RESOURCES *for the* FUTURE

RFF Response to US Department of Energy Notice of Intent and Request for Information Regarding Establishment of a Civil Nuclear Credit Program, (#2022-03156)

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RESOURCES *for the* FUTURE

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Office of Nuclear Energy
US Department of Energy
1000 Independence Ave SW
Washington, DC 20585

Greetings,

On behalf of Resources for the Future (RFF), I am pleased to share the accompanying comments with the US Department of Energy (DOE) on the Civil Nuclear Credit (CNC) Program.

RFF is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.

While RFF researchers are encouraged to offer their expertise to inform policy decisions, the views expressed here are those of the individual authors and may differ from those of other RFF experts, its officers, or its directors. RFF does not take positions on specific legislative proposals.

Several RFF researchers have provided comments on the issues listed below:

- It will be important for DOE to provide transparent guidance on the appropriate assumptions that generators should use regarding energy prices, emissions accounting, and changes in costs over time in developing their CNC bids. This will allow for comparison across generators in a competitive auction. Allowing generators to make their own assumptions and designs in these domains will make comparison difficult and amplify the opportunities for strategic bidding.
- DOE should consider how emissions reductions will be factored into the CNC program. We share different options for incorporating emission reductions into the CNC certification and/or auction process.
- The choice between a discriminating price and uniform price auction will have important implications for costs, efficiency, auditing needs, and adjustment index design. We suggest a uniform price design in the absence of high-quality information on generators' true costs and revenues. A discriminating price auction may be more cost effective if DOE has sufficient information to discourage strategic bidding and accurately adjust credit prices with an index.

If you have any questions or would like additional information, please contact me at palmer@rff.org.

Sincerely,

Karen Palmer, Senior Fellow; Director, Electric Power Program

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Prepared by Molly Robertson, Dallas Burtraw, Karen Palmer, and Dan Shawhan

The CNC proposal offers a preliminary implementation strategy for the program authorized in H.R. 3684. Below, we offer our thoughts on what the Nuclear Energy Office should consider when finalizing the details of implementation and designing the certification procedure and the auction structure. Overall, we believe it is important to consider the accuracy, predictability, and transparency of information in the nuclear power sector to determine the optimal policy design. In an ideal world, both the public and the nuclear generators would have accurate and predictable information about their future costs and revenues. In such a world, an auction system to determine the funds necessary to sustain nuclear power generation would be unnecessary: the Department of Energy would simply determine which generators needed the least subsidy per MWh to stay operational and offer them those subsidies.

The auction described in the CNC proposal is a tool best leveraged in situations where information is imperfect due to a lack of transparency. In other words, nuclear generators have accurate and predictable information about their costs, but the public and government do not. The auction, if properly designed, is an opportunity to force generators to 'reveal' something approximating their true expected subsidy need by allowing them to compete with other generators for resources.

The auction, even if well-designed, does not fully resolve inefficiencies due to inaccurate or unpredictable information. If generators *don't* have a good understanding of their likely costs and revenues in the future due to energy price uncertainty or other factors, their competitive bids may yield inefficient or inflated results reflecting a risk premium to address uncertainties. Perhaps a generator mistakenly bid $15/MWh when they really needed $25/MWh, and they received credits over a plant that bid $17/MWh. The former generator would be unprofitable, and the latter generator, if not subject to cost variability, would have been the more cost-efficient investment, but due to inaccurate information an *ex post* inefficient outcome would be reached. Concrete and transparent assumptions set out in the certification process, and an index adjustment mechanism for credit values, will be important tools for dealing with inaccurate or uncertain information.

We believe DOE is best positioned to determine the information gaps that exist in this sector, but you will see these ideas referenced repeatedly below because the quality of information affects the policy pathways we would recommend.

1. Certification Application Criteria and Process

Pollution reduction requirements

Addresses RFI questions 3, 6, 7

The proposal requires applicants for certification to prove their continued operation will reduce air pollution, including not only emissions of carbon and methane, but also of six criteria air pollutants (see p. 16 of DOE's Request for Information). Estimated emissions impacts from continued operation will differ based on core assumptions about how the system is expected to evolve. For example, should generators assume that other nuclear generators continue to operate? Should they project the growth of renewables in the coming years based on policy goals and expected investment responses? Establishing an explicit list of assumptions and a common methodology for calculating pollution abatement will be critical for receiving estimates that are comparable across bidders. Additionally, it may be worth considering not just whether nuclear operation will reduce greenhouse gas emissions and local air pollution (as a part of the certification process), but the magnitude and value to society of the displaced pollution. In prior analysis Dr. Ray Kopp at RFF estimated the following annual CO_2 emissions reduction impacts for maintaining operations at a list of economically endangered nuclear plants.

Table 1 demonstrates the wide variation in estimated social value of displaced CO_2 emissions from various nuclear generating units.

Table 1. Value of Annual Avoided Emissions using SSC (Brattle Report)

Unit	*Avoided CO_2 emissions millions of short tons*	*Value of avoided emissions @ $45/ton*
Prairie Island-2	6.16	$ 277,200,000
Byron-2	7.86	$ 353,910,079
Quad Cities -2	6.13	$ 275,850,000
Prairie Island-1	6.16	$ 277,200,000
Byron-1	7.68	$ 345,396,779
Palisades	3.98	$ 179,251,176
Quad Cities-1	6.16	$ 277,200,000
Diablo Canyon-2	4.08	$ 183,394,652
Diablo Canyon-1	4.08	$ 183,394,652
Indian Point-2	4.31	$ 193,984,338
Pilgrim	2.86	$ 128,853,825
Clinton	8.92	$ 401,400,000
Three Mile Island-1	5.44	$ 244,757,400
Surry-2	5.44	$ 244,757,400
Davis Besse	6.04	$ 271,817,535
Surry-1	5.44	$ 244,757,400
Indian Point-3	4.40	$ 197,882,660

Nine Mile Point-2	2.69	$	121,152,261
Ginna	2.46	$	110,617,282
FitzPatrick	3.60	$	161,980,060
Nine Mile Point-1	2.69	$	121,152,261

DOE may want to consider these benefits to society when prioritizing units for support. Pollution reductions could be considered in the following ways: (1) a minimum level of pollution must be displaced based on the credit value provided, (2) individual plants must prove that the value of their displaced emissions is greater than the credit value they receive, or (3) plants are prioritized in the auction based on the cost effectiveness of their pollution reductions. Option 3 could mean ordering plants first by ascending bid amount for credit payments, then within groups with similar bid amounts, ordering plants so that those with greater pollution reductions receive credits first. Options 2 and 3 involve not only the certification process but the auction design, which is discussed below. The values of displaced emissions could be specified on a regional basis in the application guidelines drawn, for example, on a recent EPA Regulatory Impact Analysis (RIA) that used benefits per ton of emissions reduction estimates for conventional air pollutants. This approach was used in a previous RIA for the Mercury and Air Toxics Rule.

It is important to note that Dr. Kopp's research finds that, as of 2016, all economically endangered nuclear generators offered greater value in avoided emissions than the costs required to keep them operational. Since that time the official estimate of the Social Cost of Carbon has increased but the mix of generators on the grid has also changed, with coal falling from 33% in 2015 to about 21% in 2020. As renewables continue to proliferate, and other carbon cutting policies come into effect, the emissions benefits of nuclear may shift. For these reasons we feel it would be prudent to conduct a more detailed accounting of the value of reduced pollution and emissions for generators applying to participate in the CNC program. In any case, the guidelines for application should specify an unambiguous method or methods for providing these estimates.

Prioritization of plants without state support

Addresses RFI questions 3, 4

The proposal prioritizes certification of plants that are not receiving state support through Zero Emissions Credits or other subsidy programs. The benefits provided by these state programs must be incorporated into the assumed operating revenues of the potentially eligible nuclear generators. It is important to note that this structure will disincentivize states from offering these programs to subsize nuclear, particularly in a discriminating price auction (discussed below), where plants receive only enough funds to meet their operating costs. In such a system, $1 of state subsidy will equate to $1 less in federal payments. This may be a predicted and desirable outcome, to relieve the burden on states to continue operating these subsidy programs, but it is worth considering prior to implementation. There may be benefits to nuclear plant operation outside of emissions reductions and grid reliability, including tax revenues and local employment. It will be important to communicate with states to determine what the interaction between these programs should be.

2. Bid Submission and Auction

Variability in wholesale energy markets

Addresses RFI question 6

The variability of wholesale power prices differs among power markets. Even with equivalent expected value outcomes, greater variability would imply a higher hurdle rate for irreversible investment decisions according to **option theory and thus higher bids for payments in the credit auction**. This feature of bidding strategies could affect credit auction outcomes that disfavor bids from regions with greater fuel price variability, for example, if natural gas is a prominent marginal resource. Where investments are necessary to keep a plant in service, market uncertainty will likely be reflected in higher bids. Where the irreversibility is primarily evident through *disinvestment* in existing units, then option theory suggests plants would submit bids to attempt to buy time and learn more about market outcomes before taking this step. Climate policy uncertainty may affect this calculation also. However, from a system perspective, a resource with little fuel price and cost variability such as nuclear energy should be preferred. The value of nuclear might be evaluated in a regional context not only with respect to expected market outcomes, but also with respect to market variability. To enable a consideration of the variability in market prices in each region, analysis of multiple scenarios might be invited, describing low and high market price scenarios in addition to expected value. This also highlights the importance of consistent assumptions across plants in their bid development process, to ensure bids in the same auction are comparable. This information could be considered in the bid evaluation.

Uniform value vs. discriminating price auction

Addresses RFI questions 9, 12

The proposal does not address whether the award of credits will be conducted at a uniform value within each group of bidders, or if it will be a discriminating price auction (such as pay-as-bid). In most settings, especially when bidders have private information about their costs, a uniform price auction has advantages (see Kahn et al. 2001, and Abbink et al. 2002 for evidence). It encourages bidders to bid at something resembling their true minimum willingness to accept because they will receive the bid value of the marginal unit regardless of their specific bid. In many settings, there is little or no benefit to marginally increasing their bid, and there is a risk of being excluded from the group of winning bidders. Additionally, participants face greater incentives to reduce their operating costs, because for a uniform credit value, lower costs will allow generators to achieve greater profits. This can lead to lower operating expenses of the program over time.

Despite its benefits, if the agency has good information about plant characteristics or expects to achieve truthful revelation of costs, a uniform value auction can be more costly for the credit allocator (DOE) than a discriminating price auction and will lead to fewer plants receiving credits under a fixed budget of $1.2 billion. RFF researchers Dr. Dan Shawhan and Kathryne Cleary investigated the emissions reduction impacts of these two approaches, assuming full information and no strategic bidding in the discriminating price credit auction. The results are shown in table 2. They also assumed that the program would apply to the entire United States rather than just to competitive market areas, so their numbers are more optimistic than under what passed in HR 3684, but the ratios of their numbers with uniform versus discriminating subsidies still apply, under the given assumptions of full information and no strategic bidding.

Table 2. Estimated 2025 impact of credit value systems for a $1.2 billion annual budget

	Estimated Generation Capacity Saved (GW)	Estimated CO_2 Emissions Abated per Year (Million Metric Tons)
Uniform Value Credit	26	82
Discriminating Value Credit	37	116

Data comes from research from Shawhan and Picciano, 2019

In reality, a discriminating price auction will place more strain on the auditing system and the credit price adjustment mechanism to ensure plants are receiving the right amount of support, that is, that they have truthfully revealed their costs and accurately bid their minimum willingness to accept. In many experimental settings, discriminating price (minimum value) auctions invite strategic bidding. An important consideration may be whether nuclear generators have enough information about the economic status of other generators to guess a reasonable range of the marginal bid. For example, if generators know that $1.2 billion dollars will be distributed, and they believe the marginal bid will be between $10/MWh and $20/MWh, a generator with a true need of $1/MWh may think it reasonable to bid up to $10/MWh instead. The risk of being excluded from the auction is low and the benefit of succeeding is very high, because their credits will be ten times as valuable when their bid is accepted. The program would need to rely on the auditing and price-adjustment mechanisms to regulate this behavior.

One option explored by RFF researcher Dr. Ray Kopp is a tiered auction structure with uniform values within each tier. Certified plants submit sealed bids. Participants know they will receive a uniform price within their tier, but they do not know what the tier threshold will be. After receiving the bids, the DOE would select a tier cutoff based on the relative needs of different plants. Dr. Kopp finds a natural discontinuity in generator need to select the cutoff point. Generators would be as well-off or better-off than in a discriminating price auction, but the credit program would be less expensive than the single uniform value structure. Without knowing where the tiers will be defined, the benefit of a generator inflating their bid is somewhat reduced.

Credit value decisions also impact the incentive for generators to enter the program. Consider two generators: generator A is losing an average of $2/MWh and generator B is profiting an average of $2/MWh prior to the implementation of the CNC. Generator A is certified but generator B is not because it is profitable without the program. In a discriminating price auction with truthful revelation of costs, generator A will still be worse off than generator B, because generator A will receive just enough support that they break even on their costs. However, in a uniform value structure, generator A may be able to profit more from their allocated credits if the auction clearing price is above their bid, potentially becoming more profitable than generator B. This creates perverse incentives for plants to present themselves as marginally unprofitable so they can participate in the program. Options to address this issue include: (1) setting a maximum profit for plants participating in the program, perhaps by implementing a tiered auction (2) using a discriminating price auction that would require profits for participating plants would be zero (3) establishing fees or punishments for plants that participate in this behavior, assuming it can be identified by the audit system.

Auction frequency

Addresses RFI questions 4, 9, 12

The proposal indicates credits are valid for four years (as required by the legislation). This improves generators' ability to plan in the medium term, but it seems inconsistent with the annual acceptance of certification applications. Will plants that were ineligible to participate in the first auction have to wait 4 years to be considered? Or will there be annual auctions in parallel with the certification process? More frequent auctions would mean more generators are served by the program, but in a uniform value auction the value of credits will differ by the year the auction takes place. It also complicates the distribution of funds because the DOE must decide how much funding to leave aside for potentially newly eligible generators applying for credits after the first auction. This process would be streamlined if all eligible plants participated in the same auction schedule.

3. Credit Price Adjustment and Recapture

Index for price adjustment

Addresses RFI question 9

Within a multi-period (e.g., four year) credit allocation, if electricity prices rise above expected value, the nuclear units would receive a bonus in profits. As written, the proposal calls for an *Adjustment* to payments (p.9) if actual performance would not have led to a loss in the absence of the allocation of credits. An annual settlement mechanism to adjust the award would be appropriate. As noted, state zero emissions credit programs use market indices to adjust credit values. This provision should be supported to protect the public interest.

The proposal suggests that applicants may be required to propose an index or strike price against which the market price values would be netted. (p. 9). A more robust way to deliver revenue stability for the nuclear units might be for DOE to select a generic index through a contract for differences measured against a strike price as an element of the reverse auction. In this framework, the request for bids would stipulate an expected wholesale power price in regional markets, which would be interpreted as the strike price, and nuclear operators would bid a quantity and credit price combination contingent on this expected electricity market price. The calculation of this value may need to account for potential capacity market revenues. The award that a nuclear credit would provide would be based on the winning bid, modified by the change in a metric of the stipulated and realized wholesale market prices. If the realized electricity market price fell, the payment to the nuclear operator would increase proportionately, and vice versa. An issue with this approach would be to identify an appropriate measure of the wholesale power price. Because nuclear units tend to be operated in baseload fashion, a straight average of the wholesale price on a monthly basis might be appropriate. Without ensuring a consistent assumption for prices across generators, bidders could make their bids more appealing in the auction by assuming a high energy price. This would allow them to bid for credits at a lower rate, while taking advantage of the index adjustment when the higher energy prices are not realized.

The details of the index design may depend on the type of auction design selected, and the amount of information index creators have regarding the variables impacting nuclear generators' profitability. The proposal above assumes that uncertainty regarding nuclear plant profitability is largely due to fluctuating

energy prices (compared to tax rates, labor costs and other factors). The degree to which variation in other costs affects nuclear plant profitability could make an index more or less successful in adjusting credit prices. Importantly, the precision of the index matters more in a discriminating price auction, where plants are operating at exactly their break-even point. In a uniform price auction, most plants are offered some cushion from their break-even point, so an index adjustment mechanism can be coarser without risking plants' continued operation, although it remains relevant with respect to the cost effectiveness of the program overall. This would work more similarly to state ZEC programs that use an index to adjust prices.

Penalties for underperformance

Addresses RFI question 9

The proposal describes a *Recapture* provision (p.10), through which DOE may recapture credits. This approach would help discipline bidders and encourage truthful bidding to some extent. Another approach may be the inclusion of a penalty for failure to perform if a bid is accepted. The penalty might be implemented by requiring a financial performance bond.