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Clean Energy Standard: Summary and Analysis of S. 2146

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Summary

U.S. policymakers have considered and deliberated on several policy designs that could potentially reduce energy-related carbon emissions. In his 2011 State of the Union address, President Obama proposed the concept of a Clean Energy Standard (CES) that would result in 80% of U.S. electricity generation from clean energy sources by 2035. In March of 2012, the Clean Energy Standard Act of 2012 (S. 2146) was introduced in the Senate.

The primary goal of S. 2146 is to reduce carbon dioxide (CO_2) emissions from the U.S. electricity sector, which represents approximately 41% of total U.S. CO_2 emissions. Generally, the approach used to achieve this goal is to require certain utility companies to source a portion of their electricity generation from qualified clean energy generators. Utilities located in either Alaska or Hawaii are exempted from CES requirements.

Some utility companies that sell electricity directly to consumers (retail sales) would be required to comply with the CES. Determining which utilities have to comply is based on each utility company's total amount of annual retail sales. Starting in 2015, a utility company that sold more than 2 million megawatthours (MWh) of electricity to consumers would be required to comply. The retail sales level for compliance decreases by 100,000 MWh each year until 2025, where it remains constant at 1 million MWh. These thresholds represent a minority of electric utilities but a majority of U.S. electricity sales.

Utilities required to comply with the CES would need to obtain a percentage of their electricity from qualified clean energy generators. In 2015 the minimum percentage is 24% and rises to 84% by 2035. The percentage is applied to a utility company's total retail sales; however, all electricity obtained from hydropower and nuclear power facilities placed in service before 1992 can be deducted from the sales base, potentially making compliance easier.

The bill provides a four-part definition of electricity that would qualify as "clean energy": (1) electricity from renewable energy, biomass, natural gas, hydropower, nuclear power, or waste-to-energy facilities placed in service after 1991, (2) electricity from combined heat and power (CHP) systems or any non-biomass energy source that emits less than 0.82 metric tons of CO_2 per MWh, (3) certain efficiency or capacity additions to nuclear or hydropower facilities that were placed in service before 1992, and (4) electricity from facilities that capture and store CO_2.

Utility companies can comply with the CES requirement by submitting clean energy credits, making alternative compliance payments (ACP), or a combination thereof. The ACP design element essentially caps the cost of CES compliance. ACP levels start at three cents per kilowatthour in 2015 and increase by 5% annually thereafter.

Analysis by the Energy Information Administration (EIA) projects that enactment of S. 2146 could result in the following changes to the U.S. power sector in 2035, compared to EIA's reference case projections: (1) CO_2 emissions from electric power facilities decline 44%, (2) electricity from coal decreases by 54%, (3) nuclear power and non-hydro renewable electricity increases by 62% and 34%, respectively, and (4) average electricity prices increase by 18%. EIA also notes that regional price disparity among exempt and non-exempt utilities could range between 3% and 30%. However, it should be noted that any projections over such a long time frame are difficult to accurately predict due to uncertainties associated with assumptions used to make such estimates.

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Introduction

Policymakers have several options when considering legislation that would result in reducing carbon dioxide (CO_2) emissions from the U.S. electricity sector. Some policy options might include a carbon tax or a carbon cap-and-trade approach. A federal clean energy standard (CES), such as that proposed in the Clean Energy Standard Act of 2012 (S. 2146), is an alternative approach that requires certain utility companies to provide a prescribed amount of electricity from qualified clean energy sources based on a percentage of each utility company's annual electricity sales to consumers.[1] Several CES policies have been proposed in the past, although none have become law.[2]

According to the Energy Information Administration (EIA), the electric power sector represents approximately 41% of U.S. energy-related CO_2 emissions.[3] The remaining 59% of CO_2 emissions are from the transportation (33%) and buildings/infrastructure (26%) sectors. Unlike previous carbon reduction policy proposals, S. 2146 is focused only on CO_2 emission reductions in the U.S. electric power sector.

The concept of a U.S. clean energy standard was proposed by President Barack Obama in his 2011 State of the Union address, and the White House subsequently published a proposed framework for a federal CES.[4] In March of 2011, the Senate Energy and Natural Resources Committee (SENR) released a Clean Energy Standard white paper that solicited feedback on several CES policy design questions.[5] On March 1, 2012, the Clean Energy Standard Act of 2012 (S. 2146) was introduced in the Senate. This report provides a summary and analysis of the CES proposed in S. 2146.

S. 2146 proposes to amend Title VI of the Public Utility Regulatory Policies Act (PURPA) of 1978 (16 U.S.C. 2601 et seq.)[6] by adding a new section, Section 610, titled "Federal Clean Energy Standard."[7] According to the proposed bill, the stated purpose of the Federal Clean Energy Standard is:

> to create a market-oriented standard for electric energy generation that stimulates clean energy innovation and promotes a diverse set of low- and zero-carbon generation solutions in the United States at the lowest incremental cost to electric consumers.

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[1] Generally, there are many different opinions about what energy sources should be considered "clean energy." As a result, the definition of "clean energy" for different policy proposals typically varies.

[2] For additional background on CES policy design elements and a comparison of previously proposed CES legislation, see CRS Report R41720, *Clean Energy Standard: Design Elements, State Baseline Compliance and Policy Considerations*, by Phillip Brown.

[3] "Annual Energy Outlook 2010," U.S. Energy Information Administration, April 2010, available at http://www.eia.gov/oiaf/archive/aeo10/pdf/0383(2010).pdf.

[4] White House Office of Media Affairs, "President Obama's Plan to Win the Future by Producing More Electricity Through Clean Energy," February 3, 2011, available at http://www.whitehouse.gov/the-press-office/2011/02/03/president-obama-s-plan-win-future-making-american-businesses-more-energy.

[5] Senators Jeff Bingaman and Lisa Murkowski, White Paper on a Clean Energy Standard, Committee on Energy and Natural Resources, United States Senate, March 21, 2011, available at http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=d9286e01-b2ea-0c97-971a-6b9d16ef32ef.

[6] For background information about PURPA, see CRS Report 98-419, *Electricity Restructuring Background: The Public Utility Regulatory Policies Act of 1978 and the Energy Policy Act of 1992*, by Amy Abel.

[7] The Energy Policy Act of 2005 included several PURPA modifications. For more information see CRS Report RL33248, *Energy Policy Act of 2005, P.L. 109-58: Electricity Provisions*, by Amy Abel.

Policy Design Elements

The Clean Energy Standard Act of 2012 includes a number of design elements that define the CES structure, methods of compliance, and other aspects. This report describes the proposed policy, based on the following general questions: (1) Who is required to comply? (2) What are the compliance requirements? (3) What types of electricity generation would qualify for the CES? and (4) What mechanisms are available as a means of CES compliance? Additional design elements are also briefly discussed.

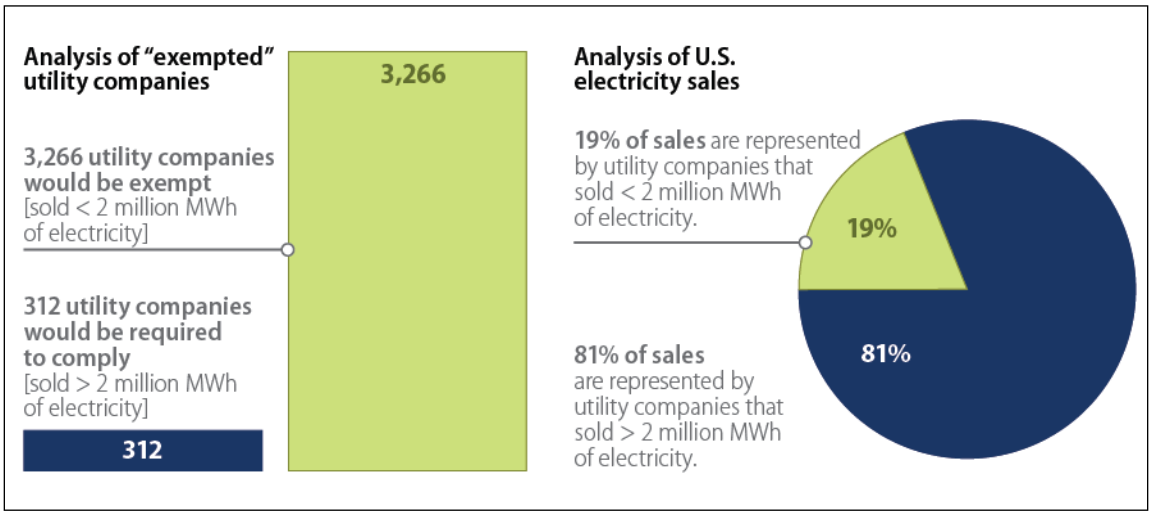
Entities Required to Comply

Some utility companies that sell electricity to consumers in U.S. states, except Alaska and Hawaii, plus the District of Columbia and Puerto Rico, would be required to obtain a certain percentage of electricity sales from qualified clean energy generators.[8] Whether or not a utility company is required to comply with the CES depends on the total amount of its annual electricity sales to consumers, in megawatthours (MWh). Beginning in 2015, S. 2146 requires utilities that sold 2 million MWh or more the previous calendar year to comply with the CES. The annual sales threshold for utility compliance declines by 100,000 MWh each year from 2015 to 2025, after which the level remains constant at 1 million MWh of annual electricity sales.

This electricity sales threshold exempts the majority of utility companies from having to comply with the CES. According to EIA data, there are more than 3,500 utility companies operating in the contiguous 48 United States. Preliminary analysis based on 2010 electric utility sales data indicates that just over 300 utility companies would be required to comply with the CES starting in 2015 (see **Figure 1**). However, these 300 utility companies required to comply with the CES would represent approximately 81% of total national electricity sales.

Figure 1. Preliminary Analysis of Potential Utility Company Exemptions

(Based on S. 2146 Clean Energy Requirements in 2015)



Source: CRS analysis of Energy Information Administration Form 861 survey data for 2010. EIA's Form 861 data can be found at http://www.eia.gov/cneaf/electricity/page/eia861.html.

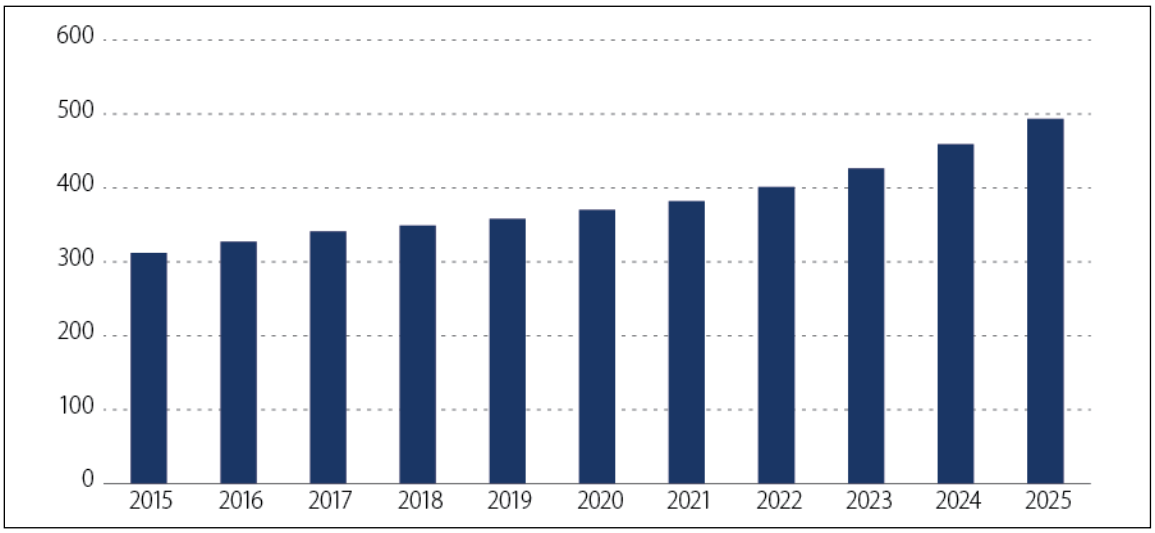
[8] According to PURPA definitions: "The term 'State' means a State, the District of Columbia, and Puerto Rico." S. 2146 specifically excludes Alaska and Hawaii from CES compliance requirements.

Notes: EIA Form 861 includes annual retail sales (in megawatt hours) for more than 3,500 utility companies in the U.S. CRS categorized each utility based on annual retail sales being either more than or less than 2 million megawatt hours per year. Electric utilities located in Alaska and Hawaii were excluded from this analysis. Many of the 3,266 exempt utility companies include electric cooperatives and municipal utilities. Utility companies included in EIA's Form 861 survey data may include wholly owned subsidiaries of a parent company that may have retail sales less than 2 million megawatt hours. The parent company of these subsidiaries may have aggregate retail sales of more than 2 million megawatt hours. However, an assessment of parent and subsidiary companies is beyond the scope of this report. EIA performed a regional analysis of exempt retailer sales as a percentage of total sales in each region. Results from EIA's analysis are provided in Appendix B of "Analysis of the Clean Energy Standard Act of 2012," U.S. Energy Information Administration, May 2012, available at http://www.eia.gov/analysis/requests/bces12/pdf/cesbing.pdf.

As the threshold sales level decreases from year 2015 to 2025, the number of utility companies required to comply gradually increases to nearly 500 in 2025 (see **Figure 2**), at which time approximately 87% of national electricity sales would be subject to CES requirements.

Figure 2. Estimated Number of Utilities Required to Comply with S. 2146

(2015–2025)



Source: CRS analysis of S. 2146 and Energy Information Administration Form 861 survey data for 2010.

Notes: The estimated number of utilities required to comply increases over time as the retail sales threshold for compliance decreases from 2 million MWh per year in 2015 to 1 million MWh per year in 2025. Also, see **Figure 1** notes above.

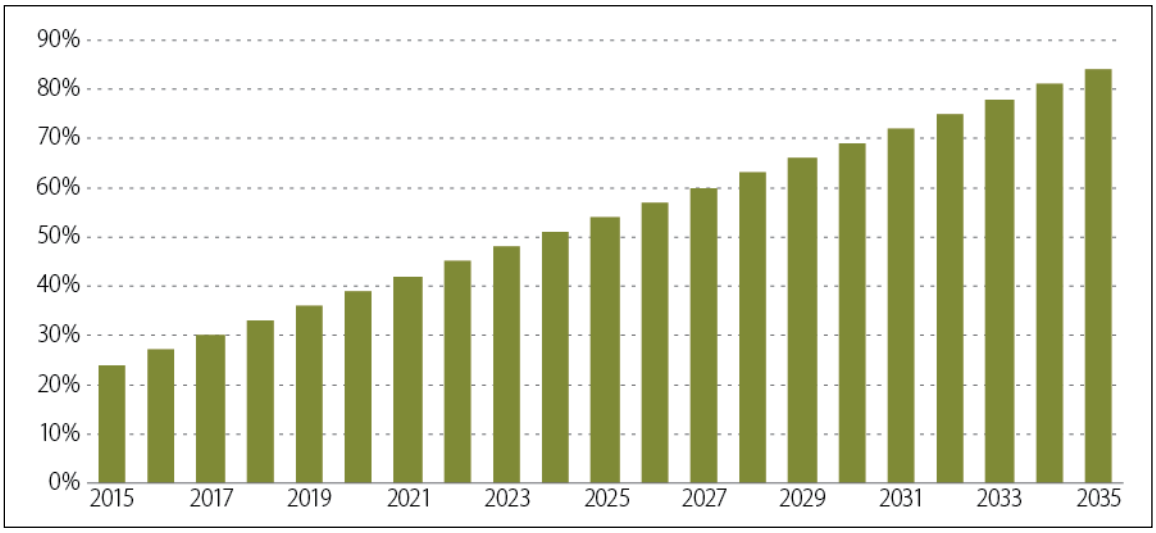
Clean Energy Compliance Requirements

Starting in 2015, S. 2146 would require non-exempt utilities, as described above, to obtain a percentage of their total electricity sales to consumers—less applicable deductions of certain hydropower and nuclear power electricity—from qualified clean energy generators. (Definitions for qualified clean energy are discussed and provided in the next section.) Clean energy includes electricity generated from facilities using renewables, nuclear, natural gas, and other specific energy sources, that were placed in service after 1991, plus other technologies described in the next section of this report.

The standard requires a minimum of 24% clean energy by 2015. The percentage requirement increases an additional 3% each year until 2035, when 84% of electricity sold from non-exempt utilities must be sourced from clean energy generators (see **Figure 3**). Non-exempt utility companies can deduct their hydropower and nuclear power electricity generation, as long as the electricity is generated from facilities placed in service before 1992, from their applicable sales base. This deduction could potentially make it easier for certain utilities (especially those with large amounts of hydropower and nuclear power in their portfolio) to comply with the standard as a result of decreasing the total amount of qualified clean energy needed to meet annual CES compliance requirements (see example in **Table 1**).

Figure 3. Clean Energy Standard Compliance Requirements

(Percentage of annual electricity sales to consumers)



Source: S. 2146.

Table 1 provides an illustrative example of how the pre-1992 nuclear and hyropower deduction might affect the amount of qualified clean energy needed by three hypothetical utility companies in order to comply with the CES. In this example, three hypothetical utility companies with different generation fuel mixes, but the same amount of total electricity sales (2 million MWh annually), are compared. As **Table 1** indicates, CES compliance requirements for different utilities can vary depending on the fuel sources used for generation. While the total retail sales for each utility might be the same, adjusting the applicable sales base by deducting nuclear and hydro electricity from facilities placed in service before 1992 results in varying amounts of qualified clean energy needed for compliance.

Table 1. Hypothetical Example of How Nuclear and Hydro Deductions Might Impact CES Requirements

(All numbers in annual megawatthours)

	A Non-qualified Fossil	B Pre-1992 Nuclear & Hydro	C Post-1991 Renewables	D Total Elect. Sales Base A + B + C	E Adjusted Sales Base D - B	F 2015 CES Requirement E x 24%
Utility 1	1,000,000	500,000	500,000	2,000,000	1,500,000	360,000

	A Non-qualified Fossil	B Pre-1992 Nuclear & Hydro	C Post-1991 Renewables	D Total Elect. Sales Base A + B + C	E Adjusted Sales Base D - B	F 2015 CES Requirement E x 24%
Utility 2	500,000	1,000,000	500,000	2,000,000	1,000,000	240,000
Utility 3	1,500,000	300,000	200,000	2,000,000	1,700,000	408,000

Source: CRS.

Qualified Electricity Generation

In order to comply with proposed CES requirements, electric utilities that sell electricity to consumers would need to generate or purchase electricity that is qualified as "clean energy."[9] S. 2146 provides a four-part definition of the term "clean energy."

1. Electricity generation from facilities placed in service after 1991 that use the following energy sources: renewable energy,[10] renewable biomass,[11] natural gas,[12] hydropower, nuclear power, or waste-to-energy.[13]
2. Electricity generation from facilities placed in service after the date of enactment that use either combined heat and power or non-biomass energy sources that emit less than 0.82 metric tons of CO_2 per MWh.[14] Additional information about qualified CHP is discussed below in the section titled "Combined Heat and Power."
3. Electricity generation that results from efficiency or capacity additions made after 1991 to nuclear or hydropower facilities that were originally placed in service before 1992.
4. Electricity generation from facilities that capture and store CO_2 regardless of each facility's placed-in-service date.

[9] For additional discussion about qualified clean energy, see CRS Report R41797, *Clean Energy Standard: Potential Qualifying Energy Sources*, coordinated by Kelsi Bracmort.

[10] S. 2146 defines renewable energy to include the following energy sources: (1) solar, (2) wind, (3) ocean, (4) current, (5) wave, (6) tidal, and (7) geothermal.

[11] S. 2146 defines qualified renewable biomass as follows: "The term qualified renewable biomass means renewable biomass produced and harvested through land management practices that maintain or restore the composition, structure, and processes of ecosystems, including the diversity of plant and animal communities, water quality, and the productive capacity of soil and the ecological systems."

[12] While natural gas facilities are included as qualified generators, electricity derived from natural gas would receive partial CES credits based on the carbon dioxide intensity of each natural gas generator.

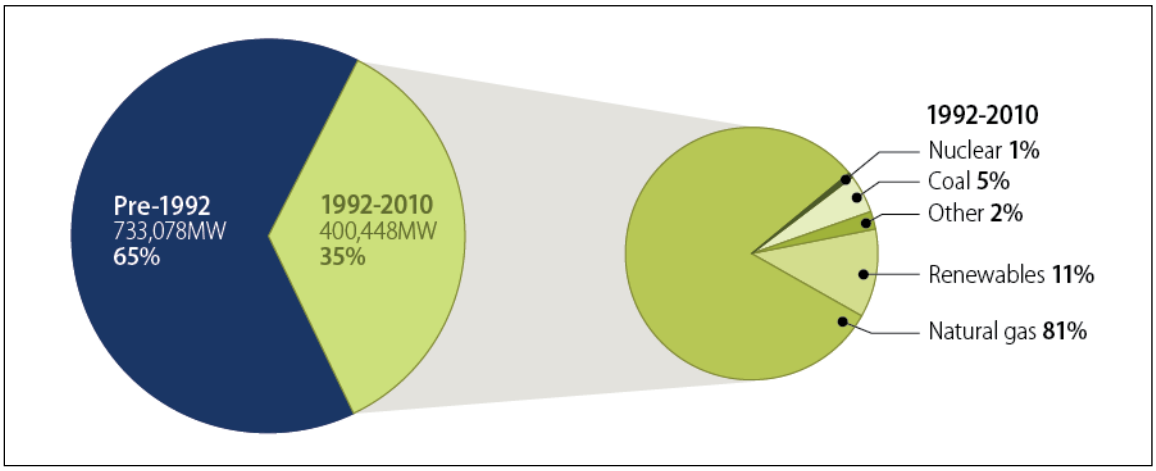
[13] S. 2146 defines qualified waste-to-energy as follows: "The term qualified waste-to-energy means energy produced from the combustion of—(i) post-recycled municipal solid waste; (ii) gas produced from the gasification or pyrolization of post-recycled municipal solid waste; (iii) biogas; (iv) landfill methane; (v) animal waste or animal byproducts; or (vi) wood, paper products that are not commonly recyclable, and vegetation (including trees and trimmings, yard waste, pallets, railroad ties, crates, and solid-wood manufacturing and construction debris), if diverted from or separated from other waste out of a municipal waste stream." S. 2146 also requires that waste-to-energy facilities have annual certifications and be in compliance with all applicable federal and state environmental permits.

[14] Carbon dioxide emissions of 0.82 metric tons per MWh-net are typically equivalent to CO_2 emissions from a Supercritical Pulverized Coal (PC) electricity generating facility. Additional discussion about MWh-net versus MWh-gross can be found in this report under the section titled "Potential Areas for Further Clarification."

Regarding item 1 above, according to EIA, approximately 1.1 million megawatts (MW) of electricity generation capacity exists in the lower 48 United States.[15] Roughly 400,000 MW of electric power capacity was installed during the years 1992 to 2010. Approximately 93% (nuclear, natural gas, and renewables) of this electric power capacity would qualify under the "clean energy" definition (see **Figure 4**).[16] Most of this qualified "clean energy" capacity is natural gas facilities—although natural gas generation is only eligible for partial CES credits based on the amount of CO_2 emissions per MWh of electricity produced. This qualified clean energy generating capacity is distributed throughout the United States. **Figure 5** shows the amount of qualified clean energy capacity located in each state.

Figure 4. Analysis of Placed-in-Service Dates for U.S. Electric Power Capacity

(Total Contiguous U.S. Electric Power Capacity = 1.13 million MW)



Source: CRS analysis, Energy Information Administration, Form EIA-860 Data Files for 2010, available at http://www.eia.gov/cneaf/electricity/page/eia860.html.

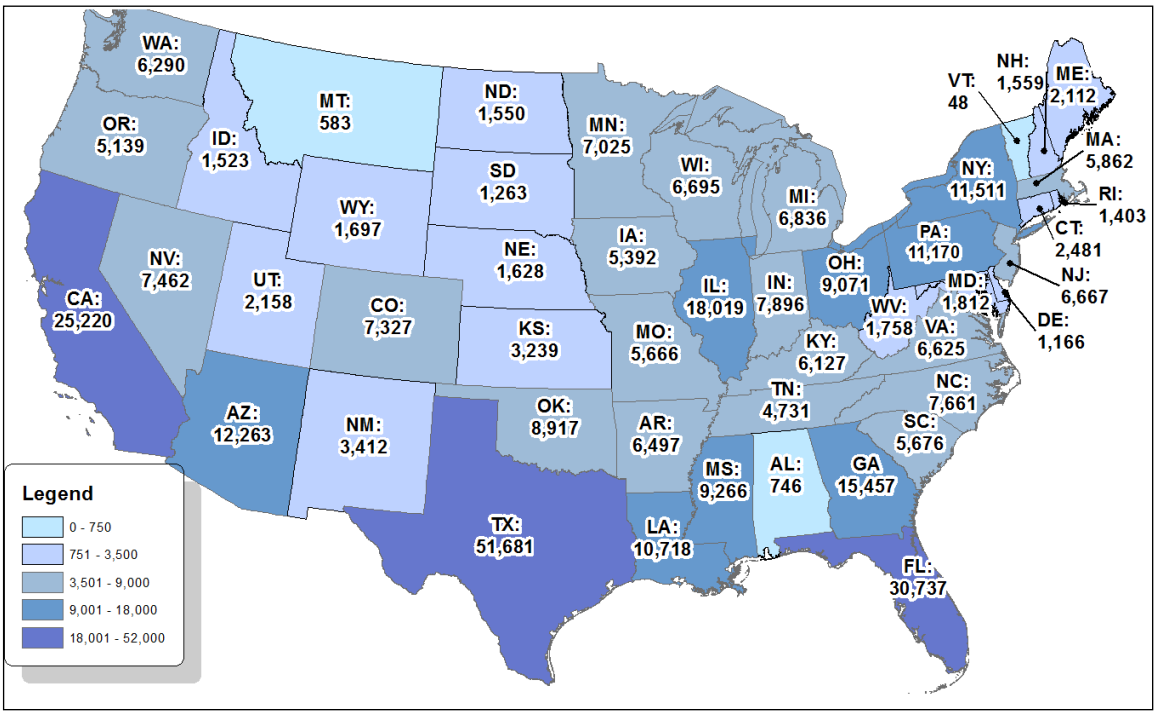
Notes: It is important to realize that electric power capacity (MW), represented in this figure, is different than electricity generation (MWh). S. 2146 places a clean energy requirement on annual electricity generation (MWh). Data contained in this figure only represents the potential for electricity generation from qualified clean energy generators, per S. 2146, and may not be representative of actual electricity that may be produced.

[15] Energy Information Administration, Form EIA-860 Data Files for 2010, available at http://www.eia.gov/cneaf/electricity/page/eia860.html.

[16] Ibid.

Figure 5. Distribution of Existing Qualified Clean Energy Generating Capacity

(Megawatts)



Source: CRS analysis of Energy Information Administration Form EIA-860 Data Files for 2010, available at http://www.eia.gov/cneaf/electricity/page/eia860.html.

Notes: See notes in **Figure 4** above.

Clean Energy Standard Compliance

Utility companies required to comply with the CES have two compliance options: (1) submit clean energy credits to the Secretary of Energy, and/or (2) make alternative compliance payments to the Secretary of Energy.

Clean Energy Credits

Clean Energy Credits would be issued by the Secretary of Energy to qualified electricity generation facilities owned by an electric utility.[17] Generally, clean energy credits are issued based on the CO_2 emission intensity, as determined by the Secretary of Energy, of qualified electricity generation compared to the CO_2 emission intensity of a pulverized coal plant—which is estimated to be approximately 0.82 metric tons of CO_2 per MWh. Whether or not this CO_2 intensity metric is on a gross or net basis is not specified in the bill. Additional discussion about gross vs. net emission intensity is discussed in the section below titled "Potential Areas for Further Clarification."

[17] PURPA defines the term "electric utility" to mean "any person, State agency, or Federal agency, which sells electric energy." This definition could include both wholesale and retail electricity sales. As a result, electricity generated by both vertically integrated utility companies and independent power producers (IPPs) could be eligible to receive CES credits based on the qualification criteria described in the proposed bill.

The formula used to calculate the per-MWh CES credit amount for qualified electricity generators is as follows:

$$\text{CES Credit}_{\text{MWh}} = 1 - [(\text{Metric Tons of } CO_2 \text{ per MWh}_{\text{qualified generator}})/0.82]$$

For example, a qualified clean energy generator that uses a renewable energy source with a CO_2 emission intensity of 0 would receive 1 CES credit per MWh of electricity generation. However, a qualified generator that uses a fossil energy source with a CO_2 emission intensity of 0.41 would receive a partial, in this case 0.5, credit for each MWh of electricity generated.

Once CES credits are issued, they can be (1) used to comply with annual CES requirements, (2) sold to other entities, or (3) held in reserve (also known as 'banking') and used for compliance in future years (i.e., CES credits do not expire). For qualified clean energy sold under contract—in effect on the date of enactment of the proposed bill—into the wholesale market, CES credits for the electricity generated would be issued to the purchaser of the electricity; unless the contractual terms for wholesale electricity transactions include other conditions regarding title to CES credits.

The Secretary of Energy is required to establish a Federal Clean Energy Trading Program to facilitate, document, and track CES compliance. The Secretary of Energy also has the option of delegating the market function of CES credit trading to qualified entities.

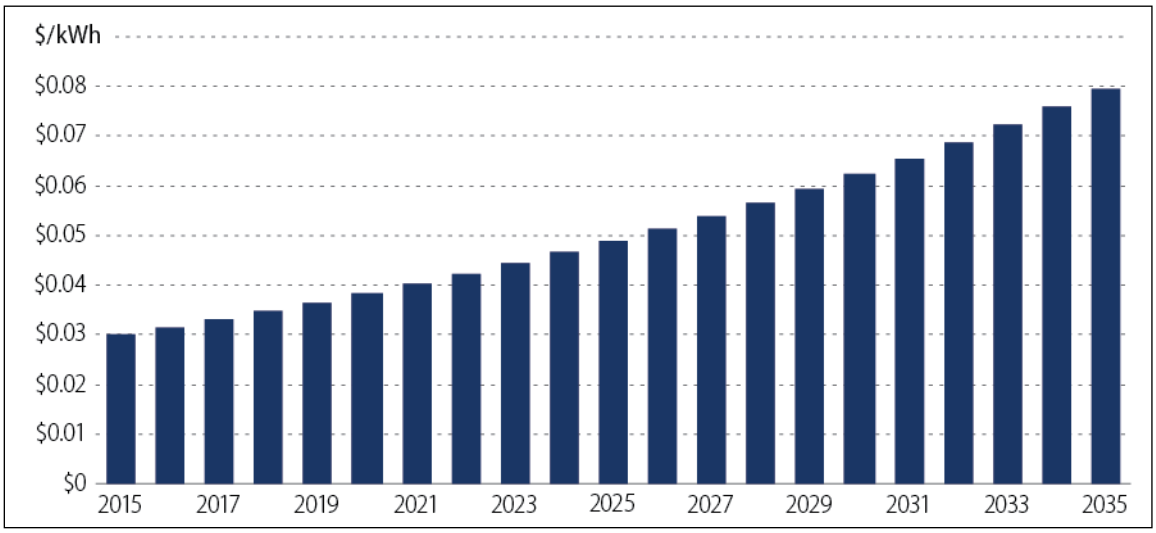
Alternative Compliance Payments

Another CES compliance option for non-exempt utilities is making alternative compliance payments (ACP) instead of generating or purchasing CES credits. The ACP design element essentially places a cap on the cost of CES compliance. S. 2146 sets the initial ACP level at three cents ($0.03) per kilowatthour in 2015. The ACP increases 5% per year—adjusted for inflation (see **Figure 6**). All ACP collections, and any civil penalty payments (discussed further below), would be used for a State Energy Efficiency Funding Program, which would distribute 75% of all collections to states for energy efficiency initiatives.[18] Distribution amounts to each state are proportional to the percentage of collections received from each respective state.

[18] Generally, the reason that only 75% of the value of ACPs is returned to the states is to make this provision revenue neutral from a federal budget perspective. ACPs can be deducted as an expense by a company that makes such payments. As a result, a company's taxable income would be reduced, thereby reducing the amount of federal tax collections. By retaining 25% of collections from a federal program that collects payments, such as the CES, the federal government is essentially offsetting any revenue losses that might occur as a result of companies deducting ACP payments as an expense. For more information about the 25% revenue offset, see "The Role of the 25 Percent Revenue Offset in Estimating the Budgetary Effects of Legislation," Congressional Budget Office, January 13, 2009, available at http://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/96xx/doc9618/01-13-25percentoffset.pdf. Historically, 25% has been the general revenue offset percentage used. However, the Joint Committee on Taxation (JCT) released its changes to revenue offsets used to assess budget impacts of various programs, with the offset percentage rising to approximately 30% in 2022. For more information, see Joint Committee on Taxation, *New Income and Payroll Tax Offsets to Changes in Excise Tax Revenues for 2012-2022* (JCX-23-12), March 6, 2012.

Figure 6. Alternative Compliance Payment Levels: 2015-2035

(2015 Dollars)



Source: CRS analysis of S. 2146.

Notes: S. 2146 stipulates that alternative compliance payments in 2015 will be $0.03 per kilowatthour. Each year thereafter ACPs increase by 5% over the previous year, and this increase is to be adjusted for inflation. This figure does not assume any inflation adjustments. Therefore, actual ACP levels for each year could vary depending on the magnitude of annual inflation. According to the proposed bill, ACPs will continue escalating by 5% each year after 2035.

Other Design Elements

In addition to the major policy design parameters in the bill, S. 2146 includes several other design elements. Some of these additional design elements are briefly discussed below.

Combined Heat and Power

Combined Heat and Power (CHP) systems may qualify for meeting CES compliance requirements. Unlike other qualified generators that only produce electricity for consumption, CHP systems produce both electricity and heat for beneficial use. Owners of CHP systems, typically industrial operations, generally consume a certain portion of the CHP energy (electricity and heat) for on-site facility and business operations. S. 2146 requires CHP systems to have an overall energy efficiency of more than 50%, produce at least 20% of useful energy in the form of electricity, and produce at least 20% of useful energy in the form of thermal energy.

The number of CES credits issued to CHP system owners is based on the amount of electricity generated by the CHP system, the relative CO_2 intensity of the electricity produced, the amount of electricity used for on-site operations, and the annual CES compliance requirement. Gross CES credits for CHP systems are calculated using the same CES credit formula discussed above; however, a certain portion of on-site electricity consumption—determined by the annual CES requirement—is deducted from the gross CES credit calculation. Additional CES credits may be issued to CHP system owners based on avoided greenhouse gas emissions that would result from eliminating the need for a dedicated on-site heat source.

Biomass

S. 2146 provides a specific definition for renewable biomass, which includes potential impacts associated with land use and management practices.[19] The bill requires the Secretary of Energy to issue interim carbon intensity regulations for biomass and to commission a study by the National Academy of Sciences (NAS) to assess total lifecycle emissions from biomass-derived electricity. Based on the results of the NAS study, the Secretary of Energy is required to issue final carbon intensity regulations for qualified renewable biomass. A similar effort to quantify lifecycle emissions, including those from land use and management practices, for growing biofuel feedstock was led by the Environmental Protection Agency (EPA) in response to requirements in the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140).[20] Much debate and controversy in the biofuel community resulted from the life cycle analysis, with some groups arguing that emissions were understated and some groups taking the position that emissions were overstated.[21]

Civil Penalties

Non-exempt utilities that do not meet annual CES requirements would be required to pay civil penalties equal to twice the value of adjusted alternative compliance payments (discussed above) for the deficit amount of electricity needed to comply with annual requirements.

Interaction with State Programs

As of April 2012, 29 states plus the District of Columbia and Puerto Rico had established binding renewable portfolio standard (RPS) policies.[22] Generally, RPSs are policies designed to encourage development of renewable electricity projects by requiring a certain percentage of electricity be generated from renewable sources. Each state RPS usually has some degree of unique design with regards to the amount of renewable electricity required, dates for compliance, carve-outs for certain technologies, and other aspects. The impact of a federal CES on state-level RPS policies could be a concern to some policy makers. S. 2146 states that the CES does not affect the authority of states to enforce renewable energy laws or regulations. The bill also indicates that no state laws or regulations can relieve a utility company from its federal CES compliance obligations.

Other Energy Sources

Integrating energy efficiency and thermal energy sources into a federal CES is a topic of interest to many groups. Technologies that reduce the total amount of electrical load through either efficiency or heat sources could contribute toward CO_2 emission reductions in the electric power sector. However, calculating the amount and qualification of CES credits for such technologies

[19] S. 2146 defines Qualified Renewable Biomass as follows: "The term 'qualified renewable biomass' means renewable biomass produced and harvested through land management practices that maintain or restore the composition, structure, and processes of ecosystems, including the diversity of plant and animal communities, water quality, and the productive capacity of soil and the ecological systems."

[20] For additional information, see "EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels," U.S. Environmental Protection Agency, May 2009, available at http://www.epa.gov/oms/renewablefuels/420f09024.htm.

[21] For more information about biofuel lifecycle greenhouse gas emissions, see CRS Report R40460, *Calculation of Lifecycle Greenhouse Gas Emissions for the Renewable Fuel Standard (RFS)*, by Brent D. Yacobucci and Kelsi Bracmort.

[22] http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf.

can be challenging. S. 2146 requires a report that evaluates these technologies and provides legislative recommendations about how they might be integrated into the CES policy framework.

Natural Gas

The bill also requires a report on natural gas conservation, with the goal of quantifying natural gas losses during production and transportation and recommending programs and policies to promote natural gas conservation.

EIA Analysis of S. 2146

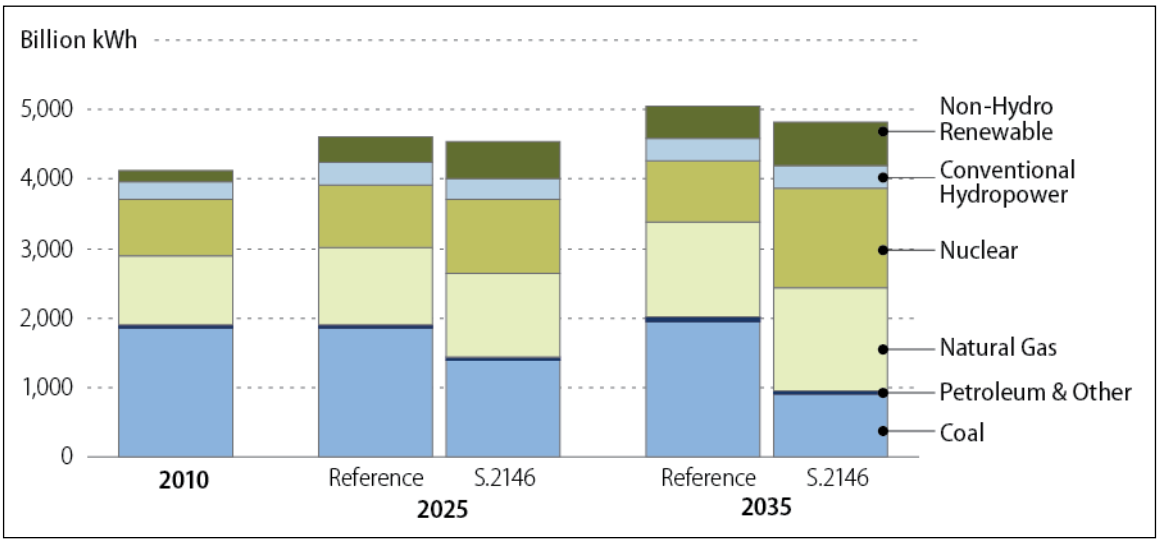
At the request of the Senate Committee on Energy and Natural Resources, EIA analyzed the potential impact of the Clean Energy Standard Act of 2012 on the U.S. electricity sector.[23] Results from EIA's analysis indicate that the projected electricity generation fuel mix would change when compared to EIA's Annual Energy Outlook reference case projections (see **Figure 7**). Changes to the electric power fuel mix are projected to reduce electric sector CO_2 emissions in 2035 by 44% when compared to EIA's reference case scenario.[24] As with any long-term forecast, models used to calculate such estimates are subject to certain economic, cost, technology, market, and other assumptions that can make the accuracy and reliability of long-range projections questionable. EIA's analysis compares two scenarios (Reference and S. 2146) with identical macro-level assumptions and adds policy parameters defined in the CES to the S. 2146 scenario. While this approach may not be able to accurately predict what will actually happen in 2035, it does provide some indication of potential changes to the electric power sector associated with the CES policy design. However, it is possible that changes to certain underlying assumptions could yield different results than those provided in the analysis of S. 2146.

[23] "Analysis of the Clean Energy Standard Act of 2012," U.S. Energy Information Administration, May 2012, available at http://www.eia.gov/analysis/requests/bces12/pdf/cesbing.pdf.

[24] Ibid.

Figure 7. Projected Impact to Electricity Generation Fuel Mix

(Each bar represents 100% of U.S. electricity generation for each scenario)

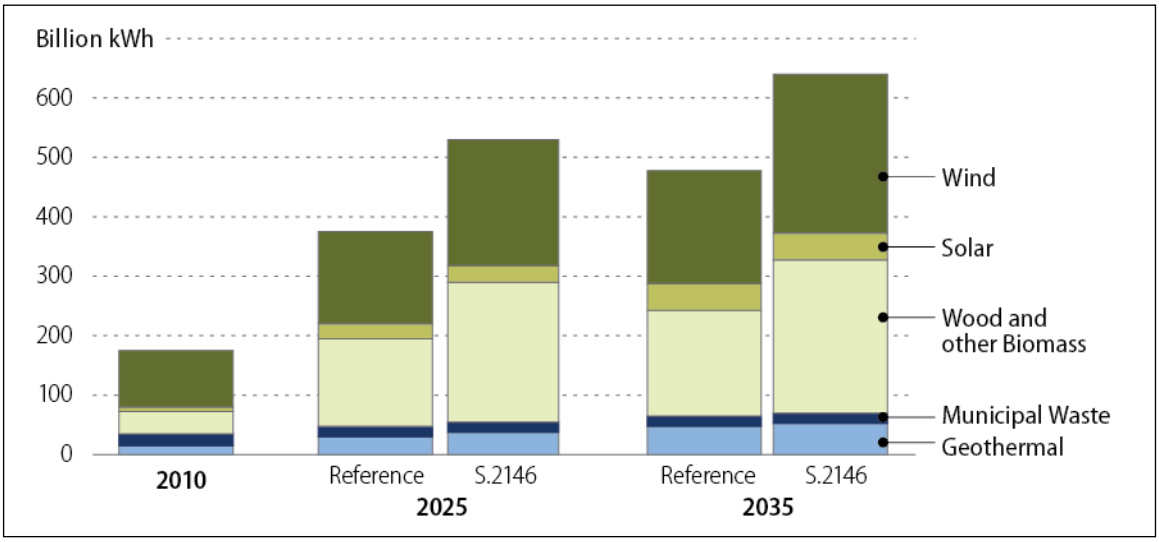


Source: "Analysis of the Clean Energy Standard Act of 2012," U.S. Energy Information Administration, May 2012, available at http://www.eia.gov/analysis/requests/bces12/pdf/cesbing.pdf.

Coal, nuclear, and non-hydro renewable energy sources would experience the most significant changes. In 2035, electricity generated from coal would decrease by 54%, nuclear power would increase by 62%, and non-hydro renewables would increase by 34% relative to reference case projections. Growth in non-hydro renewable sources of electricity is dominated by wind and wood/biomass; however, solar electricity is essentially the same as in EIA's reference case projections (see **Figure 8**).

Figure 8. EIA Projections for Non-Hydro Renewables

(Each bar represents 100% of non-hydro renewable electricity generation for each scenario)



Source: "Analysis of the Clean Energy Standard Act of 2012," U.S. Energy Information Administration, May 2012, available at http://www.eia.gov/analysis/requests/bces12/pdf/cesbing.pdf.

Natural gas generation is also expected to experience a relatively modest increase of 8% over 2035 reference case projections including natural gas-fired CHP generation, which would increase by 21% in 2035. EIA's analysis also indicates that S. 2146 results in essentially no carbon capture and sequestration (CCS) projects as a means of CES compliance.

With regard to the potential impact on electricity prices, EIA projects that average U.S. electricity prices would increase, compared to EIA reference case projections, by approximately 4% in 2025 and 18% in 2035. EIA also notes that the provision in S. 2146 to exempt certain utility companies from CES compliance requirements could create some degree of regional price disparity between exempt and non-exempt utilities. Using one estimation approach, EIA indicates that by 2030 electricity prices from non-exempt utilities could be 3% to 30% higher than exempt utilities. Finally, EIA's analysis estimates that the use of alternative compliance payments as a means of CES compliance is minimal throughout the projection period.

Potential Areas for Further Clarification

S. 2146 includes a number of policy design elements that are integrated to create a structure for the Clean Energy Standard policy. The proposed CES raises some areas that Congress may decide to further clarify during future deliberations about the proposed bill.

Is the carbon intensity metric (0.82 metric tons per MWh) on a gross or net basis?

S. 2146 specifies a carbon intensity metric of 0.82 metric tons per MWh as the basis for calculating partial CES credits for fossil energy generators. However, the bill does not specify if this metric is on a gross or net basis. **Table 2** compares the CO_2 emission intensity of subcritical and supercritical pulverized coal plants under certain operating conditions. Whether or not carbon intensity is on a gross or net basis could determine if certain plants qualify for partial CES credits and this determination could also affect the magnitude of partial credits issued to qualified natural gas generators.

Table 2. Comparison of Carbon Dioxide Emission Intensity

(Subcritical and Supercritical Pulverized Coal)

	Subcritical Pulverized Coal	Supercritical Pulverized Coal
CO_2 Emissions (lb/MWh$_{gross}$)	1,783	1,675
CO_2 Emissions (lb/MWh$_{net}$)	1,888	1,768
CO_2 Emission intensity (gross)	0.81	0.76
CO_2 Emission intensity (net)	0.86	0.80

Source: "Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity," National Energy Technology Laboratory, November 2010.

Notes: Gross emissions represent the total amount of CO_2 emissions divided by the total amount of electricity generated. Net emissions represent the total amount of CO_2 emissions divided by the net amount of electricity available for sale after deducting electricity required for plant operations. Emission intensity numbers are calculated by dividing CO_2 emissions (lbs per MWh) by 2,200 (lbs per metric ton). CO_2 emission estimates from this study are based on bituminous coal. However, CO_2 emissions per MWh of electricity generated can vary based on coal type (bituminous, sub-bituminous, lignite, etc.), plant location, and local environmental conditions.

How do utilities that operate in multiple states calculate their aggregate retail sales for determining if they are required to comply with the CES?

The clean energy requirement in S. 2146 indicates that non-exempt electric utilities that sell electricity to consumers "in a State," are required to comply with annual CES requirements. S. 2146 also indicates that the calculation of total electricity sold by a utility, for determining whether or not a utility is exempt from the CES requirement, should include electricity sold by all affiliates and associated companies. Utility companies that operate in multiple states may question whether they should aggregate company, affiliate, and associated company sales within each state or aggregate electricity sales from electric power operations in all states when calculating their total sales to determine if they are required to comply with the CES.

Policy Question: How to Define Clean Energy?

Should Congress choose to continue evaluating the possible implementation of a Clean Energy Standard for the U.S. electric power sector, future debate about the proposed policy may include various topics associated with defining "clean energy." S. 2146 defines clean energy based on carbon dioxide emissions at the point when electricity is generated. However, S. 2146 generally does not take into account potential emissions, waste, or other environmental impacts that might occur throughout the entire lifecycle of electricity generation from various energy sources. Some may argue that the entire lifecycle (energy extraction, transportation, land use, etc.) should be considered when defining clean energy, while others may argue that a CES focused on reducing electric power CO_2 emissions is a sound approach to reducing greenhouse gas emissions.

Every energy source for electricity generation has benefits and drawbacks. Nuclear power can provide carbon-free, reliable, and baseload electricity, yet there are concerns with disposal of spent fuel and weapons proliferation. Natural gas generation emits roughly half the amount of CO_2, compared to coal, per MWh of electricity generated; however, there are environmental concerns with natural gas extraction. Hydropower could be considered a carbon-free and renewable source of electricity, but there are fish, wildlife, and water quality concerns associated with hydropower development. Non-hydro renewable electricity, with possibly the exception of biomass, is generally considered to be the cleanest source of power generation; however, there are concerns with endangered species, animal habitat, land use, and other issues associated with renewable electricity development.[25]

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[25] For more information about renewable electricity resources and challenges, see CRS Report R41954, *U.S. Renewable Electricity Generation: Resources and Challenges*, by Phillip Brown and Gene Whitney.

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