

The Economics of State Government Assistance to Nuclear Plants

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Abstract

Coal was the largest source of electricity generation in the United States for decades before being supplanted by natural gas in 2015. Nuclear plants have also been a significant electricity source in America but now many of them are on the verge of closing. Meanwhile, the amount of electricity produced by renewable sources is growing. The rise of both natural gas and renewables has weakened the financial prospects of nuclear as a long-term power source. In response, executives of nuclear power plants are lobbying government officials for assistance and officials in many states have been receptive. This paper provides a brief background of electricity generation, discusses some of the current proposals to assist nuclear plants, and explains the economics of the proposed government assistance plans.

Executive Summary

Nuclear plants have been a significant electricity source in America, but America's aging nuclear fleet is underperforming compared with more competitive natural gas and renewables. In fact, many older nuclear plants have closed or are on the verge of closing. With the long-term prospects for nuclear power in question, executives of some nuclear power plants are lobbying local government officials for assistance.

This paper discusses some of the current proposals in Ohio and Pennsylvania to assist nuclear plants and explains the economics of the proposed government assistance plans.

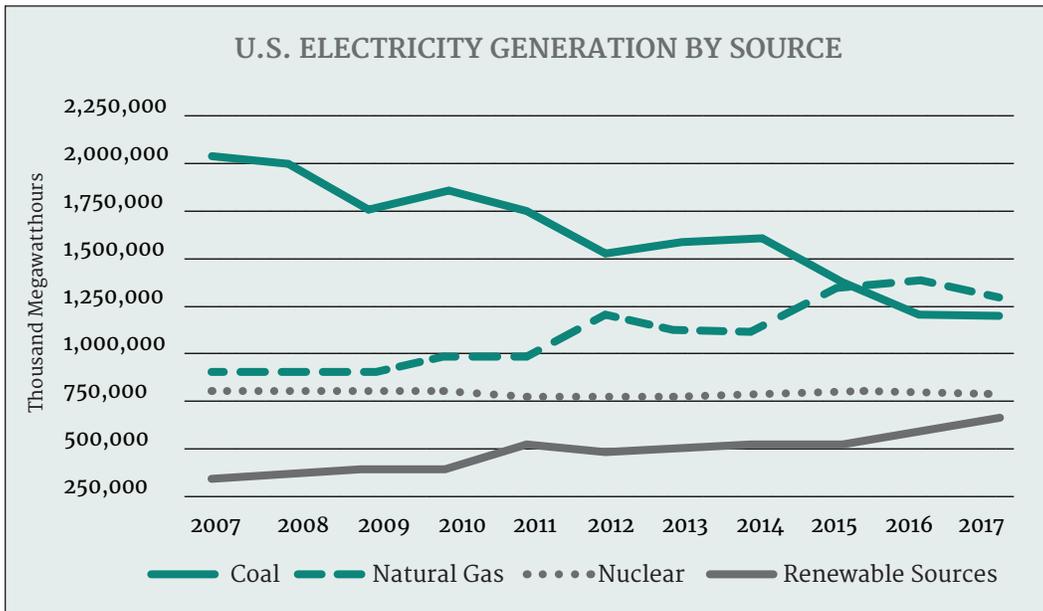
- **Flat Nuclear Supplanted by Rising Natural Gas, Renewables.** U.S. electricity generated from nuclear has been nearly constant since 2007, while natural gas has become the nation's dominant source of electricity. Research shows that sharply falling natural gas prices played a key role in stifling a potential nuclear renaissance in the early 2000s. Today, nuclear power's initial high fixed costs are a deterrent to building new nuclear plants and several existing plants are closing or scheduled to close.
- **Construction of Nuclear Plants Slower, More Expensive.** Data shows that construction costs of nuclear plants have risen since the 1970s and the time to build increased from the 1950s to the 1970s. Both trends cast doubt on nuclear power's future, especially given the advances in natural gas production.
- **Nuclear Wants Subsidies, But They Aren't the Answer.** Some public officials, including lawmakers in Ohio, Pennsylvania, and Illinois, are calling for subsidies to help struggling nuclear plants. This includes proposals to require utilities to purchase more nuclear power or to otherwise prop up nuclear plants scheduled to close. But data shows that the majority of nuclear plants in the Midwest and Mid-Atlantic are not in financial trouble. PJM Interconnection found that only three of 18 nuclear plants in the region—Three Mile Island in Pennsylvania and Davis-Besse and Perry in Ohio—won't be able to cover their costs at least one year between 2019 to 2021. Subsidies would not only be costly, but also unnecessary for the broader nuclear industry.

- **Pennsylvania’s Plan.** In Pennsylvania, a proposal to include nuclear power as a source of zero-emissions energy would mandate more nuclear by requiring electric companies to acquire at least half their power—or purchase equivalent credits—from zero-emissions sources. This is projected to cost the average customer more than \$38 per year. This plan was proposed after Exelon significantly increased its lobbying spending and political donations in Pennsylvania in 2018, nearly tripling them from 2016 levels.
- **Ohio’s Plan.** In Ohio, lawmakers have proposed to subsidize zero-emissions energy more broadly to prevent the closure of two nuclear plants. All electricity customers would pay a monthly surcharge—as much as \$2,500 in some cases—to fund this subsidy. Similar to Exelon in Pennsylvania, FirstEnergy and its allies have spent millions on campaign contributions and lobbying to push nuclear subsidies. This includes nearly \$2.7 million to lobbyists and PR firms and over \$1 million dollars to Ohio candidates and political parties. If passed, the measure would result in \$300 million in new fees on Ohio’s electric bills.
- **Illinois’ Nuclear Subsidies.** In Illinois, lawmakers passed a measure in 2016 to provide \$235 million in ratepayer-funded credits annually for two nuclear plants for 10 years. Now, the state’s lawmakers are considering a new bill with additional subsidies to keep nuclear plants operating. At present, subsidized nuclear plants in Illinois must compete with unsubsidized nuclear plants. This distorts the energy market, but new subsidies will only worsen the problem without addressing the underlying causes.
- **Subsidies for Nuclear Are Not an Effective Climate Solution.** Since 2005, U.S. carbon emissions in electricity have declined by 28 percent, thanks largely to natural gas-related power generation. Subsidizing inefficient nuclear plants is not an economical way to address climate change and is also likely to crowd out new, more efficient electricity plants. With demand for power flat or declining, the profit motive for investing in new, more efficient power plants is weakened if less efficient plants are subsidized to prevent them from closing.
- **Nuclear Subsidies Unlikely to Improve Consumer Welfare.** Subsidies can do more harm than good if they are not carefully calculated or applied to the right goods or services. The cost of estimating the correct subsidy, implementing it, and administering it must be considered. If these costs are especially large such that they outweigh the potential gains in efficiency then the economy would be better off without the subsidy. It doesn’t appear that Ohio or Pennsylvania lawmakers have rigorously estimated the appropriate subsidy or accounted for the costs of implementing and administering one in their proposals. The proposed nuclear subsidies seem to be a case of more harm than good, as they appear to be primarily designed to help a few unprofitable nuclear plants rather than carefully measured proposals to create more low-emissions energy.

Introduction

Natural gas has become the dominant source of electricity generation in the United States. As shown in figure 1, natural gas surpassed coal in 2015 and has remained ahead since. Electricity generated from nuclear has been nearly constant since 2007. Meanwhile, electricity generated from renewable sources has largely tracked natural gas's growth trend but remains only about half the size.

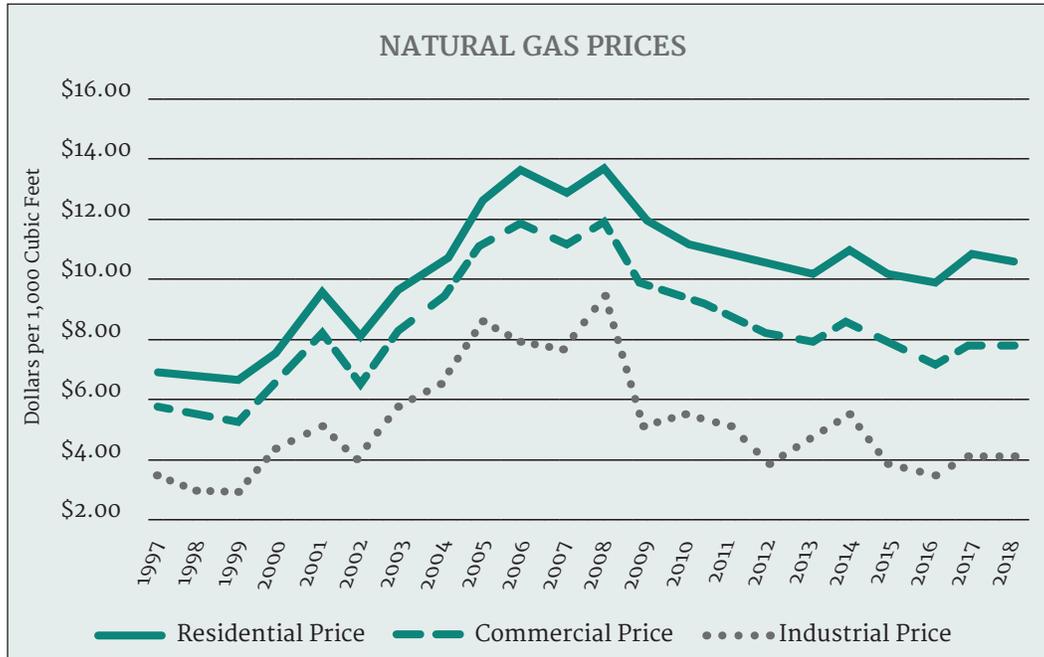
FIGURE 1



Notes: Data from U.S. Energy Information Administration Electric Power Annual Report Table 3.1.A. Renewable sources include hydroelectric, solar, wind, wood, geothermal, landfill gas, and others. Data does not include energy produced by small-scale (primarily rooftop) solar photovoltaic systems.

The increase in the use of natural gas since 2009 corresponds with the sharp decrease in its price that began in 2008. The prices of natural gas for residential, industrial, and commercial users have all decreased substantially since 2008, with the industrial price falling by more than half (see figure 2). Lower natural gas prices are the result of regulatory reforms in the 1980s and 90s, the development of efficient markets for natural gas, and technological innovations (e.g. hydraulic fracturing) that made shale gas economical (Joskow 2013).

FIGURE 2



Notes: Data from U.S. Energy Information Administration annual natural gas prices. https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm.

The decline in the price of natural gas relative to other energy sources such as coal and nuclear has created financial issues in the latter industries. Lucas (2012) discusses how lower natural gas prices played a part in stifling a potential nuclear renaissance in the early 2000s. Nuclear power is characterized by initial high fixed costs of plant construction followed by relatively low operating costs. When alternative energy sources—such as coal, oil, solar, etc.—are expensive it can make economic sense to bear the high costs of nuclear plant construction. But when other prices are low, as in today’s environment with abundant natural gas and increasingly competitive wind and solar power, it is hard to justify new plant construction.

Additionally, Lucas (2012) shows that the construction costs of nuclear plants have risen since the 1970s and the time to build increased from the 1950s to the 1970s. Progressively higher costs and longer build times are both surprising considering the technological advances in construction over the last 60 years, and both trends cast doubt on the notion that nuclear power can supplant natural gas as America’s main energy source anytime soon.

Proposals for nuclear subsidies

Current economic conditions are clearly working against new nuclear plants, but they are also unfavorable to many existing plants. Since 2010, several plants around the country have closed and economic conditions, particularly low natural gas prices, are often cited as a factor.¹ Additional plants in Ohio, Pennsylvania, Connecticut, and New Jersey are also on the verge of closing due to financial struggles.²

Unsurprisingly, officials from the companies that own and operate the struggling plants are seeking government assistance from state legislatures. A recent report in the York Dispatch shows that Exelon Corp.—the owner of some of the struggling plants—significantly increased its lobbying spending in Pennsylvania in 2018 compared to the previous five election cycles.³ Spending increased from an average of just over \$646,000 from 2008 to 2016 to nearly \$1.8 million in 2018. Reports also note that FirstEnergy Solutions spent nearly \$2.7 million lobbying Ohio lawmakers to support a nuclear subsidies bill.⁴

This lobbying is consistent with the empirical evidence that lobbying increases when there are large benefits or costs at stake (De Figueiredo and Richter 2014). There is also evidence that lobbying influences outcomes, though causality is hard to pin down given the available data as discussed in De Figueiredo and Richter (2014).

In this case there is evidence that lobbying is having an effect. There are bills in several states that would require electric companies to purchase some of their power from zero-emissions sources, which includes nuclear power, or purchase equivalent credits. Such bills would induce demand for nuclear power and supporters argue they would allow struggling plants to keep operating. Illinois' legislature debated a bill of this type and it passed in 2016.⁵ The law provides \$235 million in ratepayer-funded credits annually for two nuclear plants for 10 years.

Another example is a Pennsylvania Senate bill. This proposal would amend the state's Alternative Energy Portfolio Standards Act (AEPS) to include nuclear power as a source of zero-emissions energy. The bill would require electric companies to acquire at least 50% of their power—or purchase equivalent credits—from zero-emissions sources.⁶ Like the Illinois bill, the Pennsylvania bill helps nuclear companies by giving them credits for their zero-emissions energy production that they can then sell to other energy producers that use natural gas or other emissions-producing fuels.

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- 1 Laron, Aaron. *U.S. Nuclear Power Plant Closures*. June 25th, 2016. <https://www.powermag.com/u-s-nuclear-power-plant-closures-slideshow/>
 - 2 Seewer, John. *Utility plans to close nuclear plants in Ohio, Pennsylvania*. March 29th, 2018. <http://www.chroniclet.com/state-news/2018/03/29/Utility-plans-to-close-nuclear-plants-in-Ohio-Pennsylvania.html>
 - 3 Hullinger, Logan. *Exelon spent millions in lobbying after announcing TMI closure*. April 2nd, 2019. <https://www.yorkdispatch.com/story/news/local/2019/04/02/exelon-corp-nearly-tripled-its-lobbying-expenditures-between-2016-and-2018-and-soon-see-if-paid-off/3325424002/>
 - 4 Tobias, Andrew J. *FirstEnergy and its allies, seeking nuclear plant bailout, have spent millions on influence campaign*. April 17th, 2019. <https://www.cleveland.com/open/2019/04/firstenergy-and-its-allies-seeking-nuclear-plant-bailout-have-spent-millions-on-influence-campaign.html>
 - 5 Sweeney, Rory D. and Rich Heidorn Jr. *Illinois Lawmakers Clear Nuke Subsidy*. Dec. 2nd, 2016. <https://www.rtoinsider.com/illinois-exelon-nuclear-power-legislation-34810>
 - 6 Thompson, Charles. *Should Pennsylvanians pay more to subsidize TMI and other nuclear plants?* April 3rd, 2019. <https://www.pennlive.com/news/2019/04/reactor-reactions-new-bill-emerges-to-subsidize-pennsylvanias-nuclear-fleet.html>

Current estimates suggest that nuclear would account for 38.5 to 41.5 percentage points of the 50 required by the Pennsylvania bill, with renewables making up the other 8.5 to 11.5 percentage points. The bill is projected to increase the price per kilowatt hour by 0.3 to 0.37 cents, or up to \$38.28 per year for the average customer using electricity to heat her home.⁷

Subsidies work by taxing one group and giving the revenue to another. In the Pennsylvania bill and similar bills, the funding for the subsidy (credits) is raised via higher electricity rates on all electricity consumers, regardless of the energy source they use.

Ohio lawmakers have also proposed a bill to subsidize zero-emissions energy more broadly, though it appears to primarily be a response to the potential closure of two nuclear plants in the state, Davis-Besse and Perry.⁸ If passed, each megawatt hour of zero-emissions energy would be eligible for a subsidy of \$9.25. The subsidy would be paid for by a monthly surcharge on electricity customers that varies by type and ranges from \$2.50 to \$2,500 per month. In short, all electricity customers in Ohio, whether they be residential, commercial, or business customers, will pay more via the monthly fee.

Supporters of the Pennsylvania and Ohio bills argue that nuclear is a vital source of clean energy and without these bills nuclear plants will continue to shut down. But despite competition from natural gas and renewables, it's not clear that the nuclear industry as a whole is currently in deep financial trouble. For example, according to a recent analysis, all but one of Pennsylvania's five nuclear plants are covering their costs.⁹ Since there is no financial stress requirement in the Pennsylvania bill, profitable plants in the state will benefit just as much as the current unprofitable one—Three Mile Island Unit 1.

More broadly, a recent State of the Market Report for PJM, which is the regional transmission organization that coordinates the movement of wholesale electricity in Pennsylvania, Ohio, and other nearby states, also casts doubt on the general unprofitability of nuclear power. The report projects that only three of 18 nuclear plants in the region—Three Mile Island in Pennsylvania and Davis-Besse and Perry in Ohio—won't be able to cover their costs at least one year between 2019 to 2021.¹⁰ The report also notes that all three plants are single unit sites that have higher operating costs than more efficient multiple unit sites.

As noted previously, some supporters of the nuclear subsidies are broadening the goal of the subsidies to include supporting zero-emissions energy more broadly to combat climate change. But it's not clear subsidizing inefficient nuclear plants is the most economical way to address climate change.

In fact, a major driver of reduced emissions in electricity generation recently has been natural gas, not nuclear. From 2005 to 2017, U.S. carbon emissions from the power sector declined by 28% according to the Energy Information Administration

7 Maykuth, Andrew. 'Goal is not to bail out Exelon': Pennsylvania's \$500 million nuclear rescue bill pushes clean energy. April 3rd, 2019. <https://www.philly.com/business/new-pennsylvania-nuclear-rescue-bill-would-steer-some-money-renewables-20190403.html>

8 Siegel, Jim. *Ohio nuclear plant bailout encourages other zero-carbon energy*. April 12th, 2019. <https://www.dispatch.com/news/20190412/ohio-nuclear-plant-bailout-plan-encourages-other-zero-carbon-energy>

9 Maykuth, Andrew. 'Goal is not to bail out Exelon'. 2019

10 Table 7-17 p. 331 http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2018/2018q3-som-pjm.pdf

(EIA).¹¹ The displacement of coal by natural gas was responsible for almost 50% of this decrease. Thus natural gas can help reduce carbon emissions from electricity production, which weakens the case for nuclear subsidies.

Economics of subsidies

The bills being debated in Pennsylvania, Ohio, and other states don't consider the opportunity costs of the subsidies and thus it's not clear that the bills will lead to a net improvement in consumer welfare if passed.

There is evidence that carbon emissions contribute to climate change. The effect of carbon emissions on the climate is not accounted for in the current price of energy from carbon-emitting sources such as coal and natural gas, and thus using such fuels is cheaper than it would be if the cost to the climate was included. To fix this, many economists support a tax on carbon that accounts for its effects on the climate, but the United States currently doesn't have one and estimates for the appropriate tax amount vary due to the variety of assumptions that must be made (Gillingham et al. 2015).

Subsidies for non-carbon-emitting energy sources, such as nuclear power, are often viewed as an alternative to a carbon tax but they have problems of their own (Metcalf 2009). First, subsidies reduce rather than raise the cost of nuclear power from the customer's perspective. The proposed fees in Pennsylvania and the other states are levied on all electricity use, not just electricity from nuclear, and then the revenue is transferred to nuclear producers. This makes nuclear power appear cheaper relative to other energy sources, which increases the quantity demanded of nuclear, often at the expense of other energy sources including renewables. If the source of power isn't truly zero-emissions—and nuclear isn't once facility production, disposal, and storage costs are factored in—any increase in use will also increase these other costs.

Subsidies also often favor one energy source over another or some providers over others even if there is no economic reason to do so. This could be the result of miscalculating subsidies across different energy sources or due to political bargaining that results in favoritism towards certain producers. In the case of the Ohio bill discussed previously, all zero-emissions electricity plants are eligible for subsidies but wind and solar plants have some restrictions concerning size for reasons that aren't obviously economic. Finally, other policies interact with subsidies which can limit their effects. In Ohio, set-back requirements for wind turbines have limited the use of wind power in the state and any new subsidies for zero-emissions energy won't address this.¹²

11 Energy Information Administration website https://www.eia.gov/todayinenergy/detail.php?id=37392&_sm_au_=iVVfkMoqBMBFoVrH

12 Kowalski, Kathiann M. *Lawsuit: Ohio wind setbacks were adopted in violation of state constitution*. Nov. 15th, 2018. <https://energynews.us/2018/11/15/midwest/lawsuit-ohio-wind-setbacks-were-adopted-in-violation-of-state-constitution/>

Resources also have an opportunity cost that needs to be considered. If something is put to one use, it can't simultaneously be put to another. The revenue used to maintain inefficient and outdated nuclear plants could be used to produce other government goods or services or left in the hands of taxpayers to use in the private marketplace as they see fit. The bills being debated in Pennsylvania, Ohio, and other states don't consider the opportunity costs of the subsidies and thus it's not clear that the bills will lead to a net improvement in consumer welfare if passed.

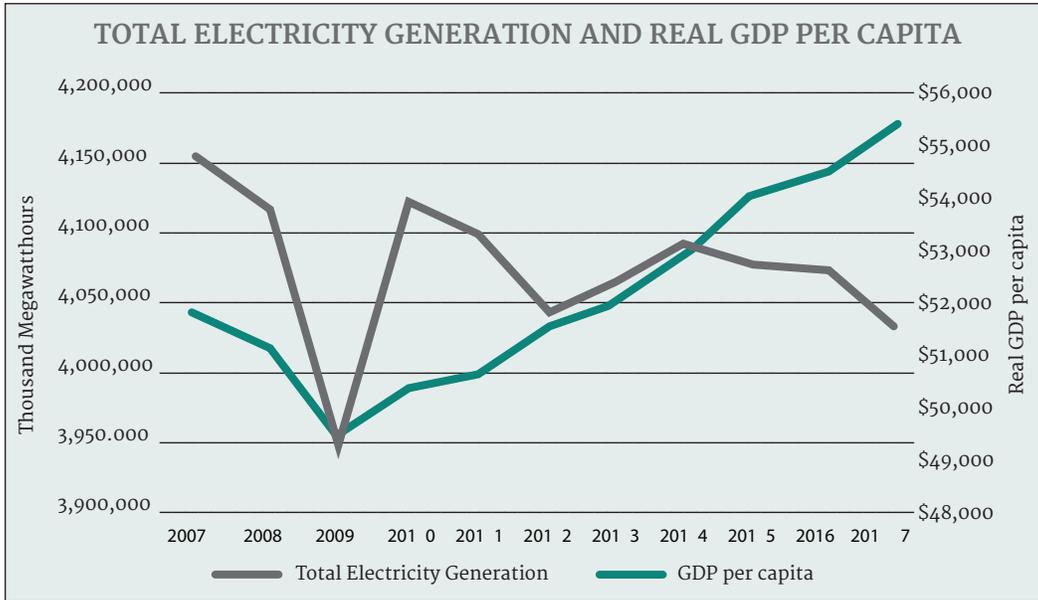
In fact, the unprofitability of the nuclear power plants motivating the current subsidy proposals is a signal that the resources needed to operate and maintain these plants are being wasted and could be put to better use elsewhere. Supporting these plants via government assistance exacerbates this waste without changing the underlying economic fundamentals of the plants. As long as the economic fundamentals do not change—and there is little reason to believe they will—the subsidies will have to continue for the plants to remain operational. Otherwise, the consequences the current bills claim to avoid—job losses, more carbon emissions—are instead only being delayed. This means that assistance described as temporary is likely to last longer than taxpayers are being told.

Subsidies to nuclear plants are also likely to crowd out new, more efficient electricity plants. Total electricity generation in the United States has declined slightly since 2010 despite economic growth in the form of real GDP per capita, as seen in figure 3. In a world of declining or even stable electricity use, the profit motive for investing in new capacity is weakened if new plants are not allowed to out-compete less efficient plants for market share. So as long as less efficient nuclear plants are meeting consumer demand, newer plants powered by natural gas, wind, solar, or some other source will have a difficult time finding a market. Stu Bressler, senior vice president of operations and markets for PJM Interconnection, recently said essentially this when he told Ohio lawmakers that subsidizing less competitive plants "... could prevent the building of more efficient and cost effective plants, including cleaner technologies like solar and wind."¹³

In fact, the unprofitability of the nuclear power plants motivating the current subsidy proposals is a signal that the resources needed to operate and maintain these plants are being wasted and could be put to better use elsewhere. Supporting these plants via government assistance exacerbates this waste without changing the underlying economic fundamentals of the plants.

13 Siegel, Jim. *Ohio nuclear plant bailout...*2019

FIGURE 3



Notes: Total electricity data from U.S. Energy Information Administration Electric Power Annual Report Table 3.1.A. GDP per capita data from FRED website. GDP data are adjusted for inflation (chained 2012 dollars).

Finally, just because a subsidy has the potential to improve economic efficiency doesn't mean it will. A subsidy that is too small will not generate the optimal amount of the good or service while a subsidy that is too large can generate more inefficiency than no subsidy at all. The cost of estimating the correct subsidy, implementing it, and administering it must also be considered. If these costs are especially large such that they outweigh the potential gains in efficiency from the subsidy then the economy would be better off with no subsidy. It doesn't appear that Ohio or Pennsylvania lawmakers have rigorously estimated the appropriate subsidy or accounted for the costs of implementing and administering one in their proposals. Without such analysis, it is unlikely that the proposed nuclear subsidies will improve consumer welfare.

Conclusion

In theory, some subsidies can improve economic efficiency. To do so, a subsidy must be carefully calculated and the costs of implementing it and administering it must be considered. If not, a subsidy can do more harm than good. The proposed nuclear subsidies appear to be examples of subsidies that will do more harm than good, as they seem to be primarily designed to help a few unprofitable nuclear plants rather than carefully thought out pieces of a broader plan to create more low-emissions energy. Resources are scarce so it's important that they aren't wasted, and it's hard to view the proposed subsidies to inefficient nuclear plants as a good use of scarce resources.

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