MARKETS DRIVE INNOVATION

Why History Shows that the Clean Power Plan Will Stimulate a Robust Industry Response

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EXECUTIVE SUMMARY

On June 2, 2014, the Environmental Protection Agency (EPA) proposed the Clean Power Plan (CPP) to implement section 111(d) of the Clean Air Act (CAA).[1] While the proposed rule does not mandate a market-based approach to compliance, ample evidence from previous CAA rules suggests that market-based mechanisms are likely to develop under the CPP, and that these mechanisms will spark an industry response that will make available a wide array of cost-effective compliance options.

Past Rules Show that Market-Based Mechanisms Unleash Industry Response

By setting a regulatory signal and allowing for market-based compliance mechanisms, EPA rules have initiated the development of active and efficient markets in reducing the lead content in gasoline, combatting acid rain, and controlling regional transport of ozone due to emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x). These prior regulatory programs offer strong evidence that industry responds rapidly and effectively to regulatory signals set by EPA when market-based compliance mechanisms are allowed, enabling the development and delivery of a wide array of compliance solutions at low cost.

The successful development of efficient and active markets under these programs is demonstrated by the widespread use of trading by affected entities, the use of credit banking where available, and the lack of volatility in market prices for emission allowances. The development and use of markets for emission allowances under these programs provided affected entities with a range of cost-effective emission reduction measures to choose from. As a result, emissions were reduced more quickly than required, compliance costs were significantly lower than expected, and well-functioning private markets in pollution-reducing technologies evolved rapidly in response to the EPA rules.

The Advanced Energy Industry Is Ready to Respond to Market-Based Mechanisms

There is every reason to believe the same thing will happen under the CPP. The basic structure of the CPP allows and even encourages the development of market-based compliance mechanisms that would facilitate the use of technologies and services that deliver emission reductions. Technologies suitable for CPP compliance include a wide range of advanced energy products and services available in the market now that are particularly well suited to such market-based mechanisms. These include electricity generation technologies like natural gas, wind, solar, hydro, and nuclear power; demand technologies and services like building energy efficiency and demand response; and electricity delivery and management technologies like energy storage. The U.S. market for these and other advanced energy technologies and services was $200 billion in 2014, equal to the pharmaceutical industry.[2] Utilities and power plant operators already engage in a variety of markets to procure advanced energy — from direct purchase or operation of renewable resources, to investment in energy efficiency programs, to trading certificates for the attributes of these resources.

Not surprisingly, a number of stakeholders — ranging from state regulators to utilities to regional grid operators to credit-tracking vendors — have already initiated the process of adapting the existing mechanisms used in these advanced energy markets to support market-based options that facilitate CPP compliance. Given the structure of the proposed rule and the status of current markets, the development of market-based compliance mechanisms is a probable, if not inevitable, outcome.

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[1] 79 Federal Register 34830 (June 18, 2014).

[2] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.

Market-Based Compliance Will Achieve Goals, Reduce Cost, Spur Economic Growth

The market-readiness of a wide array of compliance measures available to respond to a market signal for emission reductions indicates that compliance under the CPP will likely mirror not only the approach, but also the success of market-based compliance outcomes under prior CAA rulemakings. Robust markets for advanced energy technologies and services, coupled with existing tracking systems customized to meet CPP requirements, together provide a nearly turnkey solution for state compliance needs, ready to deliver emission reductions as soon as the implementation period begins. In turn, a clear and timely regulatory signal from the CPP will drive further investment and deployment of advanced energy technologies and services, delivering emission reductions while also driving market growth, technology improvement, and associated benefits ranging from grid modernization to job growth.

I. INTRODUCTION AND OVERVIEW

On June 2, 2014, the Environmental Protection Agency (EPA) proposed the Clean Power Plan (CPP) to implement section 111(d) of the Clean Air Act (CAA).[4] The CPP seeks to reduce carbon dioxide (CO_2) emissions from existing fossil-fueled electric generating units (EGUs). It targets an overall decrease in power sector CO_2 emissions of 30% by 2030 as compared to 2005 levels, with interim emission reduction milestones between 2020 and 2029. As required by section 111(d), the proposed CPP would establish "guidelines" under which states would develop existing source performance standards, which would be submitted to EPA for review and approval.

This paper examines whether the regulatory signal sent by the CPP implementation framework will stimulate markets in technologies and services for emission reduction and expand the availability of a broad range of flexible, low cost compliance options for regulated power plants. It begins by reviewing the history of prior EPA rules structured to mobilize market forces and the success of these rules in catalyzing functional emission trading markets and encouraging innovative market-driven responses to emission reduction requirements. It then discusses how the structure of the proposed CPP allows for similar market-based compliance mechanisms, and the likelihood that such mechanisms will develop under state or federal compliance plans after EPA releases the final rule. Finally, the paper turns to the market-readiness of a wide array of compliance measures available to respond to a market signal set by the CPP, demonstrating that market-based compliance under the CPP will likely follow the track record of success under prior CAA rulemakings.

The central conclusion of the paper is that EPA's historical success in stimulating effective market-driven responses to emission reduction targets is likely to be replicated under the CPP, and that states and EGUs will have broad access to these market-based tools in devising low cost, flexible compliance strategies. In turn, compliance will drive further investment and deployment of emission reduction technologies and services, delivering emission reductions while also driving market growth, technological improvements, and the co-benefits associated with many of these technologies.

II. THE TRACK RECORD OF PRIVATE MARKET DEVELOPMENT AND INDUSTRY INNOVATION IN RESPONSE TO EPA PROGRAMS

EPA regulatory programs designed to stimulate market activity and achieve environmental compliance have been evaluated in depth by several academic economists, other experts, and EPA itself. Drawing on these analyses, the discussion that follows examines three programs that provide the best analogues for the type of market based compliance mechanisms that will be allowed under the CPP. These programs served to address: (i) lead content in gasoline; (ii) acid rain; and (iii) ozone and fine particulate matter ($PM_{2.5}$). These prior EPA rules offer strong evidence that markets respond rapidly and effectively to regulatory signals set by EPA, enabling the development and delivery of a wide array of compliance solutions at low cost.

[4] 79 Federal Register 34830 (June 18, 2014).

The successful development of efficient and active markets under these programs is demonstrated by the widespread use of trading by affected entities, the use of credit banking where available, and the lack of volatility in market prices for emission allowances. The development and use of markets for emission allowances in response to these three programs provided affected entities access to a wide array of cost-effective emission reduction measures. The consensus among students of these programs is that emissions were reduced more quickly than policymakers had expected, that compliance costs were significantly lower because of the flexibility provided by market mechanisms, and that well-functioning private markets evolved rapidly in response to the opportunities created by EPA's rules.

A. Reducing Lead in Gasoline

After initially limiting lead in gasoline through command-and-control regulations, EPA in 1982 introduced a lead credit trading program to accelerate the phase-out of lead. This program delivered cost-effective and timely lead reductions by stimulating efficient investment in lead-removal technology in the refining industry.

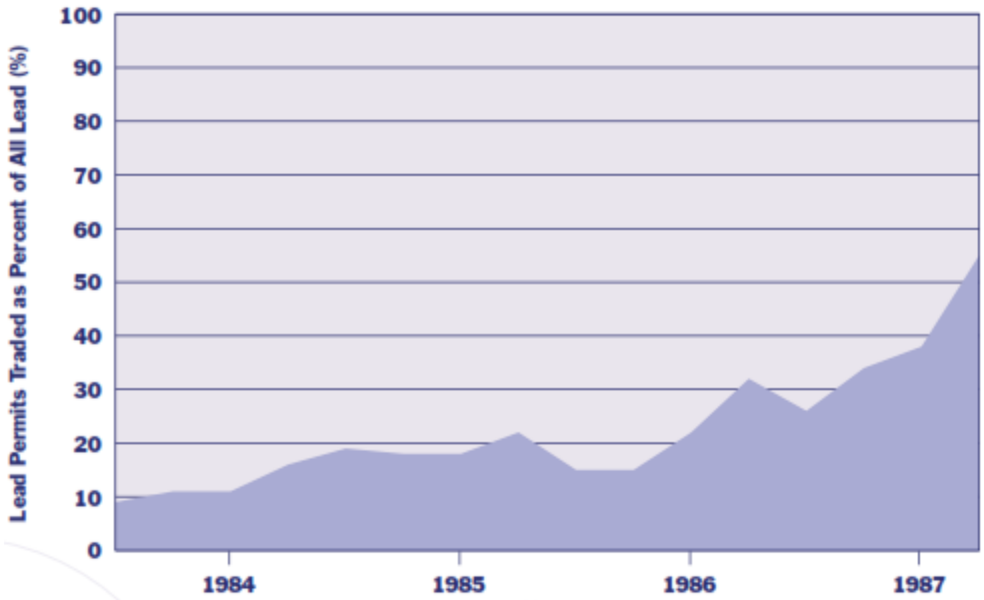
EPA began a sustained effort to phase down the lead content of gasoline starting in the mid-1970s,[5] and by the early 1980s the lead content of gasoline had declined significantly. This initial reduction was achieved through a command-and-control program. However, facing the need for deeper lead reductions and concerns about compliance burdens, EPA sought to ease the transition for refineries through a system of inter-refinery averaging. This approach stemmed from a recognition that larger refiners had developed technology that enabled them to remove more lead than required by regulatory limits while smaller refiners could not meet these limits without substantial costs. To provide greater compliance flexibility and account for the difference in costs among refiners, EPA allowed them to trade lead credits from late 1982 to the end of 1987. The wide distribution of gasoline meant national trading would not undermine compliance goals, making this a viable option. In addition, since experience had shown that refiners could reduce costs by controlling the timing of lead-abatement investments, EPA allowed banking of compliance credits between 1985 and 1987.

According to Professors Denny Ellerman and Paul Joskow of the Massachusetts Institute of Technology and David Harrison of NERA Economic Consulting, the opportunities for trading and banking enabled by EPA are "widely regarded as a success" and resulted in development of an "increasingly vigorous market in lead rights."[6]

As they emphasize, refinery participation was extensive and a large percentage of lead rights were traded, as depicted below:

[5] This overview of the lead phase-down is largely drawn from Richard G. Newell and Kristian Rogers, *The U.S. Experience with the Phasedown of Lead in Gasoline*, Resources for the Future (June 2003) (hereafter "Newell and Rogers").
[6] A. Denny Ellerman, Paul L. Joskow and David Harrison, *Emissions Trading in the US: Experience, lessons and Considerations for Greenhouse Gases*, Pew Center on Global Climate Change (May 2003), at 10 (hereafter "Ellerman et al.").

Figure 1. Lead Permits Traded as Percent of All Lead Emissions, 1983-1987



Source: Ellerman et al. at 10.

They add that the level of banking was "even higher than predicted," resulting in a "faster reduction in lead emissions than might otherwise have occurred."[7]

A 2003 Resources for the Future study of the lead phasedown by Richard Newell and Kristian Rogers likewise concluded that "[t]he marketable lead permit system was highly cost-effective, saving hundreds of millions of dollars relative to comparable command-and-control policies not allowing trading or banking."[8] Newell and Rogers further emphasize that the flexibility of the program likely led to even greater savings than initially expected, saying, "EPA's *ex ante* projection that banking would save upwards of $226 million probably turned out to be an underestimate, as their figures assumed that 9.1 billion grams of lead would be banked, whereas, 10.6 billion grams were actually banked." The trading and banking program was successful, according to Newell and Rogers, because "it allowed for a more cost-effective allocation of technology investment within the refining industry."[9] They note that transaction costs were relatively small, in part because EPA "left the logistics of trading up to the refineries."[10] Ellerman et al. make a similar point, lauding the program's "streamlining of the process for measuring compliance and certifying tradable credits."[11]

Most importantly, according to Newell and Rogers, "[n]ot only was the program effective in meeting its environmental objectives, but it did so more quickly than it would have done without the allowance of permit banking. The phase-down from 1979 to 1988 accelerated the virtual elimination of lead by at least a few years, reducing by 1988 an additional half-million tons over what the fleet turnover would have produced."[12]

The steep and rapid decline in the lead content of gasoline as a result of EPA's program is shown below:

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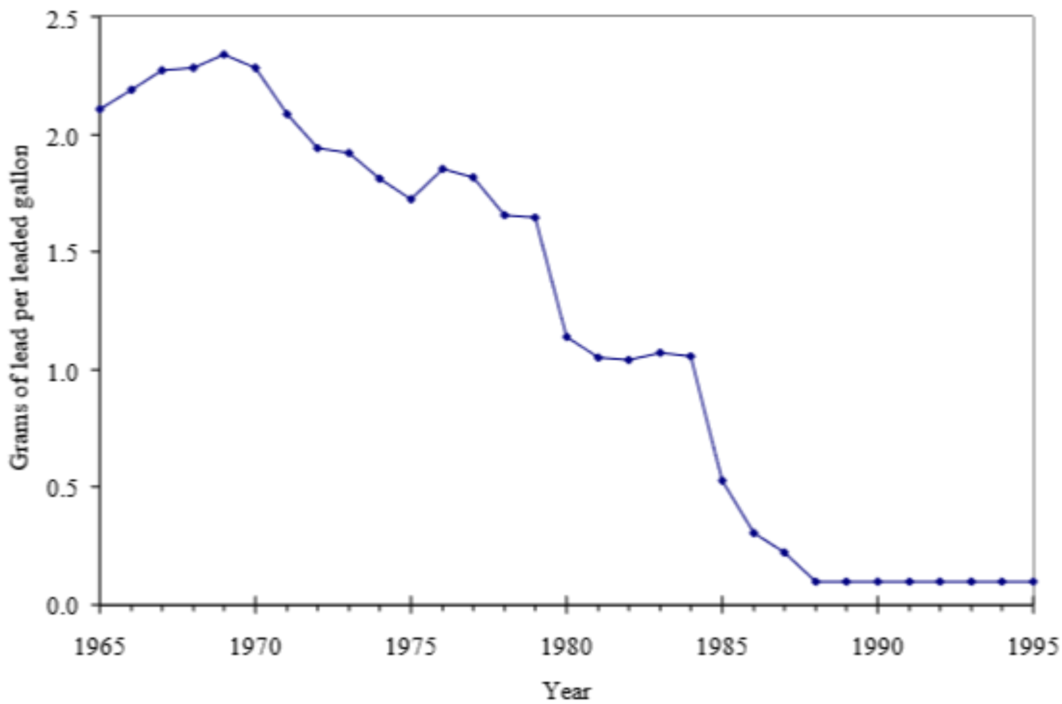
[7] *Id.* at 11.
[8] Newell and Rogers, at 22.
[9] Ibid.
[10] *Id.* at 7.
[11] Ellerman et al., at 11.
[12] Newell and Rogers, at 22.

Figure 2. Lead Content in Leaded Gasoline (U.S. average)



Source: Newell and Rogers at 25.

Thus, market-based trading and banking of lead credits in the second phase of EPA's program to reduce the lead content of gasoline created an active market that accelerated lead reduction while reducing compliance costs.

B. Combatting Acid Rain

Despite its success in initiating an active trading market, the lead phasedown was relatively unique among EPA programs until the 1990 CAA Amendments, when Congress authorized the use of market mechanisms to address the persistent issue of acid rain. Title IV of the 1990 amendments created a national program to reduce SO_2 emissions focused on coal-burning power plants, the main source of SO_2. This program resulted in a highly efficient and active market, and like the lead phasedown program has been widely praised for the unusual speed with which SO_2 emissions declined and the high cost-effectiveness of these emission reductions.

Title IV put in place a two-phase cap on SO_2 emissions. Phase I, which took effect in 1995 and remained in place until 1999, covered 110 coal-burning power plants, representing 374 generating units. Phase II, which began in 2000 and was designed to continue indefinitely, expanded the universe of covered sources to include virtually all fossil-fueled generating units in the United States. Under the final Phase II cap, U.S. emissions were expected to be roughly half of levels in the early 1980s.

Title IV also put in place an allowance-based trading system to meet its emission caps. The law directed EPA to issue allowances to each covered facility based on its heat input during 1985-87. These allowances, distributed free-of-charge to existing plants, were to decline each year, corresponding to a steadily declining level of SO_2 emissions that, when aggregated at the national level, equaled the Phase I and Phase II caps. A small number of allowances (2.8%) were reserved for an annual auction conducted by EPA, with the proceeds to be rebated to utilities in rough proportion to their percent of overall allowance allocations. The purpose of this auction was to jumpstart market activity in the event trading among regulated sources was slow to develop. Allowance holders were required to surrender to EPA sufficient allowances to cover each year's emissions or suffer non-compliance penalties. Because power plants were obligated to measure their SO_2 emissions using Continuous Emission Monitoring Systems (CEMS), tracking compliance could be accomplished at low cost and with a high degree of reliability. As with lead credits, Title IV allowances can be bought and sold without limitation anywhere in the United States, and can also be held ("banked") to assure compliance or for sale in later years.

Title IV allowed generating units subject to Phase II to obtain allowances during Phase I and thereby become subject to Phase I emission limits. This proved to be a more important incentive for earlier SO_2 reductions than Congress envisioned.

The Title IV program has been widely praised by economists for its success in creating vibrant trading markets and reducing SO_2 emissions more quickly and at lower cost than even supporters had forecast in advance of its adoption. Typical is the assessment of Ellerman et al., who write that:

> The most remarkable feature of [Title IV] is the striking reduction of SO_2 emissions in the first year of the program . . . [T]he reduction was far greater than anything that had been seen before, and there can be no doubt that it was caused by Title IV. The only precedent for such a rapid reduction in emissions of this magnitude in the history of the Clean Air Act is the lead phasedown program, which was also implemented by the use of emissions trading and banking.[13]

The authors add that:

> The purchase and sale of allowances by the owners of affected units has created an active and efficient market for SO_2 allowances. This is evidenced by the single price for allowances at any one time regardless of the source of the price quote, by the high volume of inter-firm trades that can be deduced from the allowance registry maintained by EPA, by the low transaction costs associated with trading and by the development of an active and diverse contract and futures market. [14]

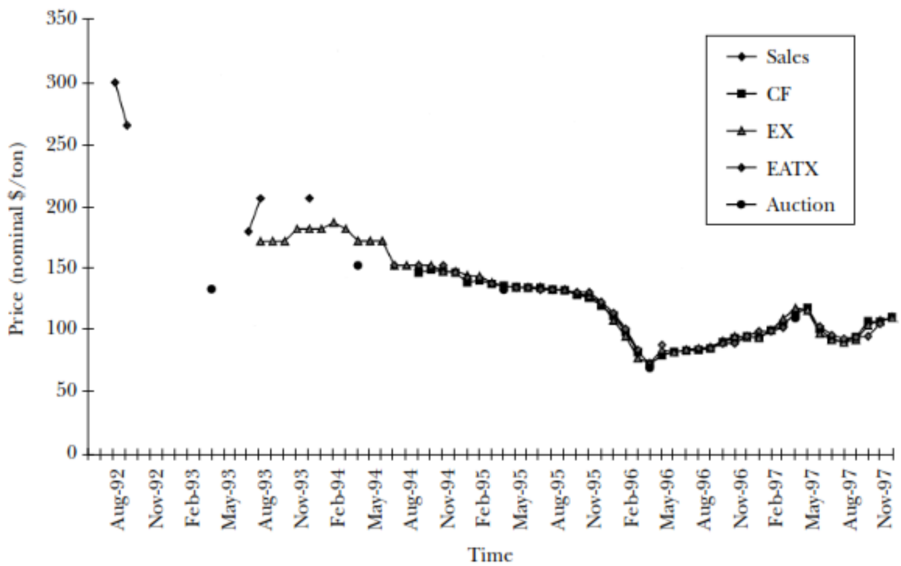
Further documenting the rapid development of the market, a detailed study by Joskow and Ellerman, joined by MIT colleagues Richard Schmalensee, Juan Montero and Elizabeth Bailey,[15] plotted prices of vintage 1995 allowances between 1992 and 1997 using a variety of sources, including private market-making organizations:

[13] Ellerman et al., at 26.

[14] Ibid.

[15] Richard Schmalensee, Paul L. Joskow, A. Denny Ellerman, Juan Pablo Montero and Elizabeth M. Bailey, *An Interim Evaluation of Sulfur Dioxide Emissions Trading*, 12 Journal of Economic Perspectives (Summer 1998), at 53-68 (hereafter "Schmalensee et al.").

Figure 3. Allowance Prices, 1992-97 (1995 or Current Vintage)



Sources: Selected issues of Allowance Price Indications 1993-97; Cantor Fitzgerald Environmental Brokerage NY, NY, Compliance Strategy Review 1992-97; Fieldston, Washington DC, Exchange Value, 1993-97; Emission Exchange Corp., Escandido, CA.

The trends shown above illustrate the general consistency of allowance prices across different trading platforms and EPA auctions, as well as a general downward movement in prices without significant volatility. In addition, the authors also note the steady increase in trading volumes as the markets matured, with private market volumes for March-April 1995, 1996, and 1997 at 1.6 million, 4.9 million and 5.1 million allowances respectively.[16]

Scholars also agree that the costs of reducing emissions under Title IV were well below likely costs under a command-and-control program. The cost savings estimated by Ellerman et al. are shown below:

Table 1. Abatement Cost and Cost Savings from Title IV Emissions Trading

	Abatement Cost Without Trading	Abatement Cost with Trading	Total Cost Savings with Trading	Percentage Savings with Trading
Average Phase I Year (1995-99)	1,093	735	358	33%
Average Phase II Year (2000-07)	3,682	1,400	2,282	62%
13-Year Sum	34,925	14,875	20,050	57%

Souce: Adapted from Ellerman et al. at 15.[17] Note from source: All costs are in millions of present-value U.S. 1995 dollars. Estimates are based on economic reasoning assuming reasonably efficient markets based on observed allowance prices and abatement. A cost estimate is provided for only the first eight years of Phase II since this is the time period when most of the cost savings from banking were thought likely to be realized.

In short, Phase I reduced compliance costs by $358 million per year, or 38%; the first eight years of Phase II reduced compliance costs by about $2.3 billion per year, or over 60%; and over the first 13 years of the

[16] Schmalensee et al., at 62-63.

[17] Ellerman, A. Denny, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero, and Elizabeth Bailey, *Markets for Clean Air: The U.S. Acid Rain Program,* Cambridge, UK: Cambridge University Press (2000).

program, cost reductions of about $20 billion, or 57%, were achieved. As Ellerman et al. emphasize, trading "has allowed sources with high abatement costs to reduce emissions less — and those with low abatement costs to reduce emissions more — than under a command-and-control mechanism requiring uniform emission rates and thus has reduced the overall cost of the mandated emission reduction."[18]

In addition to providing compliance flexibility, the trading approach had an additional, indirect impact on compliance costs and outcomes by enabling industry-led innovation to occur. Improvements in emission control technology began under pre-Title IV sulfur controls, and "may well have been accelerated by the passage of Title IV," according to Schmalensee et al., who further note: [19]

> …the observed per-ton cost of scrubbing in 1995 was substantially below earlier estimates, and our investigation indicates that this difference reflected unanticipated improvement in instrumentation and controls that reduce personnel requirements, innovative sludge removal techniques, and higher than expected utilization of scrubbed units (which reduces capital cost per ton of sulfur removed). Moreover, new ways were found to adapt Midwestern boilers to blends of local and Powder River Basin coals.

Along with other factors, this industry-led innovation following from the issuance of sulfur emission limits enabled timely and cost-effective compliance. The bottom line of Ellerman, Joskow and their colleagues is that "[n]ot only did Title IV more than achieve the SO_2 emissions goal established for Phase I, it did so on time, without extensive litigation, and at costs lower than had been projected."

C. Regional Control of NO_X and SO_2 for Ozone

Against the backdrop of the successful acid rain program, a series of rulemakings was launched under the CAA in the late 1990s that evolved and expanded over two decades to address regional transport of NO_x and SO_2.

First, NO_x controls were administered by the Ozone Transport Commission (OTC) in 16 states starting in the 1990s. The OTC NO_x control program in the mid-Atlantic and New England Coast set a region-wide cap on NO_x emissions from covered sources, with each state allocated a share of allowable emissions. The OTC decided to implement this cap through a region-wide allowance trading program during the summer ozone season.

While the original OTC NO_x control program was soon eclipsed by EPA's broader efforts to tackle regional transport, its success was widely recognized and built upon by EPA. Emissions decreased by 54% from the "uncontrolled" 1990 baseline.[20] Farrell et al. estimated that, when fully implemented, the program would save $900 million over the assumed command-and-control alternative.[21] Notwithstanding a shaky start, Ellerman et al. comment that "[t]he speed with which the NO_x market developed is also notable" and they attribute "[t]he quick development of the market . . . to the participation of marketing and brokerage firms that participate in power, emissions, fuel and other markets simultaneously and to whom generators are turning for risk management services."[22] They also point out that the "NO_x market involved greater use of derivative products (i.e. options) than the SO_2 market, because of its greater price volatility and its later start."[23] Butraw and Szambalen emphasize that, "[o]ver the course of the program market activity was clearly robust, as there were

[18] Ellerman et al., at 18.
[19] Scmalensee et al., at 65.
[20] Dallas Butraw and Sarah Jo Szambelan, *US Trading Markets for SO_2 and NO_x*, Resources for the Future (October 2009), at 22 (hereafter "Butraw and Szambelan").
[21] Farrell, A.E., R. Carter and R. Rauffer, *The NOx Budget: Market-based Control of Tropospheric Ozone in the Northeastern United States,* 21 Resources and Energy Economics (1999).
[22] Ellerman et al., at 31.
[23] Ibid.

many transactions between economically unrelated sources and across state lines."[24] These market characteristics were carried forward by the subsequent EPA rules on NO_x and SO_2.

Expanding upon the success of the OTC NO_x program, in October 1998 EPA finalized a comprehensive set of NO_x control requirements for 22 Eastern states and the District of Columbia.[25] They were termed the "NO_x SIP call" because they obligated upwind states to amend their State Implementation Plans (SIPs) to require controls on NO_x emissions contributing to downwind non-attainment. EPA's SIP call set "NO_x budgets" — i.e. the upper limit of allowable NO_x emissions — for each of the covered states to include in their SIPs. States were allowed to decide how to implement these budgets, but EPA provided a "model rule" utilizing an allowance-based cap-and-trade program that states could adopt.

Recognizing the need for a more ambitious effort to address pollution transport in the Eastern United States in order to attain the National Ambient Air Quality Standards (NAAQS) for ozone and fine particles, EPA finalized a Clean Air Interstate Rule (CAIR) in May 2005.[26] The rule applied to 27 Eastern states and the District of Columbia and was focused entirely on power plants. As with the SIP call, CAIR involved setting state "emission budgets" to be incorporated in SIPs, encouraged adoption of cap-and-trade programs, and created a multi-state trading region. Departing from its approach in the SIP call, EPA set SO_2 emission budgets for the states on the basis of a proportionate reduction in the allocation of allowances under the CAA Acid Rain program and based NO_x budgets on the relative mix of generation fuels within each state, giving larger budgets to states with a higher proportion of coal-fired power plants.

In July 2011 EPA issued an updated version of CAIR, entitled the Cross-State Air Pollution Rule (CSAPR),[27] in response to a D.C. Circuit Court ruling that called for a new rule to replace CAIR on grounds largely unrelated to the trading program.[28] CSAPR required deeper reductions of SO_2 and NO_x emissions and applied to 27 states in the Eastern United States. Since the first phase of reductions was to take effect on January 1, 2012 and the D.C. Circuit had directed EPA to replace CAIR expeditiously, EPA's rule took the form of a set of Federal Implementation Plans (FIPs) for the 27 states. While CSPAR was vacated by a 2-1 margin by the D.C. Circuit Court in 2012,[29] this decision was later reversed by a 6-2 Supreme Court decision, which substantially upheld CASPR.[30] On October 23, 2014, the D.C. Circuit rescinded the stay of CSPAR and EPA then followed up on November 21, 2014 with an interim final rule resetting the CSPSAR compliance dates.[31]

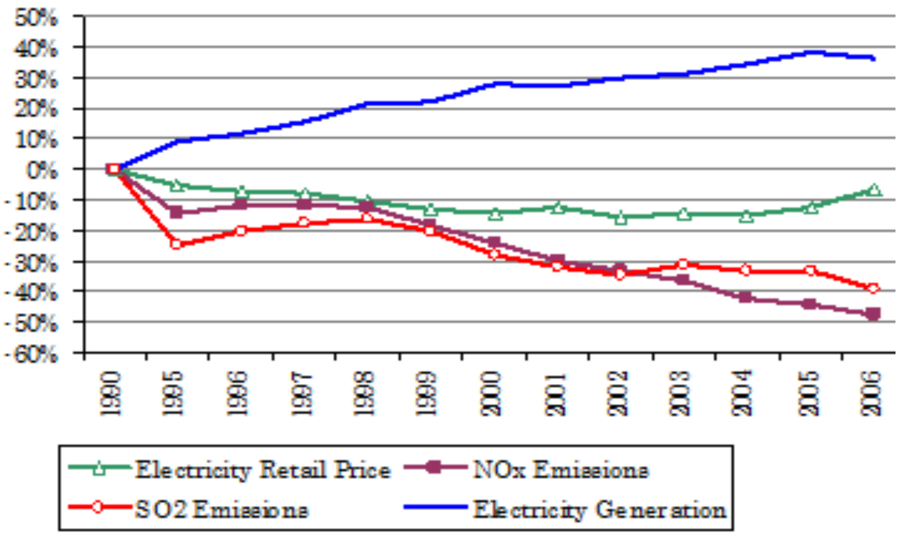
Despite the complexities of litigation and EPA's evolving emission reduction goals, the trading programs implemented under these rules maintained remarkable continuity between 1998 and 2015, and achieved extraordinary success in reducing emissions. EPA's 2012 Progress Report on its CAA allowance trading programs,[32] the latest report issued by the Agency, indicates that SO_2 emissions in that year were 3.3 million tons, 68% below 2005 levels; ozone season NO_x emissions were 514,000 tons, 37% below 2005 levels; and annual NO_x emissions were 1.7 million tons, 53% below 2005 levels. Private allowances transferred (i.e. excluding state or EPA allowance allocations or auctions) totaled 8,446,107 for the SO_2 program; 318,299 for the ozone season NO_x program; and 758,588 for the annual NO_x program. EPA reported that, for all three programs, about 25% of allowance transfers were between separate and distinct economic entities (as opposed to intra-company transfers). It further noted that, as in previous years, all facilities reporting to EPA were in

[24] Butraw and Szambalen, at 23.
[25] 62 Fed. Reg. 60318 (proposed rule); 63 Fed. Reg. 57356 (final rule).
[26] 69 Fed. Reg. 4566 (proposed rule); 70 Fed. Reg. 25165 (final rule).
[27] 76 Fed. Reg. 48208 (final rule).
[28] *North Carolina v EPA*, 550 F.3d 1176 (D.C. Cir. 2008).
[29] EME Homer City Generation, LP v EPA, 696 F.3d 7 (D.C. Cir. 2012).
[30] *EPA v. EME Homer City Generation*, LP, 134 S. Ct. 1584, 78 ERC 1225.
[31] Under this rule, CSAPR's Phase I emissions budgets now apply in 2015 and 2016 (instead of 2012 and 2013) and Phase II emissions budgets and assurance provisions apply in 2017 and beyond (instead of 2014 and beyond). 79 Fed. Reg. 71663.
[32] U.S. EPA, *2012 Progress Report: SO_2 and NOx Emissions, Compliance and Market Analyses* (2013), at 14.

compliance with emission requirements, the result of stringent penalties for non-compliance coupled with rigorous emissions monitoring and reporting requirements and public availability of high-quality, transparent emissions information.

Implementation of NO_x and SO_2 trading was accompanied by a 10% reduction in ozone levels in participating states between 2002 and 2007, with a strong correlation between upwind NO_x emissions and ozone levels in downwind states.[33] As emissions dropped, total electricity generation and fossil-fuel consumption increased while electricity prices remained fairly stable, as shown below:

Figure 4. Trends in Electricity Generation, Electric Prices, and SO_2 and NO_x Emissions



Source: EPA, 2007

NO_x and SO_2 trading has been credited with cost-saving technological innovations. According to Butraw and Szambelan, "[t]echnological innovation . . . took the form of extensive small-scale modifications to existing capital that likely would not have occurred under command-and-control regulation."[34] A study by Linn concluded that these innovations improved the performance of existing controls and accounted for 10%-15% of total reductions.[35]

The emission allowance markets created by the NO_x and SO_2 rules rapidly expanded in volume and sophistication. As NO_x and SO_2 markets developed, private allowance transfers (as opposed to EPA transfers) increased significantly, tripling for SO_2 and nearly quadrupling for NO_x from 2000 to 2006. In parallel, transactions between economically distinct entities rose markedly, another indicator of true market activity. According to EPA officials, 30% of NO_x allowance transfers and 50% of SO_2 allowance transfers in 2005 were economically significant.[36] EPA officials tracking these trends attributed them to expansion of the "spot" and "forward" markets that occurred as "participants grew in number and experience." As they explained:[37]

[33] Butraw and Szambelan, at 25.
[34] Ibid., at 26.
[35] Linn, J., *Technological Modifications in the Nitrogen Oxides Tradable Permits Program,* 29 The Energy Journal (2008), at 153-76.
[36] Sam Napolitano, Melanie LaCount and Daniel Chartier, *SO_2 and NO_x Trading Markets: Providing Flexibility and Results, Air and Waste Management Association* (June 2007), at 22 (hereafter "Napolitano et al.").
[37] Ibid.

> [A]ctivity moved beyond immediate settlement transactions to offer more flexibility and opportunities for risk management, including additional options and forward contracts. Options give the buyer the right to purchase allowances at a certain price by a certain date. Options provide a way to bridge risk against price fluctuations, but also may be used to maximize revenue on a portfolio of allowances. Forward contracts enable a purchaser to contractually agree to buy a number of allowances for delivery in the future at an agreed-upon price, providing buyers with long-term planning capability and certainty.

To accommodate the growing sophistication of transactions, the Chicago Climate Futures Exchange and New York Mercantile Exchange began to operate NO_x and SO_2 futures markets, providing clearing services and assuring that futures transactions are standardized and financially guaranteed. In addition, NO_x and SO_2 trading opportunities attracted the attention of firms "that operated specialized trading operations [and] entered the market to seek arbitrage opportunities."[38] These trading features are the mark of highly developed markets that afford participants many opportunities to structure transactions that incentivize cost-effective emission reductions.

More recently, following patterns in the larger energy marketplace, market entrants have included hedge funds, investment banks, and insurance companies, further increasing trading activity and efficiency. To support trading, firms (e.g., Cantor Fitzgerald and Evolution Markets) have stepped in to provide price indices for both the SO_2 and NO_x markets, which offer important information in structuring transactions. EPA recently identified 13 traders and brokers involved in the purchase and sale of NO_x and SO_2 allowances. [39] Again, the presence of these market professionals contributes to price stability and assures that the infrastructure is in place to support a large volume of transactions, contributing to market liquidity and giving regulated parties a wide choice of options to achieve compliance.

According to three EPA experts, a "look at the market activity in well-established [NO_x and SO_2] programs provides a fascinating window into the many opportunities and strategies that have arisen from the compliance flexibility and economic motivation provided by" these programs.[40] EPA adds that "[t]husfar, market history and experience suggest that, once emission cap and trade programs are established, there is long-term, relatively stable emissions allowance market performance with gradually declining prices as significant emission reductions are achieved."[41]

Summing up the experience with market-based programs implemented by EPA and others, Ellerman, Joskow, and Harrison conclude that:[42]

> **Emissions trading has been successful in its major objective of lowering the cost of meeting emission reduction goals.** Experience shows that properly designed emissions trading programs can reduce compliance costs significantly compared to command-and-control alternatives. While it is impossible to provide precise measures of cost savings compared to hypothetical control approaches that might have been applied, the available evidence suggests that the increased compliance flexibility of emissions trading yields costs savings of as much as 50 percent.
>
> **The use of emissions trading has enhanced — not compromised — the achievement of environmental goals.** While some skeptics have suggested that emissions trading is a way of evading

[38] Ibid.
[39] EPA, *Allowance Markets* <http://www.epa.gov/airmarkets/participants/allowance/index.html> (accessed May 2015).
[40] Napolitano et al., at 22.
[41] EPA White Paper, *Allowance Market Assessment: A Closer Look at the Two Biggest price Changes in the Federal SO2 and NOx Allowance Markets* (April 23, 2009), at 10.
[42] Ellerman et al., at iv-v (emphasis in original).

environmental requirements, experience to date with well-designed trading programs indicates that emissions trading helps achieve environmental goals in several ways. For one thing, the achievement of required emission reductions has been accelerated when emission reduction requirements are phased-in and firms are able to bank emissions reduction credits. The Lead Trading program for gasoline, the Acid Rain program for the electric industry, the federal mobile source ABT programs,[43] and the Northeast NO_X Budget programs each achieved environmental goals more quickly through these program design features. Moreover, giving firms with high abatement costs the flexibility to meet their compliance obligations by buying emissions allowances eliminates the rationale underlying requests for special exemptions from emissions regulations based on "hardship" and "high cost." The reduction of compliance costs has also led to instances of tighter emissions targets, in keeping with efforts to balance the costs and benefits of emissions reductions. Finally, properly designed emissions trading programs appear to provide other efficiency gains, such as greater incentives for innovation and improved emissions monitoring.

III. MARKET-BASED COMPLIANCE MECHANISMS ARE LIKELY TO DEVELOP UNDER THE CPP

Historical experience with EPA rules allowing for market-based compliance mechanisms clearly demonstrates that markets respond to EPA's regulatory signals under the CAA. When markets develop, affected entities have access to a wider variety of cost-effective compliance options because they are able to make use of purchased emission reductions that have occurred elsewhere (i.e., "beyond the fence line" of a specific regulated facility).

As with the prior rules described above, the proposed CPP is structured in a way that allows and encourages the development of market-based compliance mechanisms. This section discusses how the structure of the CPP and the CAA allow for market-based compliance mechanisms; explains that the ownership, operation, or purchase of generation or credits from eligible compliance measures that will take place under the CPP is consistent with current market activity by states and EGUs; and discusses some of the work that stakeholders are already doing to set up the infrastructure to allow market-based compliance mechanisms to develop under the proposed CPP.

A. The CPP Allows for Market-Based Compliance Approaches

The CPP leaves to states the selection of policy tools to meet state emission reduction targets. States have a variety of emission reduction options, including but not limited to the four Building Blocks EPA has defined as the Best System of Emission Reduction (BSER) under CAA section 111 (see Appendix A). States have broad discretion to decide how to implement these strategies and can employ a range of market-based tools and incentives.

Under section 111(d), the development of state performance standards must be "similar" to the state implementation plan (SIP) process established under section 110 for achieving NAAQS compliance. Section 110(a)(2)(A) explicitly authorizes SIPs to include "economic incentives such as fees, marketable permits and auctions of emission rights." These tools will likely be available to states implementing EPA guidelines under

[43] Ellerman et al. include the federal mobile source averaging, banking, and trading (ABT) program in their analysis.

section 111(d). EPA has explicitly indicated that trading programs are permissible compliance strategies under the CPP[44] and, indeed, previously used section 111(d) as the basis for a multi-state program for trading mercury allowances (later invalidated on other grounds).[45] In other rules, EPA has interpreted section 111(d) to allow state compliance plans to utilize rate-based trading.[46]

It is likely that states will be receptive to adopting market-based trading programs in their CPP implementation plans, given their positive experience with these programs for conventional pollutants like NO_x and SO_2, and with non-CAA markets for renewable energy certificates (RECs) and other energy and environmental credits. Moreover, mass-based trading is already occurring through the California greenhouse gas cap-and-trade program initiated by A.B. 32[47] and the Regional Greenhouse Gas Initiative (RGGI),[48] which provide direct precedents for states to build on under the CPP.

Market-based mechanisms will provide opportunities for power generators and third parties to cost-effectively access both "inside the fence line" and "beyond the fence line" measures embodied in the CPP Building Blocks (See Appendix A). Examples of markets that would provide compliance flexibility and reduce costs include: (i) the trading of allowances by fossil-fuel power plants based on inside-the-fence or fleet-wide emission reductions resulting from greater plant efficiency, increased utilization of natural gas, or other strategies such as co-firing with bio-mass; (ii) the trading of RECs and/or associated emission reduction credits among renewable energy developers, fossil-fuel plant owners, retail power distributors and third-party investors and brokers; (iii) trading of emission reduction credits generated by other zero- or low-emission resources such as nuclear power and natural gas-fired generation; (iv) similar transactions in energy efficiency certificates (EECs) and/or associated emission reduction credits created by utility demand reduction programs or third-party initiatives to conserve energy through home retrofits, transmission or distribution upgrades, or other efforts; and (v) alternate market mechanisms, such as a carbon price adder, that similarly allow for flexible access to a broad scope of compliance options by delegating certain compliance decisions to the marketplace.

Adoption of these approaches will be up to the states, and other compliance strategies will be available, but these examples illustrate a number of market mechansims are available to states under the CPP as options to .increase access to compliance technologies and services, reduce costs, and encourage innovation in energy technologies and services.

Furthermore, EPA can adopt a market-based compliance approach under a federal plan it imposes on states that do not submit satisfactory state plans under the CPP.[49] EPA's authority to issue such a plan under section 111(d) is linked to its authority to issue a FIP under section 110(c) in states that do not submit adequate SIPs to attain NAAQS.[50] EPA's FIP authority under this provision — and therefore its analogous authority under section 111(d) — explicitly includes the option to impose "enforceable emission limitations or other control measures, means or techniques."[51] This broad mandate would undoubtedly encompass market-based compliance mechanisms.

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[44] The preamble to the CPP proposal confirms that market-based allowance trading programs are permissible compliance tools for states under section 111(d) of the CAA. 79 Fed. Reg. at 34927.

[45] The 2005 Clean Air Mercury Rule (CAMR) allowed states to implement allowance trading for mercury. 70 Fed. Reg. 28606 (May 18, 2005). In conjunction with that rule, EPA amended its 111(d) regulations to add "allowance system" to the description of emissions standards states can adopt. CAMR was struck down by the D.C. Circuit on the unrelated ground that EPA should have relied on section 112 of the CAA to control EGU mercury emissions. *New Jersey v EPA*, 517 F.3d 574 (D.C. Cir. 2008).

[46] Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources; Municipal Waste Combustors, 60 Fed. Reg. 65387, 65402 (Dec. 19, 1995).

[47] California Environmental Protection Agency, *Assembly Bill 32 Overview* <http://www.arb.ca.gov/cc/ab32/ab32.htm> (accessed June 15, 2015).

[48] Regional Greenhouse Gas Initiative, *Welcome* <http://www.rggi.org/> (accessed June 15, 2015).

[49] Advanced Energy Economy, *Design Principles for a Rate-Based Federal Plan under EPA's Clean Power Plan* (May 21, 2015), *available at* http://info.aee.net/rate-based-federal-plan-under-clean-power-plan.

[50] CAA § 111(d)(2), 42 U.S.C. § 7411(d)(2).

[51] CAA § 302(y), 42 U.S.C. § 7602(y).

More generally, courts have interpreted EPA's authority to include "all of the rights and duties that would otherwise accrue to the state" to develop a CAA plan.[52] In effect, when issuing a FIP, EPA "stands in the shoes of the defaulting state."[53] Since section 110(a)(2) and (in all likelihood) the CPP itself authorize a state to incorporate tradable rate or mass credits into its compliance plan, EPA may do the same under a section 111(d) FIP. In fact, EPA has proposed and utilized market-based measures to implement federal requirements under both section 111(d) and section 110(c).[54] This authority should extend to the use of tradable emission reduction credits for zero- and low-emitting resources and demand-side resources as a compliance mechanism by power generators subject to CPP requirements.

B. States and EGUs Are Currently Accessing Compliance Solutions Through Existing Markets

States and EGUs currently make use of market-based mechanisms — including credit-trading systems — to access eligible CPP compliance solutions, such as renewable energy and demand-side resources, to meet policy requirements or electricity needs. Moreover, the electricity sector has extensive experience with market-based programs for conventional pollutants. Thus, market-based compliance under the CPP will not be starting from scratch, but rather from a solid foundation backed by decades of experience.

Owners and operators of EGUs procure both renewable energy and energy efficiency through a variety of means. Many fossil fuel-fired EGU owners also own renewable energy generating resources, contract for renewable energy, procure renewable energy through bilateral contracts, run or fund programs to reduce customer demand, or provide energy efficiency services. This market activity spans across different utility types, including investor-owned utilities, municipal utilities, and cooperative utilities; across different market structures, both regulated and deregulated; and either extends or could extend to independent power producers (IPPs) or merchant generators.[55]

In addition, many utilities are active participants in markets for RECs in order to comply with state renewable portfolio standards (RPS).[56] Entities not subject to an RPS — such as IPPs, residential consumers, commercial businesses, and industrial facilities — can or do also participate in these markets through voluntary REC purchases.[57] RECs are used in all regions of the country to track generation from renewable energy sources. All 10 REC tracking systems in use in the United States were designed and engineered by APX, a leading developer of software systems for tracking RECs and other credits, and therefore have common functionality.

Experience with EECs is more limited, but there is precedent for EEC trading. EECs use a common currency for energy savings (avoidance of one MWh per hour) and allow efficiency improvements to be monetized and traded.[58] Virtually all energy efficiency measures and technologies can form the basis of EECs. Evolution Markets has reported that Connecticut, Massachusetts, Pennsylvania and Nevada have adopted legislation requiring efficiency as part of a portfolio standard and allowing for the creation and trading of EECs. The

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52 Cent. Ariz. Water Conservation Dist. v. EPA, 990 F.2d 1531, at 1541 (9th Cir. 1993) (citation omitted).
53 *Id.* (citation omitted).
54 CAIR FIP, 71 Fed. Reg. 25,328 (2006); CSAPR, 76 Fed. Reg. 48208 (Aug. 8, 2011); *see also* Federal Implementation Plans To Reduce the Regional Transport of Ozone, 63 Fed. Reg. 56394 (*proposed* Oct. 21, 1998); Federal Plan Requirements for Clean Air Mercury Rule, 71 Fed. Reg. 77100 (*proposed* Dec. 22, 2006).
55 For more detail and examples, see: Advanced Energy Economy, *AEE Supplemental Comments on EPA's Clean Power Plan* (December 1, 2014), *available at* http://info.aee.net/clean-power-plan-comments.
56 Jan Hamrin, *REC Definitions and Tracking Mechanisms 1*, Clean Energy States Alliance (Jun. 2014), *available at* http://www.cesa.org/assets/2014-Files/RECs-Attribute-Definitions-Hamrin-June-2014.pdf.
57 J Heeter & T. Nicholas, *Status and Trends in the U.S. Voluntary Green Power Market (2012 Data),* National Renewable Energy Laboratory (Oct. 2013), *available at* http://www.nrel.gov/docs/fy14osti /60210.pdf. ("More than 25 companies offer unbundled RECs to retail customers via the Internet, and a number of other companies market RECs solely to commercial and wholesale customers.")
58 Supria Nanade and Matthew Deery, Evolution Markets, *Energy Efficiency Credits Vie for the Next Big Thing Status* (2010).

Connecticut legislation, enacted in 2007, was the first and, according to Evolution Markets, has been a success, with an auction of EECs netting $3.3 million in 2008. As of 2010, Evolution Markets estimated the size of the current EEC market at around $200 million and cited predictions that the market could grow to $1 billion in five years.[59]

Furthermore, the Cadmus Group has pointed out that utilities with long experience in demand side management programs have developed sophisticated tools to quantify energy efficiency increases from a wide variety of measures and to track them in databases used for internal and public reporting of energy efficiency performance. Although trading among these utilities is now limited, three established tracking systems for RECs — NAR, NC-RETS and NEEPOOL GIS — have the capability to track EECs.[60]

Access to eligible compliance measures by states and EGUs through existing markets provides not only a precedent for market-based compliance, but also the infrastructure and institutional knowledge necessary to support similar trading under the CPP (see Section III.C., below). The availability of these existing markets that can be tailored to meet 111(d) requirements will facilitate the development of market-based mechanisms in response to the CPP.

C. Stakeholders Are Developing the Infrastructure for Market-Based Compliance Solutions Under the CPP

Market-based compliance measures are not only allowed by the CAA and consistent with current market practices, but are also the subject of much stakeholder discussion and collaboration. While these stakeholder conversations are currently laying the groundwork for more formal compliance planning following the release of the final CPP, the depth and breadth of engagement indicates that market-based mechanisms will indeed develop to facilitate compliance.

Most notably, state regulators charged with advising or drafting state compliance plans have engaged in conversations around options for market-based compliance. For example, a group of state regulators, regulated utilities, transmission and distribution cooperatives, and merchant power producers participating in the Midwestern Power Sector Collaborative (MPSC) wrote to EPA requesting additional support and clarity around market-based compliance, saying, "EPA should provide or approve the use of credit tracking systems for states that wish to implement trading programs and accept reductions or credits from other states as valid compliance currency. EPA already has such systems in place for other pollutants."[61]

A number of states and other stakeholders have also expressed interest in some form of partial coordination with other states based on credit trading for certain elements of a compliance plan, such as "beyond the fence line" measures. In the Southeast, the Nicholas Institute at Duke University termed this idea a "common elements" approach, and described several market-based mechanisms that could enable cost-effective compliance. The common elements approach was born out of the observation that "[m]any state officials and

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[59] This does not account for any market stimulus that the CPP will provide. Ibid.

[60] Cadmus Group, *Exploring and Evaluating Modular Approaches to Multi-State Compliance with EPA's Clean Power Plan in the West* (April 29, 2015), at 42, *available at* http://www.cadmusgroup.com/wp-content/uploads/2015/05/Cadmus_WIEB_Exploring-and-Evaluating-Modular-Approaches-Multi-state-Compliance-EPA-Clean-Power-Plan_April2015.pdf (hereinafter "Cadmus").

[61] Midwestern Power Sector Collaborative, *Final Comments to the U.S. EPA on Draft §111(d) Guidelines* (December 1, 2014), *available at* http://www.betterenergy.org/sites/www.betterenergy.org/files/MPSC%20Consensus%20Comments%20to%20EPA_12-1-2014_Final.pdf.

other stakeholders are considering market-based approaches to CPP compliance because the approaches offer potential economic benefits and leave energy planning decisions to EGU operators and utility commissions."[62]

Similarly, following panel discussions on the topics of rate- and mass-based interstate credit trading featuring state regulators and power company representatives as participants, the Georgetown Climate Center released a paper exploring options for interstate trading, noting that "States and stakeholders have indicated significant interest in the possibility of developing single-state compliance plans that would allow for the option of interstate trading of compliance instruments."[63] The states of the Western Interstate Energy Board (WIEB) are also analyzing a "modular approach" whereby states coordinate on certain aspects of their compliance plans through tracking and trading of credits for renewable energy and energy efficiency. These states commissioned the Cadmus Group to assess the ability of existing tracking systems "to facilitate certificate tracking, trading, and reporting of RE [renewable energy] and EE [energy efficiency]." The report concluded, "the modular approach is a valid strategy for compliance with the requirements of 111(d)."

Utilities tasked with compliance have also put forth varying proposals to meet state CPP targets through a range of market-based compliance mechanisms. For example, Exelon has proposed that a carbon price adder be applied to all emitting generating units. In advocating for market-based CPP compliance, Exelon stated, "The Clean Air Act does not require a choice between greenhouse gas regulation and efficient markets… [Federal Energy Regulatory] Commission-jurisdictional markets can be a tool to implement the Clean Power Plan if FERC and EPA work together."[64] Similarly, the Edison Electric Institute (EEI), which represents all U.S. investor-owned utilities, addressed several different market-based compliance approaches in its comments to EPA on the proposed rule, saying that "states could choose to require in-state resources to include a carbon adder pre-determined by EPA when bidding resources into the market."[65] EEI also endorsed the idea of market-based trading, saying that "a streamlined multi-state trading approach should be allowed" and that EPA should "provide as much flexibility as possible" for such an approach.[66]

Regional transmission organizations (RTOs) and Independent System Operators (ISOs), including the Midcontinent Independent System Operator (MISO), the Southwest Power Pool (SPP), and PJM Interconnection (PJM), have also indicated support for market-based compliance options. Initial modeling by MISO shows that regional compliance would be 40% cheaper than state-by-state compliance,[67] and MISO and SPP are both working with the Midcontinent States Environmental and Energy Regulators (MSEER) to develop an interstate trading platform for CPP compliance.[68] Similarly, PJM found that compliance was cheaper under a modeled scenario in which compliance is achieved through a regional carbon price applied to all generating resources, as compared to a state-by-state approach.[69] In a filing prior to a series of FERC technical conferences convened to

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[62] Jonas Monast et al., *Enhancing Compliance Flexibility under the Clean Power Plan: A Common Elements Approach to Capturing Low-Cost Emissions Reductions,* Nicholas Institute for Environmental Policy Solutions, Duke University (March 2015), available at https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_pb_15-01.pdf.

[63] Lissa Lynch et al., *Clean Power Plan Implementation: Single-State Compliance Approaches with Interstate Elements,* Georgetown Climate Center (May 2015), *available at* http://www.georgetownclimate.org/sites/www.georgetownclimate.org/files/GCC_ComplianceApproacheswithInterstateElements_May2015.pdf.

[64] Kathleen L. Barrón, *Prepared Testimony, Fed. Energy Regulatory Commission*, Docket No. AD15-4-000, *available at* http://www.ferc.gov/CalendarFiles/20150218113754-Barron,%20Exelon.pdf.

[65] Edison Electric Institute, *Comments of the Edison Electric Institute on Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units,* Docket No. EPA-HQ-OAR-2013-0602 (December 1, 2014), at 166, available at http://www.eei.org/issuesandpolicy/testimony-filings-briefs/Documents/EEI_111(d)_Comments_Final_12012014.pdf.

[66] *Id.* at 212-13.

[67] Midcontinent Independent System Operator, *Analysis of EPA's Proposal to Reduce CO2 Emissions from Existing Electric Generating Units* (December 2014), at 12, *available at* https://www.misoenergy.org/Library/Repository/Communication%20Material/EPA%20Regulations/AnalysisofEPAsProposaltoReduceCO2EmissionsfromExistingElectricGeneratingUnits.pdf.

[68] Rich Heidorn, Jr., *MISO, SPP Stakeholders Developing Trading Plan to Comply with EPA Carbon Rule* (RTO Insider, April 2, 2015) <http://www.rtoinsider.com/epa-ferc-clean-power-plan-miso-spp-14140/> (accessed June 15, 2015).

[69] PJM Interconnection, *PJM Interconnection Economic Analysis of the EPA Clean Power Plan Proposal* (March 2, 2015), *available at* http://www.pjm.com/~/media/documents/reports/20150302-pjm-interconnection-economic-analysis-of-the-epa-clean-power-plan-proposal.ashx.

discuss the CPP, PJM described how existing markets would support a carbon price adder or a mass-based trading approach:[70]

> In some ways, the Clean Power Plan can be seen as another policy choice to which the markets will react. Just as with the [Mercury and Air Toxics Standards] MATS rule and state RPS rules, the EPA Clean Power Plan will adjust the type of resources that bid into the market but will not require wholescale market redesign. In this way, the markets provide an important role in revealing the least cost compliance options while also facilitating innovation by allowing new ideas to be tested and monetized if successful (or replaced if unsuccessful). The markets are also able to quickly internalize the costs of compliance and respond to any implicit or explicit price on carbon dioxide emissions. Whether a cap and trade system is developed on a regional basis or units simply have to bid their individual compliance costs, the market provides a sorting function that allows the least cost solutions to emerge.

PJM's endorsement of market-based compliance under the CPP sends a clear signal to states that existing markets represent a viable tool for compliance.

Other entities have also explored and endorsed different ideas for how market-based compliance might develop under the CPP. Advanced Energy Economy released a model Federal Plan that would apply to states that do not submit acceptable state plans to EPA. The proposal includes a voluntary market for reduction credits that could be traded by any affected entity, which would allow EGU owners to access "beyond the fence line" resources.[71]

In the state plan context, Western Resource Advocates proposed a Carbon Reduction Credit (CRC) program with tradable CRCs calculated based on the difference between the emission rate of a generating resource and a state's target emission rate. The CRC Program would allow for interstate trading, banking, buying, and selling of CRCs.[72]

Stakeholder discussions or proposals calling for market-based trading for CPP compliance are based on an implied or stated understanding that existing tracking infrastructure is technically sufficient to meet the needs of the CPP. The Cadmus Group examined this question in detail at the request of the WIEB, finding that each of the 10 systems for REC tracking currently used in the United States "provides all of the essential capabilities and the necessary functionalities to track, establish transfer of ownership, retire, and generate compliance reports for 111(d)-eligible RE [renewable energy] and EE [energy efficiency] activities."[73] The report identifies some beneficial features for CPP purposes not currently incorporated in existing tracking systems, but does not find any technical barriers to building out these features. This conclusion underscores that, with some adjustments, existing infrastructure for REC and EEC trading should provide a secure foundation for CPP Building Blocks 3 and 4.

The CPP rulemaking has already stimulated a concerted effort by states, third-party experts and data-system providers to amend existing tracking and accounting systems such that they can support private market activity under the CPP. In May 2015, APX announced that its "North American Renewables Registry (NAR) will be adding key features to support state implementation efforts for the [CPP]" and that "[w]ith the new features NAR will serve as a viable prototype of what we believe is necessary for cost-effective market-based solutions to

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[70] Michael J. Kormos, *Prepared Testimony, Fed. Energy Regulatory Commission*, Docket No. AD15-4-000 (February 19, 2015), at 3, *available at* http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14299200.

[71] Advanced Energy Economy, *Design Principles for a Rate-Based Federal Plan under EPA's Clean Power Plan* (May 21, 2015), *available at* http://info.aee.net/rate-based-federal-plan-under-clean-power-plan.

[72] Steven Michel and John Nielsen, *Carbon Reduction Credit Program: A State Compliance Tool for EPA's Clean Power Plan Proposal,* Western Resource Advocates (November 12, 2014), *available at* http://www.westernresourceadvocates.org/energy/pdf/CRC%20Program%20-%20WRA%20working%20paper%2011%2012%2014.pdf.

[73] Cadmus at 75.

implement" CPP requirements.[74] Because APX designed and engineered all tracking systems currently in use in the United States, this prototype will be broadly applicable across the country, ensuring that market-based trading is feasible in any state choosing to pursue market-based compliance.

These tools to track RECs and EECs work alongside well-established tracking systems that can support state or regional allowance trading programs for EGU CO_2 emissions. Under EPA's Part 75 regulations, all but the smallest fossil-fuel burning EGUs are required to conduct continuous emission monitoring of CO_2 and report these data to EPA. EPA's Emissions and Generation Resource Integrated Data-base (eGRID) compiles extensive data from multiple sources on environmental attributes of electric power systems, including plant-specific data on emissions and generation characteristics. In addition, two regional tracking systems, NEPOOL GIS and PJM-GATS, track all generation resources in order to support power disclosure programs and to provide system emission rates of various pollutants, including CO_2, to state regulators.[75] These data systems will help assure the transparency and integrity of allowance trading and inspire confidence in third-party markets.

The applicability of existing tracking and accounting infrastructure, coupled with the significant engagement of state regulators, utilities, grid operators, and other stakeholders on potential market-based compliance under the CPP, indicates that such an approach is seen as both desirable and viable. Barring a sudden change in thinking, the development of market-based mechanisms is likely to play a key role in CPP compliance.

IV. THE ADVANCED ENERGY INDUSTRY IS READY TO PROVIDE CPP COMPLIANCE SOLUTIONS

As illustrated above, historical experience indicates that EPA rules allowing for market-based compliance mechanisms can deliver cost-effective and timely compliance outcomes as industries respond to a market signal and step up to provide compliance solutions. Given the robust and well-established markets for technologies that reduce carbon emissions from the electricity sector, compliance with the CPP is unlikely to prove an exception to the rule. By participating in compliance markets, advanced energy technologies and services will not only drive market efficiency and robust market activity, but will also provide states and EGUs with myriad compliance options.

This section explores the broad suite of readily available and cost-effective solutions that can deliver emission reductions and other co-benefits under the CPP.

A. A Broad Array of Market-Ready Solutions Are Available for Compliance Purposes

In addition to including renewable energy and energy efficiency as two of its BSER Building Blocks (see Appendix A), EPA has signaled in the proposed CPP that it will allow a variety of additional, non-BSER technologies to contribute towards compliance. Under a market-based approach to CPP compliance, any available, cost-competitive, and reliable emission reduction measure would be able to contribute to compliance

[74] APX Research, *The North American Renewables Registry Adds Functionality to Support Clean Power Plan Implementation* (May 13, 2015), *available at* http://www.narecs.com/2015/05/13/the-north-american-renewables-registry-adds-functionality-to-support-clean-power-plan-implementation/.

[75] In these registries, a certificate representing the power attributes is issued for every MWh generated in the region. Power attributes include the source of the generation, the fuel/technology type, the emission rates for specific pollutants (such as CO_2), the time of generation (vintage), additional information required by regulators, and the tracking of each MWh of electricity generated. See APX Research, *The North American Renewables Registry Adds Functionality to Support Clean Power Plan Implementation* (May 13, 2015), *available at* http://www.narecs.com/2015/05/13/the-north-american-renewables-registry-adds-functionality-to-support-clean-power-plan-implementation/.

progress, provided that it can deliver emission reductions that are effective, measurable and enforceable. Simply put, much like the historical examples described earlier, market based compliance will allow states and EGUs to access solutions produced by industry in a cost-effective manner.

Today, there are a number of technologies both within and outside of BSER that already meet these requirements and stand ready to participate in CPP compliance. These solutions include a number of advanced energy technologies and services. *Advanced energy* can be broadly defined as technologies and services that are modernizing and streamlining the ways in which we produce, manage, and use energy. Many of these technologies and services also reduce emissions from the electric power sector by providing lower-emission sources of energy or reducing overall generation needs and thereby reducing demand for higher-emitting units.[76] A study produced by Google.org, the philanthropic arm of Google Inc., found that select advanced energy technologies could, by 2030, save consumers over $900 annually per household, reduce U.S. greenhouse gas emissions by 13%, create 1.1 million net new jobs, and increase U.S. GDP by $155 billion per year.[77]

These technologies represent a significant and growing sector of our energy economy. The market for advanced energy technologies was nearly $200 billion in the United States in 2014, equal to the pharmaceutical industry, bigger than the airline industry, and nearly as big as consumer electronics.[78] Advanced energy technologies are currently deployed at commercial scale in markets across the country,and many provide significant emission reductions.[79] For at least two decades, advanced energy has represented the majority of new capacity additions, and in 2014 nearly 100% of incremental installations came from advanced energy, dominated by new natural gas (49%), wind (27%), and solar (20%) installations.[80] These and other advanced energy technologies are impacting the ways in which we produce, transport, and consume electricity. To name a few:

- **Low- or zero carbon generation resources** lower carbon emissions in the electricity system by reducing the need to run high-emitting EGUs.
    - **Biomass** generation technology uses wood and wood-derived fuels to provide 6% of U.S. non-hydro renewable electricity. Plants are operating in 47 states, including both dedicated biomass facilities and plants that co-fire biomass with coal.
    - **Combined heat and power (CHP)** provides efficient electricity and useful heat and currently makes up 8% of U.S. electricity generation, totaling 83 GW.[81] CHP achieves fuel efficiencies of 75% to 80%, delivering cost and energy savings to sites where it is deployed.[82]
    - **Fuel cells** are a technology suite that utilities and commercial and industrial customers are increasingly adopting. Utilities such as Delmarva Power, Dominion, and NRG Energy are all adding fuel cell capacity to deliver reliable power to their grid networks and reduce emissions.[83]
    - **Geothermal power** had a total operating capacity of 3.5 GW in the United States at the end of

[76] Advanced Energy Economy, *Advanced Energy Technologies for Greenhouse Gas Reduction: 40 Solutions for Cutting Carbon Emissions from Electricity Generation* (May 13, 2014), available at http://info.aee.net/epa-advanced-energy-tech-report.

[77] Google.org, *The Impact of Clean Energy Innovation: Examining the Impact of Clean Energy Innovation on the United States Energy System and Economy* (July 2011), *available at* http://www.google.org/energyinnovation/The_Impact_of_Clean_Energy_Innovation.pdf.

[78] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.

[79] Advanced Energy Economy, *Advanced Energy Technologies for Greenhouse Gas Reduction: 40 Solutions for Cutting Carbon Emissions from Electricity Generation* (May 13, 2014), available at http://info.aee.net/epa-advanced-energy-tech-report.

[80] Federal Electric Reliability Commission, *Office of Energy Projects Energy Infrastructure Update For December 2014* (2015), *available at* http://www.ferc.gov/legal/staff-reports/2014/dec-infrastructure.pdf.

[81] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.

[82] Center for Climate and Energy Solutions, *Cogeneration / Combined Heat and Power (CHP)* < http://www.c2es.org/technology/factsheet/CogenerationCHP> (accessed May 25, 2015).

[83] Sandra Curtin and Jennifer Gangi, *The Business Case for Fuel Cells Reliability, Resiliency & Savings*, Breakthrough Technologies Institute (2013), *available at* http://www.fuelcells.org/pdfs/2013BusinessCaseforFuelCells.pdf.

2014, with an additional 1.3 GW under development.[84]

- **Hydroelectric power** currently constitutes the largest and oldest source of renewable electricity in the United States, producing 51% of renewable electricity and 7% of total electricity from all sources in 2013, not including pumped storage.[85]
- **Landfill Gas** projects numbered 645 as of early 2015, spanning 48 states and totaling over 2 GW in capacity. These projects include over 430 electricity generation projects as well as CHP and direct use projects.[86]
- **Natural Gas** fired electricity generation has increased rapidly over the past decade, driving its share of U.S. electricity generation from 18% in 2004 to 27% in 2014. Through the first four months of 2015, natural gas accounted for 29% of U.S. generation, reaching 32% in April.[87]
- **Nuclear power** plants produce about 20% of the country's electricity. There are 99 licensed reactors operating in 30 states and totaling 115 GW of capacity.
- **Solar** capacity in the United States reached 8 GW for utility-scale photovoltaic (PV) and 1.7 GW for concentrated solar power (CSP) by the end of 2014, with a record 3.9 GW of utility-scale PV, 0.8 GW of CSP, and 2.2 GW of distributed solar power capacity installed in 2014 alone.[88,89]
- **Waste-to-Energy (WTE)** operations are active across 84 U.S. facilities. Located in 23 states, primarily in the Northeast, these facilities have a generating capacity of over 2.7 GW and process more than 30 million tons of municipal trash annually.[90]
- **Wind power** technology is used at over 900 wind farms across 39 states.[91] With more than 46,000 operating turbines providing over 62 GW of wind capacity, the United States ranks first globally in wind power generation and second in installed capacity.[92,93]

- **Energy Efficiency** lowers electricity sector emissions by reducing demand for power from affected EGUs.
  - **Behavioral Energy Efficiency** is used by utilities across the country to reduce customer energy use. Opower, a leading behavioral efficiency company, works with more than 95 utility partners in 35 states and eight countries to reach over 50 million households and businesses.[94]
  - **Building Energy Management Systems** deliver energy savings to a range of building types, from Bank of America Plaza in Columbia, SC,[95] to 470 Massachusetts state buildings.[96] The

[84] Benjamin Matek, *2015 Annual U.S. & Global Geothermal Power Production Report*, Geothermal Energy Association (February 2015), *available at* http://geo-energy.org/reports/2015/2015%20Annual%20US%20%20Global%20Geothermal%20Power%20Production%20Report%20Draft%20final.pdf
[85] U.S. Energy Information Administration, *Monthly Energy Review* <http://www.eia.gov/totalenergy/data/monthly/> (accessed April 30, 2015).
[86] U.S. EPA, *Energy Projects and Candidate Landfills* <http://www.epa.gov/lmop/projects-candidates/index.html> (accessed April 30, 2015).
[87] Energy Information Administration, *Electric Power Monthly, Table 1.1: Net Generation by Energy Source: Total (All Sectors), 2005-April 2015* (June 25, 2015), *available at* http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_1.
[88] U.S. Department of Energy, *Powering New Markets: Utility-Scale Photovoltaic Solar* (February 2015), *available at* http://energy.gov/sites/prod/files/2015/02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf.
[89] Solar Energy Industries Association, *U.S. Installs 6.2 GW of Solar PV in 2014, Up 30% Over 2013* (March 10, 2015) http://www.seia.org/news/us-installs-62-gw-solar-pv-2014-30-over-2013 (accessed May 15, 2015).
[90] Ted Michaels, *The 2014 ERC Directory of Waste-to-Energy Facilities*, Energy Recovery Council (May, 2014), *available at* http://www.energyrecoverycouncil.org/userfiles/files/ERC_2014_Directory.pdf.
[91] American Wind Energy Association, *Industry Statistics*, *available at* http://www.awea.org/Resources/industrystatistics.aspx.
[92] American Wind Energy Association, *New analysis: U.S. is world's number one wind energy producer, leading China and Germany* (November 11, 2014) <http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=6965> (accessed May 15, 2015).
[93] American Wind Energy Association, *Wind Energy Facts at a Glance* <www.awea.org/Resources/Content.aspx?ItemNumber=5059&navItemNumber=742> (accessed May 15, 2015).
[94] Opower, *Overview* <http://opower.com/company> (accessed May 12, 2015).
[95] Johnson Controls, *Case Study: Bank of America Plaza, Columbia, South Carolina* <http://www.johnsoncontrols.com/content/dam/WWW/jci/be/case_studies/Bank_of_America_Case_Study.pdf> (accessed May 14, 2015).
[96] EnerNOC, *Massachusetts Taps EnerNOC for $10 Million State-Wide Energy Efficiency Project* (April 9, 2010) <http://investor.enernoc.com/releasedetail.cfm?ReleaseID=457832> (accessed May 14, 2015).

global BEMS market is expected to grow from $2.8 billion in 2014 to $10.8 billion by 2024.

- **Efficient Appliances & Electronics** generally account for the top 25% most efficient products across 60 product categories (specifically, Energy Star certified products), from refrigerators to DVD players.[97]
- **Efficient Building Envelope Technologies** including insulation, low-emissivity windows, and cool roofs represent a major market in the United States, producing an estimated $15.2 billion in revenue in 2014.[98]
- **Efficient Heating, Ventilation, and Air Conditioning (HVAC)** systems use a huge amount of energy, and switching to efficient models produces significant savings. The market for efficient HVAC systems was $13.1 billion in the United States in 2014, an increase of 7% over 2013.[99]
- **Efficient Lighting and Intelligent Lighting Controls** have begun to dominate the lighting market based on a combination of performance and economics, pushing demand for conventional incandescent lights down by half from 2007 to 2012.[100]
- **Efficient Water Heaters** made up 11% of the gas water heating market and 1% of the electric water heating market in 2011, representing a viable market with ample room for further growth.[101]
- **Energy Service Companies (ESCOs)** deliver energy savings to building owners, including municipalities, universities, schools, and hospitals. ESCO services was a $4.8 billion market in 2012,[102] and the market is expected to double or triple by 2020.[103]
- **Utility Energy Efficiency Programs & Services** first emerged in the 1970s, and now most utilities throughout the country offer efficiency programs or services to their customers. The utility efficiency programs market totaled $5.7 billion in 2012.[104]

- **Efficient Grid Technologies** reduce emissions by reducing line losses and improving electricity management across all levels of the grid. These technologies also lower emissions by enabling distributed energy resources and variable renewable energy resources to compete in the marketplace.
  - **Advanced Distribution Management Systems (ADMS)** is relatively new but has been deployed by a number of utilities, including PPL Electric Utilities in Pennsylvania; CenterPoint in Texas; and Oklahoma Gas and Electric in Arkansas and Oklahoma.[105]
  - **Advanced Metering Infrastructure (AMI)** has become commonplace across the United States. As of mid-2014, there were over 50 million smart meters installed in the United States, covering about 43% of households.[106]

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[97] U.S. EPA, *Residential Energy Efficiency* <http://www.epa.gov/statelocalclimate/local/topics/residential.html> (accessed April 28, 2015).
[98] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.
[99] Ibid.
[100] General Electric Lighting, *A Transforming Global Lighting Industry* (2010), *available at* http://www.gelighting.com/LightingWeb/na/consumer/images/GE-Transforming-Global-Lighting-Industry.pdf.
[101] Steve Ryan and Rosemarie Stephens-Booker, *ENERGY STAR Appliance & Water Heater Highlights* (October 23, 2012) <https://www.energystar.gov/ia/partners/downloads/U.S._EPA-Ryan_and_Stephens-Booker.pdf> (accessed May 21, 2015).
[102] Navigant Research, *The U.S. Energy Service Company Market* (2013), *available at* http://www.navigantresearch.com/research/the-u-s-energy-service-company-market.
[103] Elizabeth Stuart et al., *Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry,* Lawrence Berkeley National Laboratory (September, 2013), *available at* http://emp.lbl.gov/sites/all/files/lbnl-6300e_0.pdf.
[104] Consortium for Energy Efficiency, *The Efficiency Program Industry by State and Region* (2013), *available at* http://library.cee1.org/sites/default/files/library/10535/2012_AIR_Tables_-_All_Tables_FINAL_-_with_erratum_NEW_VERSION.pdf.
[105] U.S. Department of Energy, *Smart Grid Investment Grant Program: Progress Report* (July 2012), *available at* https://www.smartgrid.gov/files/sgig-progress-report-final-submitted-07-16-12.pdf.
[106] The Edison Foundation, *Utility-Scale Smart Meter Deployments: Building Block of the Evolving Power Grid* (September 2014), *available at* http://www.edisonfoundation.net/iei/Documents/IEI_SmartMeterUpdate_0914.pdf.

- **Demand Response** is utilized by utilities, grid operators, and their customers in markets across the country, and provided an estimated potential peak load reduction of almost 29 GW in 2013, up 9% from 2012.[107]
- **Distribution Automation** is used by utilities to improve reliability, optimize voltage and reactive power, integrate distributed generation, and increase efficiency without requiring customer action. Global revenue is expected to grow from $6.3 billion 2013 to $11.3 billion in 2020.[108]
- **Electric Vehicle (EV) Charging Stations** in the United States numbered 9,266 as of early 2015, not counting private charging stations.[109] This infrastructure can be integrated with intelligent controls to provide "smart charging", as demonstrated by utility pilot programs.[110,111]
- **Energy Storage** capacity in the United States is currently dominated by pumped storage hydro, but newer technologies are gaining market share. In 2014, 62 MW of non-hydro electromechanical/electrochemical capacity was added. Another 220 MW expected in 2015.[112]
- **Flexible Alternating Current Transmissions Systems (FACTS)** were first deployed in the 1970s, and today different FACTS solutions are relied upon by utilities across the country.[113]
- **High Temperature Superconducting (HTS) Transmission** is a newer technology that is being used by utilities in Long Island and Albany in New York and in Columbus, Ohio.[114]
- **High Voltage Direct Current (HVDC)** has a long track record in underwater and underground transmission. Use for aboveground transmission is rising to move remote wind and hydroelectric power to distant load. Global investment in HVDC systems was $6.1 billion in 2014.[115]
- **Microgrids** can be either customer-sited or utility-connected. The United States is the leader in microgrid adoption, with nearly 1,500 MW of microgrid capacity installed and another 1,100 MW in planning.[116]
- **Synchrophasors** began significant deployment just in 2009, but today North America is already using around 1,700 synchrophasors, providing data coverage of a significant portion of the bulk power system.[117]
- **Voltage and Volt-Ampere Reactive (VAR) Optimization (VVO)** can reduce distribution line losses by 2%-5% or more, resulting in significant cost and energy savings.[118,119]

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[107] Federal Energy Regulatory Commission, *Assessment of Demand Response & Advanced Metering* (December 2014), *available at* http://www.ferc.gov/legal/staff-reports/2014/demand-response.pdf.
[108] Navigant Research, *Distribution Automation* (2013), *available at* https://www.navigantresearch.com/research/distribution-automation.
[109] U.S. Department of Energy, *Electric Vehicle Charging Station Locations* <http://www.afdc.energy.gov/fuels/electricity_locations.html> (accessed June 15, 2015).
[110] National Renewable Energy Laboratory, *Distributed Grid Integration: Vehicle-to-Grid Project* <http://www.nrel.gov/electricity/distribution/projects_vehicle_grid.html> (accessed June 15, 2015).
[111] Itron, *Pepco Deploys Itron and ClipperCreek Electric Vehicle Smart Charging Station* (November 6, 2014) <https://www.itron.com/na/newsAndEvents/Pages/Pepco-Deploys-Itron-and-ClipperCreek-Electric-Vehicle-Smart-Charging-Solution.aspx> (accessed June 15, 2015)
[112] National Renewable Energy Laboratory, *The Role of Pumped Storage Hydro Resources in Electricity Markets and System Operation* (May 2013), *available at* http://www.nrel.gov/docs/fy13osti/58655.pdf; GTM Research, *U.S. Energy Storage Monitor* (February 20, 2015), *available at* http://www.greentechmedia.com/research/us-energy-storage-monitor.
[113] Siemens, *Static Var Compensator* <http://www.energy.siemens.com/us/en/power-transmission/facts/static-var-compensator-classic/#content=References> (accessed May 20, 2015).
[114] Office of Electricity Deliver and Energy Reliability, *HTS Cable Projects* (February 16, 2007), *available at* http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/cable_overview2.pdf.
[115] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.
[116] Angelique Mercurio, *Microgrids and Energy Security: The Business Case* (International Association for Energy Economics, 2013) at 46, *available at* http://www.iaee.org/documents/2013EnergyForum4qtr.pdf.
[117] North American SynchroPhasor Initiative, *Synchrophasor Technology Fact Sheet* (October 2014), *available for download at* https://www.naspi.org/File.aspx?fileID=1326.
[118] National Electrical Manufacturers Association, *Volt/VAR Optimization Improves Grid Efficiency*, *available at* http://www.nema.org/Policy/Energy/Smartgrid/Documents/VoltVAR-Optimazation-Improves%20Grid-Efficiency.pdf.
[119] U.S. Department of Energy, *Application of Automated Controls for Voltage and Reactive Power Management – Initial Results* (December 2012), available at https://www.smartgrid.gov/files/VVO_Report_-_Final.pdf.

This list clearly demonstrates that robust markets for wide variety of emission-reducing advanced energy technologies already exist, indicating that such technologies are readily available to respond to a market signal sent by the CPP. Robust advanced energy markets coupled with existing tracking systems customized to meet CPP requirements provide a nearly turnkey solution for state compliance needs, ready to deliver emission reductions as soon as the implementation period begins.

B. Advanced Energy Provides Cost Effective Options for Compliance

Advanced energy technologies are not just viable market-ready solutions; in many cases, they are the least-cost and highest-value options for meeting compliance needs. Some advanced energy products are already cost-competitive with conventional technologies, while other technologies are on a trajectory to reach or dip below grid parity with increased deployment.[120]

For example, the long-term growth in renewable energy deployment has been accompanied by continuous improvements in technology performance and cost. Wind power purchase agreement (PPA) costs have decreased by more than 90% since the 1980s,[121] and in 2013 the national average price for wind PPAs hit an all-time low of $25/MWh.[122] In 2013, wind power bid prices were so low that even with no requirement to purchase renewable energy, American Electric Power (AEP) bought three times more wind power in Oklahoma than it had originally intended because of its value to ratepayers.[123] In the same year, Xcel Energy signed PPAs for 700 MW of wind energy at prices below most of its natural gas-fired generation, and the company expects to save as much as $590 million in fuel costs over the life of the contract.[124] The prices of PPAs for solar-generated electricity have fallen more than 60% in the past 6 years, from an average of $175/MWh in 2008 to $50-70/MWh in 2014, making electricity from utility-scale projects broadly competitive with other new sources of generation in certain regions.[125] The system prices for residential and commercial PV declined 6%-8% per year, on average, from 1998 to 2013.[126] Projections by the National Renewable Energy Laboratory (NREL) and Lawrence Berkeley National Laboratory (LBNL) show that this sustained price drop over eight years is expected to continue, with solar moving toward widespread grid parity over time.[127] A 2015 Deutsche Bank report similarly predicts that over the next four or five years solar will see a 40% reduction in costs, with distributed solar achieving grid parity in 41 states by 2017.[128]

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[120] Advanced Energy Economy, *Competitiveness of Renewable Energy and Energy Efficiency in U.S. Markets* (June 23, 2015), *available at* http://info.aee.net/competitiveness-of-renewable-energy-and-energy-efficiency-in-us.

[121] U.S. Department of Energy, *Revolution Now: The Future Arrives for Four Clean Energy Technologies* (September 2013), *available at* http://energy.gov/sites/prod/files/2013/09/f2/200130917-revolution-now.pdf.

[122] Ryan Wiser et al., *2013 Wind Technologies Report,* U.S. Department of Energy (August 2014), *available at* http://energy.gov/sites/prod/files/2014 /08/f18/2013%20Wind%20Technologies%20 Market%20Report_1.pdf.

[123] NYTimes, "Solar and Wind Energy Start to Win on Price vs. Conventional Fuels," Nov 23, 2014.

[124] American Wind Energy Association, *Citing low costs, Xcel Energy Plans 'Significant Increase' in Wind Purchases* <http://aweablog.org/blog/post/citing-low-costs-xcel-energy-plans-significant-increase-in-wind-purchases> (accessed April 30, 2015).

[125] U.S. Department of Energy, *Powering New Markets: Utility-Scale Photovoltaic Solar* (February 2015), *available at* http://energy.gov/sites/prod/files/2015/ 02/f19/DOE_LPO_Utility-Scale_PV_Solar_Markets_February2015.pdf.

[126] Galen Barbose et al., *Tracking the Sun VII: An Historical Summary of the Installed Price of Photovoltaics in the United States from 1998 to 2013,* Lawrence Berkeley National Laboratory (Sept. 2014), available at http://emp.lbl.gov/sites/all/files/lbnl-6808e_0.pdf.

[127] David Feldman et al., National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, *Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections* (September 22, 2014), *available at* http://www.nrel.gov/docs/fy14osti/62558.pdf?utm_source=Solar%20Energy %20Prices%20See.

[128] Deutsche Bank Markets Research, *Solar* (February 27, 2015), *available at* https://www.db.com/cr/en/docs/solar_report_full_length.pdf.

Energy efficiency is already delivering cost savings in markets across the country. Lazard estimates the levelized cost of energy saved to be between zero and $50/MWh.[129] LBNL has studied the cost of energy efficiency deployed through utility-sponsored programs, and estimates that the average "total cost of energy saved" by customer-funded utility energy efficiency programs in the United States is $46/MWh, based on an analysis of programs in 20 states over a five-year period.[130] This is less than half the U.S. average retail price of electricity.[131] The total cost of energy saved through these programs varies by state, ranging from a low of $29/MWh in New Mexico to a high of $79/MWh in Massachusetts, where energy efficiency programs have been in place for 25 years and utilities are obligated to obtain all energy efficiency that is cost-effective.

Similarly, demand response in the PJM wholesale market results in net savings of over $275 million annually.[132] Technologies enhancing transmission and distribution efficiency can also deliver significant savings. For example, Commonwealth Edison, an Illinois utility, found that voltage optimization could reduce retail sales by 2%, with a levelized cost of saved energy of less than $0.02/kWh, well below the cost of purchased energy.[133] Similarly, after installing distribution automation controls as part of a smart grid upgrade project, the Electric Power Board of Chattanooga in Tennessee and Georgia realized $1.6 million in annual operating savings, as well as $2 million in wholesale demand savings due to improved voltage control.[134] Other technologies such as non-hydro energy storage, ADMS, VVO, and fuel cells stand poised for rapid deployment, which will drive further improvement in economics as production increases and costs decrease.

Advanced energy technologies clearly provide a suite of emission reduction options that are either competitive today or rapidly improving in cost, indicating that cost-competitive emission reduction solutions will be available to states and EGUs for compliance purposes under market-based approaches to CPP compliance.

C. Advanced Energy Delivers Systemic Benefits Beyond Emission Reductions

In addition to falling costs, advanced energy provides important benefits to the electricity sector, consumers, and the broader economy.

Many advanced energy technologies deliver significant performance benefits to the electric system that enhance their value proposition for customers making investment choices. The benefits range widely: demand response enhances reliability and helps defer large capital investments to meet peak generation needs;[135] combined cycle gas generation provides flexible generation for more responsive grid operation; solar power and wind power provide zero emission generation with no fuel costs as a hedge against fuel price volatility;[136]

[129] Lazard's levelized cost of energy (LCOE) for energy efficiency measures the cost of avoided electricity, not the cost of generation, but is an appropriate point of comparison as an alternative to generating a unit of power. Lazard, *Lazard's Levelized Cost of Energy Analysis—Version 8.0* (September 2014), *available at* http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf.

[130] Ian M. Hoffman et al., *The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs,* Lawrence Berkeley National Laboratory (April 2015), *available at* http://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf.

[131] U.S. Energy Information Administration, *Electric Power Monthly* <http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_03> (accessed April 27, 2015). (Table 5.3 shows an average retail price of power in 2014 of $0.1045/kWh.)

[132] PJM Interconnection, *PJM Efficiencies Offer Regional Savings*, available at http://www.pjm.com/~/media/documents/presentations/pjm-value-proposition.ashx.

[133] Applied Energy Group for Commonwealth Edison Company, *Voltage Optimization (VO) Feasibility Study* (December 17, 2015) at 5, *available at* http://blogs.edf.org/energyexchange/files/2015/04/ComEd-study.pdf.

[134] U.S. Department of Energy, *Electric Power Board of Chattanooga (EPB) Smart Grid Project* (July 2014), *available at* https://www.smartgrid.gov/files/EPB_Final_Project_Description_-_20140422_reformatted.pdf

[135] Alex Lopez and Aaron Tinjum, *An Olympic-sized Challenge: Across US, Demand Response is Helping Utilities Navigate Treacherous Winter Peaks* (Jan. 9, 2014), <http://blog.opower.com/2014/01/an-olympic-sized-challenge-across-us-demand-response-is-helping-utilities-navigate-treacherous-winter-peaks/> (accessed June 15, 2015).

[136] April Lee, Owen Zinaman, and Jeffrey Logan, Opportunities for Synergy Between Natural Gas and Renewable Energy in the Electric Power and Transportation Sectors, National Renewable Energy Laboratory (December 2012), available at http://www.nrel.gov/docs/fy13osti/56324.pdf.

efficiency lowers and flattens the demand curve; energy storage helps manage fluctuating demand while also providing ancillary grid services; distributed generation resources and energy efficiency provide new customer offerings and consumer choices; smart meters provide better data and control; and grid technologies such as distribution automation, synchrophasors, and advanced distribution management systems provide greater flexibility and control, increasing overall system efficiency.[137] Combined, these benefits improve the reliability and performance of the electric grid.

At the same time, advanced energy deployment provides economic benefits beyond the electric power system. As a robust and expanding industry, advanced energy is a source of economic activity, and an important and growing source of employment. For example, the U.S. solar industry supported over 173,000 jobs in November 2014, including approximately 157,500 workers whose jobs are dedicated 100% to the solar industry.[138] Similarly, the U.S. wind industry supports over 73,000 jobs in development and operations, construction and maintenance, and manufacturing;[139] the U.S. hydroelectric power industry employs approximately 300,000 workers through project development, manufacturing, and facility operations and maintenance;[140] and the nuclear power industry currently supports over 100,000 jobs nationally.[141] Even smaller industries bring significant benefits; for example, waste-to-energy employs an estimated 14,000 U.S. workers.[142] The states provide a microcosim of the impact of the aggregate adanced energy industry. Studies show that advanced energy and related companies employ 16,000 in Arkansas,[143] 23,000 in North Carolina,[144] 17,000 in South Carolina,[145] 22,000 in Iowa,[146] 430,000 in California, [147] and 100,000 workers in Illinois.[148]

The advanced energy sector produces economic activity that is commensurate with the employment discussed above. The U.S. market for advanced energy technologies and services was $200 billion in 2014, equal to the pharmaceutical industry, and the United States is a leader in advanced energy, accounting for 15% of the global revenue in advanced energy in 2014. Advanced energy is also a rapidly growing industry. U.S. advanced energy revenue grew 14% from 2013 to 2014 – five times the rate of overall U.S. economic growth.[149]

Increased deployment of advanced energy technologies under the CPP will not only achieve emission reductions, but also amplify these associated economic benefits.

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[137] For numerous examples of these benefits as deployed across the country, see: The Edison Foundation, *Innovations Across the Grid: Volume II* (December 2014), *available at* http://www.edisonfoundation.net/iei/Documents/IEI_InnovationsGrid_volII_final_LowRes.pdf; and The Edison Foundation, *Innovations Across the Grid* (December 2013), *available at* http://www.edisonfoundation.net/iei/Documents/InnovationsAcrosstheGrid_LoRes_InstElcInnv.pdf.

[138] The Solar Foundation, *National Solar Jobs Census 2014* (January 2015), *available at* http://www.thesolarfoundation.org/wp-content/uploads/2015/01/TSF-National-Census-2014-Report_web.pdf.

[139] American Wind Energy Association, *Wind Facts at a Glance* <http://www.awea.org/Resources/Content.aspx?ItemNumber=5059> (accessed July 15, 2015).

[140] National Hydropower Association, *Hydropower is Creating Jobs* <http://www.hydro.org/why-hydro/job-creation/> (accessed June 3, 2015).

[141] Nuclear Energy Institute, *Cost & Benefits Analyses* <http://www.nei.org/Issues-Policy/Economics/Cost-Benefits-Analyses> (accessed June 3, 2015).

[142] Eileen Brettler Berenyi, *Nationwide Economic Benefits of the Waste-to-Energy Sector* (August 2013), *available at* http://www.wte.org/userfiles/files/130820%20Berenyi%20Nat%27l%20WTE%20Economic%20Benefits.pdf.

[143] Arkansas Advanced Energy Foundation, *The Economic Impact of Advanced Energy in Arkansas: A Survey of Business Activity in 2014* (2014), *available at* http://www.arkansasadvancedenergyfoundation.org/files/dmfile/AEJOBSReport.FINAL.pdf.

[144] NC Sustainable Energy Association, *North Carolina Clean Energy Industry Census* (February 2015), *available at* http://c.ymcdn.com/sites/www.energync.org/resource/resmgr/Docs/2014census.pdf.

[145] South Carolina Clean Energy Business Alliance, *2013 Industry Survey Results*, *available at* http://www.resh.com/SCCEBA_2013_Survey_Results_Final.pdf.

[146] Advanced Energy Economy, *Iowa Advanced Energy Employment Survey* (December 2014), *available at* http://info.aee.net/ia-jobs-report-14.

[147] Advanced Energy Economy, *California Advanced Energy Employment Survey* (December 2014), *available at* http://info.aee.net/ca-jobs-report-14.

[148] Clean Jobs Illinois, *Survey Results* <http://www.cleanjobsillinois.com/2015/#ch/soaring> (accessed June 18, 2015).

[149] Advanced Energy Economy, *Advanced Energy Now: 2015 Market Report* (March 2015), *available at* http://info.aee.net/aen-2015-market-report.

VI. TIMELY CPP IMPLEMENTATION WILL ACCELERATE ADVANCED ENERGY DEPLOYMENT AND INNOVATION

While the benefits of advanced energy technologies and services favor their deployment even without an added policy incentive, market-based compliance mechanisms under the CPP will nonetheless provide an additional market signal to accelerate the deployment of advanced energy by states and EGUs. Experience under existing state and federal policies designed to stimulate advanced energy not only corroborates this prediction, but also underscores the importance of timely and predictable policy in establishing robust market growth and driving further cost and performance improvements.

While existing policies — including RPS, energy efficiency resource standards (EERS), tax incentives, building codes, rebates, carbon regulations, and other state and Federal policies — are not perfect analogues for advanced energy deployment under the CPP, they do indicate how advanced energy has responded to policies that establish a market signal. For example, state RPS policies have a long history of enabling renewable energy deployment. NREL found a significant relationship between renewable energy deployment and state policies that include RPS mandates; this correlation increased with policy longevity.[150] These RPS mandates often serve to remove structural barriers to entry, allowing a competitive resource to gain a foothold.[151] Of the 29 states (plus Washington, D.C.) with RPS policies, most have consistently achieved full compliance with their RPS targets, and 61% of non-hydro renewable capacity added from 1998 to 2013 served RPS-obligated entities.[152]

Similarly, of the 26 states that have enacted EERS policies, half *exceeded* their electricity savings target for 2011, reflecting the fact that the energy savings delivered by these policies are economically viable.[153] Despite the proven cost-effectiveness of energy efficiency programs, states with no EERS have lower levels of energy savings.[154]

Other policies have had similar impacts. In California, a 2010 state law, A.B. 2514, required the state's utilities to collectively procure 1.3 GW of energy storage. Southern California Edison was the first utility to procure energy storage under these requirements and announced contracts for 261.1 MW of new energy storage capacity, five times the amount required under the law.[155] In this case, while policy helped to catalyze the market demand, ultimately the performance and economic benefits of advanced energy spurred even greater investment. Under

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[150] Elizabeth Doris and Rachel Gelman, *State of the States 2010: The Role of Policy in Clean Energy Market Transformation,* National Renewable Energy Laboratory (January 2011), *available at* http://www.nrel.gov/docs/fy11osti/49193.pdf.

[151] To cite one example, the renewable energy industry barely existed in Texas when its RPS was established in 1999. By 2005, the RPS was deemed so successful in diversifying the state's energy economy that it was extended and expanded with overwhelming support from the Texas legislature. With 13,515 MW of renewable energy capacity as of 2012, the state has far exceeded its RPS requirement of 5,880 MW by 2015. Sources: Barry G. Rabe, *Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards,* Pew Center on Global Climate Change (June 2006), *available at* http://www.pewtrusts.org/~/media/legacy/uploadedfiles/www.pewtrustsorg/reports/global_warming/PCGCCrenewable0601406pdf.pdf; PowerPortal, Advanced Energy Economy, *Texas Energy Polices* <http://powersuite.aee.net/portal/states/TX/energy_policies> (accessed June 15, 2015); American Council on Renewable Energy, *Renewable Energy in Texas* (January 2014), *available at* http://www.acore.org/files/pdfs/states/Texas.pdf.

[152] Galen Barbose, *Renewables Portfolio Standards in the United States: A Status Update,* Lawrence Berkeley National Laboratory (December 4, 2014), *available at* http://emp.lbl.gov/sites/all/files/2014%20REM.pdf.

[153] Annie Downs and Celia Cui, *Energy Efficiency Resource Standards: A New Progress Report on State Experience,* American Council for an Energy-Efficient Economy (April 2014), *available at* http://aceee.org/sites/default/files/publications/researchreports/u1403.pdf.

[154] Annie Downs and Celia Cui, *Energy Efficiency Resource Standards: A New Progress Report on State Experience,* American Council for an Energy-Efficient Economy (April 2014), *available at* http://aceee.org/sites/default/files/publications/researchreports/u1403.pdf. (Only states with active EERS policies have achieved energy savings greater than 1% of electricity sales.)

[155] Southern California Edison, *Local Capacity Requirements ("LCR") RFP* <https://www.sce.com/wps/portal/home/procurement/solicitation/lcr/!ut/p/b1/rVRNc5swFPwrzsEzyQHrgfjSUUkYG-rWTXAngYtHCEHIgISBpE1_fTGl0-nBJplaJ703q5V2345QjB5RLNlrkbOuUJKVhzq2d4F_S_Wlafiba90DGvrurbfyINzYPSDqAXBkUTh5_hNGDyhGMZdd3T2hqOVix5XshOx2Qs5h3M9BSNHkb7O6Uf> (accessed June 15, 2015); and Southern California Edison, *Announcements* <https://scees.accionpower.com/_scees_1401/announce.asp> (accessed June 15, 2015).

the same law, Pacific Gas & Electric received bids for 5,000 MW of energy storage when seeking 74 MW, suggesting that the advanced energy market is ready to deliver when given a policy signal.[156]

By providing a long-term policy signal, the CPP can help to overcome existing market barriers and create greater market certainty. In turn, accelerated deployment of advanced energy under the CPP will drive further cost and performance improvements. The relationship between cost and deployment is often referred to as the *learning rate* and visualized as an *experience curve* or *learning curve*. Quite simply, the learning rate refers to cost reductions that accompany every doubling in the market deployment of a technology due to economies of scale and technological improvements.[157] Learning rates are common to all technologies, from computers to energy technologies, and advanced energy technologies are no exception.[158] Wind turbine efficiency has improved by 260% since 1999, [159] and general efficiency of flat plate solar PV is expected to increase from 16% in 2011 to 25% by 2030, reducing costs by 35%.[160]

As policy signals amplify existing market drivers of advanced energy, the increased deployment that follows in turn leads to further technology improvements. This acts as a positive feedback loop in which strong and predictable policy implementation is a catalyst that initiates the natural market deployment and development of emerging technologies. Thus, as advanced energy technologies move along the learning curve with increased deployment under the CPP, compliance will become easier to attain. Clear market signals that enable deployment of advanced energy technologies early in the CPP compliance period can thereby reduce overall compliance costs and provide increased public benefit.

Conversely, policy uncertainty or delay can handcuff emerging markets, damage established markets, and slow the positive feedback loop of technology improvement. For example, policy uncertainty around the federal production tax credit (PTC) for wind has been associated with a boom-bust cycle that has interrupted the industry growth over the years.[161] The impact of such uncertainty is recognized as a major threat to deployment of renewable energy technologies by the International Energy Agency (IEA): "Policy uncertainty remains a key challenge to renewable deployment. Unanticipated changes to incentive schemes represent a risk that investors cannot manage, and can lead to elevated financing costs and boom-and-bust development patterns."[162] Uncertainty of any kind impedes the growth or development of a market sector, and policy uncertainty is no exception. A delay in the finalization and implementation of the CPP would introduce market uncertainty, dampening deployment and investment in advanced energy technologies and slowing down further cost improvements.

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[156] Herman K. Trabish, *PG&E Flooded with 5,000 MW of applications for Energy Storage,* Utility Dive (May 29, 2015) <http://www.greentechmedia.com/articles /read/california-dreaming-5000mw-of-applications-for-74mw-of-energy-storage-atpg?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+ greentechmedia%2Fnews+%28Greentech+Media%3A+News%29> (accessed June 15, 2015).

[157] These cost improvements reflect a number of different factors, including increased production volume; lower input costs; production standardization; streamlined development, construction, installation, and operation of projects; and improvements in technology performance. Patrick Hearps and Dylan McConnell, *Renewable Energy Technology Cost Review* (May 2011), *available at* http://www.energy.unimelb.edu.au/files/site1/docs/pubs/Renewable% 20Energy%20Tech%20Cost%20Review.pdf.

[158] While different studies estimate a broad range of learning rates for advanced energy technologies, they consistently report positive rates, i.e. cost decreases with increased deployment, for all energy generation technologies except nuclear power. For example, a review of 22 studies gave a range of learning curves for solar PV between 10%-53% over different time periods, meaning that cost has decreased by 10%-53% with each doubling of cumulative installed capacity. Electric Power Research Institute, *PRISM 2.0: Modeling Technology Learning for Electricity Supply Technologies* (September 19, 2013), *available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002000871.

[159] Levi Tillemann, *Revolution Now: The Future Arrives for Four Clean Energy Technologies,* U.S. Department of Energy (September 17, 2013), *available at* http://energy.gov/sites/prod/files/2013/09/f2/200130917-revolution-now.pdf.

[160] Patrick Hearps and Dylan McConnell, *Renewable Energy Technology Cost Review* (May 2011), *available at* http://www.energy.unimelb.edu.au/files/site1/ docs/pubs/Renewable%20Energy%20Tech%20Cost%20Review.pdf.

[161] Barradale, Merrill Jones, *Impact of public policy uncertainty on renewable energy investment: Wind power and the production tax credit* (September 16, 2010), *available at* http://www.sciencedirect.com/science/article/pii/S0301421510006361

[162] International Energy Agency, *Renewable Energy: Medium-Term Market Report 2014* (2014), *available at* http://www.iea.org/Textbase/npsum/MTrenew2014S UM.pdf, at 9.

Therefore, a clear and timely market signal is essential to minimize the cost of compliance with the CPP and maximize the economic benefits of deploying advanced energy for compliance. By leveraging current market trends and existing tracking and accounting infrastructure, market-based compliance mechanisms will ensure that states and EGUs have access to a broad variety of increasingly cost-effective options for CPP compliance.

VII. CONCLUSION

As demonstrated in this paper, there is an extensive track record of previous EPA emission reduction programs allowing market-based compliance mechanisms in parallel with formal regulatory requirements. These programs are widely recognized as successful in motivating the development of efficient and active credit or allowance markets characterized by broad-based private sector participation, market stability, and a wide range of compliance instruments.

The CPP will undoubtedly build on this experience. Given the framework of the proposed CPP, EPA can be expected to structure the final rule such that states – individually or collaboratively – will design implementation plans that allow market-based compliance mechanisms to develop. Initial stakeholder engagement on the CPP that has focused on enabling market-based solutions further indicates that the development of market-based compliance mechanisms markets is a probable, if not inevitable, compliance outcome.

The existence of a robust market of proven and cost-effective advanced energy technologies that can deliver readily verifiable carbon emission reductions also suggests that the CPP will follow the trend of previous EPA rules. The advanced energy industry is clearly ready to step in and implement solutions because it is already doing so across the country. Acceleration of this advanced energy deployment in response to the CPP will further stimulate the cost improvements and technological innovations already underway, making compliance both easier and cheaper to attain. The sooner this policy signal is sent, the sooner this positive feedback will initiate. Conversely, delayed implementation will introduce market uncertainty, slowing the progress of advanced energy innovation and curtailing the delivery of significant economic benefits from this growing sector of the energy economy.

The development of highly active and efficient market-based compliance mechanisms that enable widespread participation can ultimately provide CPP-regulated power plants with a broad spectrum of low cost, flexible compliance strategies.

APPENDIX A.

A. Defining the Best System of Emission Reduction under the CPP

The central focus of this paper is that EPA's historical success in stimulating effective market-driven responses to emission reduction targets is likely to be replicated under the CPP. Yet questions have been raised about EPA's legal authority to send such market signals. This Appendix explains why such concerns appear unwarranted.

The proposed 111(d) guidelines are based on EPA's determination of the Best System of Emission Reduction (BSER), a critical term in CAA section 111 which defines the allowable levels of emissions that covered sources must achieve. BSER, in turn, must reflect the Agency's identification of available emission reduction strategies that are demonstrated in practice and realistically implementable, taking into account the costs of these measures.

In the case of the CPP, EPA has defined BSER for existing EGUs to include grid-level strategies throughout the interconnected electric system. This definition reflects the integrated nature of the electricity grid and accounts for the impact on CO_2 emissions of both overall electricity demand and the mix of fuels used to produce power. To apply this approach, EPA has identified four core strategies, termed "Building Blocks" in the CPP, of proven effectiveness and feasibility in lowering power sector CO_2 emissions. These Building Blocks include: (i) improving the thermal efficiency of coal-fired EGUs so their emissions per unit of electricity output are lower; (ii) increasing the utilization of natural gas-fired EGUs and reducing operation of higher-emitting fossil-fuel-fired units; (iii) maintaining and increasing the production of power from non-emitting nuclear and renewable sources (mainly wind and solar); and (iv) increasing energy efficiency and reducing the power production required to meet demand.

Using its definition of BSER, EPA then calculated state-by-state emission reduction goals based on each state's existing mix of power sources and ability to reduce emissions by implementing the Building Blocks. The CPP would allow states, in developing plans to reach these goals, to select the mix of policy tools and reduction pathways they deem most effective, drawing on the Building Blocks and additional measures. As proposed, the CPP would express state goals as emission rate reduction targets but would allow states to convert these targets into mass-based emission limits. States could also partner with each other to implement reductions on a regional scale, although whether and to what extent multi-state plans are developed would be a matter for state discretion.

B. The Legal Basis for EPA's Definition of BSER

Some CPP critics have stated that the CAA does not authorize EPA to define BSER as including measures that require action beyond the facility "fence line," arguing that such measures are beyond the control of the EGU owner or operator. They insist that only end-of-pipe controls or other operational or technological changes that can be implemented within the boundaries of the regulated source can qualify as BSER.

However, section 111 as framed does not limit BSER to technological improvements at individual plants nor does it prohibit measures to reduce emissions outside facility boundaries. The only conditions imposed by the statute are that the required emission reduction strategies are demonstrated in practice, technically feasible and not unduly costly.

Moreover, it is simply not correct that EGU owners and operators cannot indirectly or directly implement emission reduction measures beyond the "fence line" of an EGU. The most straightforward examples of this are integrated electric utilities that have a diverse mix of generation assets and not only produce but also distribute electricity. These utilities have the ability to increase operation of gas-fired plants and decrease coal unit output; to add renewable power to their generation mix and reduce reliance on fossil generation; and to implement demand reduction programs that shrink emissions by decreasing the amount of power required to serve loads. The success of many utilities in reducing CO_2 emissions over the last decade reflects application of these strategies[163] and they will be implemented more aggressively as power companies both respond to the changing dynamics of energy markets and seek to meet their CPP obligations.

Even when EGU owners do not directly control dispatch among energy sources, reduced utilization of EGUs due to increased reliance on renewable generation or energy efficiency is still feasible within the rules of RTOs and ISOs, such as by reducing the bidding of these units into the market. Utilities operating in such markets can also make long-term decisions about capacity additions going forward. Merchant power producers or IPPs can similarly diversify their generation assets to reduce their emission rates.

Furthermore, all EGU owners and operators have access to a variety of market-based options for reducing emissions, including bilateral contracts or PPAs for renewable generation, purchase of RECs, purchase of EECs, and direct investment or involvement in energy efficiency programs or projects. Many EGU owners and operators can also access renewable energy and energy efficiency through subsidiaries of a shared holding company.[164] These measures are already being implemented in markets across the country.

Thus, EGU owners and operators will have the ability and incentive to reduce emissions directly (for example, by curtailing coal plant utilization) and/or to comply with the CPP by offsetting CO_2 emissions with direct investments in renewables and energy efficiency or the purchase of credits generated by the investments of others. That these compliance strategies are feasible and cost-effective is fully demonstrated by the many examples of EGU owners and operators employing these very strategies now in the current electric system.[165]

While EGU owners and operators are already investing in the full spectrum of emission reduction measures included in EPA's BSER, implementation of the CPP through market-based compliance mechanisms will further ease and enable such "beyond the fence line" measures. Market-based compliance measures will ensure that EGU owners and operators receive credit for such investments and provide a market incentive for emission reductions.

[163] Power plant emissions fell by approximately 16% from 2005 to 2012, a period in which natural gas replaced coal at a rapid pace and renewables increased their share of overall power production. U.S. Energy Information Administration, *Monthly Energy Review:* Table 12.6 Carbon Dioxide Emissions From Energy Consumption (June 2015), *available at* http://www.eia.gov/totalenergy/data/monthly/#environment.

[164] For example, NextEra Energy Solutions (operating as Florida Power and Light Energy Services in Florida) is an energy service company (ESCO) for federal, state and local governments as well as business customers NextEra provides performance contracting services that reduce energy usage by its customers, including through appliance upgrades, building retrofits, energy management and other solutions. These savings can offset the CO_2 otherwise emitted from EGUs owned and operated by sister company NextEra Resources. FPL Energy Services, *ESCO: Delivering Superior Conservation and Renewable Solutions* (2014) <http://www.fples.com/business/fpl-services-energy-management.shtml> (accessed June 18, 2014). For more examples, see: Advanced Energy Economy, *AEE Supplemental Comments on EPA's Clean Power Plan* (December 1, 2014), *available at* http://info.aee.net/clean-power-plan-comments

[165] For examples and greater discussion of the many ways that all categories of EGU owners and operators access advanced energy through existing markets, see: Advanced Energy Economy, *AEE Supplemental Comments on EPA's Clean Power Plan* (December 1, 2014), *available at* http://info.aee.net/clean-power-plan-comments.

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