This document contains the Pew Center's responses to the questions posed by Senators Bingaman and Murkowski in their recently released white paper on a clean energy standard (CES). The Senators' CES white paper is available at http://1.usa.gov/gkPt24.

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- **How would the CES interact with other policies?**
    - A CES that effectively required that 80 percent of U.S. electricity come from clean energy by 2035 would likely achieve power-sector GHG emission reductions consistent with U.S. goals for broader GHG emission reductions required to address concerns about climate change (e.g., an 80 percent economy-wide reduction by 2050).
    - A CES would not address all of the challenges (e.g., market failures and barriers) facing clean energy technologies and should be complemented by technology-specific policies and support for clean energy research and development.

1 What should be the threshold for inclusion in the new program?

1.1 Should there be a threshold for inclusion or should all electric utilities be subject to the standards set by a CES?

The targets and timetable for a CES define the level of clean electricity generation required. Typically, federal electricity portfolio standards have specified “headline” or nominal targets and timetables that can differ substantially from the actual effective requirements of the standards. Two main electricity portfolio standard design parameters determine the difference between the nominal targets and the actual effective targets. First, any exemptions from compliance (e.g., for small utilities) make the effective target lower than the nominal target. Second, any exclusions from the “base quantity” of electricity sales (i.e., the electricity sales to which the nominal target applies) make the effective target lower than the nominal target.

The federal renewable electricity standard included in the House-passed Waxman-Markey American Clean Energy and Security Act of 2009 illustrates the difference between nominal and effective targets. The Waxman-Markey bill included a federal renewable electricity standard with a nominal target of 20 percent by 2020. However, Waxman-Markey included a compliance exemption for small utilities (i.e., those with sales of less than 4 million megawatt-hours per year) responsible for roughly 20 percent of total electricity sales. Moreover, Waxman-Markey excluded conventional hydropower from the base quantity of electricity sales. As such, Waxman-Markey effectively required only that 20 percent of large utilities’ non-hydropower electricity sales come from qualified renewable sources. EIA estimated that the effective Waxman-Markey renewable electricity standard target for 2020 was 16.5 percent of total U.S. electricity sales as opposed to the headline target of 20 percent.

Mindful that an exemption for small utilities can substantially weaken a CES’s effective target in comparison to its headline target, policymakers should consider whether such an exemption is justified. The following points suggest that an exemption for small utilities is not justified. First, by its very nature as a market-based program with compliance demonstrated via tradable credits, a CES does not impose higher costs on smaller utilities simply as a function of their smaller scale. This might be in contrast to certain environmental regulations where, for example, the cost of installing pollution controls (in $/kW of capacity) decreases with larger plant sizes as a result of economies of scale, in which case smaller utilities that own or are supplied by smaller power plants might face higher costs than larger utilities. However, under a CES, all utilities—small and large—can determine the most cost-effective strategy for meeting the CES requirements through a combination of increased clean generation from self-owned facilities, purchase of clean energy credits (CECs), or some other compliance means allowed under the program. Second, the current status of clean energy generation suggests that small utilities can successfully deploy clean energy technologies. For example, the generation and transmission cooperatives that supply rural electric cooperatives with nearly half of their electricity have made significant investments in developing and deploying clean energy technologies. The National Rural Electric

Cooperative Association (NRECA) reports that seven generation and transmission cooperatives are currently partnering with universities, laboratories and research firms to explore methods for capturing and utilizing carbon emissions from existing fossil power plants.[1] In addition, NRECA reports that electric cooperatives are partial owners of operating nuclear plants in seven states and are actively planning to participate in the development of new reactors; moreover, a consortium of cooperatives is working on licensing the first small modular nuclear reactors.[2]

1.2 Should any states or portions of states be specifically excluded from the new program's requirements?

The most cost-effective generation mix that will achieve a given overall national goal for clean energy (e.g., 80 percent by 2035) will differ in its composition across utilities, states, and regions. Under a flexible, market-based program, some states and regions will generate greater levels of clean power than others, and clean electricity will constitute higher proportions of electricity sales for some utilities than for others in order to achieve a specified national clean energy goal at the lowest overall cost. Hawaii and Alaska are two states with characteristics—including the magnitude of their electricity demand and their feasible clean energy options--that suggest that, were they included under a federal CES, they might generate a lower proportion of their electricity supply from clean energy sources than the national target (e.g., 80 percent by 2035) and comply in some measure by purchasing clean energy credits (CECs) from qualified generators in the lower-48 states.[3] Given that the purpose of a market-based program like a federal CES is to allow for flexible compliance with some entities over-complying and others under-complying, the more limited options for in-state clean energy generation that utilities in Hawaii and Alaska might face are not a reason to exclude them from the CES requirements.

1.3 How should a federal mandate interact with the 30 existing state electricity standards?

One option for dealing with existing state renewable and alternative energy portfolio standards is to preempt them with a federal standard. This is likely to run counter to the wishes of state officials who would likely prefer to retain their prerogative to set requirements for clean energy that might be more stringent than a federal CES or that might require compliance via in-state clean energy generation. For example, in September 2010, a bipartisan group of 23 governors signed a letter to the Senate leadership urging passage of a federal renewable electricity standard that, they said, "should build on these state [renewable electricity standard] examples while allowing states the flexibility to set higher renewable energy goals."[4]

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[1] http://www.nreca.org/PressRoom/Releases/20090426CCUSymposium.htm

[2] http://www.nreca.org/issues/FuelsOtherResources/Pages/Nuclear.aspx

[3] Hawaii does, however, have a state renewable portfolio standard (RPS) that calls for 40 percent of electricity to come from renewable sources by 2030. Today, more than three-fourths of Hawaii's electricity comes from petroleum. See http://www.pewclimate.org/node/6695.

[4] Letter from the Governor's Wind Energy Coalition, 13 September 2010, see http://washingtonindependent.com/wp-content/uploads/2010/09/RES-letter.pdf.

Alternatively, a federal CES could be distinct from existing and any new state programs. Under this approach, covered utilities would need to comply with the federal CES via federally issued clean energy credits (CECs) that are different from and not fungible with credits issued under state programs (e.g., state renewable electricity credits, RECs). In this case, many state portfolio standards would likely prove less stringent than the federal CES and thus effectively non-binding on utilities such that these states' RECs would trade at or near a price of zero. Some states might have or set electricity portfolio standards that would require more clean energy from in-state generators than would occur under only the federal CES. If a state sets an electricity portfolio standard that is thus more stringent than the federal CES, this is likely to lead to higher compliance costs in that state but lower compliance costs in other states than would be the case under just the federal CES.[5]

Under the approach that treats state electricity standards as separate from the federal CES, policymakers may take two steps to promote the fair treatment of utilities subject to state standards in addition to the federal CES; these steps were included in Sec. 610(h) of the American Clean Energy Leadership Act of 2009 (S.1462) from the 111th Congress. First, utilities that have purchase agreements for state RECs at the time of enactment of a federal CES might be assured that they will receive federal credits associated with the renewable electricity generation that creates those state RECs absent contracts that stipulate otherwise. Second, to the extent that regulated entities comply with state standards by making payments to state authorities, a federal CES could assign to utilities making such payments ownership of the federal credits associated with any clean energy generation funded by such payments to states. Both of the above provisions should be accompanied by adequate steps to avoid any double-counting of clean power generation under the federal standard.

One argument—and perhaps the primary one—for preempting state programs is to avoid a "patchwork" of state programs in addition to a federal standard. However, compliance with distinct state and federal electricity standards is unlikely to prove onerous for utilities compared to compliance with only a federal CES, so this argument for preemption of state programs is a weak one.

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[5] For example, if a state sets a more stringent electricity standard than the federal CES, regulated entities in the state must go beyond the requirements of the federal CES, meaning that regulated entities outside of the state face a less stringent compliance obligation since the CES applies to national aggregate electricity generation or sales.

2 What resources should qualify as "clean energy"?

2.1 On what basis should qualifying "clean energy" resources be defined? Should the definition of "clean energy" account only for the greenhouse gas emissions of electric generation, or should other environmental issues be accounted for (e.g. particulate matter from biomass combustion, spent fuel from nuclear power, or land use changes for solar panels or wind, etc.)?

From the perspective of addressing the threat of dangerous climate change by reducing greenhouse gas (GHG) emissions from electricity generation, "clean energy" can be understood as the generation of low-carbon electricity or the avoided use of electricity (and thus avoided emissions) from energy efficiency and conservation (i.e., "negawatt-hours"). While one might easily define "clean energy" with respect to climate change, one should also note that at least some stakeholders have concerns about negative aspects of nearly all low-carbon electricity sources—including concerns about natural gas "fracking," nuclear waste, geologically sequestered CO_2, and "energy sprawl" associated with utility-scale renewables.[6]

There are two primary rationales for defining "clean energy" based solely on GHG emissions or some equivalent proxy (e.g., heat rate for natural gas power plants without carbon capture and storage). First, any attempt to broadly define "clean" would surely prove intractable. How would policymakers define a suitable set of criteria for determining an energy technology's degree of "cleanliness"? Would noise pollution from wind turbines be included? Would the criteria include water use or the use of toxic chemicals during manufacturing? Even if policymakers could define a set of criteria, how would they weigh the various criteria against one another? How would policymakers, for example, weight the wastewater treatment challenges associated with hydraulic fracturing to produce unconventional shale gas as compared to bird and bat mortality caused by wind turbines? Second, the United States lacks a policy for decarbonizing the electric power sector as necessitated by the threat of dangerous climate change. The United States does, however, have a host of local, state, and federal policies already in place for dealing with issues like non-GHG air and water pollution and wildlife impacts. To the extent that such policies insufficiently address the relevant environmental issues, policymakers ought to modify them or enact new policies that directly target the issues of concern. As such, policymakers can focus on reducing GHG emissions via a federal CES and rely on other polices to address concerns that some stakeholders raise when judging whether an energy technology is "clean" or not.

In achieving a given level of clean energy generation and associated benefits (e.g., GHG emission reductions), the cost-effectiveness of a CES increases with the number of energy sources that are low-carbon and that qualify for credits under the CES proportional to their

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[6] "Fracking" refers to the technique of hydraulic fracturing that is behind the rapid growth in U.S. unconventional natural gas production from shale gas resources. Stakeholders have raised concerns about water contamination issues associated with "fracking." For more information, see EIA's "What Is Shale Gas and Why Is It Important?" at http://www.eia.doe.gov/energy_in_brief/about_shale_gas.cfm.

carbon-intensity. The more cost-effective a CES program is, the smaller the cost impacts are for households and businesses.

2.2 Should qualifying clean energy resources be expressly listed or based on a general emissions threshold? If it is determined that a list of clean energy resources is preferable, what is the optimal definition for "clean energy" that will deploy a diverse set of clean generation technologies at least cost? Should there be an avenue to qualify additional clean energy resources in the future, based on technological advancements?

A CES must expressly list the types of electricity generation that qualify as clean or define criteria that technologies must meet to be eligible for credits under a CES. A CES might provide full credit to electricity from non-emitting technologies (e.g., renewables and nuclear power) and partial credit to electricity from lower-carbon technologies (i.e., natural gas generation and fossil fuel use coupled with carbon capture and storage, CCS).

The least-cost emission reduction pathway for the power sector involves both reducing electricity demand growth via efficiency and conservation and lowering the GHG emissions intensity of total electricity generation through a combination of changes among fossil-fueled generators (i.e., retirement of carbon-intensive generators, efficiency improvements at generating units, fuel switching from coal to biomass or natural gas, and use of CCS) and growth in generation from non-emitting technologies (i.e., nuclear and renewables). In terms of achieving GHG emission reductions, the most cost-effective CES would encourage this full range of approaches to reducing the carbon-intensity of electricity generation and provide a financial incentive via clean energy credits to particular approaches that are proportional to their contribution to reducing emissions.

One option for a CES to spur a wide array of lower-carbon generation is to issue clean energy credits (CECs) to a given electricity generator in proportion to the degree to which that generator's GHG emissions intensity is lower than that of a new coal-fired power plant without CCS (see Equation 1).

Equation 1: Formula for Awarding CECs to Clean Energy Sources

$$[\#\text{ of CECs} / \text{MWh}] = 1 - \frac{[\text{Generator's GHG Intensity in tCO}_2\text{e} / \text{MWh}]}{[\text{GHG Intensity in tCO}_2\text{e} / \text{MWh of a New Coal-Fueled Power Plant without CCS}]}$$

The intent of Equation 1 might be duplicated in a CES bill indirectly via the following legislative provisions:

- Provide 1 CEC for each MWh of generation from a list of technologies (all non-emitting) that includes nuclear power, wind, solar, and other renewables;

- Provide CECs for natural gas generation without CCS as a function of a generator’s heat rate since CO_2 emissions per MWh are a simple function of heat rate for natural gas generation;
- Provide CECs for fossil fuel generation coupled with CCS via a formula using the carbon content of the fuel input, the amount of generation, and the number of tons of CO_2 captured and permanently sequestered.

Should policymakers choose an approach like that outlined in the bullets above, provision should be made for new “clean” technologies to qualify for credits under a federal CES so as to provide an incentive for technology innovation. This might be done by establishing a procedure for the CES program administrator to evaluate new technologies and determine to what extent they should be eligible for credits under the CES.

2.3 What is the role for energy efficiency in the standard? If energy efficiency qualifies, should it be limited to the supply side, the demand side, or both? How should measurement and verification issues be handled?

Many analyses find that energy efficiency and conservation can provide large greenhouse gas (GHG) emission reductions via avoided electricity generation at a relatively low cost, and recent congressional electricity portfolio standards have allowed for some degree of compliance via credits awarded for demonstrated electricity savings. For example, the renewable electricity standard in the Senate Energy and Natural Resource Committee’s American Clean Energy Leadership Act of 2009 allowed for a utility to meet up to 25 percent of its compliance obligation via credits awarded for electricity savings.[7]

In theory, a CES that awarded credits for demonstrated electricity savings from energy efficiency and conservation measures would reduce GHG emissions more cost-effectively than one that did not. However, at least three interrelated issues arise when credits are awarded for electricity savings:

- Measuring electricity savings may prove difficult and politically contentious.
- Awarding credits to utilities for electricity savings that are already factored into “business-as-usual” projections for electricity demand lowers the effective target of a CES and the clean energy technology deployment and GHG emission reductions achieved by the policy.

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[7] The House and Senate renewable electricity standards and Senator Graham’s clean energy standard in the 111th Congress placed similar limits on credits for electricity savings. Senator Lugar’s Diverse Energy Standard placed no limit on compliance via electricity savings from efficiency and conservation. See the Pew Center’s “Comparison Chart: Diversified/Renewable Energy Standard Provisions in Climate and Energy Legislation in the 111th,” at http://www.pewclimate.org/federal/analysis/congress/111/comparison-chart-diversifiedrenewable-energy-standard-provisions-clima.

- Historically, certain states and utilities have been more aggressive in pursuing energy efficiency than others. With substantial efficiency programs and requirements already in place, these states and utilities may object to any requirement under a CES that credits only be awarded for electricity savings beyond "business as usual."

Nonetheless, the federal electricity portfolio standard proposals in the 111th Congress allowed for at least partial compliance via credits for demonstrated electricity savings from energy efficiency. Moreover, at least 10 states currently provide credits for electricity savings from energy efficiency under their state renewable or alternative electricity portfolio standards.[8]

While providing credits for electricity savings from energy efficiency would, in theory, make a CES more cost-effective in terms of reducing emissions, it may not achieve other policy goals to the same extent. For example, a CES that does not provide credit for electricity savings may do more to promote the diversification of energy sources and new clean energy technology deployment.

President Obama's CES proposal suggests that certain energy efficiency and conservation measures (e.g., highly efficient industrial combined heat and power, CHP) may be more amenable to inclusion in a CES while others (e.g., electricity savings from residential energy efficiency) might be better addressed via complementary policies (e.g., equipment efficiency standards and financial incentives for residential and commercial energy efficiency investments). Such an approach would make the deployment of clean energy generation technologies the focus of a CES as opposed to, for example, the reduction of emissions.

Even if a CES does not give compliance credits directly for electricity savings, electricity savings from energy efficiency and conservation still indirectly count toward compliance with the CES requirements. Because each unit of electricity savings reduces the base quantity of electricity sales to which the CES percentage targets apply, a utility can lower the number of clean energy credits (CECs) that it must surrender in any given year to meet the CES requirements by lowering its electricity sales via electricity savings.

If credits are directly awarded for electricity savings from energy efficiency and conservation under a CES, policymakers must decide how many credits to award for each unit of electricity savings. Because each unit of electricity savings reduces the base quantity of electricity sales to which the CES percentage targets apply, policymakers can treat one unit of electricity savings as equivalent to one unit of clean energy generation by providing partial credits for each unit of electricity savings, with the partial credit for electricity savings declining as the CES percentage target increases over time.

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[8] http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm

2.4 Should retrofits or retirements of traditional fossil-fuel plants be included in the standard?

A CES should provide credits for generation from fossil-fueled power plants that are retrofit with carbon capture and storage (CCS), and credits should be awarded for generation from these plants in proportion to the carbon-intensity of their generation.

The least-cost greenhouse gas (GHG) emission reduction pathway for the power sector involves both reducing electricity demand growth via efficiency and conservation and lowering the GHG emissions intensity of total electricity generation through a combination of changes among fossil-fueled generators (i.e., retirement of carbon-intensive generators, efficiency improvements at generating units, fuel switching from coal to biomass or natural gas, and use of CCS) and growth in generation from non-emitting technologies (i.e., nuclear and renewables). In terms of achieving GHG emission reductions, the most cost-effective CES would encourage this full range of approaches to reducing the carbon-intensity of electricity generation and provide incentives to particular approaches that are proportional to their contribution to reducing emissions.

The CES proposed by Senator Graham (the Clean Energy Standard Act of 2010, S.20) in the 111th Congress would have provided credits for early retirement of carbon-intensive generating units (e.g., old coal plants), where early retirement was defined as retirement between enactment of the bill and the end of 2014. Under Senator Graham's proposed CES, eligible retired units received partial credits for their avoided generation during this period.

As under Senator Graham's proposal, a CES might offer some shut-down credits in order to spur the early retirement of additional coal plants facing retrofit requirements to comply with pending air, water, and waste regulations. Under a broadly defined CES, providing credits for avoided generation from retired coal plants lowers the CES's effective target, but the magnitude of this effect might be small if the shut-down credits were limited in number (e.g., granted for a short duration). Moreover, the net effect of granting such shut-down credits likely depends on the level of any alternative compliance payment (ACP) under the CES.

2.5 Should the standard be focused solely on electricity generation, or is there a role for other clean energy technologies that could displace electricity, such as biomass-to-thermal energy?

[No Response]

3 How should the crediting system and timetables be designed?

3.1 Should the standard's requirements be keyed to the year 2035 or some other timeframe?

The electric power industry needs to invest billions of dollars in new power plants and other infrastructure over the coming decades to meet new demand for electricity and to replace an aging power plant fleet. Long-term regulatory certainty can help electric power industry firms make optimal investments particularly since investments in electricity generation facilities often require long lead times and have financial horizons that span multiple decades. As such, a CES that establishes targets and requirements for at least the next 25 years can provide the power industry with regulatory certainty over roughly the timeframe for which they will plan in the near future.

3.2 What interim targets and timetables should be established to meet the standard's requirements?

Setting annual clean energy requirements under a CES that are roughly linear in their progress toward a final target (e.g., 80 percent by 2035) is likely to incentivize a realistic and substantial level of clean energy technology deployment. Moreover, providing temporal compliance flexibility via clean energy credit (CEC) banking and at least limited borrowing allows regulated entities to optimize the actual deployment of clean energy technology in light of the CES targets and timetables.

An alternative option is to set annual requirements that increase more slowly in the early years of a CES in order to give the power sector more time to ramp up deployment of clean energy technology over time. While certain clean energy technologies (e.g., new nuclear reactors and fossil fuel use coupled with CCS) doubtless require longer lead times than others (e.g., wind farms and solar arrays), the recent growth of clean generation suggests that the power sector can readily meet CES targets that simply increase linearly from the current percentage of clean energy generation. In the near term, continued rapid growth in renewable generation, increased utilization of existing natural gas combined cycle plants, and new natural gas-fired capacity can increase clean energy's share of U.S. power generation while power generators take steps to initiate clean energy projects with longer lead times (e.g., nuclear power and fossil fuel use coupled with CCS).

Data on the recent growth in clean energy support the feasibility of a simple approach to setting targets and timetables. A CES that required the percentage of clean energy to increase linearly from the level at the program's enactment to 80 percent by 2035 would require that the percentage of U.S. electricity supplied from clean energy sources increase by about 1.6 percentage points per year. From 2005 to 2010, the share of U.S. electricity supplied by clean energy other than conventional hydropower increased from 30 to 35 percent—i.e., in the absence of any overarching policy such as a CES to drive clean energy growth, the growth in clean energy generation over the last five years has been almost two-thirds as much as would be needed under a CES with a 2035 target of 80 percent and with linearly increasing targets.[9]

One reason not to establish rates of increase for CES annual requirements that vary over time is that setting targets that start off low and rise slowly in the early years of a CES program might lead some stakeholders to support restrictions on credit banking—lest early over-compliance with easily met CES targets undermine near- and medium-term clean energy deployment and emission reduction goals and shrink the difference between clean energy generation under a CES and under "business as usual." Credit banking provides useful temporal compliance flexibility for regulated entities and makes a CES more cost-effective, and setting roughly linearly increasing CES targets can avoid undermining support for credit banking.

3.3 What are the tradeoffs between crediting all existing clean technologies versus only allowing new and incremental upgrades to qualify for credits? Is one methodology preferable to the other?

All of the federal electricity portfolio standards in the 111th Congress (i.e., the Waxman-Markey and Senate renewable electricity standards and the proposals from Senators Lugar and Graham) provided credits to all renewable electricity (new and existing) with the exception of conventional hydropower, for which only incremental generation received credits. The electricity portfolio standards from Senators Lugar and Graham provided credits to certain non-renewable clean energy sources but, with respect to existing nuclear plants, provided credits only to incremental output.

There are five issues to consider related to granting clean energy credits (CECs) to existing clean energy facilities under a CES.

Target-Setting

The level of incremental clean energy required by a given "headline" CES target will vary depending on whether or not generation from existing facilities counts toward the target. Providing credits to all clean energy generation (new and existing) makes it simple to translate a target like President Obama's goal of supplying 80 percent of electricity from clean energy by 2035 into a CES target. Providing credits only to new or incremental clean energy generation means that, all else equal, the actual level of clean energy generation in a given year will be a function both of the percentage requirement set under the CES and the level of generation from existing clean energy sources that do not receive credits under the CES.

Incentives for Incremental Output

To the extent that an additional financial incentive can lead to greater output from existing clean energy facilities, then providing credits to at least incremental generation from existing clean

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[9] Data cited are for the electric power sector only as reported in EIA's *Annual Energy Review 2009* and *Electric Power Monthly March 2011 Edition*.

power facilities improves the cost-effectiveness of a CES. For example, if credits are not awarded to existing clean energy generation, then awarding credits for incremental output from existing clean energy generators can provide an incentive for nuclear uprates and higher utilization of existing natural gas combined cycle power plants.

“Windfall Profits”

Granting credits under a CES to existing facilities can raise concerns about “windfall profits.” The cost of credits under a CES is borne in large part by electricity consumers. Granting credits to existing clean energy facilities for non-incremental output can simply transfer wealth from electricity consumers who bear the cost of acquiring such credits to certain producers without incentivizing any clean energy generation that would not have otherwise occurred.[10]

Unintended Incentives

Because existing clean energy facilities (e.g., nuclear plants and hydroelectric dams) face very low variable production costs, they are unlikely to reduce their output if they do not receive credits under a CES in the near and medium run; however, to the extent that owners of existing clean energy facilities will eventually need to make investments to continue producing clean energy, they may ultimately choose to retire facilities rather than extend their lives if the owners do not receive credits for the plants’ clean energy output under a CES. Similarly, providing credit to only incremental output from natural gas power plants (under a CES that provided any credit for natural gas) might introduce competition between new and existing natural gas generation.

Regional Impacts

Granting credits to existing clean generation has implications for how the impacts of a federal CES are distributed among utilities, states, and regions. For example, assuming uniform percentage requirements for all utilities, providing credits for non-incremental generation from existing clean energy facilities makes utilities that, at the time of enactment of a CES, have relatively low levels of clean energy generation net buyers of CECs from utilities that start out with relatively high shares of electricity from clean energy sources.

On balance, the issues described above suggest that policymakers ought to provide CECs only to generation from new clean energy facilities and incremental output from existing clean energy facilities. Policymakers can establish a bright-line distinction between new and existing clean energy generators. Policymakers might set the online date used for distinguishing between new and existing facilities some time before enactment of the CES in order to reward “early action.”

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[10] Note that this issue of wealth transfers from consumers to producers is nuanced. In some competitive electricity markets, a CES might actually lower wholesale power prices during certain periods. In such cases, existing clean power facilities might be less profitable under a CES than they would otherwise have been which might be an argument for providing credits to existing facilities.

Further analysis can determine the extent to which the unintended consequences noted above (e.g., retirement of clean energy facilities) associated with providing credits only to new and incremental clean energy generation may be material rather than just theoretical concerns. A CES could include provisions to address those unintended consequences that are expected to be material. For example, if analysis suggests that nuclear plant owners will not relicense their reactors without receiving credits under a CES even when such relicensing would be part of the most cost-effective pathway to meeting an overall clean energy goal, then policymakers might provide some amount of credits for generation from existing nuclear plants upon their relicensing.

The concerns described above regarding granting credits under a CES to non-incremental generation from existing clean energy facilities apply primarily to existing nuclear, hydropower, and natural gas facilities simply because they provide about 90 percent of current U.S. clean electricity (giving natural gas generation half credit as clean). While many of these concerns may apply qualitatively to existing non-hydro renewable facilities, such facilities represent such a small portion of existing generation that a CES might provide credits to all non-hydro renewable generation without significant undesirable consequences.

3.4 Should partial credits be given for certain technologies, like efficient natural gas and clean coal, as the President has proposed? If partial credits are used, on what basis should the percentage of credit be awarded? Should this be made modifiable over the life of the program?

A federal CES should give partial credits to certain technologies that are low- or very low-emitting but not non-emitting technologies. For natural gas without carbon capture and storage (CCS), partial credits should be awarded in proportion to the units' heat rates since this GHG emissions are a direct function of heat rate for such power plants. For fossil fuel use coupled with CCS, partial credits should be awarded as a function of the carbon content of the fuel and the percentage of this carbon content that is captured and permanently sequestered.

3.5 Is there a deployment path that will optimize the trade-off between the overall cost of the program and the overall amount of clean energy deployed?

Providing interim annual requirements for clean energy generation under a CES provides the policy certainty that firms require for making long-term investments in clean energy. Policymakers might simply establish roughly straight-line annual clean energy requirements that ramp up to an ultimate national goal (e.g., 80 percent by 2035) and allow covered entities temporal compliance flexibility. Allowing for credit banking and borrowing provides compliance flexibility to covered entities so that they can optimally time their investments in clean energy deployment to minimize the overall cost of the program.

An alternative option is to set annual requirements that increase more slowly in the early years of a CES in order to give the power sector more time to ramp up deployment of clean energy technology over time. While certain clean energy technologies (e.g., new nuclear reactors and fossil fuel use coupled with CCS) doubtless require longer lead times than others (e.g., wind farms and solar arrays), the recent growth of clean generation suggests that the power sector can readily meet CES targets that simply increase linearly from the current percentage of clean energy generation. In the near term, continued rapid growth in renewable generation, increased utilization of existing natural gas combined cycle plants, and new natural gas-fired capacity can increase clean energy's share of U.S. power generation while power generators take steps to initiate clean energy projects with longer lead times (e.g., nuclear power and fossil fuel use coupled with CCS).

Data on the recent growth in clean energy support the feasibility of a simple approach to setting targets and timetables. A CES that required the percentage of clean energy to increase linearly from the level at the program's enactment to 80 percent by 2035 would require that the percentage of U.S. electricity supplied from clean energy sources increase by about 1.6 percentage points per year. From 2005 to 2010, the share of U.S. electricity supplied by clean energy other than conventional hydropower increased from 30 to 35 percent—i.e., in the absence of any overarching policy such as a CES to drive clean energy growth, the growth in clean energy generation over the last five years has been almost two-thirds as much as would be needed under a CES with a 2035 target of 80 percent and with linearly increasing targets.[11]

One reason not to establish rates of increase for CES annual requirements that vary over time is that setting targets that start off low and rise slowly in the early years of a CES program might lead some stakeholders to support restrictions on credit banking—lest early over-compliance with easily met CES targets undermine near- and medium-term clean energy deployment and emission reduction goals and shrink the difference between clean energy generation under a CES and under "business as usual." Credit banking provides useful temporal compliance flexibility for regulated entities and makes a CES more cost-effective, and setting roughly linearly increasing CES targets can avoid undermining support for credit banking.

3.6 What would be the effect of including tiers for particular classes of technology, or for technologies with different levels of economic risk, and what would be a viable way of including such tiers?

One option for designing a CES program is to make it technology-neutral and to avoid "picking winners" from among various clean energy technologies. Including tiers for particular technologies or classes of technologies makes a CES program less technology-neutral. One rationale for being technology-neutral is to maximize the cost-effectiveness of a CES program. However, a purely technology-neutral CES may not be the most cost-effective policy for promoting clean energy deployment since different market failures and barriers hinder the deployment of clean energy technologies to varying degrees. For example, the current lack of a

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[11] Data cited are for the electric power sector only as reported in EIA's *Annual Energy Review 2009* and *Electric Power Monthly March 2011 Edition*.

premium for clean energy hinders the deployment of less mature and more commercially risky clean energy technology but so does the lack of financial reward for the “spillover” benefits that come from deploying such technology—e.g., moving a technology down its learning curve or reducing uncertainty by demonstrating the real-world cost and performance of a first-of-a-kind commercial-scale facility. Moreover, to the extent that ensuring a role for certain technologies can help alleviate concerns about interstate or interregional disparities, including a tier for such technologies might make a CES program fairer.

State renewable and alternative electricity portfolio standards provide precedents for including tiers for particular clean technologies or classes of technologies. Several state renewable electricity portfolio standards (RPSs) include a tier (or “carve-out”) specifically for solar power. Pennsylvania and Ohio both have alternative energy portfolio standards (AEPSs) covering their utilities that have tiers. Pennsylvania has separate tiers for renewable and non-renewable, alternative energy sources. Ohio similarly requires that at least half of the clean energy used to comply with its AEPS comes from renewable energy.

The most obvious effect of including tiers for particular classes of technology under a federal CES would be to ensure particular minimum levels of deployment for these classes of technology. To the extent that these minimum levels of deployment are less than the corresponding levels of technology deployment that a CES without tiers would incentivize, then the tiers would have little to no effect on the cost-effectiveness of the CES or other program impacts. To the extent that these minimum levels of deployment are more than the corresponding levels of technology deployment that a CES without tiers would incentivize, the effect of including tiers on the overall cost-effectiveness of a CES is ambiguous. Policymakers might define tiers that set minimum deployment requirements for particular classes of technologies that far exceed the most cost-effective deployment level under an overall goal for clean energy. As explained above, though, there are market failures and barriers that tiers for certain classes of technologies may address and thereby improve the overall cost-effectiveness of a CES program. For example, if a tier for less mature technologies leads to substantial technology learning and associated cost reductions and performance improvements, then the inclusion of the tier could ultimately lower the cost of achieving the overall goal for clean energy.

Policymakers might define a tier to ensure a minimum level of renewable energy deployment. Such a tier might be set at a level similar to the targets included in the federal renewable electricity standards passed by the House and reported out of the Senate Energy and Natural Resources Committee in 2009. In the case of renewables, a tier might operate by creating a special designation for clean energy credits (CECs) that come from renewables (e.g., CEC-Rs). CEC-Rs could be fully fungible with other CECs and could be used in any amount to demonstrate compliance with the CES. However, the CES could require that each covered entity meet a certain portion of its overall compliance obligation under the CES with CEC-Rs in order to create a tier and minimum level of deployment for renewables.

3.7 Should the same credit be available to meet both the federal mandate and an existing state standard or should a credit only be utilized once?

The simplest approach for treating state electricity portfolio standards is for a federal CES to be distinct from existing and any new state programs. Under this approach, covered utilities would need to comply with the federal CES via federally issued clean energy credits (CECs) that are different from and not fungible with credits issued under state programs (e.g., state renewable electricity credits, RECs). A clean energy facility could accrue both CECs and state RECs for its qualified generation.

Under the approach that treats state electricity standards as separate from the federal CES, policymakers may take two steps to promote the fair treatment of utilities subject to state standards in addition to the federal CES; these steps were included in Sec. 610(h) of the American Clean Energy Leadership Act of 2009 (S.1462) from the 111th Congress. First, utilities that have purchase agreements for state RECs at the time of enactment of a federal CES might be assured that they will receive federal credits associated with the renewable electricity generation that creates those state RECs absent contracts that stipulate otherwise. Second, to the extent that regulated entities comply with state standards by making payments to state authorities, a federal CES could assign to utilities making such payments ownership of the federal credits associated with any clean energy generation funded by such payments to states. Both of the above provisions should be accompanied by adequate steps to avoid any double-counting of clean power generation under the federal standard.

3.8 Should there be a banking and/or borrowing system available for credits and, if so, for how long?

As a market-oriented policy under which covered entities demonstrate compliance via credits, a CES provides entities with flexibility that substantially lowers the cost of achieving goals like clean energy deployment compared to non-market-oriented policies with the same goals. Banking and borrowing of credits under a CES provide further compliance flexibility and further reduce the cost of achieving a given clean energy goal (e.g., 80 percent by 2035).

One might argue that banking of credits should be limited under some electricity portfolio standard policies. For example, a renewable electricity standard (RES) that sets targets that are roughly the same as or even lower than "business-as-usual" projections in some early years might warrant restrictions on banking since, with banking of credits allowed, early over-compliance with these very modest early requirements might undermine the policy's impact on the longer-term deployment of renewables since such a policy would effectively require a smaller cumulative increase in renewable energy generation compared to "business as usual" with banking allowed than without banking. However, there is no such rationale for limitations on banking under a CES with clean energy targets that are significantly higher than "business as usual" projections—e.g., a CES consistent with President Obama's goal of 80 percent clean energy by 2035).

In theory, borrowing is simply the mirror image of banking and an additional means of providing regulated entities with temporal compliance flexibility. Allowing for borrowing does, though, raise some implementation challenges regarding enforcement of repayment and the risk that firms will rely excessively on borrowing credits from the future thus creating pressure for policymakers to lower future clean energy targets. This dynamic jeopardizes the overall clean energy deployment goal and also increases regulatory uncertainty for firms. In light of these issues, policymakers might allow for limited borrowing of credits under a CES, perhaps tied to projected output from specific clean energy facilities that are reasonably anticipated to come online in the future.

4 How will a CES affect the deployment of specific technologies?

4.1 How valuable would clean energy credits have to be in order to facilitate the deployment of individual qualified technologies?

It is difficult to say how valuable clean energy credits would have to be in order to facilitate the deployment of individual qualified technologies. Estimates of the levelized cost of electricity (LCOE) for various clean technologies can provide some insights but only tell part of the story.

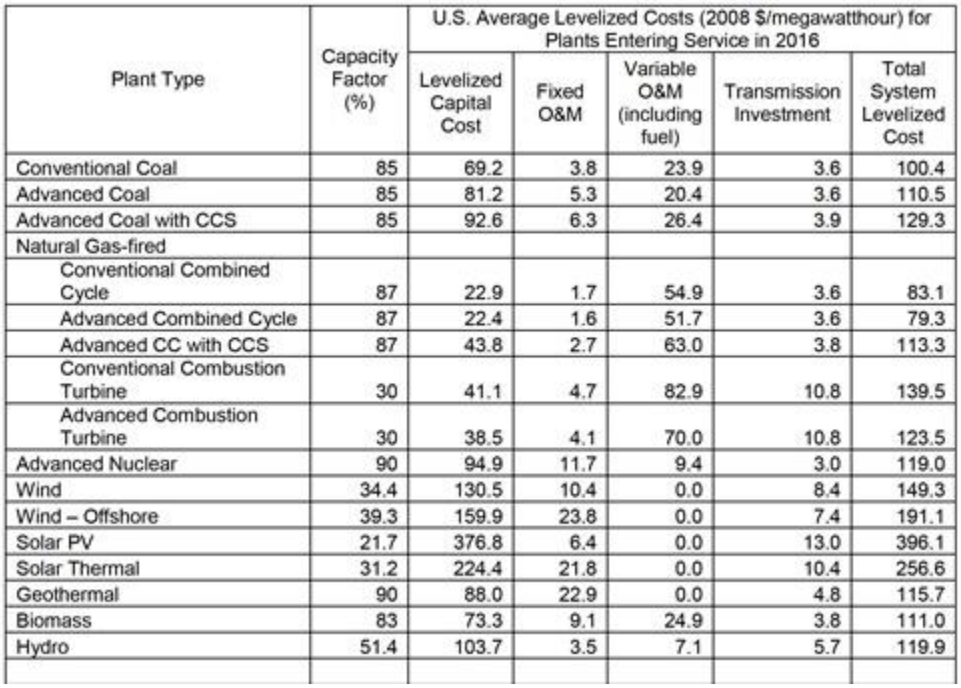
In rough terms, assuming extension of the current production tax credit (PTC) and investment tax credit (ITC) for renewables, electricity from new wind, biopower, geothermal, nuclear, and coal and natural gas coupled with carbon capture and storage plants is less than $50 per MWh more expensive on a levelized-cost basis than electricity from a new natural gas combined cycle plant (see details below).

This comparison of LCOE estimates does not tell the whole story for at least four reasons, however. First, the LCOE estimates for various new power plant types do not fully reflect the value of all potential subsidies for clean power generation. Second, LCOE is an incomplete measure. Simply providing a sufficient subsidy to equate the LCOE of a certain clean energy technology with the LCOE for a new fossil fuel-based power plant may not, in many cases, be sufficient to tip the scales in favor of the clean technology. This may be the case because of a variety of factors not captured in LCOE—including the lower value of electricity from variable (or intermittent) renewable generation, risks or additional costs associated with less mature technology (e.g., carbon capture and storage), and regulatory impediments (e.g., uncertainty over long-term nuclear waste storage, long-term liability for geologically sequestered CO_2, and siting challenges for new transmission lines necessary to harness renewable resources distant from the high population areas where electricity demand is concentrated). Thirdly, providing half credit for natural gas generation under a CES complicates the matter and probably requires higher credit prices to tip the scales in favor of new non-emitting generation. Finally, and perhaps most importantly, the tradable credit price under any CES that would achieve substantial clean energy technology deployment must not only change economic incentives in favor of new clean energy generation vs. new fossil fuel-based generation, it must also change such incentives to a significant degree with respect to new clean energy generation vs. generation from existing fossil fuel-based generators, particularly existing coal-fired power plants. This last point suggests that, in order to drive the replacement of coal-fired electricity with new clean power, the value of clean energy credits must be larger than the cost premium between new clean energy generation and new fossil fuel-based generation.

The tables below show EIA's estimates of the U.S. average LCOE from various plant types (Table 1) and the LCOE cost differentials between these estimates and the LCOE for a new natural gas combined cycle (NGCC) power plant (Table 2).

The tables below suggest that, if the existing federal tax subsidies for renewable power are extended beyond their current expiration dates, a tradable credit price under a CES of roughly $50 per MWh might make onshore wind, biopower, geothermal, new nuclear, and fossil fuel use coupled with carbon capture and storage competitive with NGCC plants as new sources of electricity at least on an LCOE basis. Sophisticated power sector modeling analysis could provide a better estimate of the actual cost premium of clean energy generation for different overall clean energy technology deployment goals.

Table 1: Estimated Levelized Cost of New Generation Resources, 2016[12]



Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2008 $/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	69.2	3.8	23.9	3.6	100.4
Advanced Coal	85	81.2	5.3	20.4	3.6	110.5
Advanced Coal with CCS	85	92.6	6.3	26.4	3.9	129.3
Natural Gas-fired						
Conventional Combined Cycle	87	22.9	1.7	54.9	3.6	83.1
Advanced Combined Cycle	87	22.4	1.6	51.7	3.6	79.3
Advanced CC with CCS	87	43.8	2.7	63.0	3.8	113.3
Conventional Combustion Turbine	30	41.1	4.7	82.9	10.8	139.5
Advanced Combustion Turbine	30	38.5	4.1	70.0	10.8	123.5
Advanced Nuclear	90	94.9	11.7	9.4	3.0	119.0
Wind	34.4	130.5	10.4	0.0	8.4	149.3
Wind – Offshore	39.3	159.9	23.8	0.0	7.4	191.1
Solar PV	21.7	376.8	6.4	0.0	13.0	396.1
Solar Thermal	31.2	224.4	21.8	0.0	10.4	256.6
Geothermal	90	88.0	22.9	0.0	4.8	115.7
Biomass	83	73.3	9.1	24.9	3.8	111.0
Hydro	51.4	103.7	3.5	7.1	5.7	119.9

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[12] EIA, *Annual Energy Outlook 2010*, see http://www.eia.doe.gov/oiaf/archive/aeo10/electricity_generation.html. Note that the costs shown above do not include any federal or state tax or other financial incentives. Also, the LCOE for renewable sources varies widely across the country depending on relative resource endowments.

Table 2: Cost Premium of Clean Power vs. Natural Gas Combined Cycle (NGCC)[13]

Plant Type	Total System Levelized Cost (2008$ / MWh)	Premium to NGCC (2008$ / MWh)	Premium to NGCC after Renewable PTC/ITC (2008$ / MWh)
Conventional Coal	$ 100.4	$ 21.1	$ 21.1
Advanced Coal	$ 110.5	$ 31.2	$ 31.2
Advanced Coal with CCS	$ 129.3	$ 50.0	$ 50.0
Natural Gas-fired			
Conventional Combined Cycle	$ 83.1	$ 3.8	$ 3.8
Advanced Combined Cycle	$ 79.3	$ -	$ -
Advanced Combined Cycle with CCS	$ 113.3	$ 34.0	$ 34.0
Advanced Nuclear	$ 119.0	$ 39.7	$ 39.7
Wind	$ 149.3	$ 70.0	$ 49.0
Wind - Offshore	$ 191.1	$ 111.8	$ 90.8
Solar PV	$ 396.1	$ 316.8	$ 203.8
Solar Thermal	$ 256.6	$ 177.3	$ 110.0
Geothermal	$ 115.7	$ 36.4	$ 15.4
Biomass	$ 111.0	$ 31.7	$ 20.7
Hydro	$ 119.9	$ 40.6	$ 40.6

4.2 How might a CES alter the current dispatch order of existing generation (such as natural gas-fired power plants), which has been driven by minimization of consumer costs, historically?

Nuclear, hydroelectric, wind, and solar power all have low variable production costs, so a CES that provided an extra incentive to these technologies is unlikely to change the dispatch order for these technologies. A CES will, of course, incentivize greater deployment of these technologies (to the extent that they are eligible for credits under a CES), and the growth in clean generating capacity will necessarily displace some traditional fossil fueled power generation.

Providing partial credits under a CES to generation from highly efficient natural gas plants (e.g., to modern combined cycle power plants) would likely lead to the displacement of generation from traditional coal plants (i.e., those without carbon capture and storage, CCS) by natural gas-fired generation through both changing the dispatch order among existing coal and natural gas plants and spurring the deployment of additional natural gas plants that would displace coal-fueled generation.

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[13] Production tax credit (PTC) assumed to apply to wind, geothermal, and biomass in the amounts of 21, 21, and 11 2008$ / MWh, respectively. A 30 percent investment tax credit was deducted from the levelized capital costs of solar PV and solar thermal plants. Note that these estimates do not reflect all potential subsidies for renewable power if all existing subsidies are extended nor do they take into account the limited life of the PTC for qualified projects (i.e., the first 10 years of plant operation).

Power sector modeling analyses often find that some degree of fuel switching from coal to gas is a low-cost means of reducing pollution (including greenhouse gas, GHG, emissions) from the power sector. Moreover, the recent shale gas "revolution" has dramatically increased estimates of economically recoverable domestic natural gas resources and lowered natural gas price projections thus mitigating concerns that a "dash to gas" in the power sector might lead to large price increases that could negatively impact other economic sectors (particularly natural gas-dependent manufacturers).

While power plant dispatch orders have historically dispatched coal plants before natural gas generation (owing to the lower variable productions costs of the former) in order to minimize total generation costs and thus consumer costs, this approach to cost minimization is based only on private costs borne by power generators. To the extent that pollutants are unregulated (as in the case of the GHG emissions that cause climate change), least-cost, economic dispatch fails to account for the full social costs associated with power generation. To the extent that a CES program provides financial incentives to change the dispatch order to favor cleaner technologies that have lower environmental impacts and technologies that provide non-environmental spillover benefits (e.g., learning-by-doing technology improvements), the changes in power plant dispatch can lower the overall social cost of electricity production.

In addition, in competitive electricity markets where wholesale power prices are set by marginal generators and where efficient natural gas generators are frequently the price-setting units, a CES that provides credit to such generators will lower these generators' variable operating costs and thus lower their price-setting power market bids and thus wholesale market clearing prices. While sophisticated power sector modeling can best project the net effect of a CES on retail electricity prices, the above discussion suggests that at least in some cases, a CES might lower wholesale electricity prices.

4.3 What is the expected electricity generation mix for a target of 80 percent clean energy by 2035, under the President's proposal or an alternative construct?

Sophisticated power sector modeling analyses can provide insights into the likely electricity generation mix that would cost-effectively meet a target of 80 percent clean energy by 2035 as proposed by President Obama. Unfortunately, very few published modeling studies have looked at national electricity portfolio standards that provide credit for a wide range of clean energy technologies and that set targets comparable to President Obama's goal. The publicly available study that comes closest to modeling an electricity standard comparable to the President's proposed CES is Palmer et al. (2010), which modeled several variations of federal electricity standards with the most ambitious and broadly defined one (called "CEPS-All" by Palmer et al.)

requiring about 85 percent as much clean energy by 2030 as President Obama's proposed CES likely would (assuming straight-lined targets from now until 2035).[14]

The results from Palmer et al. illustrate how a CES might change the power sector's generation mix. Figure 1 shows the electricity generation mix projected by Palmer et al. in their modeling of a CES similar in design to but less aggressive than the CES proposed by President Obama. The CES modeled by Palmer et al. resulted in 61 percent of total electricity generation coming from clean sources (giving half credit to natural gas) in 2030. Palmer et al. projected that, in 2020, non-hydro renewable and nuclear generation would be 40 and 12 percent higher than under "business as usual," respectively, while natural gas and coal generation would be 3 and 12 percent lower, respectively. By 2030, however, Palmer et al. projected a substantial increase in natural gas generation—55 percent higher than under "business as usual"—and smaller increases in non-hydro renewable and nuclear power generation—29 and 36 percent higher than under "business as usual," respectively. These increases came at the expense of coal-fueled generation which was projected to be 55 percent lower than under "business as usual."

Needless to say, one should view these precise projections of power sector generation shares 25 years in the future with some skepticism. However, the results from Palmer et al. do suggest that a broadly defined CES could lead to growth in generation from natural gas, renewables, and nuclear power—this result might allay concerns that one technology would dominate.

While natural gas generation increases substantially in Palmer et al.'s modeling, if it receives only partial credit (e.g., half credit) as clean energy under a CES, then natural gas can only deliver a declining maximum fraction of total electricity in order to meet increasing requirement for the share of electricity to come from clean energy sources. For example, if a CES requires that 80 percent of electricity come from clean energy sources and count natural gas-fired generation as half clean, then natural gas generation (unless coupled with carbon capture and storage) could only account for a maximum of 40 percent of total electricity generation in 2035.

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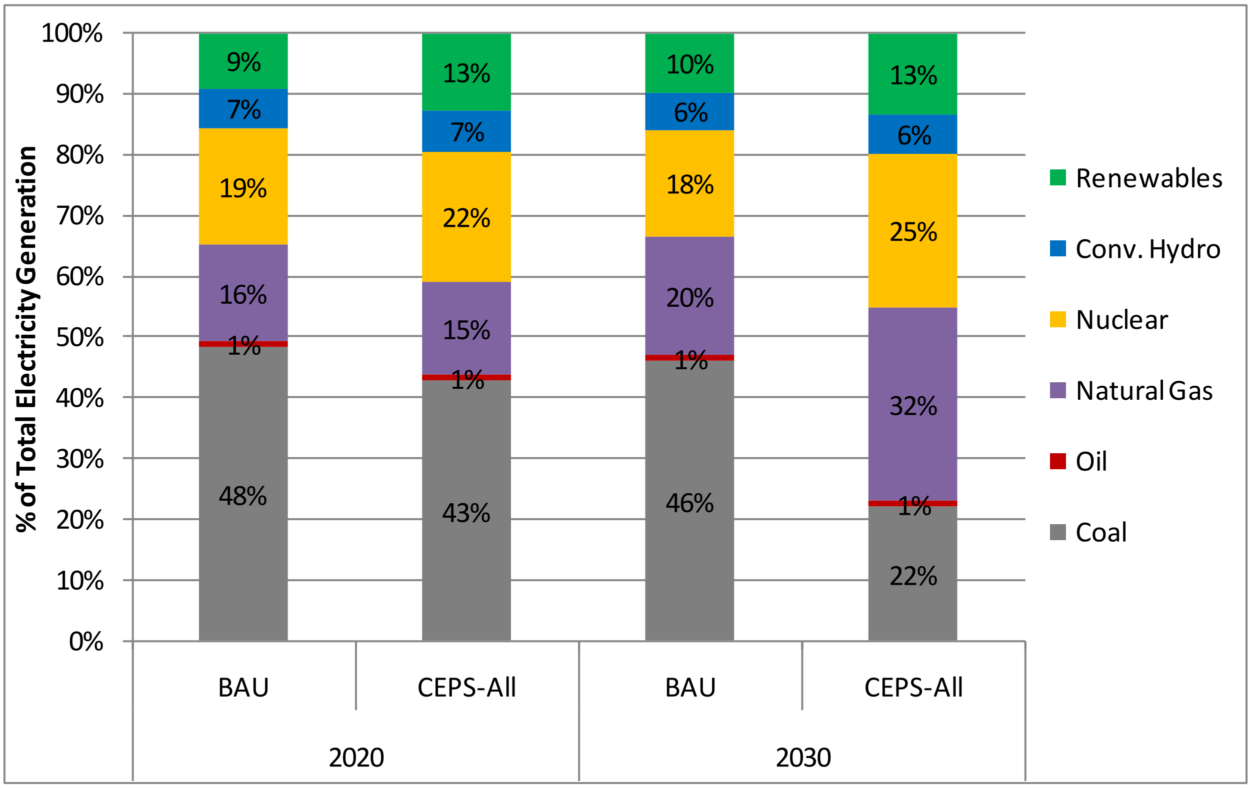
[14] Palmer, Karen, Richard Sweeney, and Maura Allaire, Resources for the Future, 2010, *Modeling Policies to Promote Renewable and Low -Carbon Sources of Electricity*, see http://www.rff.org/Documents/Features/NEPI/RFF-BCK-Palmeretal.-LowCarbonElectricity.pdf.

Figure 1: Projected Electricity Generation Mix under a CES from Palmer et al.[15]



4.4 Could different crediting and requirements than those proposed by the President be more effective in deploying clean technologies?

[no response]

5 How should Alternative Compliance Payments, regional costs, and consumer protections be addressed?

Inherently, a broadly defined CES can incentivize the deployment of clean energy technology cost-effectively. The compliance flexibility provided by clean energy credits (CECs) and the large number of energy choices granted at least partial credit under a CES as proposed by President Obama have the effect of containing costs and providing power generators with a range of options so that they can choose the technologies and compliance options that work best for them. For example, a CES allows both for the exploitation of renewable resources that are concentrated in particular geographic areas as well as natural gas and nuclear power that may be more suitable for other regions.

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[15] "BAU" refers to the "business-as-usual" scenario used by Palmer et al., and "CEPS-All" refers to the CES policy modeled by Palmer et al. that most closely resembled President Obama's proposed CES.

While the U.S. power generation mix is roughly 40 percent clean today (giving half credit to natural gas generation), the percentage of electricity deliveries from clean energy sources varies greatly among utilities, and much of this variation is regional—for example, some regions of the country are more coal-dependent than others. Policymakers may craft a CES so as to avoid creating unfair regional impacts. In addition to providing at least partial CECs to a variety of renewable and other clean energy technologies, a CES program can ameliorate concerns about regional disparities through its targets and compliance formula. In particular, a CES can minimize disparate regional impacts by providing credits only to generation from new clean energy facilities or incremental generation from existing facilities and by setting percentage requirements for clean energy that apply to a "base quantity" of electricity sales that excludes generation from existing clean energy facilities. This approach, for example, avoids large credit purchases by utilities with relatively lower levels of existing clean generation from utilities with historically higher levels of clean generation.

As with other market-oriented policies that rely on tradable certificates, a CES can make use of banking and borrowing to provide regulated entities with temporal compliance flexibility to minimize costs for consumers.

Policymakers could also set "safety-valve" prices for CECs (i.e., by allowing for alternative compliance payments). All of the congressional electricity portfolio standards in the 111th Congress included alternative compliance payments (ACPs). In each case, the congressional proposals specified an initial ACP value that would increase at the rate of inflation (and thus maintain a constant value in real dollars). These constant real dollar values are shown in Table 3.

Table 3: Alternative Compliance Payments under Proposed Federal Electricity Portfolio Standards

111th Congress Proposal	**Alternative Compliance Payment ($/MWh)**[16]
Waxman-Markey Renewable Electricity Standard (RES)	$25
Senate Energy Bill RES	$21
Lugar Diverse Energy Standard	$50
Graham Clean Energy Standard	$35

ACPs are common in state electricity portfolio standards as well. A 2008 survey of electricity portfolio standards in 25 states and the District of Columbia found that only four standards had

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[16] The various bills require the ACPs to escalate with inflation, but this escalation starts in different years in the bills. As such, the values shown above would be slightly different if all were converted to real dollars for the same base year. To convert from dollars per MWh to cents per kWh, divide by 10.

neither an ACP nor some similar policy mechanism for capping the maximum cost of compliance.[17]

The value of any ACP is a crucial policy design decision. If the ACP level is set too low, it can substantially undermine the deployment of clean energy technology and the achievement of emission reductions. For example, a recent study modeled a federal renewable standard similar to the one in Waxman-Markey both with and without the ACP specified in the bill; this study projected that the policy scenario without an ACP led to the deployment of roughly 2.5 times as much incremental renewable generating capacity (compared to "business as usual") as did the policy scenario with an ACP.[18]

Because few studies have modeled the potential costs and other impacts of a CES with targets comparable to President Obama's goal of 80 percent clean energy by 2035, there are limited data points from which to judge what a reasonable value might be for an ACP under a CES like that proposed by President Obama—i.e., an ACP that protects against excessive costs but that also ensures clean energy technology deployment and emission reductions commensurate with the nation's goals.

One ACP option that might offer promise for mitigating consumer costs while also promoting long-term clean energy technology deployment is an ACP value that escalates in real terms rather than the constant real ACP values included in recent congressional proposals.

5.1 What are the anticipated effects on state and regional electricity prices of a CES structured according to the President's proposal? What are the anticipated net economic effects by region?

Given the lack of specifics regarding the treatment of new and existing clean energy facilities and cost containment provisions (e.g., banking, borrowing, and alternative compliance payments) as well as the relative dearth of sophisticated power sector modeling results, it is too soon to say what the anticipated effects of a CES structured according to the President's proposal would be on state and regional electricity prices and what the regional net economic effects would be.

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[17] Wiser, Ryan and Galen Barbose, *Renewables Portfolio Standards in the United States — A Status Report with Data Through 2007*, April 2008, Lawrence Berkeley National Laboratory, http://eetd.lbl.gov/ea/emp/reports/lbnl-154e-revised.pdf, see Table 9.

[18] Palmer et al. (2011) modeled a federal renewable electricity standard with a target of 20 percent by 2020. The ACP was set at $25 per MWh, and the cumulative emission reductions compared to "business as usual" were projected through 2035. The comparison of incremental technology deployment impacts refers to the projections for non-hydro renewable generating capacity for 2035. Palmer et al. projected that, when unconstrained, REC prices would range from roughly 1.3 to 3.7 times the ACP value; although, Palmer et al. did not allow for banking of RECs, which would have smoothed the projected REC prices and likely lowered the maximum projected REC price. See Palmer et al., 2011, *Federal Policies for Renewable Electricity: Impacts and Interactions*, Resources for the Future Discussion Paper 10-53.

5.2 Would other CES formulations or alternative policy proposals to meet a comparable level of clean energy deployment have better regional or net economic outcomes?

While the U.S. power generation mix is roughly 40 percent clean today (giving half credit to natural gas generation), the percentage of electricity deliveries from clean energy sources varies greatly among utilities, and much of this variation is regional—for example, some regions of the country are more coal-dependent than others. Policymakers may craft a CES so as to avoid creating unfair regional impacts. In addition to providing at least partial CECs to a variety of renewable and other clean energy technologies, a CES program can ameliorate concerns about regional disparities through its targets and compliance formula. In particular, a CES can minimize disparate regional impacts by providing credits only to generation from new clean energy facilities or incremental generation from existing facilities and by setting percentage requirements for clean energy that apply to a "base quantity" of electricity sales that excludes generation from existing clean energy facilities. This approach, for example, avoids large credit purchases by utilities with relatively lower levels of existing clean generation from utilities with historically higher levels of clean generation.

5.3 How might various price levels for the ACP affect the deployment of clean energy technologies?

The value of any ACP is a crucial policy design decision. If the ACP level is set too low, it can substantially undermine the deployment of clean energy technology and the achievement of emission reductions. For example, a recent study modeled a federal renewable standard similar to the one in Waxman-Markey both with and without the ACP specified in the bill; this study projected that the policy scenario without an ACP led to the deployment of roughly 2.5 times as much incremental renewable generating capacity (compared to "business as usual") as did the policy scenario with an ACP.[19]

Sophisticated power sector modeling could provide insights into the levels of clean energy deployment that policymakers should expect under various ACP price levels; however, such modeling has so far been limited and thus more analysis is needed in order to reliably evaluate the effects of different ACP price levels.

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[19] Palmer et al. (2011) modeled a federal renewable electricity standard with a target of 20 percent by 2020. The ACP was set at $25 per MWh, and the cumulative emission reductions compared to "business as usual" were projected through 2035. The comparison of incremental technology deployment impacts refers to the projections for non-hydro renewable generating capacity for 2035. Palmer et al. projected that, when unconstrained, REC prices would range from roughly 1.3 to 3.7 times the ACP value; although, Palmer et al. did not allow for banking of RECs, which would have smoothed the projected REC prices and likely lowered the maximum projected REC price. See Palmer et al., 2011, *Federal Policies for Renewable Electricity: Impacts and Interactions*, Resources for the Future Discussion Paper 10-53.

5.4 What options are available to mitigate regional disparities and contain costs of the policy?

Inherently, a broadly defined CES can incentivize the deployment of clean energy technology cost-effectively. The compliance flexibility provided by compliance via clean energy credits (CECs) and the large number of energy choices granted at least partial credit under a CES as proposed by President Obama have the effect of containing costs and providing utilities with a range of options so that they can choose the technologies and compliance options that work best for them. For example, a CES allows both for the exploitation of renewable resources that are concentrated in particular geographic areas as well as natural gas and nuclear power that may be more suitable for other regions.

While the U.S. power generation mix is roughly 40 percent clean today (giving half credit to natural gas generation), the percentage of electricity deliveries from clean energy sources varies greatly among utilities, and much of this variation is regional—for example, some regions of the country are more coal-dependent than others. Policymakers may craft a CES so as to avoid creating unfair regional impacts. In addition to providing at least partial CECs to a variety of renewable and other clean energy technologies, a CES program can ameliorate concerns about regional disparities through its targets and compliance formula. In particular, a CES can minimize disparate regional impacts by providing credits only to generation from new clean energy facilities or incremental generation from existing facilities and by setting percentage requirements for clean energy that apply to a "base quantity" of electricity sales that excludes generation from existing clean energy facilities. This approach, for example, avoids large credit purchases by utilities with relatively lower levels of existing clean generation from utilities with historically higher levels of clean generation.

As with other market-oriented policies that rely on tradable certificates, a CES can make use of banking and borrowing to provide regulated entities with temporal compliance flexibility to minimize costs for consumers.

Policymakers could also set "safety-valve" prices for CECs (i.e., alternative compliance payments). All of the congressional electricity portfolio standards in the 111th Congress included alternative compliance payments (ACPs). In each case, the congressional proposals specified an initial ACP value that would increase at the rate of inflation (and thus maintain a constant value in real dollars). These constant real dollar values are shown in Table 3.

Table 4: Alternative Compliance Payments under Proposed Federal Electricity Portfolio Standards

111th Congress Proposal	**Alternative Compliance Payment ($/MWh)[20]**
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Lugar Diverse Energy Standard	$50
Graham Clean Energy Standard	$35

ACPs are common in state electricity portfolio standards as well. A 2008 survey of electricity portfolio standards in 25 states and the District of Columbia found that only four standards had neither an ACP nor some similar policy mechanism for capping the maximum cost of compliance.[21]

The value of any ACP is a crucial policy design decision. If the ACP level is set too low, it can substantially undermine the deployment of clean energy technology and the achievement of emission reductions. For example, a recent study modeled a federal renewable electricity standard similar to the one in Waxman-Markey both with and without the ACP specified in the bill; this study projected that the policy scenario without an ACP led to the deployment of roughly 2.5 times as much incremental renewable generating capacity (compared to "business as usual") as did the policy scenario with the ACP specified in the bill.[22]

Because few studies have modeled the potential costs and other impacts of a CES with targets comparable to President Obama's goal of 80 percent clean energy by 2035, there are limited data points from which to judge what an appropriate value might be for an ACP under a CES like that proposed by President Obama—i.e., an ACP that protects against excessive costs but that also ensures clean energy technology deployment and emission reductions commensurate with the nation's goals.

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[20] The various bills require the ACPs to escalate with inflation, but this escalation starts in different years in the bills. As such, the values shown above would be slightly different if all were converted to real dollars for the same base year. To convert from dollars per MWh to cents per kWh, divide by 10.

[21] Wiser, Ryan and Galen Barbose, *Renewables Portfolio Standards in the United States — A Status Report with Data Through 2007*, April 2008, Lawrence Berkeley National Laboratory, http://eetd.lbl.gov/ea/emp/reports/lbnl-154e-revised.pdf, see Table 9.

[22] Palmer et al. (2011) modeled a federal renewable electricity standard with a target of 20 percent by 2020. The ACP was set at $25 per MWh, and the cumulative emission reductions compared to "business as usual" were projected through 2035. The comparison of incremental technology deployment impacts refers to the projections for non-hydro renewable generating capacity for 2035. Palmer et al. projected that, when unconstrained, REC prices would range from roughly 1.3 to 3.7 times the ACP value; although, Palmer et al. did not allow for banking of RECs, which would have smoothed the projected REC prices and likely lowered the maximum projected REC price. See Palmer et al., 2011, *Federal Policies for Renewable Electricity: Impacts and Interactions*, Resources for the Future Discussion Paper 10-53.

One ACP option that might offer promise for mitigating consumer costs while also promoting long-term clean energy technology deployment is an ACP value that escalates in real terms.

5.5 What are the possible uses for potential ACP revenues? Should such revenues be used to support compliance with the standard's requirements? Should all or a portion of the collected ACP revenues go back to the state from which they were collected? Should ACP revenues be used to mitigate any increased electricity costs to the consumer that may be associated with the CES?

Federal electricity portfolio standard proposals in the 111th Congress required that ACP revenues be directed to the states in which the utilities making the payments were located and directed the states to use these revenues for related purposes (e.g., funding additional clean energy deployment). Adopting this approach under a CES program allows for the ACP to serve as a cost containment measure, directs ACP revenue to the benefit of the ratepayers who paid it, and furthers the goal of the CES program (i.e., deploying clean energy technology).

5.6 Should cost containment measures and other consumer price protections be included in a CES?

Inherently, as a market-oriented policy, a broadly defined CES can incentivize the deployment of clean energy technology cost-effectively. The compliance flexibility provided by compliance via clean energy credits (CECs) and the large number of energy choices granted at least partial credit under a CES as proposed by President Obama have the effect of containing costs and providing utilities with a range of options so that they can choose the technologies and compliance options that work best for them. For example, a CES allows both for the exploitation of renewable resources that are concentrated in particular geographic areas as well as natural gas and nuclear power that may be more suitable for other regions.

As with other market-oriented policies that rely on tradable credits, a CES can make use of banking and borrowing to provide regulated entities with temporal compliance flexibility to minimize costs for consumers.

Policymakers could also allow for alternative compliance payments, which would act as a "safety-valve" for CEC prices. All of the congressional electricity portfolio standards in the 111th Congress included alternative compliance payments (ACPs). In each case, the congressional proposals specified an initial ACP value that would increase at the rate of inflation (and thus maintain a constant value in real dollars). These constant real dollar values are shown in Table 3.

Table 5: Alternative Compliance Payments under Proposed Federal Electricity Portfolio Standards

111th Congress Proposal	Alternative Compliance Payment ($/MWh)[23]
Waxman-Markey Renewable Electricity Standard (RES)	$25
Senate Energy Bill RES	$21
Lugar Diverse Energy Standard	$50
Graham Clean Energy Standard	$35

ACPs are common in state electricity portfolio standards as well. A 2008 survey of electricity portfolio standards in 25 states and the District of Columbia found that only four standards had neither an ACP nor some similar policy mechanism for capping the maximum cost of compliance.[24]

The value of any ACP is a crucial policy design decision. If the ACP level is set too low, it can substantially undermine the deployment of clean energy technology and the achievement of emission reductions. For example, a recent study modeled a federal renewable standard similar to the one in Waxman-Markey both with and without the ACP specified in the bill; this study projected that the policy scenario without an ACP led to the deployment of roughly 2.5 times as much incremental renewable generating capacity (compared to “business as usual”) as did the policy scenario with the ACP specified in Waxman-Markey.[25]

Because few studies have modeled the potential costs and other impacts of a CES with targets comparable to President Obama’s goal of 80 percent clean energy by 2035, there are limited data points from which to judge what an appropriate value might be for an ACP under a CES like that proposed by President Obama—i.e., an ACP that protects against excessive costs but that also ensures clean energy technology deployment and emission reductions commensurate with the nation’s goals.

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[23] The various bills require the ACPs to escalate with inflation, but this escalation starts in different years in the bills. As such, the values shown above would be slightly different if all were converted to real dollars for the same base year. To convert from dollars per MWh to cents per kWh, divide by 10.

[24] Wiser, Ryan and Galen Barbose, *Renewables Portfolio Standards in the United States — A Status Report with Data Through 2007*, April 2008, Lawrence Berkeley National Laboratory, http://eetd.lbl.gov/ea/emp/reports/lbnl-154e-revised.pdf, see Table 9.

[25] Palmer et al. (2011) modeled a federal renewable electricity standard with a target of 20 percent by 2020. The ACP was set at $25 per MWh, and the cumulative emission reductions compared to “business as usual” were projected through 2035. The comparison of incremental technology deployment impacts refers to the projections for non-hydro renewable generating capacity for 2035. Palmer et al. projected that, when unconstrained, REC prices would range from roughly 1.3 to 3.7 times the ACP value; although, Palmer et al. did not allow for banking of RECs, which would have smoothed the projected REC prices and likely lowered the maximum projected REC price. See Palmer et al., 2011, *Federal Policies for Renewable Electricity: Impacts and Interactions*, Resources for the Future Discussion Paper 10-53.

One ACP option that might offer promise for mitigating consumer costs while also promoting long-term clean energy technology deployment is an ACP value that escalates in real terms.

5.7 How much new transmission will be needed to meet a CES along the lines of the President's proposal and how should those transmission costs be allocated?

[No response.]

5.8 Are there any technological impediments to the addition of significantly increased renewable electricity generation into the electrical grid?

Aside from cost, the primary impediments to greater reliance on renewable electricity technologies are the variability of their output (in the cases of wind and solar) and their distance from population centers (in the cases of many utility-scale renewable electricity technologies).

Building new transmission lines to bring power from distant renewable resources to population centers is not hampered by technical impediments. The challenges to building new transmission are primarily institutional and political.

Integrating variable energy sources into the power grid where electricity supply and demand must be constantly balanced does pose some technical challenges variable renewables can be accommodated using supply flexibility (e.g., flexible gas-fired generators, larger balancing areas, and increased transmission links among grid regions), demand flexibility (e.g., demand response), and electricity storage (e.g., utility-scale batteries).

A 2008 study conducted by the Department of Energy, national laboratories, and the American Wind Energy Association (AWEA) examined the technological and market impediments to greatly expanded use of variable wind power in the United States (in particular, a scenario with wind power providing 20 percent of total U.S. electricity by 2030) and found that:

> wind's variability need not be a technical barrier to incorporating it into the broader portfolio of available options. Although some market structures, generation portfolios, and transmission rules accommodate much more wind energy than others, reforms already under consideration in this sector can better accommodate wind energy. Experience and studies suggest that with these reforms, wind generation could reliably supply 20% of U.S. electricity demand.[26]

While the aforementioned study focused exclusively on wind, its findings suggest that grid operators can similarly incorporate other variable renewable technologies (e.g., solar power) at high levels of penetration. Moreover, deriving 20 percent of electricity supply from variable renewable sources is likely roughly consistent with the goal of achieving 80 percent clean energy by 2035 via a broadly defined set of technologies that includes much more than just variable

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[26] U.S. Department of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, July 2008, p. 75.

renewable technologies. Moreover, the aforementioned study analyzed the integration of wind power providing 20 percent of U.S. electricity without the need for electricity storage technologies. At some point, higher levels of penetration of variable renewables would likely require some deployment of electricity storage technologies.

5.9 What are the costs associated with replacing or retrofitting certain assets within the existing generation fleet in order to meet a CES?

[No Response]

5.10 What level of asset retirements from within the existing generation fleet are anticipated as a result of a CES?

In the absence of sophisticated power sector modeling analyses, it is challenging to offer insights regarding the potential levels of generating asset retirements under a CES. However, given the U.S. Energy Information Administration's current projections for relatively slow electricity demand growth through 2035, basic arithmetic suggests that meeting the goal of 80 percent clean energy by 2035 will require retiring a sizeable percentage of existing coal plants, retrofitting them with carbon capture and storage (CCS), or some combination of the two.

An overview of the current and extrapolated age profile of the fleet of coal power plants might allay some concerns about prematurely retiring these generating assets. The magnitude and type of generating capacity brought online has varied over time. For example, natural gas power plants and non-hydro renewables dominated generating capacity additions in the 2000s, and nearly all nuclear capacity came online in the 1970s and 1980s. The bulk of the existing coal fleet came online between the 1950s and the 1980s. As such, less than 6 percent of total coal-fueled generation capacity is 20 years old or less, and more than a third of the coal fleet is more than 40 years old.[27]

Figure 2 projects the evolution of the age distribution of the existing fleet of coal plants over time (assuming no plants are retired and excluding any new plants). In the real-world, coal plant retirement and replacement decisions are complicated economic and regulatory decisions and involve consideration of such factors as the cost of compliance with current and expected future regulations (e.g., pollution control retrofits), anticipated fuel and electricity prices, the cost of replacement capacity, and expected electricity demand. However, one might assume a 60-year "useful life" for a coal plant as an illustrative cut-off point for identifying coal plants that are suitable for retirement and replacement (in reality, based on the aforementioned considerations, a coal plant might be economically viable for more or fewer than 60 years). Figure 2 shows that only about 1 percent of the existing coal fleet has reached the 60-year mark today. By 2020, 13

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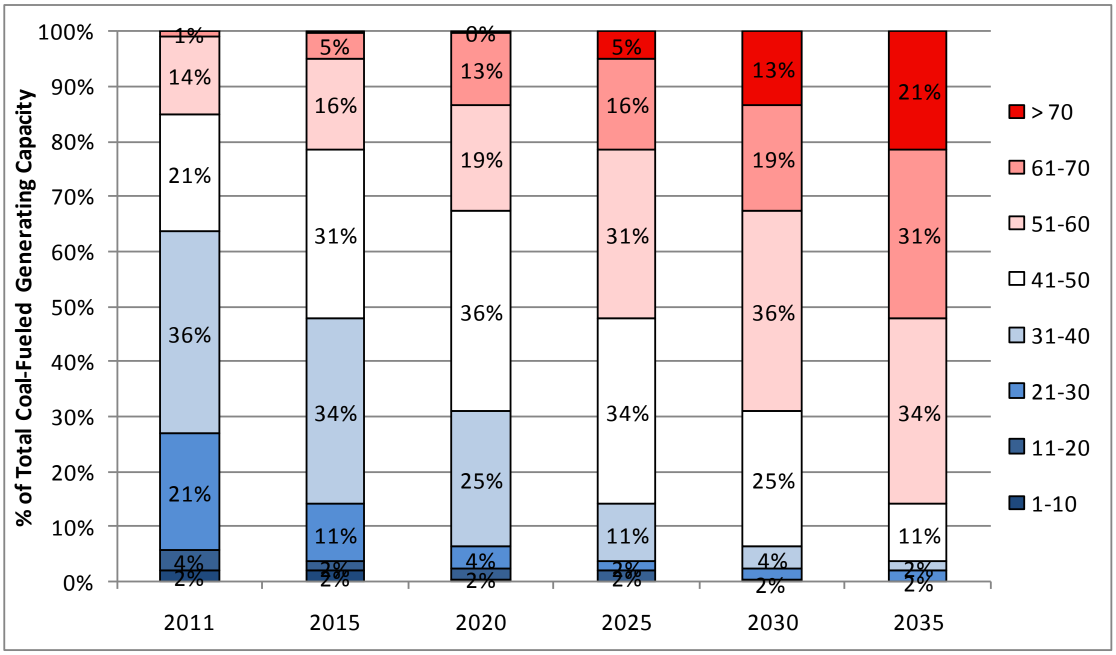
[27] The data cited in this section come from the EIA-860 Database and exclude "industrial" and "commercial" generators reported in the database. Unless otherwise indicated, references to capacity in this section refer to nameplate capacity. The data in the EIA-860 Database provide a snapshot of the power sector as of the end of 2009 and thus do not reflect subsequent new units and retirements. Moreover, to the extent that units have already been retired, the data do not fully reflect the deployment of generating capacity over time since only extant units are included in the data shown.

percent of today's coal plants (in terms of nameplate capacity) will have reached the end of their assumed 60-year useful lives. The percentage of the current coal fleet that will have hit the 60-year mark if not retired will be 33 percent in 2030 and 52 percent in 2035. Retiring half of the existing fleet of coal power plants and replacing it with clean energy generation by 2035—at the end of the coal plants' assumed 60-year useful lives—is roughly consistent with President Obama's overall goal for clean energy deployment (i.e., 80 percent of total electricity generation from clean energy by 2035).

Figure 2: Evolution of Age Distribution of Existing Coal Fleet over Time (Share of Generating Capacity by Age Range in Years)[28]



6 How would the CES interact with other policies?

6.1 To what extent does a CES contribute to the overall climate change policy of the United States, and would enactment of a CES warrant changes to other, relevant statutes?

In 2009, CO_2 emissions from fossil fuel combustion for electricity generation accounted for more than 32 percent of total U.S. greenhouse gas (GHG) emissions and more than 41 percent of total U.S. CO_2 emissions from fossil fuel combustion.[29] Not only does electricity generation produce a large fraction of U.S. GHG emissions, but many analyses find that the lowest-cost pathway to

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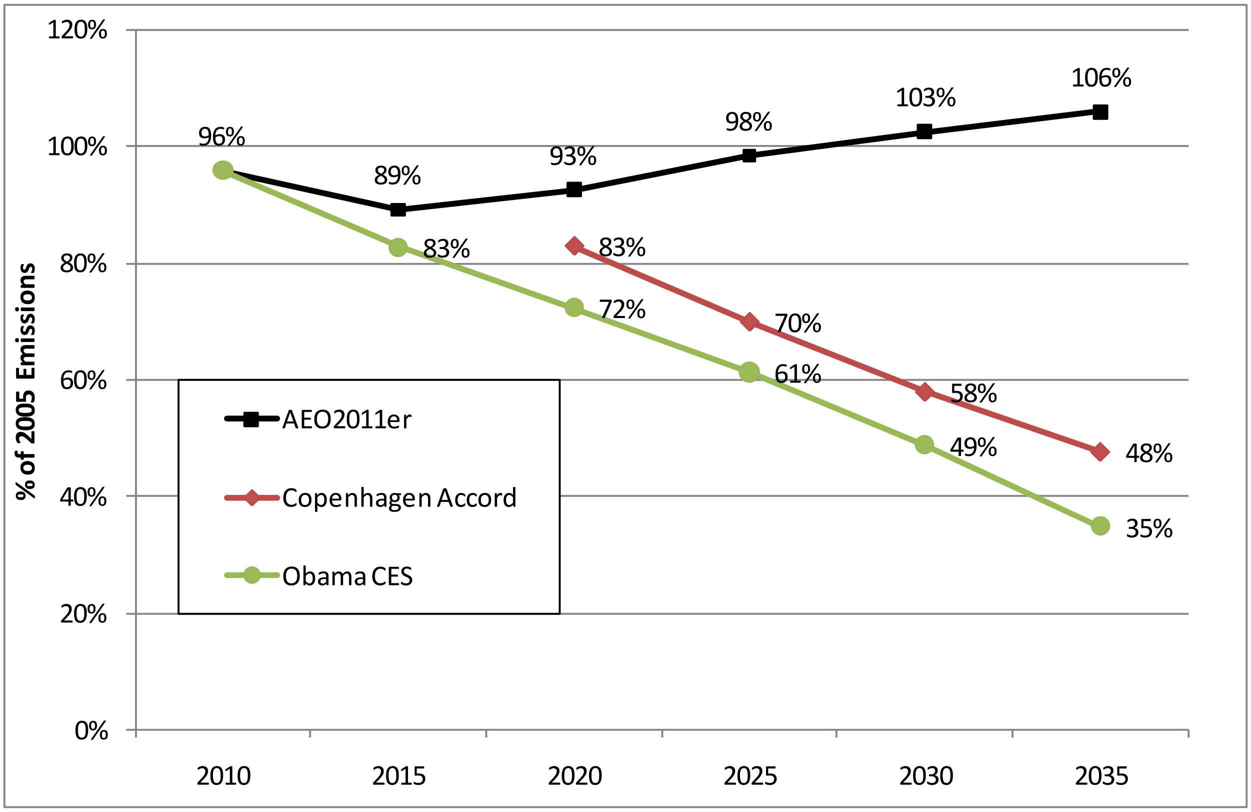
[28] EIA-860 Database. Excludes "industrial" and "commercial" generators reported in EIA-860. Figure 2 projects the age distribution only of coal plants online at the end of 2009 assuming no retirements.

[29] U.S. Environmental Protection Agency (EPA), *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, February 2011.

reducing economy-wide GHG emissions includes greater proportional GHG emission reductions from the power sector than from other sectors.[30]

In the absence of results from sophisticated power sector modeling, one can make rough estimates of the potential impact on power-sector CO_2 emissions of a CES like that proposed by President Obama. Figure 3 presents the results of such an estimate and shows that a CES that leads to clean energy sources providing 80 percent of electricity by 2035 might reduce power-sector CO_2 emissions to roughly 65 percent below 2005 emissions by 2035—a reduction in that sector that is consistent with the percentage reduction goals for U.S. economy-wide GHG emissions noted in the U.S. pledge under the Copenhagen Accord.[31]

Figure 3: Estimated Power-Sector CO_2 Emissions under a CES with a Target of 80% by 2035[32]



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[30] See, for example, Fawcett et al., 2009, “Overview of EMF 22 U.S. Transition Scenarios,” *Energy Economics* 31: S198–S211.

[31] In its submission under the Copenhagen Accord, the United States specified a 2020 emission reduction target of 17 percent below 2005 emissions and noted that this would be part of an emission reduction pathway that “would entail a 30 percent reduction in 2025 and a 42 percent reduction in 2030, in line with the goal to reduce emissions 83 percent by 2050.” See http://unfccc.int/files/meetings/application/pdf/unitedstatescphaccord_app.1.pdf.

[32] “Copenhagen Accord” applies the U.S. economy-wide emission reduction percentage targets from the Copenhagen Accord to the power sector. “AEO2011er” shows the projected power-sector CO_2 emissions from the Annual Energy Outlook 2011 Early Release. “Obama CES” assumes a CES with annual targets that start at 40 percent and increase linearly to 80 percent in 2035. The “Obama CES” case assumes the same electricity demand and power generation mix as in AEO2011er except that non-emitting generation coal generation without CCS are adjusted to meet the CES percentage targets with power-sector CO_2 emissions adjusted accordingly.

6.2 What are the specific challenges facing individual technologies such as nuclear, natural gas, CCS, on- and offshore wind, solar, efficiency, biomass, and others?

Every clean technology faces a single common challenge, and several other challenges hinder the deployment of particular clean energy technologies. The common challenge facing clean energy technologies is the lack of a policy that distinguishes between more and less carbon-intensive megawatt-hours of electricity generation. The other challenges include the need for federal financial support for clean energy technology research, development, and demonstration and various other market failures and regulatory and institutional barriers.

In 2009, CO_2 emissions from fossil fuel combustion for electricity generation accounted for more than 32 percent of total U.S. greenhouse gas (GHG) emissions and more than 41 percent of total U.S. CO_2 emissions from fossil fuel combustion.[33] Despite the significant contribution of electricity generation to the GHG emissions that cause anthropogenic climate change, the United States has no policy to change the relative costs of different power sources based on their carbon-intensity to reflect the damages from climate change caused by these emissions. As such, power generators have no comprehensive financial incentive to shift from more to less carbon-intensive energy sources. A CES would change the relative costs of more and less carbon-intensive energy sources and drive a shift from the former to the latter.

While a CES will resolve the current failure to reflect the social costs associated with GHG pollutants in the private costs of power generation, particular clean energy technologies face additional challenges beyond this failure. Existing federal policies address certain of these challenges to some extent, but these challenges might warrant additional policies.

Less mature and more costly clean energy technologies generally suffer from an underinvestment in research, development, and demonstration. Both because of the lack of a comprehensive financial incentive to shift to less carbon-intensive energy generation and because of the spillover benefits from clean energy technology research and development (R&D), private firms under-invest in R&D given the returns such investments yield for society as a whole. This is the classic rationale for government financial support for clean energy R&D. Many stakeholders support increased federal spending on clean energy R&D. For example, the Institute For 21st Century Energy (an affiliate of the U.S. Chamber of Commerce) supports at least doubling federal spending on clean energy R&D.[34] In addition to clean energy R&D, the initial deployment of less mature clean energy technologies also provides spillover benefits (e.g., demonstrated success and real-world cost and performance data that reduce uncertainty and cost and performance improvements from “learning by doing”). Failure to reward initial deployment of these technologies for such spillover benefits leads to lower levels of deployment than are

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[33] U.S. Environmental Protection Agency (EPA), *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, February 2011.

[34] http://www.energyxxi.org/issues/Increase_Clean_Energy.aspx

socially optimal. The aforementioned spillover benefits from clean energy R&D and initial deployment are particularly relevant to more costly and less mature technologies such as solar, CCS, offshore wind, and next-generation nuclear power plants. Federal support for R&D and demonstration projects can improve the cost and performance of clean energy technologies and reduce market risk and uncertainty regarding first-of-a-kind clean energy projects.

Other market failures and regulatory and institutional challenges also hold back particular clean energy technologies. A comprehensive description of all such challenges is beyond the scope of this discussion, but the remainder of this section describes some of the most important challenges for certain clean energy technologies.

Wind and solar power both face challenges related to their variability and their need for new transmission lines. The best utility-scale solar and wind power sites tend to be located far from the population centers that require electricity and thus necessitate new transmission lines, which can be difficult to site and build under the current regulatory framework. Moreover, certain electricity market structures have proven more hospitable to the integration of variable renewable technologies like wind and solar than others.

In addition to support for R&D and "first-mover" projects, the federal government and perhaps state governments could facilitate widespread deployment of CCS through enhancements of the legal and regulatory framework governing geologic sequestration of CO_2.[35]

Federal loan guarantees can support the first wave of new nuclear reactors and allow the nuclear industry to demonstrate that it can build new reactors on time and on budget and that the streamlined nuclear regulatory process works. In addition, the deployment of new nuclear reactors beyond those already under construction may require addressing concerns about safety and regulation in the aftermath of the nuclear reactor damage and emergency in Japan following the earthquake and tsunami there. Lastly, the United States has yet to finalize a plan for the long-term handling of spent nuclear fuel. Resolving this uncertainty would likely enable growth in nuclear power in the long run.

Energy efficiency faces a host of well-documented market failures and barriers that a CES alone cannot address—e.g., misaligned incentives, lack of information, and capital constraints.

The "shale gas revolution" presents the nation with the opportunity to exploit an abundant and affordable domestic fuel source that can provide less carbon-intensive electricity than traditional coal-fueled electricity generation, fuel flexible power plants that backup variable renewables, and eventually be coupled with CCS. Making optimal use of U.S. shale gas resources, however, will necessitate careful steps by the natural gas industry and government regulators to ensure that shale gas extraction does not lead to public health risks and undue environmental harms.

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[35] See, for example, the recommendations from the Interagency Task Force on CCS at http://www.whitehouse.gov/administration/eop/ceq/initiatives/ccs.

6.3 Will the enactment of a CES be sufficient for each technology to overcome its individual challenges?

A policy that lowers the cost of clean energy technologies relative to competing energy sources—as a CES would do—is the most important single policy for spurring widespread deployment of clean energy technologies. However, a CES does not address all of the challenges that clean energy technologies face.

Every clean technology faces a single common challenge, and several other distinct challenges hinder the deployment of particular clean energy technologies. The common challenge facing clean energy technologies is the lack of a policy that distinguishes between more and less carbon-intensive megawatt-hours of electricity generation. In 2009, CO_2 emissions from fossil fuel combustion for electricity generation accounted for more than 32 percent of total U.S. greenhouse gas (GHG) emissions and more than 41 percent of total U.S. CO_2 emissions from fossil fuel combustion.[36] Despite the significant contribution of electricity generation to the GHG emissions that cause anthropogenic climate change, the United States has no policy to change the relative costs of different power sources based on their carbon-intensity to reflect the damages from climate change caused by these emissions. As such, power generators have no comprehensive financial incentive to shift from more to less carbon-intensive energy sources. A CES would change the relative costs of more and less carbon-intensive energy sources and drive a shift from the former to the latter.

While a CES will resolve the current failure to reflect the social costs associated with GHG pollutants in the private costs of power generation, particular clean energy technologies face additional challenges beyond this failure. Existing federal policies address certain of these challenges, but some of these challenges might warrant additional policies. For example, in addition to providing non-emitting electricity generation, the initial deployment of certain less mature clean energy technologies also provides spillover benefits (e.g., demonstrated success and real-world cost and performance data that reduce uncertainty and cost and performance improvements from "learning by doing"). Failure to reward initial deployment of these technologies for such spillover benefits leads to lower levels of deployment than are socially optimal.

Certain clean technologies face regulatory or institutional challenges as well. The best utility-scale solar and wind power sites tend to be located far from the population centers that require electricity and thus necessitate new transmission lines, which can be difficult to site and build. Energy efficiency faces a host of well-documented market failures and barriers that a CES alone cannot address—e.g., principal-agent problems and lack of information. Enhancements of the legal and regulatory framework governing geologic sequestration of CO_2 could facilitate widespread deployment of carbon capture and storage (CCS).

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[36] U.S. Environmental Protection Agency (EPA), *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, February 2011.

6.4 Should there be an examination of energy connected permitting?

[No Response]

6.5 Are there specific supporting policy options that should be considered for coal, nuclear, natural gas, renewable energy, and efficiency?

A policy—like a CES—that lowers the cost of clean energy technologies relative to competing energy sources is the most important single policy for spurring widespread deployment of clean energy technologies. However, technology-specific specific supporting policies can help deploy clean energy technology more cost-effectively by addressing market failures and barriers that a CES alone cannot address.

The future of coal depends on carbon capture and storage (CCS). While a CES that provides at least partial credit for generation from fossil fuel use coupled with CCS can provide a financial incentive for CCS deployment, a CES alone may not be sufficient to spur widespread CCS deployment. Policies that provide additional financial incentives for "first-mover" CCS projects can reward such projects for demonstrating the commercial viability of CCS, providing real-world cost and performance data to reduce uncertainty, and improving the cost and performance of CCS technologies by moving them along their "learning curve."

While CES credits can provide a helpful financial incentive for building new nuclear reactors, until the nuclear industry has demonstrated that it can build new reactors on time and on budget, initial nuclear deployment may require federal loan guarantees. In addition, the deployment of new nuclear reactors beyond those already under construction may require addressing concerns about safety and regulation in the aftermath of the nuclear reactor damage and emergency in Japan following the earthquake and tsunami there.

A CES creates an added incentive for an LDC to pursue energy efficiency programs because electricity savings from energy efficiency reduce the LDC's base quantity of electricity sales and thus the number of clean energy credits it must obtain. A CES might also give credit directly for demonstrated electricity savings. Energy efficiency, however, faces a set of well-documented market failures and barriers that a CES alone would not address. For example, a 2009 study by McKinsey & Company estimated that exploiting only efficiency measures that offered positive financial returns would reduce U.S. electricity demand by 26 percent compared to "business as usual" in 2020.[37] While a CES would, even if it did not directly credit electricity savings from energy efficiency, provide an incentive for LDCs to work with their ratepayers to exploit these unrealized energy efficiency savings, it would not by itself address the market failures and barriers that prevent households and businesses from exploiting them today despite their positive returns. Policies such as efficiency standards and information programs can help realize electricity savings from energy efficiency.

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[37] McKinsey & Company, *Unlocking Energy Efficiency in the U.S. Economy*, 2009

The discussion above focuses on policies to promote the deployment of clean energy technologies. Clean energy technologies also warrant additional support for research, development, and demonstration (RD&D).

6.6 What is the current status of clean energy technology manufacturing, and is it reasonable to expect domestic economic growth in that sector as a result of a CES?

Clean energy jobs represent a small but growing fraction of U.S. employment. A 2009 study by the Pew Charitable Trusts found that from 1998 to 2007, clean energy jobs grew by 23 percent.[38] A federal CES will spur growth in U.S. clean energy technology manufacturing. State experience with electricity portfolio standards suggests that such standards can lead to economic growth in clean energy technology manufacturing. For example, a 2011 report from Michigan's Public Service Commission found that the state's renewable portfolio standard, enacted in 2008, had already led to the first in-state production of utility-scale wind turbines.[39]

As in other markets for manufactured goods, increased demand for clean energy technologies under a federal CES will be met with both domestically manufactured clean energy technology and imported technology. However, in considering the positive economic impacts of growth in clean energy technology deployment, policymakers should not focus exclusively on jobs manufacturing clean energy technology.

The Pew Center's 2010 brief, *Clean Energy Markets: Jobs and Opportunities*, made the following points about economic and employment benefits from growth in clean energy.[40]

> Many of the low-carbon technologies that would be incentivized under climate and clean energy policy—such as solar panels, wind turbines, efficient automobiles and advanced batteries, nuclear power plants, next generation coal plants incorporating CCS, and others—are complex products with many components and extensive value chains that may span several countries. For example, some components of a new wind turbine may be manufactured in China, and others in the United States; likewise, individual parts of a solar panel may be manufactured in several different countries before its final assembly and installation. Within these value chains, many jobs—such as installers, welders, and construction workers—must be located where the demand is and therefore cannot be outsourced overseas. This means that even if a clean energy technology company is based in a foreign country or manufactures some technology components elsewhere, if it sells products in the United States it is very likely to create local jobs and hire American workers—if domestic clean energy technology markets exist. Domestic markets can

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[38] Pew Charitable Trusts, *The Clean Energy Economy: Repowering Jobs, Businesses, and Investments across America*, June 2009, see Exhibit 3.

[39] Michigan Public Service Commission, *Report on the Implementation of the P.A. 295 Renewable Energy Standard and the Cost-Effectiveness of the Energy Standards*, February 2011.

[40] Pew Center on Global Climate Change, *In Brief - Clean Energy Markets: Jobs and Opportunities*, April 2010.

entice firms in other countries to shift some of their production to the United States, creating additional jobs.

This is already occurring to some extent, both to meet demand in today's relatively small domestic markets and in anticipation of future U.S. climate and clean energy policy:

- Researchers at the Peterson Institute for International Economics have found that the complex, globalized nature of the wind energy industry means that local demand will generate local production and jobs, regardless of where companies are headquartered.[41]
- For example, Goldwind, a Chinese company, is looking to expand into the U.S. wind power market, a move which will likely require the hiring and training of U.S. workers.[42]
- Suntech, a Chinese solar power firm and the largest photovoltaics manufacturer in the world, is opening a manufacturing facility in the United States—and hiring American workers—in an effort to expand further into the North American market and take advantage of what it perceives to be good prospects for U.S. solar panel demand.[43]

These examples illustrate how foreign investment can lead to job creation in the United States. However, today's domestic markets remain relatively small, and these levels of investment – and the number of jobs created – could be much larger if domestic demand were greater.

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[41] Kirkegaard, Jacob, Thilo Hanemann, and Lutz Weischer, *It Should Be a Breeze: Harnessing the Potential of Open Trade and Investment Flows in the Wind Energy Industry,* Peterson Institute of International Economics, December 2009.

[42] Yiyu, Liu, "Goldwind to Spread Wings Overseas for Growth," *China Daily*, December 15, 2009.

[43] Burnham, Michael, "China's Solar King Plots U.S. Manufacturing Plant," *Environment and Energy Daily*, May 11, 2009.