POLICY

CLEAN ENERGY STANDARDS: STATE AND FEDERAL POLICY OPTIONS AND IMPLICATIONS

DISCUSSION PAPER PREPARED BY THE

REGULATORY ASSISTANCE PROJECT AND THE CENTER FOR CLIMATE AND ENERGY SOLUTIONS

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RAP

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CONTENTS

FOREWORD

EILEEN CLAUSSEN, PRESIDENT, CENTER FOR CLIMATE AND ENERGY SOLUTIONS

Transitioning from conventional fossil fueled electricity generation to cleaner sources is an importantpolicy goal with numerous benefits—the growth of new clean energy industries, diversification of energy supply, and reductions in harmful greenhouse gases and other pollutants.

A clean energy standard (CES) is one approach to increase the proportion of our electricity generated by clean sources, and has recently received bipartisan support at the federal level. Several Republican Senators sponsored CES proposals in the last Congress, and President Obama endorsed a federal CES in his 2011 State of the Union address. Many states continue to be policy innovators in this area, enacting and strengthening both renewable and clean energy portfolio standards and goals.

We would like to thank the Regulatory Assistance Project (RAP) for collaborating with us on this discussion paper and bringing important insights from their extensive experience working with state public utility commissions. The authors introduce the concept of a CES, explaining how it works, the benefits that a CES can deliver, and federal and subnational options for CES policies. This paper also explores some of the nuances of CES policy design and the implications of different design choices. This discussion and the conclusions reached aim to help policymakers, regulators, and other stakeholders decide whether a CES is an appealing option and to help such stakeholders understand the potential impacts of a CES.

The paper points out that absent significant new policies to promote clean energy, the share of total U.S. electricity generation obtained from clean energy sources will likely not increase by more than a few percentage points over the next 25 years. Such a reality will mean the U.S. would forgo substantial important benefits, including growth of new industries, diversification of the energy supply to limit exposure to fuel price volatility and regulatory risk associated with particular energy sources, and the mitigation of environmental and public health impacts from electricity generation. A CES warrants consideration by policymakers at all levels as a potential tool for achieving the many benefits of a clean energy transition.

FOREWORD

RICHARD SEDANO, DIRECTOR OF U.S. PROGRAMS, REGULATORY ASSISTANCE PROJECT

At RAP, we take an interest in practically every kind of public policy affecting the electric power sector. Electricity portfolio standards are particularly interesting and important to us because these policies directly support policymakers' efforts to define and to plan for desired outcomes for power sector resources while letting markets work to find the best means to achieve them. Environmental quality has always motivated government to adapt utility regulation in important ways to further the public interest.

At the time that RAP was founded in 1992, only one state (Iowa) had enacted an electricity portfolio standard. Today, more than half of the states have adopted this kind of policy. But as we often see with policymaking, states did not merely replicate Iowa's groundbreaking policy, which focused exclusively on electric generation from renewable resources. Instead, the idea of a portfolio standard evolved, state by state by state. Clean energy standard (CES) policies are the latest stage in this evolution. These are policies that favor not just renewable energy, but also low-emission, non-renewable energy resources. Although only a handful of states have enacted a CES, there is reason to think this idea could spread. Of the last six states to enact an electricity portfolio standard, four have opted for a CES rather than the more common renewable portfolio standard (RPS). The states with CES policies also seem to have a lot in common with the remaining minority of states that have no electricity portfolio standard at all – suggesting that the CES idea has room to grow. And finally, many of the most promising proposals for a national portfolio standard have tended toward the CES approach rather than the RPS approach.

RAP has enjoyed having the opportunity to collaborate on this paper with the Center for Climate and Energy Solutions. We feel that this partnership allowed two very different organizations to combine their strengths. The Center is an influential and thoughtful advocate for national and international climate change policies, and has its finger on the pulse of Congressional debate. RAP, on the other hand, works primarily at the invitation of U.S. state governments and does not advocate for legislation. Furthermore, all of RAP's principals and senior associates are former energy or environmental regulators. We felt we could contribute a state-level perspective and a regulator's perspective to some of the key issues that arise in designing CES policies, including issues that go beyond climate change considerations.

We hope that this paper will facilitate a broader and better-informed discussion of clean energy standards, at both the state and federal levels. Cleaning up the electric power sector is a challenge of monumental proportions, but we've already seen the power of RPS and CES policies and feel certain that even more progress can be made.

EXECUTIVE SUMMARY

A transition from conventional fossil fueled electricity generation to clean energy offers several benefits—particularly the growth of new clean energy industries and associated jobs, diversification of energy supply, and reductions in the public health and environmental damages (especially from air pollution) associated with conventional electricity generation.

The current status of clean energy generation depends on how one defines clean energy. While there is no universally agreed upon definition of clean energy in the power sector, various stakeholders endorse some or all of the following as at least partially clean energy options: highly efficient natural gas combined cycle generation; fossil fuel use coupled with carbon capture and storage (CCS); nuclear power; renewables; and electricity savings from energy efficiency and conservation. These generation sources provide about half of U.S. electricity today. While market dynamics and current state and federal policies have led to recent growth in clean energy generation—such as the growth in renewable generation driven in part by state renewable electricity portfolio standards—projections for the power sector indicate that, absent significant new policies to promote clean energy, the status quo in terms of power generation will continue largely unchanged for at least the next quarter century.

Given the benefits of clean energy and the dependence of substantial growth in clean energy generation on new policies, policymakers have lately turned their attention to the idea of a clean energy standard (CES). A CES is a type of electricity portfolio standard that would set aggregate targets for the level of clean energy that electric utilities would need to sell while giving electric utilities flexibility by: (1) defining clean energy more broadly than just renewables, and (2) allowing for market-based credit trading to facilitate lower-cost compliance. As a concept, a CES builds on the successful experience of the majority of states that have implemented renewable and alternative energy portfolio standards and draws on a history of federal policy deliberation regarding national electricity portfolio standards.

States could pursue new CES policies singly or jointly to create multi-state programs. State CES programs could complement existing state renewable portfolio standards, and a CES may be a promising option in states where more narrowly defined renewable electricity policies have had less appeal. A handful of states have already enacted electricity portfolio standards that have many of the attributes of a CES.

The federal government could also enact a national CES. A federal CES has recently received bipartisan support, with several Republican Senators sponsoring federal CES proposals in the last Congress and President Obama endorsing a federal CES in his 2011 State of the Union address. While the prospects for near-term enactment of a federal CES are uncertain, a federal CES has received substantial attention and warrants close consideration by stakeholders.

This paper introduces stakeholders to the concept of a CES, explains how a CES works, describes the benefits that a CES can deliver, and explores federal and subnational options for CES policies. This paper also explores some of the nuances of CES policy design and the implications of different design choices. This discussion can help both state and federal policymakers, utility

regulators, and other stakeholders decide whether a CES is an appealing option and to help state stakeholders understand the potential impacts of a federal CES on their states so that they might formulate and communicate federal CES policy design preferences.

Several of the paper's key points are summarized below.

- Absent significant new policies to promote clean energy, the share of total U.S. electricity generation obtained from clean energy sources will likely not increase by more than a few percentage points over the next 25 years.
- Substantial increases in clean energy generation can offer important benefits, including:
  - Growth of new clean energy industries and associated jobs—e.g., wind turbine manufacturing, solar panel installation, and nuclear power plant construction;
  - Diversification of energy supply to limit electric utilities' and ratepayers' exposure to fuel price volatility and regulatory risk associated with particular energy sources;
  - Mitigation of environmental and public health impacts from electricity generation—including criteria and hazardous air pollutants, greenhouse gases emissions that contribute to climate change, and other impacts.
- A CES is a promising policy for spurring a transition to clean energy in the power sector.
  - As a type of electricity portfolio standard, a CES sets requirements for the percentage of electricity sales that must be supplied from qualified clean energy sources and allows electric utilities to demonstrate compliance via tradable credits that they earn themselves for their own generation or buy from other electric utilities or clean energy generators.
  - As a market-based policy, a CES can effectively increase clean energy generation and achieve associated benefits while offering substantial compliance flexibility for electric utilities thus minimizing impacts on electricity consumers.
  - By broadly defining clean energy, a CES provides opportunities for utilities, states, and regions to exploit their unique mix of clean energy options.
  - A CES program can build upon the success of existing electricity portfolio standards that a majority of states have already implemented, provided that the percentage targets are increased in proportion to the potential of newly eligible resources. If additional clean energy resources are allowed to qualify for an existing portfolio standard without increasing the targets, the mix of resources used to meet the standard and the resulting compliance costs may change, but the total amount of clean energy generation will not increase and the goals of the policy may not be furthered.
  - At the state and federal levels, CES policies have attracted bipartisan support, including CES proposals from President Obama and Republicans in Congress.
- CES programs enacted by the federal government or by states singly or in coordination could spur incremental clean energy generation and deliver associated benefits.
  - Federal CES proposals have attracted bipartisan support in previous years, but it is not clear if or when legislation to create a federal CES will move forward.

    - States have already proven themselves to be policy innovators with respect to renewable electricity portfolio standards, and states may seek to reap the benefits of clean energy for themselves by implementing new CES policies—either singly or as part of multi-state programs.
    - At least four states (Michigan, Ohio, Pennsylvania, and West Virginia) already have electricity portfolio standards that credit cleaner, non-renewable energy sources, and Indiana has a similar but voluntary program. These states offer several lessons for future state or federal CES programs, including:
        - Utilities tend to comply with electricity portfolio standards by deploying the lowest-cost qualified resources, so policymakers may need to include special provisions in a CES if they hope to provide a meaningful incentive for less commercially mature and higher-cost technologies.
        - Policymakers can design CES programs that have very modest impacts on electricity rates.
        - A combination of factors—including the policy's target and the types of energy sources that qualify—determine how much incremental clean energy generation a CES program will deliver beyond "business as usual," and policymakers should consider the interaction of such factors in developing a CES to ensure the program can meet their goals for additional clean energy generation.
- The net effects of a CES policy are a function of interrelated policy design decisions. Policymakers and stakeholders should understand CES policy design options and their interactions and implications. Policymakers and stakeholders might usefully evaluate a CES in terms of key criteria and think about implications of different policy design decisions in light of these criteria.
    - Effectiveness – What is the magnitude of the policy's desired impacts?
        - CES targets set the requirements for overall clean energy generation.
        - The degree to which a CES delivers the benefits associated with clean energy depends on how policymakers define qualified clean energy under the program.
        - Certain policy design options (e.g., exemptions for certain utilities and alternative compliance payments) can have the effect of reducing a CES program's effective target for incremental clean energy deployment.
        - Policymakers may include provisions in a CES to provide particular incentives to certain technologies—e.g., less commercially mature or higher cost ones—in order to reap particular clean energy-related benefits.
    - Cost-effectiveness – how efficiently does the policy achieve its intended aims?
        - As a market-oriented policy, a CES is an inherently cost-effective program.
        - Policymakers have several options for providing electric utilities with compliance flexibility under a CES (e.g., banking and borrowing of credits).

    - In general, the more flexibility that utilities have for meeting clean energy targets (e.g., the more broadly clean energy is defined), the more cost-effective a CES program will be.
- Fairness – does the policy lead to any undue burdens or unearned windfalls for particular utilities, power generators, or regions and customers?
    - Owing to a variety of factors, different electric utilities supply their customers with electricity from widely varying existing generation mixes. In addition, utilities, states, and regions have different cost-effective options for increasing clean energy generation (e.g., because of different renewable resource endowments).
    - How policymakers set CES targets, treat new vs. existing clean energy generators, and define qualified clean energy sources determine how the effects of a CES program vary among different utilities, power generators, or customers.

1 INTRODUCTION

This paper is intended to inform debate and deliberation among policymakers and stakeholders regarding state and federal clean energy standards (CES) for the electric power sector. A CES is still a relatively new policy option for increasing the role of "clean" energy in the power sector and realizing the associated benefits. This paper seeks to promote understanding of what a CES is and how policymakers might best design such a policy to achieve particular goals.

A word is in order regarding use of the word "clean," both in this paper and in the larger debate. There is no commonly accepted definition of "clean" energy. Indeed, one person's definition of "clean" can differ dramatically from another's if their objectives for energy policy differ. Renewable energy, nuclear power, natural gas, coal with carbon capture and sequestration, energy efficiency, and emissions offsets all have their advocates as falling under the definition of clean. Unless otherwise noted, this paper will use the term "clean" to refer to these options and "conventional" to refer to all other electricity generation. When referring to the share of total electricity obtained from clean energy sources, this paper will, unless otherwise noted, count natural gas generation as half clean for reasons that will be explained later. This paper does not choose what options should be considered clean. Rather, this paper explores issues pertaining to clean energy broadly and looks at the specifics of a policy mechanism (i.e., a clean energy standard) whose workings and implications are largely separate from the choice of how to define clean energy.

This paper is organized as follows. Sections 2 and 3 describe the current status of and outlook for clean energy absent new policies and the benefits of expanding clean energy generation through new policies. Sections 4 and 5 explain what a CES is, and what advantages and disadvantages a CES policy might have for promoting clean energy. Sections 6 and 7 provide an overview of recent proposals for a national CES, relevant state experience with CES-like programs, and options for new state or multi-state CES programs. Section 8 takes an in-depth look at the particular policy design elements of a CES and the implications of different design choices. Finally, Section 9 offers conclusions.

2 STATUS AND OUTLOOK FOR CLEAN ENERGY

Some context regarding the status and outlook for clean energy in the power sector can help inform the discussion of a CES. The following observations are of particular relevance:

- The United States currently obtains nearly half of its electricity from traditional coal-fired electric power plants (see Figure 1).
- Natural gas has dominated new capacity additions in the power sector over the past two decades, and renewables, particularly wind power, have seen strong growth in the last decade (see Figure 2).
- The latest projections from the U.S. Energy Information Administration (EIA) of "business as usual" trends for the power sector (from EIA's *Annual Energy Outlook 2011*, AEO2011) suggest that the share of total U.S. electricity generation obtained from several clean energy sources is unlikely to increase by more than a few percentage points over the next quarter century.
- Absent a new energy policy, natural gas is projected to be the dominant technology choice for new electricity generation.[1] This is projected to be the case even when taking into account sensitivity to such factors as forthcoming EPA regulations, natural gas prices, and extension of federal tax incentives for renewables (see Figure 3).
- A majority of states have adopted binding renewable and alternative energy portfolio standards to drive increases in clean energy generation (see Figure 4), but the expansion of such policies to new states may be slowing (see Figure 5).
- In the absence of supportive financial incentives and policies, renewables and other clean energy technologies (with the exception of energy efficiency technologies) are generally more costly than new natural gas combined cycle power plants, the least costly and cleanest fossil fuel technology (see Figure 6) for new capacity additions. Clean energy technologies may also face other challenges, as detailed in Appendix A.1.

The observations above suggest that, absent significant new policies to promote clean energy, the United States will not see a substantial shift toward clean energy.

Figure 1: Electric Power Sector Net Generation, 1990-2010[2]

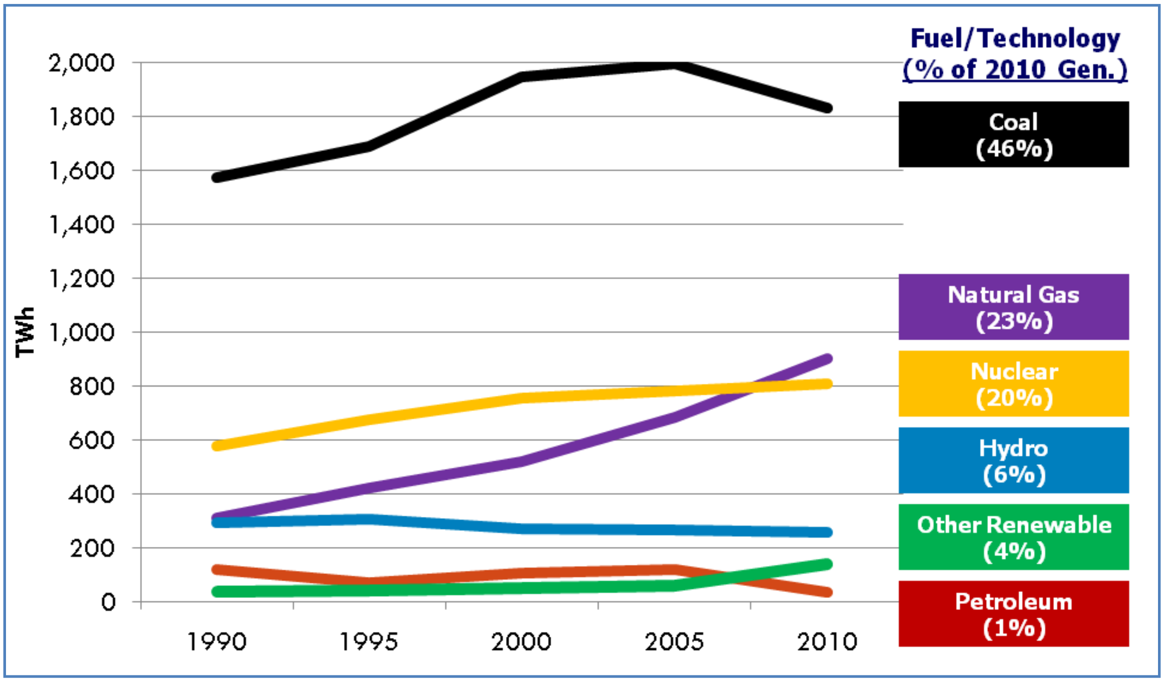


Figure 2: U.S. Electric Generation Capacity by In-Service Decade and Fuel/Technology[3]

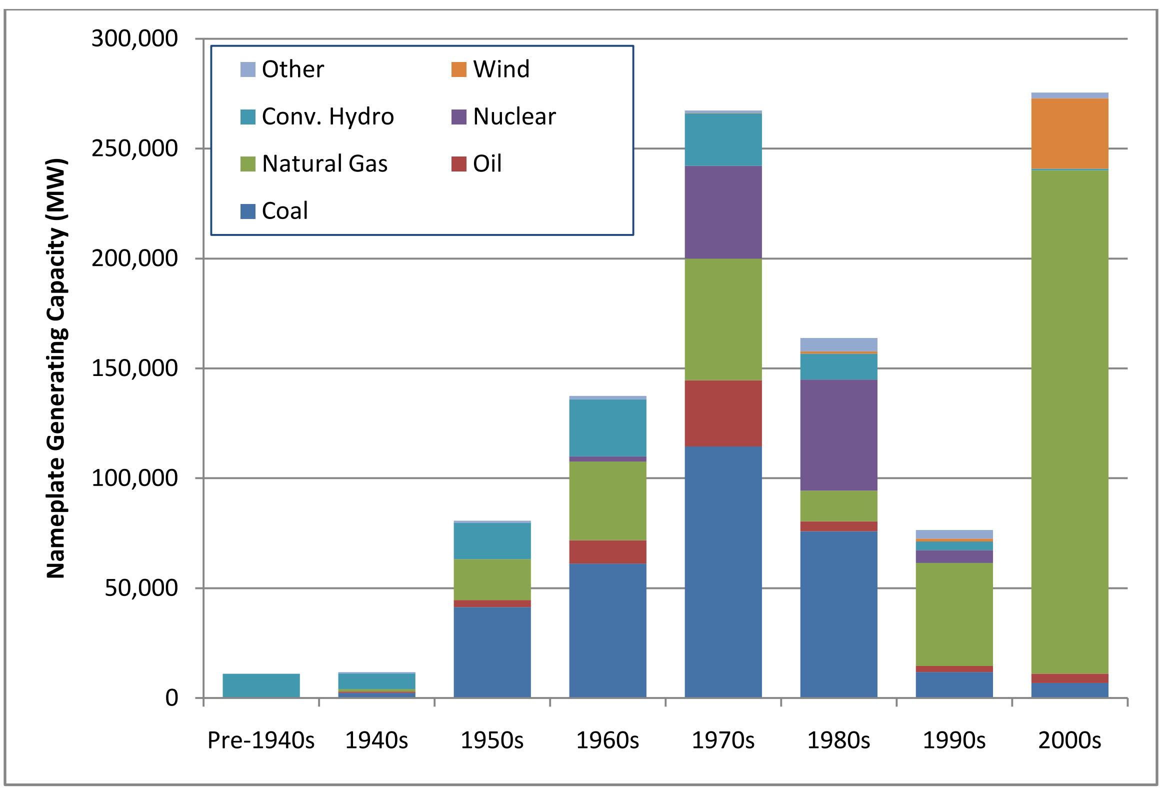


Figure 3: Projected Electric Power Sector Generation Mix from AEO2011 Reference Case and Sensitivity Cases[4]

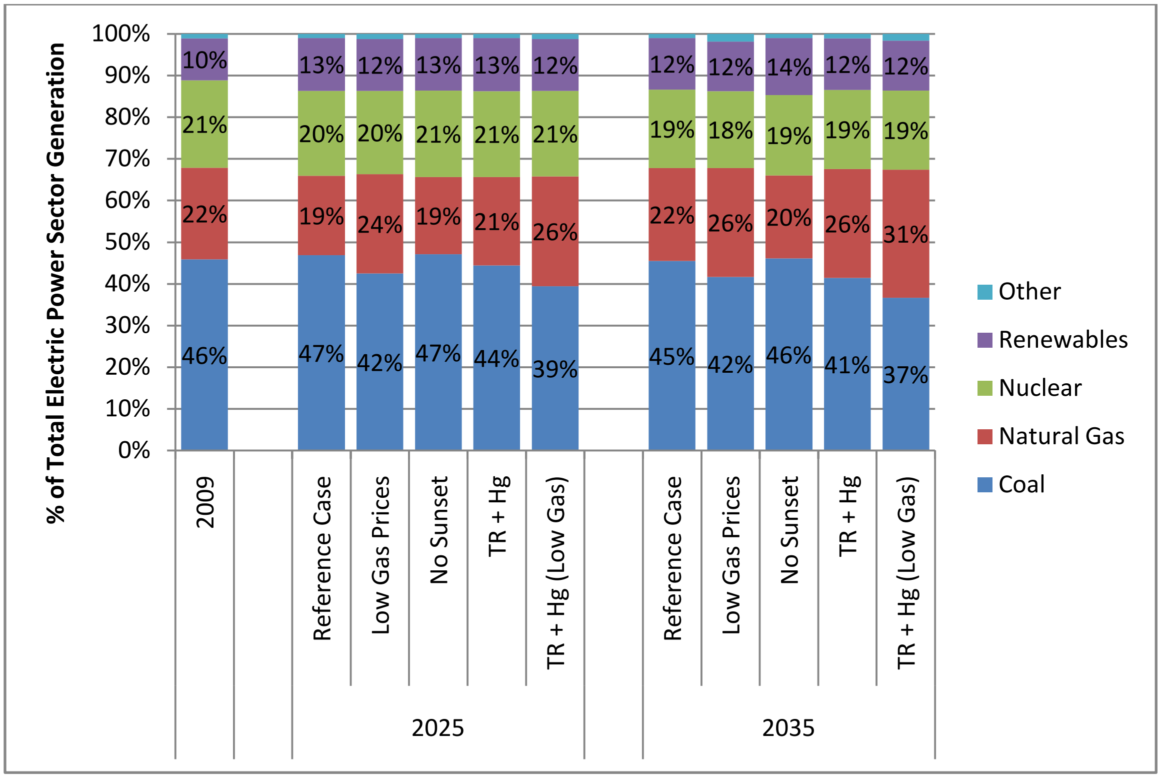


Figure 4: 31 States and the District of Columbia Have Renewable or Alternative Energy Portfolio Standards[5]

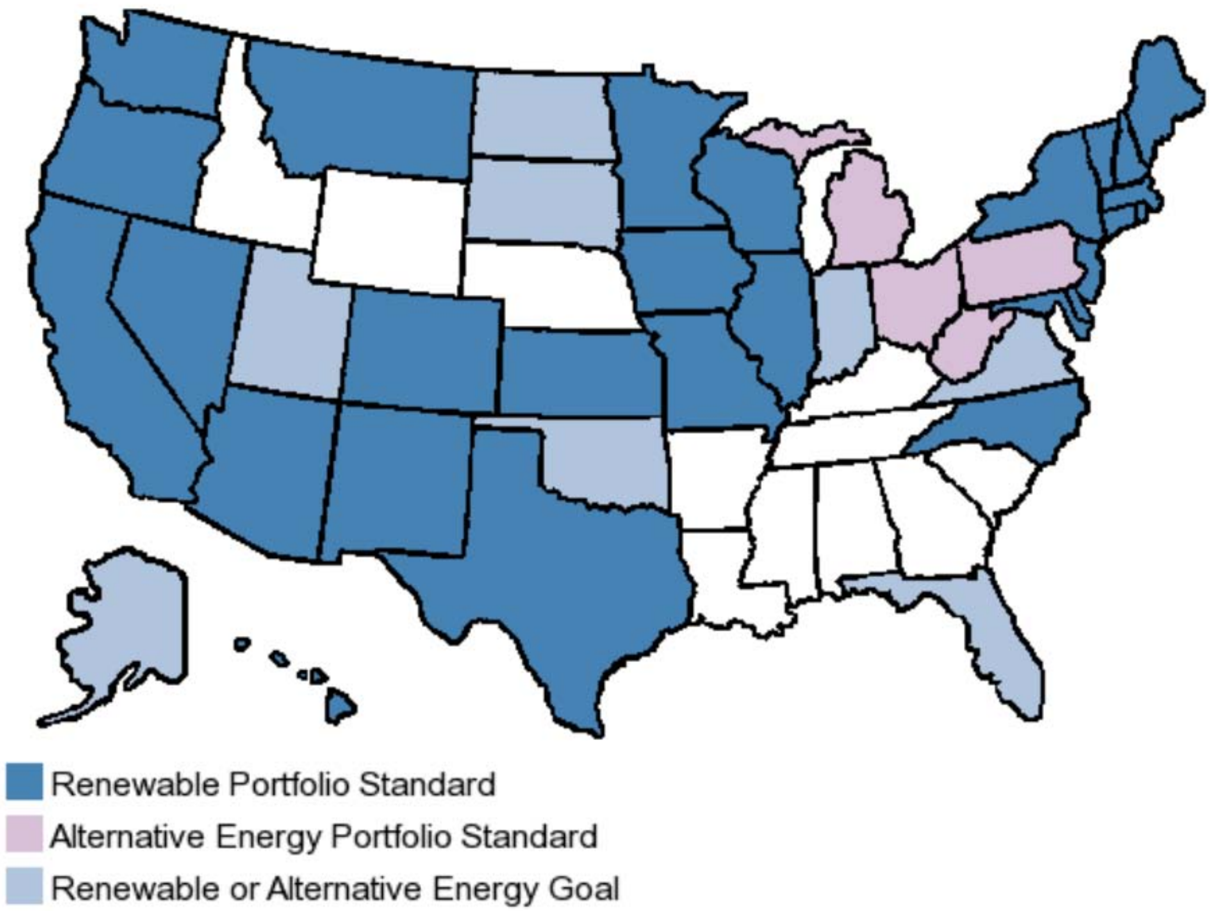


Figure 5: Timeline of State Renewable Portfolio Standard Adoption[6]

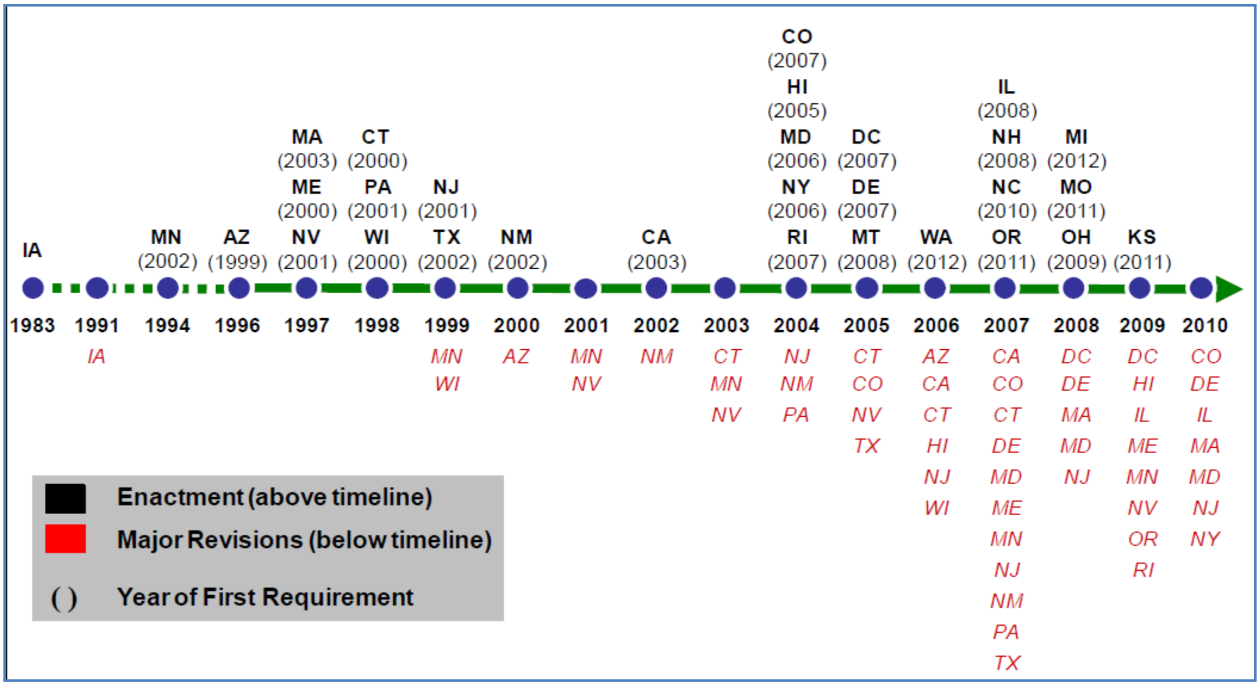
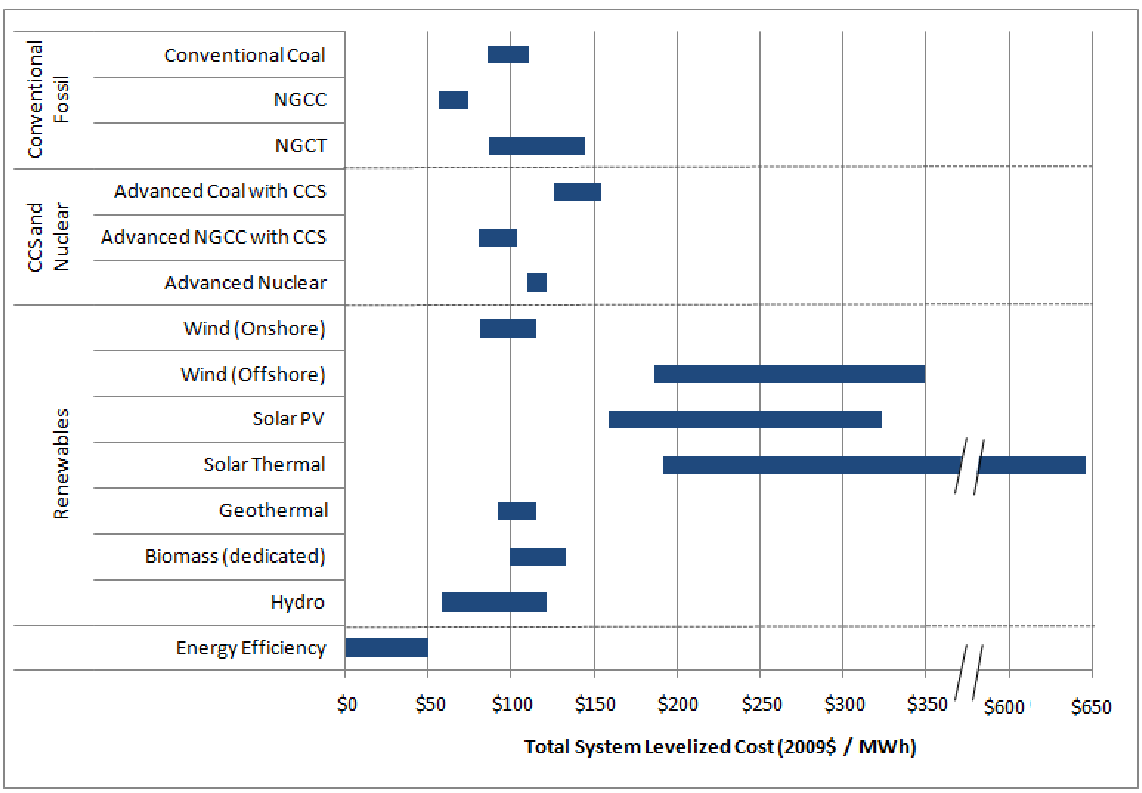


Figure 6: Estimated Levelized Cost of Electricity by Fuel/Technology (2016 Online Year) from AEO2011[7]



3 BENEFITS OF EXPANDING CLEAN ENERGY GENERATION

Growing the share of electricity provided by clean energy sources can provide a range of important benefits—chief among them fostering clean energy industries and jobs, diversifying the energy supply, and improving the environmental and public health profile of electricity generation. A CES designed to maximize one of these benefits, however, might not maximize another. This section discusses the range of benefits. Section 8 discusses how the particular design elements of a CES might be more productive in achieving one benefit than another.

3.1 FOSTERING NEW CLEAN ENERGY INDUSTRIES

By most definitions, clean technology is one of the fastest growing industries of the 21st century. John Doerr, a partner at the leading venture capital firm Kleiner Perkins Caufield & Byers, described green technologies, including clean energy, as "the next great global industry" in 2009 testimony before the United States Senate Committee on Environment & Public Works.[8]

A recent report finds that global clean energy finance and investment grew significantly in 2010 to $243 billion, a 30 percent increase from the previous year. The clean energy sector is emerging as one of the most dynamic and competitive in the world, witnessing 630 percent growth in finance and investments since 2004. The United States had been leading the world in clean energy investment until 2009, when it was surpassed by China. Subsequently, the U.S. fell to third after being passed by Germany in 2010. When clean energy investment is viewed as a percentage of gross domestic product, the U.S. is outspent by China, Canada, Australia, Brazil, and nearly all of Europe.[9] Some form of national clean energy standard is in place in all of these except Canada. Since these countries already invest more than the U.S. in clean energy, it is difficult to argue that U.S. clean energy policies create an unfair burden on U.S. companies relative to these overseas competitors.

New policies to promote clean energy in the United States would stimulate research, development, and investment and accelerate clean technology deployment at scale – by accelerating "learning by doing," innovation, competition, and increased rationalization of emerging supply chains – allowing the United States to keep pace with global competitors. Policies that create a predictable, steadily growing demand for clean energy provide motivation and reduce uncertainty for investors, financiers, merchant power companies, and regulated utilities. As demand for clean energy grows, innovation and competition follow, and these factors lead to significant reductions in cost per kilowatt-hour (kWh).

History supports these assertions. A 2010 study by IHS Emerging Energy Research found that 90 percent of the non-hydro renewable capacity built in the United States since 2004 was built in states with a mandatory renewable portfolio standard (RPS) policy. IHS further asserts that RPS policies will be the most critical driver determining the pace of U.S. renewables growth going forward.[10] And analyses by the National Renewable Energy Laboratory (and others) have consistently shown that the cost per kWh of various renewable energy technologies has decreased, steadily and significantly, over the past three decades.[11] Continued large-scale deployment can drive these costs down to where consumers, businesses and utilities increasingly choose clean energy.

3.2 CREATING NEW CLEAN ENERGY JOBS

Increasing the level of electricity supplied by clean energy sources could stimulate domestic job growth in clean energy industries.[12]

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.[13] Substantial increases in clean energy generation would spur growth in U.S. clean energy technology manufacturing jobs (e.g., wind turbine and solar panel manufacturing, and large manufactured components in advanced technology (CCS or nuclear) power plants) and in non-manufacturing jobs related to clean energy technologies (e.g., construction, installation, and operation). 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 RPS, enacted in 2008, had already led to the first in-state production of utility-scale wind turbines.[14]

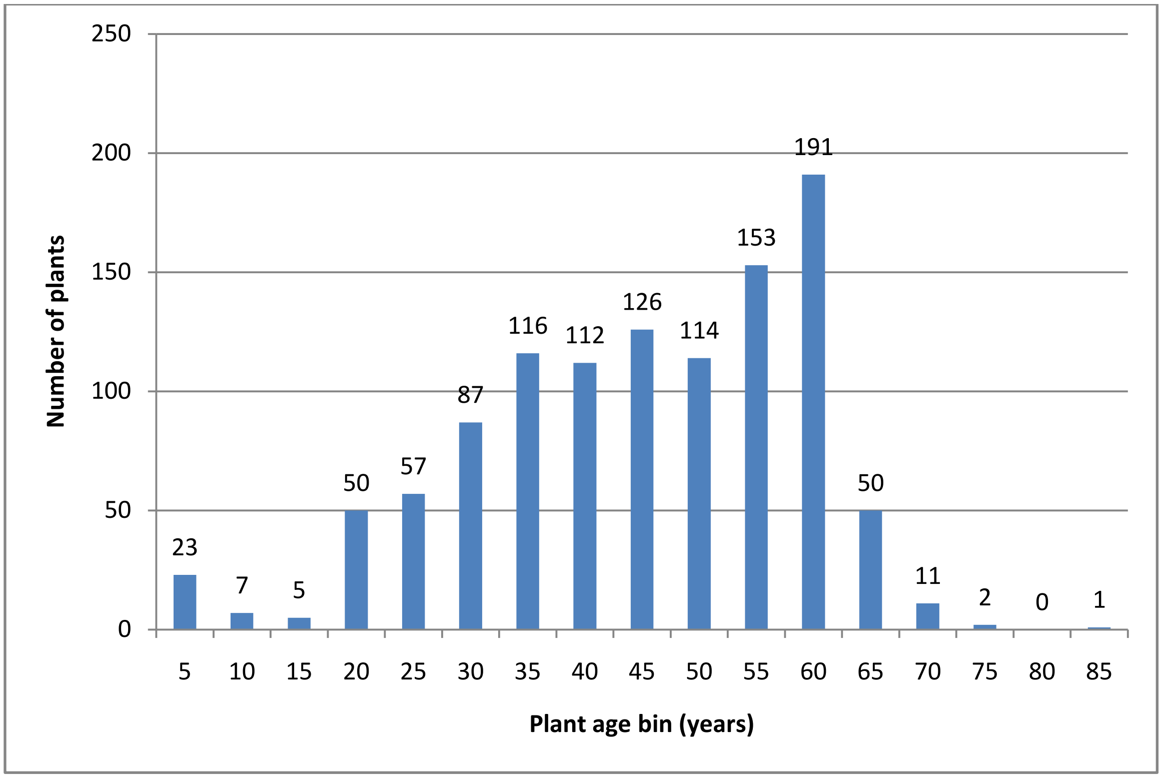
Wei et al. (2010) reviewed and synthesized the results from 15 studies published between 2001 and 2009 on the job creation potential of renewable energy, energy efficiency, and other clean energy technologies such as nuclear power and coal with carbon capture and storage (CCS).[15] The authors suggest that solar photovoltaics, landfill gas-to-energy projects, and energy efficiency create the most jobs per unit of energy, and generally found that the clean energy resources analyzed create more jobs per unit of energy delivered than conventional fossil fuel technologies.

3.3 DIVERSIFYING ENERGY SUPPLY

Construction of new electricity plants raises concerns about the possible overreliance on natural gas. As shown in Figure 1, the United States currently obtains about 20 percent of its electricity from natural gas. In the last decade, however, natural gas has accounted for 81 percent of total generation capacity additions.[16] There is reason for caution regarding the current projections of low natural gas prices: natural gas prices have historically exhibited a large degree of price volatility; there have been four major price spikes in the last decade alone.[17]

As shown in Figure 1, the United States obtains roughly half of its electricity from coal-fired power plants (without CCS). Some states use more than others: according to EIA data from 2009, eight states obtained more than 80 percent of their electricity from coal. Furthermore, as shown in Figure 7, about 80 percent of all U.S. coal-fired power plants are at least 30 years old and more than a third are at least 50 years old. In addition, the implementation of new safety, health or environmental standards pertaining to coal may have significant impacts on electricity prices in areas so heavily reliant on coal.

Figure 7: Age Distribution of U.S. Coal-Fired Power Plants[18]



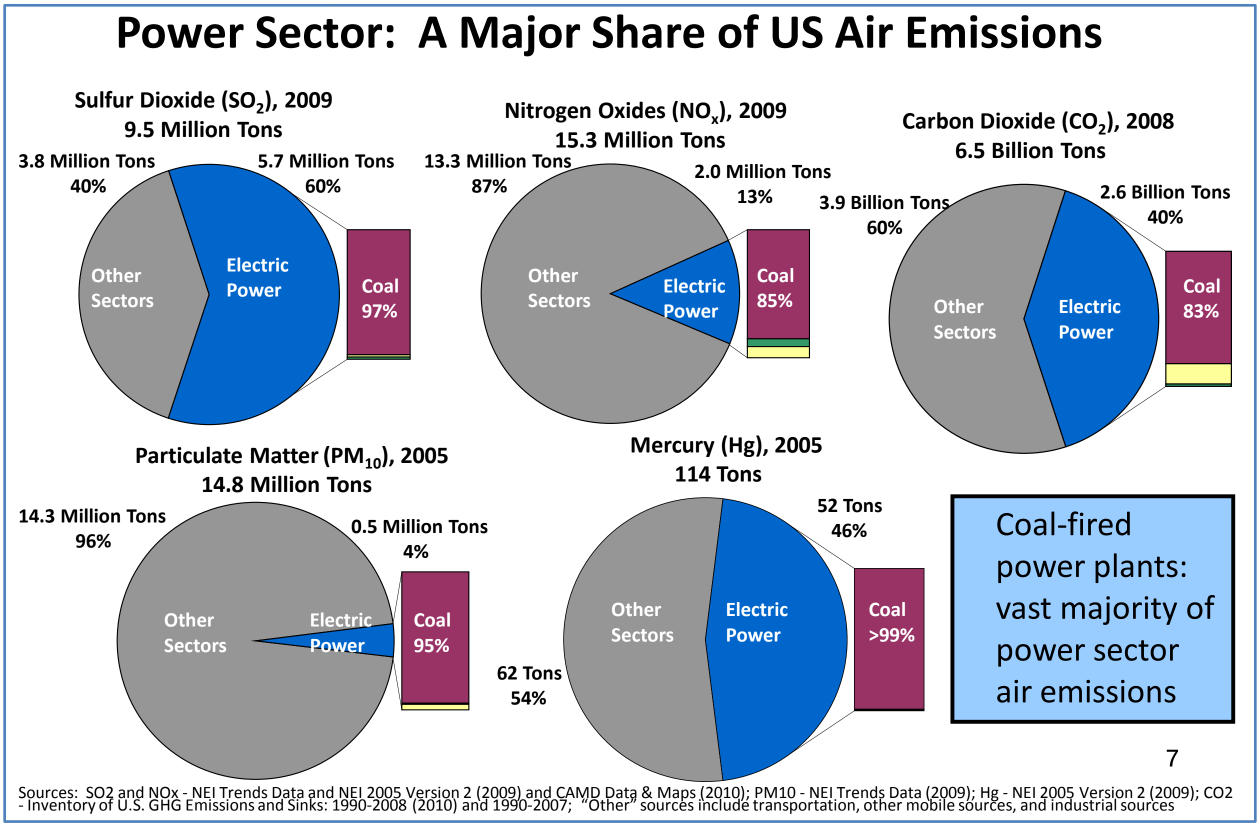
These facts raise questions about the extent to which the United States is vulnerable or could become vulnerable to price shocks and supply disruptions due to overreliance on any given energy source. A CES could be designed to address these concerns by diversifying the nation's energy supply by explicitly requiring greater use of other technologies, none of which are currently producing half as much electricity in the United States as coal. One of the benefits of a more diverse generation portfolio is that it could lessen the country's vulnerability to temporary fossil fuel supply disruptions and associated price spikes, skilled labor stoppages or shortages, and problems in quickly obtaining needed equipment or replacement parts.[19]

3.4 PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT

Electric power plants (particularly older, less-efficient coal plants that lack a full suite of modern pollution controls) are major sources of air pollutants that have significant negative effects on public health and the environment. According to the U.S. Environmental Protection Agency (EPA), more than 125 million Americans live in areas with unhealthy levels of air pollution.[20] Replacing conventional fossil fueled electricity generation with new clean energy generation can reduce pollution and protect public health and the environment.

Electric power plants are the leading U.S. source of emissions of sulfur dioxide, mercury and many other metals, and acid gases. The electricity sector also ranks third among all U.S. sources of nitrogen oxide emissions and fourth in emissions of fine particulates. As shown in Figure 8, the vast majority of the emissions in this sector are associated with coal-fired power plants.

Figure 8: Power Sector Contribution to Air Pollution[21]



Most of the renewable energy technologies, as well as nuclear power and energy efficiency, do not release any of the kinds of air pollutants that most often cause immediate and direct public health impacts: criteria air pollutants such as fine particulates, sulfur dioxide, and nitrogen oxides, as well as hazardous air pollutants (HAPs) such as mercury, other metals, and acid gases. Highly efficient natural gas combined cycle (NGCC) generation emits less particulate matter than conventional coal-fired generation, and virtually no sulfur dioxide or metals (see Appendix A.2).

According to U.S. EPA, the electricity sector also accounts for about 33 percent of total U.S. greenhouse gas (GHG) emissions and 40 percent of carbon dioxide (CO_2) emissions.[22] U.S. power sector GHG emissions are larger than those of any other economic sector. As shown in Figure 8, over 80 percent of GHG emissions associated with electricity generation are from the combustion of coal.

Nearly all renewable energy technologies either do not emit GHGs at all, or only emit GHGs that would eventually be released to the atmosphere anyway.[23] Nuclear power is also a non-emitting energy source, and energy efficiency reduces emissions by avoiding electricity generation. And while there are GHG emissions associated with electricity fueled by natural gas or coal with CCS, both of these technologies have a significantly smaller carbon footprint than traditional coal-fired power plants.

To improve air quality and address pollution-related public health problems, EPA is now in the process of tightening several federal standards. Although these standards implicate all sources of air pollution, many analysts believe that more cost-effective emission reductions can be achieved in the power sector than in other sectors of the economy; it is not surprising then that EPA is also proposing a suite of new regulations that specifically focus on the power sector.[24] Utilities and state regulators are likely to find that in some cases it is cheaper in the long run to replace old coal-fired power plants with new clean energy generation than it is to install the pollution control equipment that will be necessary to comply with emission standards.[25]

4 WHAT IS A CLEAN ENERGY STANDARD (CES)?

This section explains what electricity portfolio standards are, how a CES is a particular type of electricity portfolio standard, and how a CES is similar to and different from other policy options for promoting clean energy in the electric power sector. Section 8 below presents a detailed discussion of particular CES policy design decisions and their implications.

Simply put, a CES is a policy to increase the share of electricity demand met via clean energy sources (and perhaps electricity savings from energy efficiency). Given the range of benefits of increasing clean energy generation noted above, policymakers and other stakeholders have shown interest in pursuing CES policies. In states that already have electricity portfolio standards to promote renewables, a CES could promote further increases in clean energy generation beyond just renewables. States without electricity portfolio standards might be interested in a CES that broadly defines clean energy to include more options than just renewables. Beyond the interest of individual states, a CES could be the focus of multi-state cooperation.

As reviewed in detail in Section 6, the idea of a federal CES has attracted attention from national politicians from both parties in recent years.

This paper discusses issues relevant to a CES implemented in a single state, as a multistate program, and as a national program. Certain issues will only be relevant in the case of a multistate or federal CES.

4.1 ELECTRICITY PORTFOLIO STANDARDS

A CES is a type of electricity portfolio standard. Electricity portfolio standards are flexible, market-based policies that typically set requirements for the percentage of electricity demand that must be met via qualified energy resources—e.g., by 2025, 25 percent of electricity sales must be met via renewable electricity generation. A majority of states have already enacted some type of electricity portfolio standard (see Figure 4), and members of Congress have proposed federal electricity portfolio standards.

As with the definition of "clean," electricity portfolio standards go by different (and sometimes confusing) names, in large part depending on what types of energy resources count toward the requirements. Typically, an electricity portfolio standard that sets a requirement only (or primarily) for renewable electricity is called a renewable portfolio standard (RPS) or renewable electricity standard (RES). The nomenclature gets more complicated when electricity portfolio standards allow for non-renewable electric generation or savings from energy efficiency measures to qualify toward compliance with the policies' requirements. Policymakers have referred to such policies as "alternative," "advanced," "diverse," and "clean" energy (portfolio) standards. Moreover, there is no clear distinction between an RPS/RES and these other types of electricity portfolio standards since some policies that are called an RPS/RES – because they primarily require an increase in renewable electricity – also allow for at least some limited compliance via nonrenewable electricity generation or energy efficiency.[26]

For the purposes of this paper, the term clean energy standard or CES will refer to an electricity portfolio standard that sets a requirement for the amount of electricity sales to be met via qualified resources where those sources include at least some non-renewable electric generation technologies. Again, rather than specifying which technologies should be considered "clean," the authors assume that policymakers will determine for themselves which technologies should qualify. But for illustrative purposes, a number of technologies that have been defined as "clean" in actual state laws or proposed federal laws are used throughout this paper (e.g., nuclear power, fossil fuel use coupled with CCS, natural gas, etc.).

4.2 HOW DOES A CES WORK?

It is important to recognize the context in which a CES would operate. There is no completely free market in electricity generation; the market is subject to a host of regulations, including electricity price regulation in some states and a variety of state and federal environmental regulations. Subject to regulatory and policy constraints, utilities will generally choose to obtain new capacity from the resource with the lowest life-cycle levelized cost, including all quantifiable environmental compliance costs, costs of integration, incremental transmission, etc. In today's market, renewable resources seldom offer the lowest life-cycle levelized cost, as demonstrated in Figure 6. For this reason, objectives beyond maintaining the lowest cost electricity require policy measures.

As a type of electricity portfolio standard, a CES works much like the electricity portfolio standards already in place in a majority of states and the District of Columbia. Under a CES, an electric utility faces a requirement to supply a certain fraction of its electricity sales to end-use customers from qualified clean energy sources (potentially including electricity savings from energy efficiency).[27,28] Electric utilities demonstrate compliance with the CES requirement by either owning or contracting for delivery from clean energy generating assets, or by purchasing tradable credits. Each clean energy credit (CEC) represents one unit of clean energy generation (or potentially electricity savings from energy efficiency. For example, one CEC might correspond to one megawatt-hour (MWh) of output from a qualified clean energy facility (e.g., a wind farm or a nuclear power plant) or one MWh of energy savings. Thus, if a utility sells one million MWh of electricity to retail customers in a given year, and its CES obligation is 50 percent, it must somehow obtain 500,000 CECs and surrender those credits to the CES program administrator to demonstrate compliance.

Qualified clean electricity generators earn credits in proportion to their output and may earn these credits at different rates. In other words, the owner of a qualified clean energy facility will earn some number of CECs for each MWh generated and this number of CECs may vary depending on the type of clean energy facility. Importantly, the tradable credits are "unbundled" from the clean electricity to which they correspond—i.e., they can be sold separately. This means that a generator may sell the electricity to one party, and sell the CEC to the same party, or keep it, or sell it to a third party.[29] By allowing this kind of trading, the CES is an inherently flexible way to promote clean energy.

Electric utilities that own qualified clean energy facilities receive the CECs associated with their generation. Electric utilities can also buy CECs from qualified generators or other electric utilities. The reliance on unbundled credits means that some utilities might deliver more clean electricity than specified by the standard and others might deliver less. The CEC market price provides a financial incentive for deployment of clean electricity technology. Recent modeling analysis suggests that a properly designed CES, compared to "business as usual" policies, can increase electricity generation from a broad portfolio of clean energy technologies.[30] Appendix A.3 discusses how a CES works in traditionally regulated and competitive electricity markets.

5 ADVANTAGES AND DISADVANTAGES OF A CES

A CES offers advantages and disadvantages compared both to alternative means for increasing clean energy generation and to the policy status quo.

5.1 ADVANTAGES OF A CES

5.1.1 A FLEXIBLE, MARKET-BASED POLICY

A CES is a flexible, market-based policy for increasing investment in and generation from clean energy technologies (and potentially increasing energy efficiency as well). This flexibility makes a CES a cost-effective policy for promoting clean energy and provides electric utilities with a wide array of compliance options.

A CES sets a target for clean energy for a state, a region, or the entire country (depending on the scope of the program) and creates a market signal (the credit trading price) to guide the decisions of electric utilities, merchant generators, regulators, and other entities about investments in new generation, retirements, retrofits, utilization, and energy efficiency programs. This market signal under a CES directs these myriad actors to seek the least-cost approach for achieving the policy's aggregate goal for clean energy.

The use of tradable credits to demonstrate compliance gives electric utilities substantial compliance flexibility and keeps costs low since no electric utility needs to generate or deliver any specific quantity of clean energy itself. Rather, electric utilities can generate or deliver more or less clean energy themselves and sell or buy credits accordingly depending on whether they have relatively more or less access to cost-effective clean energy sources. Beyond this basic degree of compliance flexibility, a CES can also include other forms of flexibility such as a broad array of qualifying energy sources, temporal compliance flexibility (banking and borrowing of credits), and various policy options for keeping costs manageable (see Section 8 below for more details on the flexibility mechanisms).

5.1.2 INVESTMENT GUIDANCE FOR UTILITIES AND OTHER POWER GENERATORS

A CES policy can create a more predictable regulatory future for power generators. In today's policy environment, utilities and merchant generators are in a bind. For the most part, there is an expectation that future regulatory requirements will demand a transition to clean energy and much lower emissions of air pollutants in coming decades. EPA air pollution regulations, state and regional GHG cap and trade programs like the Regional Greenhouse Gas Initiative (RGGI) in northeastern states, and state RPS policies are already pushing in this direction. New state, regional, and federal programs will likely require even greater emission reductions and clean energy generation than these policies; however, the total amount of clean energy required and the schedule on which it is needed is mostly unknown. The same can be said for the stringency of future air pollution requirements.

All of this uncertainty makes it very difficult, and risky, to determine when and how much to invest in clean energy, pollution controls, or conventional fossil fueled power plants. On the one hand, utilities cannot be certain that regulators will allow them to recover the costs of clean energy investments if investment decisions are based purely on speculation about future requirements, and merchants that invest too much or too soon could lose a lot of money. Merchants may also find that their access to capital is reduced because of regulatory uncertainty. On the other hand, delaying action until the policy issues become resolved has its own risks, financial and otherwise, and in some cases isn't even an option. Some utilities need to make decisions about capacity additions, power plant retirements, or pollution controls immediately or in the very near term. These decisions frequently come with a price tag of tens or hundreds of millions of dollars, or even billions, and deciding what is best requires the utility and the regulator to make assumptions about future regulatory requirements. If those assumptions turn out to be wrong, somebody – shareholders, ratepayers, or both – will pay the price.

One of the underappreciated effects of regulatory uncertainty is that it can, over time, create capacity and reliability problems. If regulatory uncertainty makes utilities and merchants unwilling or unable to invest in new power plants or pollution controls, natural demand growth may eventually put pressure on existing capacity. This phenomenon was experienced in some parts of the country in the 1990s, when uncertainty about the deregulation of electricity markets caused a slow-down in new power plant construction.

With a long-term CES policy in place, utilities would have a much better sense of what is expected of them, and they could make investment decisions that regulators are more likely to view as necessary, prudent, and in the public interest. Merchant generators would have the knowledge about supply and demand that they need to make investment decisions that are best for their bottom line.

5.1.3 BROAD POLITICAL APPEAL

State and federal policymakers have enacted or at least considered a variety of policies other than a CES that would have the effect of increasing clean energy generation. The other policy options include renewable portfolio standards, cap-and-trade programs, and traditional emission performance standards (see Appendix A.4 below for a comparison of a CES to these other policy options).

A CES policy offers the promise of a way forward on a long-term policy for promoting clean energy and reducing pollution from the power sector that minimizes regional disparities and is less politically charged or controversial than many alternatives. This is borne out by the fact that a substantial majority of U.S. states have enacted renewable or alternative energy portfolio standards already under the leadership of both major political parties.

If renewable and alternative energy portfolio standards have proven popular among the states, there is reason to think a CES could be even more popular. Many of the states that have thus far eschewed renewable portfolio standards policies are fossil fuel exporters, and may view renewable energy as a threat to those industries. However, some of these states may be more receptive to policies that encourage natural gas, coal with CCS, and nuclear power.

For example, in terms of the percentage of electric generation fueled by coal in each state, the top five states are West Virginia, Indiana, Kentucky, Wyoming, and North Dakota. All five of these states also rank in the top 10 states for coal production, producing nearly 70 percent of U.S. coal. Kentucky, Wyoming, and North Dakota do not currently have a mandatory RPS policy. (North Dakota has a non-binding 10 percent RPS goal.) But West Virginia, which ranks number one in coal generation percentage and number two in coal production, enacted a Renewable and Alternative Energy Standard in 2009 that provides credit to a wide range of energy sources—including renewables, natural gas, and advanced coal technologies. And more recently, Indiana enacted a voluntary clean energy goal that recognizes natural gas and nuclear power. The West Virginia and Indiana examples demonstrate that a broadly defined CES can appeal to states that might not be receptive to renewable energy standards. This appeal might also hold at the federal level.[31]

The CES is a relatively new idea, only recently attempted by a few states and only recently attracting federal attention, but it may offer a politically palatable way for states that already have an RPS as well as those that do not to spur clean energy deployment and for federal policymakers to find common ground to establish national goals for clean energy.

5.2 DISADVANTAGES OF A CES

Any given CES may also have its disadvantages. Several disadvantages are worth mentioning, and deserve further exploration. For example, a key challenge is defining "clean energy," for which there is no universal definition. One person's preferred CES may not promote the technologies preferred by another person. Determining what technologies qualify as "clean" under a CES has implications for achieving the policy objectives, and for the cost-effectiveness of the program. Another challenge is that the diversity of state electricity portfolio standards – with different clean energy definitions and target goals – may complicate efforts to harmonize the state standards or to create harmony between a federal standard and state standards. This could lead to higher CEC prices than under a harmonized approach.

For those who view reducing pollution as a key objective of a CES, one disadvantage of a CES may be that it increases the portion of generated electricity that is clean, but does not guarantee an absolute level of pollution reduction. Given that the amount of electricity generated by each facility varies with supply and demand, it would not be practical for policymakers to use a CES to guarantee a specific absolute level of pollution reduction. Also, since a CES is a power-sector-specific policy whose tradable credits are likely denominated in units of clean electricity generation instead of absolute pollution reduction, it is difficult to link and expand the CES to programs focused on other sectors (like transportation or manufacturing).The advantages and disadvantages of specific design aspects of a CES are further examined in Section 8.

6 FEDERAL CES PROPOSALS

The idea of a federal CES has attracted increasing attention from policymakers and various stakeholders. This section summarizes recent federal CES proposals from President Obama and several Senators. Table 4 in Appendix A.5 contains more detail on these proposals.

6.1 PRESIDENT OBAMA'S PROPOSAL

In his 2011 State of the Union address, President Obama called for a CES that would require that 80 percent of U.S. electricity come from clean energy sources by 2035—a target that is based on doubling the share of electricity from clean energy sources over the next 25 years (giving half credit to generation from natural gas combined cycle units).[32] According to the President's proposal, a CES should:[33]

- Ensure broad deployment and provide maximum flexibility in meeting the target by issuing clean energy credits for electricity generated from renewable and nuclear power, with partial credits given for coal use coupled with carbon capture and storage (CCS) and efficient natural gas generation;
- Be paired with energy efficiency programs, such as stronger appliance efficiency standards, tax credits for energy efficiency upgrades, and the proposed Home Star program;
- Include provisions to encourage deployment of new and emerging clean energy technologies, such as coal with CCS.

6.2 RECENT CONGRESSIONAL PROPOSALS

Recent years have seen several proposals for federal electricity portfolio standards. Congress has several times debated a federal renewable electricity standard (and the House and Senate have even separately passed such standards). In 2006, Senator Norm Coleman (R-MN) proposed a clean energy portfolio standard that granted credits to nonrenewable, low-carbon technologies.[34] The 111th Congress (2009-2010) saw passage in the House of Representatives of a federal renewable electricity standard as part of a comprehensive climate and energy bill (the Waxman-Markey American Clean Energy and Security Act of 2009). The Senate saw the introduction of three proposals for federal electricity portfolio standards in 2010 – one renewable electricity standard by Senator Jeff Bingaman (D-NM), and two CES proposals by Senators Richard Lugar (R-IN) and Lindsey Graham (R-SC). Most recently, in the 112th Congress (2011-2012), Senators Jeff Bingaman and Lisa Murkowski (R-AK) released a CES white paper in March 2011 that solicited feedback from stakeholders on the design of a federal CES.[35]

Comparing the recent Senate proposals for federal electricity portfolio standards from the last session of Congress and President Obama's CES proposal, one finds several important differences that point to the range of potential objectives and designs for a CES. Among other things, the CES proposals differed in terms of how they defined clean energy, how they treated energy efficiency, how they limited the cost impacts of the policy, and how much incremental clean energy generation they would require beyond "business as usual."[36]

7 STATE AND REGIONAL CES OPTIONS

As of September 2011, 31 states and the District of Columbia have adopted some form of mandatory RPS policy through legislation, regulation, or public utility commission order (shown in Figure 4). Another eight states have adopted non-mandatory renewable portfolio goals.[37] In addition, 23 states have established mandatory long-term energy savings targets through an Energy Efficiency Resource Standard (EERS), with two other states having a non-mandatory energy savings goal.[38] In some of these cases, the state RPS policy is combined or linked to the EERS policy.

Although many of these state policies have only been recently adopted, it is not too soon to learn some basic lessons from the results achieved. Some of the lessons learned are summarized in this section. Based on these lessons, this paper also considers some fundamental questions about how to transition from dozens of individualized state RPS policies into a more consistent set of regional or national CES policies.

7.1 LESSONS LEARNED FROM STATE ELECTRICITY PORTFOLIO STANDARDS

Perhaps the most important lesson to be learned from state RPS programs is that they succeed in accelerating the deployment of renewable resources. As noted earlier, 90 percent of the non-hydro renewable capacity built in the United States since 2004 was built in states with a mandatory RPS policy. Another clear (and expected) lesson is that state RPS policies tend to result in the deployment of the cheapest available renewable energy options. In most states, this means utility-scale wind power projects. State RPS policies are given a good deal of the credit for establishing a viable wind turbine supply chain in the United States, along with training and credential programs and some domestic manufacturing facilities. A third key lesson is that the impact of RPS policies on electricity rates is difficult to isolate from other factors that influence prices, but in most states modest RPS targets appear to have resulted in only modest impacts.[39]

While these broad lessons are useful, this subsection further examines five-states (Michigan, Ohio, Pennsylvania, West Virginia, and Indiana) that have adopted electricity portfolio standards or goals that provide credit for non-renewable electric generation technologies and are most similar to recently proposed federal CES policies.[40] Table 5 in Appendix A.6 summarizes these state programs.

7.1.1 MICHIGAN

In 2008, Michigan enacted what it calls a Renewable Electricity Standard. Michigan's standard, however, meets this paper's definition of a CES because it actually allows for some compliance via non-renewable generation. Michigan's standard requires 10 percent of electricity to come from qualified energy resources by 2015. Michigan's law allows utilities to meet up to 10 percent of their compliance obligation through the use of "energy optimization" credits (i.e., energy efficiency) or "advanced cleaner energy credits," if approved by the public utility commission.[41] The following technologies qualify as advanced cleaner energy facilities: coal with CCS, coal gasification, and industrial combined heat and power (CHP) facilities. Advanced cleaner energy credits are issued at a severe discount in most cases, such that 10 MWh of generation from these facilities are equal to one MWh of renewable generation or energy efficiency. The only notable exception is for generation at industrial CHP facilities, which is not discounted.

The Michigan Public Service Commission published a status report on the implementation of its electricity portfolio standard in February 2011.[42] Although utilities do not have a percentage target to meet until 2012, they were required to file renewable energy plans that were reviewed by the Commission and served as the basis for the status report. The Commission found that 71 of the 74 electric providers in the state, representing 97 percent of statewide load, have a feasible plan to meet the 10 percent by 2015 standard without exceeding rate impact caps that were established as part of the law. For the two largest utilities in the state, the average cost of renewable generation is more than seven times the average cost of energy optimization (i.e., energy efficiency). Only one utility registered advanced cleaner energy credits in the first year of implementation.

The Commission report indicates that the 10 percent cap on compliance via non-renewable resources is not proving to be a barrier to the development of advanced cleaner energy credits for any utility, thus far. The reported cost advantage of energy optimization, however, underscores this important point: if a CES has only modest targets and it includes energy efficiency without a cap or discounting mechanism, the policy will substantially favor energy efficiency over renewable or alternative energy due to the price differential between the two types of resources.

7.1.2 OHIO

In 2008, Ohio adopted what it termed the Renewable and Advanced Energy Portfolio Standard with a target of 25 percent by 2025, as well as an EERS with targets of 1 percent savings by 2014 and 2 percent by 2019. In addition to the types of renewable technologies included in most state RPS laws, the Ohio CES allows for up to 50 percent of the compliance obligation to be met through "advanced energy resources." This term includes demand side management and energy efficiency measures in excess of those required to meet the EERS, advanced nuclear power, distributed combined heat and power (CHP) facilities, and coal with CCS.[43] The Ohio law also includes a small carve-out for solar photovoltaic generation, meaning that part of the requirement must be met with this type of resource. Ohio's CES is currently the only mandatory state electricity portfolio standard in the country that specifically allows nuclear power to qualify for credit.

To date, Ohio utilities have only filed two years of compliance reports and the Ohio Public Utilities Commission has not produced any kind of aggregated, statewide status report. Individual compliance reports from Ohio's four largest electric utilities (in terms of retail sales) did not indicate any use of advanced energy resources for compliance with year 2010 obligations.[44]

It may take several more years before conclusions can be drawn about the effects of Ohio's CES in promoting advanced energy resources. One would not expect to see those resources deployed and generating electricity just one year after the CES took effect; it can take longer than a year to construct a CHP facility and many years to construct nuclear or coal with CCS facilities. Energy efficiency, on the other hand, can be implemented very quickly and can save a kWh of electricity for less than the cost of generating a kWh via renewable or "advanced" energy resources. Given, however, that Ohio only allows energy efficiency in excess of its EERS to qualify for the CES, and the EERS becomes more ambitious over time, it may be that the use of energy efficiency for CES compliance will be less than what might otherwise be expected.

7.1.3 PENNSYLVANIA

Pennsylvania's electricity portfolio standard (called the Alternative Energy Portfolio Standard) was adopted in 2004. It requires utilities to increase their use of clean energy resources each year, with a final target of generating eight percent of all electricity from "Tier I" energy resources and ten percent from "Tier II" energy resources in 2021. Tier I is similar to the list of qualifying renewable technologies in most state RPS laws, while Tier II includes demand side management and energy efficiency measures, waste coal, coal gasification, and distributed generation.[45] As in Ohio, Pennsylvania's CES also includes a small carve-out for solar photovoltaic generation, which is part of the eight percent Tier I target.

The Pennsylvania Public Utility Commission, in its most recent compliance report, found that the average price of Tier I credits in 2009 was ten times higher than the average price of Tier II credits. The Commission also reported that there were at least 45 percent more Tier II credits created in each of the years from 2005 through 2008 than will be needed in 2021. The total cost of compliance with the CES was equal to about 0.25 percent of the cost of electric service.[46] These findings suggest three major lessons. First, the law has not had a dramatic effect on electricity costs. Second, if Pennsylvania had not placed renewable and non-renewable resources in separate tiers, its CES would provide very little incentive for increased deployment of renewables, because the vast majority of compliance would come through cheaper waste coal generation and energy efficiency measures. Third, the fact that more credits have been generated than are likely to be needed suggests that the 10 percent by 2021 requirement for Tier II was not sufficiently ambitious to provide any meaningful incentive beyond business-as-usual. Pennsylvania broke new policy ground in 2004 with its CES, but if the state wants to encourage additional energy efficiency, coal gasification projects, or increased use of other Tier II resources, the current law might need to be revised.

7.1.4 WEST VIRGINIA

In 2009 West Virginia established its Alternative and Renewable Energy Standard, which requires 25 percent of electricity to come from "alternative and renewable energy resources" by 2025. The non-renewable alternative technologies that qualify for West Virginia's CES include demand side management and energy efficiency projects, waste coal, coal bed methane, coal with CCS, coal gasification or liquefaction, natural gas, synthetic gas, and GHG offset projects. West Virginia awards two credits for each MWh of electricity generated from renewable resources, but only one credit per MWh generated from alternative energy resources or MWh saved via energy efficiency measures. Offset projects can also earn one credit per ton of GHG reduced. This is currently the only mandatory CES in the country that includes natural gas as a qualifying technology, but utilities may only use natural gas to meet up to 10 percent of their compliance obligation.

West Virginia utilities do not have a CES compliance obligation until 2015, but they were required to file compliance plans with the West Virginia Public Service Commission in January 2011. Although the Commission has not yet approved these compliance plans, they provide an early indication of the effects that the CES law might have. The compliance plans proposed by the two dominant companies in the state are illustrative. American Electric Power's plan would result in increased generation from advanced coal technologies and natural gas, as well as increased energy efficiency, but would not likely result in any new renewable generation capacity between now and 2025. Even the increases may not be attributable to the CES law, as this company's plan would vastly over-comply with the standard and bank large numbers of credits for sale or future use. Allegheny Power similarly reported to the Commission that it can comply with the CES through 2025 using currently available resources. These two companies provide 99 percent of all retail sales in the state.

Thus far it does not appear that the West Virginia CES is greatly advancing renewable generation, though it may be providing an incentive for cleaner advanced coal generation, natural gas, and energy efficiency.

7.1.5 INDIANA

Indiana became the most recent state to adopt a clean energy policy with the enactment in May 2011 of its Voluntary Clean Energy Portfolio Standard. Unlike the prior four examples, Indiana's law creates clean energy incentives (described below) rather than requirements for public utilities. In order to receive incentives, a utility must apply for the program and be approved by the Indiana Utility Regulatory Commission. To be approved, the utility must demonstrate to the Commission's satisfaction that in the year 2025 the utility has a reasonable expectation of obtaining from qualified energy resources an amount of electricity equal to 10 percent of its total base year (2010) retail sales. There are also two multi-year interim targets that the utility must meet in order to maintain eligibility for incentives: in the years from 2013 through 2018, the annual average percentage from qualified resources must equal four percent of base year sales, and from 2019 through 2024 the annual average must equal seven percent of base year sales.

In addition to a typical list of qualifying renewable resources, Indiana's voluntary program recognizes electric generation or savings from energy efficiency and other demand side management programs; energy storage systems; distributed generation; coal bed methane; CHP and waste heat recovery; nuclear power; and natural gas from a facility constructed in Indiana after July 1, 2011, which displaces electricity generation from an existing coal fired generation facility.

The law is very specific about the incentives that the Commission is authorized to provide to participating utilities. If a participating utility can attain the stated clean energy goals, the Commission has discretion to award shareholder incentives in the form of an increased overall rate of return on equity, not to exceed 50 basis points over the utility's authorized rate of return. The number of additional basis points authorized by the commission may be different for each of the goal periods, as the Commission determines appropriate, and may also be based on the extent to which the participating utility met its goal using renewable resources. Participants are also assured of cost recovery through a periodic rate adjustment mechanism.

Because the law is so new, the Commission has not yet promulgated implementation rules. In addition, it remains to be seen whether any utilities will apply for this voluntary program.

7.2 HOW MIGHT EXISTING STATE RPSS BE EXPANDED TO/COMPLEMENTED BY CES?

Regardless of the existence of a federal CES, states that already have an RPS policy could certainly choose to expand the list of resources that qualify for their own standards. If states wish to increase both renewable and non-renewable clean energy, the early results from some of the first experiments with a CES suggest that the targets and schedule would need to be adjusted accordingly to ensure that the policy change does not result in a substitution of one for the other. In other words, a state that currently has a 25 percent by 2025 RPS will not promote additional clean energy deployment if it switches to a 25 percent by 2025 CES that includes natural gas, though it may reduce compliance costs for utilities. Instead the state should consider higher targets and/or a more aggressive schedule when it expands from an RPS to a CES.[47]

If a federal CES policy is adopted, states may wish to retain their RPS policies, especially if the federal policy lacks ambition or treats all clean resources equally. This would provide a way for states to ensure (and control) the amount of renewable energy that is in their clean energy supply mix or express local preferences about which renewable energy resources are most valued. One way to allow state RPS policies to operate concurrently with a federal CES policy would be to develop tracking systems that assign multiple distinct credits to each unit of clean energy generation. For example, a megawatt-hour of generation that is considered "clean" under both laws would receive one federal CES credit and one state RPS credit. The owner of the credit would separately retire the federal CES credit for federal compliance purposes and the RPS credit for compliance in any one state where the credit would qualify for RPS compliance purposes.[48]

7.3 POTENTIAL FOR REGIONAL COORDINATION AND MULTI-STATE PROGRAMS

As previously noted, in the absence of a federal CES policy states could expand their RPS policies to become CES policies. Another option would be for states to pursue coordinated and harmonized multi-state or regional policies. These regional programs could be along the lines of a traditional RPS, or a CES.

Some regional coordination has already occurred with respect to RPS credit tracking systems, and state policies typically allow the use of credits from generation in other states. What has not happened, however, is a more systematic effort to harmonize across states the types of eligible resources, the targets and schedule, or other requirements. To the extent that common definitions of "clean" are adopted across jurisdictions, credit trading programs and tracking systems can be much simpler.

The Regional Greenhouse Gas Initiative (RGGI) may provide a useful example of how states collaborated on a regional policy affecting the electricity sector. Although differences do exist in the policies of each state, they all fit into a single regional framework for achieving a regional GHG reduction target. In addition, the states worked with three different regional power pools to coordinate consistent tracking systems. The same thinking could be applied to achieving a regional clean energy target.

8 CES POLICY DESIGN OPTIONS AND IMPLICATIONS

This section describes the options for key CES policy design parameters and the implications of different choices. As described in Section 3, increasing the share of electricity provided by clean energy sources can advance a range of important objectives—including fostering clean energy industries and jobs, diversifying the energy supply, and improving the environmental and public health profile of electricity generation. Choosing one policy design over another, however, may have the effect of favoring one objective over another.

Design choices may also be evaluated in light of additional criteria, including:

- Effectiveness – what is the magnitude of the policy's desired impacts?
- Affordability – does the policy balance the benefits associated with increased clean power generation against the cost impacts of the policy?
- Cost-effectiveness – how efficiently does the policy achieve its intended aims?
- Fairness – does the policy unfairly burden particular groups or lead to any undue burdens or unearned windfalls for particular utilities, power generators, or customers?

Design choices may be further evaluated with Equations 1 and 2 below, which highlight the difference between the "nominal" amount of clean energy required under a CES and the actual amount of clean energy generated. They also help explain one of the most important and least understood facets of CES design: the impact of defining "base quantity of electricity sales."

One can think of a CES as defining a simple equation that electric utilities must balance:

Equation 1: Illustration of CES Requirement for an Electric Utility

$$[\text{CES \% Requirement}] = \frac{[\text{Qualified Clean Energy Generation}]}{[\text{Base Quantity of Electricity Sales}]}$$

Equation 1 highlights three of the most important policy design decisions for a CES, namely:

1. What is the nominal annual percentage requirement for electric utilities under the CES?
2. What receives credit under a CES as qualified clean energy generation?
3. To what base quantity of electricity sales does the CES percentage requirement apply?

The distinction between the nominal annual percentage requirement of a CES and the total amount of clean energy that is actually generated under the CES is illustrated by Equation 2.

Equation 2: Decomposition of Total Clean Energy Generation under a CES into Relevant Parts

$$[\text{\% Clean Energy}] = \frac{[\text{Qualified Clean Energy Generation}] + [\text{Other Clean Generation}]}{[\text{Base Quantity of Electricity Sales}] + [\text{Other Electricity Sales}]}$$

Equation 2 illustrates the possibility that the nominal annual percentage requirement of a CES – the number by which the CES is known to most of the public – will not be the same as the amount of clean energy that will actually be generated under the CES. Policymakers will be familiar with the impact that the definition of qualified clean energy will have on the difference between the nominal requirement and the actual generation of clean energy. What may be less understood is the importance of defining the base quantity of electricity sales, as discussed throughout this section, but especially in Section 8.4.

8.1 POINT OF REGULATION

The "point of regulation" refers to the entity upon which the compliance obligation is imposed under a CES. The choice for policymakers is between: 1) regulating electric utilities and making their CES compliance obligation a function of their electricity sales; and 2) regulating generators and making their CES compliance obligation a function of their electricity generation.[49] A majority of states already have renewable or alternative energy standards, and all of them have placed this obligation on electric utilities. Recent congressional RPS and CES proposals as well as the Obama Administration's proposal call would also place the regulatory obligation on electric utilities.[50,51]

Recently, however, some have argued for reconsidering the point of regulation. In particular Joseph Aldy (Harvard/Brookings) and Dallas Burtraw et al. (Resources for the Future, RFF) have suggested that the obligation should be on electricity generators rather than electric utilities.[52,53] Aldy proposes a national clean energy standard with a point of regulation on power generators rather than electric utilities for the purposes of administrative simplicity and to avoid creating an incentive for industry to adopt on-site fossil fuel generation to evade electricity price increases associated with the CES. Burtraw et al. argue that placing the obligation on electric utilities is a "blunt" instrument that treats large categories of existing facilities (e.g., all coal plants) as a homogeneous group, despite substantial variations in heat rates and CO_2 intensities, and provides limited or no incentives for generators to improve their efficiencies. Burtraw et al. acknowledge, however, that there are arguments in support of placing an obligation on electric utilities, and that they relate to the unique position of electric utilities with respect to promoting end-use energy efficiency and network efficiency (in terms of transmission and distribution) and to electric utilities' regulated status.

Finally, one additional reason for focusing the requirement on utilities is that any given generator, if made the point of regulation, would have fewer compliance options.[54]

8.2 COVERAGE

The coverage of a CES refers to the set of entities at a particular point of regulation that are subject to a CES. This section discusses coverage under a CES with the point of regulation on electric utilities. The two issues to address are whether small utilities should be exempt from requirements, and whether certain types of utilities should be exempt based on ownership structure.

8.2.1 EXEMPTIONS BASED ON UTILITY SIZE

Previous federal electricity portfolio standard proposals have included exemptions for smaller utilities (see Appendix A.5). However, an exemption for small utilities can substantially weaken a CES's effective target and shift the responsibility for achieving a national goal for clean electricity generation to a subset of utilities and ratepayers. Policymakers should evaluate whether such an exemption is justified in light of the following considerations.

By its very nature as a market-based program, a CES does not impose disproportionately higher costs on smaller utilities simply as a function of their smaller scale. This is in contrast to those command-and-control environmental regulations which require the installation of specific pollution controls on specific sources – requirements that have less impact on electricity costs (in $/kW of capacity) at larger plants because of economies of scale. For such pollution controls, smaller utilities that own or are supplied by smaller power plants, or that depend heavily on a few large plants, would likely face higher costs than larger utilities. 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.[55] While exclusion of smaller utilities dramatically reduces the number of regulated entities (see Appendix A.7), based on the low administrative costs of market-based pollution control programs,[56] implementing a market-based CES program with a large number of regulated entities unlikely to be a significant administrative burden.

8.2.2 EXEMPTIONS BASED ON OWNERSHIP STRUCTURE

Some state RPS laws only cover investor-owned utilities, with municipal utilities, public power marketers, and electric cooperatives exempted from all requirements. The theory underlying this policy choice in most cases appears to be that municipal governments, rather than state government, should establish policy for municipal utilities, while cooperatives should be governed by their members. However, not all states exempt these entities. Furthermore, such an approach if adopted in a federal CES would fail to cover roughly one third of the electric power sector, and could contribute to exaggerated regional inequities. Investor-owned utilities in Mississippi, for example, supply over 75 percent of all retail electricity while there are no investor-owned electric utilities in the entire state of Nebraska.

8.3 TARGETS AND TIMETABLES

The targets and timetable for a CES define the level of clean electricity generation required and thus the extent of clean energy technology deployment and the degrees to which associated benefits are realized (e.g., pollution mitigation). This subsection explores three issues relevant to CES targets and timetables.

8.3.1 NOMINAL VS. EFFECTIVE TARGETS

As illustrated by Equation 1 and Equation 2 above, electricity portfolio standards can specify aggregate nominal targets and timetables that can differ substantially from the actual effective aggregate requirements of the standards.

Two main 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 overall effective target (across all utilities) lower than the nominal target. Second, exclusions from the base quantity of electricity sales (i.e., the electricity sales to which the nominal target applies) can make the effective target lower or higher than the nominal target depending on what sort of electricity sales are excluded.[57,58]

Other provisions of a CES can also lower the effective target relative to the nominal target, including bonus credits for specific technologies (e.g., distributed renewable generation or CCS) and shut-down credits for early retirement of certain generators. These types of provisions and their effects are explained later in this paper.

8.3.2 UNIFORM VS. DIFFERENTIATED TARGETS

A CES can have a uniform percentage requirement that applies to all covered electric utilities, or can set different targets for different electric utilities. The rationale for differentiated targets is that, at the time a CES is enacted, electric utilities may supply substantially different fractions of their demand from clean energy sources. This is especially the case if a CES is a multi-state, regional or federal program. Setting targets that vary by individual electric utility, by state, or by region may promote more equitable distribution of costs under a CES (see Section 8.11 for more on this topic). An argument against differentiated targets is that they can disadvantage early adopters of clean energy.

8.3.3 TIMETABLE OPTIONS

A CES may have a primary nominal target tied to a particular year in the future (e.g., 80 percent clean energy by 2035) that summarizes the policy's overall level of ambition. The timetable refers to the set of interim requirements that define electric utilities' annual compliance obligations. Policymakers may take one of two approaches to defining a CES policy's timetable.

First, policymakers might simply set annual CES requirements that ramp up to a long-term target at a constant rate. This might be done linearly—with CES targets increasing by a small, constant amount each year—or in steps—e.g., with the CES requirement increasing by a fixed number of percentage points at five year intervals. Policymakers may prefer this approach for its simplicity particularly if they think that the rate of increase is consistent with the rate of growth in clean energy that the industry can deliver cost-effectively and if the CES policy provides electric utilities with substantial compliance flexibility from credit trading and banking (and perhaps borrowing). Banking and borrowing concepts are explained later in this paper.

A second approach is to define a CES timetable such that the CES percentage requirements begin modestly, increase slowly at first, and then increase at an accelerating rate. The appeal of this approach is that it gives the industry time to ramp up its investments in clean energy and allows some time for initial longer-lead projects (e.g., new nuclear reactors) to come online.

8.4 DEFINING THE BASE QUANTITY OF ELECTRICITY SALES

Perhaps the most important and least understood concept in the design of a CES is how the definition of the base quantity of electricity affects the difference between the nominal CES target and the actual amount of clean energy generated. The base quantity of electricity sales is the portion of an electric utility's annual electricity sales to which an electricity portfolio standard's percentage requirement applies. All else being equal, excluding some types of clean electricity sales (e.g., from existing clean energy sources) from the base quantity under a CES will increase the required level of new clean energy generation and raise a CES's effective target above its nominal target. Conversely, excluding electricity sales that are not clean (e.g., from small generators) from the base quantity will lower the required level of new clean energy generation and decrease a CES's effective target below its nominal target. Finally, the concept of base quantity helps explain why utilities could have a natural incentive to promote energy efficiency under a CES, even without additional incentives. Four examples can illustrate all this.

First, consider a situation in which 40 percent of electricity is already provided by clean energy sources, and a CES is enacted with a nominal requirement that 50 percent of electricity come from clean energy sources. If the base quantity is defined as being equal to the total electricity supply (i.e., including the already-clean energy), another 10 percent of total electricity will have to come from new clean energy sources.

Second, consider a situation, again with a 50 percent nominal CES, but in which the base quantity is defined as excluding the 40 percent of electricity that already comes from existing clean energy sources. In that case, the 50 percent nominal CES will apply to the 60 percent of electricity not already supplied by existing clean energy generators. Therefore, 30 percent (50 percent of the 60 percent) of total electricity will have to come from new clean energy sources. The actual percentage of total electricity generated from clean energy sources will be 70 percent – 40 percent from existing clean energy sources plus 30 percent from new clean energy sources. Excluding some types of clean energy from the definition of base quantity raises a CES's effective target over its nominal target.

Third, consider a situation with a 50 percent nominal CES in which existing clean energy sources are defined as being included in the base quantity, but small non-clean sources which generate 20 percent of total electricity are excluded from the program, and therefore from the base quantity. Because the CES will apply only to the 80 percent of sources that are large, the actual amount of clean energy generated will be 40 percent of total electricity (50 percent of the 80 percent). Excluding some types of non-clean energy from the definition of base quantity lowers a CES's effective target below its nominal target.

Fourth, consider a situation with a 50 percent nominal CES in which existing clean energy sources are included in the base quantity, and sources of all sizes are included in the program, but utilities are deciding whether to launch projects to increase their customers' energy efficiency, which would decrease electricity demand by 10 percent. If the utilities launch the projects, the actual percentage of the originally-generated electricity (i.e., before the energy efficiency projects) generated by clean energy sources will be 45 percent (50 percent of the 90 percent). In other words, utilities will see their actual CES obligation decrease as a result of their energy efficiency projects. The concept of base quantity helps us understand why a CES would naturally create an incentive to increase energy efficiency, even if energy efficiency itself cannot directly earn clean energy credits.[59]

The above examples illustrate the effects of various definitions of base quantity on the power sector in the aggregate. A given definition of base quantity can also have importantly different impacts on different individual utilities, especially if other parameters, such as the nominal CES level and whether existing clean energy resources can be used to comply with the requirement, are also changed. (Note that whether existing clean energy is defined as part of the base quantity and whether existing clean energy can be used for compliance are two separate questions). It is beyond the scope of this paper to discuss all the possible variations, but two more examples will illustrate the possibilities.

First, consider two utilities ("Coal Utility" and "Nuclear Utility") operating under the second case above, with a 50 percent nominal CES, and in which the base quantity is defined as excluding electricity from existing clean energy sources, but also in which existing clean energy sources can be used to comply with the CES. Clean energy sources provide 16 percent of Coal Utility's electricity and 72 percent of Nuclear Utility's electricity. Coal Utility's base quantity of electricity will be 84 percent of its total electricity sales (100 percent minus 16 percent), therefore 42 percent (50 percent of the 84 percent) of Coal Utility's total electricity sales will have to come from clean energy sources, and therefore Coal Utility will have to add new clean energy or buy CECs for 26 percent of its total electricity sales (42 percent effective target minus 16 percent existing clean energy). Nuclear Utility's base quantity will be 28 percent (100 percent minus 72 percent), therefore 14 percent (50 percent of the 28 percent) of Nuclear Utility's total electricity sales will have to come from clean energy sources, and therefore Nuclear Utility will actually be able to sell CECs from 58 percent of its total electricity sales (72 percent existing clean energy minus 14 percent effective target). Some would view this as a windfall.

Second, consider the previous scenario, except with a 20 percent nominal CES (rather than 50 percent), and with existing clean energy sources not allowed to count towards compliance. As before, Coal Utility's base quantity will be 84 percent, though now only 16.8 percent (20 percent of the 84 percent) of Coal Utility's total electricity sales will have to come from clean energy sources. Also, as before, Nuclear Utility's base quantity will be 28 percent, though now 5.6 percent (20 percent of the 28 percent) of Nuclear Utility's sales total electricity sales will have to come from clean energy sources. Coal Utility will have to add more clean resources (16.8 percent) than Nuclear Utility (5.6 percent) – in other words, there will be an advantage to Nuclear Utility in having made the earlier clean energy investments – but there will be no windfall. This approach – a low nominal CES, with existing clean energy not included in the baseline and not counted towards compliance – has in fact been taken in some legislative proposals.

8.5 QUALIFIED ENERGY SOURCES

A CES must specify the types of electricity generation (potentially including “negawatt-hours” of electricity savings from efficiency) that qualify as clean and the rate at which qualified energy sources earn credits.

As mentioned above, policymakers and various stakeholders may have different opinions about what ought to count as clean under a CES. In deciding whether to include a particular fuel or technology as a qualifying clean energy source under a CES, policymakers might consider the extent to which a fuel or technology furthers the goals they have for a CES. (The same consideration holds for counting electricity savings from energy efficiency.) For example, does providing an incentive for a particular fuel or technology (or energy efficiency):

- Spur growth in clean energy industries and associated employment?
- Promote the development and deployment of less mature, advanced clean energy technologies?
- Diversify the power sector’s energy supply?
- Reduce the environmental and public health impacts from electricity generation?

It is not always easy to measure or to agree upon the extent to which a given clean energy source promotes the objectives above; moreover, stakeholders may have different views about how to weigh the objectives above in deciding whether a particular fuel or technology should qualify as clean under a CES and whether it should receive full or partial credit as clean (and if partial, what fraction).

Natural gas generation is an important case in point. Some CES proposals have included at least partial credit for highly efficient natural gas combined cycle (NGCC) electricity generation as a qualified clean energy source. Such generation does offer benefits, particularly in terms of public health and environmental impacts, compared to older, less efficient, and more highly polluting electricity technologies. However, NGCC is a mature and established technology for generating electricity. Indeed, natural gas is the dominant choice for new electricity generating capacity and support for it may draw away support for other resources that are not already cost-competitive.[60] Allowing credits from natural gas generation under a CES may, in effect, disincentivize other clean energy technologies, including technologies that are less commercially mature or have higher costs in the near term. As such, stakeholders may have different views about whether or to what extent a CES ought to count natural gas as a clean energy source, driven largely by the policy objectives they wish to advance.[61]

The possibility of retrofitting fossil fuel power plants with post-combustion CCS provides another case in point. When post-combustion CCS is added to an existing power plant, GHG emissions can decrease substantially. However, depending on the technology used, emissions of other air pollutants may not change. In addition, some of the power generated by the plant must be used to operate the CCS equipment, meaning the amount available for sale decreases. In some cases the net result may be that for a given amount of net electrical generation leaving a power plant, the addition of CCS makes GHG emissions decrease but other air pollutant emissions increase.

Deciding whether a post-combustion CCS retrofit should be considered clean could be very complicated or site-specific, and depend heavily on whether a higher priority is placed on reducing GHG emissions than reducing other air pollutants.

Given the above, in designing a CES policymakers may take different approaches to defining qualified clean energy sources and setting the rate at which they earn credit under the CES. Policymakers might simply enumerate a list of qualifying clean energy sources and assign each a rate at which it earns credits under the CES. A variety of considerations might inform this list and the assignment of full and partial credits.

Table 1 illustrates how a CES might simply list qualified clean energy technologies. This approach has the advantage of administrative simplicity, and allows for accommodation of different viewpoints since policymakers can negotiate which clean energy sources to include and the degree to which each receives full or partial credits. However, the simplicity of this approach can lead to less efficient incentives for achieving particular policy objectives.[62] This is perhaps most easily seen for the objective of reducing GHG emissions from power generation and the example in Table 1. In the example in Table 1, the CES would provide power producers with no incentive to exceed thresholds for qualification—for example, by decreasing the heat rate of an NGCC plant or increasing the level of CO_2 capture at a facility employing CCS.

Table 1: Illustration of Simple Approach to Crediting Clean Energy Generation under a CES

Electricity Generation Type	Number of CECs per MWh of Generation
Renewables	1
Nuclear	1
Coal with CCS (50-90% CO_2 capture)	0.5
Coal with CCS (90+% CO_2 capture)	1
Natural gas combined cycle (<800 lbs. CO_2/MWh)	0.5

An alternative approach is for policymakers to define a set of performance criteria that clean energy sources must meet to qualify for credit under a CES, perhaps using a formula for determining eligibility and assigning credits to qualified clean energy sources. The benefit of this approach is that it is more precise and thus can create more efficient incentives for clean energy producers. The drawback of this approach is that it is most suitable and practical when policymakers can agree on a single primary objective for a CES. If policymakers believe the primary objective of a CES is to spur GHG emission reductions in the power sector via expanded clean energy generation, they might adopt a formula like that in Equation 3 for assigning credits to clean energy sources.

Equation 3: Illustrative Formula for Awarding CECs to Clean Energy Sources

$$[\text{\# of CECs / MWh}] = 1 - \frac{[\text{Generator's GHG Intensity in tCO2e / MWh}]}{[\text{GHG Intensity in tCO2e / MWh of a New Coal Fueled Power Plant without CCS}]}$$

The fact that existing state policies differ in the resources that qualify for credit and in the amount of credits awarded to each resource complicates any effort to develop multi-jurisdictional trading and credit tracking systems. Although this is not an insurmountable problem, it could be minimized through greater harmonization of state policies.

The most important principle for policymakers to remember is that deciding what qualifies as clean goes hand in hand with deciding the CES targets. The wider the range of resources that qualify as clean, the easier it is to meet any given percentage target, and the higher the target that can be met at a given cost.

8.6 CREDITING CLEAN GENERATION FROM NEW AND EXISTING GENERATORS

A CES has to provide credit to generation from new clean energy facilities, since the main purpose of the policy is to spur deployment of clean energy technologies. Policymakers, however, have different options for treatment of generation from clean energy facilities that predate enactment of a CES.[63] The question of how a CES treats generation from such existing clean energy generators has very different implications for utilities with large existing clean energy sources than for those that do not. Some argue that providing credit for existing sources would create wealth transfers and windfall profits. Others argue that doing so would reward early adopters of clean energy, encourage existing clean resources to maintain and not reduce their output, provide for less expensive compliance with a given nominal target, and tend to make the market for CECs more robust from the beginning. The implications are especially important for the five issues below.

8.6.1 TARGET-SETTING

The level of incremental clean energy required by a given nominal CES target will vary depending on whether 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. The President's target translates directly to a requirement that utilities supply 80 percent of their annual sales from clean energy sources in 2035. On the other hand, providing credits only for 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.[64] To meet an overall goal for total clean energy generation (e.g., 80 percent of total electricity supply by 2035) with a CES that sets a requirement only for new and incremental clean energy generation it may be necessary to revise periodically the CES requirements in light of changes to existing clean energy facilities for example, due to facility retirements.

8.6.2 INCENTIVES FOR INCREMENTAL OUTPUT

To the extent that an additional financial incentive can lead to greater output from existing clean energy facilities, providing credits to at least incremental generation from existing clean energy facilities can increase clean energy generation and reduce emissions more cost-effectively. For example, if credits are not awarded to all existing clean energy generation, then awarding credits for incremental output from existing clean energy generators can provide an incentive for nuclear upgrades and higher utilization of existing natural gas combined cycle power plants. There are limits to this, of course – wind and nuclear generating units usually operate at full capacity already, and lower natural gas prices may lead to an already high dispatch of NGCC plants. Policymakers may wish to target the incentives, for example by assigning credits for output from capacity expansions or uprates at existing units.

8.6.3 WINDFALL PROFITS

Some argue that granting credits under a CES to existing facilities can create windfall profits for electricity generators. CECs are designed to be a tradable commodity with a market value. When an existing clean generation source is awarded CECs, it receives something of real economic value even though its operating costs and compliance obligations haven't changed. If this hypothetical generation source is owned by a vertically-integrated utility, the utility regulator will presumably strive to ensure that the credits are used to meet the utility's overall compliance obligations, or if the credits are sold that some or all of the proceeds are returned to ratepayers. But if the generation source is not owned by a utility, it is entirely possible that revenue from the sale of CECs goes straight to those who invested in the generator. These investors receive a windfall profit (i.e., something of value obtained at no additional cost to themselves) at the expense of the customers of the utility that purchased the credits.[65,66] The policymaker's desire to avoid or minimize this kind of windfall profit must be balanced with the desire to maximize generation from existing as well as new clean energy resources.

8.6.4 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 they do not receive credits for their clean energy output under a CES. This issue is relevant, in particular, to decisions by nuclear reactor owners regarding whether to pursue relicensing.[67]

In addition, providing credit to only incremental output from existing natural gas power plants (under a CES that provided any credit for natural gas) might introduce competition between new and existing natural gas generation; to the extent that generation from a new NGCC plant simply displaces generation from an existing NGCC plant in order to earn credits.[68] Such competition would create CES compliance credits but no additional clean energy generation on net.

Further analysis can determine the extent to which the unintended consequences noted above such as the retirement of clean energy facilities may be material rather than just theoretical concerns. A CES could include provisions to address those unintended consequences that are expected to be material.[69]

8.6.5 REGIONAL IMPACTS

Granting credits to non-incremental generation from existing clean generators has implications for how the impacts of a CES are distributed among different utilities and among states and regions under a multistate or federal program. 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. Some object to this approach, arguing that this would lead to large credit transfers and associated wealth transfers from utilities (and possibly states and regions) that are relatively more carbon-intensive to those that are relatively less carbon-intensive that are disproportionate to the level of incremental clean energy generation required by the CES. Others argue that similar wealth transfers are ubiquitous and may be seen, for example, when a region is discovered to be a new source of natural gas that other regions will buy.

8.7 CREDITS FOR ENERGY EFFICIENCY AND CONSERVATION

Many analyses find that energy efficiency and conservation can provide large multi-pollutant emission reductions via avoided electricity generation at a relatively low cost. Several states have allowed utilities to meet a portion of their compliance obligation under an electricity portfolio standard via demonstrated electricity savings from energy efficiency, as have recent congressional electricity portfolio standard proposals.[70] The administration's CES proposal does not include end-use energy efficiency and conservation, but does allow for credits for combined heat and power systems and waste-heat recovery.[71]

In addition, 23 states have established mandatory long-term energy savings targets through an Energy Efficiency Resource Standard (EERS), with two other states having a non-mandatory energy savings goal.[72] An EERS is similar in concept to an electricity portfolio standard in that it requires utilities to achieve annual energy savings equal to a specified amount, most commonly expressed as a percentage of retail sales. There are a variety of ways an EERS policy can be implemented. In some of these cases, the state RPS policy is combined with or linked to the EERS policy.

However, measuring electricity savings from energy efficiency is more challenging than measuring generation from qualified clean energy sources. In addition to this basic challenge, at least three interrelated issues arise when credits are awarded for electricity savings:

- Measuring electricity savings for a multistate or federal CES may prove administratively difficult and contentious, particularly since states already measure electricity savings from energy efficiency but not all in the same way. Some of the differences may be related to differences in climate and other objective factors between states.
- Awarding credits to utilities for electricity savings that are already factored into "business-as-usual" projections for electricity demand lessens the impact that a CES has on clean energy technology deployment and associated benefits.

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

If credits are awarded for electricity savings from energy efficiency and conservation, policymakers must decide how many credits to award for each unit of electricity savings. Unlike clean energy technologies, each unit of electricity savings from energy efficiency and conservation reduces the base quantity of electricity sales. Policymakers can treat one unit of electricity savings as equivalent to one unit of clean generation by providing partial credits for each unit of electricity savings, with the partial credit for electricity savings declining as the CES percentage requirement increases over time.

In considering whether and to what extent to credit electricity savings from energy efficiency, policymakers might consider how energy efficiency aligns with the objectives they hope to achieve through a CES.[73] Crediting energy efficiency can reduce air pollution from electricity generation but will also limit the impact of a CES on deploying clean energy generation technologies.

As Figure 6 (in Section 2 above) illustrates, energy efficiency may be substantially less expensive than clean energy generation. If a CES does credit electricity savings from energy efficiency, policymakers might limit the degree to which an electric utility can comply with the CES via energy efficiency so as to still incentivize the development of other desired technologies.[74]

8.8 SHUT-DOWN CREDITS FOR COAL PLANT RETIREMENTS

In addition to crediting qualified clean energy generation, a CES might also provide credits for avoided generation from highly polluting generating units (e.g., coal plants lacking modern pollution controls) that retire earlier than they otherwise would. A CES might offer such shut-down credits in order to spur the early retirement of coal plants facing retrofit requirements to comply with new air, water, and waste regulations.[75]

Under a CES, providing credits for avoided generation from retired coal plants lowers the CES's effective target (because the CES is granting credits both for avoided generation from retired units and for whatever incremental clean energy generation replaces this avoided generation, thereby increasing the supply of clean energy certificates and reducing the incentive to deploy other technologies). However, the magnitude of the actual impact on the level of incremental clean energy generation might be small if the shut-down credits are limited in number (e.g., granted for a short duration) or if the CES has a relatively low alternative compliance payment. Policymakers could also adjust a CES's target to take into account the effect of providing shut-down credits for coal plant retirements.

Shut-down credits might appeal to policymakers as a means to accelerate the turnover of the existing fleet's generating units and speed the transition to cleaner energy sources. In particular, providing a financial incentive in the form of shut-down credits can deter some coal plant owners from making pollution control retrofit investments that, in the long run, might prove suboptimal compared to investments in clean energy. Shut-down credits might have additional appeal under a CES that does not provide any credit for natural gas generation. Under such a CES, incremental clean energy generation might displace some new natural gas generation and older coal-fueled generation without differentiation even though the former is typically much cleaner than the latter. A CES program could provide shut-down credits only for the relatively more polluting coal plants.

8.9 PROVISIONS FOR SPECIFIC TECHNOLOGIES (BONUS CREDITS, CARVE-OUTS, AND TIERS)

A CES that is technology-neutral—one that provides credits in proportion to qualified clean energy production from all qualified facilities without any limits or special treatment of any technologies—will likely promote some clean energy technologies, namely the most mature and least costly, more than others. Policymakers, however, may want to ensure that a CES spurs deployment of specific clean energy technologies in order to promote improvements and cost reduction in that technology (e.g., by moving the technology further down its learning curve) or to promote energy supply diversification.

Figure 6 (in Section 2 above) shows the most recent estimates for the total system levelized cost of electricity (LCOE) from EIA's *Annual Energy Outlook 2011* for various power generation options.[76] While power generators' decisions about investing in new generation capacity involve much more than LCOE, Figure 6 does suggest that a uniform financial premium for clean energy might lead to substantially more deployment of some clean energy technologies compared to others. For example, Figure 6 suggests that natural gas combined cycle plants, onshore wind, and energy efficiency are substantially less expensive than many other clean energy options.

The following subsections discuss four CES policy design options that can achieve the goal of promoting a role for certain technologies that would not necessarily be competitive under a simple, technology-neutral CES.

8.9.1 BONUS CREDITS

A CES can offer extra incentive for the deployment of specific technologies (e.g., less mature and more costly technologies) by awarding bonus credits for each unit of output from such facilities. (In other words, provide more than one credit per unit of clean energy.) For example, policymakers might use bonus credits to promote solar power, next generation nuclear power, distributed generation, or first mover CCS projects—clean energy sources that might not see substantial deployment under a purely technology-neutral CES.[77]

Providing bonus credits for specific technologies will lower the effective target of a CES relative to its nominal target. If large numbers of bonus credits are provided for specific technologies, policymakers can maintain a desired effective CES target by increasing the nominal target to reflect the number of bonus credits.[78]

8.9.2 CARVE-OUTS

In an electricity portfolio standard, a carve-out is a requirement that a specific technology provide a specified minimum fraction of compliance with the overall target. Several state RPS programs include carve-outs for solar power. For example, New Jersey has an RPS that requires that 22.5 percent of electricity comes from qualified renewable generation by 2021 with a carve-out that requires that at least 2 percent of electricity come from solar power. Similarly, policymakers could establish one or more carve-outs under a CES for technologies for which they wanted to ensure at least a minimum role.

8.9.3 TIERS

Tiers are similar to carve-outs except that they set a minimum requirement for a set of clean energy sources. State electricity portfolio standards provide precedents for including tiers for particular classes of technologies. Pennsylvania and Ohio both have standards with tiers. Pennsylvania has separate tiers for renewable and non-renewable, alternative energy sources. Ohio similarly established separate tiers for renewable and non-renewable qualified energy resources, requiring that at least half of the clean energy used to comply with its standard comes from renewable energy.

8.9.4 LIMITS ON COMPLIANCE VIA PARTICULAR CLEAN ENERGY SOURCES

While the options described above provide incentives for or set minimum requirements for certain subsets of qualified clean energy sources, policymakers could also put limits on the degree to which utilities could comply with CES requirements via particular clean energy sources.[79] For example, policymakers might set maximum levels for compliance via credits earned for electricity savings from energy efficiency or new natural gas generation. Such limits can ensure that a CES provides substantial incentive for less mature clean energy technologies to further particular CES policy objectives—e.g., energy diversification and technology advancement.

8.10 ADDITIONAL COMPLIANCE FLEXIBILITY

As explained in Section 4 above a CES is a market-oriented policy whose broadly defined set of eligible clean energy sources and reliance on tradable credits to demonstrate compliance inherently provide electric utilities with substantial compliance flexibility and keep the cost of transitioning to cleaner energy sources manageable.

Beyond the flexibility and cost-effectiveness inherent in the basic design of a CES, three particular policy design options (described in the subsections below) can provide additional compliance flexibility under a CES and help ensure that the cost of complying with the CES is manageable.

8.10.1 BANKING AND BORROWING

Credit banking and borrowing lowers the cost of meeting clean energy targets by giving regulated entities compliance flexibility in terms of timing without affecting the ultimate level of clean energy generation or the achievement of associated policy objectives. Such flexibility can smooth out the price trajectory for credits and reduce price jumps over time.

Banking simply refers to saving CECs earned or purchased in one period to use for demonstrating compliance in a later period. Allowing banking can help avoid CEC price volatility.[80] All recent federal electricity portfolio standards have all allowed for credit banking—with restrictions in some cases—but little to no borrowing. The renewable electricity standard in the 2009 Senate energy bill restricted the banking of credits to three years from the year of issuance; however, the CES proposals from Senators Lugar and Graham placed no such time limits on banking. Senator Graham's proposal alone allowed for credit borrowing in cases where a utility could submit an approved plan demonstrating future over-compliance sufficient to warrant near-term borrowing against future credits.

Borrowing is 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 (thereby deferring the required clean energy deployment into the future) thus creating pressure for policymakers to lower future clean energy targets. This "debt forgiveness" dynamic may jeopardize the overall clean energy deployment goal and increase 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. For example, if a utility owns or has a power purchase agreement with a new nuclear unit under construction, a CES could allow that utility to borrow against that plant's future stream of CECs with the obligation to repay all borrowed CECs.

8.10.2 OFFSETS

Offsets are tradable compliance credits issued for actions taken by entities that are not subject to a particular market-based regulatory requirement. The concept is based on long-standing air pollution control rules that were developed to prevent increases in criteria pollutant emissions when new factories and power plants were built.[81]

Offsets could offer the same compliance flexibility under a CES as they do in air pollution control programs. West Virginia is currently the only state with an electricity portfolio standard that allows for credits from emission offset projects (such as landfill methane capture, reforestation, and certain agricultural practices), but one of the federal CES proposals also included the use of offsets.[82,83] Including offsets in a CES is most obviously aligned with the policy objective of reducing GHG emissions, but could certainly be done in a way that addresses other air pollutants. However, while including offsets in a CES would yield equivalent net GHG emission reductions, it would yield less clean energy deployment in the power sector.

The inclusion of offsets in a CES could draw upon the same principles and policy specifics associated with the use of offsets under other market-oriented regulations. Most importantly, offset provisions under other policies generally require that offset credits be real, surplus (or additional), verifiable, permanent, and enforceable.

8.10.3 ALTERNATIVE COMPLIANCE PAYMENTS AND COST OFF-RAMPS

Without cost containment provisions, a CES sets a known target for clean energy but has uncertain costs. While sophisticated and extensive policy analysis can illuminate the likely costs of achieving a given CES target, the future policy costs are innately uncertain—they may be higher or lower than projected. While a CES is an inherently flexible, market-based policy that can achieve clean energy goals cost-effectively, policymakers may choose to include cost containment provisions to keep the cost impacts of a CES within a particular range—i.e., to provide some certainty about the maximum cost of the policy. Two such options are alternative compliance payments (ACPs) and cost off-ramps. Designing cost containment provisions for a CES requires balancing the desire to protect ratepayers from excessive costs and the goal of not undermining the aims of the CES policy.

Electric utilities demonstrate compliance with CES requirements by submitting clean energy credits equivalent to the required level of clean energy generation (e.g., where one CEC equals one MWh of qualified clean energy generation). An ACP provision under a CES allows an electric utility to make payments to the CES program administrator of a specified value in lieu of submitting CECs.[84] An ACP acts as a limit on the cost of compliance with a CES – i.e., a CEC price ceiling. Electric utilities will increase their levels of clean energy delivery until the incremental cost of such energy exceeds the ACP value. Policymakers have three options in determining the value of an ACP: one that is fixed (nominally); one that increases at the rate of inflation, but remains constant in real terms; and one that increases in real terms over time as the CES target becomes more ambitious.

All recent congressional electricity portfolio standards have included ACPs (see Appendix A.5). 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 nine states had an ACP for capping the maximum cost of compliance.[85]

When including an ACP in a CES, policymakers must decide how to use the revenue raised when utilities opt to pay the ACP in lieu of supplying qualified energy. Policymakers might require that ACP revenue be used to further the goals of the CES, for example by funding clean energy deployment or research and development. Under a multi-state CES, ACP revenue might be returned to the states whose utilities paid it to further those respective states' CES program goals, or other energy goals such as ameliorating any negative cost impacts on energy-intensive, trade exposed industries and household consumers.

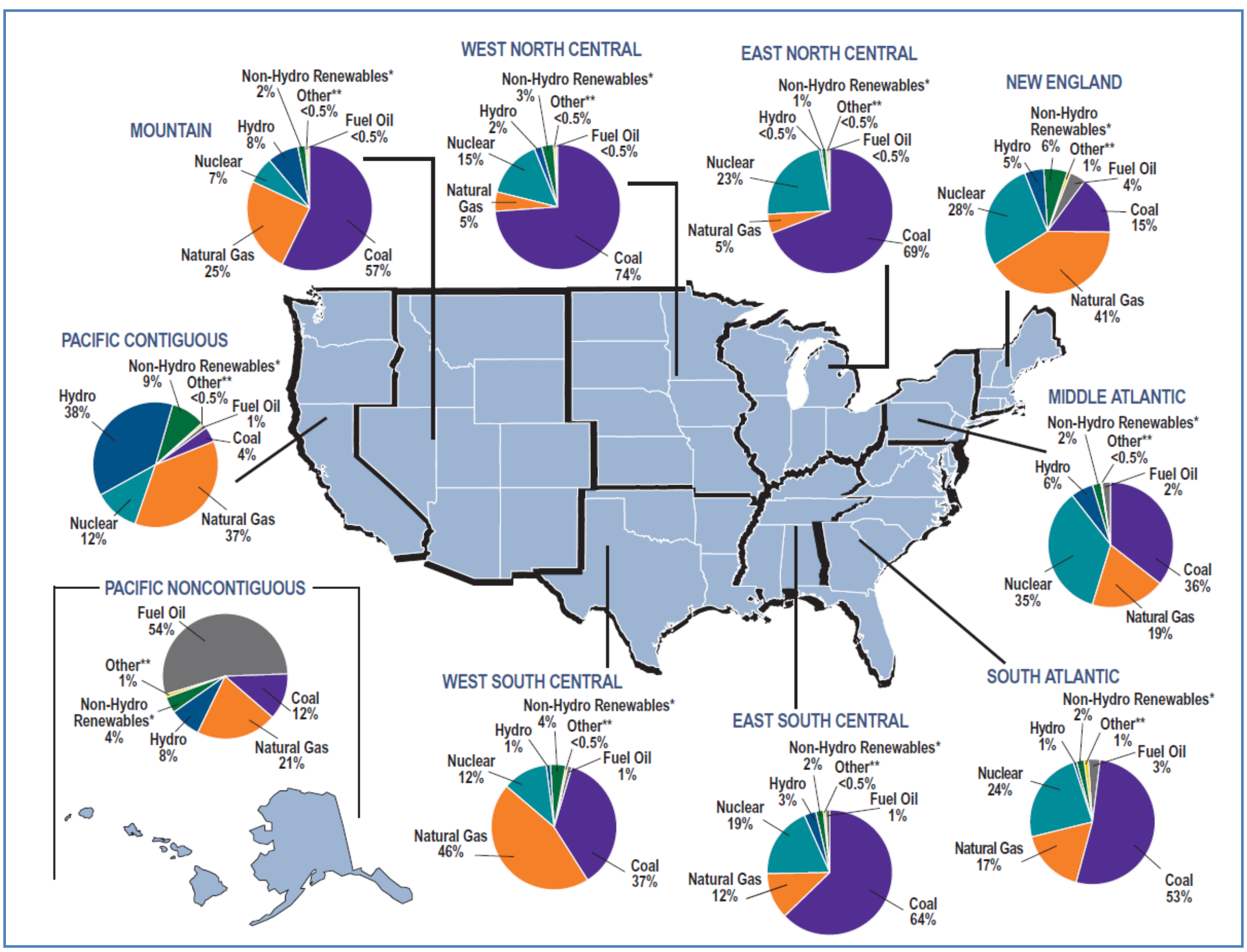
The value of any ACP (including its rate of increase if any) is a crucial policy design decision. A low value for the ACP can undermine the ability of a CES program to drive clean energy research and development and incremental clean energy deployment and deliver the associated benefits.[86] Policymakers might calibrate the ACP value to protect against excessive costs without substantially limiting the deployment of clean energy.

Another cost containment option is a cost off-ramp. Cost off-ramp provisions can take a variety of forms, but such provisions effectively limit the cost of compliance under a CES. For example, a cost off-ramp might set a maximum percentage rate impact for CES compliance such that, if an electric utility can demonstrate that full compliance with the CES would lead to compliance costs in excess of the off-ramp level, then the CES program administrator can limit the utility's compliance obligation to a level of clean energy that does not exceed the maximum rate increase. Some federal CES proposals have included cost off-ramps.[87] Cost off-ramps are also common features of existing state electricity portfolio standards. A 2008 survey of electricity portfolio standards in 25 states and the District of Columbia found that most states that did not have ACPs had some type of cost off-ramp provision.[88] However, whereas an ACP provides a direct signal (in terms of $/MWh) to investors regarding a reasonable level of new technology deployment, a cost off-ramp does not. Therefore cost off-ramps may impact the CES policy's cost- effectiveness.

8.11 PROMOTING EQUITABLE IMPACTS UNDER A CES

For a variety of reasons, the percentages of electricity supply that come from clean energy sources vary significantly among different states and regions (see Figure 9) and even among electric utilities in the same state. In addition, the availability and economics of certain clean energy sources vary among electric utilities, states, and regions. For example, Plains states have more wind and Southwest states have more solar than others.

Figure 9: Regional Electricity Generation Mix[89]



While there may be differences among electric utilities in a single state in terms of their electricity supply mixes, ensuring equitable impacts from a CES is likely to be of particular concern for policymakers in the case of a multi-state or federal CES. These factors suggest that, depending on policy specifics, a multi-state or federal CES might have different cost and electricity price impacts in different states and regions. Policymakers and other stakeholders may seek to minimize any such disparities to promote fairness. Policymakers can adjust several CES design parameters in order to promote such fairness. These policy parameters are reviewed in the Sections above, and Table 2 summarizes the implications for state/regional impacts of several of these primary policy parameters.

Table 2: CES Design Parameters and Implications for State/Regional Impacts

CES Parameter	Options and Implications for State/Regional Impacts
Percentage Requirement	A CES could include percentage requirements that are differentiated by region, state, or individual utility.
Qualified Clean Energy Sources	The broader the set of energy sources that qualify for credits under a CES, the more options electric utilities in different states/regions have for compliance and the less likely utilities are to find themselves overly reliant on buying credits from others.
Credits for Existing Clean Energy Facilities	By not awarding credits for non-incremental generation from clean energy facilities, a CES can mitigate state/regional disparities.
Base Quantity of Electricity	Excluding non-incremental generation from existing clean energy facilities from the base quantity of electricity sales can lessen the burden on states/regions that already have substantial clean energy generation.

One can make qualitative predictions about how certain policy designs will impact states and regions. However, given the number of potential variations and combinations of these policy parameters and the often complex dynamics of the power sector, substantially more sophisticated power sector modeling analysis is needed to inform policymakers and other stakeholders about the best ways to promote fairness alongside other CES policy goals. Appendix A.8 below includes results from two recent federal CES modeling analyses to provide some estimates of the potential for variations among states and regions in cost and other impacts under a multi-state CES program.

8.12 TREATMENT OF STATE PROGRAMS UNDER A MULTI-STATE OR FEDERAL CES

If a multi-state or federal CES were to be adopted, it would immediately raise questions about how to treat existing and future state electricity portfolio standards.

8.12.1 PREEMPTING STATE PROGRAMS WITH A FEDERAL CES

One option for dealing with existing state renewable and alternative energy portfolio standards is would be to preempt them with a federal standard. This could potentially upset gains made by individual states, and is likely to run counter to the wishes of state officials who would likely prefer to retain their prerogative to set requirements for clean power that might be more stringent than a federal CES or that might require compliance via in-state clean power generation.[90] 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."[91]

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.

8.12.2 KEEPING STATE AND FEDERAL PROGRAMS DISTINCT AND SEPARATE

The first issue to address is that of overlapping requirements, and the most obvious solution is for a federal CES (for example) to be distinct from existing and future state programs. Under this approach, covered utilities would need to comply with the federal CES via federally issued CECs that are different from and not fungible with credits issued under state programs (e.g., state renewable electricity credits, RECs).[92] For example, a geothermal plant might get one federal CEC and one state REC for each unit of generation, but only the CEC could be used to demonstrate federal compliance and the CEC could not be used to demonstrate state compliance.

In this case, some existing state portfolio standards would likely prove less stringent than the federal CES and thus effectively non-binding on utilities – i.e., in the process of meeting their federal obligation, utilities would obtain more than enough state credits to meet their state obligations. Consequently, state RECs in this example would trade at or near a price of zero.

On the other hand, some states might have or set more stringent clean energy requirements than a 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. Overall, such an approach may have no effect on the level of aggregate clean energy generation across the country, since the federal program would determine the aggregate total. A state program more ambitious than the federal program would simply change how clean energy generation is distributed among the states, with a disproportionate share of the national total coming from the states with ambitious standards.

State policymakers interested in promoting more clean generation than a federal CES would require may have options for ensuring that a stringent state standard leads to additional aggregate clean energy generation. One method is to require that, when a MWh of generation qualifies for both a state REC and a federal CEC, the REC and CEC be bundled and sold or transferred together. This constraint assures that even though a utility subject to the more stringent state standard will have excess federal CECs, it will not be able to trade the excess CECs to a utility in another state because the CECs are bundled with the RECs needed for compliance with the state standard.

8.12.3 ALLOWING STATES TO DEFINE CLEAN ENERGY

Another issue to address is that of conflicting definitions of clean energy. One option for treating state electricity portfolio standards under a federal CES is to allow states discretion in defining qualified clean energy sources by allowing energy sources in a particular state that qualify for credit under that state's electricity portfolio standard to also qualify for credit under the federal CES. In this case, federal policymakers would forgo their ability to define qualified clean energy themselves; although, they might set certain minimum criteria that energy sources would need to meet to qualify for credit under the federal CES based on their inclusion in state electricity portfolio standards.

8.13 INTERACTION OF STATE/REGIONAL GHG CAP-AND-TRADE PROGRAMS AND A CES

Many states with electricity portfolio standards also are participating in separate and distinct regional GHG programs, such as RGGI's power-sector CO_2 cap-and-trade programs, or are planning to implement their own state-based GHG program, such as in California. Similarly, congressional electricity portfolio standard proposals in the 111th Congress would have created programs separate and distinct from any existing state or regional GHG cap-and-trade programs or any proposed federal GHG cap-and-trade program. As with state electricity portfolio standards, any future CES programs might adopt the approach of treating a CES program as entirely distinct and separate from any GHG cap-and-trade programs. The main purpose of a GHG cap-and-trade program is to reduce GHG emissions. While this may be one of the benefits of a CES, a CES may have other goals and benefits in addition, as discussed earlier.

The interaction of a CES and GHG cap-and-trade program has not been thoroughly modeled. Nonetheless, qualitative observations can be made about the potential interaction of a CES with a GHG cap-and-trade program. Factors that would likely affect the outcomes of the implementation of both a GHG cap-and-trade program and a CES include the relative stringencies of the programs' targets, the scope of coverage of the cap-and-trade program, and the electricity market structure (i.e., competitive vs. traditionally regulated).

Under a GHG cap-and-trade program that extends beyond the power sector, a CES might lead to lower power-sector GHG emissions than the cap-and-trade program alone and thus higher emissions outside the power sector than under the cap-and-trade program alone.

A CES might lead to lower allowances prices in a GHG cap-and-trade programs since the CES will lead to emission reductions and thus lower the level of emission reductions that must be driven by the cap-and-trade allowance price.[93]

If a GHG cap-and-trade program leads to more clean energy generation than a CES alone would, then CEC prices will be lower than they would be in the absence of the GHG cap-and-trade program.

8.14 INTERNATIONAL COORDINATION

With respect to a CES, policymakers might consider issues of international coordination in the context of regional climate and energy policies that cross national boundaries and the potential to link a federal CES with market-oriented programs for clean energy deployment and environmental benefit in other countries.

U.S. regional GHG emission reduction programs might span multiple countries. The Western Climate Initiative (WCI) includes Canadian provinces as members and Mexican states as observers.[94] In the case of a regional GHG cap-and-trade program that included trading among U.S. and international jurisdictions, a CES that covered only domestic electric utilities might lead to lower GHG emissions from U.S. power generators covered by the cap-and-trade program and higher GHG emissions from covered power generators in international jurisdictions than would occur in the absence of the CES.

None of the recent congressional proposals for federal electricity portfolio standards have included provisions for international linkage. However, a CES could be linked to similar market-oriented programs outside the United States such that U.S. CECs could be exchanged for tradable credits in other countries' programs and vice versa. To enable such international coordination, policymakers would need to define criteria for determining whether an international program could be linked to and establish some means for setting an exchange rate between U.S. CECs and tradable credits from other countries' programs.

9 CONCLUSIONS

A transition from conventional fossil-fueled electricity generation to clean energy offers several benefits—particularly the growth of new clean energy industries and associated jobs, diversification of energy supply, acceleration of development and deployment of clean energy technologies, and reductions in the public health and environmental damages associated with conventional electricity generation. The current outlook for the power sector suggests, however, that absent significant new policies to promote clean energy the status quo in terms of power generation will continue largely unchanged for at least the next quarter century.

A CES holds promise as a policy for spurring growth in clean energy generation. As a concept, a CES builds on the successful experience of the majority of states that have implemented renewable and alternative energy portfolio standards and draws on a history of federal policy deliberation regarding national electricity portfolio standards.

The net effects of a CES policy are a function of interrelated policy design decisions. Policymakers and stakeholders should understand CES policy design options and their interactions and implications. Policymakers and stakeholders might usefully evaluate a CES in terms of key criteria – effectiveness, affordability, cost-effectiveness, and fairness – and think about implications of different policy design decisions in light of these criteria.

LIST OF ABBREVIATIONS

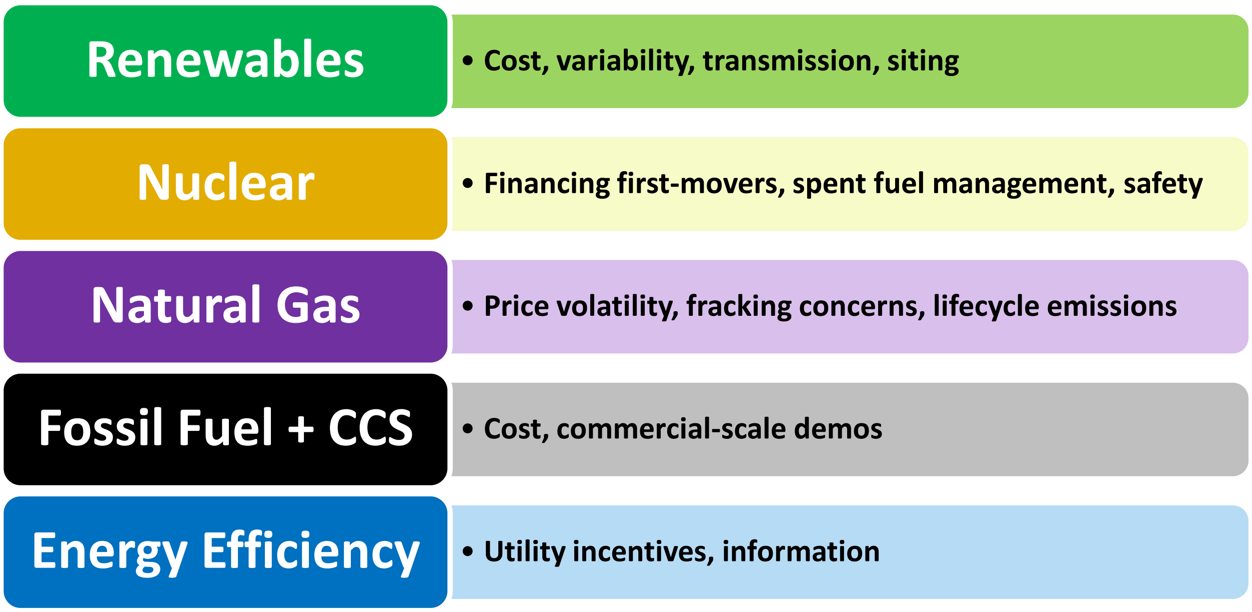
ACP	Alternative Compliance Payment
AEO	*Annual Energy Outlook*
CCS	Carbon Capture and Storage
CEC	Clean Energy Credit
CES	Clean Energy Standard
CHP	Combined Heat and Power
DES	Diverse Energy Standard
EERS	Energy Efficiency Resource Standard
EIA	Energy Information Administration
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
LCOE	Levelized Cost of Electricity
MSW	Municipal Solid Waste
MWh	Megawatt-hour
NGCC	Natural Gas Combined Cycle
NGCT	Natural Gas Combustion Turbine
RES	Renewable Electricity Standard
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standard

A. APPENDICES

A.1 CHALLENGES FACING CLEAN ELECTRICITY TECHNOLOGIES

Clean energy technologies face numerous challenges to more widespread deployment, as summarized in Figure 10.

Figure 10: Challenges Facing Clean Electricity Technologies



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.

While a CES can partially resolve the current failure of power markets to reflect all societal costs and benefits, less mature and more costly clean energy technologies face additional challenges. Existing federal policies address some of these challenges to some extent, but these challenges might warrant additional policies.

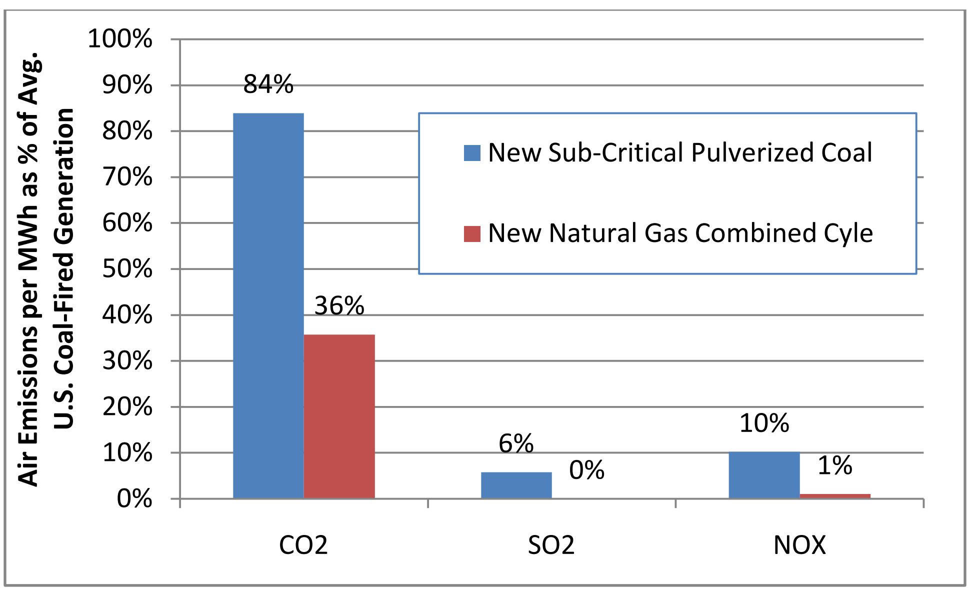
Less mature and more costly clean energy technologies generally suffer from an underinvestment in research, development, and demonstration. Both because of the lack of a comprehensive financial incentive to shift to cleaner power generation and the spillover benefits from clean energy technology research 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.[95] 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 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 power, 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.

A.2 AIR EMISSIONS FROM NATURAL GAS VS. COAL-FIRED ELECTRICITY GENERATION

Figure 11 shows air emissions for three key pollutants from electricity generation for a new natural gas combined cycle (NGCC) power plant and a new subcritical pulverized coal power plant relative to average air emissions from all U.S. coal-fired electricity generation. Note that a new coal-fired power plant with modern pollution controls is more efficient than, and has fewer air emissions than, current U.S. coal-fired electricity generation as a whole. Nonetheless, a new highly efficient NGCC power plant has even fewer air emissions.

Figure 11: Air Emissions from a New Natural Gas Combined Cycle Power Plant Relative to Emissions from Coal-Fired Electricity Generation[96]



A.3 A CES IN TRADITIONALLY REGULATED AND COMPETITIVE ELECTRICITY MARKETS

In traditionally regulated electricity markets, vertically integrated electric utilities own electricity generation assets and sell power to retail customers. In competitive electricity markets, electric utilities buy power from competitive generators for sale to retail customers. Electricity portfolio standards generally, and a CES in particular, can apply to either type of electricity market, but the standards' impacts will differ depending on the electricity market regulatory structure.

In a traditionally regulated market, a vertically integrated electric utility under a CES will accrue CECs for the output from its own qualified clean energy facilities. It may also purchase CECs from other entities or sell excess CECs that it has accrued. The vertically integrated utility will seek the least-cost approach to complying with the CES. It will invest in new clean energy generation assets and increase the utilization of existing clean energy facilities where possible—earning credits itself for the output from these facilities—when doing so is cost-effective. The electric utility will also determine the extent to which its least-cost approach is to rely to some extent on buying credits from the credit market or generating more clean energy than it needs to comply with the CES and selling its excess credit to the credit market. Under the oversight of utility regulators, the electric utility will pass on to its ratepayers cost changes associated with increasing its own clean energy generation, buying credits from the credit market, and making ACPs. The utility regulators will also ensure that any revenue realized from selling excess CECs will pass through to electricity consumers.

The perspective of an electric utility in a competitive electricity market is different. Generally, the electric utility owns no clean energy generators and must purchase tradable credits from the credit market to cover its entire CES compliance obligation and will pass on the cost of purchasing these credits to its retail customers. Competitive clean energy generators will earn a premium for their output as they realize revenue both from selling electricity and CECs, and a CES will impact competitive electricity prices as the premium for clean energy induces new entrants and increased clean energy generation.

A.4 COMPARISON OF A CES TO OTHER POLICY OPTIONS

The table below compares a CES to other policies that can achieve many of the same policy goals via different means. These policies are renewable portfolio standards, cap-and-trade programs, and emission performance standards (both traditional and tradable standards).

Table 3: Comparison of CES to Other Clean Energy and Air Emission Reduction Policies

Policy	Description	Comparison to a CES	
		Key Similarities	**Key Differences**
Renewable Portfolio Standard (RPS)	Requirement for electric utilities to supply specified percentages of their sales from qualified renewable sources with compliance via tradable credits.	Both policies focus on spurring deployment of clean energy technology. A CES and RPS can be nearly identical save for the set of fuels / technologies that qualify for credit under the policies.	A CES allows for compliance via a broader set of clean energy technologies that includes lower- and non-emitting technologies that are not renewable.

Policy	Description	Comparison to a CES	
		Key Similarities	**Key Differences**
Cap-and-Trade Program	Absolute, aggregate limit (cap) placed on emissions implemented via tradable allowances surrendered by covered entities.	Both policies are market-oriented and rely on tradable instruments. Both policies can spur clean technology deployment and reductions in air emissions.	Cap and trade directly regulates pollution while a CES directly spurs clean energy technology deployment. Cap and trade ensures a specified aggregate level of emissions whereas a CES target implies a certain level of aggregate emissions intensity. The point of regulation in a cap and trade program may differ from that of a CES. Cap and trade programs typically regulate emitters in the power sector (i.e., generators) whereas a CES typically regulates electric distribution utilities, which are often different entities than generators. Whereas cap and trade requires covered entities to hold allowances to cover all emissions, a CES requires electric utilities to surrender credits just for clean electricity sales. Cap and trade requires government distribution of allowances; under a CES, entities earn credits for qualified clean energy generation or electricity savings from efficiency.

Policy	Description	Comparison to a CES	
		Key Similarities	**Key Differences**
Tradable Performance Standards	Aggregate emissions intensity standard (e.g., lbs. / MWh) implemented via tradable permits / allowances surrendered by covered entities.	Both policies are market-oriented and rely on tradable instruments. Both policies effectively require a certain aggregate emissions intensity level. These policies can be effectively nearly identical depending on how they are designed.	A tradable performance standard program explicitly sets a requirement for the emissions intensity of generation rather than a target for clean energy generation. A tradable performance standard program may apply to emitters rather than electric utilities.
Traditional Emission Performance Standards	Standards for maximum permissible emissions per unit of input or output (e.g., lbs. / MWh) that apply to emitting facilities; maximum emission rates may be facility- or technology/fuel-specific. Emission performance standards may be binding directly on facilities or may govern electric utilities' ability to contract for power from facilities.	Both policies can spur deployment of clean technology and reduce GHG emissions.	A CES is a market-oriented policy in contrast to traditional, non-market-oriented emission performance standards. Whereas traditional emission performance standards focus on limiting emissions, a CES focuses on increasing clean energy generation. Performance standards typically apply to each emitting facility rather than to electric utilities. Traditional performance standards have an uncertain impact on both aggregate emissions and emissions intensity. Emission performance standards are enforced by environmental regulators, whereas a CES is normally enforced by utility regulators.

A.5 RECENT CONGRESSIONAL CES PROPOSALS

Table 4 below summarizes three federal electricity portfolio standard proposals from the last session of Congress (the 111th Congress) and includes a summary of President Obama's CES proposal.

Table 4: Comparison of Recent Senate Federal Electricity Standard Proposals and President Obama's CES Proposal[97,98]

	American Clean Energy Leadership Act of 2009 (S.1462)	**Practical Energy and Climate Plan Act of 2010 (S.3464)**	**Clean Energy Standard Act of 2010 (S.20)**	**President Obama's Clean Energy Standard Proposal**
Sponsor	Sen. Jeff Bingaman (D-NM)	Sen. Richard Lugar (R-IN)	Sen. Lindsey Graham (R-SC)	President Obama
Policy	Renewable Electricity Standard (RES)	Diverse Energy Standard (DES)	Clean Energy Standard (CES)	Clean Energy Standard (CES)
Point of Regulation[99]	Electric utilities	Electric utilities	Electric utilities	Electric utilities
Qualified Energy Sources	Non-hydro renewables and incremental hydropower	Non-hydro renewables, incremental hydropower, coal with CCS, incremental nuclear power	Non-hydro renewables, incremental hydropower, coal with CCS, incremental nuclear power	Renewables, nuclear power, fossil fuel use with CCS, and efficient combined cycle natural gas plants (partial credit)—no details regarding different treatment of incremental vs. non-incremental generation
Coverage	Retail electric utilities with sales of less than 4 million MWh per year are not covered.	All electric utilities	Retail electric utilities with sales of less than 4 million MWh per year are not covered.	Not specified
Targets (% of Base Quantity of Electricity Sales to Come from Qualified Energy Sources or Efficiency)	2011-2013.........3.0% 2014-2016.........6.0% 2017-2018.........9.0% 2019-2020.......12.0% 2021-2039.......15.0%	2015-2019.........15.0% 2020-2024.........20.0% 2025-2029.........25.0% 2030-2049.........30.0% 2050.................50.0%	2013-2014 ....13.0% 2015-2019 ....15.0% 2020-2024 ....20.0% 2025-2029 ....25.0% 2030-2034 ....30.0% 2035-2039 ....35.0% 2040-2044 ....40.0% 2045-2049 ....45.0% 2050 ....50.0%	80% of delivered electricity to come from clean energy sources by 2035—no interim targets specified
Exclusions from Base Quantity of Electricity	Existing hydropower, municipal solid waste (MSW),	Existing hydropower	Existing hydropower and MSW	Not specified

	American Clean Energy Leadership Act of 2009 (S.1462)	Practical Energy and Climate Plan Act of 2010 (S.3464)	Clean Energy Standard Act of 2010 (S.20)	President Obama's Clean Energy Standard Proposal
Sales	incremental nuclear, and fossil fuel with CCS			
Energy Efficiency	Credits for electricity savings from efficiency can be used for up to 26.67% of compliance.	Unlimited compliance via in-state electricity savings credits.	Credits for electricity savings from efficiency can be used for up to 25% of compliance.	Credits at least for industrial CHP
Alternative Compliance Payment	$21/MWh	Not less than $50/MWh	$35/MWh	Not specified
Other Notable Provisions	Banking of credits limited to 3 years.		Credits for early retirement of coal plants and generator-side efficiency improvements	

A.6 SUMMARY OF RELEVANT STATE PROGRAMS

Table 5 summarizes the electricity portfolio standards in Michigan, Ohio, Pennsylvania, and West Virginia, and the voluntary program in Indiana, since these states have policies that include credit for clean energy sources in addition to just renewables.

Table 5: Summary of Existing State CES Programs

	Michigan	Ohio	Pennsylvania	West Virginia	Indiana
Name of Policy	Renewable Electricity Standard	Renewable and Advanced Energy Portfolio Standard[100]	Alternative Energy Portfolio Standard	Alternative and Renewable Energy Standard	Voluntary Clean Energy Portfolio Standard
Date Enacted	October 2008	May 2008	December 2004 Amended 2008.	June 2009	May 2011
Targets	10% of electricity from qualified sources by 2015 Each utility has unique interim targets as follows: - 2012: Existing renewable energy baseline plus 20% of the gap between baseline and 10% - 2013: Baseline plus 33% of the gap between baseline and 10% - 2014: Baseline plus 50% of the gap between baseline and 10%	25% of electricity from qualified sources by 2025: - at least 12.5% from renewables - up to 12.5% from alternative energy Interim annual requirements only for renewables, starting at 0.25% in 2009, 0.5% in 2010, then increasing by 0.5% each year until 2014, then increasing by 1.0% each year until 2024[101]	18% of electricity from qualified sources by 2021: - 8% from Tier 1 sources - 10% from Tier 2 sources Interim annual targets for Tier 1 began at approximately 1.5% in 2007 and 2008, then increase by 0.5% each year until 2021 Interim annual targets for Tier 2 began at 4.2%, then increase to 6.2% in 2011 and 8.2% in 2016	25% of electricity from qualified sources by 2025 Interim targets of 10% by 2015 and 15% by 2020	NON-MANDATORY INCENTIVE PROGRAM In order to receive incentives, utilities must obtain from qualified sources an amount of electricity equal to a percentage of total base year (2010) retail sales: - 10% by 2025 - Interim targets of 4% for the period from 2013 through 2018 (annual average) and 7% for the period from 2019 through 2024

	Michigan	Ohio	Pennsylvania	West Virginia	Indiana
Qualified Energy Sources	At least 90 percent of compliance must come from renewable sources. Up to 10 percent of compliance can be met via Energy Optimization and Advanced Cleaner Energy Systems—i.e., electricity savings from efficiency and conservation, industrial CHP, gasification, and coal with CCS. Qualified energy sources must be in Michigan or in the out-of-state service territory of a Michigan utility.	Renewables, at least half of whose generation must be in-state; any other renewable generation must be shown to be deliverable into the state. Alternative energy resources include third-generation nuclear power plants, fuel cells, energy-efficiency programs, and coal with CCS.	Tier 1 sources: wind, solar, coalmine methane, small hydropower, geothermal, and biomass. Tier 2 sources: waste coal, demand side management, large hydropower, municipal solid waste, and coal integrated gasification combined cycle. Alternative Energy Credits (AECs) can be awarded to any qualified generators in the PJM footprint.	Renewables other than conventional hydropower. Electricity savings from efficiency / conservation. Credits can be awarded for emission reduction offset projects. Alternative energy sources include advanced coal technology, coal bed methane, natural gas, coal gasification or liquefaction, synthetic gas, integrated gasification combined cycle technologies, waste coal, tire-derived fuel, pumped storage hydroelectric, and recycled energy. No more than 10% of the standard can be met via natural gas generation. Qualified facilities must be in WV or PJM territory.	Renewables and alternative energy resources. Alternative energy resources include waste-to-energy facilities, energy storage systems, distributed generation, coal bed methane, CHP and waste heat recovery, demand side management, nuclear power, and natural gas from a facility constructed in Indiana after July 1, 2011, which displaces electricity generation from an existing coal fired generation facility. Qualified sources must be located within the control area of the ISO/RTO serving the utility (either PJM or MISO, depending on the utility). At least 50% of the target number of MWh must come from qualified sources in Indiana.

	Michigan	Ohio	Pennsylvania	West Virginia	Indiana
Regulated Entities	Electricity retailers.		Utilities, but coverage is phased in. 2011 is the first year that all utilities (including state's largest, PECO) will be required to fully comply.[102]	Electric utilities, excluding municipal utilities, rural electric cooperatives, and utilities serving fewer than 30,000 residential customers.	Electric utilities, excluding municipal utilities and electric cooperatives.
Carve-Outs	None.	0.5% from solar by 2025.	0.5% from solar by 2021	None.	None.
Credit Multipliers	3X multiplier for solar. Lesser bonuses awarded for on-peak production, storage, and using in-state labor or equipment.	None.	None.	2 credits for each MWh of renewable electricity; 3 credits for renewable energy from reclaimed surface mines in WV.	None.
Alternative Compliance Payment	None, but the law caps entities' compliance obligation once compliance costs reach per customer maximums (e.g., $3/month per residential customer).	$45 / MWh (except for solar)	$45 / MWh for Tier 1 (except solar) and Tier 2.[103]	Lesser of $50/MWh or 200% of average credit trading price.	None.
Banking / Borrowing		Up to 5 years.	Banking allowed for up to 2 years.[104]	Banking allowed.	Banked credits may only be applied in the compliance period immediately following the period in which the credits were generated.

A.7 ELECTRIC UTILITY SIZE THRESHOLD UNDER A FEDERAL CES

Table 6: Covered Electricity Sales and Regulated Entities under Different Thresholds (WRI Analysis)[105]

Threshold (MWHs)	Total covered electricity sales (MWHs)	Total potential regulated entities	Percent of total 2009 sales	Percent of total entities	Effective 2035 target
4,000,000	2,695,360,808	165	74%	5%	60%
1,000,000	3,140,693,666	399	87%	12%	69%
500,000	3,327,802,469	666	92%	20%	74%
0	3,617,942,578	3,347	100%	100%	80%

Source: EIA form 861 data, 2009 and WRI Analysis. Effective 2035 target assumes an 80 percent clean energy target and that 2035 percent of total sales is the same as in 2009.

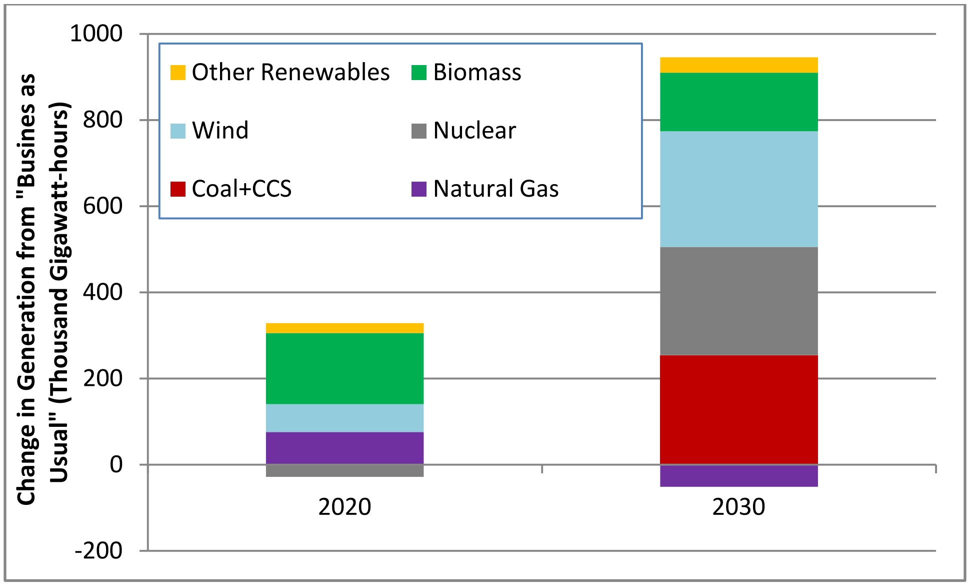
A.8 FEDERAL CES MODELING RESULTS AND REGIONAL IMPACTS

There are relatively few sophisticated modeling analyses of CES programs. The Bipartisan Policy Center (BPC) and Resources for the Future (RFF) have, though, recently released results from modeling analyses that looked at federal CES programs similar to President Obama's proposal.

This paper presents these study results in order to illustrate how a federal CES might affect states/regions differently and what magnitude those differences might have. However, one should view these results cautiously since they represent just two recent studies that looked at only a small set of potential policy designs. More analysis like that conducted by BPC and RFF of a variety of possible CES policy designs can provide the insights necessary to design a CES that achieves its intended goals fairly. In particular, the results below do not model cost containment provisions (like an ACP), and they do not try to ameliorate regional or interstate disparities in terms of cost impacts. As such, one might interpret these modeling results as illustrative of possible disparate regional impacts with the potential to substantially ameliorate such impacts via deliberate policy design choices.

Overall, BPC's modeling analysis of President Obama's CES proposal shows that a CES can drive incremental growth in electricity generation from a portfolio of clean technologies. Compared to a "business as usual" policy case, Figure 12 shows changes in clean power generation under a CES.

Figure 12: Projected Changes in Clean Power Generation under President Obama's CES Proposal Compared to "Business as Usual"[106]



In April 2011, the BPC released a staff paper that presented results from an initial analysis of a federal CES modeled after President Obama's proposal using ICF International's Integrated Planning Model (IPM).[107] The BPC study's results are a function of its CES policy design assumptions. BPC assumed that a federal CES would provide credit for generation from new/incremental and existing non-hydro renewable energy facilities but give credit only to new/incremental nuclear, hydro, and natural gas generation. BPC assumed that existing hydropower generation would be excluded from the base quantity of electricity sales. Figure 13 and Figure 14 show the BPC study's projections for how compliance with such a federal CES might vary among regions. Certain states/regions might find it less expensive to rely on buying credits from other states/regions, and the extent to which a state/region relies on in-state/region clean energy generation to meet its CES compliance obligation may change over time. As shown in Figure 13 and Figure 14 the BPC study also suggests that the net effect of a federal CES on retail electricity rates might vary among states/regions.

Figure 13: BPC Study - CES Credits Generated by Region in Comparison to Regional Requirement, 2020

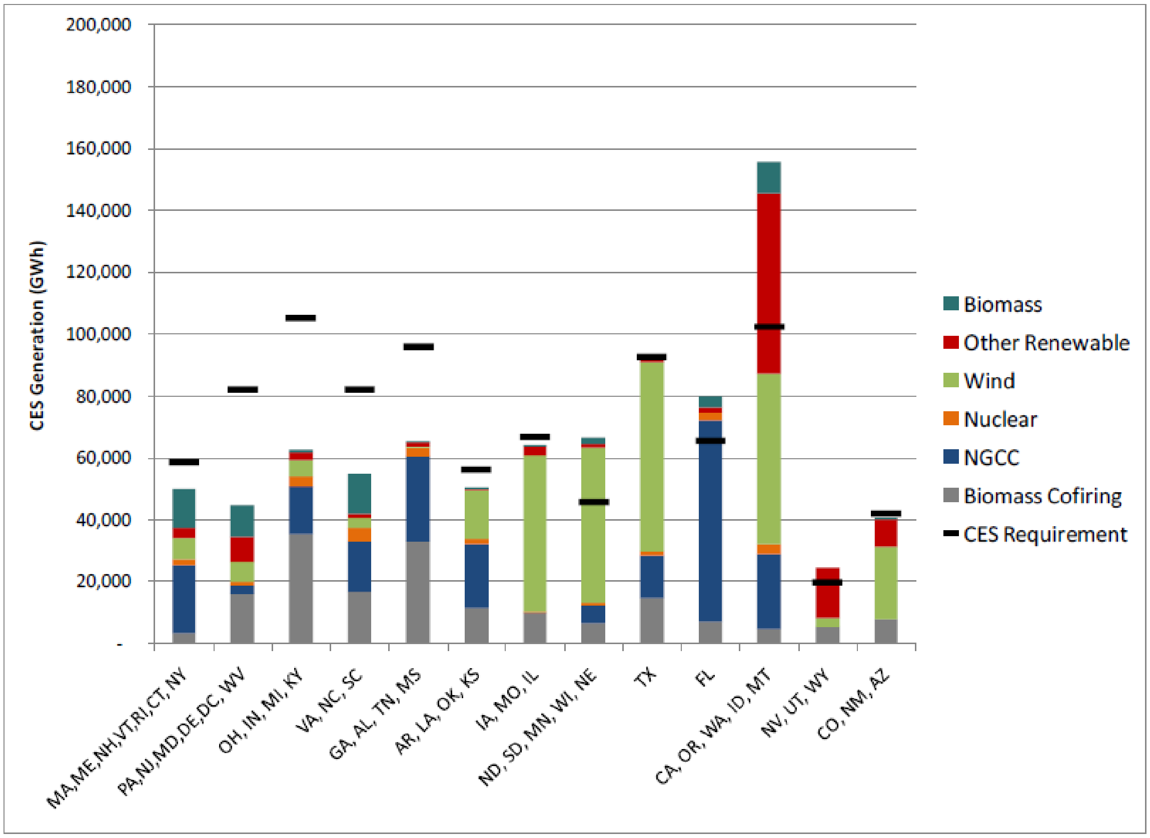


Figure 14: BPC Study - CES Credits Generated by Region in Comparison to Regional Requirement, 2030

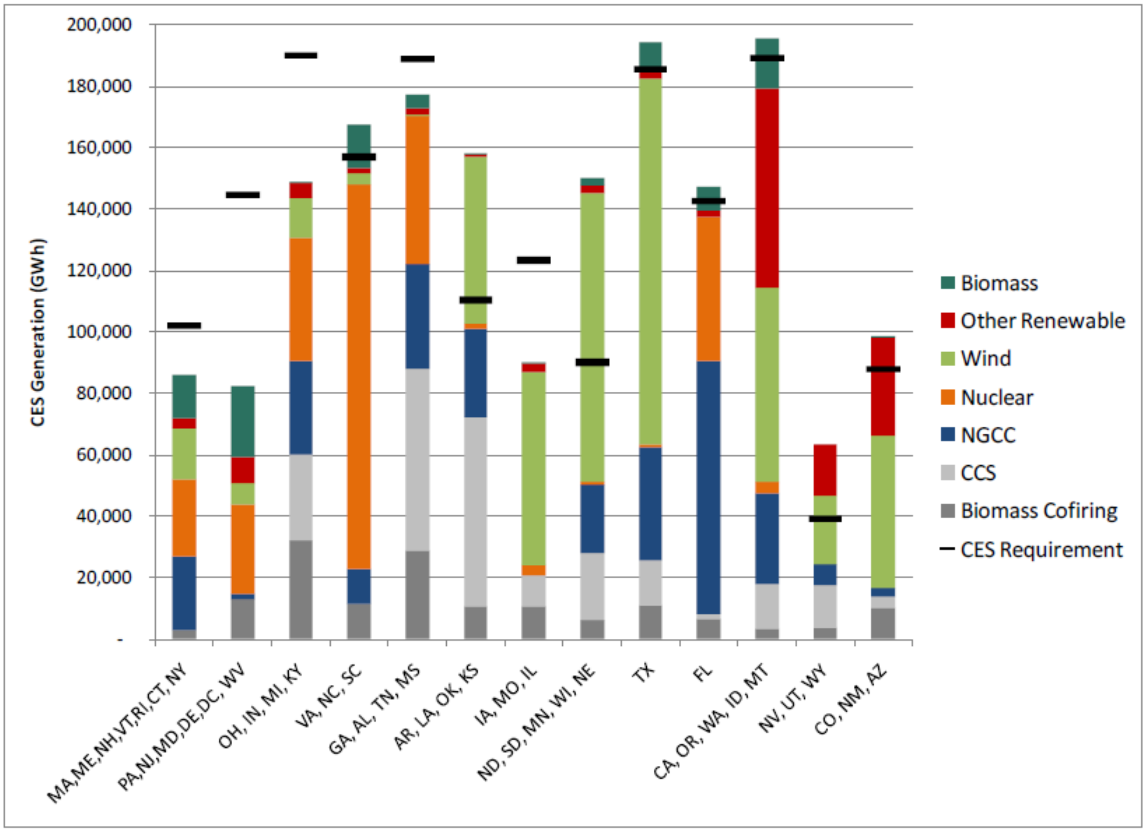


Table 7: BPC Study - Average Retail Electricity Price Impact of the CES

Region Name	NERC Region	Regulatory Status	Projected Average Rate Impact	
			2013 to 2020	2013 to 2030
Northeast	NPCC	Mix	-3%	-4%
Mid-Atlantic	RFC in PJM	Mix	7%	6%
Southeast	SERC (non-Delta)	Regulated	6%	8%
Florida	Florida	Regulated	1%	0%
Gulf Coast	SERC Delta	Regulated	7%	9%
Southern Plain States	SPP	Mix	1%	2%
Midwest	RFC (non-PJM)	Mix	7%	8%
Upper Midwest	MRO	Regulated	-6%	-4%
ERCOT	TRE	Competitive	-2%	-5%
WECC	WECC (non-California)	Regulated	1%	2%
California	California	Regulated	-7%	-7%
Total US	Continental US	Mix	1%	1%

RFF also modeled a federal CES program similar to President Obama's proposal using its Haiku power-sector model.[108] Figure 15 shows the different regional electricity price impacts that RFF projected for a federal CES, and Figure 16 shows how RFF projected that those price impacts would differ if a federal CES gave credit to existing nuclear and hydropower. RFF's projections illustrate that the treatment of existing clean energy facilities under a federal CES is one important factor that determines how the electricity price impacts of a federal CES differ across states/regions.

Figure 15: RFF Study - Projected CES Price Impacts from Federal CES (No Credit for Existing Nuclear and Hydropower), 2035[109]

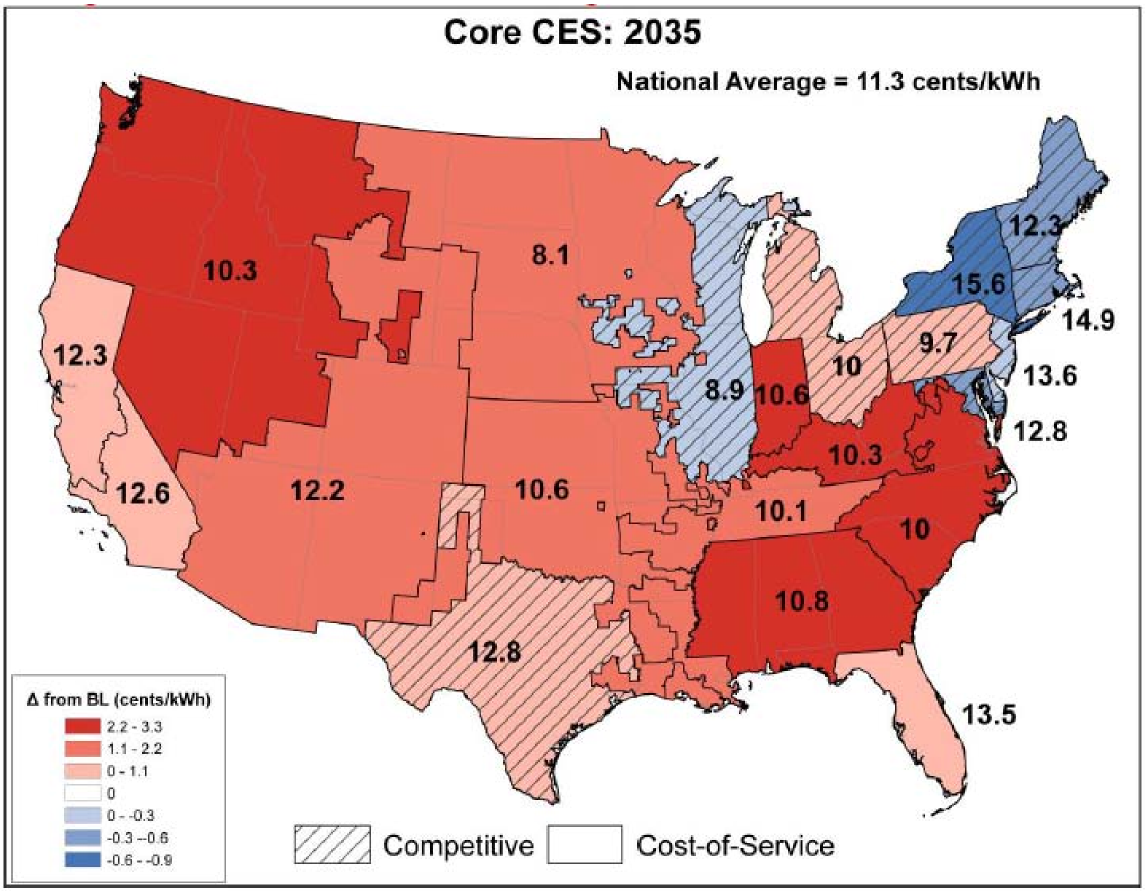
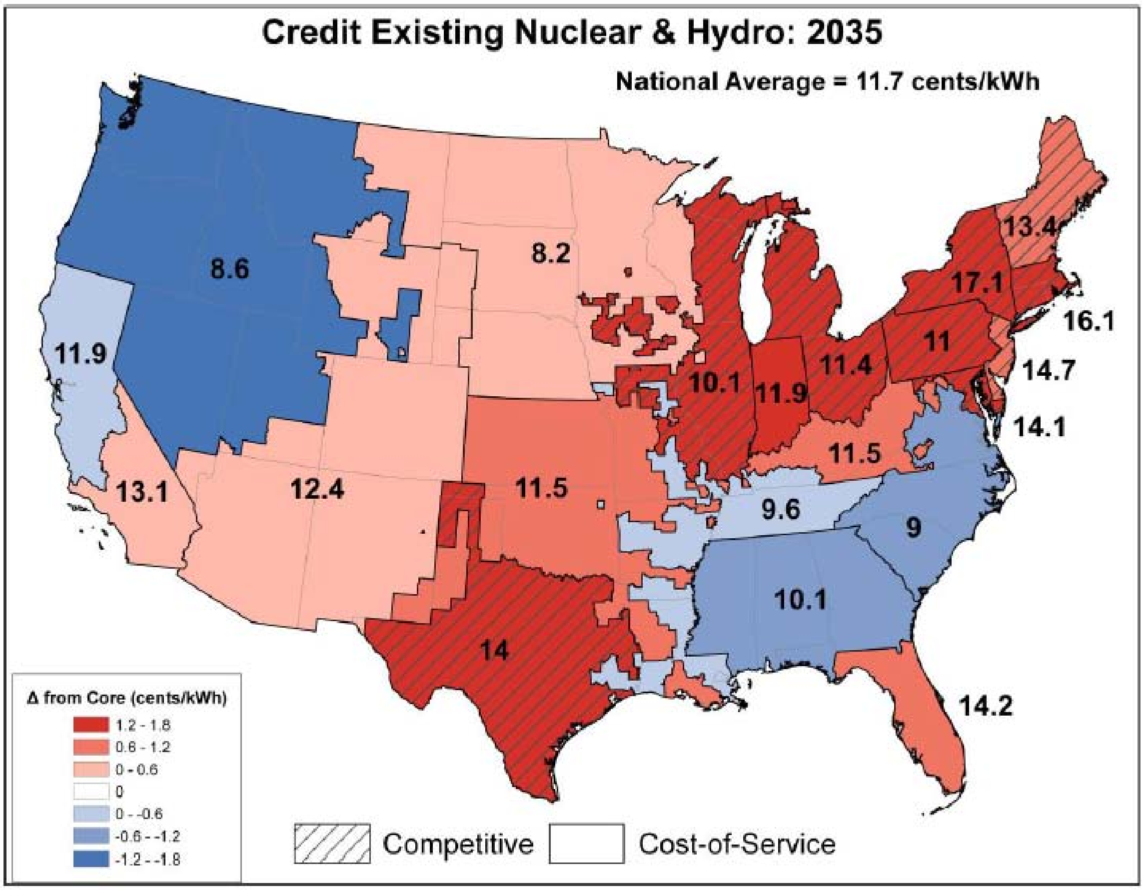


Figure 16: RFF Study - Projected Changes in CES Price Impacts from Crediting Existing Nuclear and Hydropower, 2035



ENDNOTES

[1] U.S. Energy Information Administration, "Electricity" in *Annual Energy Outlook 2011* (Washington, DC: U.S. Department of Energy, 2011), http://www.eia.gov/forecasts/aeo/MT_electric.cfm.
[2] U.S. Energy Information Administration, "Table 8.2a Electricity Net Generation: Total (All Sectors), 1949-2009" in *Annual Energy Review 2010* (Washington, DC: U.S. Department of Energy, 2011), http://www.eia.gov/totalenergy/data/annual/txt/ptb0802a.html
[3] "Form EIA-860 Annual Electric Generator Report," U.S. Energy Information Administration, last modified January 4, 2011, http://www.eia.gov/cneaf/electricity/page/eia860.html. Excludes industrial and commercial generators reported in EIA-860.
[4] U.S. Energy Information Administration, *Annual Energy Outlook 2011* (Washington, DC: U.S. Department of Energy, 2011), http://www.eia.gov/forecasts/aeo/index.cfm. Figure 3 includes projections from EIA's main "business as usual" case (Reference Case) as well as from several side cases that examined the sensitivity of projections to the following factors: low natural gas prices ("Low Gas Prices"), an indefinite continuation of federal subsidies for renewable electricity ("No Sunset"); new EPA pollution regulations (the Transport Rule (TR) and mercury (Hg) and other hazardous air pollutant regulations, "TR + Hg"); and the combination of new EPA regulations and low natural gas prices ("TR + Hg (Low Gas)"). The "Low Gas Prices" case refers to EIA's "High Shale EUR" case. The "TR + Hg" case refers to EIA's "Retrofit Required 5" case which assumed more stringent regulation of air emissions from coal-fired plants would require the installation of flue gas desulfurization (FGD) scrubbers and selective catalytic reduction (SCR) systems and a 5-year capital recovery period for retrofit investments.
[5] "Renewable & Alternative Energy Portfolio Standards," Center for Climate and Energy Solutions, last modified August 25, 2011, http://www.c2es.org/what_s_being_done/in_the_states/rps.cfm. Note that while Figure 4 indicates that Vermont has a renewable portfolio standard (RPS), the state actually has a goal for renewables that, if not met, will lead to the creation of an RPS program.
[6] Ryan Wiser, "State of the States: Update on RPS Policies and Progress" (presentation, Renewable Energy Markets 2010, October 20, 2010), http://www.renewableenergymarkets.com/docs/presentations/2010/Wed_State of the Markets_Ryan Wiser.pdf.
[7] "Levelized Cost of New Generation Resources in the Annual Energy Outlook 2011," U.S. Energy Information Administration, last accessed September 26, 2011, http://www.eia.gov/oiaf/aeo/electricity_generation.html.
Figure 6 shows the most recent estimates for the total system levelized cost of electricity (LCOE) from EIA's *Annual Energy Outlook 2011* for various power generation technologies (as well as electricity savings from energy efficiency). Importantly, the values shown do not reflect various incentives including state or federal tax credits that may be available. The total system LCOE estimates include levelized capital, fixed operation & maintenance (O&M), variable O&M (including fuel), and transmission investment costs. Note, the LCOE estimate for electricity savings from energy efficiency is not from *AEO2011* but rather based on Paul et al., *Supply Curves for Conserved Electricity,* Discussion Paper (Washington, DC: Resources for the Future, 2011), http://www.rff.org/RFF/Documents/RFF-DP-11-11.pdf, which finds that electricity savings of one to three percent are available at a marginal cost of $50/MWh. NGCC and NGCT refer to natural gas combined cycle and combustion turbine plants, respectively. CCS refers to carbon capture and storage.
[8] *Briefing on Investing in Green Technology as a Strategy for Economic Recovery, Day 1, Before U.S. Senate Committee on Environment and Public Works.* 111th Congress. 2009. (Statement of John Doerr, Partner at Kleiner Perkins Caufield & Byers). Statement available at: http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=df8869c6-c972-417b-b0a7-14b09d8c50bc.
[9] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G-20 Investment Powering Forward* (Washington, DC: The Pew Charitable Trusts, 2011), http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/G-20Report-LOWRes-FINAL.pdf.

[10] IHS Emerging Energy Research, *US RPS Markets and Utility Strategies: 2010-2025* (Cambridge, MA: IHS Emerging Energy Research, 2010), http://www.emerging-energy.com/Content/Document-Details/Renewable%20Power/US-RPS-Markets-and-Utility-Strategies-20102025/791.aspx. An RPS is one form of a CES; the distinctions are explained in Section 4 of this CES report.

[11] See, for example, NREL cost curve presentations at http://www.nrel.gov/analysis/docs/cost_curves_2002.ppt and http://www.nrel.gov/analysis/docs/cost_curves_2005.ppt.

[12] For more information on the opportunity for clean energy industry growth and job gains, see the Center for Climate and Energy Solutions, *In Brief: Clean Energy Markets: Jobs and Opportunities* (Arlington, VA: Center for Climate and Energy Solutions, 2011), http://www.c2es.org/publications/brief-clean-energy-markets-jobs-and-opportunities. See also the National Commission on Energy Policy, *Task Force on America's Future Energy Jobs* (Washington, DC: National Commission on Energy Policy, 2009), http://www.bipartisanpolicy.org/library/report/task-force-americas-future-energy-jobs.

[13] The Pew Charitable Trusts, *The Clean Energy Economy: Repowering Jobs, Businesses, and Investments across America* (Washington, DC: The Pew Charitable Trusts, 2009), http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf.

[14] Michigan Public Service Commission, *Report on the Implementation of the P.A. 295 Renewable Energy Standard and the Cost-Effectiveness of the Energy Standards* (2011), http://www.michigan.gov/documents/mpsc/Report_on_Implementation_of_PA_295_RE_Standards_and_Cost_Effectiveness_of_Standards_345871_7.pdf.

[15] Max Wei, Shana Patadia, and Daniel M. Kammen, "Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US?," *Energy Policy* 38 (2010) 919-931. According to the authors, "Unlike most other renewable energy studies, an attempt [was] made to take into account job losses in the coal and natural gas industry as a first step to capturing wider economy effects."

[16] "Most electric generating capacity additions in the last decade were natural gas-fired," U.S. Energy Information Administration, last modified July 5, 2011, http://www.eia.gov/todayinenergy/detail.cfm?id=2070.

[17] "U.S. Natural Gas Wellhead Price (Dollars per Thousand Cubic Feet)," U.S. Energy Information Administration, last modified August 29, 2011, http://www.eia.gov/dnav/ng/hist/n9190us3M.htm.

[18] Robert Peltier, "Predicting U.S. Coal Plant Retirements," *Power*, May 1, 2011, http://www.powermag.com/coal/Predicting-U-S-Coal-Plant-Retirements_3632_p4.html.

[19] For example, in 2005 back-to-back train derailments in the Powder River Basin region held up more than 20 million tons of coal deliveries, and some power plants were reportedly within one week of running out of coal. That same year, natural gas production and deliveries were disrupted and prices spiked following the devastation caused by Hurricane Katrina. A more recent example comes from abroad, where severe flooding in Australia in January 2011 disrupted mining operations and caused coal prices to spike by 35 percent.

[20] Joseph Goffman, "From Reducing Pollution from Power Plants" (presentation, Environmental Regulation and Electric System Reliability, Washington, DC, October 22, 2010), http://www.bipartisanpolicy.org/events/2010/10/environmental-regulation-and-electric-system-reliability.

[21] Joe Bryson, "Reducing Pollution from Power Plants" (presentation, National Association of State Utility Consumer Advocates Annual Meeting, Atlanta, Georgia, November 16, 2010).

[22] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2009* (Washington, DC: U.S. Environmental Protection Agency, 2011), http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[23] Biomass and landfill gas technologies, for example, release GHG during the combustion process that would ultimately be released anyway as methane inevitably escapes the landfill or is flared releasing CO2, or as biomass decomposes in nature.

[24] See, for example, Allen A. Fawcett et al., "Overview of EMF 22 U.S. Transition Scenarios," *Energy Economics 31*, supplement 2 (2009): S198-S211, http://emf.stanford.edu/files/res/2369/fawcettOverview22.pdf.

[25] For example, the capital cost of installing a new 300 MW advanced natural gas combined cycle power plant would be roughly $300 million, based on EIA data. In contrast, according to the Brattle Group's recent analysis of possible EPA regulations, the cost of retrofitting pollution controls on a 300 MW coal plant to reduce nitrogen oxide, sulfur dioxide and mercury emissions (but not GHG emissions) could exceed $200 million. Metin Celebi et al., "Potential Coal Plant Retirements Under Emerging Environmental Regulations" (presentation, EUCI Presents a Web Conference on: Coal Plant Retirements under New EPA Regulations, December 8, 2010), http://www.brattle.com/_documents/uploadlibrary/upload898.pdf.

[26] Some states have also adopted energy efficiency resource standards (EERS). An EERS can be similar to an electricity portfolio standard except that only electricity savings from energy efficiency count toward compliance with an EERS. This paper does not consider an EERS in isolation as a form of electricity portfolio standard, but does allow for the possibility of a CES that treats energy efficiency savings as one type of qualifying resource.

[27] In this paper, the term "electric utility" will generally be used to refer to any entity that sells electric energy at retail to end-use customers. Where references are made to specific state laws or specific federal laws that have been proposed, the term "utility" may in some cases be defined more narrowly in the applicable statute or bill, for example to include investor-owned utilities but not electric cooperatives.

[28] Section 8 (CES Policy Design Options and Implications) below explains how a CES specifies what fraction of sales must come from clean energy sources.

[29] For a more thorough explanation of the unbundling of electricity attributes into different commodities such as the megawatt-hour (MWh) energy commodity and CECs, see Ed Holt, "Renewable Energy Certificates and Generation Attributes," *Issuesletter,* (Regulatory Assistance Project, 2003), http://www.raponline.org/docs/RAP_Holt_IssuesLetter-RenewableEnergyCertificatesAndAttributes_2003_05.pdf.

[30] See Appendix A.8 for illustrative CES modeling results.

[31] Part of the dilemma faced by coal-producing states is that most of them have relatively small populations and electric load. They are fuel exporters. RPS policies established in other states, over which the coal producing states have no control, may eventually reduce coal's share of the generation pie. And forthcoming EPA regulations could have an even more dramatic effect, given the impacts of coal on air and water quality. These two factors might substantially reduce the future demand for coal. But it is not inconceivable to think that a federal CES policy could stimulate research, development, and deployment of lower-emitting coal-based technologies like CCS that would otherwise be cost-prohibitive, and thereby provide an "insurance policy" for coal-producing states.

[32] Roughly 30 percent of U.S. electricity currently comes from hydropower, other renewables, and nuclear power, while natural gas generation, which the White House proposal gives half credit for being cleaner than conventional coal use, provides about 20 percent of total electricity.

[33] See the White House's factsheet on the proposed clean energy standard at http://www.c2es.org/docUploads/SOTU factsheet CES.PDF and details on the CES proposal in the Obama Administration's *Blueprint for a Secure Energy Future* at http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf.

[34] U.S. Energy Information Administration, *Energy Market Impacts of a Clean Energy Portfolio Standard* (Washington, DC: U.S. Department of Energy, 2006), http://www.eia.gov/oiaf/servicerpt/emice/index.html.

[35] See Center for Climate and Energy Solutions, "Responses to the Senate Energy and Natural Resources Committee CES White Paper" (Arlington, VA: Center for Climate and Energy Solutions, 2011), http://www.c2es.org/federal/analysis/responses-senate-energy-and-natural-resources-committee-ces.

[36] See Table 4 in Section A.5 for a side-by-side comparison of the proposals across some of their key design parameters.

[37] In addition, the U.S. Territories of Puerto Rico, Virgin Islands, and Northern Mariana Islands have adopted standards and Guam has adopted a goal.

[38] "Energy Efficiency Standards and Targets," Center for Climate and Energy Solutions, last modified August 11, 2011, http://www.c2es.org/what_s_being_done/in_the_states/efficiency_resource.cfm. See also

American Council for Energy-Efficient Economy, *State Energy Efficiency Resource Standard (EERS) Activity* (Washington, DC: American Council for Energy-Efficient Economy, 2011), http://www.aceee.org/files/pdf/fact-sheet/State%20EERS%20Summary%20June%202011_1.pdf.

[39] For an earlier analysis of the effects of state RPS policies, refer to Chen et al., *Weighing the Costs and Benefits of State Renewables Portfolio Standards: A Comparative Analysis of State-Level Policy Impact Projections* (Berkeley, CA: Lawrence Berkeley National Laboratory, 2007), http://eetd.lbl.gov/ea/emp/reports/61580.pdf.

[40] The five states featured in this subsection are not the only ones with policies that credit non-renewable resources. More than half of the state policies allow at least some resources that don't generate electricity (e.g., energy efficiency or solar hot water heating) to qualify on an MWh-equivalent basis. More than half of the state policies also define municipal waste as an eligible renewable resource, and two include waste tires. It is also fairly common for state policies to allow fuel cells, combined heat and power facilities, and distributed generation to qualify, in some cases regardless of whether the energy source is renewable. For a table summarizing all of the resources that qualify under each state RPS or CES policy, see http://www.c2es.org/docUploads/Qualifying-Resources-by-State.pdf.

[41] 2008 Michigan PA 295. http://www.legislature.mi.gov/documents/2007-2008/publicact/htm/2008-PA-0295.htm.

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

[43] Under Ohio rules, "advanced nuclear energy technology" includes generation III technology as defined by the Nuclear Regulatory Commission; other, later technology; or significant improvements to existing facilities.

[44] Individual compliance reports of Ohio Power Company, Columbus Southern Power Company, Duke Energy Ohio, and First Energy available online, see "Alternative Energy Portfolio Status Reports – 2010," The Public Utilities Commission of Ohio, last accessed September 26, 2011, http://www.puco.ohio.gov/puco/index.cfm/industry-information/industry-topics/alternative-energy-portfolio-status-reports-2010.

[45] Pennsylvania's AES Tier I qualified energy technologies are: solar photovoltaic energy, solar thermal, wind power, low-impact hydropower, geothermal energy, biologically derived methane gas (including landfill gas), fuel cells, biomass energy, coal mine methane, black liquor, and large-scale hydropower (certain restrictions apply). Tier II energy technologies are: waste coal, distributed generation systems, demand-side management, large-scale hydropower, municipal solid waste, generation of electricity utilizing by-products of the pulping process and wood, and integrated combined coal gasification technology. More information about Pennsylvania's electricity portfolio standard, see "Alternative Energy," Pennsylvania Public Utility Commission, last accessed September 26, 2011, http://www.puc.state.pa.us/electric/electric_alt_energy.aspx.

[46] Pennsylvania Public Utility Commission, *2008 and 2009 Annual Reports Alternative Energy Portfolio Standards Act of 2004* (2010), http://www.puc.state.pa.us/electric/pdf/AEPS/AEPS_Ann_Rpt_2008-09.pdf.

[47] In recent years, legislation expanding the list of qualifying resources has been introduced in a number of states, sometimes successfully and sometimes not. These proposals have most often focused on adding resources that generate or save relatively few MWh compared to the overall policy targets. But in several notable cases (e.g., Maine and Arizona), proposals to include high-output resources like nuclear power and natural gas generation without increasing the targets have been defeated.

[48] In practice, this could require a fairly complicated national tracking system, especially if the definition of "clean" varies across jurisdictions, but the concept is not unprecedented and is certainly realistic. Some states already collaborate on tracking systems despite having different lists of qualifying RPS resources. The key points are to ensure that any one credit cannot be used where it is not eligible and cannot be used twice.

[49] This paper uses the term "electric utilities" to describe entities selling electric energy at retail to end use customers. This is in fact a gross simplification but it is sufficient for describing the concepts in this paper. In today's complex restructured electric power industry, the reality is that end use customers may be purchasing power from a distribution-only utility, a vertically-integrated utility that owns generation assets,

an electric cooperative, a public power entity, or a competitive retail electric supplier. Some of these entities will not meet the legal definition of "utility" in every jurisdiction. The distinction between electric utilities and generators is further explained in Appendix A.3.

[50] See Table 4 in Appendix A.5.

[51] The White House's *Blueprint for a Secure Energy Future* says of the President's CES proposal that it "would work by giving electric power plants clean energy credits for every megawatt-hour (MWh) of electricity they generate from clean energy" and "[u]tilities that serve retail customers would be responsible for making sure the utilities had enough credits to meet their target."

[52] Joseph E. Aldy, *Promoting Clean Energy in the American Power Sector,* The Hamilton Project (Washington, DC: The Brookings Institution, 2011), http://www.brookings.edu/papers/2011/05_clean_energy_aldy.aspx.

[53] Dallas Burtraw, "Additional Topics," in *RFF Analyzes Clean Energy Standard in Response to Senate White Paper Questions* (Washington, DC: Resources for the Future, 2011), 53-55. http://www.rff.org/Documents/Features/110415_RFF_CES_Responses_Final.pdf.

[54] Consider the case of a merchant coal plant. Under a CES with the point of regulation on electric utilities, this coal plant may earn some credits (e.g., via CCS retrofit) to sell to electric utilities or not earn any credits, but the coal plant will never have to pay for any credits or allowances to cover its emissions. Under Aldy's proposal though, the coal plant would eventually, if it did not retrofit with CCS, have to pay to buy credits to cover its emissions.

[55] 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. In April 2009, the National Rural Electric Cooperative Association (NRECA) reported 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. 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.

[56] California Market Advisory Committee, "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California" (Sacramento, CA: California Environmental Protection Agency, 2007), http://www.climatechange.ca.gov/market_advisory_committee/index.html.

[57] Excluding clean energy generation (e.g., from existing facilities) from the base quantity means a CES has an effective target for overall clean energy generation that is higher than its nominal target, all else equal. Excluding non-clean energy generation from the base quantity means a CES has an effective target for overall clean energy generation that is lower than its nominal target.

[58] U.S. Energy Information Administration, *Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009* (Washington, DC: U.S. Department of Energy, 2009), http://www.eia.gov/forecasts/aeo/index.cfm. The federal renewable electricity standard included in the House-passed Waxman-Markey American Clean Energy and Security Act of 2009 (H.R. 2454 of the 111th Congress) 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 (those with annual sales of less than four million MWh) responsible for roughly 20 percent of total U.S. 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.

[59] The fourth example is offered to illustrate how energy efficiency can change the base quantity of sales and thereby change the amount of actual clean generation needed to satisfy a CES. The authors do not intend to suggest that this "incentive" for energy efficiency is necessarily or in all cases sufficient to overcome other *disincentives* a utility might have for investing in efficiency.

[60] In its AEO2011 Reference Case, EIA projects that natural gas-fired plants account for 60 percent of capacity additions from 2010 through 2035.
[61] Combustible renewable fuels face a similar issue. Whereas biomass, biogas, and landfill gas can be viewed as neutral with respect to long-term emissions of GHG, the same is not true for non-GHG air pollutants. When burned, these fuels release criteria air pollutants (e.g., SO_X, NO_X, and particulate matter) and hazardous air pollutants, though usually in smaller quantities than the typical coal-fired power plants operating today. This point is illustrated in part by EPA's proposal to exempt natural gas power plants from new HAP emission regulations, based on EPA finding that the public health impacts from HAP emissions at those power plants are negligible. Nonetheless, if reducing non-GHG air pollutants is an important CES policy goal, policymakers might consider provisions to address the non-GHG pollutants from these renewable technologies.
[62] Generally, it's challenging to create and assign generation technologies into credit categories that are equitable because of plant-to-plant as well as technology-by-technology variation in emission rates.
[63] The federal electricity portfolio standards proposed in the 111th Congress 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 Graham and Lugar (S.20 and S.3464 of the 111th Congress) provided credits to certain non-renewable clean energy sources but, with respect to existing nuclear plants, provided credits only to incremental output. See Table 4 in Appendix A.5 for details.
[64] For example, if the baseline of existing clean energy generation was 40 percent before the policy is enacted, then a 40 percent CES that credits only new and incremental generation could be equivalent to an 80 percent CES that provides credit to existing, new, and incremental generation.
[65] The 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.
[66] See Appendix A.3 for a discussion of a CES in traditionally regulated and competitive electricity markets.
[67] Ray Kopp et al., *RFF Analyzes Clean Energy Standard in Response to Senate White Paper Questions* (Washington, DC: Resources for the Future), http://www.rff.org/News/Features/Pages/RFF-Responds-to-Senate-CES-Request.aspx. Based on RFF's modeling President Obama's CES proposal that did not provide credits to non-incremental output from existing clean energy facilities, up to five GW of existing nuclear capacity would retire rather than relicense by 2035 (depending on natural gas prices). RFF projected that these units would not retire under a CES that provided them with credit for non-incremental output. To put this figure in context, the Nuclear Regulatory Commission (NRC) reports that, between 2012 and 2035, the operating licenses for 74 GW of existing nuclear capacity will expire if not renewed. For NRC data, see U.S. Nuclear Regulatory Commission, "Information Digest, 2011–2012" (NUREG-1350, Volume 23), Appendix A, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350.
[68] Meghan McGuinness, *The Administration's Clean Energy Standard Proposal: An Initial Analysis*, Bipartisan Policy Center Staff Paper (Washington, DC: Bipartisan Policy Center, 2011), http://www.bipartisanpolicy.org/sites/default/files/CES_paper_revised.pdf.
[69] For example, if analysis suggests that nuclear plant owners will not relicense their reactors without receiving credits under a CES (even when generation from such reactors receives indirect credit by its exclusion from the base quantity), then policymakers might provide some amount of credits for generation from existing nuclear plants upon their relicensing.
[70] See Table 4 in Appendix A.5 for details on the federal proposals.
[71] The White House's *Blueprint for a Secure Energy Future* says the President's CES should be paired with energy efficiency policies that "will lower consumers' energy bills, such as stronger appliance efficiency standards, tax credits for energy efficiency upgrades, the proposed Home Star rebate program, the ENERGY STAR program, and technical assistance for industrial efficiency."
[72] "Energy Efficiency Standards and Targets," Center for Climate and Energy Solutions, last modified August 11, 2011, http://www.c2es.org/what_s_being_done/in_the_states/efficiency_resource.cfm.

[73] Policymakers could also consider an energy efficiency resource standard (EERS) as a complementary policy to a CES.
[74] Table 4 in Appendix A.5 shows that two of the three federal electricity portfolio standards in the last Senate included limits on how much compliance could come from energy efficiency.
[75] For example, Senator Graham's Clean Energy Standard Act of 2010 (S. 20 of 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 the proposal, eligible retired units received partial credits for their avoided generation during this period.
[76] Note that the LCOE estimates do not reflect any state or federal tax or other financial incentives.
[77] For example, Senator Graham's CES proposal from 2010 provided double credits for generation from the first five new coal power plants to use CCS and the first five CCS retrofit projects at existing coal plants. The proposal required that new coal with CCS projects sequester at least 1 million tons per year of CO_2 and retrofit projects capture and sequester the CO_2 from at least 200 MW of generation capacity. The proposed CES would also have adjusted bonus credits downward for CCS projects that sold captured CO_2 for use in enhanced oil recovery (EOR) projects.
[78] Using bonus credits to provide an extra incentive for deployment of particular technologies poses an additional challenge under a CES if such bonus credits are of a very large scale. For example, if a CES's nominal target is increased in order to maintain a certain effective target in light of substantial numbers of anticipated bonus credits for widespread CCS deployment, then the CES will turn out to be much more ambitious than intended if those anticipated CCS projects never materialize. One option for addressing this issue is to grant the bonus credits on a competitive basis (e.g., via a reverse auction); this approach would prevent policymakers from defining a rate for awarding bonus credits for CCS (e.g., double credits for first movers) only to find this rate insufficient to spur CCS projects, thus leaving the bonus credits unclaimed and the overall CES targets overly stringent.
[79] Strictly speaking, by setting minimum requirements for certain clean energy sources, carve-outs and tiers also set maximum levels of compliance from all other clean energy sources.
[80] One might argue that banking of credits should be limited under some electricity portfolio standard policies. For example, a renewable electricity standard that sets targets that are at or even below "business-as-usual" levels in the early years might warrant restrictions on banking since early over-compliance with very modest requirements might substantially undermine the longer-term deployment of renewables. However, 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) may not face the same issue with regard to banking.
[81] More recently, offsets have been a key feature in GHG cap-and-trade programs and proposals—including RGGI, California's cap-and-trade program, and recent congressional GHG cap-and-trade bills. Under a GHG cap-and-trade program, entities who are not subject to an emissions cap (e.g., farmers and forest managers) could receive offset credits for quantified emission reductions or biological carbon sequestration (e.g., credits for carbon sequestered via reforestation) that they could sell to entities that are covered by the emissions cap for compliance with the cap on emissions. Such credits are called "offsets" because they allow an entity that does not have a compliance obligation to take some actions to offset the actions (e.g., GHG emissions) of entities that do face compliance obligations. For more information on offsets in the context of GHG cap-and-trade programs, see Center for Climate and Energy Solutions, *Greenhouse Gas Offsets in a Domestic Cap-and-Trade Program* (Arlington, VA: Center for Climate and Energy Solutions, 2008), http://www.c2es.org/federal/congressional-policy-brief-series/greenhouse-gas-offsets-domestic-cap-and-trade-program.
[82] Alternative and Renewable Energy Portfolio Act, West Virginia Code §24-2F (2009), see http://www.legis.state.wv.us/Bill_Status/bills_text.cfm?billdoc=hb103%20ENR.htm&yr=2009&sesstype=1X&i=103.
[83] In 2006, Senator Coleman (R-MN) proposed a federal Clean Energy Portfolio Standard that allowed for compliance via credits issued for biological sequestration projects, see U.S. Energy Information Administration, "Appendix B. Proposed Clean Energy Portfolio Standard" in *Energy Market Impacts of a Clean*

Energy Portfolio Standard - Follow-up (Washington, DC: U.S. Department of Energy, 2007), http://www.eia.gov/oiaf/servicerpt/portfolio/pdf/appb.pdf.

[84] An ACP may be specified in $/MWh. For example, if an electric utility had to demonstrate that it delivered 1000 MWh of qualified clean electricity under a CES, it might submit CECs equivalent to 500 MWh of clean energy and pay the ACP for the remaining 500 MWh.

[85] Ryan Wiser and Galen Barbose, *Renewables Portfolio Standards in the United States — A Status Report with Data Through 2007*, (Berkeley, CA: Lawrence Berkeley National Laboratory, 2008), http://eetd.lbl.gov/ea/emp/reports/lbnl-154e-revised.pdf, 31.

[86] A recent study modeled a federal renewable standard with a target of 20 percent by 2020 both with and without the ACP ($25/MWh). Compared to "business as usual," 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 as did the policy scenario with an ACP through 2035. See Karen L. Palmer et al., *Federal Policies for Renewable Electricity: Impacts and Interactions*, Discussion Paper (Washington, DC: Resources for the Future, 2011), http://www.rff.org/RFF/Documents/RFF-DP-10-53_Final.pdf.

[87] Senator Graham's CES proposal (S.20) from the 111th Congress, for example, capped the program's rate impact at 4 percent per year per customer.

[88] See Table 9 in Ryan Wiser and Galen Barbose, *Renewables Portfolio Standards in the United States — A Status Report with Data Through 2007.*

[89] Edison Electric Institute, *Different Regions of the Country Use Different Fuel Mixes to Generate Electricity* (Washington, DC: Edison Electric Institute, 2009), http://www.eei.org/ourissues/ElectricityGeneration/FuelDiversity/Documents/diversity_map.pdf.

[90] State laws that specifically require in-state generation have been challenged in court on constitutional grounds, with litigants asserting a violation of the interstate commerce clause. See, for example, American Tradition Institute v. State of Colorado. Although resolution of this legal question is important, it is beyond the scope of this paper.

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

[92] Under this approach, policymakers may take two steps to promote the fair treatment of utilities subject to state standards in addition to the federal CES. 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 any federal credits associated with the renewable electricity generation that creates those state RECs. 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 power 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. These steps are based on the provisions in Sec. 610(h) of the American Clean Energy Leadership Act of 2009 (S.1462) from the 111th Congress.

[93] This interaction between an electricity portfolio standard and a GHG cap-and-trade program is illustrated by the modeling results in two studies from RFF that compared GHG cap-and-trade programs alone to cap-and-trade in combination with an RPS. Palmer et al., *Federal Policies for Renewable Electricity: Impacts and Interactions.* Burtraw et al., *Allocation of CO_2 Emissions Allowances in the Regional Greenhouse Gas Cap-and-Trade Program*, Discussion Paper (Washington, DC: Resources for the Future, 2005), http://www.rff.org/documents/RFF-DP-05-25.pdf.

[94] "Regional Initiatives," Center for Climate and Energy Solutions, last modified July 18, 2011, http://www.c2es.org/what_s_being_done/in_the_states/regional_initiatives.cfm#wci.

[95] "Increase Clean Energy R+D," Institute for 21st Century Energy, last accessed September 26, 2011, http://www.energyxxi.org/issues/Increase_Clean_Energy.aspx

[96] Air emissions from average coal-fired power plants come from EPA's "Air Emissions," last modified December 28, 2007, http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html. Air emissions for new NGCC and coal-fired power plants come from National Energy Technology Laboratory's "Bituminous_Performance_Tool," last accessed September 26, 2011, http://www.netl.doe.gov/energy-analyses/pubs/Bituminous_Performance_Tool_Rev6.swf.

[97] The summary of President Obama's CES proposal draws from the CES discussion in the White House's *Blueprint for a Secure Energy Future*. As a high-level proposal rather than actual legislation, President Obama's CES has fewer details than the Senate bills.
[98] For a detailed side-by-side comparison of the proposals, see: the Center's "Comparison Chart: Diversified/Renewable Energy Standard Provisions in Climate and Energy Legislation in the 111th," last modified May 8, 2011, http://www.c2es.org/federal/analysis/congress/111/comparison-chart-diversifiedrenewable-energy-standard-provisions-clima.
[99] Each of the bills summarized in Table 4 uses the definition of "electric utility" from the Public Utility Regulatory Policies Act of 1978 (PURPA), 16 U.S.C § 2602(4) —i.e., any person, state agency, or federal agency, which sells electric energy—and applies the portfolio standard requirement to electricity sales to consumers for purposes other than resale.
[100] Ohio utilities also face a requirement for peak demand reduction and electricity savings from energy efficiency and conservation programs.
[101] Todd Williams, "Ohio's Renewable Portfolio Standards" (presentation, Toledo City Council, February 28, 2011), http://www.scribd.com/doc/49792124/Ohio-s-Renewable-Portfolio-Standards.
[102] The law exempts utilities from complying until the companies have fully recovered their competitive or intangible transition charges, or until their generation rate caps have expired, whichever period is later.
[103] PJM Environmental Information Services, "Comparison of Renewable Portfolio Standards (RPS) Programs in PJM States" (Norristown, PA: PJM Environmental Information Services, 2010), http://www.pjm-eis.com/~/media/pjm-eis/documents/rps-comparison.ashx.
[104] Ibid.
[105] Kevin Kennedy et al., *Submission to the U.S. Senate Committee on Energy and Natural Resources: Response to the Committee's White Paper on a Clean Energy Standard* (Washington, DC: World Resources Institute, 2011), http://www.wri.org/stories/2011/04/how-design-clean-energy-standard.
[106] McGuinness, *The Administration's Clean Energy Standard Proposal: An Initial Analysis*. BPC's paper found that the main CES policy case led to slightly lower levels of nuclear power generation and natural gas-fired generation than under "business as usual" in 2020 and 2030, respectively. BPC projected more natural gas-fired generation under a CES when lower natural gas prices were assumed.
[107] Ibid.
[108] Kopp et al., *RFF Analyzes Clean Energy Standard in Response to Senate White Paper Questions*.
[109] "BL" refers to RFF's baseline or "business-as-usual" model scenario.

Center for Climate and Energy Solutions
2101 Wilson Blvd., Suite 550
Arlington, VA 22201
Phone (703) 516-4146
www.c2es.org

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The Regulatory Assistance Project
50 State Street, Suite 3
Montpelier, Vermont 05602
Phone: (802) 223-8199
www.raponline.org

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