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# Bad Faith Arguments for More Nuclear Power

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## ABSTRACT

In the US, the decline of the nuclear industry has often been portrayed in the media and in politics as a result of partisanship and public fear. This essay argues that such claims, at least for the development of new facilities, are being made in bad faith, and that the industry's problems have more to do with technical, logistical and market difficulties that strain the financial viability of new projects. Because markets in the electricity sector are regulated, political rhetoric can have a significant, though diffuse, impact on market-making policies for all potential new energy assets connected to the electric grid, and so it is important that this rhetoric takes seriously the range of issues involved. To encourage better sense-making, this article summarizes, at a high level, the basic obstacles facing the development of new nuclear power facilities in the US, including the fragmentation of electrical markets, a failure to develop standardized designs, the slow pace of technological innovation, limits imposed by distribution and transmission systems, and troubles with waste and the environmental impacts of water use and uranium mining.

**Keywords:** Nuclear Power, Energy Policy, Electric Grid, United States, Climate Change, Reactionary Politics.

## Advocacy

In recent years, mainstream and conservative media have published a succession of articles "advocating" for dramatically increased nuclear electrical production in the United States. In April 2019, for example, the New York Times put out an Op-Ed by Joshua Goldstein, Staffan Qvist and Steven Pinker arguing for the construction of new nuclear plants in defiance of popular fears about nuclear technology (Goldstein et al., 2019). Articles regularly pop up elsewhere in such varied publications as the National Review (Bryce, 2016; Bryce, 2019), Forbes (Shellenberger, 2019b), Quillette (Shellenberger, 2019a), Bloomberg (Marques, 2020) and Grist (Holthaus, 2018), all variations on this theme. These media efforts bolster "support" for nuclear power among politicians and talking heads in the center and on the right who are concerned about fossil fuel consumption and energy independence, and, ostensibly, they represent a position on US energy policy.

Nuclear power in the United States has been on the decline for decades now, with only two new plants having been completed since 1993, and a number of facilities around the country closing or slated to be closed as we enter a new decade. Billions have been spent since the 1990s for failed projects and those incomplete and long in development, and the construction of nuclear facilities, both replacement work and new work, has seen escalating cost (MIT Energy Initiative, 2018; Morgan et al., 2018; Cardwell, 2017; Moore, 2018; Cho 2020); during the same time, the expense of building and deploying renewable energy and natural gas has dropped precipitously, encouraging a flurry of new investment (Schneider et al., 2019). While decisions about existing nuclear assets entail different considerations than the development of new ones (Haratyk, 2017), without new development, the decline of nuclear power in the US could become terminal (Lesser, 2019; Schneider et al., 2019). This article will focus, therefore, on the potential for new nuclear projects.

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The frequent premise of these articles is that a) greenhouse gas emissions need to be curbed, b) but renewable energy sucks, and c) nuclear power is amazing and cheap and has been thwarted by an irrational, feckless political agenda. It is true that the deployment of new nuclear power assets could significantly decarbonize the electricity sector. While the natural gas facilities that have replaced many older coal plants are cleaner and less carbon intensive than the latter, fracking and natural gas together emit tons upon tons of carbon pollution into the atmosphere; replaced by nuclear capacity, these emissions could largely be eliminated. It is also true that renewable energy technologies deployed at scale create their own set of problems and these also should be taken seriously; for example, renewable sources like solar and wind, even paired with energy storage assets like batteries, because of their intermittency and distributed deployment, pose technical difficulties to resource adequacy, and to the coordination of grid operation. Sadly, these articles don't address in any detail the range of substantive difficulties, technical, financial, and political, that must be overcome for a nuclear renaissance in the United States. Similarly, they refuse to look closely at the particulars of how natural gas and renewable energy technologies have almost monopolized new asset development in recent years.

Electricity markets are not only complex, they vary greatly between jurisdictions and are closely regulated; nuclear engineering is famously difficult. To the extent that market-making policies are a function of political governance, the public and its political leaders need access to accurate cost/benefit information that is adequately reflective of the underlying facts. Recently, natural gas and renewable energy technologies have been very successful in garnering huge financial investments during a time of major change in the electric grid, so the choice of nuclear power, a less successful technology over the same interval that nevertheless is not carbon-emitting, presents obvious appeal for those oriented by reactionary political feeling. Thus, the temptation to make reductive representations about various technologies for the purpose of reactionary posturing can impair good planning and decision-making.

In order to make the issues involved here more comprehensible to the non-specialist, this article will summarize, as a heuristic, the main obstacles to a resurgence in the construction of nuclear facilities in US. The summaries present only a high level view of potential issues; tenable analyses of market-making policies or proposals for particular projects require a great mound of detail that would be beyond this article's scope and purpose. There is no intention here to make a technical or financial case for any particular technology in any particular market, nor to suggest that the problems summarized here cannot be overcome. Rather, the article offers some guideposts for better *sense-making* when these issues come up in public discourse, so that the credibility of proposals or representations can be properly evaluated.

## Fragmentation

Traditionally, the US electric industry has been regionally centralized, with utilities, as regulated monopolies, building power plants, maintaining transmission and distribution lines, and billing their account holders. A number of trends, especially since the energy shock of the 1970s, have coalesced throughout the last four decades to produce a much more complicated, fragmented system with many opportunities for participation by third party asset owners. The modern grid is bifurcated into two major segments, the transmission networks, which control large volumes of interstate power flows on high voltage lines, and the distribution systems, which feed power directly to utility customers. In both segments, responsibility for management and oversight is distributed hierarchically among many stakeholders according to defined roles and according to geographic and political divisions (The National Academies of Sciences, Engineering & Medicine, 2016).

The costs for the whole system are ultimately borne by utility customers at the distribution level, but up and down the chain there are a huge variety of asset owners providing different energy services to other stakeholders down the hierarchy, over different time intervals, utilizing different metering and transaction schemes, operating under different regulatory rules, connected according to different engineering standards, all throughout the vast, dispersed physical network of wires and switches that constitute the grid. Effectively, there are *thousands* of physically intertwined, but separately maintained markets for electrical energy in the US, and these markets regularly change over the life of most assets. The "economics" of a given new power plant are derived from the underlying costs of the asset's technology, construction and operations, now AND in the future, set against the specific structure of the market it would be connected to, now AND in the future. There doesn't exist a single, elementary model of financial viability for any power generating technology that automatically scales across the national grid.

If we step back from all the localized variation among these markets, we can see that the development of energy assets is determined largely by who foots the bill for their construction: that is, investment decisions made by private financial concerns and independent developers, on one hand, and the utilities, on the other. Private companies want to own assets that can be built quickly, that generate a reasonable return on investment and that have low risk. The utilities have to balance their role in maintaining transmission and distribution networks, operating generating assets (where this is allowed) and serving the public interest under federal and state regulations; typically, they prefer to build assets that minimize upgrades to existing infrastructure, which simplify daily operation and which curtail costs in demand-based markets or those incurred by market events that are the result of stress on grid infrastructure. The lack of new nuclear facilities in recent decades would seem to indicate that neither have been particularly motivated to plunk down billions of dollars for more nuclear capacity, with all the risks involved, when they can make financially safe, incremental bets on renewables and storage, or lucrative, somewhat riskier bets on natural gas.

## Standardization

One of the biggest drivers of cost to the deployment of nuclear power is the engineering and compliance activities that underlie permitting and procurement during plant construction. These costs could theoretically be reduced if a series of projects were built with the same basic design in a relatively short period of time (MIT Energy Initiative, 2018; Lesser 2019). France, for example, is noted for having successfully taken this approach among its fleet of nuclear assets in the 1970s and 1980s (Kidd, 2009). Standardization requires suitably uniform, general regulations across jurisdictions, capable engineering and project management, and a pipeline of projects to be developed and installed by the same government entity or private group. Unfortunately, the US electricity markets have long been balkanized geographically between states and even within states, and anything involving nuclear materials also draws attention from the federal Nuclear Regulatory Commission (NRC). Construction firms and engineers have not successfully navigated the regulatory and economic waters to pursue a standardized approach. This is partly due to the structure of the regulations, but the failures of engineers and construction firms among developers have also played a significant role (MIT Energy Initiative, 2018; Cardwell, 2017; Lesser 2019). Business strategy for the sector has fared no better: private investors are not enthusiastic about building single nuclear plants, much less a whole slew of them, and federal and state agencies have not chosen to participate much in building new nuclear assets since the 1990s, or provided sufficient targeted incentives. At the moment, there are no private or government entities in the US who have the motivation, sufficient capitalization, organizational efficiency and engineering excellence to pursue an aggressive national construction program with standardized design and planning. Regulatory changes, particularly at the NRC, might ease this problem (MIT Energy Initiative, 2018; Lesser 2019), but this would require significant political leadership at a federal level in tackling complex technical issues, and would do nothing to address the capital and organizational deficiencies involved in a large national or regional construction campaign.

## Innovation

The US has not successfully commercialized any innovative reactor designs in recent decades (Morgan et al., 2018). There should be more funding from the public sector, and, while there has been some activity on the private side, not enough has been invested to fully commercialize new technology. New ideas could definitely bring down development costs; this could involve, as already discussed, an “assembly line” approach to construction, or it could prove advanced reactor types that use new processes and materials (MIT Energy Initiative, 2018). However, even if a massive commitment of time and resources from the federal government in partnership with private entrepreneurial ventures exceeded even recent renewed efforts, at best, the fruits of these labors wouldn’t be generating electricity until sometime in the 2030s (Cho 2020). Successful innovation in this sector is most likely to happen in China, where large pools of resources can be mobilized immediately by government fiat, and it is doubtful that possible innovations could appear on American shores until we’re approaching mid-century (Morgan et al., 2018; MIT Energy Initiative, 2018).

## Services

At the moment, nuclear power plants come in one size: very large. Most plants in the US have multiple reactors, each of which approaches or exceeds 1,000 MW (by contrast, a typical residential PV system might be 7 kW). There has been significant research on smaller nuclear facilities, but nothing is close to commercialization (Morgan et al., 2018). Because no one is especially eager to park a massive nuclear plant in the middle of an urban area, they are mostly sited at the edges of large urban clusters or in rural locations. This means that nuclear power offers little relief to problems of circuit congestion in dense, urban locations. This issue has increased in recent decades as urban populations have risen, cities sprawled, and more and more of American life has come to depend on electrical devices and machines. Because congestion is driven by loads across particular constrained distribution or transmission circuits, rather than constraints on production sources, the problems caused by it have to be managed locally, or mitigated with infrastructure upgrades. With cities taking up an ever-larger slice of economic activity in the US, the construction of huge production assets is not in line with the imperative to mitigate costs at the "grid-edge", and so is often not a prime focus of regulators and utilities. Congestion is not the only problem that grid operators combat on a daily basis. Transients, surges, rapid shifts in load, damage to power lines, power quality and power factor issues, voltage sag – all of these events have to be managed through the deployment of utility assets or the incentives embedded in regulated markets.

Modern nuclear plants may be able to assist with some of these problems better than legacy facilities, but more nuclear power will be not the most cost-effective solution in every case, and even where it is competitive, operational principles will not be identical to what they might have been in 1960s or the 1990s. Strangely, none of these articles on nuclear power discuss the contribution of congestion and these other concerns as structural factors determining the overall cost structure behind tariff rates and new construction.

## Resilience

Climate change has created conditions for more and larger natural disasters across the country. Along with population growth and the proliferation of electrical devices on aging infrastructure, we face an increasing risk of operational failures on the electrical grid, large and small. Highly centralized production sources, like nuclear and coal power plants, are not as resilient as small sources that can be locally isolated. This is because local sources can be managed individually with less cumulative impact in each case, whereas a big, central power plant that takes a long time to come back online has a massive effect on a large area.

## Risk

It's senseless to have emotional arguments about whether or not nuclear power plants are "safe" when reviewing energy policy. The risk of apocalyptic catastrophe can never be eliminated, but nor can intense fear be reasoned with. A better course is to reduce concerns about accidental loss of life and property to a financial question framed in terms of insurance. The downside risk of catastrophic failure at a nuclear facility is basically uninsurable, especially at sites near large urban centers. Under the Price-Anderson Act, the US federal government sets a premium per reactor site, with additional fees assessed in the case of an actual claim. These monies are collected into an insurance pool currently totaling about $13.4 billion, available in the case of any single disaster (United States Nuclear Regulatory Commission, 2019). Here are two points of comparison for the cost of major disasters: in the immediate aftermath of the 2010 Deepwater Horizon oil spill, BP promised to pay out $20 billion (Stelloh & the Associated Press, 2016); Hurricane Katrina may have caused $161 billion in damage to property in New Orleans and around the Gulf Coast (CNN Library, 2019).

This insurance pool is available in the case of incidents of any size. If damages exceed this amount, the federal government is on the hook. This is a sensible policy, but it is also major public subsidy. The bulk of risk, in the case of calamity, would be borne by the local community and the federal government, not the plant owner or the insurance company or even many of the rate-payers, and so the value of this risk in excess of the mandated insurance pool, as it might be underwritten on empirical grounds, has to be tallied as a subsidy when cost comparisons are being made between different electrical energy technologies.

## Waste

Nuclear waste storage is a permanent, expensive obligation. Long after our many nuclear plants have been decommissioned, we will be dealing with and possibly paying for a hoard of waste (Wade, 2019). It's unclear how to financially model the burden of radioactive waste management over, potentially, hundreds of thousands of years, but if we're comparing how "expensive" or "cheap" different energy technologies are, such future liabilities have to be considered. The federal government, by the Nuclear Waste Policy Act of 1982, is supposed to collect nuclear waste from power plants and weapons programs in a permanent, safe repository. A site at Yucca Mountain near Las Vegas, NV, was chosen under this Act, and a large, expensive facility has been built there (United States Nuclear Regulatory Commission, 2018). However, because of political opposition, the facility has not been used for this purpose, and waste is generally stored on site at power plants across the country. Many of these power plants are beginning to run out of room for "temporary" storage (Brady, 2019). It could be argued that nuclear power production creates, by volume, a miniscule fraction of the waste generated by fossil fuels and even renewable energy systems, and this has to be factored to its credit. But nuclear waste is correspondingly more toxic and dangerous, and this toxicity could well last longer than our current civilization. Without a streamlined, successful policy of waste management, it is hard to argue that we should be generating even more spent nuclear fuel.

## Mining

Nuclear fuel is not renewable, and uranium has to be mined out of the ground. New promised technologies, like fusion reactors, that could use other kinds of materials are nowhere near commercial viability (Morgan et al., 2018). Like other mining activities, uranium mining and refining are a significant ongoing, and possibly increasing, cost of operation, whereas renewable energy assets demand minimal operational expense. Uranium mining also has the potential to cause serious pollution problems that linger for decades, and that are carried as unpriced externalities by parts of society not involved in electricity production. A well known example of devastation wrought by uranium mining comes from the many abandoned sites in the Navajo Nation from the second half of the 20th century; unremediated tailings and open shafts are known to have caused a scourge of high cancer rates and other health problems among local inhabitants, most of them Native Americans (United States Environmental Protection Agency, 2019; Macmillan, 2012). While, no doubt, mining can be conducted more safely with modern methods, the risk of serious, long term pollution must be accounted for.

## Water

Most coal and nuclear power plants use large steam turbines that require a prodigious use of water. According to a 2015 study by the US Geological Survey, 41% of the useful water in the US runs through a thermo-electric power plant somewhere in the country (United States Geological Survey, 2018). Much of this water is withdrawn and returned to a water course, and is not consumed. Water withdrawals, while not as detrimental to the environment and other users as massive water consumption, still alter the hydrological character of nearby and downstream ecosystems, and undermine their resilience in cases of drought or flooding. Returned water is also warmer than when withdrawn and this can impact local aquatic flora and fauna. Water resources, especially out West, are becoming ever more limited and under stress, and water scarcity may argue for ruling out a number of otherwise viable sites for nuclear power production.

## Advocacy?

A company who wants to build a nuclear power plant has to figure out how to overcome all of the obstacles presented here, and then, with a site and plans for a particular project in hand, get in front of the independent system operator or local utility, the state public utility commission, the NRC and some investors with billions of dollars to burn and years to wait before they can see their first returns. This is how projects get built. If what is being proposed is a revolution in the US electric grid to replace most of the currently operating coal and natural gas assets with new nuclear plants, there will need to be *hundreds* of them. The economic models under which these assets might be financed are governed by policy-making that entails a dizzying array of highly technical details, involving, to name a few, the structure of transmission-level markets, the efficacy of nuclear engineering regulations, nuclear waste disposal, the costs and benefits of waste mitigation through reprocessing, and funding the prevention and/or cleanup of pollution from uranium mining activities. Project development and policy reform both demand a high level of expertise and professionalism to carry off successfully, and good faith public communications require not only the nexus of some specific project or policy, but grounding in such professional competence. These articles appear to be "advocating" for nuclear power as a general political condition, minimally related to the many particulars, as if investment and all the risk a nuclear power plant carries for a multiplicity of stakeholders were merely a function of ambient public attitudes. Whatever one imagines as an impediment to nuclear-friendly policy or a new proposed power plant – mass protests, uncomfortable demonstrations by anti-nuclear fanatics, industry lobbying, political corruption, left-wing media legerdemain – the actual building of new facilities will only happen where the industry and its counterparts in government exhibit vision and execution at a high level, not merely a special political feeling.

The best way to make good on the premise of these articles would be to: a) nationalize the whole industry of electricity production, transmission and distribution, including stripping certain regulatory powers from state and regional authorities, b) implement broad anti-competitive measures in electricity markets designed to favor new nuclear asset building and corresponding infrastructure, c) immediately allocate billions in federal funding towards this asset construction, and d) make aggressive use of eminent domain for siting and waste disposal. In other words, socialism! The New York Times article (i.e., Goldstein et al., 2018) cites Sweden and France, both noted for having strong central governments and generous social policies, as countries that have successfully scaled up major nuclear capacity, and this is no coincidence. And there is, in fact, a precedent in the US for nationalized power, the Tennessee Valley Authority, which, as might be expected, is responsible for those last two successfully completed nuclear reactors, at the Watts Bar site in Tennessee (Cardwell 2017). It is ironic that most of the enthusiastic chatter for nuclear power comes from conservatives who, supposedly, hate “socialism” and who intermittently trash the legacy of the New Deal. While the US electric grid is tightly regulated, the system, as a whole, is fundamentally market driven, and not administered from on high by a centralized state authority. At any time, there is likely to be an appetite somewhere in America for ANY technology that is convenient to system operators, beneficial to ratepayers, and offering of a nice, low-risk payout to investors.

These articles on nuclear power are not about energy policy itself, but more about creating a smokescreen so that those at a certain register of reactionary feeling can avoid uncomfortable realities. Climate change threatens civilization, if not the future of human existence, and we don’t know, in the coming years, if we will be equal to the forces that have been unleashed by industrialization. The earth may not be able to support 7+ billion human beings, with current levels of energy usage and decent standards of living, for more than a century or two; indeed, a sustainable human worldwide human population could be frighteningly smaller. Flora and fauna around the world have been dying at an alarming rate, and this trend will continue to accelerate in coming decades as weather and ecosystems are thrown into chaos. The era of cheap energy may be coming to a close, for technical and structural reasons, and, if this is true, there is no coagulation of political opinion, or utopian yearning, that will change the facts.

We should not discount the potential of nuclear technology to contribute to decarbonization, as new investments are made in the electric grid, but it is good sense-making on the merits of the details which will permit new nuclear assets to be constructed. To the extent that regulation in the electric sector is market-making, and therefore subject to public attitudes and political maneuvering, reactionary thinking has no legitimate role. So when nuclear advocates peddle claims about the benefits of nuclear power without wrestling the list of issues summarized here – well, anyone selling a free lunch is not to be trusted.

## Competing Interests

No potential conflict of interest was reported by the author(s).

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