A NUCLEAR PHOENIX?

Concern about Climate Change is Spurring an Atomic Renaissance

By Jim Motavalli
itting in the belly of the beast—Dominion's 2,000-megawatt Millstone nuclear power plant in Waterford, Connecticut—the company's chief nuclear officer, Dave Christian, seems an unlikely environmentalist. But he says concern about climate change is what got him involved in the peaceful pursuit of the atom in the first place.


Dominion is the kind of big power player that has long had an antagonistic relationship with the environmental movement. In addition to Millstone Units 2 and 3 (Unit 1 was shut down in 1998), the $45 billion company operates two nukes in Virginia, owns 7,900 miles of interstate natural gas pipelines, 6,000 miles of electrical transmission lines and 965 billion cubic feet of underground natural gas storage.

The case for Dominion as a friend of the Earth is based on a few simple facts: It generates 45 percent of Connecticut's electricity and 30 percent of Virginia's without taking a huge toll in smokestack-emitted global warming gas. In fact, there are no smokestacks, because (aside from the occasional release of radioactive material) the only thing nuclear power plants vent is steam. What's more, in contrast to the modest current capacity of wind and solar power, nukes can produce very large amounts of electricity—enough to counter global warming by taking highly polluting coal-burning plants offline even as electricity demand increases.

Nuclear advocates will be the first to tell you that their U.S. plants avoid the emission of almost 700 metric tons of carbon dioxide annually. Worldwide, it's two billion metric tons. Given this reality, some prominent environmentalists have signaled a cautious détente with the nuclear power industry. While stopping short of endorsing the Bush Administration's push for hundreds of new nukes in the U.S., they say that nuclear power merits reconsideration. But they're being met by equally powerful arguments from the scientific community that nuclear power has never been and never will be a solution to global warming.

The Big Push

As worldwide emissions soar, people wait for a white knight. Newsweek columnist Robert J. Samuelson wrote recently, "We Americans want it all: endless and secure energy supplies; low prices; no pollution; less global warming; no new power plants (or oil and gas drilling, either) near people or pristine places. This is a wonderful wish list, whose only shortcoming is the minor inconvenience of massive inconsistency." Growing awareness of this inconsistency makes it difficult to dismiss the technology out of hand.

Nuclear power has already won some powerful allies in the environmental community. Fred Krupp of Environmental Defense says, "We should all keep an open mind about nuclear power." Jared Diamond, best-selling author of Collapse, says, "To deal with our energy problems we need everything available to us, including nuclear power," which should be "done
carefully, like they do in France, where there have been no accidents.” To which Stewart Brand, another apostate green who founded *The Whole Earth Catalog* and *Whole Earth Review*, adds, “The only technology ready to fill the gap and stop the carbon dioxide loading of the atmosphere is nuclear power.” James Lovelock, originator of the Gaia theory about the planet’s self-regulating systems, has called for, to quote *The Independent*, “a massive and immediate expansion of nuclear power.” Actor Paul Newman visited New York’s Indian Point plant and praised its climate role. In many cases, these environmentalists see nuclear as only a temporary fix.

There’s no questioning the credentials of these environmental leaders, but other nuclear cheerleaders are suspect. For instance, Greenpeace co-founder Patrick Moore has been widely quoted supporting nukes, but he left Greenpeace many years ago, turned 180 degrees, and has supported many anti-environmental initiatives. He is now the co-chair (with former Environmental Protection Agency Secretary Christine Todd Whitman) of an industry-funded initiative called the Clean and Safe Energy Coalition. Not all the newspapers and magazines printing his commentaries have noted that he’s on the payroll.

The industry is moving ahead with its attempt to revive commercial nuclear power, but it’s unlikely to happen quickly. Dave Christian of Dominion says that although 30 new nuclear power plant licenses are pending, the first of these probably won’t be online until 2015 or 2016. “The success of the industry moving forward depends on how these first units work out,” he says.

Christian acknowledges that the chance of some of those license applications succeeding is only five percent. “They’re taking a leap of faith,” he says. It may be that the funding issue alone derails the nuclear push: A Standard and Poor’s report last year priced nuclear at $1,500 per kilowatt—twice the cost of a new coal plant. And cost overruns, it said, “are highly probable.” The base price for a plant is $3 billion today.

Most of the proposed new nuclear stations are in the Southeast, and (partly to minimize local antagonism) most are on the site of existing units.

**Targeting the South**

Entergy Nuclear operates New York’s Indian Point as well as nine other stations. At a recent press conference, Steve Melancon of Entergy stood in front of a PowerPoint map of the U.S. dotted with proposed new plants: in New York, North Carolina, Louisiana, Texas, Alabama, South Carolina, Georgia, Mississippi and Virginia. According to Melancon, Entergy, in conjunction with eight other utilities, has settled on two existing locations to apply for combined construction and operating licenses: Grand Gulf, near Port Gibson, Mississippi and Bellefonte, near Scottsboro, Alabama. Actual operations would not begin until at least 2014.
It's not surprising that Port Gibson (spared by Ulysses S. Grant during the Civil War because it was "too beautiful to burn") is 80 percent African-American, rural and something less than affluent, with a third of the population living below the poverty line. And it's also not surprising that some city residents welcome the revenue it brings to an otherwise impoverished community.

Moff Headley II, who is both a former Port Gibson county supervisor and the father of a current one, says that the Grand Gulf nuclear plant has been a "good neighbor" that has "made it possible for the county to do some positive things it otherwise couldn't have done," including fixing up a building on Main Street and constructing a new library. "We're hoping we get the new plant," says Headley, "because the few industries we had around here have all dried up. We don't worry about safety too much because we've never had any plant accidents."

There's no constant in nuclear plant sitings.

that replacing Indian Point was feasible, in part by "repowering" existing coal or fuel-oil plants to run on cleaner fuels such as natural gas. But it could cost $3 billion, says Westchester County Executive Andrew Spano.

Meanwhile, Indian Point has hardly been making a good case for its continued existence. After a transformer fire early last spring forced it to shut down for the second time in a week, the Nuclear Regulatory Commission (NRC) downgraded its safety assessment.

Is nuclear power cheap? The industry likes to cite a figure of 1.72 cents per kilowatt-hour, cheaper than climate-aggravating coal. But Michael Levi, a fellow for science and technology at the Council on Foreign Relations, calls this "a spurious claim" because it "ignores the capital costs." Including these expenses, an influential Massachusetts Institute of Technology (MIT) report entitled "The Future of Nuclear Power" prices nuclear at 6.7 cents per kilowatt-hour.

Some prominent environmentalists have signaled a cautious détente with the nuclear power industry.

Scottsboro, Alabama, site of the famous 1931 "Scottsboro Boys" case is today an almost exclusively white community with a median family income of $42,000. It has never tasted revenues from nuclear power, and local officials seem primed by the prospects of 400 permanent jobs and 2,000 construction positions. "Many of us grew up watching that plant get built, so we're excited about finally seeing it operate," Goodrich Rogers, president of the Jackson County Economic Development Authority, told Greenwire.

The Cost of Nukes

There are 103 operating nuclear reactors in 31 states, capable of producing 100 gigawatts, or some 20 percent of U.S. power needs. Dominion's Christian says many of these plants are aging, and if we let them retire after 60 years, they'd have to be replaced with an annual input of 3.4 trillion cubic feet of natural gas or 200 million tons of coal. Replacing nukes is also an issue for the activists who want to shut down the two reactors at the Indian Point nuclear power station in New York. Of similar size to Millstone, Indian Point generates 2,000 megawatts of electricity—enough to power two million homes.

Calling for a shutdown, increasingly vocal Westchester County residents hired a consultant to prepare a feasibility study, and Congresswoman Nita Lowey (D-NY) commissioned a National Academy of Sciences report on the subject, which was released last year. It concluded markedly more expensive than coal at 4.2 cents.

The MIT report, released in 2003, says that nuclear power "is not now cost competitive with coal and natural gas," but it concludes that nukes "could be an option for reducing carbon emissions." However, the industry's "stagnation and decline" makes that unlikely.

Taking the Scare Out

To get the public to accept a major expansion of nuclear power, the industry will have to convince Americans terrified by the specter of Chernobyl, Three Mile Island and intentional terrorism-related sabotage. Don Miley, a pro-nuclear spokesman for the Idaho National Laboratory,
(INL), stood on a hotel patio in downtown Idaho City and, before an audience of horrified reporters, knowingly exposed himself to radiation. Miley was exposing himself to Coleman lantern mantles, “Fiesta” dinnerware, and an old “Exit” sign—all made with radioactive materials. It was cheap theatrics, but each item set off a Geiger counter. On average, Miley said, Americans receive 360 millirems of naturally occurring radiation per year, just from the sun, rocks and soil. If you’re an airline pilot, it goes up to about 1,000 millirems. A smoker gets 1,300 with or without a frequent flyer card. In 14 years working at INL, close to a nuclear reactor, Miley says he’s been dosed with only 13 millirems of extra radiation. In one trip to the dentist, he adds, he took in 150 millirems.

Hours later, the delegation was taken inside INL’s Advanced Test Reactor, the largest of its kind in the world, and looked down into 20 feet of cool, rippling water, below which lay highly radioactive nuclear fuel rods that could kill in an instant. When Miley was asked if he’d take a swim in this deceptively attractive cooling pond, he offered to don his trunks.

Back in Connecticut, Dominion spokesman Pete Hyde stopped at a padlock-protected fence and pointed across to an unassuming concrete bunker. This was the site of Millstone’s dry-cask nuclear storage, what the company calls an “interim measure” until long-delayed federal storage options are available. The steel-reinforced bunker has five-foot-thick walls. Some 32 highly radioactive spent fuel rods are loaded into a 40-ton steel canister and stored horizontally in the bunker. As many as 135 of these canisters can be stored on site, so Millstone is not likely to run out of storage space soon.

The obvious question, however, is whether these on-site storage facilities are vulnerable to determined terrorist attacks. Hyde says computer simulations show no breach of the fuel (and only an inch of movement in the concrete) when an engine from a commercial airliner hits the bunker at 600 miles per hour.

That may sound reassuring, but a federal National Academies of Science report released in 2005 argued that a high-temperature fire caused by the loss of cooling water in a spent

Looking forward, the U.S. government’s Energy Information Administration sees no great breakthrough for renewable sources of electrical power in the next 23 years. According to its 2007 outlook report, “Oil, coal and natural gas still are projected to provide roughly the same 86 percent share of the total U.S. primary energy supply in 2030 that they did in 2005.”

Coal, the federal experts think, will still be providing 57 percent of America’s electricity generation in 2030, and despite federal subsidies, the projection actually sees the nuke share declining by 2030, from 19 percent in 2005 to 15 percent in 2030.

The feds see only a modest gain in wind power, from 0.4 percent of total generation to 0.9 percent in 2030. Geothermal will

The Clean Energy Path:

stand still at 0.4 percent, as will municipal solid waste technology (trash to energy) at 0.5 percent. Photovoltaic solar will see modest gains—to a whopping 0.1 percent of the grid.

If these projections prove accurate, our planet will be awash in global warming gasses by 2030 and the world will soar past the 500 to 550 parts per million of carbon dioxide in the atmosphere that many scientists see as the catastrophic tipping point. But there’s still hope.

According to climate expert Dr. James Hansen of the National Aeronautics and Space Administration (NASA), “there is tremendous potential in energy efficiency and renewable energies, including solar power, wind energy, biofuels and geothermal.”

The Union of Concerned Scientists adds, “The government should adopt policies that maximize energy efficiency and conservation, increase the use of renewable energy resources, and eliminate barriers to existing technologies.”

The Bush Administration has not heeded this advice, but the renewable share is growing anyway. In 2006, some 2,454 megawatts of new wind-generating capacity was added to the U.S. grid with a $4 billion investment, says the American Wind
fuel pool could release large amounts of radiation. The report found that dry cask storage of the type found at Millstone is safer, in part because the fuel rods are stored separately.

Meanwhile, plans to relocate America’s nuclear plant waste to a secure federal site at Yucca Mountain in Nevada are slowly inching forward. The facility is designed to house 77,000 tons of nuclear waste, including the 50,000 tons already waiting for storage at reactor sites in dozens of states. The project director, Edward Sproat, said that a 2017 start date is now unlikely, and that the waste facility may never be built without increased Congressional funding.

The current plan is to transport the waste to Yucca Mountain, stored in reinforced casks, by truck and rail through 43 states. The watchdog group Public Citizen says this plan would put the waste “within half a mile of 50 million people.” And it adds that “more waste would be shipped in the first year alone than has been shipped in the U.S. in the past three decades.”

These facts led an increasingly skeptical Atlanta Constitution to write, “[W]orldwide, it would take some 2,000 new nuclear power plants, at a cost of over $1 trillion, to make a dent in greenhouse gas emissions. Those plants would require a new Yucca Mountain-sized repository every few years to store the tidal wave of highly radioactive nuclear waste. With no answer to its radioactive nuclear waste, it is clear that nuclear energy will not be the answer to global warming.”

Federal Incentives

The renaissance of nuclear power benefits from significant federal incentives. Vice President Cheney’s energy task force in 2001 called for the construction of 1,300 to 1,900 new power plants, many of them nukes, and since then the Bush administration has done what it can to stimulate new construction and licensing. The administration’s energy legislation, enacted in 2005, contains billions of federal dollars for nuclear tax breaks and loan guarantees. A Public Citizen analysis says these incentives add up to $10.1 billion, including $5.7 billion in production tax credits ($18 per megawatt-hour of new generation, up to 6,000 megawatts).

Energy Association (AWEA). That’s a 27 percent increase in installed capacity and makes wind the largest renewable. Randy Swisher, AWEA executive director says, “Wind power is now one of the largest sources of new power generation in the U.S., and an essential element of the climate change solution.”

Just one nuke can equal all the 2,400 megawatts of new wind. But most new wind installations are large-scale wind “farms” with hundreds of turbines. The largest U.S. wind farm, in Texas, generates 736 megawatts of electricity. If we find room for a million two-megawatt turbines, we could produce hydrogen for millions of fuel-cell vehicles.

The photovoltaic industry addresses the capacity issue with so-called concentrating solar power installations (see “Big is Beautiful,” Currents, May/June 2007) that can be scaled into the hundreds of megawatts. George Crabtree, a senior scientist at the federal Argonne National Laboratories points out, “Sunlight is not only the most plentiful energy resource on Earth, it’s also one of the most versatile, converting readily to electricity, fuel and heat. The challenge is to raise its conversion efficiency.”

Crabtree and other scientists see opportunities to ramp up photovoltaic electricity production and efficiency through the use of new, cheaper materials, including films, dyes and organics. The American Solar Energy Association’s “Tackling Climate Change” report foresees pathways to both a 60 and an 80 percent carbon reduction by 2030 through energy efficiency and renewables. “Renewable energy [could] provide approximately 40 percent of the U.S. electric energy need projected for 2030,” the report says. Wind could provide 20 percent of U.S. electricity by 2030 and account for 15 percent of emissions reductions.

Biomass can be burned to generate electricity, offsetting huge carbon emissions, and biofuels (made from corn, agricultural residue and energy crops) could offset 58 million metric tons of carbon emissions per year by 2030.

The U.S. geothermal resource is actually far greater than total U.S. energy demand. The trick is recovering it in an economically viable manner. Unlike oil, geothermal is not necessarily concentrated in large, easily accessible reservoirs; considerable research has to be done to locate hot spots and recover the heat in commercial quantities. Geothermal plants release carbon dioxide, but far less than do coal, petroleum or natural gas production, and technological improvements have improved the picture.

The bottom line is that there exist eminently feasible alternatives to the Energy Information Administration’s highly pessimistic scenario.

The loan guarantees mean that the public could subsidize as much as 80 percent of new reactor costs, the group said.

"There is a tsunami of new nuclear plant applications," says Dr. Harold McFarlane, president of the American Nuclear Society. The revival is coming after so many years of inactivity that McFarlane notes there are now fewer than 200 nuclear-qualified welders in the U.S.

Still, the industry is forging ahead, aided by an administration determined to streamline the licensing process. Hoping to avoid the debacle, common in the nuclear-phobic 1970s, of fully built plants unable to begin operations, the industry is now seeking to receive both construction and operating permits before it puts the first spade in the ground.

The Mixed Picture

Around the world, the nuclear picture is mixed. Six U.S. reactors have closed since 1996, and seven in Canada are unlikely to operate again. Although a large 10,000-megawatt plant is slated to begin construction in India next year, other countries—including Germany and Sweden—have been working on formal phase-outs of the technology. But even there the future is uncertain. German Chancellor Angela Merkel has called the phase-out of the country's 17 plants (which produce a third of German electricity) by 2020 "disastrous," and some are worried that replacing the nukes with coal or natural gas plants could make it difficult to meet the provisions of the Kyoto Treaty.

The Netherlands, Belgium and Spain have agreed not to build any more plants. (Switzerland, by contrast, failed to renew its nuclear ban in a 2003 referendum.) Nuclear programs in Eastern Europe, South Korea and Japan have slowed pace, but in other countries the technology is going strong. France has 59 reactors generating more than three quarters of the country's power. Pakistan, Egypt, Finland and Iran each hope to build nuclear power plants, and China plans to increase nuclear capacity.

Nuclear power supplied about 17 percent of the world's needs in 2002. According to researchers at MIT, global energy demand could grow by 75 percent by 2020. Anti-nuclear activists are deeply worried that public apathy in the 18 years since the devastating Chernobyl meltdown will allow the emergence of a dangerous and radioactive new world.

An Unacceptable Risk?

In spite of its obvious benefits, nuclear power may simply be too risky. Opponents of the nuclear renaissance point to a host of serious concerns. "They're proposing a replay of a demonstrated failure," says Paul Gunter, director of the reactor watchdog project at the Nuclear Information and Resource Service (NIRS). "The financial risks have only gotten worse, and our concerns about safety issues are heightened now that these plants are known terrorist targets."

Alex Matthiessen, director of Hudson Riverkeeper, declares, "In the post-9/11 era, nuclear power plants pose an unacceptable risk." He points out that NRC studies conclude that a serious accident at one of Indian Point's two working reactors could cause 50,000 early fatalities.

Al Qaeda operatives have, by their own admission, considered attacking nuclear facilities. And according to Riverkeeper, only 19 percent of Indian Point guards think they can protect the facility from a conventional assault, let alone a suicidal mission. Riverkeeper says that the proposed evacuation plans for the area are woefully inadequate, and the site is vulnerable to an airborne attack. Plant operator Entergy refuses these charges, and says that the 3.5-foot steel-reinforced concrete containment structures protecting the reactor and other radioactive materials are "among the strongest structures built by man."

The U.S. nuclear industry has avoided serious accidents since the near-catastrophic accident at Pennsylvania’s Three Mile Island plant in 1979. But there have been near-misses. In March 2002, workers repairing a cracked nozzle at the Davis-Besse Nuclear Power Station in Ohio discovered a football-sized cavity in the reactor. Because of corrosion, all that was holding back the 2,400-pounds per square inch (psi) pressure of the core was a bulging stainless steel liner approximately 3/16th of an inch thick. If the liner had failed, a loss-of-coolant accident similar to Three Mile Island would have occurred.

Millstone also had its share of troubles before Dominion bought it in 2001. In the mid-1990s, the four nuclear power plants run by then-owner Northeast Utilities were cited for more than 100 safety violations in two years. In late 2000, Millstone reported two lost fuel rods. The Union of Concerned Scientists (UCS) says, "The [NRC] must stop allowing plant owners to conduct fewer inspections and to defer inspections for economic reasons."

More recently, in July of 2006, the Forsmark nuclear reactor 1 on Sweden’s east coast experienced a short circuit and went into emergency shutdown. Two of four emergency-cooling diesel engines did not start as expected, disabling control room operations—and thus human control—for a critical 23 minutes. According to the German magazine Der Spieg,,"For
critics, the incident shows yet again how vulnerable nuclear power plants are to a failure in electricity systems.”

In early April of this year, operators of the Vogtle Nuclear Plant near Augusta, Georgia received low marks for their response to a simulated nuclear accident. The NRC judged that the emergency director had “overdiagnosed” the problem (a pump shaft breakage that caused metal parts to fall into the reactor coolant system) and gave the plant a “poor” grade. Nuclear defenders point out that these are the problems of aging Generation II plants, and the new Generation IV units will have many safety and efficiency advantages. Pebble bed reactors, for instance, are now in the planning stages in China and South Africa, and supporters say a meltdown is nearly impossible with that design. Pebble beds simplify waste storage and can be built quickly, they say, without the crippling cost overruns.

Economists question if the technology is cost-effective. The U.S. Energy Information Administration has stated that even if next-generation nuclear plants can be built efficiently, their costs are likely to be two to four times greater than building natural gas, coal or wind plants. Both the Congressional Budget Office and the private firm Standard and Poor’s concluded that investing in loans to build nuclear power plants is an unwise risk. A host of insurance analysts have come to the same conclusion. The last American nuclear power plant to go online, the Tennessee Valley Authority’s Watts Bar, fired up in 1996 after 23 years of construction and billions of dollars of over-budget spending.

**A Renaissance under Fire**

In its 2003 study, “The Future of Nuclear Power,” MIT researchers concluded that some 1,000 to 1,500 new reactors would have to be built worldwide by 2025 in order to put a serious dent in global warming. There are only 400 atomic power plants online now, and any major expansion would meet a host of economic, political, security and NIMBY (“not-in-my-backyard”) challenges.

Because of planned plant retirements, the industry will have to work hard simply to keep up current nuclear capacity, let alone ramp it up to offset global warming. Current projections by the U.S. Energy Information Industry show very little nuclear growth by 2030.

The uranium supply is also an issue. On the spot market, uranium prices have soared as existing reactors have worked through supplies from mothballed plants. Demand is projected to exceed supply and push prices higher. The shortfall in uranium mining can be at least partly made up in uranium enrichment (an outgrowth of atomic bomb development), but capacity is limited there, too.

Uranium enrichment also aggravates both global warming and ozone depletion. The single remaining uranium enrichment plant in the U.S., Paducah Gaseous Diffusion in Kentucky, emits highly destructive chlorofluorocarbons (CFCs), used to dissipate heat generated by the compressors. And the plant is fired by two large, extremely dirty coal power plants.

Although nukes avoid the smokestack problem, the nuclear process is not emission-free. The cycle from uranium mining to milling and processing, as well as waste storage and transportation, all involve greenhouse gas emissions.

In his book *Insurmountable Risks: The Dangers of Using Nuclear Power to Combat Global Climate Change* (IEER Press), Brice Smith admits that, when compared to fossil fuels, nuclear power emits far lower levels of greenhouse gases, even when mining, enrichment and fuel fabrication are taken into account. But to effectively challenge the global warming problem, he says, a new reactor would have to come online somewhere in the world every 15 days on average between 2010 and 2050. Even with this growth, he calculates that the proportion of electricity coming from nuclear sources would grow only slightly, from 16 to 20 percent over the period.

Also, says Smith, a huge nuclear expansion would increase the dangers of nuclear proliferation. The world’s capacity to enrich uranium would have to go up dramatically by a factor of 2.5 to six. A dozen new enrichment plants would produce thousands of tons of highly deadly plutonium each year. And just one percent of that capacity would be enough to support the construction of 210 nuclear weapons per year.

NIRS argues that, in the next 60 years, the industry is capable of building only half the 1,500 new reactors needed to significantly offset global warming, and that the enormous construction costs—estimated in the many trillions of dollars—would be much more effectively spent on renewable energy projects.

“Even under an ambitious deployment scenario, new plants could not make a substantial contribution to reducing U.S. global warming emissions for at least two decades,” says the Union of Concerned Scientists.


**JIM MOTAVALLI** is *editor of E.*