



The demise of the Duane Arnold Nuclear Plant: As Nature takes its course, humans make choices on energy

By David Osterberg

An Apocryphal story

The headline easily could be imagined: “Nature strikes at human attempt to slow global warming.” That would be an ironic perspective on the loss of the Duane Arnold Energy Center (DAEC), Iowa’s only nuclear power plant.

A land hurricane, a derecho, blew across Iowa in August, bringing winds of up to 140 miles per hour to Cedar Rapids. The storm arose in South Dakota and petered out in Indiana. This was a spectacular event. Besides flattening acres of Iowa’s corn crop, downing trees and damaging buildings all over Cedar Rapids, the August 10, 2020, storm curtailed production from the nearby nuclear plant by damaging its cooling system. The derecho showed the kind of extraordinary weather a warming world gives us.

Some see nuclear power as a valid answer to global warming. So, in this case, a power plant that produces carbon-free electricity without causing more warming is downed because of the previous warming. A replacement for a carbon-dioxide-spewing coal power plant is stopped, forever. What a story — but one needs to look further.

The rest of the story

All of the brief narrative above is true. The massive and possibly unprecedented¹ storm caused the shutdown of the DAEC but it did so just two months before it was scheduled to close anyway.

The DAEC had a license from the U.S. Nuclear Regulatory Commission (NRC) until 2034 since the NRC has decided that reactors can safely operate for at least 60 years. The plant had a contract to produce power for Interstate Power and Light (IPL), a part of the multistate Alliant network of companies, for another five years.² However, the utility company chose to break the contract and agreed to pay NextEra Energy Resources (NextEra), the owner of the reactor, \$110 million to stop taking power in 2020.³ The plant was just too expensive. IPL could get electricity cheaper over the next five years even after paying for the early closing.

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embraced nuclear energy. Coal and natural gas plants contribute to warming the earth by producing carbon dioxide all the while they produce electricity. Reactors do not. While many environmentalists including those in the Midwest RE-AMP network who point out that with "...heavy reliance on coal, the states of the Upper Midwest have contributed vastly disproportionate amounts of carbon to the atmosphere, resulting in climate change impacts..."⁴ Not all members of this energy coalition are thrilled with nuclear power but nearly all agree that given the choice, coal facilities should close before nuclear reactors.

NextEra has a contract with IPL to replace some of the electricity formerly produced by DAEC by revamping four existing wind power units with bigger blades and equipment to produce more electricity.⁵ So non-carbon dioxide producing electricity will be partially replaced with similar non-carbon electricity. However, much of the replacement will come from Alliant's gas and coal plants. The loss of DAEC five years before its planned closing date will increase global warming.

The future of existing single unit reactors

Single-reactor nuclear plants are very often uncompetitive in the United States since they have less production to share the costs. Six other reactors have closed or announced early closings since 2013.⁶ When the plants were built the story was that they would cost a lot to build but once in service they would run cheaply, much less than the cost of the alternative, coal plants. Some even boldly used the phrase "too cheap to meter" in describing the kilowatt hours produced by nuclear plants.

Many existing nuclear plants like DAEC now cannot compete with brand new wind turbines, and utility-scale solar plants are nearly as cheap even in the center of the country. There are various reasons. The 2011 Fukushima Daiichi disaster helped regulators discover what could go wrong and caused increases in safety costs at all existing reactors. Nuclear fuel is not free, and it is costly to store the spent fuel. Even as reactors have depreciated their capital costs some, especially single reactor sites, produce electricity at a higher cost than new wind, solar and natural gas plants.

When built, reactors have a supposed life expectancy of up to 60 years or even 80 years.⁷ Thus far none has lasted that long in the U.S. and many have closed well before that. A 2018 report by authors at the Union of Concerned Scientists (UCS) rated the 99 nuclear reactors then existing in the U.S. on their operation profitability. It found that cheap natural gas, wind and solar, along with efficiency and less demand for kilowatt-hours has made about a third of the nuclear reactors uneconomic or already scheduled to close, DAEC among them.⁸ Policy that recognizes the danger of climate change could help the economics of existing U.S. reactors. One often cited policy is a carbon tax on carbon dioxide producing electric plants. Of the 99 reactors at 60 plants, the UCS found most would be restored to profitability by some level of carbon tax. DAEC and seven other plants would still not get to profitability even with a tax of \$15 per ton of carbon. At \$25 per ton DAEC enters the marginally competitive category.⁹ If we are to believe the UCS analysis, a \$25 per ton carbon tax could keep that reactor in production up to the original retirement date of 2025. That assumes that the derecho damage to the cooling system is not severe.

Other recent reports document the problem with the existing U.S. nuclear fleet. A study in 2017 by Bloomberg New Energy Finance "found that more than half of nuclear plants were losing money" and there was other evidence of economic problems in the industry according to a news article in Forbes.¹⁰ The World Nuclear Industry Status Report 2019 (Status Report 2019)¹¹ demonstrates the

industry's problems are worldwide. According to the report, recent cost drops of renewables has been dramatic, “[b]etween 2009 and 2018, utility-scale solar costs came down 88 percent and wind 69 percent, while new nuclear costs increased by 23 percent.”¹² That and the advantage of getting “green” electricity with few or no adverse health considerations has led to many new kilowatt hours from wind and solar, also according to Status Report 2019.

Over the past decade, non-hydro renewables have added more kilowatt-hours than coal or gas and twice as many as hydropower, while nuclear plants generated less power in 2018 than in 2008.¹³

Public Policy can keep reactors going

National carbon policy like a carbon tax could keep existing nuclear plants in operation. In addition to national policy, state subsidies for existing plants has been another policy prescription. In 2018, at the writing of the UCS report, state governments in Illinois, New York and New Jersey had passed legislation to subsidize a total of 10 reactors at seven sites. To that number were later added two reactors in Ohio.

That states should intervene to save the plants is a data question. Just because a company claims they need to close an uneconomic reactor does not mean it is the case. Joseph Bowring, who serves as the Independent Market Monitor of the very large PJM electricity reliability region, appeared at the hearing in New Jersey to grant subsidies to reactors in the state in 2017 to argue:

The proposed legislation in New Jersey to subsidize specific nuclear power plants would result in a market intervention that would have a negative impact on PJM's competitive wholesale power markets and would provide subsidies to units that have not demonstrated that they are not financially viable.¹⁴

Notwithstanding Mr. Bowring's analysis, New Jersey became one of the states to subsidize reactors. The companies can make a compelling case and Republicans who often support big business combined with Democrats trying to protect good union jobs have often given way to threats of reactor closings. Such subsidies are controversial and difficult to get through the legislative process since they increase costs to ratepayers or taxpayers. In Ohio in the summer of 2020 bribes are alleged to have been given to pass nuclear plant subsidies. According to the Toledo Blade newspaper:

Former Ohio House Speaker Larry Householder (R., Glenford) and four of his allies face charges that they conspired to funnel \$61 million from FirstEnergy and related interests to help elect lawmakers loyal to Mr. Householder and get him elected speaker. They are accused of then using that power to push through a controversial law bailing out the Davis-Besse plant near Oak Harbor and Perry plant east of Cleveland as part of Ohio's energy policy.¹⁵

Mr. Householder was deposed as Speaker and faces federal charges. In Illinois, another Speaker of the House, this one a Democrat, has been named in an investigation of subsidies for nuclear reactors. U.S. Attorney John Lausch announced that the utility company, ComEd, has agreed to a \$200 million fine for its part in granting favors to legislative officials involved in passing reactor bailouts.

Prosecutors said the utility attempted to “influence and reward” Madigan by providing financial benefits to some close to him, often through a key confidant and adviser at the center of the probe. Madigan, the nation’s longest-serving speaker and Illinois Democratic Party chairman, has not been charged with any wrongdoing.¹⁶

While both examples involve Speakers of the House in Midwestern states, the two examples are quite different. The Illinois legislation was supported by the environmental community. Along with keeping three reactors from being closed, solar energy was greatly expanded. Equity was considered since part of the legislation included “... the Illinois Solar for All Program, providing a comprehensive, low-income, solar deployment and job training program that will open up access to the solar economy for millions of low-income families.”¹⁷

The Illinois Chapter of the Sierra Club worked as part of the coalition that created the legislation. Director Jack Darin explained the Chapter’s support:

While this bill contains difficult compromises, this is a tremendous leap forward for clean energy in Illinois. With these policies now in place and strengthened, we will continue the work to reduce dangerous carbon pollution, support opportunities for family-sustaining jobs in Illinois’ energy economy, ramp up renewable energy and ensure that clean energy opportunity is prioritized for communities burdened for decades by pollution.¹⁸

Bailout legislation in Ohio was very different. “Ohio just passed the worst energy bill of the 21st century” was the headline at Vox, a news agency that supports free journalism. Besides giving subsidies to two reactors, the legislation subsidized coal plants. It also eviscerated earlier established Ohio state standards for renewable energy and energy efficiency.¹⁹ Clearly the legislation made climate change worse. Again, picking the Sierra Club Chapter as a voice for the environmental community:

House Bill 6 bails out corporate shareholders and undermines Ohio’s clean energy economy. The law contains the most regressive energy policies in the country, providing hundreds of millions of dollars in bailouts for aging coal and nuclear plants, and only heightens the costs and impacts of increasingly chaotic climate change. HB 6 guts Ohio’s efficiency and renewable standards which have saved billions of dollars for Ohio’s families, business and industry.²⁰

Problems with existing plants identified in the UCS report show that without a carbon tax or similar climate policy, many US reactors are in trouble, increasing the temptation to rescue even more plants. Many of the plants in danger of early retirement are in the middle of the country.

The Midcontinent Independent System Operator has the greatest unprofitable nuclear capacity (8.3 GW, 63 percent of its total nuclear capacity) due to lower-than average wholesale electricity prices and a higher concentration of single-reactor plants.²¹

Given that bribes of elected officials have been shown or seriously alleged, there will always be suspicion that even legislation with the good intentions to fight climate change, keep good union jobs, and keep companies solvent might be tainted. Elected officials making decisions benefiting nuclear power must henceforth strive even harder to show they are serving only the people.

Furthermore, citizens are intervening at various levels to stop the subsidies going to Exelon and FirstEnergy, the companies accused of benefiting legislators in Illinois and Ohio. Such actions bring more uncertainty to the process.²² Thus, state subsidies produce other problems for the nuclear industry so federal climate focused legislation is preferable.

Where are the new reactors? An example in Finland

The example of the DAEC and the need for subsidies to keep plants like it alive is troubling for the continued production of non-carbon electricity. One solution is to build new, more efficient reactors using technology of the 21st century rather than that developed in the 1970s. However, aside from new construction in China and Russia, the future of new reactors is not so bright because of cost overruns and delays.

The saga of one nuclear reactor delayed and exceeding its budget is well described in articles from Finnish media. The Olkiluoto reactor was planned to be completed in 2009. The first story about the plant, written in 2006, described a short delay: *New Nuclear Reactor One Year Behind Schedule*.²³

The next article from the same source shows how big the delay would get. *Long-delayed Olkiluoto 3 nuclear reactor to go online in January 2020*.²⁴ The lengthy title of the last report from Finnish media shows that, at this writing, the plant is still not complete. *Olkiluoto 3 reactor delayed yet again, now 12 years behind schedule: Finland's fifth nuclear reactor will not begin regular operations before 2021, rather than 2009 as originally planned*.²⁵

This reactor story must be part of any consideration of whether to trust nuclear technology for future sources of electricity. A 2017 article in the UK news outlet Financial Times comments on the new Olkiluoto reactors and quotes a Finnish power company executive, “If the nuclear industry wants to have a future it cannot afford more projects like this.”²⁶ The Financial Times article was written in 2017, before the last two delays described in the final two Finnish news articles. In addition to the delay for the date when rate payers could expect electricity from the plant was the cost. By the end of 2018, costs had increased more than two and a half times.²⁷

For this to be a lesson, the story of the Finnish plant must be part of a pattern. Do nuclear reactors usually come in late and over budget in the United States? Yes, they do.

Future of new reactors: U.S. experience

There can be a situation worse than having the power source you depend upon coming in years late and far over budget. The plant can be started but never completed with at least part of the costs assigned to rate payers who are never to see a kilowatt hour from the plant. This was the outcome of the so-called “nuclear renaissance” in the United States in the first decade of this century. Republicans supporting business²⁸ and Democrats supporting labor unions²⁹ pushed for subsidies to restart the industry.

Early in 2009, because of generous federal support, applications for licenses were filed with the NRC for 26 new nuclear plants.³⁰ More were forthcoming and eventually the NRC received 31 applications.³¹ But as years passed more and more of the planned units were canceled, some after much work and money had been expended. Four reactors actually made it deep into the

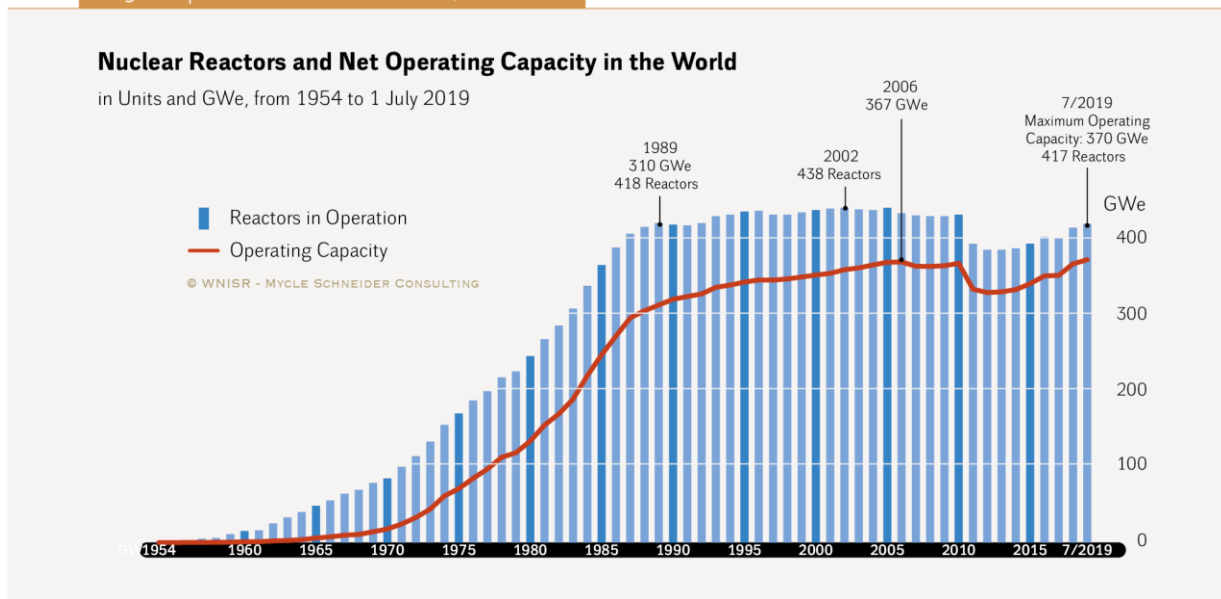
construction stage.³² But in 2017, the V.C. Summer twin reactors in South Carolina were abandoned after \$9 billion had been sunk into the plant.³³ The estimated cost to complete the plant had ballooned to \$23 billion. Industry sources claim the last two units, the Vogtle reactors, will be completed in 2021 and 2022.³⁴ However, those dates make both reactors four years late as well as billions over budget.³⁵ In retrospect, the nuclear renaissance looks more like a swan song.

The nuclear industry in the world

Reactor problems are not limited to Finland and the United States. Nuclear expansion has been uneven worldwide. China and Russia continue to build reactors and are responsible for most of the plants listed as in the planning stage. Planned plants in other countries will probably never be completed. Studies have examined nuclear power’s potential especially since it can be an answer to climate change, replacing electricity produced from fossil fuel. The MIT Future Series seemed sympathetic with that eventuality. However, the 2018 report did not find much hope and concluded, “Without cost reductions, nuclear energy will not play a significant role.”³⁶

Retirements with few new reactor additions is described in the figure below which shows industry expansion through the 1980s but then a drop off. There were fewer nuclear reactors in the world in mid-2019 than there were 30 years ago.³⁷ The figure shows the downturn began after the 1986 Chernobyl accident. The Fukushima Daiichi disaster in 2011 is also obvious from the figure below.

Figure 7 | World Nuclear Reactor Fleet, 1954–2019



Curtailing the expansion in the number of reactors was affected by nuclear accidents. However, much of the turning away from nuclear technology was because of a perennial problem with cost overruns. A recent comment in a leading journal quotes a study by the U.S. Congressional Budget Office, which “found that the quoted cost for ... 75 plants was \$89.1 billion, but the real cost was \$283.3 billion.”³⁸ An even more recent article found:

...overruns afflicted more than 97 percent of nuclear projects and led to a mean cost escalation of 117 percent per project. Sixty-four projects in our sample had cost overruns exceeding \$1 billion, ...14 projects that displayed more than \$5 billion in overruns per project as well as the 10 projects that each experienced a cost escalation of more than 400 percent.³⁹

If there are to be significant carbon-free kilowatt hours from reactors, those already in service will have to be prevented from early retirement. This is especially true in the U.S. Midwest.

Reliability of renewables, the alternative to nuclear power

Since this essay began with the derecho knocking out a power plant it would be good to know if the great storm damaged renewable electric plants. MidAmerican Energy, which has the largest fleet of wind turbines in wind-power-rich Iowa, had no problems.⁴⁰ However, while that may be an advantage for renewables we must remember that reactors can produce power more than 90 percent of the time. They can be depended upon to produce “firm power.” Solar and wind plants are available less than about 40 percent of the time. However, having a great deal of renewable power on the system can be easily integrated with other, more dependable, power sources. Iowa in 2019 produced 42 percent of all its electricity from wind turbines.⁴¹ Even an entire country can depend on a large component of renewable electricity. Denmark, in 2019, produced 47 percent of the country’s electricity from wind.⁴²

Second, battery storage can make wind and solar function more as firm power sources. Some of the kilowatt hours produced from solar at midday can be stored and released at high demand times later in the evening. Electricity storage is expanding quickly. “Arizona plans to boost solar-plus-storage from today’s 6 MW to a whopping 850 MW by 2025, more than the entire capacity of large-scale batteries in the U.S. today.”⁴³ This is not a single-state phenomenon. “Wood Mackenzie projects that about 27,500 MW of cumulative battery storage capacity will be installed by 2025, just under Bloomberg NEF’s estimate of roughly 32,000 MW by 2025. The Energy Storage Association in 2017 set a goal of 35,000 MW of new energy storage capacity by 2025 from all technologies.”⁴⁴ Renewable power with or without firm storage of electrons has a great future. However, we are approaching a climate crisis that must be met now.

Conclusion

Iowa lost its only nuclear reactor in a storm that only caused a few months delay to its planned demise. Without plants like the DAEC, how do we rapidly get to a non-fossil fuel future?

Going forward, energy efficiency is always the first choice since it is cheapest and keeps jobs local. Local jobs also can come from wind, solar and electricity storage. There is no need to risk large overruns and years of delay by embracing unreliable nuclear energy for new sources of electricity. The last word from Status Report 2019 says it well: “Stabilizing the climate is urgent, nuclear power is slow. It meets no technical or operational need that these low carbon competitors cannot meet better, cheaper, and faster.”⁴⁵

While new reactors — at least in Finland and the United States — are not an affordable answer, we must remember that many U.S. plants can compete, according to the UCS report. As these plants meet their natural demise, new renewable sources will replace them in an orderly transition to confront climate change.

What about the old, single-reactor plants like DAEC that are very expensive? Some and perhaps even the DAEC itself could be kept alive for a limited time. Policy changes at the state level could keep plants going. Two conditions should be met for any subsidies to be considered. First, remembering the testimony of Joseph Bowring in New Jersey's decision, the state should demand the data of need for help. Second, any nuclear bailout should be part of overall policy to fight climate change across the board and not make things worse as Ohio legislation did. Assuming the derecho damage to the cooling system is not extensive, keeping DAEC in business until 2025, until the original planned end of its contract, could be combined with a gradual increase in solar power to replace the reactor's production. Hopefully, this action could be accomplished with no bribes since 500 good union jobs at the plant and solar power are both popular with voters.

Some of the solar to replace the electricity from the DAEC reactor could come from the site itself. A new 100-megawatt solar plant in southern Iowa will stretch over about 800 acres. The present DAEC 500-acre site could accommodate a solar field that could replace some of the 615 megawatts of the reactor's capacity. NextEra has mentioned this as a possibility.⁴⁶

Nuclear reactors may be a sideline in confronting climate change. But nuclear power has a role as a bridge to a renewable energy future dominated by wind and solar and what new renewable sources human technology will produce over the next years. To fully utilize the reactors that we have, policy to combat climate change is needed and it needs to be put in place soon.

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David Osterberg is a senior researcher at Common Good Iowa. A former Iowa state representative who chaired the House Energy and Environmental Protection Committee as well as the Agriculture Committee, he co-founded the Iowa Policy Project, which merged in 2020 with the Child and Family Policy Center to form Common Good Iowa. He is a former climate change consultant at the Iowa Department of Natural Resources, and has testified in nuclear and utility regulation cases. Osterberg holds M.S. degrees in water resources management and agricultural economics from the University of Wisconsin-Madison. He is professor emeritus in the Department of Occupational and Environmental Health at the University of Iowa.

Common Good Iowa is a nonpartisan, nonprofit organization built on a collective 50 years of experience of two respected Iowa organizations — the Child and Family Policy Center and Iowa Policy Project.