A major expansion of nuclear power is essential as a measure against climate change, John Rowe told a Harvard audience in 2008. But the chairman and CEO of Exelon, the nation’s largest utility company, and owner and operator of the largest fleet of nuclear plants in the United States (who was delivering a Future of Energy lecture sponsored by the Harvard University Center for the Environment), also said that an investment in new plants simply doesn’t make financial sense for a company like his, even after the promise of federal loan guarantees—a position he reiterated earlier this year.

Surprising or seemingly paradoxical positions on nuclear power are not unusual these days. And the complexity of Rowe’s perspective on the subject illustrates the way, all across the spectrum of political opinion, analysts are now looking at the potential benefits and risks of nuclear power with fresh eyes, weighing anew a range of issues, including the need for regulatory and technological safeguards and the political, social, and economic questions surrounding the prospect of new plants that many see as a need for a resurgence of the industry—a hoped-for major expansion that is often described as a “nuclear renaissance.”

The new impetus is driven overwhelmingly by one factor: the push for ways of meeting ever-growing needs for energy without using more fossil fuels, which add to the already risky levels of greenhouse gases going into the atmosphere and which are vulnerable to disruptions in foreign supplies.

The consequence is that after a quarter-century hiatus nationally in orders for new nuclear plants—a period during which globally the number of functioning reactors also leveled off—the first new licensing requests by American companies have been made this year, in the wake of President Obama’s call for loan guarantees for the new plants. But despite that slight bounce, essentially nobody thinks the road ahead for nuclear power will be an easy one.

For a nuclear resurgence to have any significant impact on those concerns, the global industry “really has to grow a lot,” says Matthew Bunn, associate professor of public policy at the Harvard Kennedy School and co-principal investigator of the Belfer Center’s Project on Managing the Atom. During the short-term, the promised 20 new plants that could be deployed per year and the subsequent construction of 25 new plants a year from now until 2050, “It’s often argued,” Ansolabehere continues, “that it’s ‘because of regulation’ that the costs of nuclear power often exceed those of most other sources, he says. But detailed analyses, such as a 2003 study from MIT, showed “the real driver of cost was the capital costs of building the plants, because of the long lead times and high degree of perceived financial risk. Similar factors also drastically drive up the price of other large, complex installations, including proposed new combined-cycle coal plants with carbon capture systems, he adds.

For the present, at least, nuclear power remains the most politicized of all potential power sources, and the one with the highest negative public perceptions. In a recent survey, Ansolabehere found that 55 percent of Americans were strongly opposed to having a nuclear plant built within 25 miles of their homes, compared to 45 percent for a coal plant, 36 percent for a natural gas plant, and just 11 percent for a wind power facility.

On the other hand, people are generally much more likely to accept new nuclear plants at sites where they already operate, Ansolabehere found. “If you ask people about expanding at existing sites, the responses are much more positive,” he says. Bearing that in mind, “companies should be much more attentive to the local communities, where there is usually a lot of support,” especially when they represent stable jobs in an uncertain economy. “But you’ve got to maintain that.

The Economic Picture

When Rowe said it would be too risky for a utility to order a new nuclear power plant today, his conclusion was based on the present economic realities—even in light of the administration’s offer of loan guarantees. But why should it be so hard for a self-professed advocate of nuclear power, and for a company that has extensive experience in the area, to justify such an investment?

“Capital costs are huge, and have gone up by about a factor of two in the last few years,” says Bunn. “There are a variety of proposals that could ultimately lead to lowered costs—including a standardization of designs—but for the time being, the choices available tend to be large, non-standardized, and expensive.

Bunn’s argument is one that many see as a need for a resurgence of the industry—a hoped-for major expansion that is often described as a “nuclear renaissance.”

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The Nuclear Renaissance

By David L. Chandler

Nuclear Renaissance

Matthew Bunn, associate professor of public policy at the Harvard Kennedy School and co-principal investigator of the Belfer Center’s Project on Managing the Atom.
It’s crazy that we’ve come to a point 60 years after the start of commercial nuclear power with no plan for how nuclear waste will be disposed of.

Bunn says. But if such designs prove themselves, they could become major players in the nuclear power industry, even though China is talking about large numbers of them.

The Waste Issue
Regardless of whether, and how fast, a nuclear renaissance is to be had, dealing with the nuclear waste already discarded by commercial nuclear-power operators during the past five decades remains a problem. At the moment, there are few encouraging models. The United States has spent more than two decades, and perhaps $10 billion, developing plans for a single repository to hold all of the nation’s high-level nuclear waste at a site called Yucca Mountain in Nevada, but after years of lawsuits by the state, that option has now been taken off the table once and for all—with no replacement in sight. “It’s crazy,” says Galison, “that we’ve come to a point 60 years after the start of commercial nuclear power with no plan for how nuclear waste will be disposed of.”

But the issue may be more political than technological. “There’s a lot of debate,” he says. “Should we build one big gigantic reactor, and get the side products and steam, which are stable, but have a risk of water infiltration? Or in salt mines, where there’s a prima facie case for no water infiltration since any water that has dissolved the salt? There, the issue is ‘they close up, so it’s not recoverable,’ if a future generation wanted to dig up the radioactive material for use in new plants or for some new purpose, we haven’t thought of yet. And there are a variety of other feasible options for underground storage.”

“This is a debate we really need to have as a country,” Galison says. “We have this waste already, it’s not theoretical. The waste we have is not all the same, it’s a mix, and so we have to figure out what to do with that stuff.” And the quantities of waste will be increasing. “There are so many plants already slated for production, it’s not just inevitable, it’s already happening.” Apart from new plants in the United States, China and India are gearing up for major increases, and many other nations are eager to use nuclear energy for the first time. There are three main concerns about the waste, Galison says: water, theft, and longevity. Water, he says, is the most significant worry. “The biggest issue, it seems to me, which is both incredibly simple and incredibly complex, is water. If water gets into a site,” he explains, “this will cause radioactive waste to migrate, and if it gets into aquifers, that’s a real danger. To me, that is the number one issue.”

The second concern, he says, is the risk of people trying to dig into the repository to get hold of the waste for the purposes of making weapons: whether in the form of simple ‘durry bombs,’ or for reprocessing to provide the material for nuclear weapons; and the third is simply the need to keep highly radioactive material sequestered for the thousands of years that it takes for the radioactivity to decline to safe levels—“periods of time comparable to the history of civilization itself,” as Galison puts it.

All of those issues, however, might be moot if the material were stored under ground in large salt formations. Because the salt would seal itself up around the buried waste, the radioactive material would be virtually impossible to recover—either intentionally or by accident.

And such formations are not subject to water infiltration. Other kinds of geological storage may also offer similar levels of protection. “It’s a problem, but it’s not a big safety issue,” says Bunn. “You want to put it deep underground and have it there only moderate risks.” And it’s important to keep the risks in perspective, he says: “Compared to the tens of thousands of people who die every year from the emissions from coal plants, it’s minuscule.”

The big question is how to get a site chosen and accepted. On this, the track record has not been encouraging. The U.S. is not the only country without a plan. France, often touted as a shining example of an effective nuclear power program, doesn’t have one either. There, most of the waste has remained under the regulatory control of the French government, and is stored at the current facilities for the indefinite future. In addition, planners decided early on to locate the site near an operating nuclear plant, where there is already an active power plant. Standardization would make it possible to take advantage of the learning curve offered by monitoring large numbers of identical plants. Bunn says. “You don’t get economies until you have large-scale production.”
on-site spent fuel pool. So the choices facing that community were to keep the waste stored on the surface, or have it buried deep underground. “That’s a no-brainer,” Bunn says. Galison says “the attempt to find a rational and well-engi-
neered disposal site is essential.” And those who oppose such a fa-
cility on environmental grounds need to be realistic about what the alternatives are. “It’s not
robin in an untouched meadow versus a nuclear disposal site. It’s a current unregulated mess ver-
sus something protected against leaks.” Getting it right is mostly a matter of how it gets decided at this point, he says. “You have to have an open enough, clear enough process, not get stuck with decisions. I don’t think this is impossible. It’s complicated, but it’s necessary.”

Accidents and Attacks

When it comes to thinking about the potential risks associ-
ated with nuclear power, most people tend to have
about the risks of airplanes ver-
sus cars. “To the extent we’re fearful of low-probability seri-
ous outcomes,” Hammitt says, “you compare nuclear with coal and other fossil fuels, I’m quite sure that burning coal is having serious health effects on people; but it’s very hard to estimate the low chance of some really catastrophic event at a nuclear plant.” So people are weighing “the certainty of lots of deaths and illnesses, against the uncertainty of a probably small, but probably very serious outcome.”

If the risk of accidents is over-
estimated, the opposite may be true for the risk of attack. Even in the post-9/11 era, it’s a possibility that gets relatively little serious attention. But Graham Allison, Dillon pro-

essor of government and Director of the Belfer Center for Science and International Affairs at HKS, has been studying the is-

ue for years. He says the risk of terrorist exploitation of nuclear power and its by-
products, though real, also needs to be put into proper perspective. First, he explains, it’s important to realize that even an all-out nuclear bomb-like explosion. Still, “if I compare the threats of an attack on a spent-fuel pool with the threats to chlorine tanks that are on the rails, or the chemical facilities that are in many cities, the chemical risks are much greater.” In an advanced industrial society we live with lots of very dangerous stuff.”

A much more serious concern regarding nuclear material, Allison says, is prolifera-
tion. There are many risks associated with the production and disposal of nuclear fuel—in particular with the facilities that produce the fuel for the reactor, and the facilities that extract plutonium from nuclear waste. Nuclear weapons can be made from either enriched uranium, or plutonium. “Enriched uranium is made by putting it through an industrial process, including centrifuges, like vast washing machines that spin at the speed of sound to separate Uranium 235 (U-235),” he explains. For use in a nuclear power plant, the uranium is enriched to a level of 4 or 5 percent U-235. To make a bomb, U-235 is typically enriched to about 90 percent, but in both cases the enrichment takes place in a similar facility. “With a little re-piping, you can produce 90 percent. So if any state that decides to build nuclear plants also decides to build a fuel-production facil-
ity explains Allison, “it’s a straight step to a nuclear bomb.” Likewise, reprocessing spent nuclear fuel to separate plutoni-
um, as France does, produces material that can be used to run nuclear power plants, but also to make bombs.

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Professor of government Stephen Ansolabehere is an author of energy sources, nuclear power has the one of the highest negative public perceptions.

Similarly, Abu Dhabi recently entered into an agreement to buy four nuclear

plants from a South Korean company. But in the process, Allison says they signed a contract “saying that for the lifetime of those plants, they will buy their fuel from an outside supplier, and ship their spent fuel back to them.” That not only provides security, but it also makes sense, he explains. “In terms of economics, the potential of enriching your own uranium makes no sense unless you’re operating

James K. Hammitt, professor of economics and decision sciences at the Harvard School of Public Health. “We are people more fear about technologies that seem unfamiliar, exotic, or that we don’t understand,” Hammitt says in reference to public attitudes about nuclear power.

People also react differently to a single large event than to a large number of smaller ones, as with the inverted im-
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with a fuel supplier, along with a backup. “The Iranians have used nuclear power: to provide them port, degradation, and toxicology of chemical contaminants during water reuse. Since reservoirs are the center of many water reuse strategies, Rich will focus his research on trace organic pollutants in reservoirs that receive highly treated wastewater intended for future consumptive use.”

Outgoing Environmental Fellows: Class of 2008-10

Etienne Benson (Ziff Environmental Fellow) will join the Max Planck Institute for the History of Science in Berlin, where he will continue his work on the history of endangered species science. Etienne’s first book, Wired Wilderness: Technologies of Tracking and the Making of Modern Wildlife, will be published this fall by Johns Hopkins University Press. William Boos (French Environmental Fellow) will join the Department of Geology and Geophysics at Yale University as an assistant professor, where he will continue his work on tropical climate dynamics. Susan Cameron (Kernan Environmental Fellow) will join the University of Florida as an assistant professor in the Department of Wildlife Ecology and Conservation. Mauricio Santillana (Henson Environmental Fellow) will begin a new postdoctoral fellowship in the School of Engineering and Applied Sciences, where he will continue his research in atmospheric chemistry. Mauricio will also teach a graduate course in applied mathematics in the fall. Alex Wissner-Gross (Ziff Environmental Fellow) will join the Department of Electrical Engineering and Computer Science, inc. and a development company he co-founded in 2007 that is leading the convergence of physical and digital worlds. Shengwei Zhu (Ziff Environmental Fellow) will return to China where he plans to join the Beijing Urban Planning School of Huazhong University of Science and Technology—one of the top ten schools in the country.

Stay tuned for more information on the future of energy and the potential role of emerging technologies in this field. The Environmental Turn in Literary and Cultural Studies April 8, 2010 Co-sponsored with the Humanities Center and the Leverhulme Centre on the field of “ecocriticism” featured HUCE faculty associates Lawrence Buell (Dept. of English and American Literature and Language) and Karen Thompson (Dept. of Comparative Literature), along with Ursula Heise of Stanford University. Among the highlights of the event was a discussion about the convergence of environmentalism and the arts, humanities, and the social and natural sciences.

Environment @ Harvard A sampling of the spring semester’s events

Conferences and Workshops

Promises and Challenges of Development and Conservation in the Amazon March 18, 2010 Co-sponsored with the David Rockefeller Center for Latin American Studies, this event featured presentations and commentary by Ana Carolina “Bibhu” Marques, Governor of the State of Acre, Brazil; Jorge Viana, Former Governor of the State of Acre, Brazil; Roberto Mangabeira Unger, Professor of Law (HLS); and former Minister of Strategic Affairs for the Brazilian government; and HUCE faculty associate John Bruceo, (SEAS, HSPH) and former World Bank Country Director for Brazil.

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Outgoing Series

The Future of Energy

The Future of Energy is an ongoing lecture series focused on finding secure, safe, and cost-effective power to support the world economy. The spring series opened with Aubrey McClendon, chairman and CEO of Chesapeake Energy Corporation, who co-founded in 2007 that is leading the convergence of physical and digital worlds. The event featured presentations and commentary by Ana Carolina “Bibhu” Marques, Governor of the State of Acre, Brazil; Jorge Viana, Former Governor of the State of Acre, Brazil; Roberto Mangabeira Unger, Professor of Law (HLS); and former Minister of Strategic Affairs for the Brazilian government; and HUCE faculty associate John Bruceo, (SEAS, HSPH) and former World Bank Country Director for Brazil.

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