COMPLIANCE WITH EPA'S CLEAN POWER PLAN USING SOLELY RENEWABLE POWER GENERATION IN THE WESTERN UNITED STATES

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This paper concerns Environmental Protection Agency ("EPA") regulation of greenhouse gas ("GHG") emissions from fossil fuel-fired power plants under the Clean Power Plan. I will argue that compliance with the EPA's Clean Power Plan requirements can be achieved by replacing GHG-intensive power generation exclusively with zero-emission generation in the western United States, a region rich in renewable resources. In order to fully appreciate this compliance approach, it is important to have an understanding of applicable background material. First, I will describe several physical aspects of climate change that obligate regulation of power plant GHG emissions. Second, I will examine several federal court cases, along with EPA regulations that either evolved from such cases or were contested in these cases. Finally, I will present various options that EPA could employ in regulating power plant GHG emissions, the most efficient of which is regulating GHG emissions from new and existing power plants under sections 111(b) and (d) respectively, of the Clean Air Act.

The focus of this paper is GHG emissions from existing power plants. In order to comply with EPA's rule for existing plants, also known as the Clean Power Plan, an approach that replaces GHG-intensive power generation exclusively with generation from renewable resources can be derived using spreadsheet modeling. I will quantitatively illustrate this approach by examining several western states that have rich endowments of wind, solar and/or geothermal resources. While such an approach relies on generally achievable clean power output projections, there are some instances where the target for clean power production exceeds what has

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been deployed historically. Because of this reality, I will examine public policy both in terms of financial support and environmental regulation. I then note changes for both policy areas that would facilitate deployment of renewable power generation. Assuming such policy changes are implemented, I conclude it is feasible to comply with EPA's Clean Power Plan using solely renewable resources that are abundant in the western United States.

I. INTRODUCTION

Climate change was deemed "the most pressing environmental challenge of our time" by petitioners in the landmark *Massachusetts v. Environmental Protection Agency* Supreme Court case.[1] Eight years later, during talks in Paris, France in late 2015, nearly every sovereign nation ratified the Paris Agreement, which bound each signatory to submit individualized climate change mitigation pledges called Intended Nationally Determined Contributions ("INDCs").[2] The United States and China, two of the most significant contributors to greenhouse gas emissions, have already submitted theirs.[3] Domestically, however, climate change remains a politicized debate. Since the early 2000s, both houses of Congress have introduced legislation addressing climate change, but nothing has been signed into law. Even if this legislation were

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1 Massachusetts v. E.P.A., 549 U.S. 497, 497 (2007).

2 Joseph E. Aldy & William A. Pizer, *The Road to Paris and Beyond: Comparing Emissions Mitigation Efforts*, 189 RESOURCES 18 (2015); *see also* Joseph E. Aldy, *William A. Pizer, & Keigo Akimoto, Comparing Emissions Mitigation Efforts across Countries*, RESOURCES FOR THE FUTURE 1, 13 (2015). Most countries submitted INDCs prior to the Paris negotiations.

3 *Id.* at 22.

passed, none of the proposals are comprehensive enough to adequately address the issue. Thus, the burden of addressing climate change has fallen on the executive branch, and particularly the EPA.[4]

Unfortunately, EPA actions to date have failed to reduce emissions levels to those that would either stabilize or decrease atmospheric GHG concentrations.[5] Action is required to reduce GHG emissions in order to limit global warming to 2° Celsius or less, which would be associated with stabilization of atmospheric carbon dioxide (CO_2) concentration at 450 parts per million.[6] Temperature increases of greater than 2° Celsius will too severely strain human society and natural ecosystems.[7] Even with a 2° Celsius increase in temperature, the Earth will experience stronger and more frequent extreme weather events, decreased water availability, reduced food production, and damaged ecosystems. In response to this need for action, EPA finalized rules in 2015 that will, for the first time, regulate GHG emissions from a specific and significant category of stationary sources—power plants.

This article advances the thesis that the western United States, given its varied and rich renewable energy resources, can comply with final EPA rules for power plants exclusively through increased deployment of renewable power generation. In Section II, I will examine several aspects of climate change that drive the need for EPA regulation of GHG emissions from power plants. In Section III, I will cover seminal cases that either examined EPA rules or generated EPA rulemakings. In Section IV, I will explore options available to EPA for regulating GHG emissions from power plants. Section V will include summaries of the final rules for regulating GHG emissions from new and existing power plants. It also describes proposed rules developed by certain non-governmental entities, notable because they also featured compliance plans and modeling of effects of compliance on GHG emissions and other variables. Section VI presents compliance plans for EPA's final rule for existing power plants, the Clean Power Plan, for several western states—plans that rely exclusively on renewable power generation for compliance and derived using quantitative spreadsheet modeling. Colorado, Nevada, and Wyoming, three representative states variously well-endowed with wind, solar, and/or geothermal resources, are used to illustrate how compliance

[4] *See* Gary C. Bryner, *Carbon Markets: Reducing Greenhouse Gas Emissions Through Emissions Trading*, 17 TUL. ENVTL. L.J. 267, 270–75 (2004); Lauren E. Schmidt & Geoffrey M. Williamson, *Recent Developments in Climate Change Law*, 37 COLO. LAW. 63, 66–67 (2008).

[5] Kassie Siegel et al., *Strong Law, Timid Implementation. How the EPA Can Apply the Full Force of the Clean Air Act to Address the Climate Crisis*, 30 UCLA J. ENVTL. L. & POL'Y 185, 187 (2012).

[6] *Id.* at 220.

[7] *Id.*

could be achieved using only renewable energy generation. The compliance approach advanced in this article, quantitative in nature and relying on a single compliance measure, is novel. Finally, Section VII presents potential modifications to current policies in order to improve deployment of renewable power generation. These modifications will ensure that compliance with EPA regulation of GHG emissions from existing power plants can be achieved using renewable generation as a sole compliance measure.

II. CLIMATE CHANGE

This section briefly describes the physical aspects of climate change using selected variables. The physical dimension of climate change drives the need for GHG emission-related EPA rules, which in turn require compliance measures that are the focus of this paper. Working Group I detailed the physical aspects of climate change in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change ("IPCC"). That portion of the assessment report presented the relationship between changes in atmospheric constituents and the detection/attribution of climate change.[8] Two approaches to expressing degrees of certainty are used: confidence in validity of a finding[9] and probabilistic uncertainty.[10]

Physical aspects of climate change are organized into five principal sections in the IPCC assessment report: changes in the climate system, drivers of climate change, understanding the climate system, projections of global and regional climate change, and uncertainties.[11] I will emphasize selected variables for three of these physical aspects because of their relevance to GHG emission regulation: changes in the climate system,[12] drivers of climate change,[13] and projections of global and regional climate change.[14]

Regarding changes in the climate system, short-term (i.e., mid-nineteenth century to present) climate system observations are derived from direct measurement and remote sensing instrumentation, whereas

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8 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 33, 53–79 (2013) [hereinafter IPCC REPORT].

9 Confidence is defined as an aggregate of type, amount, quality, and consistency of evidence, as well as agreement concerning that evidence. Confidence is expressed qualitatively, with ratings of very high, high, medium, low, or very low.

10 Probabilistic uncertainty is quantitative, based on statistical analysis of observations or model results.

11 IPCC REPORT, *supra* note 8, at 34.

12 *Id.* at 37.

13 *Id.* at 53.

14 *Id.* at 79.

longer-term observations are obtained from paleoclimate archives.[15] Global mean surface temperature has increased since the late nineteenth century,[16] and the upper ocean (i.e., 0–700 meters in depth) has warmed since 1971.[17] Both of these changes are *virtually certain*.[18] Regarding changes in water cycle and cryosphere variables, Arctic sea ice extent has decreased over years 1979–2012; there is *very high confidence* in this trend.[19] In addition, it is *very likely* that glaciers worldwide have decreased in mass over years 1971–2009.[20] Changes in sea level are due to two factors—expansion of ocean water as it warms and transfer of land-based glacier and ice sheet water to the ocean.[21] It is *very likely* that global mean sea level has risen between years 1901 and 2010.[22]

Regarding drivers of climate change, radiative forcing is a variable describing net change in the Earth system's energy balance. Radiative forcing of all GHGs was nearly three Watts per square meter in 2011.[23] This is a finding for which there is *very high confidence*.[24] CO_2, methane (CH_4), and nitrous oxide (N_2O) accounted for a majority of this total GHG radiative forcing value.[25] Halocarbons, ozone, and water vapor were additional contributors.[26]

Regarding projections of global and regional climate change, many climate models ranging from simple to comprehensive are used to project changes in the climate system. Modeling is done within the framework of the Coupled Model Inter-Comparison Project Phase 5. Changes are projected near-term (i.e., to year 2050) and long-term (i.e., to year 2100), relative to climate data from 1986–2005.[27] Long-term global mean surface temperature increases will *likely* be 3.7° Celsius for the Representative Concentration Pathways ("RCP") 8.5 scenario.[28] Other scenarios project lesser increases in temperatures. The RCP 8.5 scenario predicts that Arctic sea ice extent will be reduced and global mean sea

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15 *Id.* at 37.

16 This increase has been 0.89° Celsius for combined land surface air and sea-surface temperatures. *Id.*

17 *Id.* at 38.

18 Virtually certain means with 99–100 percent probability.

19 IPCC REPORT, *supra* note 8, at 40.

20 Very likely means with 90–100 percent probability. This decrease in glacial mass has been 226 Gigatons per year. *Id.* at 41.

21 *Id.* at 46.

22 The rise in sea level has been 0.19 meters. *Id.*

23 *Id.* at 53.

24 *Id.*

25 CO_2, CH_4 and N_2O accounted for 1.82, 0.48 and 0.17 Watts per square meter, respectively, of the total GHG radiative forcing value of 2.83 Watts per square meter. *Id.*

26 *Id.* at 54.

27 *Id.* at 57.

28 Likely means with 66–100 percent probability.

level will increase, with other scenarios again yielding lesser increases in sea level.[29]

These changes in the climate system, drivers of climate change, and projections of global and regional climate change provide important background for the Clean Air Act ("CAA"), regulations promulgated by the EPA under the CAA, and cases that have produced regulation of stationary sources of GHG emissions.

III. CASES AND REGULATIONS LEADING TO FINAL RULES FOR NEW AND EXISTING POWER PLANTS

This section begins by considering *Massachusetts v. Environmental Protection Agency*. Shortly after this case was decided, EPA issued an endangerment finding in 2009, followed by its first ever regulation of GHG emissions—the so-called Tailpipe Rule—in 2010. The section ends with an examination of two recent cases, *Coalition for Responsible Regulation v. Environmental Protection Agency*,[30] decided by the D.C. Circuit, and *Utility Air Regulatory Group v. Environmental Protection Agency*,[31] decided by the Supreme Court. Both courts largely upheld the EPA's authority to regulate GHG emissions from both mobile and stationary sources. Coverage of these cases and various EPA rules provides important background for EPA regulation of GHG emissions from power plants and compliance measures.

A. Massachusetts v. Environmental Protection Agency

The Supreme Court's 5-4 decision in *Massachusetts v. Environmental Protection Agency* held that GHGs meet the CAA's definition of pollutant, giving EPA authority to regulate GHG emissions through the Act.[32]

In 1999, a group of private organizations petitioned EPA for rulemaking, requesting regulation of GHG emissions from new motor vehicles.[33] The petition alleged that GHG-induced climate change would negatively affect human health and the environment. After requesting public comment in 2001, EPA denied the rulemaking in 2003 for two principal reasons. First, EPA did not believe that it had authority to

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29 Reduced Arctic sea ice extent is predicted to be 94 percent, with global mean sea level rising 0.62 meters. IPCC REPORT, *supra* note 8, at 41, 54, 63, 92.

30 606 Fed. App'x. 6 (D.C. Cir. 2015).

31 134 S. Ct. 2427 (2014).

32 Justices Stevens, Kennedy, Souter, Ginsburg and Breyer delivered the Court's opinion, with Justices Roberts (joined by Justices Scalia, Thomas and Alito) and Scalia (joined by Justices Roberts, Thomas and Alito) dissenting. Massachusetts v. E.P.A., 549 U.S. 497, 503 (2007).

33 *Id.* at 510.

address climate change through the CAA.[34] This interpretation was at odds with that of former General Counsels for the EPA.[35] EPA General Counsel in 2003, however, concluded that the agency lacked such authority. Second, even assuming such authority, EPA determined that it would not have been prudent to regulate GHGs at that time because of various policy considerations.[36]

Petitioners were joined by intervenor Massachusetts, as well as several other states and cities, and sought judicial review in the U.S. Court of Appeals for the D.C. Circuit.[37] Two judges opined that the EPA Administrator exercised appropriate discretion in denying the petition for rulemaking. Both of these judges concluded that such discretion could be based on a mix of scientific and policy considerations; one judge also held that petitioners lacked standing because they failed to demonstrate particularized injury.[38] In contrast, the third judge asserted that petitioner Massachusetts indeed satisfied all requirements for standing.[39] The Supreme Court subsequently granted certiorari to hear the case.

After establishing that petitioners had standing,[40] the Court addressed denial of the petition for rulemaking. The Court noted that denials of petitions for rulemaking are susceptible to judicial review, although limited and deferential. The CAA expressly permits judicial review under section 307(b)(1).[41] EPA maintained that it could not regulate GHGs under the CAA because they are not air pollutants covered by the statute.[42] The Court disagreed, however, reading the CAA's definition of air pollutant in section 302(g)[43] to be capacious and holding that GHGs fit within it.[44] Consequently, the Court required EPA to either make an endangerment finding by concluding that GHGs contribute to climate change,[45] or alternatively determine that GHGs do not contribute to

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34 *Id.* at 511.
35 *Id.* at 510.
36 *Id.* at 511.
37 Massachusetts v. EPA, 415 F.3d 50 (D.C. Cir. 2005).
38 *Massachusetts*, 549 U.S. at 514–15.
39 *Id.* at 515.
40 *Id.* at 521–26 (noting that, with regard to injury, Massachusetts owned a significant portion of coastal land which could be lost to rising sea levels associated with climate change, causation was not contested by EPA, and concluding, for redressability, that the EPA position that regulating GHG emissions from new motor vehicles would not reverse climate change was unsatisfactory; also noting that EPA is responsible for acting to reduce GHG emissions, even if the extent of reduction is insufficient to reverse climate change).
41 42 U.S.C. § 7607(b)(1) (2015).
42 *Massachusetts*, 549 U.S. at 528.
43 42 U.S.C. § 7602(g) (2015).
44 *Massachusetts*, 549 U.S. at 528–29.
45 *Id.* at 534 (opining that uncertainty regarding the link between GHGs and climate change was insufficient grounds for denying the petition for rulemaking).

climate change, which would require no further action by EPA.[46] With regard to the endangerment finding, the Court ruled that denial of the petition for rulemaking was arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with the law.[47] Justices Roberts[48] and Scalia[49] filed vigorous dissents to the majority opinion.

The Court's decision, requiring EPA to take certain administrative actions, set up a series of subsequent rulemakings and court challenges that are detailed in the following subsections.

B. Endangerment Finding

In 2009, after a change in presidential administrations, EPA initiated a series of rulemakings in response to the *Massachusetts v. Environmental Protection Agency* decision.[50] The first of these actions was an endangerment finding.[51] EPA determined that six directly-emitted GHGs persisting in the atmosphere endangered public health and welfare because of their contributions to climate change.[52] Further, EPA concluded that GHGs specifically emitted from new motor vehicles and new motor vehicle engines cause or contribute to GHG pollution that endangers public health and welfare.[53] In making these determinations, EPA relied heavily upon three assessments, those of the IPCC,[54] the U.S. Global Climate Research Program,[55] and the National Research Council.[56] Each of these assessments synthesized thousands of individual studies.[57] EPA determined that increased atmospheric concentrations of

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46 *Id.* at 533.

47 *Id.* at 534.

48 In his dissent, Chief Justice Roberts argued that petitioners failed to satisfy the standing requirement of particularized and imminent injury in their claim of loss of coastal land and also did not satisfy the requirements of causation and redressability. *Id.* at 535–49 (Roberts, C.J., dissenting).

49 Justice Scalia opined that the EPA Administrator was not required to make an endangerment determination, as held by the Court. He also disagreed with the notion that GHGs are air pollutants because, unlike criteria pollutants, GHGs reside high in the atmosphere instead of near the surface of the Earth. *Id.* at 549–60 (Scalia, J., dissenting).

50 Kassie Siegel et al., *supra* note 5, at 192–205; *see also* Charles De Saillan, *United States Supreme Court Rules EPA Must Take Action on Greenhouse Gas Emissions: Massachusetts v. EPA*, 47 NAT. RESOURCES J. 793, 808–09 (2007).

51 Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,496–99 (Dec. 15, 2009).

52 These GHGs included CO_2, CH_4, and N_2O (all mentioned in Section II), as well as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. *Id.* at 66,497.

53 Indeed, motor vehicle emissions at that time accounted for 4 percent and 23 percent of total global and total U.S. GHG emissions, respectively. *Id.* at 66,498.

54 *Id.* at 66,497.

55 *Id.*

56 *Id.*

57 *Id.* at 66,510.

GHGs affect public health[58] and public welfare.[59] Importantly, section 302(h) of the CAA specifically includes weather and climate in the scope of public welfare.[60]

C. Mandatory Reporting of Greenhouse Gases Rule

In 2009, the EPA promulgated the Mandatory Reporting of Greenhouse Gases Rule (the "Reporting Rule") in response to legislative direction (fiscal year 2008 Consolidated Appropriations Act),[61] as well as section 114[62] of the CAA.[63] This section of the CAA provides EPA with authority to collect data to enforce the Act's provisions. The Reporting Rule required all direct GHG emitters (e.g., electric utility generating units, or EGUs), fossil fuel suppliers, industrial gas suppliers, and heavy-duty vehicle and engine manufacturers to report GHG emissions.[64] Importantly, data obtained via this Rule would inform EPA regarding the use of section 111 of the CAA to regulate GHG sources.[65] In addition, collecting these data would improve quality of the EPA's annual report that tracks national GHG emissions and removals, given that most programs contributing to this inventory in 2009 were voluntary and relatively narrow in their scope. The Reporting Rule required GHG emission data collection to begin on January 1, 2010, with the first annual report due in early 2011.

D. Timing Rule

EPA promulgated the Timing Rule in 2010.[66] Here, EPA announced its determination that any source emitting air pollutants would be subject to regulation once any EPA regulation controlling that air pollutant took effect. The Tailpipe Rule (see below), affecting mobile GHG emission sources, was to become effective on January 2, 2011. Thus, stationary

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58 Effects on public health include those on air quality, temperature, extreme weather events, food- and water-borne pathogens, and aeroallergens. *Id.* at 66,497.

59 Effects on public welfare include those on food production and agriculture, forestry, water resources, sea level and coastal areas, energy, infrastructure and settlements, as well as effects on ecosystems and wildlife. *Id.*

60 42 U.S.C. § 7602(h) (2015).

61 Consolidated Appropriations Act of 2008, Pub. L. No. 110-161, 121 Stat. 1844 (2007).

62 42 U.S.C. § 7414 (2015).

63 Mandatory Greenhouse Gas Reporting, 40 C.F.R. §§ 98.1–98.9, 98.30–98.38, 98.40–98.48 (2015).

64 40 C.F.R. § 98.2.

65 74 Fed Reg 56,265 (Oct. 30, 2009). For an explanation of how 42 U.S.C. § 7411(b) may be used to regulate GHGs, see *infra* Part IV.D.

66 Reconsideration of Interpretation of Regulations That Determine Pollutants Covered by Clean Air Act Permitting Programs, 75 Fed. Reg. 17,004, 17,006 (Apr. 2, 2010) (codified at 40 C.F.R. §§ 50, 51, 70, 71).

GHG source permitting under the Prevention of Significant Deterioration ("PSD") of air quality and Title V programs (see below) was determined by EPA to also become effective on that date.[67]

E. Tailpipe Rule

Also in 2010, EPA published the Tailpipe Rule.[68] This was more than a decade after initial petition for this type of rulemaking.[69] The Tailpipe Rule contained standards for new light-duty vehicles that would both reduce GHG emissions and increase fuel economy for these vehicle types. Passenger cars, light-duty trucks, and medium-duty passenger vehicles for model years 2012–2016 are covered by the Tailpipe Rule. The Tailpipe Rule is not only the first EPA regulation of GHG emissions, but its promulgation presumably triggered regulation of stationary sources of GHG emissions under both the PSD and Title V programs.

F. Tailoring Rule

EPA also promulgated the Tailoring Rule in 2010, which addressed GHG pollutant thresholds under the CAA.[70] The PSD (construction permits) and Title V programs (operating permits) involve permitting thresholds of 100 (or 250) tons per year for any air pollutant emitted from stationary sources.[71] GHGs, however, are emitted in much larger quantities than "traditional" pollutants and therefore innumerable GHG-emitting sources would be subject to these permitting programs, given the levels statutorily prescribed in the CAA. Consequently, EPA determined that it would initially require permitting for only those sources that emit 75,000 (or 100,000) tons per year of GHGs; by so doing, EPA tailored which stationary sources of GHGs would be subject to permitting requirements.

G. American Electric Power v. Connecticut[72]

This case established that the CAA and any subsequent EPA regulations authorized by it displace federal common law in abating GHG

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[67] Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31,514, 31,515 (June 3, 2010) (codified at 40 C.F.R. §§ 50, 51, 70, 71).

[68] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule, 75 Fed. Reg. 25,324 (May 7, 2010) (codified at 40 C.F.R. §§ 85, 86, 531, 533, 536–38, 600).

[69] Petition for Rulemaking and Collateral Relief Seeking the Regulation of Greenhouse Gas Emissions from New Motor Vehicles Under Section 202 of the Clean Air Act, 1–2 (1999).

[70] Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule, 75 Fed. Reg. 31,514 (June 3, 2010) (codified at 40 C.F.R. §§ 50, 51, 70, 71).

[71] *Id.* at 31,516.

[72] Am. Elec. Power Co. v. Connecticut, 131 S. Ct. 2527 (2011).

emissions from fossil-fueled EGUs. The Supreme Court's opinion was unanimous.[73]

Respondents were several states and New York City, as well as three land trusts, which sought abatement of GHG emissions from several of the nation's largest EGU operators via federal common law public nuisance claims.[74] Petitioners were four private EGU companies, as well as the federally-owned Tennessee Valley Authority, that collectively accounted for 25 percent of the domestic EGU sector's GHG emissions at that time.[75] The injunctive relief sought consisted of caps on GHG emissions and stepwise reductions in those emission caps over one decade.[76] Respondents had their case dismissed as non-judiciable in the U.S. District Court for the Southern District of New York.[77] The district court decision was vacated and remanded by the U.S. Court of Appeals for the Second Circuit.[78] The Second Circuit determined that the CAA did not displace federal common law because EPA rulemaking that addressed GHG emissions had not been completed.[79] The Supreme Court granted certiorari.

The Supreme Court opined that, unlike interstate pollution,[80] GHG-induced climate change constitutes a different legal issue because of its global impact.[81] In enacting the CAA, Congress addressed an issue that eliminated the need for federal court involvement. Therefore the CAA, specifically section 111,[82] and any accompanying EPA regulations displace a federal common law right to GHG emission reductions.[83] In *Massachusetts v. Environmental Protection Agency*, the Supreme Court held that the EPA had authority to regulate GHGs under the mobile source section of the CAA.[84] Since that ruling, EPA had finalized the above-mentioned rule regulating light- and medium-duty vehicular emissions and initiated rulemaking for heavy-duty vehicles. Importantly, EPA had also initiated rulemaking to limit GHG emissions from new,

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73 Justices Ginsburg, Roberts, Scalia, Kennedy, Breyer, Kagan, Alito and Thomas considered and decided this case. Justice Sotomayor did not take part in either consideration of or the decision in this case. *Id.* at 2531.

74 *Am. Elec. Power Co.*, 131 S. Ct. at 2529.

75 *Id.* at 2534.

76 *Id.*

77 Connecticut v. Am. Elec. Power Co., 406 F. Supp. 2d 265 (S.D.N.Y. 2005).

78 Connecticut v. Am. Elec. Power Co., 528 F.3d 309 (2d Cir. 2009).

79 *Am. Elec. Power Co.*, 131 S. Ct. at 2529–30.

80 *See* Georgia v. Tennessee Copper Co., 206 U.S. 230, 236–39 (1907) (holding that federal common law is applicable).

81 *Am. Elec. Power Co.*, 131 S. Ct. at 2536–37.

82 42 U.S.C. § 7411.

83 *Am. Elec. Power Co.*, 131 S. Ct. at 2537–39.

84 *Massachusetts*, 549 U.S. at 531–32.

modified, and existing EGUs under section 111[85] of the CAA. The Court disagreed with the Second Circuit's holding that federal common law was not displaced until EPA rulemaking was complete, holding instead that displacement occurred when Congress delegated authority for rule promulgation to EPA.[86] That displacement, according to the Court, was desirable because it made an expert agency rather than federal judges responsible for GHG regulation. It has been noted, however, that seeking relief under state nuisance law may not be precluded.[87]

H. Coalition for Responsible Regulation v. Environmental Protection Agency[88]

This case involved several industry and state challenges to EPA's Endangerment Finding and its Timing, Tailpipe, and Tailoring Rules. The United States Court of Appeals for the D.C. Circuit considered the consolidated challenges, one which was subsequently argued before the Supreme Court after petitioners' appeal.

The D.C. Circuit first considered the challenge to EPA's endangerment finding, which the court held not to be arbitrary and capricious; that is, EPA judgment that climate change induced by human activities endangers public health and welfare was rational and entitled to deference.

The D.C. Circuit also considered a challenge to the Tailpipe Rule. It noted that EPA was obligated to directly consider only costs of regulating GHG emissions from new motor vehicles subsequent to its endangerment finding, as required by CAA section 202(a)(1).[89] Thus, the assertion that EPA's lack of consideration of stationary source GHG emissions was arbitrary and capricious was also found to be without merit.[90]

As for the challenges to the Timing and Tailoring Rules, the D.C. Circuit determined that industry and states lacked standing because there were no findings of an actual or imminent injury. Ironically, the Tailoring Rule adjusted the PSD and Title V permitting thresholds such that GHG

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85 42 U.S.C. § 7411.

86 *Am. Elec. Power Co.*, 131 S. Ct. at 2538. If, as desired by certain members of Congress, EPA's authority to regulate GHGs is reduced, federal common law nuisance claims might again be filed to mitigate GHG emissions.

87 Katherine A. Trisolini, *The Sweet Taste of Defeat: American Electric Power Co. v. Connecticut and Federal Greenhouse Gas Regulation*, 30 UCLA J. ENVTL. L. & POL'Y 227, 242 (2012).

88 Coalition for Responsible Regulation v. E.P.A., 684 F.3d 102 (D.C. Cir. 2012).

89 42 U.S.C. § 7521(a)(1) (2015).

90 *Coalition for Responsible Regulation*, 684 F.3d at 113. The D.C. Circuit also held that EPA did not have discretion to defer the Tailpipe Rule because the National Highway Traffic Safety Administration was simultaneously promulgating fuel economy standards. The Court noted that the Tailpipe Rule would provide benefits in addition to those provided by the fuel economy standards.

regulation would begin with only the largest emitters. Step 1 of the Tailoring Rule involves only emitters of greater than 75,000 tons per year of GHGs that are already subject to PSD requirements for non-GHG pollutants.[91] Step 2 of the Tailoring Rule requires a PSD permit for emitters of at least 75,000 (or 100,000) tons per year of GHGs.[92] The D.C. Circuit therefore opined that these rules actually delayed (per the Timing Rule) and lessened or even eliminated (per the Tailoring Rule) industry's and states' alleged injuries.

I. Utility Air Regulatory Group v. Environmental Protection Agency[93]

This 2014 Supreme Court case resulted from an appeal of the D.C. Circuit's decision in *Coalition for Responsible Regulation*. The Supreme Court limited itself to consideration of EPA's specific permitting thresholds for stationary sources of GHG emissions—the Tailoring Rule.[94] The specific CAA permitting program in question was the PSD program, which consists of construction permitting of new sources in areas that are in attainment for a given national ambient air quality standards ("NAAQS") pollutant.[95] In addition to PSD permitting, Title V of the CAA requires an operating permit for any major source of air pollutants.[96] As noted above, statutory emission thresholds for the PSD program are low relative to typical GHG emissions and would therefore trigger permitting for innumerable GHG emission sources. EPA therefore promulgated the Tailoring Rule to phase in regulation of GHG emissions.[97] Significantly, EPA was to regulate only those major sources already subject to permitting for NAAQS pollutants in Step 1 of the Tailoring Rule; these sources were to employ best available control technology ("BACT") to control GHG emissions that would otherwise exceed 75,000 tons annually.[98] In Step 2, any stationary sources with potential to emit 100,000 tons per year of GHGs, irrespective of their emissions of other pollutants, would be regulated.[99] The Court opined that EPA's "tailoring" of new emission thresholds for permitting was

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91 75 Fed. Reg. 31,514, 31,516 (June 3, 2010) (codified at 40 C.F.R. §§ 50, 51, 70, 71).

92 *Id.* In justifying the Tailoring Rule, EPA invoked several lines of reasoning, one of which was the so-called absurd results notion; that is, adhering to the CAA's requirement of regulating emitters of more than 100 (or 250) tons per year of GHGs would involve the permitting of innumerable emission sources.

93 Util. Air Regulatory Grp. v. E.P.A., 134 S. Ct. 2427 (2014).

94 *Id.* at 2444–46.

95 *Id.* at 2435.

96 *Id.* at 2435–36.

97 *Id.* at 2437; *see also* 40 C.F.R. §§ 70, 71 (2015).

98 *Util. Air Regulatory Grp.*, 134 S. Ct. at 2437.

99 *Id.* Sources to be regulated during Step 1 account for 83 percent of U.S. GHG emissions, with Step 2 sources accounting for only an additional 3 percent of GHG emissions.

impermissible because it was clearly contrary to the CAA's unambiguously-stated thresholds for permitting in the PSD and Title V programs.[100]

Nevertheless, the Court decided that EPA's requirement of BACT for GHG emission sources otherwise subject to PSD and Title V review (i.e., Step 1 of the Tailoring Rule) was permissible.[101] It opined that this requirement did not extend EPA authority over countless GHG sources that had not been previously regulated; moreover, the BACT requirement was deemed reasonable by the Court.[102]

IV. REGULATORY OPTIONS FOR EPA UNDER THE CAA

This Section considers the four principal options available to EPA under authority of the CAA for regulating GHG emissions from stationary sources. These options include the PSD (CAA sections 170–179[103]) and Title V programs, NAAQS (CAA sections 108–110[104]), hazardous air pollutants ("HAPs," found in CAA section 112[105]), and new source performance standards ("NSPSs," found in CAA section 111[106]).[107] Due to significant limitations in use of either the NAAQS or the HAP approach, only the PSD and Title V programs, as well as NSPSs, are options available to EPA to regulate GHG emissions. Consideration of these various options provides important background for EPA regulation of both new and existing power plant GHG emissions.

A. PSD and Title V

The PSD program is administered under the New Source Review ("NSR") program.[108] In geographic areas satisfying the NAAQS for a given pollutant, construction permits for new or modified major sources

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100 *Id.* at 2444–46. Although Justice Breyer concurred in part with the Court's opinion, he dissented with respect to its rebuke of EPA's enumeration of new emission thresholds. *Id.* at 2452 (Breyer, J., dissenting). He opined that Congress was focused on NAAQS pollutants when it set the 100-/250-tons per year thresholds and that EPA was, with its Tailoring Rule, merely exempting relatively small GHG sources and instead focusing on large stationary sources of GHG emissions. *Id.* at 2453.

101 *Id.* at 2447–49.

102 *Id.*

103 42 U.S.C. §§ 7470–7479 (2012).

104 42 U.S.C. §§ 7408–7410 (2012).

105 42 U.S.C. § 7412 (2012).

106 42 U.S.C. § 7411 (2012).

107 Scott Schang & Teresa Chan, *Federal Greenhouse Gas Control Options from an Enforcement Perspective*, 2 SAN DIEGO J. CLIMATE & ENERGY L. 87, 102–08 (2010).

108 Arnold W. Reitze, *Federal Control of Carbon Dioxide Emissions: What Are the Options?*, 36 B.C. ENVTL. AFF. L. REV. 1, 8 (2009).

are issued through the NSR PSD program.[109] In non-attainment areas where NAAQS thresholds are exceeded, the non-attainment NSR program is operative.[110] Issuance of a PSD permit requires determination of BACT for the major source under consideration; in this determination, cost is one factor to be considered.[111] EPA uses a top-down procedure, which consists of five steps leading to BACT determination.[112] Notably, while the general process of determining BACT is well established, specific guidelines for BACT that reduces GHG emissions have not yet been made available by EPA.[113] For the non-attainment NSR program, lowest achievable emission rate technology is required.[114]

Also as mentioned above in Section III, GHG emission regulation under the PSD program will be phased in at thresholds much higher than those normally employed.[115] In Step 1 of the Tailoring Rule, new or modified major sources of GHG emissions that are already subject to the PSD program for NAAQS pollutants (with their associated thresholds of 100 or 250 tons per year or more) and have the potential to emit 75,000 tons per year or more of GHGs must comply.[116] In Step 2, new major sources with potential for emission of 100,000 tons per year or more of GHGs (75,000 tons per year or more for modified major sources), even if they are in compliance with NAAQSs for criteria pollutants, will be required to comply.[117] Steps 1 and 2 had compliance dates of January 2 and July 1, 2011, respectively. Recently, however, EPA removed Step 2 from PSD and Title V regulations due to the Supreme Court decision in *Utility Air Regulatory Group v. Environmental Protection Agency*.[118] Title V operating permit issuance will also require consideration of GHG emissions.[119]

States are responsible for both PSD and Title V permitting to accomplish GHG regulation.[120] In late 2010, EPA determined that 13 states had inadequate state implementation plans ("SIPs") for such

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109 *Id.* at 8.

110 *Id.* at 8–9.

111 42 U.S.C. § 7479(3) (2012).

112 Arnold W. Reitze, *The Intersection of Climate Change and Clean Air Act Stationary Source Programs*, 43 ARIZ. ST. L.J. 901, 915 (2011).

113 *Id.* at 916.

114 Reitze, *supra* note 108, at 8–9.

115 Reitze, *supra* note 112, at 917–18.

116 *Id.* at 917.

117 *Id.*

118 Prevention of Significant Deterioration and Title V Permitting for Greenhouse Gases: Removal of Certain Vacated Elements, 80 Fed. Reg. 50,199; 50,199–200 (Aug. 19, 2015) (to be codified at 40 C.F.R. pts. 51, 52, 70 and 71); *see generally supra* Part II.

119 Reitze, *supra* note 108, at 12.

120 Reitze, *supra* note 112, at 916.

permitting.[121] Five of these states agreed to revise their SIPs, while EPA issued federal implementation plans for the remaining states to allow permitting to continue uninterrupted.[122]

B. NAAQS

After identifying an air pollutant as a criteria pollutant and specifying its effects on public health and welfare (CAA, section 108[123]), primary and secondary NAAQS for that pollutant must be established by EPA (CAA, section 109[124]).[125] Criteria pollutants currently include particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide, ozone and lead.[126] Establishing NAAQS is most problematic for GHG regulation.[127] GHGs are uniform in their atmospheric concentrations, unlike criteria pollutants.[128] As a result, if EPA were to set NAAQS for GHGs above their current atmospheric concentrations (say, 450 parts per million for CO_2), all states in the United States would be in attainment and therefore not be required to file SIPs under section 110 of the CAA.[129] Conversely, if EPA were to set NAAQS for GHGs below their current atmospheric concentrations, no states would be in attainment and submitting SIPs to achieve NAAQS for GHGs would likely be futile.[130] Thus, although some have advocated a NAAQS approach to GHG emission regulation,[131] most scholars are of the opinion that such an approach is unlikely to be effective.[132]

C. HAPs

HAPs are pollutants that pose serious threats to human health and the environment (e.g., carcinogens) and nearly 200 such pollutants are listed in section 112(b)(1) of the CAA.[133] A recent example of EPA regulating HAPs emitted by EGUs is the 2012 Mercury and Air Toxics Standards

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121 *Id.* at 918.
122 *Id.* at 918–19.
123 42 U.S.C. § 7408 (2012).
124 42 U.S.C. § 7409 (2012).
125 Schang & Chan, *supra* note 107, at 106–07.
126 Reitze, *supra* note 112, at 913.
127 Reitze, *supra* note 108, at 4–5.
128 Reitze, *supra* note 112, at 914.
129 42 U.S.C. § 7410 (2012).
130 Reitze, *supra* note 112, at 914.
131 *See* Siegel et al., *supra* note 5, at 208–12; Nathan Richardson, *Greenhouse Gas Regulation Under the Clean Air Act: Does Chevron Set the EPA Free?* 29 STAN. ENVTL. L.J. 283, 298, 321–22 (2010).
132 *See* Reitze, *supra* note 108, at 3–4; Reitze, *supra* note 112, at 913–14.
133 42 U.S.C. § 7412(b)(1) (2012).

("MATS") rule, under authority of section 112[134] of the CAA.[135] The status of MATS is currently uncertain.[136] A HAP approach would, however, be an unlikely regulatory path for EPA to follow for GHG emissions. Major sources are defined as those emitting 10 tons per year or more of a single HAP or 25 tons per year or more of a combination of HAPs.[137] This would present a more extreme version of the problem encountered in the PSD and Title V programs for GHG regulation, one of innumerable major sources that would require another version of the Tailoring Rule in order to regulate in a reasonable fashion.[138] An additional difficulty with regulating GHGs as HAPs is that maximum achievable control technology is the obligatory standard for treatment, making the cost of compliance prohibitive.[139]

D. NSPSs

Because both the PSD and Title V programs for GHG regulation apply only to major emitters already subject to regulation, and because NAAQS and HAPs are non-ideal regulatory approaches, EPA has opted to employ a NSPS approach, under authority of section 111 of the CAA,[140] to supplement regulation of GHGs emitted from power plants. EPA is responsible for the two initial steps in the NSPS approach.[141] First, EPA must list categories (and possibly sub-categories) of sources of GHG emissions. Since the EGU category represents the largest source of GHG emissions in the United States (approximately 33 percent of domestic GHG emissions[142]), it is a logical starting point. Second, EPA must establish a standard of performance that reflects the full extent of emission reduction under the best system of emission reduction ("BSER"). This standard of performance can be either a technology or the functional equivalent of a technology.[143] Factors such as cost and energy requirements must be considered when creating NSPSs.[144]

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134 42 U.S.C. § 7412 (2012).

135 40 C.F.R. §§ 63.1–63.16, 63.40–63.56 (2015).

136 *See* Michigan v. E.P.A., 135 S. Ct. 2699, 2701–02 (2015) (remanding to the D.C. Circuit for consideration of costs in developing MATS).

137 Reitze, *supra* note 112, at 923.

138 *Id.* at 922–24.

139 *Id.* at 922.

140 42 U.S.C. § 7411 (2012).

141 Schang & Chan, *supra* note 107 at 105–06; Reitze, *supra* note 108, at 5–6.

142 U.S. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2012, ES-23 (2014).

143 BSER becomes the minimum for the NSR PSD and non-attainment NSR program standards. NSR programs can superimpose additional state-level emission control requirements upon the national NSPS.

144 Reitze, *supra* note 112, at 921.

For new or modified sources of GHG emissions, authority resides in section 111(b) of the CAA;[145] for existing sources, section 111(d) applies.[146] Importantly, to regulate existing sources under section 111(d), plans similar to SIPs are used to provide for the implementation, maintenance, and enforcement of a performance standard.[147] This process is similar to that employed under the NAAQS approach.[148] For section 111(d) to provide control, GHG emissions from existing sources cannot already be regulated under NAAQS or HAPs.[149] However, EPA rarely uses this authority to regulate air pollutants, making the degree of flexibility allowable in a SIP-like plan for GHG emission regulation uncertain.

There has been much speculation in recent legal literature about using economic controls, permissible with NSPSs, to regulate GHG emissions. Two economic approaches to reducing GHG emissions are an emission fee and an emission cap, often termed a carbon tax and cap-and-trade, respectively.[150] A carbon tax is viewed more favorably by the EGU sector because it provides cost certainty;[151] however, GHG emission reductions to be realized are less certain.[152] A carbon tax may also be beneficial because it is more economically efficient if abatement costs rise sharply with increasing abatement, which is likely.[153] A carbon tax is, however, politically unpalatable. Cap-and-trade, on the other hand, provides emission reduction certainty if the quantity of tradable permits held by emitters is progressively reduced over time.[154] Still, for the EGU sector, the permit price will vary and subsequently lead to cost uncertainty.[155] Further, cap-and-trade is less economically efficient when abatement costs rise sharply as marginal abatement increases very little, creating diminishing marginal returns.[156]

Many proposed plans concerning BSER prior to issuance of the proposed and final rules for existing power plants included a cap-and-trade approach, in part because it is more politically palatable than a carbon tax and partly because EPA has occasionally either employed or

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145 42 U.S.C. § 7411(b) (2012).
146 42 U.S.C. § 7411(d) (2012).
147 Schang & Chan, *supra* note 107, at 105–06.
148 *Id.* at 106–07.
149 Reitze, *supra* note 112, at 921.
150 Reitze, *supra* note 108, at 19–26.
151 *See* NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE 361–62 (2007).
152 *Id.*
153 *Id.* at 351–67.
154 *Id.* at 366.
155 *Id.* at 357–58.
156 *Id.* at 356–57.

proposed this economic approach.[157] An example of the latter is in the regulation of EGU emissions of mercury. As noted above, EPA recently promulgated the MATS rule. Its predecessor, the Clean Air Mercury Rule ("CAMR"), included a cap-and-trade approach to reduce mercury emissions from EGUs.[158] CAMR was vacated because EGUs were incorrectly removed from the section 112 listing of major source categories for mercury and EPA subsequently proposed that they be regulated under section 111 of the CAA, an action the D.C. Circuit held to be unlawful.[159] Thus, use of a cap-and-trade measure by EPA under CAA section 111 was not the reason the D.C. Circuit vacated CAMR, and EPA subsequently replaced it with the MATS rule.

EPA will allow cap-and-trade in its regulation of GHG emissions from existing sources in SIP-like plans (see Section IV below) because of the flexibility of section 111 in allowing for both environmental and economic efficiency. A cap-and-trade program will be limited to just one sector—EGUs.[160] It therefore appears likely that states participating in the Regional Greenhouse Gas Initiative ("RGGI") would have RGGI's cap-and-trade program approved as a key element in their SIP-like plans, given that it involves only the EGU sector. Because California's cap-and-trade program involves multiple GHG-emitting sectors, its inclusion in a SIP-like plan may be subject to greater scrutiny.[161]

V. PROPOSED RULES FOR NEW AND EXISTING EGUS

This section details EPA's final rules for new and existing power plants, which are promulgated under authority of CAA Sections 111(b) and (d), respectively. The New Power Plant Rule includes separate NSPSs for steam EGUs and natural gas-fired stationary combustion turbines. The Existing Power Plant Rule, also known as the Clean Power Plan, includes state-specific standards that are derived from three categories of GHG emission-reducing measures. Compliance with this latter rule is the focus of this paper. A comparison of three proposed compliance plans from non-governmental entities is also presented. All of these compliance plans were proposed prior to EPA's issuance of the

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157 Bryner, *supra* note 4, at 267–70.

158 Standards of Performance for New and Existing Stationary Sources: Electric Utility Generating Units, 70 Fed. Reg. 28,606, 28,624–32 (May 18, 2005) (superseded by 40 C.F.R. §§ 60, 72, 75 (2015)).

159 New Jersey v. E.P.A., 517 F.3d 574, 583–84 (D.C. Cir. 2008).

160 Teresa B. Clemmer, *Staving Off the Climate Crisis: The Sectoral Approach Under the Clean Air Act*, 40 ENVTL. L. 1125, 1148–50 (2010).

161 Franz T. Litz et al., What's Ahead for Power Plants and Industry? Using the Clean Air Act to Reduce Greenhouse Gas Emissions, Building on Existing Regional Programs 17–19 (Feb. 2011) (WRI Working Paper) (on file with World Resources Institute).

Clean Power Plan, but all contain some, if not all, of EPA's emission-reducing measures as compliance measures. These proposed compliance plans are useful to compare with this paper's compliance proposal. Finally, this article narrows the use of all three GHG emission-reducing measures to a single measure—zero-emitting renewable power generation.

In 2006, EPA promulgated a rule establishing new EGU emission limits for criteria air pollutants.[162] While this rule revised emission limits for PM, SO_2 and NO_2, it did not address GHG emissions. A number of states and environmental organizations petitioned the D.C. Circuit to review the rule.[163] Three years after the 2007 Supreme Court decision in *Massachusetts v. Environmental Protection Agency*, EPA and the petitioners negotiated a settlement agreement with deadlines for rules limiting GHG emissions from new and existing EGUs.[164] The New Power Plant Rule is one result of that settlement agreement.

A. New Power Plant Rule

EPA proposed this rule in late 2013.[165] It was actually a revision of a rule proposed in early 2012, and that prior proposed rule was withdrawn simultaneously.[166] The new rule included separate NSPSs for new electric utility steam generating units (utility boilers) and natural gas-fired stationary combustion turbines, both with capacities greater than 25 megawatts.[167] When this proposed rule was finalized in 2015, separate NSPSs were retained, but both the BSER and the standard of performance for utility boilers were adjusted.

The new rule established a standard of performance of 1,400 pounds of CO_2 per megawatt-hour (MWh) of output for utility boilers, using supercritical pulverized coal technology in conjunction with partial carbon capture as the BSER.[168] The new rule also established a standard of performance of 1,000 pounds of CO_2 per MWh for stationary combustion turbines meeting baseload power demand, with natural gas

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162 40 C.F.R. § 60 (2015).

163 U.S. EPA, Proposed Settlement Agreement for Fossil Fuel-Power Plants (Dec. 23, 2010).

164 Reitze, *supra* note 112, at 922.

165 Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 1430 (Jan. 8, 2014) (to be codified at 40 C.F.R. pt. 60, 70, 71, and 98).

166 40 C.F.R. § 60.

167 The utility boiler sub-category also includes integrated gasification combined cycle (IGCC) units burning coal, petroleum coke, or other fossil fuels.

168 Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,510; 64,513–14 (Oct. 23, 2015) (to be codified at 40 C.F.R. pts. 60, 70, 71, and 98).

combined cycle ("NGCC") technology as the BSER.[169] In addition to this sub-category for stationary combustion turbines meeting baseload power, two other sub-categories—non-baseload units and multi-fuel-fired units—were included in the final rule.[170] In the withdrawn rule, a single standard of performance of 1,000 pounds of CO_2 per MWh had been proposed for all fossil fuel-fired units, with partial carbon capture specified as the BSER to meet this standard of performance.[171] Only emissions of CO_2 are regulated with this rule.[172]

B. Existing Power Plant Rule

This rule, also known as the Clean Power Plan, was finalized in August 2015 by EPA. It is the other outcome of the aforementioned post-*Massachusetts* settlement agreement. In it, EPA finalized standards of performance for states to follow in developing SIP-like plans to reduce CO_2 emissions from existing EGUs. Standards of performance, also known as emission guidelines, were developed for both interim (i.e., years 2022–2029)[173] and final time periods (i.e., year 2030 and beyond). EPA estimated that by 2030 under this plan, national GHG emissions will be reduced 32 percent from 2005 levels.[174] Net benefits, balancing quantified benefits to climate and air quality against compliance costs, were estimated to be between 26 and 45 billion U.S. dollars in 2030.[175]

EPA determined the BSER for existing power plants to consist of three categories of emission reduction measures, or so-called building blocks. All three building blocks are widely used either by utility corporations or states and are therefore adequately demonstrated.[176] It is important to note that EPA only used the BSER to arrive at state-specific emission guidelines; states, in developing SIP-like plans to comply with their emission guidelines, are not obligated to use all or even any of the EPA building blocks. The first of these building blocks is improved heat rate

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[169] *Id.* at 64,514–15.

[170] *Id.* at 64,515.

[171] Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 77 Fed. Reg. 22,392; 22,392–95 (Apr. 13, 2012) (to be codified at 40 C.F.R. pt. 60).

[172] Other GHGs such as CH_4 and N_2O constitute less than 1 percent of GHG emissions from fossil fuel-fired EGUs.

[173] EPA established 3 interim step periods within the interim period of 2022–2030: years 2022–2024, 2025–2027, and 2028–2029.

[174] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,665 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

[175] *Id.* at 64,934–35.

[176] *Id.* at 64,727–30. EPA also noted in the rule that states have already utilized these emission reduction measures (e.g., renewable power generation) in SIPs for attaining/maintaining NAAQS.

of affected EGUs.[177] Heat rate of affected EGUs can be improved by certain operating practice and technological changes, an example being the drying of higher-moisture coal prior to combustion that improves efficiency by directing more heat to the turbine (instead of evaporating coal's moisture content).[178] The second building block is dispatch of less emission-intensive EGUs instead of more emission-intensive EGUs; for example, NGCC EGUs can be dispatched instead of coal-fired, steam EGUs.[179] The last building block entails dispatching zero-emission EGUs instead of emission-intensive, affected EGUs.[180] EPA proposed that a combination of all three building blocks represents the BSER because a combined approach reduces GHG emissions more efficiently than any one building block alone, among other reasons.[181] A state SIP-like plan can incorporate all, some, or none of the measures that comprise the BSER, and can alter the contribution of any given building block from that used by EPA in determining the state-specific emission guideline. A state's SIP-like plan will be due on September 6, 2016. A state can request a due date extension to September 6, 2018 if an initial plan is submitted in 2016.[182]

Focusing on the third building block—dispatch of zero-emission generation such as that derived from renewable resources—EPA grouped states into three regions: the Western Interconnection ("WI"), Texas Interconnection ("TI"), and Eastern Interconnection ("EI").[183] Under the BSER, EPA calculated the WI's requirement for incremental renewable power generation (i.e., renewable generation in addition to that operational in 2012 plus that added during years 2012–2021 under a business-as-usual scenario) using a seven-step process involving both average and maximal nameplate capacity changes for five well-established renewable energy technologies.[184] Predicted capacity factors for these renewable technologies during years 2022–2030 were also used in calculating incremental renewable power generation. Required incremental renewable generation values were calculated for years 2022–2023 using average nameplate capacity change; values for 2024–2030

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177 *Id.* at 64,709. Affected EGUs are those fired by fossil fuels that are capable of selling more than 25 MW to a utility distribution system and have a fossil fuel heat input rating of greater than 250 million BTU per hour.
178 *Id.* at 64,787–89.
179 *Id.* at 64,795.
180 *Id.* at 64,803.
181 *Id.* at 64,666–67.
182 *Id.* at 64,828.
183 *Id.* at 64,808–09.
184 *Id.* at 64,807–09. Average and maximal nameplate capacity changes were calculated for the most recent five years (years 2010–2014) for onshore wind power, utility-scale solar photovoltaic (PV) power, concentrating solar power, geothermal power, and hydropower.

were calculated using maximal capacity change. For the WI, these calculations resulted in a requirement of more than 165,000,000 MWh of incremental renewable generation by year 2030.[185] While EPA acknowledged the variable nature of renewable power generation, it also noted that reliability has not been compromised with the rapid growth in renewable generation that has occurred in recent years and is unlikely to be compromised with future growth.[186]

C. Comparison of Proposed Compliance Plans

To provide input into EPA's proposed Existing Power Plant Rule, a number of environmental organizations and other entities proposed plans for compliance. Most plans included a proposed standard of performance for existing power plants, as well as suggestions for BSER. A subset of these proposals modeled effects of their proposals on variables such as magnitude of GHG emission reduction and electricity price, making them particularly informative. Key features of proposals that included modeling are summarized in Table 1.

One such proposal is that of the Natural Resources Defense Council ("NRDC").[187] In this plan, NRDC proposed benchmark emission rates for various time periods, for both coal and natural gas.[188] State-specific generation shares of coal and gas were calculated, as was a statewide emission rate to be achieved, based on benchmark emission rates and generation shares.[189] Modeling using this approach (NRDC's Policy Case) yielded national emission reductions ranging from 18 to 22 percent depending on whether comparisons were made within or between cases (Table 1).[190] The NRDC plan assumed only renewable power generation that complied with state Renewable Portfolio Standards ("RPSs").[191] Thus, for the NRDC Policy Case, 15.9 percent of power generation was

185 *Id.* at 64,809–10.

186 *Id.* In addition, EPA noted that, in delaying commencement of the interim period from year 2020 (as in its proposed rule) to 2022 (in the final rule), additional time was available to plan for reliability. Furthermore, inclusion of a so-called reliability safety valve that allows for affected EGU operation in the event of an unexpected situation jeopardizing reliability will ensure reliable grid operation.

187 NATURAL RES. DEF. COUNCIL, CLOSING THE POWER PLANT CARBON POLLUTION LOOPHOLE: SMART WAYS THE CLEAN AIR ACT CAN CLEAN UP AMERICA'S BIGGEST CLIMATE POLLUTERS, 13–34 (2013).

188 *Id.* at 13–14.

189 As an example, for a state with 90 percent of its fossil fuel-fired electric generation being coal-fired and the remainder being gas-fired, and using benchmark emission rates of 1500 and 1000 pounds of CO_2 per MWh for coal and gas, respectively (proposed by NRDC for the 2015–2019 time period), a statewide emission rate of 1450 pounds of CO_2 per MWh would be required.

190 NATURAL RES. DEF COUNCIL, *supra* note 187, at 25–28.

191 *Id.* at 13. Further details on RPSs are provided below. *See infra* Part VI.

from renewable technologies.[192] The NRDC proposal placed greater emphasis on energy efficiency approaches than on renewable generation to achieve GHG emission reductions.[193]

Another proposal is that of the Clean Air Task Force ("CATF").[194] CATF proposed an emission credit-trading scheme within the context of either a rate-based or mass-based performance standard, and either separate coal and gas standards or a blended fossil standard.[195] CATF dismissed a rate-based standard by noting that operational changes (e.g., generating for more hours at an identical or even lower rate) could negate GHG emission reductions, and focused its modeling efforts on a mass-based standard with either separate standards or a blended standard.[196] Separate and blended standards resulted in similar GHG emission reductions by year 2020 relative to 2005 with the CATF plan; emission reductions were less when compared to year 2020 Base Case emissions (Table 1).[197] Longer-term, however, a blended, mass-based standard achieved greater GHG emission reductions. The emission credit-trading scheme reduced GHG emissions, primarily by replacing coal with gas for power generation.[198]

A third proposal involving modeling is that advanced by Resources For the Future ("RFF").[199] RFF proposed a tradable performance standard with generators outperforming the standard earning credits and those underperforming relative to the standard having to purchase credits.[200] RFF also proposed cap-and-trade programs that return auction revenue to either state governments or electricity customers.[201] The 2013 baseline included all contemporary environmental policies (e.g., RGGI and California cap-and-trade programs).[202] In all three cases, a 367 million-ton reduction in CO_2 emission mass was achieved, resulting in 14 to 19 percent reductions in emission rate (Table 1).[203] Increases in electricity price were modest if auction or credit revenue remained in the electricity sector.

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192 *Id.*

193 *Id.* at 15–18.

194 BRUCE PHILLIPS, ALTERNATIVE APPROACHES FOR REGULATING GREENHOUSE GAS EMISSIONS FROM EXISTING POWER PLANTS UNDER THE CLEAN AIR ACT: PRACTICAL PATHWAYS TO MEANINGFUL REDUCTIONS 19–29 (2014).

195 *Id.* at 1–3.

196 *Id.* at 10–13.

197 *Id.* at 20–22.

198 *Id.* at 25–28.

199 Dallas Burtraw et al., *The Costs and Consequences of Clean Air Act Regulation of CO_2 from Power Plants*, 104 AM. ECON. REV. 577, 582–88 (2014).

200 *Id.* at 2.

201 *Id.*

202 *Id.* at 6.

203 *Id.* at 6, 8–11.

Table 1 – Comparison of proposed compliance plans for existing power plant rule

Plan and Baseline Period	GHG Emission Reduction	Costs	Benefits	Other Considerations
NRDC (2013) Baseline Period: 2008–2010	18%, 2020 v. 2012; 22%, 2020 v. 2020 for Reference Case	$4 billion	$25–60 billion (for public health- & climate change-related benefits)	1) Heavy emphasis on energy efficiency 2) Renewable energy generation also part of plan (based on RPSs) 3) 4% decrease in wholesale price of electricity
CATF (2014) Baseline Period: 2005	27%, 2020 v. 2005; 15%, 2020 v. 2020 for Base Case	$8.6–9.4 billion	$34 billion (for public health- & climate change-related benefits)	1) Mass-based better than rate-based standards to reduce GHG emissions 2) Separate coal & gas standards minimize wholesale electricity price increases, short-term
RFF (2014) Baseline Period: 2005	14%, cap-&-trade (revenues to government); 18%, cap-&-trade (revenues to customers); 19%, tradable performance standard (revenues to generators)	$3–7 billion	$34–38 billion (for SO_2- & climate change-related benefits)	1) Electricity price increase ranged from 1% (cap-&-trade, revenues to generators) to 9% (tradable performance standard, revenues to government)

A limitation of all of these proposals is their relatively modest GHG emission reductions; furthermore, they are conservative in their deployment of renewable power generation. Natural gas-fired generation is a key compliance measure in all proposals, as it is for EPA's BSER in its final rule.[204] A recent proposal by the Union of Concerned Scientists is instructive in that it promotes a more aggressive deployment of renewable generation.[205] This increased proportion of generation from renewable resources is achieved by using renewable growth rates during years 2009–2013 to set state targets for renewable generation. This deployment would reduce national GHG emissions by 40 percent (up from EPA's 32 percent) by year 2030, with an increase in electricity price of less than 1 percent.[206]

D. Narrowing Compliance to Renewable Power Generation

Western states have numerous measures available to comply with the Clean Power Plan, most notably EPA's building blocks that were used to determine state emission guidelines. The Rule's flexibility permits other technological measures such as improvement in transmission efficiency,[207] as well as economic measures such as a cap-and-trade system.[208] Nonetheless, given the widespread use of EPA's building blocks, it seems likely that states will heavily employ them as compliance measures. It is therefore important to examine strengths and weaknesses of each building block.

EPA's first building block, improvement in heat rate of affected EGUs, is a measure of limited utility. While EPA has estimated potential heat rate improvement to be 2.1 percent, 2.3 percent, and 4.3 percent for coal-fired EGUs in the WI, TI and EI, respectively,[209] other parties have noted the challenge of obtaining such improvement.[210] Furthermore, improving heat rate typically requires costly technological retrofitting of often-aging fossil fuel-fired generation infrastructure.[211] On the other hand, retirement of older, less efficient coal-fired EGUs will improve average affected

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204 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,795 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

205 UNION OF CONCERNED SCIENTISTS, STRENGTHENING THE EPA'S CLEAN POWER PLAN 3–7 (2014).

206 *Id.* at 4–5.

207 Carbon Pollution Emission Guidelines, 80 Fed. Reg. at 64,901.

208 *Id.* at 64,904–08.

209 *Id.* at 64,789.

210 Gordon Heft, *Heat Rate Improvements Can Be Challenging for Coal-Fired Plants Under Clean Power Plan*, BLACK & VEATCH, http://bv.com/Home/news/solutions/energy/clean-power-plan-heat-rate-improvements-challenge-coal-plants (last visited Apr. 17, 2015).

211 U.S. EPA, AVAILABLE AND EMERGING TECHNOLOGIES FOR REDUCING GREENHOUSE GAS EMISSIONS FROM COAL-FIRED ELECTRIC GENERATING UNITS 25–36 (2010).

EGU heat rate. This trend, already apparent due to EPA's MATS rule (see Section III), is likely to continue with implementation of the Clean Power Plan.

EPA's second building block, re-dispatch of less emission-intensive EGUs (instead of more emission-intensive EGUs), appears to be of greater utility. Dispatching a NGCC unit, which is usually a less emission-intensive EGU, instead of a coal-fired steam EGU, results in GHG emission reductions of approximately 50 percent at the site of power generation.[212] Natural gas availability for the EGU sector, at least in the western United States, has recently been shown to be adequate under most scenarios.[213] In addition, natural gas has been relatively cheap because of historically high U.S. production, making it competitive with coal. Nonetheless, there are concerns with using natural gas for power generation. First, fossil fuel prices are historically volatile, raising fears that reconfiguring fleet generation to use a high proportion of gas-fired EGUs may eventually raise electricity prices. Second, while CO_2 emissions are lower for natural gas than coal when power is generated, gas extraction and transmission release CH_4 emissions. The magnitude of these CH_4 emissions is currently uncertain, but this is the focus of intense investigation. It does appear that these emissions are greater than the U.S. GHG Inventory presently suggests.[214] Given that CH_4 is a GHG of much higher potency than CO_2,[215] it is possible that natural gas-fired EGUs are more GHG-intensive than coal-fired units over the power generation life cycle.[216] Finally, even if gas is less GHG-intensive than coal over the power life cycle, it may not be the ideal bridge fuel to a low-GHG power sector. If natural gas availability continues to be high, its use for power generation could fail to reduce GHG emissions significantly because of increased demand, which would delay the deployment of zero-GHG energy generation.[217]

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212 Carbon Pollution Emission Guidelines, 80 Fed. Reg. at 64,795.

213 ENERGY AND ENVTL. ECON., NATURAL GAS INFRASTRUCTURE ADEQUACY IN THE WESTERN INTERCONNECTION: AN ELECTRIC SYSTEM PERSPECTIVE 8–20 (2014).

214 A.R. Brandt et al., *Methane Leaks from North American Natural Gas Systems*, 343 SCIENCE 733, 733–35 (2014). The U.S. GHG Inventory currently indicates that the magnitude of CH_4 emissions over the natural gas life cycle is approximately 1 to 2 percent of gas production. Brandt and colleagues suggest that actual emissions are 25 to 75 percent greater than estimated by the U.S. GHG Inventory.

215 Drew T. Shindell et al., *Improved Attribution of Climate Forcing to Emissions*, 326 SCIENCE 716, 716–18 (2009). The global warming potential of CH_4 at 100 years is 34, meaning that it is 34 times greater than CO_2 in terms of its radiative forcing capacity 100 years after being emitted.

216 Tom M.L. Wigley, *Coal to Gas: The Influence of Methane Leakage*, 108 CLIMATIC CHANGE 601, 601–08 (2011).

217 *See* Haewon McJeon et al., *Limited Impact on Decadal-Scale Climate Change from Increased Use of Natural Gas*, 514 NATURE 482, 482–85 (2014); Richard G. Newell & Daniel Raimi, *Implications of Shale Gas Development for Climate Change*, 48 ENVTL. SCI. TECH. 8360,

EPA's third building block, re-dispatch of zero-emission generation, involves increased use of renewable power generation. For the types of renewable generation considered in this paper, GHG emissions associated with geothermal generation are minimal and no GHG emissions are associated with either wind or solar PV generation. An additional advantage of all three types of generation is that while capital costs of such projects are relatively high, operating costs (e.g., fuel costs) are low.

Renewable power generation does, however, have certain drawbacks. While geothermal generation can provide baseload power similar to fossil fuel-fired forms of generation, wind and solar PV generation are variable in their output. Wind and solar PV generation are dispatched as baseload generation when available because of their low operating costs, even though they are less reliable.[218] Integration of renewable generation is therefore challenging, and reliability of the electric grid can be compromised. These issues have been examined in some detail in recent years, with numerous solutions proposed. An insightful examination of these challenges and solutions, according to Duane and Griffith,[219] was conducted by the Regulatory Assistance Project for the Western Governors Association.[220] The Regulatory Assistance Project identified several strategies to integrate variable generation, including: expanding sub-hourly scheduling and dispatch; facilitating dynamic transfers between balancing authorities; implementing an energy imbalance market; improving weather, wind, and solar forecasting; leveraging geographic diversity of renewable resources; improving reserve management; improving use of demand response to complement renewable generation; improving flexibility of existing generation dispatch; and emphasizing flexibility of new generation.[221] The WI, with its many balancing authorities (nearly 40 in number), necessitates the use of many, if not most, of these strategies.[222] Balancing authorities perform the task of balancing electric power demand with the dispatch of power generation on a moment-to-moment basis. Several of the strategies are synergistic and should therefore be employed together.

8360–68 (2014); Christine Shearer et al., *The Effect of Natural Gas Supply on US Renewable Energy and CO_2 Emissions*, 9 ENVTL. RES. LETTERS 094008, 1–8 (2014).

218 Steven Ferrey, *Restructuring a Green Grid: Legal Challenges to Accommodate New Renewable Energy Infrastructure*, 39 ENVTL. L. 977, 987–88 (2009).

219 Timothy P. Duane & Kiran H. Griffith, *Legal, Technical, and Economic Challenges in Integrating Renewable Power Generation into the Electricity Grid*, 4 SAN DIEGO J. CLIMATE & ENERGY L. 1, 41 (2012–2013).

220 W. GOVERNORS' ASS'N, REGULATORY ASSISTANCE PROJECT, MEETING RENEWABLE ENERGY TARGETS IN THE WEST AT LEAST COST: THE INTEGRATION CHALLENGE 4–12 (2012).

221 *Id.* at 4–12.

222 *Id.* 2–3.

An example of synergistic strategies is an energy imbalance market, which is a market mechanism that allows dispatch of generation and transmission resources across balancing authorities to correct generation-demand differences.[223] A western United States energy imbalance market, consisting presently of the California Independent System Operator, PacifiCorp, and NV Energy, began operations in late 2014. It will add Puget Sound Energy, Arizona Public Service, Portland General Electric, and Idaho Power in 2016, 2016, 2017 and 2018, respectively.[224] In such a synergistic geographic arrangement, the diversity of renewable resources increases, the demand increases, and the transmission increases much more than it would at an individual level.[225] Technological diversity of renewable generation, if present, also creates synergies. Notably, in this market's first 20 months of operation, gross benefits of nearly $90 million were realized from market operation.[226]

Use of these strategies to integrate renewable generation should also mitigate reliability concerns. While certain elements of the Clean Power Plan such as the required renewable generation have been questioned because of reliability concerns,[227] other commentators have opined that compliance with this rule will not compromise reliability. For renewable generation, the technological and operational tools currently available already appear able to both integrate wind and solar generation at greater generation levels than required by the rule and maintain reliability of the grid.[228]

VI. Western State-Specific SIP-Like Plans Using Renewable Generation

This Section introduces a novel proposal for complying with the Clean Power Plan. The thesis is that compliance can be achieved exclusively by using EPA's third building block: zero-GHG-emitting, renewable power generation. I will use Colorado, Nevada, and Wyoming to illustrate how wind, solar, and/or geothermal resources can be utilized to achieve compliance with the Rule because these states are well-endowed with these renewable resources.

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223 Duane & Griffith, *supra* note 219, at 46–49.

224 *Energy Imbalance Market (EIM) Overview*, California ISO, http://www.caiso.com/informed/pages/eimoverview/default.aspx (last visited June 4, 2016).

225 *Id.*

226 California ISO, Benefits for Participating in EIM: Q2 Report 4–8 (2016).

227 North Am. Elec. Reliability Corp., Potential Reliability Impacts of EPA's Proposed Clean Power Plan: Phase I 29–35 (2015).

228 Adv. Energy Econ. Inst., NERC's Clean Power Plan 'Phase 1' Reliability Assessment: A Critique, 1–10 (2015).

The WI is one of three grids in the United States. The WI includes all or portions of Washington, Oregon, California, Nevada, Arizona, Idaho, Montana, Utah, Wyoming, Colorado, and New Mexico.[229] This Section explores power derived from wind, solar PV, and geothermal energy that is transmitted on the WI to comply with the Clean Power Plan.

The EPA standard of performance for affected fossil fuel-fired EGUs is a crucial part of the Clean Power Plan. This standard is expressed both as mass-based (expressed as CO_2 emission mass) and rate-based (expressed as CO_2 emission mass per unit of EGU output) emission guidelines in the Rule.[230] This Section relies on the rate-based guidelines. EPA calculated baseline emission rates for year 2012 and derived state-specific standards of performance by using emission and generation data from the Emissions and Generation Resource Integrated Database ("eGRID").[231] As a state with abundant wind and solar resources,[232] Colorado will be used as a representative western state to illustrate how a SIP-like plan involving wind- and solar PV-derived power generation to reduce CO_2 emissions could be developed. In addition, Nevada, which is well-endowed with both geothermal and solar resources,[233] will be used as a representative western state to illustrate how a SIP-like plan combining power generation from these two renewable resources could be developed. Finally, Wyoming, a state rich in wind resources,[234] will be used to illustrate how a SIP-like plan involving a single renewable resource could be developed. These three states are representative in that all western states are endowed with renewable resources. For example, Washington has potential to generate power from wind and California can generate power from all three GHG-free resources. This Section assumes that renewable generation will replace energy produced with fossil fuels. It also assumes that there will be either no growth in power demand or that any small increase in demand[235] will be offset by energy efficiency measures that are common in the WI. Further, the Section assumes that there will be no exporting or importing of electric generation by WI states. This assumption, while untrue for certain states in the WI,

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229 *WECC 101*, W. ELECTRICITY COORDINATING COUNCIL, https://www.wecc.biz/Pages/home.aspx. (last visited May 15, 2014).

230 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,824–25 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

231 *eGRID*, U.S. EPA, http://www.epa.gov/energy/egrid (last visited Oct. 15, 2015).

232 M.M. HAND ET AL., RENEWABLE ELECTRICITY FUTURES STUDY: RENEWABLE ELECTRICITY GENERATION AND STORAGE TECHNOLOGIES 10-3–10-5, 11-3–11-5 (2012).

233 *Id.* at 7-4–7-7, 10-3–10-5.

234 *Id.* at 11-3–11-5.

235 *Consumption & Efficiency*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/consumption (last visited Feb. 16, 2015).

is necessary to make our modeling relatively straightforward. I used a spreadsheet-based model to derive required renewable generation additions. Finally, I assume that compliance with the Existing Power Plant Rule will be achieved over years 2018–2030.

This Section assumes that EPA's emission standards state plans, which are SIP-like plans to comply with federally-enforceable emission guidelines, will operate.[236] Importantly, states can earn Emission Rate Credits ("ERCs") for each MWh of power generated from renewable resources, and these ERCs can be used to comply with a state's rate-based emission guideline.[237]

A. Colorado

In 2012, power generation by affected fossil fuel-fired EGUs in Colorado totaled approximately 42 million MWh (Table 2).[238] The weighted average emission rate for these EGUs in 2012 was 1,973 pounds of CO_2 per MWh.[239] To achieve EPA's required 40.5 percent reduction in this fossil-fired emission rate, more than 17 million MWh of fossil fuel-fired power generation will need to be replaced by renewable generation, as illustrated in Table 2 below.[240] Colorado's 2012 capacity factors (averages, weighted for generation) for wind (26 facilities) and solar PV generation (20 facilities) are shown in Table 3.[241] These factors mean that the state's wind generators created approximately 35 percent of their nameplate power generation capacities in 2012, while its solar PV generators generated roughly 24 percent of their nameplate power generation capacities.[242] Geographic diversity in renewable EGUs is therefore desirable, as noted in Section IV, so that renewable generation is spatially heterogeneous; that is, certain renewable generators or groupings of generators generate during one time period while others generate during different time periods. Supplementing production from

236 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,832–34 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

237 *Id.* at 64,834.

238 *eGRID*, U.S. EPA, *supra* note 231.

239 *Id.*

240 Carbon Pollution Emission Guidelines, 80 Fed. Reg. at 64,824.

241 *eGRID*, U.S. EPA, *supra* note 231.

242 In contrast to these relatively low capacity factors for wind and solar PV generators, the weighted average capacity factor for Colorado's affected fossil fuel-fired EGUs was 0.6228 in 2012. This illustrates an important requirement for replacement of fossil fuel-fired electric generation with renewable resource-derived generation: due to their lower capacity factors, greater nameplate capacities for renewable generators must be available in order for renewable resources to replace fossil fuels for generation.

wind with solar PV generation can mitigate these relatively low capacity factors.

Table 2 – Power generation by affected fossil fuel-fired EGUs and its reduction required by the Clean Power Plan

State	Generati-on of Affected EGUs (MWh)	Genera-tion Lost in Reducing Emissions from Affected EGUs (MWh)	Weighted Emission Rate of Affected EGUs (2012; pounds/MWh)	Weighted Emission Rate of Affected EGUs (2030; pounds/MWh)	Required Reduction in Emission Rate of Affected EGUs (%)
Colorado	42,337,119	17,146,533	1,972.73	1,173.78	40.5
Nevada	28,196,769	6,316,076	1,102.02	855.17	22.4
Wyoming	42,907,427	19,007,990	2,330.54	1,298.11	44.3

Table 3 – Renewable power generation to replace fossil fuel-fired generation lost in complying with the Clean Power Plan

State – Renewable Generation	Contribution to Fossil Generation Replacement (%)	Weighted Capacity Factor (2012; unitless)	Generation Replaced (MWh)	Nameplate Capacity Required (MW)
Colorado - Wind	97	0.3496	16,632,137	3392
Colorado – Solar PV	3	0.2382	514,396	138
Nevada - Geothermal	88	0.5693	5,558,147	535
Nevada – Solar PV	12	0.2003	757,929	212
Wyoming -Wind	100	0.3507	19,007,990	4653

Table 3 details the nameplate capacities of wind and solar PV power generation that must be added by the year 2030 in order to replace the 17 million MWh generated by affected fossil fuel-fired EGUs in 2012 at a capacity factor of 0.6228. The renewable mix of 97 percent wind generation and 3 percent solar PV generation is identical to the ratio of wind and solar PV produced by Colorado in 2012.[243] By year 2030, wind nameplate capacity would need to increase by a factor of 1.48 above the 2012 capacity of 2,299 MW. Likewise, by 2030, solar PV nameplate capacity would need to increase by a factor of 1.71 above 2012's capacity of 81 MW. While these goals are relatively aggressive, Colorado's availability of solar resources, for example, is equal to or greater than 6.5 kWh per square meter per day for most of the state's land area.[244] Using a land requirement of 0.0356 square kilometers per MW of solar PV nameplate capacity, the land area required to achieve its solar goals would be only about five square kilometers.[245] This appears even more realistic after considering recent historical trends, as utility-scale solar PV power generation nameplate capacity has grown at an annual rate of more than 140 percent nationally between 2009 and 2013.[246] The required annual growth rate in Colorado between 2018 and 2030 is only 13.2 percent. Trends are similarly positive for wind power. While Colorado has a required annual growth of 11.4 percent for wind-generating nameplate capacity, this is in line with the annual national growth of 15 percent over the past five years.[247]

B. Nevada

In 2012, power generation by affected fossil fuel-fired EGUs in Nevada totaled 28 million MWh, as indicated in Table 2.[248] The weighted average emission rate for Nevada's fossil fuel-fired EGUs in 2012 was approximately 1,100 pounds of CO_2 per MWh.[249] To achieve EPA's

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243 *eGRID*, U.S. EPA, *supra* note 231.

244 RYAN PLETKA & JOSH FINN, WESTERN RENEWABLE ENERGY ZONES, PHASE 1: QRA IDENTIFICATION TECHNICAL REPORT 4-33–4-45 (2009).

245 SEAN ONG ET AL., LAND USE REQUIREMENTS FOR SOLAR POWER PLANTS IN THE UNITED STATES v (2013). With a solar resource of 6.5 kWh per square meter per day, 4.92 square kilometers would need to be occupied by solar PV panels in order to satisfy the approximately 140-MW requirement. This requirement represents a fraction of 1 percent of Colorado's land area.

246 MARK BOLINGER & SAMANTHA WEAVER, UTILITY SCALE SOLAR 2013: AN EMPIRICAL ANALYSIS OF PROJECT COST, PERFORMANCE, AND PRICING TRENDS IN THE UNITED STATES 6 (2014).

247 AM. WIND ENERGY ASS'N, AWEA U.S. WIND INDUSTRY ANNUAL MARKET REPORT YEAR ENDING 2013 (2013).

248 *eGRID*, U.S. EPA, *supra* note 231.

249 *Id.*

required 22.4 percent reduction in this fossil-fired emission rate, more than six million MWh of fossil fuel-fired power generation will need to be replaced by renewable generation (Table 2).[250] Nevada's 2012 capacity factors (averages, weighted for generation) for geothermal (54 facilities) and solar PV generation (14 facilities) are shown in Table 3.[251] Table 3 also details the nameplate capacities of geothermal and solar PV power generation that must be added by the year 2030 in order to replace the six million MWh generated by affected fossil fuel-fired EGUs in 2012 at a capacity factor of 0.4809. The renewable generation mix of 88 percent geothermal generation and 12 percent solar generation mirrors the year 2012 mix of these two resources in Nevada.[252] By 2030, both geothermal and solar PV nameplate capacities would need to be essentially doubled over 2012 capacities: 535 MW for geothermal, and 219 MW for solar power. This goal for solar PV power generation growth (7.5 percent) is even less aggressive than that for Colorado. Geothermal generation, however, will be required to grow at an annual rate of 7.7 percent in Nevada, far steeper than the U.S. annual growth rate of 4 percent from 2009 to 2013.[253]

C. Wyoming

In 2012, power generation by affected fossil fuel-fired EGUs in Wyoming totaled nearly 43 million MWh, as shown in Table 2.[254] The weighted average emission rate for Wyoming's affected fossil fuel-fired EGUs in 2012 was 2,330 pounds of CO_2 per MWh.[255] To achieve EPA's required 44.3 percent reduction in this fossil-fired emission rate, approximately 19 million MWh of fossil fuel-fired power generation will need to be replaced by renewable generation (Table 2).[256] Wyoming's 2012 capacity factor (average, weighted for generation) for wind generation (30 facilities) is shown in Table 3.[257] Table 3 provides the nameplate capacity of wind power generation that must be added by the year 2030 in order to replace the 19 million MWh generated by affected fossil fuel-fired EGUs in 2012 at a capacity factor of 0.7519. Wind

250 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,824 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

251 *eGRID*, U.S. EPA, *supra* note 231.

252 *Id.*

253 This figure was calculated using the Geothermal Energy Association's annual reports from 2009–2013. GEOTHERMAL ENERGY ASS'N, 2013 ANNUAL U.S. & GLOBAL GEOTHERMAL PRODUCTION REPORT 13 (2014).

254 *eGRID*, U.S. EPA, *supra* note 231.

255 *Id.*

256 Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,824 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

257 *eGRID*, U.S. EPA, *supra* note 231.

nameplate capacity by 2030 would need to be increased 3.25 times above 2012's capacity of 1433 MW. A goal of increasing wind generation capacity by 25 percent annually is aggressive compared to the 15 percent annual national growth rate for the past 5 years, but nonetheless attainable in a favorable policy environment, given the magnitude of Wyoming's wind resources.

D. Are These Additions in Renewable Power Generation Reasonable?

This additional renewable power generation at or above the level of annual growth is attainable for several reasons. First, if states began deploying renewable generation starting in 2013 rather than 2018 (as assumed in the model), required annual growth will be less. Wind generation in Wyoming, for example, would be required to grow at just 18 percent per year instead of 25 percent annually if deployment was initiated in 2013. Second, this article used 2012 capacity factors for wind, solar PV, and geothermal generation. However, it is likely that capacity factors will increase over time, meaning that lower renewable generation nameplate capacity additions than derived here will be needed to provide for identical generation. Third, the article assumed that renewable generation mixes from 2018 to 2030 would remain identical to those in 2012. This assumption may be flawed in that optimal mixes may change with time due to factors such as renewable technology cost reductions and annual technology growth. Altered renewable generation mixes may reduce nameplate capacity additions needed for compliance. Fourth, the EPA has included an optional Clean Energy Incentive Program ("CEIP") in the Clean Power Plan. The CEIP allows renewable generators constructed after state SIP-like plan submission (in either 2016 or 2018) that generate power in years 2020 and/or 2021 to earn ERCs, matched by EPA, for zero-emission generation. The CEIP will incentivize states to accumulate ERCs because they can be used to reduce a state's emission rate starting in 2022.[258] Finally, retirement of older and more emission-intensive, coal-fired steam EGUs will necessarily decrease CO_2 emission rates for states, reducing the need for renewable generation additions in order to comply with state emission guidelines. Several such coal-fired EGUs in the WI, although included in the 2012 baseline data, are to be retired prior to 2030. For all of these reasons the article's derived deployment of renewable power generation in the representative western states is likely greater than what will actually be required.

It is instructive to compare our findings for renewable power generation required to comply with state emission guidelines with the

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[258] Carbon Pollution Emission Guidelines, 80 Fed. Reg. at 64,829–32.

findings of Jacobson and colleagues.[259] These investigators determined roadmaps to power all energy systems (i.e., electricity, transportation, heating/cooling, and industry) using only renewable power generation by year 2050 for all 50 states. This scenario, dubbed wind, water and sunlight ("WWS"), uses the following to generate renewable power: onshore wind, offshore wind, utility-scale solar PV, rooftop solar PV, concentrating solar (with storage), geothermal, wave, tidal, and hydroelectric power technologies.[260] Nationally, approximately 31 percent would come from onshore wind, 31 percent would come from utility-scale solar PV, and one percent would come from geothermal power generation under the WWS scenario.[261]

Table 4 presents this article's year 2030 proportions of total state power generation by these technologies for Colorado, Nevada, and Wyoming, as well as the proportions derived by Jacobson and colleagues for year 2050 in the same states. It is apparent that for both wind and geothermal generation, this article's derived proportions for year 2030 are similar to Jacobson's 2050 proportions for all three states. Solar PV generation, on the other hand, would be relatively less well-developed than under the WWS scenario. It is important to recognize that the rest of Jacobson's state power generation totals are also provided by renewable technologies, whereas this article's state remainders are primarily met by fossil fuel-fired generation. Jacobson and colleagues note that their WWS scenario would be associated with a net increase in employment, as well as reduced premature, air pollution-related mortality and climate change costs.[262] They further note that the WWS scenario is technically and economically feasible, with only social and political barriers to its adoption.[263]

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259 Mark Z. Jacobson et al., *100% Clean and Renewable Wind, Water, and Sunlight (WWS) All-Sector Energy Roadmaps for the 50 United States*, 8 ENERGY ENVTL. SCI. 2093, 2093–117 (2015).

260 *Id.* at 2094.

261 *Id.* at 2099.

262 *Id.* at 2108–09, 2111–12.

263 *Id.* at 2115.

Table 4 – Comparison of proportions of total state power generation derived from renewable resources in complying with the Clean Power Plan and those from the WWS scenario

Renewable Generation Technology	Colorado	Nevada	Wyoming
Wind	43.12 (55.00)	NA*	47.14 (65.00)
Solar PV	1.20 (17.56)	3.16 (19.23)	NA
Geothermal	NA	22.62 (30.00)	NA

Values are percentages of total state power generation in year 2030; values in parentheses are from WWS scenario of Jacobson and colleagues in year 2050.[264]
*NA indicates not applicable.

VII. PUBLIC POLICY

Under the scenario proposed in this article, where compliance will be achieved exclusively by renewable energy deployment, required growth in renewable power generation will need to match or even exceed the recent growth exhibited by most renewable technologies. First, I will examine state policy. Next, I will focus on federal policy, specifically funding policy for renewable energy deployment, as well as review of renewable power generation projects from an environmental perspective. I will subsequently provide several recommendations to accelerate deployment of renewable power generation.

In the absence of federal legislation targeting the reduction of climate change, state action to reduce GHG emissions has been critical. Given that states have primary control over both electricity retail sales and land use, it is unsurprising that state government has been the sole architect of RPSs and GHG emission reduction programs.[265] California, for example, has enacted legislation for both RPS (SB1078) and GHG emission reduction purposes (AB32).[266] RPSs are now in place for 29 states and the

264 *Id.* at 2099.

265 Timothy P. Duane, *Greening The Grid: Implementing Climate Change Policy Through Energy Efficiency, Renewable Portfolio Standards, And Strategic Transmission System Investments*, 34 VT. L. REV. 711, 718 (2010).

266 Ivan Gold & Nidhi Thakar, *Survey of State Renewable Portfolio Standards: Square Pegs for Round Climate Change Holes*, 35 WM. & MARY ENVTL. L. & POL'Y REV. 183, 210–18 (2010).

District of Columbia, with an additional six states having voluntary renewable energy standards. These RPSs and voluntary standards have been put in place by either state legislative action or a governor's executive order.[267] All of these RPSs and voluntary standards have wind and solar as eligible forms of renewable generation, and a large majority also include geothermal as an eligible form of generation.[268] Importantly, nuclear and large hydroelectric generation do not benefit from most state RPS programs.[269]

Although most state RPSs were developed for purposes other than mitigating climate change (e.g., to diversify power generation), greater renewable power generation can reduce the impacts of climate change and will be instrumental in stabilizing atmospheric CO_2 concentration at either 450 or 550 parts per million.[270] Given that climate change impacts such as decreased water availability will be felt particularly acutely in the arid western United States, these states have an increased incentive to develop RPSs and GHG emission reduction programs. Further, a combination of RPSs and GHG emission reduction programs appears to be more effective than either approach in isolation.[271] Table 5 details RPSs and voluntary standards in western states. Importantly, state RPSs have recently been shown to have relatively low associated costs.[272] Estimated incremental RPS compliance costs, on a weighted-average basis, were 0.9 percent of retail electricity sales when considering all states.[273] Several studies quantified the value of reduced emissions,[274] but rigorous cost-benefit analysis was not possible because of the paucity of benefit data.

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267 Duane, *supra* note 265, at 760.

268 Gold & Thakar, *supra* note 266, at 193, 214–15.

269 *Id.* at 215.

270 Gunnar Luderer et al., *The Role of Renewable Energy in Climate Stabilization: Results from the EMF27 Scenarios*, 123 CLIMATIC CHANGE 427, 427–41 (2014).

271 *See* Gold & Thakar, *supra* note 266, at 234–38; Felix Mormann, *Requirements for a Renewables Revolution*, 38 ECOLOGY L.Q. 903, 909–12 (2011).

272 J. HEETER ET AL., A SURVEY OF STATE LEVEL COST AND BENEFIT ESTIMATES OF RENEWABLE PORTFOLIO STANDARDS iv–vii (2014).

273 In states with restructured markets, costs ranged from $2 per MWh to $48 per MWh. In traditionally-regulated states, costs ranged from -$4 per MWh (i.e., no net cost) to $44 per MWh.

274 Benefits ranged from $4 per MWh to $23 per MWh.

Table 5 – Renewable portfolio standards and voluntary standards for Western U.S. states[275]

State	Renewable Energy Goal (% retail sales)	Year for Goal Attainment	Utilities Covered (%)
Arizona	15	2025	59
California	50	2030	99
Colorado	30	2020	97
Idaho	none	none	none
Montana	15	2015	60
Nevada	25	2025	88
New Mexico	20	2020	88
Oregon	50	2040	100
Utah	20	2025	NA
Washington	15	2020	88
Wyoming	none	none	none

Values for Renewable Energy Goal and Year for Goal Attainment are for large, investor-owned utilities ("IOUs"); values for Utilities Covered are for all utility types (IOUs, cooperatives, municipal utilities). Utah has voluntary Renewable Energy Goal only. NA, not applicable.

While state governmental RPSs and GHG emission reduction programs can and will influence renewable energy deployment, deploying wind, solar PV, and geothermal generation in the magnitudes detailed in Section VI (up to 325 percent above 2012 levels) will be challenging without federal assistance. Federal energy policy, and particularly policies relating to financial support of renewable power generation projects and environmental review, will be of great importance. The following two sub-sections will focus on these federal policy areas.

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[275] Gold & Thakar, *supra* note 266, at 196–205. Note that since Gold & Thakar published their article, both California and Oregon have increased their RPSs. For frequently updated figures for each state, see *Summary Maps*, *Database of State Incentives for Renewables & Efficiency (DSIRE)*, http://programs.dsireusa.org/system/program/maps (last visited Aug. 12, 2016).

A. Financial Support Policies

Virtually all participants in the national energy sector are supported by at least one federal subsidy. Although subsidies specific to renewable energy technologies have recently been criticized, some have proposed elimination of all energy sector subsidies under the assumption that the most competitive technologies would then prevail. However, this assumption overlooks the inherent advantages incumbent energy technologies, particularly those fired by fossil fuels, would enjoy in a market without federal subsidies.[276] Indeed, continuing federal subsidies are arguably necessary considering the relative competitive disadvantage of renewable energy technologies.[277] Another assumption of subsidy elimination is that all costs would be internalized, but the costs of GHG emissions associated with fossil fuel use are not presently internalized, with California and the northeastern states participating in RGGI being exceptions. Further, as noted in Section IV, it is unlikely that GHG emission costs will be internalized near-term using either a carbon tax or a cap-and-trade program. Thus, any policy resting on the idea of perfect competition between fossil fuel-fired power generation and renewable generation is likely to fail.[278] I therefore consider policies promoting renewable energy deployment with the assumption that GHG emissions will remain an externality of fossil fuel use and that some subsidies for all energy technologies will remain in effect. While some have argued that taxing GHG emissions is the best policy and issuing tax credits for renewable energy deployment is second-best,[279] it appears that the latter is the only presently feasible option.

The goal of all policies aimed at increasing renewable energy deployment is to promote private sector investment in renewable power generation projects, which are laden with risks and uncertainties.[280] Traditional barriers to renewable energy deployment include large initial capital investment requirements, a fickle market for renewable energy, and behavioral factors.[281] Felix Mormann[282] examined several policies,

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276 An example of such an advantage is the infrastructure for fossil fuel delivery that was funded in part by subsidies.

277 Craig A. Hart & Dominic Marcellino, *Subsidies or Free Markets to Promote Renewables?*, 3 RENEWABLE ENERGY L. & POL'Y REV. 196, 197–98 (2012).

278 *Id.* at 196–97.

279 *See* David Rokeach & Glenn Schatz, *From Subsidies to Markets: Pursuing a More Effective American Energy Policy*, 3 RENEWABLE ENERGY L. & POL'Y REV. 187, 191 (2012); David Weisbach, *Designing Subsidies for Low-Carbon Energy*, 20 J. ENVTL. & SUSTAINABILITY L. 1, 13 (2013).

280 Felix Mormann, *Enhancing the Investor Appeal of Renewable Energy*, 42 ENVTL. L. 681, 687 (2012).

281 *Id.* at 704–05.

282 *Id.* 695–04.

including feed-in tariffs,[283] tender regimes,[284] tax incentives,[285] and RPSs,[286] and for each policy analyzed its efficacy[287] and efficiency[288] in promoting wind and solar energy deployment. Data for Mormann's analysis came from a 2008 International Energy Agency study of renewable energy deployment in 35 nations.[289] For deployment of wind energy, feed-in tariffs were more efficacious than RPSs, with seven of the top eight countries employing this policy.[290] Feed-in tariffs were also more efficient than RPSs, tender regimes, or tax incentives, with nine of the top ten countries using tariffs. For solar energy deployment, feed-in tariffs were more efficacious than RPSs.[291] While Mormann's analysis resoundingly points to feed-in tariffs as the policy of choice for renewable energy deployment, tariffs have not gained traction in the United States, either at the federal[292] or state level,[293] in contrast to many European countries. Tender regimes are also not employed in the United States.[294] Thus, RPSs and federal tax incentives are the chief policies available to promote national renewable energy deployment. Given that RPSs are firmly established in a majority of states, this paper focuses on federal tax incentives. Although direct subsidies, such as those for research and development, support the energy sector to a limited extent, tax incentives such as tax credits are larger in monetary value.[295]

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283 Feed-in tariffs require utilities to buy power from renewable generators at subsidized rates that are greater than retail rates, over long-term periods. Tariffs are technology-specific, and are typically adjusted downward as renewable energy technologies mature.

284 Tender regimes involve renewable generators submitting bids in response to government solicitations for power that are quantity- and technology-specific. Similar to feed-in tariffs, tender regimes include premiums in excess of retail electricity rates.

285 In the United States, as well as other countries, the principal tax incentive is a production tax credit. Qualifying renewable generators are awarded tax credits for each unit of power generated.

286 A RPS requires utilities to source a certain proportion of their power sales from renewable generators. Utilities can generate the renewable power themselves, purchase it (as documented by its associated renewable energy credits ("RECs")), or purchase so-called unbundled RECs, i.e., RECs sold separately from power. RECs provide an additional revenue stream for renewable power generators.

287 Mormann defines efficacy as growth in renewable power generation relative to mid-term (i.e., year 2020) renewable power potential. Mormann, *supra* note 280, at 697–98.

288 Mormann defines efficiency as growth in renewable power generation relative to financial support required; financial support is the total remuneration involved, e.g., for a RPS, market price of power plus value of RECs. Mormann, *supra* note 280, at 698.

289 INT'L ENERGY AGENCY, DEPLOYING RENEWABLES: PRINCIPLES FOR EFFECTIVE POLICIES, 15–26, 100–08, 121–28 (2008).

290 Data for tender regimes and tax incentives were inconclusive.

291 Tender regime and tax incentive data were again inconclusive and conclusions could not be drawn for efficiency.

292 Felix Mormann, *Beyond Tax Credits: Smarter Tax Policy for a Cleaner, More Democratic Energy Future*, 31 YALE J. ON REG. 303, 309–10 (2014).

293 Hart & Marcellino, *supra* note 277, at 200–01.

294 Mormann, *supra* note 280, at 695.

295 Rokeach & Schatz, *supra* note 279, at 188.

Existing tax incentives in the United States include accelerated depreciation rates applied to income taxes, as well as the Production Tax Credit ("PTC") and the Investment Tax Credit ("ITC"). Regarding accelerated depreciation, the federal tax code depreciates wind and solar PV generation equipment over five years, although most equipment is effective for 20 years or longer.[296] This shorter depreciation schedule is of greater net present value to a renewable energy developer. Accelerated depreciation is not, however, unique to renewable power generation projects; it also applies to many other capital assets in order to promote economic growth.[297] Both tax credits, which are unique to the renewable energy sector, have been characterized by uncertainty over whether Congress will renew these measures. The PTC has particularly suffered; with Congress variably allowing the credit to lapse or extending it by only two to three years, the PTC has not been utilized fully and has subsequently fallen short in incentivizing renewable investment.[298] A related difficulty is that environmental review of renewable generation projects is frequently lengthy and PTC availability may lapse while environmental review is occurring.[299] This reality may convince a developer relying on the PTC to restrict the project scope to what can be made operable prior to tax credit expiration, rather than utilize a scope closer to project potential.[300]

The Energy Policy Act of 1992 established the PTC.[301] Eligible forms of renewable power generation for claiming the PTC have increased from only wind and biomass-derived generation in 1992 to include most forms of renewable power generation.[302] As its name suggests, the PTC provides a tax credit for each MWh of electricity produced[303] over the first ten years of facility operation. The ITC, established by the Energy Tax Act of 1978, is an investment-based tax credit.[304] The credit is one-time and must be used in the year that the project begins operating; its value, however, vests

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296 Mormann, *supra* note 292, at 312–13.

297 *Id.* at 311.

298 Kevin M. Walsh, *Renewable Energy Financial Incentives: Focusing on Federal Tax Credits and the Section 1603 Cash Grant: Barriers to Development*, 36 ENVIRONS ENVTL. L. & POL'Y J. 207, 212 (2013).

299 *See id.* at 219–25; Mitchell Ward, *The PTC and Wind Energy: Restructuring the Production Tax Credit as a More Effective Incentive*, 11 HOUS. BUS. & TAX L.J. 455, 463–65 (2011).

300 Ward, *supra* note 299, at 464.

301 *Id.* at 460.

302 Mormann, *supra* note 292, at 313.

303 The PTC is currently $23 per MWh of wind, geothermal, and biomass generation, and $11 per MWh of other types of renewable power generation.

304 The ITC is currently equal to 30 percent of the renewable energy project's qualifying costs. It will be reduced to 10 percent in 2022.

over five years.[305] It is available for most renewable energy technologies, excluding large wind generation projects.

To fully utilize the PTC, an investor must have sufficient tax equity. Tax equity is equivalent to tax liability; that is, the amount of federal tax(es) for which a firm is liable. Typically only large institutions like investment banks and insurance companies meet this requirement, resulting in a very small pool of potential investors.[306] The same restrictions apply to the ITC tax credit, but at an even more heightened level.[307] Using a tax equity investor involves a partnership structure in which the equity investor is the majority equity partner in early project years, and receives cash flows and tax credits. Later in the project, the partnership flips so that the investor becomes the minority equity partner; at that time, the project developer becomes the majority equity partner and receives cash flows and tax credits.[308] This arrangement is termed a partnership-flip structure.

These tax credits have seemingly been effective policies for increasing renewable energy deployment, as renewable generating capacity has grown substantially coincident with their availability. Still, the proportion of the United States power mix accounted for by renewable generation (excluding hydroelectric power), remains at less than 10 percent, despite billions of dollars in federal subsidies.[309] This warrants a critical examination of subsidy efficiency. A convenient counterfactual to tax credits is the section 1603 cash grant. The cash grant, which was equal to up to 30 percent of qualifying costs of a renewable project and could be taken in lieu of the PTC or ITC, was available from year 2009 through 2011.[310] Analysis has shown that the PTC had approximately $10 billion in tax credits associated with deployment of 19,000 MW of wind-generating capacity between years 2005 and 2008. The section 1603 cash grant, on the other hand, would have achieved similar deployment for $5 billion.[311] This comparison illustrates the relative inefficiency of the PTC, and raises the question of what contributes to this inefficiency. The aforementioned small pool of potential PTC investors is one contributor, as is the investment risk that accompanies participation in the PTC program. Both factors lead to a premium of up to eight percent above normal rates being exacted from project developers for investor

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305 Mormann, *supra* note 292, at 315.

306 *See* Walsh, *supra* note 298, at 235–36; Mormann, *supra* note 292, at 315–16.

307 Mormann, *supra* note 292, at 322.

308 *Id.* at 331.

309 *Id.* at 305.

310 Walsh, *supra* note 298, at 215–16. Up to 30 percent of project qualifying costs could be claimed as a grant.

311 Mormann, *supra* note 292, at 320–22.

participation.[312] This premium reduces PTC efficiency. Consistent with this notion, when the cash grant was available, at least two-thirds of wind generation project developers opted for the grant instead of using the PTC.[313] Thus, tax equity partnerships for renewable energy developers represent a scarce and expensive source of partners. These weaknesses, in turn, result in tax credits being relatively inefficient subsidies to promote renewable energy deployment. Nonetheless, the PTC and ITC have endured, possibly because tax expenditures are not as heavily scrutinized as spending measures such as the section 1603 cash grant.[314]

It seems clear that changes are required in order to improve efficiencies of the PTC and ITC. Ward[315] offers several suggested improvements, including:

> 1. Lengthening the duration of tax credit extensions and avoiding lapses in their availability. This will reduce uncertainty, therefore enhancing investment, better ensuring that projects begin operation when credits are available. In late 2015, both the PTC and ITC were extended as part of federal legislation. The PTC will remain available at its full value through the end of 2016, but will progressively decrease thereafter and expire at the end of year 2019. The ITC will be available at full value until 2019, but will decrease to and remain at 10 percent in year 2022.
>
> 2. Increasing investor pool size by relaxing the tax equity requirements. Currently, the tax equity requirements limit this pool to large corporate investors; this pool should be expanded to lower-income investors.
>
> 3. Retrofitting to improve wind generation must currently exceed 80 percent of facility value to permit re-qualifying for the PTC. While the PTC's production-based nature encourages best available technology, the retrofitting requirement is too stringent, discouraging retrofits that would improve production.

Mormann goes beyond modifications to the PTC and ITC, suggesting their replacement with other tax incentives.[316] Master limited partnerships ("MLPs") and real estate investment trusts ("REITs"), both tax-privileged structures, can been used to promote investment in the fossil fuel sector. Both the MLP and the REIT combine a corporation's fund-raising advantages with a partnership's tax advantages.[317]

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[312] *Id.* at 327–28.
[313] *Id.* at 323.
[314] *Id.* at 338.
[315] Ward, *supra* note 299, at 480–86.
[316] Mormann, *supra* note 292, at 340.
[317] *Id.* at 340.

A MLP consists of one (or more) general partner and, typically, thousands of limited partners. The latter provide capital and receive cash distributions. The tax privilege involved is taxation restricted to the limited partners; the MLP entity is not subject to taxation.[318] Unfortunately, MLPs currently must derive their income in part from exhaustible resources and renewable resources are explicitly excluded.[319] The first MLP was formed by the oil and gas sector in 1981.[320] REITs require that 75 percent of their assets consist of real estate interests. The remaining 25 percent of assets are, however, not defined and could include renewable energy assets.[321] REITs are tax-privileged in that, provided at least 90 percent of their taxable income is distributed to shareholders, only the remaining 10 percent or less of income is taxed at the entity level.[322] Shareholders' distributions are taxed as part of their gross incomes. Mormann argues that MLPs and REITs have the potential to lessen investor premium compared with either the PTC or ITC.[323] Other advantages of MLPs and REITs include reductions in project financing structure complexity and transaction costs. It would be necessary, however, for Congress to amend the tax code so that renewable resources also qualify for MLPs.

B. Environmental and Related Issues

Unlike financial support policies, federal and state environmental statutes and the regulations that they authorize cannot be readily modified. Additionally, renewable power generation projects must also pass muster regarding federal environmental compliance. Nonetheless, procedural modifications could accelerate environmental review and place greater emphasis on certain factors such as benefits to the environmental that are considered during the process. My approach here will be to first consider statutes affecting renewable energy deployment in general, and then examine how these and other statutes specifically impact wind, solar, and geothermal energy deployment. Procedural modifications will then be proposed.

The National Environmental Policy Act ("NEPA") of 1970[324] has many requirements for renewable power generation projects. While NEPA is procedural in nature, it does require federal agencies to both

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318 *Id.* at 341–42.
319 *Id.*
320 *Id.* at 343–44.
321 *Id.* at 342–43.
322 *Id.* at 342–43.
323 *Id.* at 356.
324 42 U.S.C. § 4321.

review environmental impacts and consider mitigation measures for those impacts prior to decision-making. Renewable generation projects will trigger NEPA when the project is on federal land, when a project receives federal funding, or when it involves a threatened or endangered species.[325] NEPA analysis can be abbreviated, through an Environmental Assessment ("EA"), or more intensive, as with an Environmental Impact Statement ("EIS").[326] Since an EIS, if required, can be both lengthy and expensive, environmental review can impact project planning. As noted above in discussing financial support policies, lapses in availability of either the PTC or ITC have impacted renewable generation projects due to ongoing NEPA analysis at the time that the tax credit lapsed. An action that should accelerate environmental review for projects proposed for federal lands has been issuance of Programmatic EISs ("PEISs") for wind,[327] solar[328] and geothermal generation projects on federal land.[329] These PEISs, issued by the Bureau of Land Management ("BLM"), cover federal lands in the western United States with high-quality renewable energy resources.[330] Proposed projects can develop site-specific EISs to supplement a PEIS, presumably resulting in faster environmental review. In addition to the federal environmental review process, there are also many state analogs of NEPA that must be complied with. In most states, federal and state NEPA analyses are conducted simultaneously.[331]

In addition to NEPA, the National Historic Preservation Act of 1966[332] can impact renewable energy projects in the western United States. It must be determined whether or not project development impacts historic properties or cultural resources that qualify for listing on the National Register of Historic Places.[333] Native American properties and resources,

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325 HOLLY DOREMUS ET AL., ENVIRONMENTAL POLICY LAW 228–29, 252–53 (2008).

326 *Id.* at 431–32.

327 U.S. DEP'T OF THE INTERIOR, U.S. BUREAU OF LAND MGMT, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT ON WIND ENERGY DEVELOPMENT ON BLM-ADMINISTERED LANDS IN THE WESTERN UNITED STATES (2005).

328 U.S. DEP'T OF THE INTERIOR, U.S. BUREAU OF LAND MGMT, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (PEIS) FOR SOLAR ENERGY DEVELOPMENT IN SIX SOUTHWESTERN STATES (2012).

329 U.S. DEP'T OF THE INTERIOR, U.S. BUREAU OF LAND MGMT, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR GEOTHERMAL LEASING IN THE WESTERN UNITED STATES (2008).

330 *New Energy for America*, U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MGMT, http://www.blm.gov/wo/st/en/prog/energy/renewable_energy.html (last visited June 6, 2016).

331 Amy Wilson Morris & Jessica Owley, *Mitigating the Impacts of the Renewable Energy Gold Rush*, 15 MINN. J.L. SCI. & TECH. 293, 328–29 (2014).

332 16 U.S.C. § 470.

333 Roger L. Freeman & Ben Kass, *Siting Wind Energy Facilities on Private Land in Colorado: Common Legal Issues*, 39 COLO. LAW. 43, 49 (2010).

for example, are frequently encountered on the sites of western U.S. renewable power generation projects.

1. Wind Energy

Wind power generation impacts bird and bat species.[334] While bird deaths attributable to wind turbines are relatively few in number,[335] this impact is still an issue to be considered.[336] It is of particular concern with threatened or endangered bird and bat species. The Endangered Species Act ("ESA") of 1973 protects these species in that it prohibits "taking" them under section 7 (if a federal agency is involved in the project) or section 9 (for a non-federal project).[337] Section 10 of the ESA does allow the Fish and Wildlife Service ("FWS"), one of the federal agencies responsible for enforcing the ESA, to issue incidental take permits which allow for a limited number of species takings. These permits require mitigation of impacts on the species via habitat conservation plans.[338] Similar to NEPA, there are also state analogs to ESA that must be satisfied.[339]

Two other federal statutes can also impact wind generation projects. First, the Migratory Bird Treaty Act of 1918 protects approximately 1,000 bird species that migrate through U.S. airspace.[340] Significantly, most of these species are neither threatened nor endangered.[341] Second, the Bald and Golden Eagle Protection Act of 1940 (amended in 1962) protects these specific bird species.[342] The bald eagle was removed from endangered listing in 2007, but this statute continues to protect it.[343] Both of these statutes are also enforced by FWS. Unlike the ESA, incidental permits for takings are only rarely issued under either statute.[344]

In addition to protecting threatened or endangered species, the ESA protects species habitat.[345] Wind energy generation projects disturb land

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334 *Id.* at 46–47.

335 Estimates of bird deaths due to collisions with wind turbines range from 10,000 to 40,000 per year, compared with, for example, 60 to 80 million annually due to collisions with motor vehicles.

336 K.K. DUVIVIER, THE RENEWABLE ENERGY READER 89–97 (2011).

337 16 U.S.C. § 1531.

338 *Id.*

339 Wilson Morris & Owley, *supra* note 331, at 322–23.

340 16 U.S.C. §§703–12.

341 Robert J. Martin & Rob Ballard, *Reconciling the Migratory Bird Treaty Act with Expanding Wind Energy to Keep Big Wheels Turning and Endangered Birds Flying*, 20 ANIMAL L. 145, 147–51 (2013).

342 16 U.S.C. § 668.

343 Brooke Wahlberg, *The Curious Problem of Eagles*, 44 TEX. ENVTL. L.J. 51, 52–55 (2014).

344 Freeman & Kass, *supra* note 333, at 47–48.

345 16 U.S.C. § 1533 (2012).

at tower locations and where associated infrastructure is located. This impact both reduces and fragments wildlife habitat, as exemplified by the sage grouse in the western United States. The flat, windy plains that provide high-quality wind resources are also prime habitat for this species, providing shelter and food.[346] This conflict between wind resource and sage grouse habitat has resulted in postponement or even cancellation of wind generation projects.[347]

Regulations of such diverse federal agencies as the Department of Defense, Federal Aviation Administration, and Federal Communication Commission may also impact wind power generation. These regulations affect development because the tall infrastructure and blade movement characterizing wind generation can interfere with operations of these agencies.[348]

2. Solar Energy

Similar to wind power generation, solar generation impacts animal species and their habitats. Solar generation is especially impactful on habitat. High land use and consequent impacts are of significant concern.[349] In the western United States, solar energy deployment has been concentrated in the Mojave and Sonoran Deserts of Arizona, California, and Nevada. Research indicates that the desert ecosystems where solar power generation is usually sited are known to recover slowly from disturbance.[350] The desert tortoise, protected by the Endangered Species Act, is the best-known species impacted by solar generation projects.[351] As with wind generation projects, solar projects impacting threatened or endangered species are required by the ESA to obtain incidental take permits and to mitigate takings through habitat conservation plans.[352]

Solar power generation also impacts water resources. Given the scarcity of water in the western United States, as well as its importance to desert wildlife and ecology, this impact is of particular concern.[353]

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346 Veery Maxwell, *Wind Energy Development: Can Wind Power Overcome Substantial Hurdles to Reach the Grid?*, 18 HASTINGS W.-NW. ENVTL. L. & POL'Y 323, 329–30 (2012).

347 Freeman & Kass, *supra* note 333, at 48.

348 *Id.* at 49.

349 Required land area per MW of solar generation capacity is two orders of magnitude greater than, for example, that needed for natural gas-fired generation.

350 Wilson Morris & Owley, *supra* note 331, at 298.

351 *Id.* at 297–98.

352 *Id.* at 317–18.

353 Robert L. Glicksman, *Solar Energy Development on the Federal Public Lands: Environmental Trade-Offs on the Road to a Lower-Carbon Future*, 3 SAN DIEGO J. CLIMATE & ENERGY L. 107, 114–16 (2011–2012).

While solar PV generation requires relatively low quantities of water, concentrating solar power is very water-intensive.[354]

3. Geothermal Energy

Due to its less intrusive nature, geothermal power generation does not impact animal species and their habitats to as great an extent as wind and solar generation.[355] Although the seminal *United States v. Union Oil Co.*[356] case resolved geothermal resource ownership, other legal and policy issues for geothermal development remain. Chief among these issues is western state water law applicable to geothermal water.[357] In western states, water is allocated via the prior appropriation system, a system in which the first to divert and make beneficial use of water obtains a vested right to use that water in the future. Several western states do not make exceptions to the requirement of prior appropriation for geothermal resources,[358] which is problematic for new geothermal energy development considering that most western states are fully or even over-appropriated. Other western states conditionally exempt geothermal resources from prior appropriation based on temperature; if temperature exceeds 200° Fahrenheit, these resources are exempt.[359] California and Nevada unconditionally exempt geothermal resources from prior appropriation because of their unique characteristics and the possibility of non-consumptively using geothermal waters.[360] This exemption should facilitate Nevada's development of geothermal resources at the required growth rate noted earlier in this article. Examples of other issues for geothermal resource development include conflicts with existing geothermal resource users (e.g., commercial hot springs) and surface subsidence induced by net consumption of geothermal groundwater.[361]

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354 Robert Glennon & Andrew M. Reeves, *Solar Energy's Cloudy Future*, 1 ARIZ. J. ENVTL. L. & POL'Y 91, 96–100 (2010–2011).

355 Hadassah M. Reimer & Sandra A. Snodgrass, *Tortoises, Bats, and Birds, Oh My: Protected Species Implications for Renewable Energy Projects*, 46 IDAHO L. REV. 545, 579–83 (2010).

356 549 F.2d 1271, 1279–81 (9th Cir. 1977) (determining that geothermal resources were sub-surface minerals and therefore reserved by the federal government under the Stock-Raising Homestead Act of 1916).

357 *See* Carolyn F. Burr et al., *Water: The Fuel for Colorado Energy*, 15 U. DENV. WATER L. REV. 275, 324–25 (2012); Justin Plaskov, *Geothermal's Prior Appropriation Problem*, 83 U. COLO. L. REV. 257, 273–76, 277–85 (2011).

358 These states include Colorado, Montana, Utah and Wyoming.

359 These states include Idaho, New Mexico, and Oregon.

360 Plaskov, *supra* note 357, at 286.

361 Mark D. Detsky, *Getting into Hot Water: The Law of Geothermal Resources in Colorado*, 39 COLO. LAW. 65, 70 (2010).

4. Procedural Modifications

As noted above, BLM's issuance of PEISs for wind, solar, and geothermal energy development on federal lands in the western United States should facilitate renewable energy deployment, given that site-specific EISs need only be developed to supplement PEISs. Facilitation assumes, however, that BLM resources for permitting (i.e., right-of-way permits for project siting on federal lands) and environmental review are adequate. Evidence of facilitated permitting and environmental review is mixed.[362] Since federal lands are more readily available in sizes sufficient for renewable generation projects than are state and private lands,[363] it is important to provide BLM with adequate resources. Unlike wind and solar resources, most geothermal resources are located on western federal lands.[364]

Modifying the environmental review process to take into account the host of benefits from renewable power could also enhance renewable energy deployment. It has been argued that only environmental impacts such as those on threatened or endangered species and their habitat are currently considered during NEPA analysis of renewable generation projects, without due consideration of environmental benefits of wind, solar, and geothermal power generation.[365] As noted above, consideration of environmental benefits will require adequate resources for environmental review.

Finally, the need for transmission cannot be overlooked. Renewable resources are frequently located at considerable distances from power demand, unlike most fossil fuel-fired generation. This geographic isolation often necessitates construction of new transmission infrastructure.[366] While beyond the scope of this paper, transmission projects are hindered by familiar problems such as lengthy environmental review. Further, transmission projects are susceptible to the "chicken and egg" problem: renewable deployment may not occur because of lack of

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362 Glennon & Reeves, *supra* note 354, at 114–16.

363 Wilson Morris & Owley, *supra* note 331, at 294–96.

364 Ben Tannen, *Capturing the Heat of the Earth: How the Federal Government Can Most Effectively Encourage the Generation of Electricity from Geothermal Energy*, 37 ENVIRONS ENVTL. L. & POL'Y J. 133, 159 (2014).

365 *See* Trevor Salter, *NEPA and Renewable Energy: Realizing the Most Environmental Benefit in the Quickest Time*, 34 ENVIRONS ENVTL. L. & POL'Y J. 173, 180–82 (2011); J.B. Ruhl, *Harmonizing Commercial Wind Power and the Endangered Species Act Through Administrative Reform*, 65 VAND. L. REV. 1769, 1798 (2012).

366 *See* Duane, *supra* note 265, at 766–75; Joshua P. Fershee, *Changing Resources, Changing Market: The Impact of a National Renewable Portfolio Standard On the U.S. Energy Industry*, 29 ENERGY L.J. 49, 66–68 (2008).

available transmission, yet transmission construction may not occur due to lack of renewable power generation to be added to the grid.[367]

VIII. CONCLUSION

The landmark *Massachusetts v. Environmental Protection Agency* case has led to, in the absence of legislative action by the United States Congress, a series of rulemakings by EPA. Rules for new and modified power plants and for existing power plants, promulgated under authority of section 111 of the CAA, are EPA's most recent actions. The latter rule is critical to reducing GHG emissions in the United States because the EGU sector accounts for a large proportion of total domestic GHG emissions. For western states with rich endowments of renewable energy resources, this paper has shown that replacement of fossil fuel-fired generation with renewable resource-derived generation is feasible to achieve compliance with EPA GHG emission guidelines. In addition to reducing GHG emissions, deployment of renewable energy generation offers economic development, improved energy security, and even lower electricity prices.[368]

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367 Jennifer E. Gardner & Ronald L. Lehr, *Enabling the Widespread Adoption of Wind Energy in the Western United States: The Case for Transmission, Operations and Market Reforms*, 31 J. ENERGY & NAT. RESOURCES L. 237, 248–49 (2013).

368 Fershee, *supra* note 366, at 77.