Nuclear Facts

New nuclear power plants are unlikely to provide a significant fraction of future U.S. needs for low-carbon energy

Until building new nuclear power plants becomes economically viable without government subsidies, and the nuclear industry demonstrates it can further reduce the continuing security and environmental risks of nuclear power—including the misuse of nuclear materials for weapons and radioactive contamination from nuclear waste—expanding nuclear power is not a sound strategy for diversifying America's energy portfolio and reducing global warming pollution. NRDC favors more practical, economical, and environmentally sustainable approaches to reducing both U.S. and global carbon emissions, focusing on the widest possible implementation of end-use energy-efficiency improvements, and on policies to accelerate the commercialization of clean, flexible, renewable energy technolgies.

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The most economically efficient way to address the economic, environmental, and security risks of new nuclear power plants is to internalize the costs of avoiding or mitigating these risks in the market price of electricity and fuels. The United States can do this effectively by first regulating both carbon dioxide emissions and the unique risks posed by the nuclear fuel cycle, and then letting the "invisible hand" of the market deliver the lowest-cost technologies for providing energy services that meet minimum universal criteria for environmental sustainability, public health, and energy security.

The nuclear industry rejects this "level playing field" approach. Despite the public expenditure of some $85 billion on civilian nuclear energy development over the last half century, nuclear industry lobbyists continue to aggressively seek and obtain additional federal subsidies, so that investors in new nuclear power plants can earn a return on what would otherwise be a dubious commercial investment. Meanwhile, these subsidies displace government funding that could otherwise be directed toward cleaner, more competitive technologies with a much wider market potential for reducing global warming pollution. The fastest, cleanest, and most economical solutions to global warming will come if energy efficiency and renewable energy compete on a playing field that has been "leveled" by regulatory and taxation schemes that compel the pricing of polluting energy alternatives at closer to their true costs to society and the environment, not merely at their immediate costs of extraction and combustion.

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Nuclear Facts

New nuclear power plants are not a solution for America's energy needs

Despite the fact that a national global warming emissions cap-and-trade system would materially assist the economic case for nuclear power, the nuclear industry has not been willing to openly advocate for such a system. This suggests either that the industry privately lacks confidence in its own rosy claims that nuclear energy can play a big future role in displacing carbon, or that large generating companies prefer that U.S. taxpayers shoulder the lion's share of the risk, while they harvest the carbon savings from new nuclear plants to prolong the profitability of their polluting coal-fired plants. Probably both explanations are true.

Subsidies Mask True, Uneconomic Costs of New Large-Scale Nuclear Plants

Existing nuclear plants can compete favorably with fossil-fuel plants because they have relatively low operation, maintenance, and fuel costs, and their excessive capital costs have long since been forcibly absorbed by ratepayers and bondholders. But the continuing high construction costs of new nuclear power plants make them uneconomical. In fact, there have been no successful nuclear plant orders in the United States since 1973.

To jumpstart private investment in the first 6,000 megawatts (MW) of new nuclear power capacity, Congress granted roughly $10 billion in new subsidies—in the form of production tax credits, loan guarantees, federal "cost-sharing," and "regulatory risk insurance"—as part of the 2005 Energy Policy Act. The high capital cost of constructing an individual nuclear power plant has in the past dictated a trend toward ever larger reactor units in order to recoup the multi-billion investments required. At a price tag of $2.5 billion to $4.0 billion each, reactors typically require a long investment recovery period, on the order of 25-40 years. Moreover, they usually require at least a decade or more to plan, license, and build, creating a persistent problem of economic "visibility" for nuclear reactor projects in what has now become a more competitive and shifting energy marketplace, at least in the United States.

The timescales involved in the current subsidy program illustrate the nuclear economic visibility problem. The Internal Revenue Service will distribute future annual production tax credits—nominally amounting over the first eight years of operation to a maximum of $1 billion for each thousand megawatts of new capacity—among all "qualifying" new nuclear reactor projects that have:

- applied for a construction/operating license from the Nuclear Regulatory by the end of 2008;
- begun construction of the reactor building by January 1, 2014, and;
- received a certification from the Department of Energy that it is "feasible" to place the facility in service prior to January 1, 2021.

It is difficult to forecast today what energy market conditions will be like five years hence, much less in 2021. It is also difficult to predict the size of the subsidy ultimately available to each new reactor's owner, as this depends on the total number of projects that actually begin construction by 2014. How many ways will this gift from the taxpayers be divided before the commercial viability of each individual project is undermined?

Needless to say, absent favorable shifts in the underlying economic determinants of nuclear power, the addition of 6,000-9,000 heavily subsidized nuclear megawatts to the national grid beginning 10-15 years from now does not really diminish any of the immediate challenges posed by global warming, unless these plants actually replace existing or currently planned coal-fired power plants.

Renewable Energy Technologies Are Expanding Faster Than Nuclear

It is instructive to compare this "nuclear renaissance" with the current rate of growth in wind power, which is adding about 3,000 MW of generating capacity per year. To accurately compare the two, capacity utilization must be factored in: Assuming a favorable case, namely that by 2021 the nuclear tax credits actually stimulate 1.5 times the amount of subsidized capacity, and with an average capacity utilization factor of 85 percent, then 0.85 x 9,000 MW = 7,650 MW/15 years = 510 MW/yr as the average annual expected growth for nuclear, but with none of it available for at least 10 years.

Even though wind has a much lower capacity utilization factor, and even assuming no further acceleration in the its rate of growth, then 0.35 x 3,000 MW x 15 yrs = 15,750 MW for wind over the same period, or at least 1,050 MW/yr, with all of it available each year. In other words, windpower is already growing at twice the potential growth rate of nuclear over the next decade, and the outlook for wind is for even faster growth. In a similar vein, recent dramatic improvements in the processes for mass-producing solar photovoltaic cells suggest that by the time these subsidized new nuclear plants are connected to the grid, distributed solar power will be a formidable, and likely superior competitor.

Nuclear Capital Costs Remain Too High

If these subsidized "first mover" nuclear plants fail to produce major design and production innovations that significantly reduce the high capital cost of subsequent nuclear power plants—and there is little evidence to date to indicate that they will —then private investors will return to looking unfavorably on the industry once the current tax credits expire. The cost growth already occurring in the new Areva "European" power reactor under construction in Finland is not encouraging. The 2002 cost estimate of $2.3 billion for this 1,500 MW reactor had grown to $3.8 billion by July 2006, and this number does not include "off-balance-sheet" costs of 1.5-2 billion euros ($1.92-$2.56 billion) that reactor builder Areva has separately agreed to devote to the project.

A probable total project cost at or above $5 billion for this new reactor is certain to scare U.S. utilities and capital investors from making an aggressive commitment to nuclear energy in the near term. Moreover, as the technologies for renewables, energy efficiency, and industrial waste-heat co-generation continue to improve, they will become increasingly attractive investment alternatives to nuclear power.

A national cap on carbon emissions would certainly help reduce nuclear's significant current cost differential with large coal- and gas-fired power plants, but it will not ensure that nuclear stays competitive with these smaller, cheaper, cleaner, faster, and more flexible distributed sources of electric power generation.

The Security and Environmental Health Risks of the Nuclear Fuel Cycle Must Be Further Reduced

Although the nuclear fuel cycle emits only small amounts of global warming pollution, nuclear power still poses significant risks to the world. In a number of countries, peaceful nuclear materials and equipment have already been diverted to secret nuclear weapons programs, and could be again. Even worse, they are susceptible to theft by, or eventual sale to, terrorists or international criminal organizations.

Storage pools of spent nuclear fuel are likewise vulnerable to terrorist attacks that could disperse lethal levels of radioactivity well beyond the plant perimeter. The accidental release of radioactivity, whether from a reactor accident, terrorist attack, or slow leakage of radioactive waste into the local environment, poses the risk of catastrophic harm to communities and to vital natural resources, such as underground aquifers used for irrigation and drinking water. There are continuing occupational and public health risks associated with uranium mining and milling, especially in areas where such activities are poorly regulated. And underground repositories, meant to isolate high-level radioactive waste and spent fuel from people and the environment for thousands of years, are subject to long-term risks of leakage, poisoning the groundwater for future generations.

All of these problems have potential remedies, but most are not in effect today. For example, current international arrangements are insufficient to prevent a non-weapon state, such as Iran or Japan, from suddenly changing course and using nominally peaceful uranium enrichment or spent-fuel reprocessing plants to separate nuclear material for weapons. While long-term isolation of nuclear waste in stable geologic formations appears achievable technically, there is not a single long-term geologic repository for spent nuclear fuel in operation anywhere in the world.

Before nuclear power can qualify as a strategically and environmentally sound approach to reducing global warming pollution, the international nuclear industry, the respective governments, and the International Atomic Energy Agency must also insure that:

$2.9 billion

How would you spend it?

Federal new nuclear generation tax credits (up to $1 billion per first thousand megawatts of reactor capacity) could stimulate construction of three large nuclear power reactors

=

3,000-4,500 MW; payback period of 25–40 years

OR

Renewable energy (tax credits)[a]

=

3,000 MW of clean solar power; payback period of 5–10 years.

OR

Energy efficiency policies (in California)

=

1,500 MW of end-use energy savings, avoiding 2,700 MW of new generating capacity costing $6 billion (if nuclear).[b]

a: Tax credits over 10 years leverage additional private investment in net-metered solar-rooftop distributed generation.

b: Efficiency at end-use operating 8,760 hours per year, with zero or lower continuing operational costs and no incremental costs for transmission, based on 10 years of California measured results; comparison assumes overall system load factor of 0.65 and nuclear capacity utilization factor of 0.85.

Sources: Christopher Paine, NRDC nuclear economics expert; David Goldstein, NRDC energy-efficiency expert

Nuclear Facts

- nuclear fuel cycles do not afford access, or the technical capabilities for access to nuclear explosive materials, principally separated plutonium and highly enriched uranium;
- the Nuclear Nonproliferation Treaty regulating nuclear power's peaceful use is reinterpreted to prohibit the spread of latent as well as overt nuclear weapons capabilities, by barring exclusively national ownership and control of uranium enrichment (or reprocessing) plants in non-weapon states;
- the occupational and environmental health risks associated with uranium mining and milling are remedied; and
- existing and planned discharges of spent nuclear fuel and other high-level radioactive waste are safely sequestered in geologic repositories that meet scientifically credible technical criteria for long-term containment of the harmful radioactivity they contain.

The Balance Sheet for New Nuclear Power

The Plus Side

- Very low emissions of carbon and other combustion-related air pollutants (but still some, from uranium mining, milling, enrichment, reactor construction-decommissioning, and waste manage-ment activities)
- Large, concentrated source of round-the-clock base-load power
- Low fuel costs compared to fossil alternatives
- If carbon emissions are effectively "taxed" at \$100-\$200 per ton under a carbon cap-and-trade system, nuclear might compete effectively with large coal-fired central station power plants

The Downside

- It's expensive low carbon power (\$0.9-\$0.10/kWh delivered) compared to \$0.025-\$0.030 for end-use efficiency improvements; \$0.06-\$0.07 for wind; and \$0.026-\$0.04 for recovered heat co-generation)
- Long gestation/construction period and huge capital costs increase risk of market obsolescence and "stranded costs" (i.e., costs that cannot reasonably be recovered by continuing to operate the plant for its planned life)
- Subject to infrequent, but prolonged and costly planned and unplanned shutdowns (a recent study by the Union of Concerned Scientists documents 12 year-plus reactor outages since 1995, 11 of them "safety-related)
- Large "lumpy" increments of nuclear capacity require expensive overall power system excess capacity to ensure grid reliability
- Any nuclear power investment may at any moment become hostage to the conduct of the worst performer—or even the average performer on a bad day—in the event of a reactor accident or near-accident anywhere on the globe
- No licensed path (yet) to opening first long-term geologic repository for safely isolating spent fuel, and nuclear "renaissance" will require either additional expensive and hard-to-establish geologic repositories, or even more expensive and hazardous spent-fuel reprocessing
- Nuclear security concerns and risks are heightened in an age of transnational terrorism
- Acute proliferation concerns arise if advanced fuel cycles are used, or if uranium enrichment capability spreads to additional countries that are not already nuclear weapon states
- All stages of the nuclear fuel cycle involve potentially harmful, or in some cases disastrous environmental impacts (e.g., Chernobyl), requiring continuous and vigorous regulation, with significant financial penalties exacted for poor environmental and safety performance to ensure compliance
- Huge heat dissipation requirements demand either large evaporative cooling withdrawals and/or thermal discharges into already overburdened lakes and rivers, or massive and expensive fan-driven air-cooling towers
- Climate change in the direction of hotter, drier summers spells trouble for reactors that rely primarily on cheaper once-through or evaporative water cooling
- Offer little prospect of increasing "energy independence," as the bulk of world uranium resources are located outside the United States

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