It's Time to Embrace Nuclear Energy

By Chris Wright

It is a tragic irony of the contemporary environmentalist movement that in its opposition to nuclear energy, it is doing the bidding of the fossil fuel industry and increasing the likelihood of climate apocalypse. This is the inescapable implication of the new book *A Bright Future: How Some Countries Have Solved Climate Change and the Rest Can Follow*, by Joshua S. Goldstein and Staffan A. Qvist. The anti-nuclear stance to which Green Parties, for example, are so fervently committed may seem enlightened, but in fact it is dangerous and destructive. What an informed environmentalist movement would demand above all is a rapid and globally coordinated acceleration of nuclear power plant construction, ideally at a rate of 500 or even 750 new reactors a year. This would set us on track to completely eliminate fossil fuels from the world's electricity generation within a couple of decades, as well as displacing coal as a heat source for buildings and industrial use. We would be well on the way to making the planet livable for our descendants.

A Bright Future is hardly the only recent book to make the case for nuclear power. Others include Gwyneth Cravens' *Power to Save the World: The Truth About Nuclear Energy*, Charles D. Ferguson's *Nuclear Energy: What Everyone Needs to Know*, and Scott L. Montgomery and Thomas Graham Jr.'s *Seeing the Light: The Case for Nuclear Power in the 21st Century*. What these and other books make clear is that the "green" shibboleths about nuclear energy's being dangerous, polluting, proliferation-prone, wasteful, vulnerable to terrorist attack, and excessively expensive are vastly overstated. The truth is closer to the opposite—although in the United States, because of the byzantine regulatory environment and the multiplicity (rather than standardization) of reactor designs built and operated by private companies, the economic costs of building a reactor are indeed very high.

The advantages of nuclear power

A Bright Future is framed by two contrasting stories: that of Sweden and that of Germany. From 1970 to 1990, due to its construction of nuclear power plants, Sweden was able to cut its carbon emissions by *half* even as its economy expanded and its electricity generation more than doubled. Germany has taken a different path, which has led to its emitting about twice as much carbon pollution per person as Sweden despite using one-third *less* energy per person and having approximately the same per capita GDP.

What Germany has done is to install large capacities of renewables, mostly wind and solar power, such that by 2016 they made up more than a quarter of electricity production and 15 percent of total energy production. At the same time, however, Germany cut nuclear power by roughly an equivalent amount, which means it only substituted one carbon-free source for another. CO_2 emissions have hardly decreased at all, in fact going up slightly in recent years. German energy remains dominated by coal, and greenhouse gas emissions remain around a billion tons a year.

Decades of anti-nuclear propaganda have colored public attitudes in the West, but, as Goldstein and Qvist explain, nuclear energy has many advantages. For one thing, like renewable sources, it produces no carbon emissions (although over its entire life-cycle, from mining materials to decommissioning the plants, there are some emissions—as with renewables). Unlike solar and wind but like coal, it provides baseload power, which is to say it reliably and cheaply generates energy around the clock to satisfy the average electricity demand. Renewable sources can be more flexibly deployed to match changes in demand, so they have an important role to play during periods of peak energy use, but they also tend to be intermittent and unreliable, unlike nuclear.

Goldstein and Qvist give abundant evidence for the latter claim. "As a rule of thumb," they note, "nuclear power produces at 80–90 percent of capacity on average over the year, coal at around 50–60 percent, and solar cells around 20 percent." In 2013, Europe saw an entire month in which solar produced at only 3 percent of capacity because of the lack of sunshine. Wind is somewhat more reliable than sunlight: at a massive 2,700-acre wind farm in Romania, for example, which has 240 wind turbines each as tall as a fifty-story skyscraper, production in 2013 was a little less than 25 percent of capacity. And the total capacity of this enormous wind farm was 600 megawatts, a fraction of a large nuclear power plant.

In fact, the amount of space and material needed for a solar or wind farm to produce as much energy as a large nuclear plant is mind-boggling. Take the example of Ringhals, a plant in Sweden. On just 150 acres it can produce up to 4 gigawatts of electricity, 24/7. A wind farm that was to produce as much energy would require three times the power capacity because wind is so variable. That is, it would require about 2,500 wind turbines 650 feet high, spread over 400 square miles. And its energy production would be intermittent, sometimes much higher than demand and sometimes much lower.

A solar farm equivalent to Ringhals would need a capacity of at least 20 gigawatts and would cover 40 to 100 square miles. "Imagine driving down a highway at 65 mph, with solar cells stretched out for a mile to the right of you and a mile to the left. It would take you about half an hour before you got to the end of the solar farm."

Think of the environmental (and aesthetic) costs of building scores of such immense wind and solar farms to replace both coal and nuclear.

Waste and safety

Another advantage of nuclear energy is how little waste it produces. Public fears about radioactive waste are absurdly disproportionate to the reality. In the United States, "the entire volume of spent fuel from fifty years of nuclear power—a source that produces one-fifth of U.S. electricity—could be packed into a football stadium, piled twenty feet high." Spent fuel rods can be safely stored in water for several years, becoming less radioactive, and then transferred to dry storage in concrete casks that contain the radiation. They can remain in these casks for over a hundred years. Longer-term storage, for hundreds of thousands of years, can involve burying material deep underground, as the U.S. military does for its waste from nuclear weapons.

To rebut the hysteria about radioactive waste, it surely suffices to point out that spent fuel has been stored around the world for almost 70 years with apparently no adverse health effects at all.

Other energy sources produce waste as well. When the life of solar cells is over after twenty-five years, their waste remains toxic for many decades and requires special handling for disposal. Coal waste, both solid and airborne, is not only orders of magnitude more voluminous than nuclear waste—as is true of solar waste, too—but is also toxic for centuries, and contains radioactive elements. Goldstein and Qvist observe, in fact, that if you live next to a coal plant you'll get a higher dose of radiation than if you live next to a nuclear power plant. (Humans are continually exposed to small doses of radiation that have zero or negligible health effects.)

In general, nuclear power is incredibly safe. Three famous nuclear accidents have occurred: Three Mile Island in 1979, which had no health effects because of the containment structure that surrounded the partially melted core; Chernobyl in 1986, which caused a few dozen deaths in the short term (though possibly 4,000 in the long term, according to the International Atomic Energy Agency) and was the product of terrible reactor design, terrible on-site errors by operators, and terrible bureaucratic incompetence and secretiveness by the Soviet government; and Fukushima in 2011, which caused *no deaths* from radiation exposure. (The authors investigate this question in depth and conclude that, on the worst possible assumptions, several people *might* eventually get cancer because of the accident.)

How does this record stack up against other energy sources? Coal kills at least a million people every year from particulate emissions that lead to cancer and other diseases. It also has a terrible safety record, including toxic wastes that are usually located near poor communities and coal-mining accidents that still happen multiple times a year around the world.

Methane, or natural gas, not only emits about half as much carbon dioxide as coal but also is liable to explode from time to time, killing anywhere from several people to hundreds (as when 300 children were killed in an explosion at a Texas school in 1937). And fracking, to extract oil or gas, has negative impacts on public health and the environment.

Oil, too, is less safe than nuclear (leaving aside Soviet incompetence). It spills and it blows up, as with the *Deepwater Horizon* disaster in the Gulf of Mexico in 2010, and oil trains can derail and explode, as happened in Canada in 2013, when 47 people were killed.

Hydroelectric dams are not at all safe. If a dam fails, thousands of people downstream can die. In Banquiao, China in 1975, for example, 170,000 people died when a dam burst. Dam failures have killed thousands in the U.S.; just in 2017, crises in California and Puerto Rico forced the evacuation of hundreds of thousands of people.

Imagine if nuclear energy had a record remotely comparable to coal or hydropower! Worldwide, the whole industry probably would have been shut down long ago.

An uncertain future

A Bright Future is far too rich to do justice to in a single article, but Goldstein and Qvist also address the issues of possible terrorist attacks on power plants and, in more depth, nuclear proliferation. Regarding the latter, the record over the decades since nuclear technology was developed is reassuring, due in large part to the very effective IAEA and the Non-Proliferation Treaty.

But even if nuclear energy weren't as remarkably safe as it is, we should ask ourselves if it would still be worth including as a major part of a "diversified portfolio" of clean energy. Why are we willing to tolerate so many deaths and risks from coal, oil, hydropower, and natural gas while demanding *none* from nuclear? (And even then, nuclear has a bad reputation!) Even if a fatal accident occurred from nuclear power every year or every few years, might that not be an acceptable cost if the benefit were a massive mitigation of climate change? We accept risks in every other sphere of life, as when driving cars, living near seismic fault lines, riding airplanes, etc. It's odd that we rail against nuclear energy because it isn't 100 percent risk-free.

The simple fact is that we can't solve climate change without accelerating the construction of nuclear power plants. Since the energy in nuclear fuel is millions of times more concentrated than wind or solar power, nuclear power can "scale up" much faster than renewables. "What the world already knows how to do in ten to twenty years using nuclear power," the authors write, "would take more than a century using renewables alone."

And yet in the U.S., *reverse* action is being taken. Nuclear power plants are being shut down prematurely for political reasons, as in Vermont, California, and Massachusetts, and producers are often abandoning plans to build new plants after facing endless litigation, regulation, opposition from anti-nuclear groups, and competition from cheap and highly subsidized fossil fuels. When a plant is shut down, what that means, first, is that renewables that are introduced afterwards are not contributing to decarbonization but are simply replacing a clean (and far more powerful) energy source. Second, fossil fuels have to fill most of the gap, which causes a rise in carbon emissions.

For example, after the Vermont Yankee nuclear power plant closed in 2014, carbon dioxide emission rates rose across New England, reversing a decade of declines. When Massachusetts' last remaining nuclear power plant, Pilgrim, closed last month, much more electricity generation was lost than the state generates with all its solar, wind, and hydropower combined. Several new fossil fuel plants will mainly take the place of Pilgrim.

Thus, Greenpeace and other anti-nuclear groups with money and political clout can congratulate themselves on exacerbating climate change.

Globally there are bright spots for nuclear energy, mostly in the developing world. Goldstein and Qvist discuss this topic in detail, placing some hope in Russia, China, and India, which are much friendlier to nuclear power than the U.S. They also devote a chapter to "next-generation technologies" that are being developed, such as thorium reactors, which have advantages over uranium, and fusion, which has advantages over fission.

But despite these (and other) bright spots, and despite the book's overall optimism, after I had finished reading I couldn't help feeling very, very worried about the future. We know how to address climate change. But the vast funds of the fossil fuel industry and the anti-nuclear movement, together with mass ignorance, may yet doom us in the long run. We have, it seems, a decade or two to wake up and demand government action.

Renewables, yes. But even more important: nuclear power.