to promote renewable energy or boost efficiency, with the result that the country is now lagging behind its neighbors. Despite its long, windswept coast, Finland has less wind power capacity than any central European state except the tiny, landlocked countries of Luxembourg and Switzerland. It also ranks near the bottom on energy efficiency, and its record on greenhouse gas emissions is dismal: between 1990 and 2006 (the most recent year for which data is available) the nation's carbon output leapt by ten million tons a year, or 13 percent, one of the largest spikes in any developed nation. This means that to meet the European Union goals of cutting greenhouse gas emissions by 20 percent from 1990 levels by 2020, Finland will have to either resort to austerity measures or shell out hundreds of millions more dollars for emissions credits.

"We concentrated so much on nuclear that we lost sight of everything else," says Oras Tynkynnen, a climate policy adviser in the Finnish prime minister's office. "And nuclear has failed to deliver. It has turned out to be a costly gamble for Finland, and for the planet."