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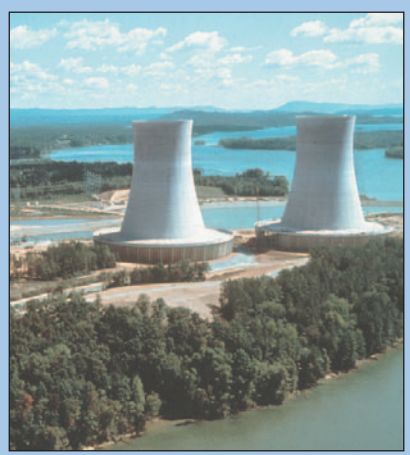
# The Political Economy of Nuclear Energy in the United States

PIETRO S. NIVOLA

"The rest of the world has continued to expand its nuclear power capacity, while we have been standing still."



A tendency among commentators, even experts like Bernard L. Cohen, the author of the sentence above, is to regard the complicated story of nuclear energy in the United States as exceptionally troubled and frustrating. The root cause of the troubles and frustrations, moreover, is commonly thought to be more political than economic. The promise of nuclear power in the United States is said to have been dimmed primarily by an eccentrically risk-averse public and an unusually hostile regulatory climate. Practically nowhere else, it is said, have political and legal institutions been so uncooperative. Supposedly the central governments of most other advanced countries have lent far more support to their nuclear industries. And because those governments are assumed to be more aggressive in combating pollution, including greenhouse gas emissions from burning fossil fuels, surely "the rest of the world" has been doing much more than America to level the playing field for the development of nuclear energy. But just how valid is this conventional picture?

With more than a hundred reactors currently in operation, the American nuclear power industry remains the world's largest. Continued reliance on nuclear energy is actually more in question in several European countries than it is here. Because electric utilities in the United States, unlike those in, say, France and Japan, have access to vast reserves of coal and natural gas as well as huge hydroelectric facilities in certain regions, the United States depends on nuclear generators to meet "only" about one-fifth of its demand for electricity.

That share (20 percent) is still greater than the worldwide average (17 percent), however, and in half a dozen U.S. states—some of which are large enough to compare to nations abroad—nuclear energy supplies over half of the electricity consumed. At any rate, even at one-fifth, total U.S. electricity production from nuclear reactors approximately equals the combined total of the world's two other nuclear giants, France and Japan.

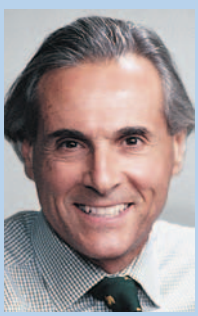
A nuclear sector of such magnitude hardly suggests that American governmental institutions and policies, national or local, have always proven particularly unreceptive to nuclear plants. The great majority of American states have accommodated such plants. Arguably, U.S. energy policies and environmental protection efforts at all levels of government have done at least as much to sustain as to hinder the viability of these facilities along with their fuel suppliers, waste management requirements, and other supporting industries. And if anything like the energy legislation that the Bush administration and the House of Representatives advanced in 2003 were to be enacted, the amount of assistance would expand significantly.

To be sure, the circumstances for nuclear energy in recent decades are a far cry from the extraordinarily favorable conditions that prevailed before the energy crisis of the 1970s. Major additions to America's already sizeable nuclear presence have not been in the offing for some time. But the hiatus in advancing nuclear power in the United States is hardly unique. A pause in new plant construction has extended to many other countries. In America, it is safe to say, the halt has to do with basic economic considerations, not just political obstacles.

If this assessment is correct, its implications may differ for the immediate and for the longer-range prospects of U.S. nuclear energy. In the teeth of inauspicious market conditions, even the additional government intervention that was envisioned in last year's omnibus energy bill probably would not suffice to entice skeptical investors in the near term. Electric companies remain skittish about being encumbered by capital-intensive investments and financial liabilities like those associated with new nuclear installations. Nonetheless, some of these companies are also keeping their options open for the longer run.

## ECONOMIC REALITIES

On average today, the electricity produced by operational nuclear plants in the United States tends to be cost competitive with gas or coal-generated power after the plants have been paid for. Indeed, the efficiency of quite a few has been upgraded, making them attractive to buyers. Between 1998 and 2002, more than a dozen old plants were sold, some fetching impressive sums. Large energy companies like Entergy, Dominion Energy, and Exelon recently have made such acquisitions, in part as a hedge against increasingly unstable fuel prices for gas-fired generation, and perhaps also in anticipation of possible further environmental restrictions on coal-fired facilities. Even foreign investors have been eyeing U.S. nuclear units. The British firm Amergen purchased three between 1998 and 2000.



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## NEW PLANTS

The commercial viability of reactors that have not yet been built is a different matter—at least for now. A recent Massachusetts Institute of Technology (MIT) study offers probably the best current estimate of the aggregated cost of constructing, licensing, and running a newly commissioned light-water reactor, and how it compares to the coal or gas substitutes. At an average of 6.7 cents per kilowatt-hour, the "levelized" cost of the nuclear plant decidedly exceeds that of a pulverized coal-fired plant (4.2 cents/kw-hr). Nor does the nuke compete with a combined-cycle natural gas-powered plant (CCGT), even assuming a high price for natural gas. Thus, if gas were priced at $6.72 per thousand cubic feet, the lifetime average for electricity from the CCGT still comes to 5.6 cents/kw-hr, which is less than the nuclear plant.

It is well known that new nuclear plants take exceptionally long to complete and, according to many analysts, cost more than they should to build safely. But, says the MIT report, even reducing completion time to just four or five years, and lowering construction costs by a quarter, would still not put the plants in contention with coal, and would just barely match the price performance of a CCGT using high-cost gas. Clearly, these figures do not auger much renewed interest in nuclear construction projects, at least for the foreseeable future.

Let us look more closely at the roots of the nuclear sector's predicament to date.

## CAPITAL COSTS: INFLATED BY REGULATION?

Twenty years ago, the cost of building a nuclear power station in the United States averaged almost $3 billion (in 2002 dollars). Years of technological refinements and potential cost-saving measures since then have not succeeded in significantly lowering that price tag. The persistence of this enormous overhead, which accounts for two-thirds of the cost of nuclear-generated electricity, is what puts it at a marked disadvantage against power from combined-cycle gas turbines or coal-burning plants.

Why capital costs are so prohibitive is a question much debated. We know that cost overruns have to do with delays in the construction process. Before 1979, it took an average of seven years for plants to go on line. By 1990, the average lag from groundbreaking to operation had reached twelve years. The delays, in turn, have been widely attributed to a ratcheting up of regulatory requirements for health, safety, and environmental reasons following episodes such as the Three Mile Island (TMI) accident in 1979. One estimate imputed to the post-TMI standards as much as 60 percent of capital costs for plants completed after 1979.

There is little doubt that regulatory strictures have slowed construction time and added to expenses. But whether those strictures have been overcautious—or, more precisely, out of line with consumer preferences and market demand—is not so clear. Nor, more basically, is it clear that government regulation stalled nuclear projects more than did other

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factors. Energy markets underwent a seismic shift after 1974. Earlier, electricity consumption had been increasing at nearly 7 percent annually. At that pace, electric utilities could count on a doubling of demand for baseload capacity every ten years. Following the crisis of 1974, the growth rate of consumption year-over-year settled to an average of around 3 percent. Perforce, in this new world of softer demand, most utilities began rethinking commitments to big and costly capacity additions. New orders for nuclear plants in particular started falling off sharply, and dozens of standing orders were cancelled, even before the Three Mile Island disaster.

There is no question that Three Mile Island marked a watershed. After it, orders for nuclear facilities ceased. Interestingly, however, the cessation occurred almost everywhere—throughout the United States but also in all but three other OECD countries, irrespective of national regulatory systems. Was the collective retreat from nuclear investment attributable to an international wave of public hysteria, and of government red tape? More plausibly, what happened was mostly the culminating consequence of negative market trends that had commenced earlier, and that now were accentuated by further loss of investor confidence and by heightened (and not wholly irrational) revealed preferences for supplemental safety measures.

## COMPETITION FROM GAS AND COAL

When measured on a present-value basis, the capital-intensity of a nuclear plant means that two-thirds or more of its costs may be incurred up front, before it opens for business—and that is without factoring in interest payments accrued during the long construction ordeal. By contrast, only a quarter of the costs of the typical gas-powered electric plant are front-loaded. No wonder that the latter have supplied almost all of the total new capacity added in recent years. The invidious comparison is a little unfair; many of the gas plants tend to be built to carry peak- or intermediate-loads, not baseloads. In most of the country baseloads are handled predominantly by coal-fired generators. These are not cheap. Their capital costs per kilowatt hour are more than twice those of combined-cycle gas turbines. Yet coal has been a formidable rival to nuclear power. Even with the latest clean-air gadgetry, coal plants are not as expensive to build as nukes, and once built, are relatively economical to operate because the price of coal has dropped steadily over the past twenty years.

In time, coal's importance to U.S. electricity producers may decline amid mounting concerns about its pollutants. But its dominance is not about to end swiftly. Coal's share of U.S. electric generation has, if anything, increased over the past several decades, reaching 50 percent in 2002. For the most part, the edge over nuclear energy simply reflects market forces: a nation so richly endowed with this particular fossil fuel naturally puts it to extensive use.

## AN AMERICAN INDUSTRIAL POLICY

The setbacks to nuclear building programs in the United States have not

been for want of government support. In varying degrees and stages, the entire nuclear food-chain, from research and development and fuel supply services to liability insurance, waste disposal, and eventual decommissioning, has been backed in one way or another by government policies.

When the infant industry experienced growing pains—unanticipated difficulties such as environmental controversies, waste management problems, or regulatory hardships—Congress was sometimes slow to lend a hand, but at the end of the day, lawmakers did pitch in. True, the decision to provide a permanent underground repository for high-level waste (the Yucca Mountain site in Nevada) is still wending its way through the courts. But in the end, if the storage plan goes ahead, it will be the largest of its kind anywhere.

Proponents of nuclear power had long complained about cumbersome regulatory hurdles, most notably the need to obtain from the Nuclear Regulatory Commission (NRC) separate approvals for constructing and then operating a new reactor. The Energy Policy Act of 1992 ended this two-step licensing procedure. Today, a utility, if granted a building permit, knows that an operating license is assured. Following the 1992 law, moreover, the NRC has pre-certified three technologies for application anywhere in the country. A builder opting for any one of them is all but guaranteed that safety features, for example, will not be open to legal challenges during licensing proceedings. That no new plants have been ordered despite these significant adjustments only furthers the impression that finances, more than regulations, continue to pose the primary barrier.

It is true that, in America as elsewhere, there is less political consensus today than there once was on policies bolstering nuclear power. Yet, under the energy legislation that Congress nearly passed in 2003—and that might eventually resurface—the U.S. nuclear industry stood to gain a tax credit for electricity generated by newly constructed plants, $2.7 billion in additional research and development subsidies over five years, $1.1 billion to build and run an experimental hydrogen-producing facility, a twenty-year extension of liability caps in the Price-Anderson Act, plus tens of millions of dollars for various pilot programs (to ease plant decommissioning, uranium mining, and more).

## THE IMPLICATIONS OF "DEREGULATION"

The U.S. electrical industry is in the midst of an overhaul. Many analysts have surmised that this process does not bode well for new investment in nuclear energy. There is no denying that, so far, liberalization of electricity supplies in countries such as the United Kingdom and the United States has not been associated with renewed private investment in nuclear projects which, by nature, entail heavy capital costs, long development times, and financial risk. Some thoughtful writers even conjecture that increasingly, competitive markets inherently introduce a bias away from such capital-intensive ventures and toward "micropower"—that is, electricity generated from renewable sources such

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as windmills, small-scale gas turbines, and heat-recycling facilities situated close to end-users, as distinct from bulk power stations operating far afield. Imaginably, the micropower theorists may prove to be right. Yet, their predictions seem premature, especially since the transformation of the U.S. electrical market is very much a work in progress, and aspects of it may not be pointing toward a complete and permanent demise of nuclear power.

Conceivably, today's restructured electricity markets may be paving the way for companies to undertake some nuclear reinvestment, rather than the other way around. Certainly the new, more competitive regime has compelled significant improvement in the technical performance of plants—so much so that even though eight reactors have closed down since 1990, increased productivity among the rest helped boost U.S. nuclear electrical output by more than a third from 1990 to 2002. The ongoing shakeout in the industry has spurred a series of mergers, joint ventures, and other sorts of management coalitions that seem likely to reduce some fifty separate nuclear utilities to about a dozen. These will be much better positioned to make major financial commitments when the time comes. In the fall of 2000, for example, the merger of two of the nation's largest utilities, PECO Energy and Unicom, consolidated the operation of seventeen reactors under a single corporate entity, Exelon Corporation. The securities of that firm now are valued at more than twice their valuation in 1998.

## SOME INTERNATIONAL COMPARISONS

Proponents of nuclear energy in the United States sometimes labor under the false impression that the political environment in this country has been radically forbidding. Other industrial nations are thought to have subjected their nuclear industries to far less political turbulence. The trouble with this view is that, though fairly valid with respect to a few other countries (France and Japan, for example), it simply does not stand up in comparisons with other countries in the OECD.

Following Three Mile Island, the building of nuclear plants and fuel production facilities ground to a stop in many countries. The development of nuclear energy is stalled in Germany, Belgium, Holland, Sweden, and Italy. In some of these places—Germany, for instance—the change of heart has come in spite of extant safety regulations that sometimes have required more redundancy and inspections than has been the case in the United States. Contrary to a prevalent misconception, America is not the only place where the application and licensing procedures for plants have come under fierce legal attacks. Germany has witnessed some similar cases. Sweden began considering a phase-out of nuclear energy in the early 1980s despite the fact that the country relies on nuclear stations for almost half of its electricity.

## GOVERNMENT SUPPORT

A casual observer of the nuclear scene might think that the U.S. government has been stingier in its support than have been the governments of most other

OECD members. Not so. Only Japan has spent more money than the United States on nuclear research and development. Granted, several other important industrial countries—including France, Japan, Germany, Italy, and Britain—have maintained (at least until recently) fuel reprocessing facilities for spent fuel, whereas reprocessing ceased in the United States in the 1970s. On the other hand, few other nations have moved ahead with plans for the alternative to reprocessing—namely, long-term burial of high-level radioactive waste. Nevada's Yucca Mountain depository took years of deliberation and will take many more before it may receive shipments, but plans for waste disposal in some other countries have proven to be just as knotty. Studies of possible disposal sites began in the 1960s in Germany. The geological salt caverns at Gorleben were selected a decade later. Intense opposition has blocked all progress since then.

## CLIMATE CHANGE

A plausible way to slow emissions of carbon dioxide into the atmosphere is to generate a larger share of electricity through nuclear power stations. Thanks to the stations currently operating, carbon emissions by the OECD countries are about one-third lower than they otherwise would be. Given that straightforward proposition, however, one might suppose that by now the climate-change issue would have boosted nuclear projects more than it has. It would seem logical, in other words, that nations formally committed to cutting emissions of heat-trapping gases would be the most pro-nuclear. Conversely, America, with its apparent high tolerance for fossil-fuel effluents, renders its nuclear industry uncompetitive.

In practice, matters are not so simple. Many of the countries that officially accepted the Kyoto Protocol's mandatory greenhouse-gas reductions have nonetheless declined to install more nuclear capacity as a means of meeting emissions targets.

True, the European Union, unlike the United States, is on track to create a tradable permits market for carbon emissions. Also true is the fact that most European countries have long restrained the consumption of (certain) fossil fuels in ways that America has never tried. For example, the minimal U.S. tax rates on oil products, particularly gasoline, contrast sharply with the much higher rates throughout Europe. However, while this difference can help explain the comparatively high American level of carbon dioxide emissions per capita, it has little bearing on the question at hand—the relative promise of nuclear power. Heavily taxing motor fuel, or any of oil's other refined products, is not the kind of carbon-curbing policy that might enhance the competitive position of nuclear power producers. The reason is plain: petroleum is no longer used to propel many electric generators in the industrial world. This, by the way, also means that soaring oil prices scarcely alter the nuclear equation.

Only taxes that cover the main competitors to nuclear-generated electricity—coal and, to a lesser extent, natural gas—would help put the nukes back in contention. To do so decisively, moreover, a broad-based carbon

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tax would have to be steep—indeed, much steeper than any OECD member has come close to levying. The same goes for emissions trading. Allowances per ton of carbon emitted would have to fetch a very high price in order for a trading system to substitute for the kind of hefty carbon tax that would be needed to put builders of nuclear plants back in business. (If, when the EU's system takes effect, its allowances trade at only, say, seven or eight Euros per ton of carbon emitted, it will represent, at best, a very distant substitute.)

## CONCLUSIONS

Eccentric government policies, including environmental ones, have not been the overriding source of the nuclear industry's tribulations in the United States over the past thirty years. Policymakers in a number of other industrial countries have distanced themselves from the nuclear enterprise, sometimes much more conspicuously than here.

Rather, quite apart from lingering reservations about safety and security, four fundamentals continue to dampen enthusiasm for a nuclear renaissance in the United States today. First, annual growth in demand for power never returned to pre-1974 heights. Second, gas-fired technology is comparatively quick and inexpensive to install. Third, there is little economic incentive to retire the nation's vast coal-burning infrastructure. And fourth, lest we forget, more than a hundred old atomic reactors are still on line.

These realities have contributed to a plush reserve margin (nearly 30 percent) in the U.S. electricity business, and to even larger surpluses in some regions (a huge reserve margin of more than 40 percent in the Southeast, for instance). That much slack will not persist in the years ahead, particularly as the national economy regains a robust rate of growth, but contrary to the claims of alarmists, neither is a genuine crunch imminent. In this setting, investors are unconvinced that basic capacity enlargement, at least on a grand scale, is urgent. And for none is prudence more warranted than for those pondering the future of nuclear power.

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