

THE CRITICS



BOOKS

GOING NUCLEAR

Some climate activists are giving atomic energy a second look. Should they?

BY ELIZABETH KOLBERT

The disaster at the Fukushima Daiichi nuclear power plant began on the afternoon of March 11, 2011, when the Tohoku earthquake, also known as the Great East Japan Earthquake and the Great Sendai Earthquake, struck the island of Honshu. The shock, which registered 9.1 on the Richter scale, was so

powerful that it knocked the island eight feet closer to Hawaii and generated a tsunami that sloshed all the way to Antarctica.

That afternoon, three of Fukushima's six reactors were up and running; the other three were down for maintenance. The quake tripped the plant's emergency-response system, and control rods were automatically inserted into the fuel as-

semblies in the units numbered one, two, and three. Even so, the reactors continued to give off heat. When the tsunami hit, about forty-five minutes later, it flooded the plant's backup generators, along with the batteries that were supposed to back up the backups. As a result, Fukushima's cooling pumps failed. Within hours, the temperature inside

Nuclear reactors were once a symbol of menace; now they've been repositioned as a necessary alternative to fossil fuels.

Unit 1 rose to five thousand degrees, and the fuel assembly started to melt down. Everyone living within a mile and a half of the plant was ordered to evacuate.

Setback followed setback, in what one report would refer to as a “chain reaction” of crises. On March 12th, exploding hydrogen destroyed much of Unit 1 and exposed the pool that housed spent fuel rods to the air. The evacuation zone was extended to six miles, then, later that day, to twelve miles. Workers at the plant tried frantically to contain the damage, by, for example, spraying seawater from fire hoses and rigging up car batteries to supply power. On March 13th, the fuel assembly in Unit 3 melted. On March 14th, that unit suffered an explosion. On March 15th, there was another explosion, this time in Unit 4, where highly radioactive waste was being stored. (The reactors’ containment domes remained intact.)

As radiation-dose rates soared, Fukushima’s owner, the Tokyo Electric Power Company, considered pulling its workers from the plant. The Prime Minister, Naoto Kan, met with aides to assess the consequences of such a move. They concluded that without workers the situation would spin further out of control and that eventually all of Tokyo, which is a hundred and fifty miles south of Fukushima, might have to be emptied. Kan grew so alarmed that, reportedly, he stormed into TEPCO’s offices to demand that the workers stay at their posts. “What the hell is going on?” he asked, according to press accounts.

In the immediate aftermath, the lesson of Fukushima seemed clear. On March 15th, Germany’s Chancellor, Angela Merkel, announced a shutdown of the seven oldest of the country’s seventeen working reactors.

“The absolutely improbable became reality,” Merkel, who had previously been staunchly pro-nuclear, said. “That changes the situation.” A few weeks later, her government decided to decommission all of Germany’s nuclear facilities. In short order, Switzerland, Belgium, and Japan announced phaseout plans. In earthquake-prone Italy, which had already shuttered its reactors, voters overwhelmingly rejected a government proposal to allow new ones to be constructed. “I am really happy,” one Roman voter told Reuters. “We do not want nuclear plants.”

But, with time, the accident’s signif-

icance has faded. When, in 2023, Germany fulfilled Merkel’s promise and shut the last of its reactors, her successor as head of the Christian Democratic Union, Friedrich Merz, mourned the event, calling it a “black day.”

“It raises the question of who here is driving in the wrong direction,” Merz said. By now, Switzerland, Belgium, and Japan have all backed away from their phaseout goals. Many countries, including Canada, France, and the United States, have signed on to a pledge to triple global nuclear capacity by 2050. Google has teamed up with a nuclear startup called Kairos Power. Amazon is investing in another nuclear startup, X-energy. Microsoft wants to reopen a shuttered reactor at Three Mile Island, in central Pennsylvania. Fourteen years after Fukushima, fission, for better or worse, is back in fashion.

Rebecca Tuhus-Dubrow, a freelance journalist, was brought up in the nineteen-nineties on whole-wheat sandwiches packed in reused paper bags. Her environmentalist parents opposed nuclear power and might well have marched at anti-nuclear protests had the U.S. not mostly given up building reactors by then. Influenced by what she calls “years of indoctrination,” she became worried about environmental problems, particularly climate change. As an adult in Southern California, she helped organize her neighbors to install solar panels. She still viewed nuclear skeptically—until she learned that some prominent climate scientists were calling it the world’s best hope for limiting warming.

“Could it really be true that something that had once threatened to doom us was now needed to save us?” she wondered. She set out to learn more, and chronicles her journey of discovery in “Atomic Dreams: The New Nuclear Evangelists and the Fight for the Future of Energy” (Algonquin).

Prominent among the book’s “evangelists” are Heather Hoff and Kristin Zaitz, who founded a group called Mothers for Nuclear. (The organization’s logo shows a mother cradling a baby, encircled by rings of electrons.) Hoff and Zaitz both work at the Diablo Canyon nuclear plant, in central California. They are athletic and adventurous, and Tuhus-Dubrow clearly admires them.

“The two women seemed like more outdoorsy and capable versions of me, the kind of person I sort of wished I were,” she writes. But, recognizing that they are being paid by the nuclear industry, she also tries to maintain her reportorial distance: “I knew to be cautious about accepting their claims at face value.”

As it happens, Hoff was in the control room at Diablo Canyon the day of the Great East Japan Earthquake. According to Tuhus-Dubrow, Hoff’s initial reaction to the meltdowns was much like everyone else’s: “her confidence in nuclear power was shaken.” Gradually, though, Hoff recovered her faith. Yes, every nuclear operator’s nightmare had come true at Fukushima. But what had been the actual consequences? No one living close to the plant, or anyone working inside it, had died from acute radiation syndrome. As the years passed, there was no discernible rise in cancer deaths in the area around Fukushima. Meanwhile, a great many people—it’s been estimated at more than two thousand—had died prematurely as result of the disruptions caused by the evacuations. (Most of these victims were sick or elderly or both.) On the Mothers for Nuclear website, Hoff eventually summarized her view as follows: “Our fears were largely misdirected.”

In her travels with nuclear evangelists, Tuhus-Dubrow hears versions of this argument over and over. The problem is not that nuclear plants are prone to catastrophic meltdowns; it’s that people are prone to catastrophic thinking. “You see time and time again that fear of radiation, fear of nuclear, has been more dangerous than nuclear itself,” Eric Meyer, a former opera singer who heads a group called Generation Atomic, tells her.

Much of “Atomic Dreams” is devoted to the plant that employs Hoff and Zaitz. This is partly a function of Diablo Canyon’s location—it’s the only working nuclear station in Tuhus-Dubrow’s home state—and partly a function of its history. No nuclear facility in the U.S., and perhaps none in the world, has been the subject of more wrangling.

The fight began all the way back in 1961, when Pacific Gas & Electric proposed siting a nuclear reactor in Bodega Bay, a fishing village north of San Francisco which Alfred Hitchcock once de-

scribed as “picturesque.” (He shot “The Birds” there.) At that point, the Sierra Club had yet to take a position on nuclear power, but it opposed P.G. & E.’s plan out of concerns that cooling towers would mar the scenery. P.G. & E. then proposed moving the plant three hundred miles south, to the Nipomo Dunes. This was where Cecil B. DeMille had filmed “The Ten Commandments,” and the Sierra Club objected again, for similar reasons. The Diablo Canyon site—a bluff on the Pacific roughly halfway between San Francisco and L.A.—was also spectacular. This time around, the Sierra Club was willing to compromise. In 1966, its executive board declared the bluff a “satisfactory alternative.” Ground was broken on Unit 1 two years later.

In 1969, geologists discovered the Hosgri Fault just offshore from Diablo Canyon. Mothers for Peace, a San Luis Obispo group originally formed to protest the Vietnam War, swivelled to take on P.G. & E. (“Mothers for Peace are fighting another war” is how the local newspaper put it.) The organization filed motion after motion aimed at halting construction. This slowed but did not stop the work. Then, in 1979, Three Mile Island’s Unit 2 suffered a partial meltdown. The ranks of Diablo Canyon’s opponents swelled. In 1981, protesters blocked the only paved access road to the plant. Within two weeks, more than nineteen hundred people were arrested.

Diablo Canyon Unit 1 finally went online in May, 1985. Unit 2 followed in March, 1986. A month later, the No. 4 reactor at the Chernobyl Nuclear Power Plant, in northern Ukraine, melted down and caught fire. (The accident, which resulted in more than a hundred cases of acute radiation syndrome and several thousand cases of thyroid cancer, is still considered the world’s worst nuclear disaster.) Mothers for Peace members took to wearing badges that said “Remember Chernobyl: It can happen here.”

For the next couple of decades, the mothers kept fighting and Diablo Canyon kept operating, more or less uneventfully. This was the case even though several additional earthquake faults were discovered nearby. All the while, though, the glow was coming off the atom. Nuclear power had been promoted as affordable—according to one famous prediction, it would be “too cheap to meter”—

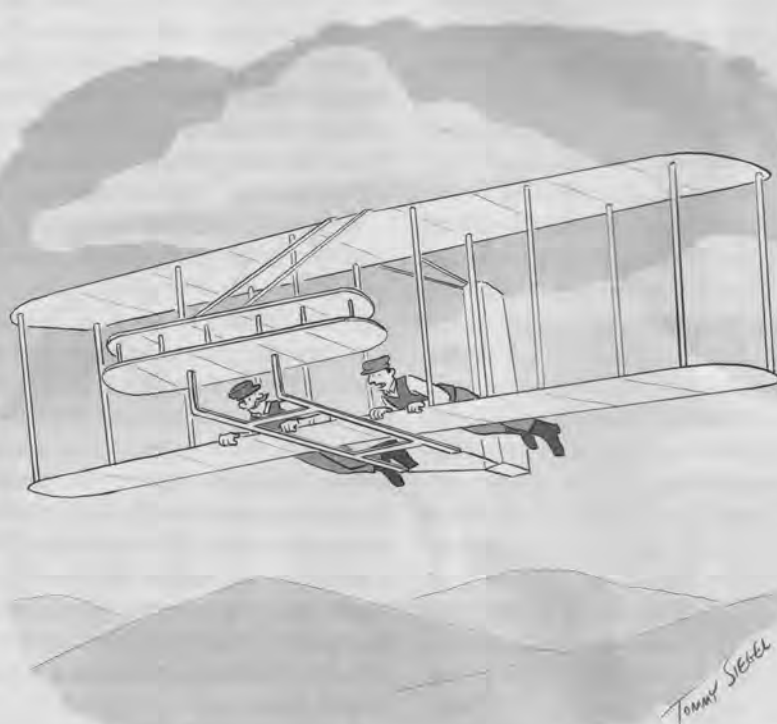
but was instead proving too expensive to sustain. By contrast, other forms of energy, such as solar and wind, were falling steeply in price. In 2016, P.G. & E. announced that it would close Diablo Canyon when the reactors’ operating licenses expired, in 2025. The utility promised to replace the power with other forms of carbon-free energy. Gavin Newsom, then the state’s lieutenant governor, called the arrangement one “we can all be proud of.”

It was around the time of this announcement that Hoff and Zaitz founded Mothers for Nuclear. The duo thought shuttering the plant was a terrible idea, and not just, they insisted, because it would cost them their jobs. (“The only way we can have a utopia is if we do nuclear!” Hoff tells Tuhus-Dubrow.) Conceived as a foil to Mothers for Peace, Mothers for Nuclear adopted many of the older group’s tactics: protesting, testifying at hearings, offering up catchy slogans—in this case, ones like “Split, Don’t Emit.” And, as with Mothers for Peace, they were—initially, at least—frustrated.

But then came yet another turn of the turbine. In the summer of 2020, California experienced a brutal heat wave. The demand for air-conditioning strained the state’s power grid, and the grid’s op-

erator, which goes by the acronym CAISO, instituted rolling blackouts. (The situation, Tuhus-Dubrow observes, “highlighted how energy use and climate change feed on each other in a vicious cycle.”) Diablo Canyon was then providing almost ten per cent of the state’s electricity, and, despite the terms P.G. & E. had agreed to, it seemed likely that, if the plant shut down, at least some of the power it generated would be replaced by burning fossil fuels. In February, 2022, more than seventy-five energy and climate experts sent a letter to Newsom, who by then had become the governor, urging him to “delay the closure of the plant.” (In the letter, the group called comparisons between Diablo Canyon and Fukushima “alarmist.”) A few months later, Newsom, in effect, ripped up the deal to decommission the plant.

“Some would say it’s the righteous and right climate decision,” he told the *Los Angeles Times*. What struck Tuhus-Dubrow most about the reaction to the Governor’s reversal was that there wasn’t much of one. Mothers for Peace, which was still actively opposing Diablo Canyon, was “furious, of course,” she reports. But “the general public sentiment seemed to be a shrug.” Late last year,



“For reasons I don’t understand, I could absolutely annihilate a tomato juice right now.”



JO EATOR

"I guess we were so distracted by the whole cookie thing we forgot he was a monster."

after "Atomic Dreams" went to press, California's public-utilities board approved a rate hike that is expected to increase the total price of electricity in the state by more than seven hundred million dollars. The hike was explicitly designed to cover the cost of Diablo Canyon's continuing operation.

Marco Visscher is a Dutch journalist whose backstory resembles Tuhus-Dubrow's. For much of his life, he regarded nuclear power with hostility. Writing in a monthly magazine called *Ode*, he once declared that the technology had "nothing good to bring to people or nature" and that "now is the time to bring the nuclear industry down." But he kept hearing about environmentalists and climate scientists who were staunchly pro-nuclear. He decided to look into the matter and, in the process, experienced a full-blown conversion. In "The Power of Nuclear" (Bloomsbury Sigma), he declares, "Just about everything we think we know about nuclear power turns out to be wrong."

Our first and most important mistake, according to Visscher, is thinking that nuclear power represents a special threat. Every form of energy production poses risks. Coal-fired power plants belch out pollutants that cause, among

many other health problems, lung disease, heart disease, and cancer. A study published in *The Lancet* estimated that coal, on a per-kilowatt basis, was nearly five hundred times deadlier than nuclear. Though gas-fired plants burn cleaner, they, too, emit dangerous particulates. Renewables, meanwhile, pose hazards of their own. Hydroelectric dams collapse; small planes fly into wind turbines. "Nuclear power is the safest of all energy sources," Visscher asserts.

So how did it get such a bad rep? In Visscher's telling, the problem, paradoxically, stems from the industry's tireless pursuit of safety. In the U.S., reactors operate under the requirement that radiation doses, for workers and the public, be kept "as low as is reasonably achievable"—for short, ALARA. The nuclear industry accepted this requirement in the nineteen-seventies "in an attempt to reassure the public," Visscher writes. "But it didn't work." ALARA reinforced the idea that any exposure was too much: "If the industry itself treated very low doses of radiation with the utmost care, it must be very dangerous, right?"

Another big mistake is the fear of nuclear waste. When spent fuel rods are first removed from a reactor, they are extremely hot, in terms of both tempera-

ture and radioactivity. Although in the first sense they will cool down in a matter of years, in the second they will remain hazardous for centuries. In the U.S., the Department of Energy has been trying for nearly five decades to draft a plan for the long-term storage of nuclear waste but has yet to come up with one that can win congressional approval. As a result, a hundred thousand tons' worth of spent fuel has piled up at reactors around the country. Two thousand additional tons are added each year. Disposal has been called the nuclear industry's Achilles' heel.

Here, again, Visscher waves away concerns. Solutions exist, he says—they just have to be implemented. Finland is currently building a "deep geological repository" for its waste; the repository, on the country's southwestern coast, will eventually consist of thirty miles of tunnels bored into the granite bedrock. Spent fuel can also be recycled or, to use the term of art, reprocessed. This is done in, among other countries, France. Finally, in what are known as fast reactors, waste can be converted into fuel. "The highly radioactive waste from nuclear plants is special, indeed, but in a good way," Visscher writes.

Among climate scientists, the most outspoken proponent of nuclear power is probably James Hansen, a former director of NASA's Goddard Institute for Space Studies, who is sometimes called the father of global warming. Hansen recently co-wrote an op-ed in the *Albany Times Union* that praised New York's governor, Kathy Hochul, for embracing "advanced nuclear" as a way to cut the state's greenhouse-gas emissions. ("Advanced nuclear" is a catchall term that's used for a variety of proposed plants, none of which have yet received operating licenses from the Nuclear Regulatory Commission.) "If the state hopes to achieve its climate goals, it will need more nuclear power," the article concluded.

Visscher presents climate change as the ultimate pro-nuclear argument. Industrialized economies need reliable electricity, and the sun and the wind provide power only intermittently. Those who disagree with him are, he suggests, either hypocrites or dupes. This group includes the Swedish climate activist Greta Thunberg, who says that nuclear plants take too long to build, and the former European commissioner for climate action Frans Timmermans, who says that

they're too expensive. Delays and cost overruns aren't reasons to oppose nuclear power, Visscher counters; they are *products* of the opposition to nuclear power, which can add years and billions of dollars to construction. Nuclear foes "have turned out to be the useful idiots" of the fossil-fuel industry, he writes.

Work on the Shoreham nuclear power plant, on the North Shore of Long Island, began in early 1973. The plant was intended to help meet the area's surging electricity demand, but, from early on, it was plagued by problems. To start with, Shoreham's owner, the Long Island Lighting Company, made the containment dome too small. A New York State official who visited the site during construction compared the equipment-stuffed dome to a shoebox crammed with junk. Another said that entering it was like walking into "the middle of a bowl of spaghetti."

LILCO had originally projected that Shoreham would take five years to build and cost five hundred million dollars. The plant was nowhere near finished when, in 1979, the Three Mile Island accident took place, and opposition exploded. On June 3, 1979, an estimated fifteen thousand people gathered on a Long Island beach to protest. Some friends and I were among them.

We were in high school then and lived across the Long Island Sound, in Westchester County. I can't remember if it was already raining when we set out, in a borrowed station wagon, but by the time we got near Shoreham it was pouring. After an hour or so of shivering in the wet, I suggested that we had registered our opinions and should head home. My friends, I recall with some bitterness, disagreed.

Three Mile Island was the kind of accident that the nuclear industry had insisted couldn't happen. When it did happen, it changed the way plants were regulated. Operators now had to develop evacuation plans in concert with local officials. Those who tried—in good faith or not—to come up with such a plan for Shoreham had to contend with Long Island's awkward geography. In the event of an accident, the only practical way to get away from the plant would be to drive west, toward New York City. (The other, impractical option would be to take a boat across Long Island Sound.)

People living east of the reactor would thus have to head into danger in order to escape it. In 1983, the Suffolk County Legislature declared there was no evacuation plan that would "protect the health, welfare, and safety" of the public.

Years of wrangling ensued. In 1985, a hurricane knocked out power for many LILCO customers; the company struggled to get the lights back on, raising fresh questions about its competence. In 1988, LILCO was convicted of misleading state regulators to win rate increases. It nearly went bankrupt. Finally, in 1989, it announced that it would abandon Shoreham. In return, the state agreed to allow the company to recoup from ratepayers the cost of the plant, which had ballooned to almost six billion dollars (roughly fifteen billion dollars in today's money). The reactor was shut down before it could deliver a single kilowatt-hour of electricity. Shoreham has been called "every utility's nightmare," a monument to human folly, and "a world-class fiasco."

The abandonment of the reactor made Long Island that much more reliant on coal and natural gas. It's been estimated that Shoreham's closure resulted in the emission of an additional three million tons of CO₂ a year, or more than a hundred million tons over the past three and a half decades.

Were those who opposed the plant wrong to do so? As Marco Visscher points out, all forms of energy production entail risk. And, as James Hansen points out,



the risk—or, really, the certainty—of continuing to burn fossil fuels is global catastrophe: major cities under water, grain belts too hot to produce grain, forests in flames, entire ecosystems unravelling.

Clearly, the new nuclear evangelists have a point. Just as clearly, they're also missing something. Say what you will, Fukushima was a world-class disaster. Hundreds of tons of highly radioactive fuel are still sitting at the bottom of Units 1, 2, and 3 because no one knows what

to do with them, or even how to get at them. Cleaning up the site could take a century, if it happens at all. And the really chilling part is that a much bigger accident was averted only by accident.

Because Unit 4 was undergoing maintenance when the tsunami hit, workers had filled its reactor well with water. Owing to a leak that shouldn't have existed, some of this water seeped into the unit's spent-fuel pool. It's likely that without this leak the hot fuel rods in the pool would have caught fire. In that case, radionuclides would have been spewed over a wide area, possibly including Tokyo. A high-ranking Japanese official called this possibility the "Devil's scenario."

Nuclear power—and this includes burying or reprocessing the resulting waste—has always been safe on paper. The trouble is that we don't live on paper. We live in a world where earthquake faults are belatedly discovered, contractors cut corners, utilities mislead regulators, and people panic—a world, in short, of errors, terrors, and corruption. As the world warms, global instability will only increase. In this sense, climate change represents a pretty good argument *against* going nuclear.

In the end, the most convincing case for learning to love fission may be the grimmest—not so much green as dark green. Few nuclearists embrace it, but it did have one influential advocate: James Lovelock, the British scientist best known for developing the Gaia hypothesis. Lovelock, writing in 2001, observed that the bubonic plague presented a great threat to medieval Europeans but was "of no consequence for the Earth itself." Much the same could be said of nuclear accidents: they are traumatic for the human beings involved but have little appreciable effect on the biosphere.

"The land around the failed Chernobyl power station was evacuated because its high radiation intensity made it unsafe for people," Lovelock, who died in 2022, on his hundred-and-third birthday, wrote. "But this radioactive land is now rich in wildlife, much more so than neighboring populated areas. We call the ash from nuclear power nuclear waste and worry about its safe disposal. I wonder if instead we should use it as an incorruptible guardian of the beautiful places of the Earth. Who would dare cut down a forest in which was the storage place of nuclear ash?" ♦