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Comments by
Nuclear Information and Resource Service
on the Proposed Clean Power Plan
of the U.S. Environmental Protection Agency
December 1, 2014

[Docket Number: EPA-HQ-OAR-2013-0602]

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Introduction

The Nuclear Information and Resource Service (NIRS) submits the following comments on the U.S. Environmental Protection Agency's (EPA) Clean Power Plan draft rule (Docket ID: EPA-HQ-OAR-2013-0602), which was issued June 2, 2014 and published in the Federal Register on June 18. NIRS welcomes the publication of the Clean Power Plan (CPP), which we regard as the most significant and promising policy development to address greenhouse gas emissions and climate disruption by the United States to date. We submit the following comments in the interest of helping EPA strengthen the Clean Power Plan and of providing EPA the necessary information to address deficiencies in the proposed regulation and supporting analyses.

Description of Commenter

Nuclear Information and Resource Service ("NIRS") is a non-profit corporation with over 35,000 members across the United States and world, established in 1978 as the national resource and network hub for individuals and organizations opposed to nuclear energy, concerned about the public health and environmental impacts of radiation and radioactive waste, and interested in advancing a safe and sustainable energy future. NIRS has a mission to promote a nuclear-free, carbon-free energy policy and a concern for the health and safety of the people and ecosphere.

Overview

On June 2, 2014, the U.S. Environmental Protection Agency (EPA) issued a draft rule and accompanying Regulatory Impact Analysis for its Clean Power Plan. The proposed rule establishes state-specific goals for reducing the rate of carbon dioxide (CO2) emissions from existing electricity generation sources, and sets forth a process, schedule, and flexible framework for state-level implementation and oversight. To establish the goals, EPA evaluated various ways of reducing emissions and grouped them into four "building blocks," comprising a "best system of emissions reduction" (BSER):

1. **Improving the fuel efficiency of existing fossil fuel plants.** EPA attributed the greatest potential in this block to efficiency improvements at older coal-fired plants, accounting for reductions of about 6%.
2. **Replacing more emissions-intensive generation sources with less intensive generation sources.** This block was credited with contributing the greatest amount of reductions, predominantly by increasing the average utilization rate of natural gas-fired generation sources from 50% to 70%, in order to displace coal-fired generation.[1]

[1] The Clean Power Plan refers to the displacement of coal generation by natural gas generation "redispatch." However, that nomenclature is easily confused with the accepted parlance, in which "dispatch" refers to the order in which electricity resources are preferentially called into service to meet

3. **Increasing low-/zero-emissions generation.** EPA included renewable energy sources and some nuclear generation.
4. **Increasing demand-side reduction measures as low-/zero-carbon resources,** principally through energy efficiency improvements.

EPA utilized the building blocks to assemble the BSER model, by which it calculated goals for each state, expressed as a target emissions rate measured by the mass of carbon dioxide emissions per unit of electricity produced (tons per kilowatt-hour, or tons/kWh). The agency then evaluated the resources in each building block to determine what is economically and technically feasible for each state. By adding up the feasible levels of generation capacity in each block and the total amount of emissions, EPA calculated a unique goal for each state. EPA determined a baseline emissions rate for each state, based on its existing portfolio of the above generation sources.

However, in the draft rule, EPA did not account for increased deployment of non-fossil fuel resources as displacing coal or natural gas. Increased deployment of Blocks 3 and 4 resources were added to the total generation supply (the denominator in the formula), but were not assumed to reduce emissions from fossil fuel sources (in the numerator) as coal and natural gas generation sources fall back in the dispatch order or are phased out. This approach did not take into account the true emissions-reducing potential of increased deployment of low-/zero-carbon resources, resulting in the calculation of artificially high emissions rate goals.

In an October 28 Notice of Data Availability (NODA), EPA responded to feedback from stakeholders on this point, and requested comment on alternative approaches that account for the displacement of fossil fuel generation by Blocks 3 and 4 resources.[2] EPA's proposed approaches differ from one another in determining which fossil fuel sources are displaced, and thereby the amounts to which emissions in the numerator of the formula would be reduced:

1. New low-/zero-carbon resources displace existing fossil fuel generation proportionally.
2. New low-/zero-carbon resources displace existing fossil fuel generation in order of emissions intensity.
3. New low-/zero-carbon resources displace a mix of existing and new fossil fuel generation.

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load. In our comments here, we use the common parlance term "displace," which should also be applied to effect of increasing deployment of non-fossil fuel resources.

[2] Environmental Protection Agency. "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. [EPA–HQ–OAR–2013–0602; FRL–9918–53– OAR] RIN 2060–AR33." Federal Register. October 30, 2014. Pp. 64552-3.

Any of these proposals would address a significant bias in the draft rule, which would both establish unrealistically lax emissions rate goals and incentivize preferences for relying on natural gas generation over non-fossil fuel resources in states' implementation plans.

These comments principally relate to provisions in the draft rule relating to nuclear power and its implications for carbon emissions, climate policy, the environment, and sustainable energy. In particular, two types of nuclear resources are incorporated into the BSER and the state goals:

- Five new reactors in construction, amounting to 5,614 MW of capacity – Summer 2 and 3 in South Carolina, Vogtle 3 and 4 in Georgia, and Watts Bar 2 in Tennessee.
- Preservation of 6% of each state's existing (2012) nuclear capacity, amounting to an estimated 5,700 MW of capacity.

The draft rule treats nuclear differently than other resources, but does not establish a clear or consistent policy basis for doing so. For instance:

- Large-scale hydro has characteristics similar to nuclear and a comparable percentage of capacity is at risk of retirement, but it is not included in the BSER. By excluding hydro from the BSER, EPA rightly leaves it to states to decide whether the benefits of preserving hydro capacity outweigh replacing it with comparable, low-/zero-carbon resources. In treating nuclear differently, the draft rule grants it a special status, encouraging states to expend resources preserving reactors that are uneconomical or deemed to be environmentally unacceptable.
- Preservation of renewable capacity or natural gas combined cycle (NGCC) generation is not considered, even though potential retirements within the compliance period greatly exceed the 6% of nuclear generation. The BSER includes existing renewable and NGCC capacity in setting the goals, but does not potential economic obstacles to the preservation or replacement of facilities that are no longer economically or technically viable. This is sensible, since retirement of uneconomical generation opens the door to deploying more cost-effective resources and greater innovation, but it means the concern expressed over the retirement of uneconomical reactors is out of place. The viability of replacing onshore wind power capacity that may retire between 2020-30 could be threatened by expiration of, and failure to renew, the Renewable Energy Production Tax Credit. Similarly, the complex market dynamics affecting natural gas prices – from regulations on hydraulic fracturing, to development of gas transmission and LNG export infrastructure – could well change the economics of replacing NGCC capacity that may retire by 2030.

In addition, the draft rule significantly underestimates the cost of including nuclear resources in the BSER, by a factor of up to fifty or greater. As discussed below, more accurate estimation of that cost, especially compared with the costs of other resources, would lead to a different conclusion about the appropriateness of subsidizing the preservation of nuclear capacity.

The draft rule sets forth an extremely flexible framework for state-level implementation, per the requirements of Clean Air Act Sect. 111(d). However, because the rule's evaluations of different resources are inconsistent and even inaccurate, particularly in the case of nuclear, it could interfere with EPA's ability to structure state-level implementation toward cost-effective and environmentally sound practices, rather than approaches that merely meet minimum levels of emissions reductions. As demonstrated by former EPA Administrator Carol Browner's service as a spokesperson for a nuclear industry-established advocacy organization (Nuclear Matters), there is a substantial amount of political pressure on states to implement new preferences and incentives for nuclear power. The inclusion of nuclear capacity in the state goals accomplishes three things that are crucial to the industry's broader effort to leverage subsidies and market preferences for existing reactors:

- It would codify nuclear power as a climate solution in U.S. emissions regulations, justifying state-level policies that would include nuclear in "clean" energy policies, programs, and standards.
- Authorizes and incentivizes states to provide subsidies and supports to nuclear power in order to meet carbon reduction requirements, so long as they are consistent with the BSER and satisfy the emissions rate goals.
- Perpetuates the notions that baseload generation is necessary for system reliability and that the variability of sustainable energy resources makes them too unreliable.

The flexibility in the implementation structure is important for encouraging innovation and the adoption of new technologies and programs not considered at the time of the rule's formulation; that flexibility also provides a durable regulatory framework that can withstand inevitable legal challenges and shifting political environments at both the federal and state level over an extended time period. Yet the unequal treatment granted to nuclear compared to other energy sources, and EPA's failure to fully consider the environmental impacts of the energy source, goes beyond providing the flexibility necessary to ensure effective implementation of the rule and achievement of its goals. By encouraging states to view nuclear as an acceptable clean energy resource and encouraging them to preserve existing capacity and to complete capacity in construction – without accurately assessing its costs nor properly evaluating its environmental impacts and risks – the draft rule creates opportunities for states to implement it in manners that could be counterproductive.

The rule also authorizes states to include nuclear power uprates and new reactors in their implementation plans, even though they are not included in the emissions-rate reductions mandated in the state goals because of their high cost and low feasibility. The implication of this provision is that states could credit nuclear capacity additions toward meeting the goals, despite their extremely high cost. By failing to provide an analysis explicating the reasons uprates and other new reactors are not included in the BSER, the draft rule makes it possible for states to misestimate the true cost or feasibility of those resources compared to other measures, such as efficiency and renewables, that could directly reduce CO2 emissions or have a longer-term impact in advancing technologies that are more promising for the transition to a low-/zero-carbon economy.

The rule also provides states the option of meeting their goals collaboratively, through multi-state or regional approaches. Together with the rule's promotion of nuclear as an emissions-reducing resource and the concern placed on preserving existing capacity, this opens up the possibility that states would turn to regional emissions programs, that permit use of nuclear as an offset to fossil fuel generation. Such programs would both limit the extent of CO2 emission reductions by providing an alternative regulatory compliance mechanism for fossil fuel plants, and they would limit the growth potential of renewables by flooding the market with emissions credits. Replacement of state renewable portfolio standards with so-called "clean" energy standards that include nuclear would have a similar effect.

Only a few efforts to create regional emissions-reduction programs have been unsuccessful in the past. For instance, under the Midwest Greenhouse Gas Reduction Accord, eleven states got as far as producing a draft cap-and-trade program design and model legislation for implementing it, but political upheaval in the 2010 elections led to the accord being shelved.[3] Founded by four states and a province[4] in 2008, the Pacific Coast Collaborative stopped short of directly regulating carbon, instead focused on expanding deployment of low-carbon resources. Only in 2013 did the participants set forth a nonbinding framework for aligning emissions regulations and climate programs.[5]

[3] Paulman, Ken. "Midwest cap and trade: Not dead, just sleeping." *Midwest Energy News.* March 4, 2011. http://www.midwestenergynews.com/2011/03/04/midwest-cap-and-trade-is-it-dead-or-no/
[4] Alaska, British Columbia, California, Oregon, and Washington.
[5] Center for Climate and Energy Solutions. "Multi-State Climate Initiatives." http://www.c2es.org/us-states-regions/regional-climate-initiatives#PCC

However, financial pressure on nuclear and coal generators and the advent of federal emissions regulations may change the political circumstances. Renewed efforts by utilities to undermine sustainable energy programs met with success in 2014:

- Indiana repealed its Energy Efficiency Portfolio Standard.
- Ohio suspended its Renewable Energy and Efficiency Portfolio Standards for two years.
- Illinois failed to revise its Renewable Energy Standard under pressure from Exelon, and passed a resolution calling for, among other things, creation of cap-and-trade programs that include nuclear.

Elsewhere, the long-established opposition to renewable energy and emissions regulations in the Southeast and the unique level of commitment among states in the region to developing new nuclear, could provide similar conditions for regional implementation plans that utilize nuclear as a primary compliance mechanism for achieving state goals. In so doing, states may be able to achieve the goals, not by reducing carbon dioxide emissions significantly, but by "diluting" their emissions rate with additional nuclear capacity.

This possibility is as much an artifact of the originally proposed BSER formula as it is a flaw of including nuclear – and renewable capacity and efficiency could produce the same effect – but EPA's failure to do an accurate calculation of the costs and environmental impacts of nuclear could create a biased yardstick by which to evaluate state implementation plans.

Analysis of the Proposed Rule and Nuclear Provisions

1. Regulatory Structure and Implementation

As a regulatory program, the Clean Power Plan's central feature is the flexibility it affords in its implementation. The rule sets forth a methodology for establishing state-specific goals for reducing the emissions rate of CO2 from existing generation sources (measured in pounds of CO2 per MWh), and a regulatory framework for evaluating states' plans for achieving the goals, evaluating their progress, and ensuring compliance.

1.A. Goal Option Scenarios

The draft rule contemplates two goal option scenarios, called Option 1 and Option 2:

1. A ten-year plan, with higher goals to be met by 2030.
2. A five-year plan, with lower goals to be met by 2025.

Option 1 is EPA's preferred plan, on which the proposed rule and state goals are based. EPA conducted all of the corresponding analyses for Option 2, and included them in the draft rule for comparison. The rule also permits states a combination of options for how to construct their plans:

- By jurisdictional approach: On a state-by-state level or on a multi-state level, in collaboration with other states.
- By emissions measure: rate (pounds of CO_2/MWh) or by mass of CO_2 emitted/year.

Thus, there are a total of eight compliance scenarios that will determine the ultimate policy outcome of the rule. The scenarios are not equivalent to one another, except that mass-based implementation plans must reconcile with the draft rule's emissions-rate-based goals. The draft rule estimates the levels of CO_2 reduction for each of four scenarios, corresponding to Options 1 and 2 and their implementation through either a single-state or multi-state approach. Option 2 results in lower levels of emissions reductions, even when compared to 2025 interim goals for Option 1. Because the goals are emissions rate-based rather than mass-based, multi-state approaches result in lower levels of emissions reductions than implementation on a state-by-state basis.[6]

NIRS supports the adoption of Option 1, but with recommendations for modifying the draft rule. A stable, long-term policy framework is necessary to ensure that the U.S. sustains its commitment to reducing emissions. In addition, the country must adopt ambitious targets that both make significant near term reductions and set us on course to meet the long-term reductions necessary to mitigate greenhouse gas concentrations and the extent of climate disruption. NIRS also supports EPA's proposed rate-based approach. It is likely that more end use of energy will shift to the electricity sector as a greater portion of transportation and space heating become electrified. It is possible that energy efficiency improvements and deployment of more efficient technologies (e.g., ground source heat pumps) and energy storage could enable the electricity sector to absorb new load sources without a significant increase in total load. However, such an outcome is not certain, and a rate-based approach would accommodate unforeseen changes in the electricity sector without compromising the effectiveness of the Clean Power Plan framework.

NIRS also recognizes that regional approaches may be advantageous, especially considering that all but five states participate in regional transmission organizations (RTOs) with interconnected electricity grids. We do, however, express concern over how regional programs could be structured to include non-BSER resources and to utilize emissions offsets. Even though establishing a regional emissions program would relieve states of none of their obligations to meet the Clean Power Plan's mandated emissions goals, the adoption of regional compacts that utilize emissions offsets and non-BSER

[6] Tables 10 and 11. Draft Rule. Federal Register Notice. pp. 34931-2.

resources could encourage the preservation of fossil fuel generation sources and uneconomical low-/zero-carbon resources. Such an outcome could both limit emissions reductions that would otherwise be possible and lead states to put off investments in new infrastructure and innovation, leaving them unprepared to make deeper reductions in emissions after 2030. NIRS therefore encourages EPA to set forth guidelines for how states may structure regional greenhouse gas programs to reflect best practices and to optimize emissions reductions and cost-effectiveness. In particular, programs that adopt emissions offsets should be strictly limited, and those that include nuclear as an offset option should be disqualified.

The Clean Power Plan identifies the Regional Greenhouse Gas Initiative (RGGI) as a model regional program. RGGI limits generation sources' applications of offsets to 3.3% of their total emissions, and sets strict criteria for qualifying offset resources—all of which directly reduce greenhouse gas emissions, remove greenhouse gases from the atmosphere, or convert gases with a greater warming intensity to gases with lower warming intensity.[7] The draft rule notes that rate-based approaches could result in nuclear power receiving disproportionate support over renewables, but does not set a guideline or standard to regulate the extent of reliance on nuclear in states' implementation plans:

> In general, when considering nuclear generation in a state plan, states may wish to consider the impacts that different types of policies may have on different types of zero-emitting generation. Under a capped approach which does not provide any ‘‘crediting’’ for zero-emitting generation, the impact on all zero-emitting units should be the same. In a rate based approach that credited zero or low-emitting generation, the crediting mechanism used could result in different economic impacts on different types of zero- or low-emitting generation.[8]

This is precisely the concern that has led states with RPS programs to exclude nuclear from qualifying. Not only would existing reactors receive benefits that are intended to support deployment of sustainable technology, drive innovation, and produce cost efficiencies, it could distort renewable energy credit (REC) markets.

Despite expressing this concern, the draft rule's incorporation of 6% of states' existing nuclear capacity in the computation of state goals would nevertheless encourage states to include nuclear as an offset in such programs. That would require states to set higher offset limits, in order to credit resources that are effective at reducing emissions or converting or removing greenhouse gases from the atmosphere. Doing so would effectively increase the amount of carbon emissions by enabling fossil fuel generation

[7] Regional Greenhouse Gas Initiative, Inc. "CO2 Offsets." Webpage. http://www.rggi.org/market/offsets
[8] Draft Rule. Federal Register Notice. p. 34923.

sources to buy their way to compliance rather than by reducing emissions. In states such as Illinois and South Carolina, in which nuclear approaches 50% of the states' electricity generation, just 6% of nuclear would account for nearly all of the 3.3% of CO2 emissions from fossil fuel generation sources—without, however, removing a single pound of CO2 from the atmosphere. Even in states with lower proportions of nuclear capacity, the effect would be the same, just to a lesser degree. EPA may not be able to directly regulate regional emissions compacts under the Clean Power Plan, but it can define the way in which measures states include in their 111(d) implementation plans are credited toward compliance. In the final rule, EPA should therefore establish guidelines defining what aspects of regional emissions programs will count toward compliance.

1.B. The Best System of Emissions Reduction

States (or groups of states) are given flexibility in determining how they meet the emissions goals. Per the Clean Air Act, EPA constructed a "best system of emission reduction" (BSER) based on a variety of resources states could utilize to reduce CO2 emissions from existing fossil-fuel plants. The BSER categorizes emissions-reducing resources into four "building blocks":

1. Improving the efficiency of fossil-fuel generation sources, as measured by plants' heat rates (BTU/kWh).
2. Replacement of fossil fuel generation ("redispatch") by lower-emitting fossil fuel plants, for instance, by operating natural gas combined-cycle plants at higher capacity rates and coal-, oil-, or gas-fired steam plants at lower rates.
3. Replacement of fossil-fuel generation with low- or zero-carbon generation sources, specifically nuclear and renewables.
4. Displacement of fossil fuel generation with demand-side load reductions, primarily through energy efficiency.

The EPA evaluated each of the resources in the building blocks to determine their feasibility for reducing emissions. Those analyses were used to establish the state goals by evaluating the levels of emissions reductions that would be feasible through utilization of the approaches and resources in each building block.

However, the draft rule does not require states to utilize the building blocks in any particular combination; states are free to develop their implementation plans based on whatever approaches they deem reasonable, so long as they are consistent with the BSER and meet the emissions goals. Neither does the draft rule prescribe criteria for cost or environmental impacts, by which state implementation plans will be evaluated:

> <u>States are not required to use each of the measures that the EPA determines constitute BSER, or use those measures to the same degree of stringency that the</u>

> EPA determines is achievable at a reasonable cost; rather, CAA section 111(d) allows each state to determine the appropriate combination of, and the extent of its reliance on, measures for its state plan, by way of meeting its state-specific goal. Given the flexibilities afforded states in complying with the emission guidelines, the benefits, cost and economic impacts reported in this RIA are not definitive estimates, but are instead illustrative of compliance actions states may take.[9]

To put a finer point on the matter, the analyses of nuclear, renewables, NGCC, etc., were utilized in generating the state goals, not as guidelines or limitations on how states must incorporate them into their implementation plans. Further, the draft rule states EPA's interpretation that section 111(d) of the Clean Air Act proscribes the agency's role in evaluating states' plans for implementing air quality regulations. The Regulatory Impact Analysis clarifies EPA's expectations in this regard:

> Under CAA sections 111(a)(1) and (d), the EPA is authorized to determine the BSER and to calculate the amount of emission reduction achievable through applying the BSER; and the state is authorized to identify the standard(s) of performance that reflects that amount of emission reduction. In addition, the state is required to include in its state plan the standards of performance and measures to implement and enforce those standards. The state must submit the plan to the EPA, and the EPA must approve the plan if the standards of performance and implementing and enforcing measures are satisfactory.[10]

In fact, while the rule provides clarity on the goals and structure of the program and the optimal means for implementation and compliance (BSER), EPA acknowledges that states may base their plans in part or in whole on resources and approaches not included in the Building Blocks, so long as the approach is consistent with the BSER:

> The state may choose the measures it will include in its plan to achieve its goal. The state may use the same set of measures as in the EPA's approach to setting the goals, or the state may use other or additional measures to achieve the required $CO2$ reductions.[11]

EPA specifically mentions construction of new nuclear capacity as an example of "other or additional measures" states may decide to incorporate, which are not included in the BSER.

[9] Regulatory Impact Analysis. p. ES-3. Emphasis added.
[10] Regulatory Impact Analysis. pp. ES-1 to ES-2.
[11] Draft Rule. Federal Register Notice. p. 34837.

1.C. Implementation Timelines

The timeline for implementation of the plan offers states flexibility primarily in the development of their plans, which are due beginning in 2016. However, states may opt for a two-phase submittal of their plans, with complete and final plans due in 2017 or 2018, depending on whether they are opting for a single-state or multi-state approach. In any case, implementation of the rule must begin in 2020 with interim goals and annual reporting.

June 2, 2014 Draft Rule Issued
June 1, 2015 Final Rule Issued
June 30, 2016 State Plans Submitted
OPTION for two-phase submission:
June 2016 Initial (partial) plan due
June 2017 Complete plan--single-state, or
June 2018 Complete plan--multi-state
June 30, 2017 (or 2018/2019) **EPA approval/disapproval**

January 1, 2020 First Interim Goal, Compliance Period Starts
July 1, 2022 First two-year progress report due
Reports covering the prior two-years due annually, thereafter
January 1, 2025 Second Interim Goal (or Completion under Option 2)
January 1, 2030 Completion under Option 1

2. Nuclear Provisions

2.A. Incorporation of Nuclear and Other Low-/Zero-Carbon Resources

EPA has structured the draft rule to include contributions of low- and zero-carbon energy resources in reducing emissions rates (Blocks 3 and 4). The agency has invited comment on whether they should be included in the final rule, or instead base the rule only on Blocks 1 and 2, efficiency and redispatch of existing fossil fuel sources. NIRS believes that low-/zero-carbon resources should be included in the BSER, but with modifications in the composition of Block 3 and in the formula for computing states' emissions goals. With respect to the former, nuclear should be removed from the BSER, for reasons described in detail below.

With respect to the latter – the BSER formula – the way in which renewables and efficiency are included in the draft rule is significantly flawed. Increased deployment of Blocks 3 and 4 resources were added to the total generation supply (the denominator in the formula), but were not assumed to reduce emissions from fossil fuel sources (in the numerator) as coal and natural gas generation sources fall back in the dispatch order or are phased out. This approach did not take into account the true emissions-reducing potential of increased deployment of low-/zero-carbon resources, resulting in the calculation of artificially high emissions rate goals.

In an October 28 Notice of Data Availability (NODA), EPA responded to feedback from stakeholders on this point, and requested comment on alternative approaches that account for the displacement of fossil fuel generation by Blocks 3 and 4 resources.[12] EPA's proposed approaches differ from one another in determining which fossil fuel sources are displaced, and thereby the amounts to which emissions in the numerator of the formula would be reduced:

1. New low-/zero-carbon resources displace existing fossil fuel generation proportionally.
2. New low-/zero-carbon resources displace existing fossil fuel generation in order of emissions intensity.
3. New low-/zero-carbon resources displace a mix of existing and new fossil fuel generation.

Any of these proposals would address a significant bias in the draft rule, which would both establish unrealistically lax emissions rate goals and incentivize preferences for relying on natural gas generation over non-fossil fuel resources in states' implementation plans. NIRS hereby adopts and incorporates the recommendations of the Institute for Energy and Environmental Resources in comments submitted by Arjun Makhijani, Ph.D and M.V. Ramana, Ph.D on this date.

The result of including low-/zero-carbon resources as EPA did in the draft rule, is that states could achieve compliance without actually reducing emissions substantially. For instance, if the state's total electricity consumption were to grow substantially over the next fifteen years, but the state satisfied enough of that demand with block 3 and 4 resources, it would effectively "dilute" its existing level of actual carbon emissions in a greater quantity of electricity produced. For example, Southern Company seems prepared to encourage Georgia along such a path, stating it intends to propose a yet another pair of new reactors, linking the proposal to implementation of the EPA rule.[13] While the deployment of so much low-/zero-carbon resources to achieve such an outcome would

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[12] Environmental Protection Agency. "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. [EPA–HQ–OAR–2013–0602; FRL–9918–53– OAR] RIN 2060–AR33." Federal Register. October 30, 2014. Pp. 64552-3.

[13] Kempner, Matt. "Georgia Power preps for more nuclear projects." *Atlanta Journal-Constitution.* August 29, 2014. http://www.myajc.com/news/business/georgia-power-preps-for-more-nuclear-projects/nhCFp/#__federated=1

signal a significant change in the trajectory of state energy policies, it would not advance the ultimate objective of reducing the amount of CO2 added to the atmosphere by existing generation sources.

That said, the rule's inclusion of nuclear power in Block 3 would also be problematic in that it could enable the diversion of economic resources from measures that would be more effective in reducing emissions of CO2 and other air pollutants. The draft rule's evaluation that nuclear power should be taken into account in the state goals — in terms of both new and existing reactors — would set a precedent by codifying it as environmentally beneficial in the most significant piece of U.S. climate policy to date. Unfortunately, it does so by disregarding the significant environmental impacts of nuclear without conducting an analysis to support such a conclusion. The draft rule also fails to conduct any meaningful analysis of the costs of nuclear generation resources of any type (existing reactors, new reactors, and reactor power uprates), and thereby fails to recognize that nuclear should be disqualified from the BSER as economically infeasible. In addition, EPA's recommendation that states provide incentives to promote the preservation of existing nuclear reactors is inconsistent with the treatment afforded other low-/zero-carbon energy resources.

2.B. Role of Nuclear Power in BSER

The EPA rule evaluates the role of nuclear energy in achieving reductions in CO2 emissions rates, which follows from the following premise:

> Nuclear generating capacity facilitates CO2 emission reductions at fossil fuel-fired EGUs [electric generating units] by providing carbon-free generation that can replace generation at those EGUs. Because of their relatively low variable operating costs, nuclear EGUs that are available to operate typically are dispatched before fossil fuel-fired EGUs. <u>Increasing the amount of nuclear capacity relative to the amount that would otherwise be available to operate is therefore a technically viable approach to support reducing CO2 emissions from affected fossil fuel-fired EGUs.</u>[14]

Based on this consideration and its evaluation of economic issues, the draft rule covers both existing and new nuclear, including the following specific recommendations:

- Ensuring that five new reactors now being constructed are completed and brought online.
- Preserving uneconomical/uncompetitive reactors that may close for financial reasons.

[14] Draft Rule. Federal Register Notice. p. 34870. Emphasis added.

- Crediting states for other types of capacity additions:
    - Power uprates for existing reactors
    - Construction of additional new reactors

The rule primarily codifies the first two recommendations by incorporating contributions from the five new reactors and a portion of existing nuclear in the BSER and computation of state goals. With respect to power uprates and further new construction, the draft rule provides no economic or technical analysis, but does say that states may utilize them as options in developing their plans.

2.B.i. New Reactors

With respect to the addition of new nuclear generation capacity, EPA recognizes the fundamentally uneconomical cost of new reactors and its impact on the viability of the resource:

> One way to increase the amount of available nuclear capacity is to build new nuclear EGUs. However, in addition to having low variable operating costs, <u>nuclear generating capacity is also relatively expensive to build compared to other types of generating capacity, and little new nuclear capacity has been constructed in the U.S. in recent years</u>.[15]

However, EPA does not appear to have performed a meaningful analysis of the costs of new nuclear. Instead, the agency accepted the premise that new nuclear is too expensive to be competitive and focused on the five new reactors already in construction, but nevertheless determined the incremental cost of their inclusion in the rule to be zero because the states/utilities involved have already decided to build them, regardless of the rule. The draft rule includes those five reactors in the calculation of the goals for the affected states (Georgia, South Carolina, and Tennessee).

EPA used the same methodology with NGCC units currently in construction, but its application to nuclear warrants a more substantive economic analysis because of its much greater costs. The agency implicitly understood this, based on its assessment that the low levels of capacity additions are due to the excessive cost of new reactors. What is more, although EPA did not conduct the requisite economic analysis to reach a properly informed conclusion as to the appropriateness of its approach, it does recognize that uncertainties remain regarding the ultimate completion of the reactors:

> [W]e are proposing that the emission reductions achievable at affected sources based on the generation provided at the identified nuclear units currently under construction should be factored into the state goals for the respective states where these new units are located. However, the EPA also realizes that reflecting

[15] Ibid. Emphasis added.

> completion of these units in the goals has a significant impact on the calculated goals for the states in which these units are located. If one or more of the units were not completed as projected, that could have a significant impact on the state's ability to meet the goal.

Without having calculated the incremental cost of bringing the reactors online, and by assuming it to be zero, EPA lacks a credible rationale for this aspect of the rule. The significance of this defect is considerable. The draft rule would incentivize the states to ensure these reactors are completed by requiring them to achieve the same emissions rate reductions, regardless of the projects' total costs nor those of the alternatives. The states would be under pressure to count the cost of including the reactors in their 111(d) compliance plans as $0. If the costs of alternative to nuclear were greater than than $0, they would appear to be less cost-effective compliance options even if, in reality, they were less expensive than completing the reactors.

Furthermore, because construction on most of the reactors is still at less than 50% complete,[16] it would be possible to avoid a significant amount of the total cost should the states or utilities decide to cancel them. It is essential that EPA calculate the cost of completing the reactors so the states may accurately compare it to other available alternatives. Such an analysis would be complicated due to its dependency on a number of variables, from the timing of the decision, the stage of completion of the reactor at that time, the escalation of costs that might influence such a decision, the "exit costs" of canceling contracts with vendors and contractors, stranded costs, etc. EPA's failure to recognize the need for such rigor makes it appear that the decision to incorporate the five new reactors into Building Block 3 was arbitrary and capricious, and conclusion-driven rather than a sound policy decision.

Based on the history of cancelled nuclear reactor projects, it is quite possible that one or more of the five reactors in construction could be cancelled. Of fifty-one reactors that were cancelled after commencing construction, nine were at an advanced stage of completion (50% or greater), including four which were more than 80% complete and one which was completed but never began commercial power operations. Utilities had

[16] The Vogtle 3&4 project is farther along than the Summer 2&3 project. With a total project cost estimated at $14 billion, Southern Co.'s share would be $6.4 billion, based on its 45.7% ownership stake. Yet, Southern reported only having $2.6 billion invested as of December 31, 2013, or 40% of its share of the total cost.
http://chronicle.augusta.com/news/business/local-business/2012-05-11/price-vogtle-expansion-could-increase-900-million
http://southerncompany.com/what-doing/energy-innovation/nuclear-energy/pdfs/Vogtle-Fact-Sheet.pdf

spent a total of over $25 billion on the projects, amounting to an inflation-adjusted (2014) $58 billion.

Reactors Cancelled After Commencing Construction

Stage of Construction	Reactors
80%-100%	5
50%-79%	4
30%-49%	6
10%-29%	7
1%-19%	13
<1%	16
TOTAL	**51**

Reactor Cancellations at Advanced Stage of Construction

Reactor	Year Cancelled	% Completion	Sunk Cost	2014 $ Value
Bellefonte 1	1988	88%	$6 billion	$12 billion
Bellefonte 2	1988	58%	(incl. w/Unit 1)	
WPPS 1 (Columbia)	1983	63%	$6 billion	$14.3 billion
WPPS 3 (Satsop)	1983	76%	(incl. w/Unit 1)	
Marble Hill 1	1984	60%	$2.5 billion	$5.7 billion
Midland 1	1984	85%	$4 billion	$8.7 billion
Midland 2	1984	85%	(incl. w/Unit 1)	
Shoreham 1	1989	100%	$6 billion	$13.2 billion
Zimmer 1	1983	97%	$1.8 billion	$4.3 billion
TOTAL	**--**	**--**	**$25.3 billion**	**$58.2 billion**

The owners of both the Vogtle[17] and Summer[18] projects have announced construction delays and cost overruns, and analysts predict that more can be expected. While the

[17] Mirshak, Meg. "Plant Vogtle expansion falling further behind schedule, construction monitor reports." *The Augusta Chronicle.* November 25, 2014. http://chronicle.augusta.com/latest-news/2014-11-25/plant-vogtle-expansion-falling-further-behind-schedule-construction-monitor
Henry, Ray. "Delays could grow at Plant Vogtle nuclear plant and cause price to rise $2 million per day, government monitors say." *Florida Times-Union.* June 23, 2014. http://jacksonville.com/news/georgia/2014-06-23/story/delays-could-grow-plant-vogtle-nuclear-plant-and-cause-price-rise-2

utilities and regulators have exhibited willingness to continue with the projects, it is quite possible they will reevaluate the projects before the reactors begin commercial operation, even if they have reached an advance stage of completion. The Tennessee Valley Authority (TVA) all but cancelled the Watts Bar Unit 2 project, suspending construction for nearly 20 years after having reached an advanced stage of construction (~80%). In addition, TVA must still receive an operating license from the Nuclear Regulatory Commission, since the reactor is being licensed under the regulations that were in place when TVA commenced the project in 1973. The exceptional level of uncertainty that plagues nuclear reactor construction warrants a thorough evaluation of these projects.

Based on their exceptional cost and the possibility that they may never be completed, EPA should remove reactors in construction from the BSER. Doing so would result in higher goals for the three affected states (and therefore lower levels of emissions reductions), but EPA has no rational basis for its decision to include them in the BSER. However, using more realistic estimates of renewable energy and efficiency additions, as recommended by IEER, would establish goals for these three states that are more economically and technically sound, and which would be comparable to or superior to those in the draft rule.

2.B.ii. Existing Nuclear Capacity

The EPA also evaluated the inclusion of existing nuclear capacity in the BSER. The central premise put forward in the draft rule is that the generation capacity of closed reactors would be replaced with fossil fuel generation sources:

> Another way to increase the amount of available nuclear capacity is to preserve existing nuclear EGUs that might otherwise be retired.

The EPA's evaluation of existing nuclear appears to be driven by a concern for its preservation not accorded to other low-/zero-carbon resources, as well as the related assumption that retired nuclear capacity will be replaced by fossil fuel sources. The draft rule does not present any technical or economic analysis for its assumption about the feasibility of replacing retired nuclear capacity with other low-/zero-carbon resources.

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[18] "Cost of new South Carolina nuclear plant could grow by $1 billion because of delays." Associated Press. Atlanta, Georgia. October 2, 2014. http://www.foxbusiness.com/markets/2014/10/02/cost-new-south-carolina-nuclear-plant-could-grow-by-1-billion-because-delays/
Staff report. "SCANA Corp. nuclear project facing further delays." *GSA Business*. August 12, 2014. http://www.gsabusiness.com/news/52173-scana-corp-nuclear-project-facing-further-delays?rss=0

The EPA recognizes that the economic conditions for existing nuclear have changed, and that some reactors are at risk of retirement due to financial pressures. The agency did not conduct a thorough analysis of the issue to understand the implications for the rule. Instead, the agency relied upon an estimate by the Energy Information Administration (EIA) that 6% of existing nuclear capacity is at risk of retirement for economic reasons (without identifying specific plants), and a Credit Suisse report estimating the average economic margin influencing closure decisions at \$6/MWh.[19] EPA then used the generic EIA and Credit Suisse figures as proxies for evaluating the feasibility of preserving existing nuclear capacity, concluding that the 6% of existing capacity could be preserved at a cost of \$6/MWh, or a cost of \$12-17 per metric ton of CO2. On that basis, the draft rule EPA recommends that 6% of each state's nuclear capacity be included in the goals.

However, it is not at all clear that EPA interpreted these two documents correctly. The EIA report is very clear that the reactors at risk of retirement for economic reasons are in states in which utility restructuring resulted in their operating as merchant power plants.[20] EPA had no reason to assume that the risk retirement of nuclear units for economic reasons would be distributed evenly throughout the country. The Credit Suisse document is a slide presentation and includes no statement that the cost margin for reactors at risk of retirement is \$6/MWh.[21] There is a chart on page 11 of the presentation which shows free cash flow margins for a number of reactors at different market price levels, and the range of shortfalls generally ranges between \$4 and \$10/MWh in the PJMW market; there is also a statement that "Layering in typical parent overhead of \$5-7 / MWH, unit economics look even worse." EPA is at pains to explain where it derived the \$6/MWh figure. As detailed below, it is an unrealistically low figure.

In addition to disregarding the EIA's clear characterization of the economic challenges facing merchant reactors, a further inaccuracy in the draft rule's evaluation of existing reactors is that nuclear generating capacity does not come in gradated percentile increments. The average generating capacity of nuclear reactors is relatively large compared to other sources. Also, reactors are designed to operate as baseload generators, and even among those types of plants, they are the most inflexible. Reactors take hours to power up or down, and can take days to restart from cold shutdown. As a result, they must run at 100% of their rated capacity to operate economically; for all practical purposes, they are either on or off, in discrete quantities of generation capacity. The US's one-hundred (soon to be 99) operating reactors range in size from 476 megawatts (MW)

[19] Draft Rule. Federal Register Notice. p. 34871.
[20] Jones, Jeffrey, and Michael Leff. "Implications of accelerated power plant retirements." Energy Information Administration. April 2014. http://www.eia.gov/forecasts/aeo/power_plant.cfm
[21] Eggers, Dan, et al., "Nuclear … The Middle Age Dilemma?: Facing Declining Performance, Higher Costs, Inevitable Mortality." Credit Suisse. February 19, 2013.

to 1,478 MW; the average size is 1,003 MW, and the median is 1,048 MW. By contrast, the rule shows the average size of the 1,266 coal-fired units as 250 MW, and the median size between 150-250 MW.[22]

Despite the availability of detailed information, EPA opted not to consider which reactors were actually at risk of closure. The factors placing reactors at risk are both plant-specific and locationally specific. As a result, the draft rule's proxy for at-risk nuclear is entirely unrepresentative of the nature and scope of the issue it purports to address. Even in Illinois, with more nuclear reactors than any other state, the smallest single reactor (Dresden 2, at 869 MW) is 7.5% of the total nuclear capacity in the state; but Dresden 2 is actually one of the reactors least at economic risk in Illinois. Those at greatest risk are Clinton (1,065 MW) and Quad Cities 1 and 2 (912 MW each), which add up to over 25% of the state's nuclear capacity. The reactors' owner, Exelon, has also stated that its Byron 1 and 2 reactors could close, which, if true, would raise the total to over 45% of Illinois' nuclear capacity. In New York, as in Illinois, over 25% of nuclear generation is at risk of closure; in MA, it is 100%; in Ohio 42%, etc. As a result, the rule as construed literally would not save a single at-risk reactor, and therefore would not serve the intended purpose.

However, because the rule offers states a high degree of latitude in developing their implementation programs, this shortcoming of the rule actually provides a strong rationale for states to include measures in their implementation plans that go far beyond what the rule contemplates. For example, Illinois could aver that it agrees wholeheartedly with the intent of rule, but 25% of its nuclear capacity is at direct risk of closure and all of the reactors have suffered economic losses for five years.[23] EPA may not give Illinois full credit toward meeting the mandated emissions goal, but the state could still divert substantial resources from renewables and efficiency under the rationale provided by the draft rule.

[22] Table 2-4. Regulatory Impact Analysis. p. 2-4

[23] Wernau, Julie. "Exelon may shut nuke sites; Clinton fears fallout." *Chicago Tribune.* March 9, 2014. http://articles.chicagotribune.com/2014-03-09/business/ct-exelon-closing-nuclear-plants-0308-biz-20140309_1_quad-cities-plant-byron-plant-exelon

Cost Estimates of Implementing Provisions for Preserving At-Risk Nuclear

Scale	Capacity Covered (MW)	Capacity Factor	Subsidy Rate ($/MWh)	Annual Cost
6%	5,700	90%	6	$270 million
Average Reactor	1,003	90%	6	$47.4 million
Illinois	11,581	90%	6	$548 million
Whole Fleet	100,000	90%	6	$4.6 billion

What is more, the economic margin affecting the most at-risk units is far greater than $6/MWh, so Illinois may propose incentives greater than that. Even if EPA's insufficient $6 rate were applied to 100% of Illinois' nuclear capacity – as the state is now considering doing, and with the draft rule's provisions as one of the primary policy rationales[24] – it would cost ratepayers at least $548 million/year, while not preventing a single reactor from closing. Nationally, such a subsidy could total $4.6 billion/year, without producing any net benefit.

EPA also did not consider how nuclear preservation incentives would be allocated. States will not want to have to decide which reactors are at risk – especially in states like New York and Pennsylvania, where different companies own reactors and the state would have to decide which ones should receive subsidies and at what levels if they are to actually prevent closures. The industry could use such dynamics as additional leverage for programs covering the operating cost margin for all of a state's nuclear capacity, which EPA would have to accept if the states show it is prudent for meeting the goals.

Another flawed assumption undergirding EPA's analysis is that, if a reactor closes, it will necessarily be replaced by fossil-fuel generation. As detailed below, EPA does not assume the same about the retirement of renewable energy resources during the compliance period, which could also be substantial. This leads the agency to ignore the total cost of offering incentives to preserve nuclear, which is actually far greater than $6/MWh – that is, $6 in addition to the cost of market revenues (wholesale, capacity, grid

[24] Daniels, Steve. "Exelon puts an opening price tag on nuclear rescue: $580 million." *Crain's Chicago Business.* September 24, 2014. http://www.chicagobusiness.com/article/20140924/NEWS11/140929909/exelon-puts-an-opening-price-tag-on-nuclear-rescue-580-million
Springer, Benjamin. "Power Politics: How Exelon Stands to Shape US Energy Policy." *GreenTechMedia.com.* November 5, 2014. http://www.greentechmedia.com/articles/read/power-politics-how-exelon-stands-to-shape-us-energy-policy

support, etc.) and other subsidies. Just the carbon rule incentives and market revenues could add up to a total cost well above, or at least comparable to, that of other, low-carbon alternatives. For instance, the average cost of wholesale wind power contracts in 2013 was $25/MWh, compared to at least $35-$40/MWh for nuclear with a $6/MWh subsidy.[25]

A more sensible solution would be to recommend that states plan to replace retired Block 3 and 4 resources with similar resources. Even aside from the question of economic competitiveness, there will continue to be instances — like the San Onofre and Crystal River nuclear plants — where the cost of repairing reactors is far above what is reasonable for ratepayers to absorb or for merchant operators to invest, and states might have a hard time meeting the goals if they have planned on keeping old nuclear plants around forever and not begun preparing to accommodate renewables and demand-side management. In fact, a better investment of ratepayer dollars to prepare for such contingencies would be to begin investing in infrastructure to support renewables and distributed generation, such as transmission lines, smart-grid, electric vehicle charging stations and vehicle-to-grid connections. As detailed below, the amount of nuclear capacity estimated to be at risk could easily be replaced by other low-carbon resources, such as wind, so there is no need to make a special case of preserving existing nuclear. Recommending that states collect a fee to plan for reactor closures and invest in renewable energy deployment, efficiency, and transmission system upgrades would be a more prudent hedge against the possibility of unannounced reactor closures. In fact, such a provision need not apply only to nuclear; the rule should simply recognize the reality that low-/zero-carbon resources will face retirements, along with nuclear and fossil fuel generation sources.

To unpack the first flaw in the provisions for existing nuclear, it is necessary to understand the actual economic problems facing the industry. The dominant factors are:

- Rising capital costs for maintaining an aging fleet of reactors, with the median age of 35 years.
- Other basic characteristics, such as the reactor's generation capacity and the number of operating reactors at the plant.
- The average market price of power in the region.

The Nuclear Energy Institute reports that reactor operating costs was $44.17/MWh in 2012, having risen over 10% from 2010 – far faster than the rate of inflation. Single-reactor plants operated at a cost of over $50.54/MWh, whereas multi-reactor sites

[25] Taking the market price figures for Exelon's Clinton ($29/MWh) and Dresden ($33/MWh) plants in Illinois as cited in the *Chicago Tribune*, and adding EPA's $6/MWh incentive.

operated at just under $39.44/MWh.[26] When compared to average market prices below $40/MWh in several regions – and less than $30/MWh in some – owners of smaller, older, single-unit nuclear plants like Kewaunee (in Wisconsin) and Vermont Yankee have found those plants with an unbridgeable economic gap and been forced to retire them.

The 5,700 MW of at-risk capacity is actually based on eight or nine specific reactors that have been cited by industry analysts and/or the operators as at risk of closure due to poor inherent economics, rising costs, and local market-based pricing levels. These reactors are almost all old, smaller, and/or single-unit plants, which have the highest operating cost profile, per unit of generation. The cost of operating these reactors is rising as they age and components need to be replaced. They are also operating in deregulated markets and in geographical areas where market electricity prices are low, generally because these reactors are in regional markets where prices are low because of an oversupply of capacity (in some places 40% or more). Exelon's Clinton and Quad Cities 1&2 reactors face this most acutely, in part because they are in more rural areas with substantial growth in wind generation.

Reactor	State	Capacity (MW)	% of State Nuc. Cap.	Years Operating	Market Structure	Owner
Clinton	IL	1,065	9.2%	27	Dereg	Exelon
Quad Cities 1	IL	912	7.9%	41	Dereg	Exelon
Quad Cities 2	IL	912	7.9%	41	Dereg	Exelon
Pilgrim	MA	688	100.0%	42	Dereg	Entergy
FitzPatrick	NY	838	15.3%	40	Dereg	Entergy
Ginna	NY	582	10.7%	44	Dereg	Exelon
Three Mile Island 1	PA	829	8.4%	40	Dereg	Exelon
Davis-Besse	OH	882	41.9%	36	Dereg	FirstEn.
TOTAL		5,870		AVG.: 38.9		

[26] Nuclear Street News Team. "NEI Lays Out the State of Nuclear Power." Nuclearstreet.com. February 26, 2014. https://nuclearstreet.com/nuclear_power_industry_news/b/nuclear_power_news/archive/2014/02/26/nei-lays-out-the-state-of-nuclear-power-in-2013-_2800_with-reactor-construction-photos_2900_-022602.aspx#.U_akEaXUwdL

The phase-out of some baseload capacity, without loss of reliability, is entirely feasible in many areas with low market prices, and would result in prices moderating upward to a level that would reduce economic pressure on the remaining plants. Such a dynamic could even incentivize further growth in wind, efficiency, and other low-carbon resources that can compete effectively in a low-price environment.

Two current efforts to preserve at-risk reactors are illustrative of the shortcoming in EPA's analysis. In New York, Exelon has petitioned the Public Service Commission to force Rochester Gas & Electric to enter into a contract for electricity from the Ginna Nuclear Power Plant that would preserve its operation through at least October 2018.[27] Although Exelon and RG&E are still negotiating a contract and a proposed power price has not been disclosed, a minimum estimate of what the corporation will seek can be calculated from Exelon's filing. Exelon states that, under a recently expired power purchase agreement (PPA) with RG&E, Ginna suffered nearly $100 million in losses during 2012 and 2013, during which period Ginna operated at 95% average annual capacity factor. Under the PPA, Exelon was guaranteed an average price of $44.76/MWh for 90% of Ginna's output, plus a capacity price of $1,850/MW-month.[28] The remainder of Ginna's output Exelon was free to sell on the NYISO wholesale market for Load Zone B (Genesee). The Day-Ahead Location Based Market Price (LBMP) for Load Zone B during the 2012-13 period was $34.22/MWh. Accounting for revenues from those sources and the $100 million in losses, Ginna's break-even operating cost would have been $56.75/MWh – $19.92/MWh greater than the total cost of electricity on the wholesale market during the same period ($36.83/MWh, with the average capacity market price included).[29] Exelon also suggests in the petition to NY PSC that it will ask for a return on investment in the contract, which could easily result in an average price of

[27] Exelon Corporation, Constellation Energy Nuclear Group, LLC, and R.E. Ginna Nuclear Power Plant, LLC. "Petition for Initiation of Proceeding to Examine Proposal for Continued Operation of R.E. Ginna Nuclear Power Plant." Filed with New York State Public Service Commission. Albany, NY. July 11, 2014. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b3046BCE2-7856-404B-B73A-29E731C6A44C%7d

[28] Calculated from data in Schedules A-C. "Power Purchase Agreement Between Constellation Power Source, Inc. and Rochester Gas and Electric Corporation. Dated as of November 24, 2003." Accessible via the Nuclear Regulatory Commission ADAMS document filing system, Accession Number ML040090198, at pp. 357-359.

[29] Had Ginna participated in the NYISO capacity market during the same period, it would have earned an average capacity market price of $1,810/MW-month, for revenue equivalent to $2.61/MWh. The average price is calculated by weighting the 2011-12 and 2013-14 winter prices proportionally to the number of months that fall within the 2012 and 2013 periods: January-April 2012 (four months) and November-December 2013 (two months). The MHh equivalent price is calculated based on Ginna's 2012-13 annual average capacity factor (95%).

at least $60/MWh, roughly $23 greater than the average market price for electricity in NYISO Load Zone B from 2009-13.

FirstEnergy submitted a petition to the Public Utility Commission of Ohio (PUCO) in August 2014 asking for similar treatment. The company is seeking relief to prevent the closure of its Davis-Besse Nuclear Power Plant and three coal-fired plants.[30] The petition requests authority to sell electricity from the plants to the utility companies FirstEnergy operates in Ohio, requiring ratepayers to pay for their full operating cost, plus an 11.15% rate of return on investment. Investment firm UBS estimates the average rate under the proposal would be $65/MWh, $26 higher than current market prices. However, considering that the operating cost of coal plants is generally lower than that of nuclear, it is likely that the costs attributable to Davis-Besse would be greater than the average price of $65/MWh. Regardless of the lack of specificity on this point, the cost of "preserving" Davis-Besse would be in the same neighborhood as Ginna. Both could be taken as more realistic proxies for what is truly necessary to prevent uncompetitive reactors from closing.

In the draft rule, EPA assumes that such reactors could be preserved with a subsidy for 6% of capacity applied at a price of $6/MWh. Those subsidy levels, if applied as the rule implies, would equate to subsidies of $1.65 million/year for Ginna and $2.51 million/year for Davis-Besse. The actual subsidies Exelon and FirstEnergy appear to require are 58-72 times greater than what the EPA's formulation would entail, suggesting an actual carbon cost of $600-$1,200 per metric ton of CO2. In the draft rule, EPA evaluates the cost of state Renewable Portfolio Standards at $3 per ton,[31] and the cost of Building Block 3 resources on the whole at $10-$40 per ton.[32] The cost-effectiveness of preserving the at-risk nuclear capacity outstrips that range by a very large margin and should be disqualified as a component of the BSER.

[30] Caddell, Ted, and Rich Heidorn, Jr. "FirstEnergy Wants Regulated Companies to Subsidize Generation." RTO Insider. August 12, 2014. http://www.rtoinsider.com/firstenergy-subsidize-gen/
[31] Draft Rule. Federal Register Notice. p. 34869.
[32] Draft Rule. Federal Register Notice. p. 34858.

Costs of Preserving Two At-Risk Reactors: Actual vs. CPP Model

Scale	Capacity Covered (MW)	Capacity Factor	PPA Rate ($/MWh)	Subsidy Rate ($/MWh)	Total Annual Cost	Annual Subsidy Cost
Ginna NPP	582	95%	56.75	19.92	$275 million	$96.5 million
Ginna @ 6%	35	90%	n/a	6	n/a	$1.65 million
Davis-Besse NPP	882	90%	65.00	26.00	$452 million	$182 million
Davis-Besse @ 6%	53	90%	n/a	6	n/a	$2.51 million

In reality, the draft rule's inclusion of at-risk nuclear is a "solution" in search of a problem. To the extent that there is potentially a carbon impact to reactor closures, the better way to deal with it would be the way the market/grid regulators do: when a closure is announced, conduct an assessment of the impact on reliability (or in this case emissions) and decide if it requires mitigation and what the best options would be. EPA should provide a more accurate analysis, like the one presented here, to assist states in evaluating the economic feasibility of subsidizing uncompetitive reactors. If states were to extend subsidies to reactors other than those truly at risk of closure, they would be providing subsidies to reactors that don't need them. That would mean literally wasting economic resources on incentives that provide no concrete benefit toward meeting carbon pollution goals, and would actually be counterproductive since those dollars could otherwise be put toward reducing emissions further through greater investment in efficiency and renewables, and consequent displacement of coal and gas generation.

2.C. Power Uprates and Additional New Nuclear

EPA does not include other means of increasing nuclear generation in the BSER, presumably because their technical and economic feasibility is not favorable. However, the agency does note in Sect. VIII.F. "State Plan Considerations," that states may include power uprates and additional new reactors in their plans, and it requests comment on "alternative nuclear capacity baselines, including whether the date for recognizing additional non-BSER nuclear capacity should be the end of the base year used in the BSER analysis of potential nuclear capacity (i.e., 2012)."[33] This suggests that EPA would consider allowing states to include these resources in their plans, credited at 100% of the

[33] Draft Rule. Federal Register Notice. p. 34923.

additional capacity relative to the baseline year, even though power uprates and additional new reactors are not included in the goal.

EPA did not include an analysis of uprates in the draft rule, but it did exclude additional new reactors from the BSER because the cost of construction is too high for them to be a feasible option. It is presumed that, of the three categories of power uprates authorized by the Nuclear Regulatory Commission, EPA refers to extended power uprates. The categories are distinguished by the degree of increase in thermal power output, but entail different types of engineering interventions, each of which may not be feasible at every reactor:[34]

Power Uprate Categories

Uprate Category	Uprate Category	Intervention Measure
Measurement Uncertainty Recapture (MUR)	<2%	Improvements in coolant flow monitoring that permit the reactor to operate at slightly higher power.
Stretch Power Uprates	2-7%	Involve instrumentation changes, but depends on the engineering margins built into the design of the reactor.
Extended Power Uprates	7%-20%	Large increases in power output, beyond what the reactor was originally designed for; require extensive upgrades and major equipment.

Beyond the five power uprates that were cancelled in 2013 and the twelve listed as pending or expected by NRC, it is not clear how much uprate capacity remains in the existing reactor fleet. A total of ninety-eight reactors have implemented power uprates, resulting in a total increase in nuclear capacity of 21,105 MW thermal capacity (~6,800 MW electric).[35]

[34] http://www.nrc.gov/reactors/operating/licensing/power-uprates/type-power.html
[35] http://www.nrc.gov/reactors/operating/licensing/power-uprates/status-power-apps/approved-applications.html

Power Uprate Capacity Additions by Category

Uprate Type	Reactors	Capacity (MWt)
MUR	58	2,765
Stretch	62	8,499
Extended	29	9,841

Given the high percentage of existing reactors that have undergone stretch uprates and the limited economic impact of MURs, the contribution available from those types of capacity increases is very limited. It is not clear how many reactors could accommodate extended uprates, but the number may be small and recent experience suggests those measures may not be economical. Five planned extended power uprates were cancelled in 2013, along with the announcements of five reactor closures and eight new reactor cancellations. Most recently, the 12% extended power uprate for the Monticello reactor in Minnesota will add 71 MW of capacity at a cost of $748 million – approximately $10.5 million/MW, more costly than most new reactors.[36]

In fact, extended uprates may actually be counterproductive to the economics of existing nuclear. Half of the at-risk reactors implemented extended uprates several years ago. In addition to the high capital cost of implementing a power uprate, the increased material stress on reactor components may either increase maintenance costs on an ongoing basis, or shorten the mechanical life of the reactor:[37]

Reactor	Uprate %	Year Approved
Quad Cities 1&2	17.8%	2001
Clinton	20%	2002
Ginna	16.8%	2006

Of the other at-risk reactors, FitzPatrick implemented a 4% stretch uprate in 1996, and the other three have implemented only small MUR uprates. The value of power uprates in improving reactors' economics would appear to be inconclusive. Given the extensive capital costs associated with extended uprates, EPA should only consider uprates on a

[36] Shaffer, David. "Xcel management blamed for cost overruns at Monticello nuclear plant." *Minneapolis Star-Tribune.* July 9, 2014. http://www.startribune.com/business/266353511.html
[37] http://www.nrc.gov/reactors/operating/licensing/power-uprates/status-power-apps/approved-applications.html

case-specific basis, and with thorough scrutiny of the calculated economic costs and benefits.

The draft rule also suggests that power uprates and new reactors could suppress natural gas and market electricity prices.[38] Given the limited capacity for further uprates, particularly within any given energy market, the impact of such an effect would have to be marginal. To provide a level of new capacity likely to displace a meaningful amount of CO2 emissions or an effect on local gas and electricity prices would require extended uprates, which could be more expensive than the associated market price impact warrants, as well as uneconomical for the future operation of the reactor. Similarly, new reactor construction could displace substantial amounts of natural gas utilization, but at an extremely high cost. In addition, the ability for nuclear to displace gas is highly conditional on the mix of fossil fuel capacity in a particular market. Nuclear might be more likely to displace coal generation in most regions, leading to little change in demand for natural gas. Furthermore, market prices are predominantly driven by the interaction between gas prices and peak load scarcity dynamics in wholesale auctions, rather than by the presence of baseload nuclear capacity. EPA should regard plans based on claims that new nuclear capacity will lower natural gas and electricity market prices skeptically, and conduct a thorough analysis of the deployment cost and market projections.

3. Treatment of Other Low-/Zero-Carbon Resources

It is important to note that not all generation sources are included in the rule. For instance, conventional hydro is not included in Block 3 because, as EPA states, it "could distort regional targets that are later applied to states lacking that existing hydropower capacity."[39] Substantially the same thing could be said of states with high levels of nuclear capacity. This is significant, because nuclear and large hydro share several critical characteristics:

- Capable of producing large amounts of electricity.
- Capable of operating in a baseload capacity.
- Some existing capacity is at risk of retirement (in the case of hydro, mostly because of ecosystem restoration efforts).
- Very low feasibility of capacity increases in the compliance period.
- Significant non-air quality impacts.

[38] Draft Rule. Federal Register Notice. p. 34934.
[39] Draft Rule. Federal Register Notice, p. 34867.

In addition, hydro has other characteristics that make it more valuable than nuclear in providing electricity system reliability: hydro can also operate as a dispatchable resource, filling the same role as NGCC plants in following load and providing reserve and peaking capacity; thus, the preservation of hydro capacity would directly displace reliance on fossil fuel resources that may otherwise be called upon. EPA's reasons for not including large hydro resources in the BSER are sound, but inclusion of nuclear is no more sensible than inclusion of hydro would be, especially considering the unwarranted value placed on the at-risk nuclear capacity.

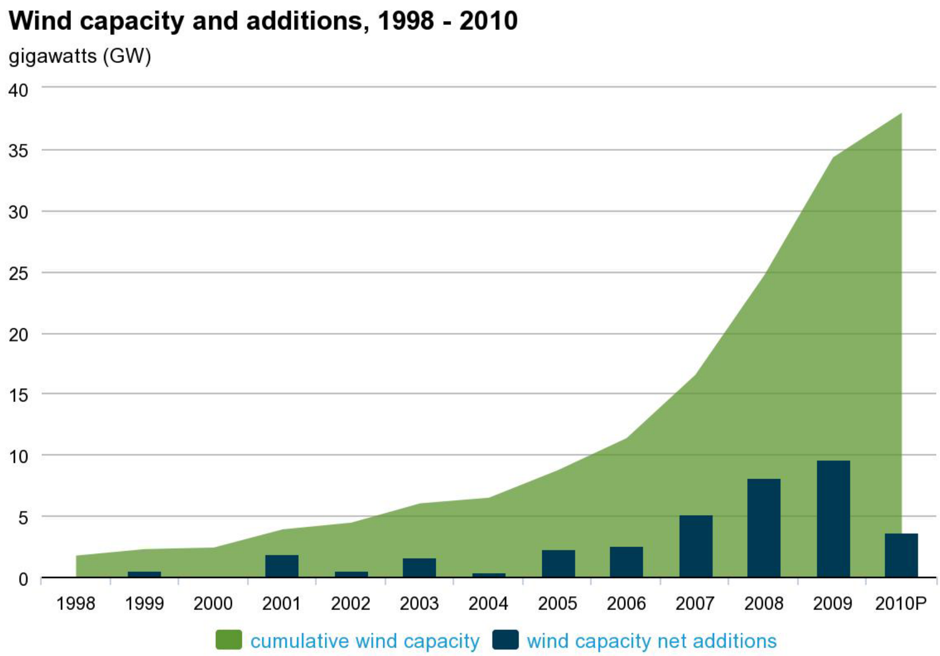
Similarly, EPA did not include grid reliability measures that could reduce operating reserve requirements in the BSER, which would directly reduce CO2 emissions. Operating reserve (also called spinning reserve) requirements often mandate that capacity sufficient to replace the largest generator on the system – up to 20% of load, in many cases – must be operating but held in reserve, meaning that fossil fuel generators are emitting CO2 that is not producing electricity. In many places, nuclear units are the largest on the system, requiring additional CO2 emissions as a result of their operation. Incorporation of storage technologies, such as super-capacitors, compressed air, and battery storage,[40] all of which have rapid ramp time characteristics, could reduce the need for spinning reserves, improve fossil fuel efficiency, and reduce CO2 emissions.

The rule also fails to consider the economic feasibility of replacing retired renewable resources during the compliance period. The rated lifespan of both wind and solar PV generators is generally 20-25 years. As a result, a significant portion of the nation's existing wind capacity will be at risk of retirement by 2030, entailing a loss of current low-/zero-carbon generating capacity greater than the amount of nuclear capacity at risk of retirement. In 2010, there were 38.0 GW of wind capacity installed in the US,[41] 64% of the 59.6 GW of the 2012 nameplate wind capacity EPA considered in the draft rule.[42] All but 1.7 GW, or 36.3 GW, of the 2010 wind capacity came online in 1998 or later. And because the BSER formula includes all existing wind capacity, the replacement of retiring wind generation is equally relevant to the success of the rule.

[40] This would be particularly true of storage in a vehicle-to-grid arrangement, in which a large amount of total capacity could be distributed close to load centers.

[41] U.S. Energy Information Administration. "Wind capacity additions slowed during 2010." May 17, 2011. http://www.eia.gov/todayinenergy/detail.cfm?id=1410

[42] Table 2-1. Regulatory Impact Analysis. p. 2-2.



Source: U.S. Energy Information Administration.

At an average capacity factor of 30% for wind -- compared to the 90% capacity factor on which EPA bases its evaluation of nuclear -- that amount of capacity represents the potential retirement of more than twice (212%) the net carbon-free generation output as the at-risk nuclear capacity.

Wind Retirements vs. Uneconomical Nuclear Retirements

Resource	At-Risk Capacity (GW)	Capacity Factor	Annual Generation (GWh)
Wind	36.3	30%	95,396
Nuclear	5.7	90%	44,940

Given the economic uncertainty the wind industry faces due to the difficulty in extending the Renewable Energy Production Tax Credit, EPA might also have expressed the same concern about the impact of wind generation retirements as it professes regarding nuclear. Yet there is good reason not to be so concerned about the viability of replacing wind generation: the economics of wind are generally favorable and improving, where the economics of new nuclear are not. In addition, wind generation can be replaced with little or no additional environmental impact, by constructing a new windmill on the same site as the retired one. The same is not necessarily possible with nuclear, given site constraints and the lengthy process of decommissioning and site remediation.

But regardless, it is the incentive to preserve *uneconomical* capacity that is unwarranted and out of place. In the case of nuclear, the amount of generation deemed to be at-risk is within the range of how much wind capacity is now routinely developed in the U.S. within one to two years,[43] and at much lower cost than the construction of new nuclear ($1.5-$2.2 million/MW for wind, compared to $6-10 million/MW for nuclear). It should, therefore, be feasible to replace the generation provided by at-risk nuclear within the compliance period (or even before it begins), through increased deployment of sustainable resources.

Replacement of At-Risk Nuclear at Current Wind Energy Deployment Rates

Resource	Annual Generation (GWh)	Capacity Factor	Installed Capacity (GW)	Time to Replace Nuclear
At-Risk Nuclear	44.94	90%	5.7	--
Wind: low capacity	44.94	30%	17.1	1 yr., 5 mo.s
Wind: high capacity	44.94	40%	12.8	1 yr., 1 mo.

The extent to which EPA has underestimated the growth potential of renewables and efficiency is underlined by the climate action pact the Obama administration recently announced with China. Under the agreement, China has committed to providing 20% of its total energy use from non-fossil fuel energy sources by 2030. China's commitment has been widely reported as equivalent to building as much new generation capacity as the United States' total generation supply in the form of renewables and nuclear. A deeper look at the probable mix of nuclear and renewables reveals that the vast majority of China's fulfillment of its obligations will be through deployment of renewables rather than nuclear.[44] The U.S. has no less robust renewable energy resources than China, so much greater rates of renewable energy deployment should be achievable.

This suggests an alternative approach to be considered: planning for replacement of retired generation resources. Rather than subsidizing the preservation of uneconomical generation sources, states could invest such funds in system planning and infrastructure

[43] In 2012, more than 12,000 MW of wind were brought online in the US, and 12-14,000 MW each are expected to be completed in each of the next two years (2014 and 2015). Morales, Alex. "Wind Power Projects to Rise to Record in 2014, Lobby Says." Bloomberg.com. April 9, 2014. http://www.bloomberg.com/news/2014-04-09/wind-power-projects-to-rise-to-record-in-2014-lobby-says.html

[44] Judson, Tim. "The Inconvenient Truth in the US-China Climate Pact?" *GreenWorld.* November 13, 2014. http://safeenergy.org/2014/11/13/the-inconvenient-truth-in-us-china-climate-pact/

development needed to accommodate the replacement of resources that may retire, whether expectedly or unexpectedly. Investing ratepayer resources in transmission upgrades, incentive programs, or low-interest revolving loan funds would ensure timely maintenance and upgrades to provide reliability, facilitate planning, lower barriers to market entry, and encourage investment in new technology.

4. Other Environmental Impacts

The draft rule does not appear to fulfill the Clean Air Act Sect. 111(a)[45] requirement that non-air quality health and environmental impacts be evaluated. This is due both to an inadequate evaluation of certain impacts, and the omission of others:

- Radioactive waste
- Water resources
- Technological advancement
- Uranium fuel production
- Nuclear accidents

4.A. Radioactive Waste

The draft rule dismisses radioactive waste impacts resulting from preservation and/or increased deployment of nuclear capacity. EPA disregards this impact as equivalent to the solid waste impacts of coal generation, but the judgment appears to be qualitative as the draft rule does not include a technical analysis to support such a claim:

> The EPA recognizes that nuclear generation poses unique waste disposal issues (although it avoids the solid waste issues specific to coal-fired generation). However, we do not consider that potential disadvantage of nuclear generation relative to fossil fuel fired generation as outweighing nuclear generation's other advantages as an element of building block 3.[46]

It is not clear which radioactive waste impacts EPA considered in making this statement, which represents the sum total of the agency's comments on the issue. In fact, there are multiple forms of radioactive waste that are directly generated by the operation of commercial nuclear reactors, including:

- Irradiated nuclear fuel and other high-level radioactive waste (HLRW).
- Contaminated reactor equipment and other low-level radioactive waste (LLRW) produced during the decommissioning and site remediation process.

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[45] U.S. Code Sect. 7411

[46] Ibid.

- Solid and liquid radioactive effluents released to the environment during normal reactor operation.
- LLRW generated during routine operation, from contaminated parts and equipment to uniforms and protective gear.
- Highly radioactive solid waste particles ("crud") from the primary coolant system.

Not only does the increased generation of radioactive waste have a long-term impact on health and the environment, it has potentially significant economic impacts both from possible environmental contamination events and due to the cost of development and management of interim and long-term storage facilities.

Presumably, the statement in the draft rule refers to irradiated nuclear fuel and high-level radioactive waste. The long-term management of HLRW is very much uncertain, and the generation of additional waste as a result of the Clean Power Plan warrants a full evaluation. The federal government's ability to fulfill those obligations faces great uncertainty, due the Nuclear Waste Policy Act's (NWPA) statutory requirement that the first repository be constructed at the Yucca Mountain site in Nevada, which faces significant technical and political obstacles. In addition, the Yucca Mountain repository is statutorily limited to storing 70,000 metric tons of commercial irradiated fuel, a quantity that has already been surpassed. Any additional waste generated by existing and new reactors would have to be disposed of at an as-yet unidentified and unauthorized repository site. In addition, the Department of Energy (DOE) is currently prohibited from collecting fees from the industry to pay for the long-term storage program, and at the same time is responsible to reimburse operators for on-site waste storage costs due to the government's default on its obligations under the NWPA. It is entirely possible that the full cost of managing irradiated fuel going forward would be borne by the general public. However, even if the DOE is able to resume charging licensees for HLRW management, most of those costs are ultimately borne by the public through charges passed on to ratepayers by utilities that own reactors.

At the same time, under its new "Continued Storage" rule the NRC now admits waste may need to be managed at reactor sites indefinitely. The failure to develop a repository has forced the agency to consider the possibility that its licensing decisions may entail indefinite or permanent storage of irradiated fuel using technologies and facilities designed for temporary storage. In promulgating the Continued Storage Rule, the NRC maintains that irradiated fuel can be stored safely in such facilities, at which the waste may need to be re-containerized every one-hundred years for as long as necessary. The

NRC estimates the ongoing costs of such a program at over $8 billion every one-hundred years, for a consolidated storage site containing 40,000 metric tons of irradiated fuel:[47]

- $11.6 million/year for "caretaking," or approximately $1.1 billion.
- $7.11 billion for replacement of storage and handling facilities.

The costs would be higher for storage at reactor sites, due to the economies of scale achieved under a consolidated storage scenario. EPA must consider the incremental costs of additional waste generated by the construction of new reactors and the continued operation of existing reactors, which are not only considerable but would potentially surpass the cost of any other energy alternative over the long and indefinite periods under which they may be incurred.

In addition, the decommissioning of reactors is an expensive process, expected to cost upwards of $1 billion per reactor going forward. While the marginal cost of decommissioning existing reactors as a result of the draft rule's provision for preserving uneconomical reactors is not likely to be significant, the full cost of decommissioning reactors in construction must be considered. The full cost of funding decommissioning those five reactors would be borne by the general public (rather than being internalized to the plant owners) because they are all to be owned and operated by utilities, which are typically permitted to charge ratepayers for the cost of building up trust funds to pay for decommissioning costs.

4.B. Water Resource Impacts

Similarly, the draft rule dismisses the impact on water resources for use in thermal cooling systems as:

1. An improvement over displaced fossil fuel generation in the case of new reactors, which are implicitly expected to utilize closed-cycle cooling systems.
2. A non-impact in the case of existing reactors, despite the fact that a majority employ once-through cooling systems.[48]

EPA's analysis also does not recognize that nuclear reactors use water at higher rates per kWh of generation, and that they require continuous use of water even when not in operation, due to the need for decay heat removal following shutdown and for irradiated fuel pool cooling. The majority of U.S. nuclear plants utilize once-through cooling systems, which require the greatest level of water withdrawals and release large volumes

[47] Nuclear Regulatory Commission. "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." September 2014. Pages 2-32 to 2-35. http://pbadupws.nrc.gov/docs/ML1419/ML14196A105.pdf
[48] Draft Rule. Federal Register Notice. p. 34883.

of thermal pollution in the form of heated water. Due to the technical characteristics of nuclear versus fossil fuel stations, and depending on the type of cooling system used, nuclear reactors require between 19% and 65% more cooling water per unit of generation and discharge into receiving waters between 20% and 69% more heat per kilowatt hour (kWh) than fossil fuel-fired stations.[49]

An appropriate analysis would compare the use of water resources to other alternatives, nearly all of which (e.g., renewable generation, energy efficiency, and NGCC plants) utilize water far more efficiently than nuclear. EPA should have conducted a more meaningful evaluation of the water resource impacts of including nuclear in the BSER, particularly considering the impact of nuclear in areas of the country that have experienced droughts, such as Georgia.[50]

4.C. Technological Advancement

The EPA also concludes that the construction of new reactors would have a positive impact in encouraging technological innovation. A serious analysis of the opportunities for technological innovation in nuclear power would reveal that the degree of innovation as a result of increased deployment is extremely limited. For instance, the period of the industry's greatest expansion (1960s-1980s) encountered both *increasing* cost of the technology (despite increases in the average size of generating units deployed) and at best a marginal level of technological advance. Deployment of nuclear effectively stopped in the U.S. for thirty years as a result of these shortcomings. The reactors currently under construction utilize effectively the same technology with very little improvement in thermal efficiency and no apparent economic improvement, suffering from the same problems with cost escalation and construction delays. This is reinforced by the fact that one of the five "new" reactors being constructed is actually a reactor that was order over 40 years ago, utilizing the original design, on which construction work was suspended for over 20 years.[51]

This is in stark contrast to the experience with wind, solar, and many efficiency applications, which benefit from precisely the characteristics that permit increased deployment to produce innovation, increasing efficiency, and/or cost-reduction: large-

[49] Gunter, Paul, et al. "Licensed to Kill: How the nuclear power industry destroys endangered marine wildlife and ocean habitat to save money." February 22, 2001. http://www.nirs.org/reactorwatch/licensedtokill/LiscencedtoKill.pdf

[50] Manuel, John. "Drought in the Southeast: Lessons for Water Management." *Environmental Health Perspectives.* April 2008; 116(4): A168–A171. http://www.ncbi.nlm.nih.gov/sites/myncbi/recentactivity

[51] World Nuclear Industry Status Report. "Forty Years Later—US Watts Bar 2 Project Allegedly 'On Time and Within Budget.'" November 5, 2013. http://www.worldnuclearreport.org/Forty-Years-Later-US-Watts-Bar-2.html

scale production, a large number of discrete units to be deployed, competition for market share by a wide variety of manufacturers, and greater ease of market entry for both manufacturers and owners. The lack of rigor in EPA's analysis results in inaccurate conclusions that favor nuclear and its unwarranted inclusion in the BSER.

4.D. Uranium Fuel Production

The production of nuclear fuel entails significant environmental impacts, including public health, environmental justice, and economic costs. The fuel production process for the light water reactors used in the United States involves the primary extraction of uranium ore (mining), its processing and refinement (milling), enrichment to the necessary concentration of U-235, and its fabrication into fuel pellets and assemblies. For every metric ton (tonne) of fuel produced for use in a reactor, this process results in vast quantities of chemical and radioactive waste:

- 18,758 tonnes of waste rock
- 3,743 tonnes of uranium mill tailings
- 6.26 tonnes of depleted uranium
- 5.44 tonnes of other solid waste
- 3,800 cubic meters of liquid waste[52]

Storage for waste rock and solid and liquid uranium mill tailings lacks strong environmental protection standards, and generally is above ground and open to the air. Leaching of waste rock and tailings piles is known to affect groundwater. Gaseous radon emissions and windblown dust containing uranium, radium, and other radioactive decay products affect communities, livestock, and wildlife. Efforts to remediate some of these sites are beginning, and estimated to be very costly.

As a result of historical uranium mining dating back to the 1940s, a collaboration among EPA and other federal agencies is tracking some 15,000 uranium mine locations. [53] These facilities have been disproportionately located on or near Native American communities and territorial lands, with over 75% located on federal and tribal lands, presenting a major environmental justice problem. In addition, EPA estimates that nearly 10 million people reside within 50 miles of abandoned uranium mines.[54] Due to the expiration of a program for converting high-enriched uranium from dismantled atomic weapons in the former Soviet states to low-enriched reactor fuel, the U.S. nuclear energy industry has resumed

[52] WISE Uranium Project. "Nuclear Fuel Material Balance Calculator." World Information Service on Energy. November 23, 2009 (Updated). http://www.wise-uranium.org/nfcm.html
[53] Abandoned Mine Lands Portal. "About AMLs." http://www.abandonedmines.gov/aa.html
[54] EPA "Technologically Enhanced Naturally Occurring Radioactive Materials From Uranium Mining Volume 2: Investigation of Potential Health, Geographic, and Environmental Issues of Abandoned Uranium Mines [EPA 402-R-08-005]." April 2008. Chapter 2, Uranium Mines Location Analysis. Page 2-4. http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-volii/402-r-08-005-v2-ch2.pdf

full-scale use of mined uranium for fuel production. Dozens of new uranium mining operations have been proposed.[55] The impacts of uranium mining and fuel production should also disqualify nuclear from inclusion in the Clean Power Plan's best system of emissions reduction.

4.E. Nuclear Accidents

The potential for radiological accidents resulting from continued operation of existing reactors and the deployment of additional, new reactors is never mentioned. Ignoring the vast financial costs and human health and environmental impacts stemming from reactor accidents distorts the evaluation of nuclear in the rule. Estimates of the financial consequences of the Fukushima nuclear disaster continue to rise, but now range from $137 billion[56] to more than $250 billion.[57] Excluding consideration of nuclear accidents would be arbitrary and capricious, particularly when the draft rule includes the construction of new reactors and the retention of aging reactors in the "best system of emissions reduction."

At the same time, the Fukushima accident has shown that such an accident can lead to a reevaluation of energy policy and regulatory actions that result in extended outages and early retirements.[58] Japan's reliance on the preservation and expansion of nuclear to achieve emissions goals left the country unprepared to meet its electricity needs without increased reliance on fossil fuel generation capacity. Germany, on the other hand, is proceeding with an accelerated but orderly phase-out of nuclear, while remaining on track with its emissions goals due to its rapid deployment of renewables. The country has also managed to do so while achieving much higher levels of system reliability than the United States.

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[55] Fettus, Geoffrey H., and Matthew G. McKinzie. "Nuclear Fuel's Dirty Beginnings: Environmental Damage and Public Health Risks From Uranium Mining in the American West." Natural Resources Defense Council. March 2012. http://www.nrdc.org/nuclear/files/uranium-mining-report.pdf

[56] Tsuyoshi Inajima and Yasumasa Song. "Fukushima $137 Billion Cost Has Tepco Seeking More Aid." *Bloomberg.* November 7, 2012. http://www.bloomberg.com/news/2012-11-07/fukushima-137-billion-cost-has-tepco-seeking-more-aid.html

[57] Starr, Steven. "Costs and Consequences of the Fukushima Daiichi Disaster." Physicians for Social Responsibility, Environmental Health Policy Institute. October 31, 2012. http://www.psr.org/environment-and-health/environmental-health-policy-institute/responses/costs-and-consequences-of-fukushima.html#_edn4

[58] Lovins, Amory. "How Opposite Energy Policies Turned The Fukushima Disaster Into A Loss For Japan And A Win For Germany." *Forbes*. June 28, 2014. http://www.forbes.com/sites/amorylovins/2014/06/28/how-opposite-energy-policies-turned-the-fukushima-disaster-into-a-loss-for-japan-and-a-win-for-germany/

Conclusion and Recommendations

NIRS welcomes the publication of the Clean Power Plan (CPP), which we regard as the most significant and promising policy development to address greenhouse gas emissions and climate disruption by the United States to date. Based on the foregoing information and analysis, we provide the following information and recommendations to support the enhancement of the proposed rule:

1. NIRS supports the overall framework of the Clean Power Plan, including the following central features:
    a. Adoption of the Option 1 scenario for 2030 emissions goals.
    b. The rate-based approach to establishing emissions goals.
    c. The option of multi-state or regional implementation plans.

2. The BSER and goal-setting formula should be modified, as set forth in comments submitted by the Institute for Energy and Environmental Research (IEER).

3. The EPA must set forth guidelines for multi-state or regional implementation plans and greenhouse gas reduction programs to reflect best practices and to optimize emissions reductions and cost-effectiveness. In particular, the utilization of emissions offsets should be strictly limited, and the inclusion of nuclear generation as an offset option should be disqualified.

4. Based on its economic and technical feasibility and its non-air quality impacts, nuclear generation should be excluded from the BSER.

5. NIRS supports the inclusion of other low-/zero-carbon resources in the BSER (including renewable generation sources, energy efficiency and demand management, and energy storage), but with the modifications recommended by IEER.
    a. As a related matter, rather than encouraging financial support for uneconomical generation resources, EPA should recommend states invest in infrastructure enhancements to support deployment and integration of renewable and distributed generation, demand management, and resiliency.

6. In order to ensure that states have the information necessary to accurately evaluate proposals to include nuclear generation in their implementation plans, EPA must include a thorough analysis of the economic and technical feasibility of various nuclear generation resources. Specifically, EPA must provide credible and technically sound analyses of the following:
    a. Completion of reactors in construction, with reference both to (1) current cost projections and project delays and (2) the historical record of reactor project delays and cancellations.

   b. The economic and technical feasibility of new reactor projects, including cost overrun trends, projected vs. actual completion times, and project cancellations (will overlap substantially with the above).
   c. The economics of existing reactors, including operating and maintenance cost trends, plant characteristics, and merchant power market dynamics.
   d. The economic and technical feasibility of reactor power uprates, and the effect of extended power uprates on overall plant economics and maintenance costs.

7. EPA must conduct a thorough analysis of the non-air quality impacts of nuclear generation, including at a minimum the following:
   a. Radioactive Waste
   b. Water Resources
   c. Technological Advancement
   d. Uranium Fuel Production
   e. Nuclear Accidents