November 22, 2013

c/o Joe Goffman
USEPA Headquarters
William Jefferson Clinton Building
1200 Pennsylvania Ave., NW
Mail Code: 6101A
Washington, DC 20460

Considerations in the Design of a Program to Reduce Carbon Pollution from Existing Power Plants

Dear Mr. Goffman:

We are grateful for the opportunity to help shape the forthcoming greenhouse gas rules for existing sources (hereinafter "GHG Rule", "existing source rule", "111(d)"). We participate in a diverse coalition that includes representatives from the business, environmental, labor and contractor communities. The Alliance for Industrial Efficiency is committed to enhancing manufacturing competitiveness and reducing carbon emissions through the greater use of combined heat and power (CHP) and waste heat to power (WHP). The GHG Rule provides an important opportunity to advance this goal. We are writing now in response to the first question in your memo dated September 23, 2013 ("What is state and stakeholder experience with programs that reduce CO_2 emissions in the electric power sector?").[1] We highlight the key role that CHP and WHP can play in reducing emissions and profile specific policies that some states and utilities have taken to encourage greater use of these technologies.

Combined heat and power (CHP) and waste heat to power (WHP) are proven means for reducing carbon emissions from the electric power system. **PART I** of this white paper highlights the carbon benefits of CHP and WHP. **PART II** demonstrates that these technologies are cost effective and adequately demonstrated. **PART III** profiles actions that states and utilities are currently taking to encourage greater deployment of these technologies. EPA should clarify in its emission guidelines that policies that create opportunities for CHP and WHP would support an equivalency determination; and states, in turn, should take steps to encourage CHP and WHP as part of their compliance plans.

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[1] U.S. EPA, Sept. 23, 2013, *Considerations in the Design of a Program to Reduce Carbon Pollution from Existing Power Plants* (http://www2.epa.gov/sites/production/files/2013-09/documents/20130923statequestions.pdf).

PART I: Combined Heat and Power and Waste Heat to Power Lower Carbon Emissions

Conventional, central power generation is woefully inefficient. In fact, on average, only 33 percent of energy inputs are converted into electricity, with roughly two-thirds lost as wasted heat. Additional line losses occur during the transmission and distribution of power from the central generator to the end user. (*see* Figure 1) This inefficiency means we waste the majority of the fuel used to produce electricity – leading to greenhouse gas emissions and unnecessary expense for end users.

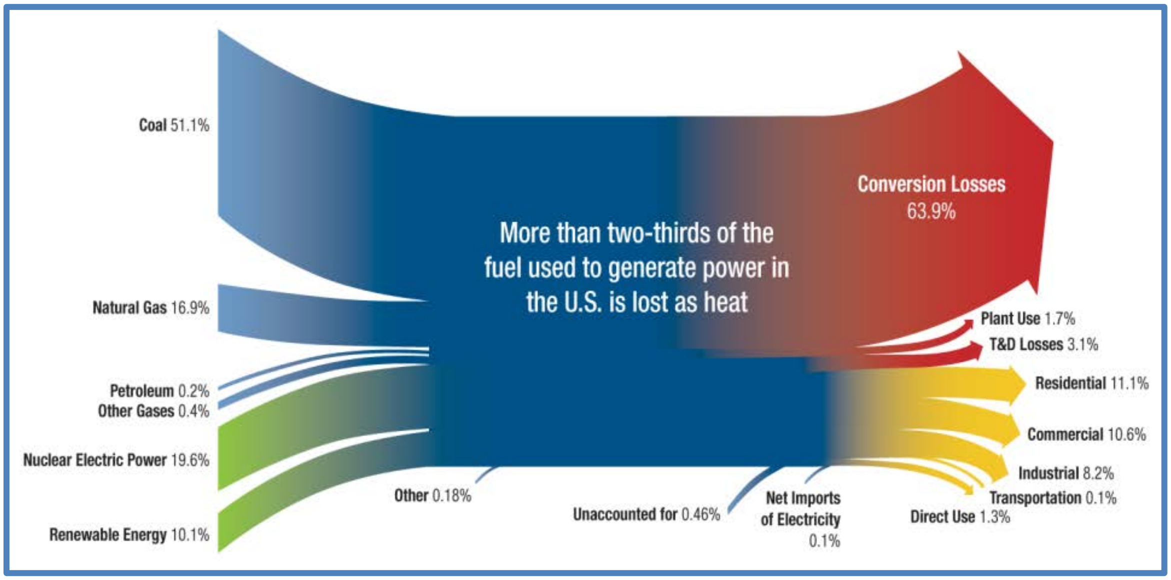

Figure 1 - Fuel Loss with Conventional Power Generation

CHP turns this inefficiency on its head. By generating both heat and power from a single fuel source, CHP can operate at efficiencies of 70 to 80 percent. WHP captures otherwise wasted heat from industrial processes to generate additional electricity, likewise improving efficiency. In this way, both CHP and WHP reduce the fuel that is needed to generate heat and electricity at universities, hospitals, and industrial facilities throughout the country. And because they reduce energy inputs, these technologies dramatically lower carbon emissions. Figure 2 illustrates the efficiency savings of CHP and WHP. While precise savings may vary, dependent on the on-site demand, the frequency that the system is used, and the emissions at the central power plant that is being displaced, EPA has proposed a simple methodology and an emissions calculator for calculating displaced fuel (and associated carbon emissions) for a CHP system.[2]

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[2] *See* U.S. EPA, CHP Partnership, Aug. 2012, *Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems* (http://www.epa.gov/chp/documents/fuel_and_co2_savings.pdf)

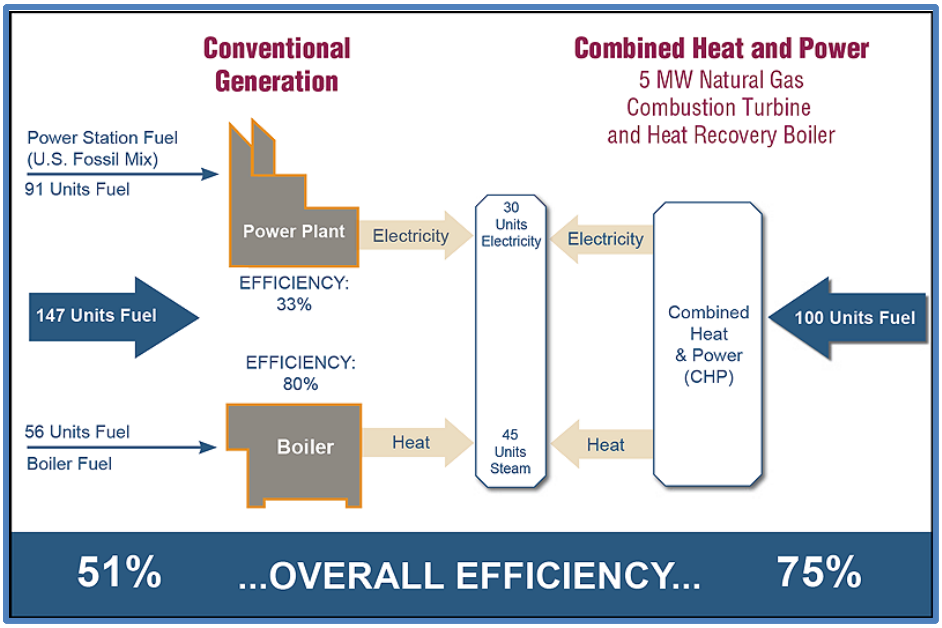

Figure 2 CHP Is More Efficient than the Separate Generation of Heat and Power[3]

As depicted in Figure 2 (above), CHP systems typically achieve total system efficiencies of 60 to 80 percent, compared to a combined efficiency of only 51 percent for the separate generation of heat and power. This is largely because producing electricity at a central power plant is so inefficient (33 percent in Figure 2). By definition, CHP decreases the fuel used at a central power plant, in exchange for increasing on-site fuel use. While the facility depicted in Figure 2 historically used 56 units of fuel to power its boiler, it is now using 100 units of fuel on site – to both power its boiler and produce electricity. While on-site fuel use has increased (from 56 units to 100 units), system-wide fuel use has declined significantly (from 147 units to 100 units).

These efficiency savings translate to substantial air quality benefits. This is because using less fuel to produce the same amount of energy produces fewer emissions. In fact, as Figure 3 (below) illustrates, CHP produces one-half the carbon emissions of the separate generation of heat and power.[4] (23,000 tons/ year compared to 45,000 tons/ year). If the electricity was produced from waste heat, emissions would be limited to those associated with the boiler (13,000 tons/ year).

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[3] U.S. EPA, CHP Partnership, Aug. 2012, *Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems*, at 5 (http://www.epa.gov/chp/documents/fuel_and_co2_savings.pdf) (figure assumes 33% efficiency for central power plant efficiency, based on eGRID 2012 (2009 data), which reflects the national average of 35.6% combined with transmission and distribution losses.

[4] U.S. EPA, Combined Heat and Power Partnership, *Environmental Benefits* (graphic) (http://www.epa.gov/chp/basic/environmental.html) (visited Sept. 27, 2013).

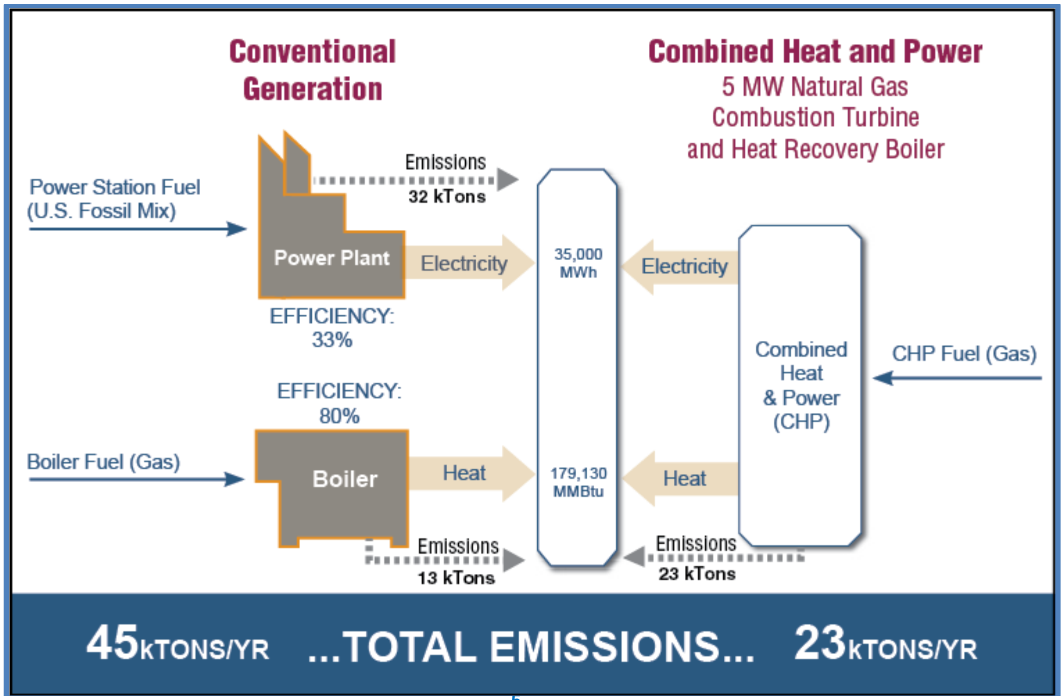

Figure 3 CHP Lowers Carbon Emissions[5]

Indeed, CHP and WHP have a significant role to play in reducing greenhouse gas emissions. In 2008, Department of Energy's Oak Ridge National Laboratory ("ORNL") assessed the economic and environmental benefits of a "high deployment strategy," wherein CHP and WHP would provide 20 percent of U.S. electric capacity by 2030 – up from nine percent today.[6] This scenario is on par with DOE's projections for wind,[7] and current nuclear power production.[8] ORNL found that such full-scale deployment would be equivalent to the power produced by more than 480 conventional power plants,[9] displacing 5.3-quadrillion BTUs of fuel from conventional sources – or half the total energy currently consumed by U.S. households.[10] It could reduce carbon emissions by more than 800 million metric tons per year – the equivalent of removing more than half of the current passenger vehicles from the road. What's more, if CHP and WHP provided 20 percent of U.S. electric capacity, over 60 percent of the projected increase in CO_2 emissions between now and 2030 could be avoided.[11] (Table 1)

[5] *Id.*
[6] Oak Ridge National Laboratory (hereinafter "ORNL"), Dec. 1, 2008, *Combined Heat and Power: Effective Energy Solutions for a Sustainable Future*, at 4 (http://www1.eere.energy.gov/industry/distributedenergy/pdfs/chp_report_12-08.pdf).
[7] U.S. Department of Energy, 2008, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply* (http://www.nrel.gov/docs/fy08osti/41869.pdf)
[8] EIA, 2013, *Electric Power Annual, Table* 1.1. (http://www.eia.gov/electricity/annual/)
[9] ORNL, *supra* note 6, at 4 reports 240,900 MW. Estimate assumes typical power generation of 500 MW from a traditional power plant.
[10] *Id.* at 4.
[11] *Id.*

TABLE 1: CHP/ WHP Projections (2030) and Environmental Benefits

	2006	2030
Total Electricity Generating Capacity	85 GW (8.9% current capacity)	241 GW (20% predicted capacity)
Annual Energy Savings	1.9 Quads	5.3 Quads
Annual CO_2 Reduction	248 MMT	848 MMT
Number of Car Equivalents Taken Off Road	45 Million	154 Million

The ORNL scenario is based on the additional deployment of 156 gigawatts of CHP and WHP from 2008 to 2030. Notably, a 2010 report confirmed 130 gigawatts of technical CHP potential in the commercial and industrial sectors.[12] A separate 2012 analysis found 7 to 10 gigawatts of additional WHP potential.[13] These assessments indicate that – with the right policies and incentives in place – the ORNL deployment scenario is tenable.

In August 2012, the White House took a first step toward achieving these carbon savings, issuing Executive Order 13264, which set a goal of increasing deployment by 40 gigawatts, or 50 percent by 2020, bringing total CHP deployment to over 120 gigawatts. While only half of CHP's technical potential, realizing this goal would nonetheless lead to significant carbon savings. In fact, in a report issued alongside the Executive Order, DOE and EPA projected that realizing this goal would reduce energy use by one quadrillion Btus (1 Quad) (the equivalent of 1 percent of all energy use in the U.S.) and lower greenhouse gas emissions by 150 million metric tons (equivalent to the emissions from over 25-million cars).[14]

EPA has consistently recognized CHP and WHP as a compliance option in its emerging GHG rules. Several years ago, EPA released a GHG permitting guidance, which emphasized the importance of thermal and electric efficiency.[15] The sample permit in Appendix H of the guidance identified WHP as a Best Available Control Technology (BACT).[16] Moreover, each of

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[12] ICF-USCHPA-WADE, Oct. 2010, *Effect of a 30 Percent Investment Tax Credit on the Economic Market Potential for Combined Heat and Power*, at 11-12 (Tables 3 & 4) (projecting roughly 65 gigawatts of technical potential in each the industrial and commercial/ institutional sectors, for a total of 130 gigawatts); *see also* DOE, EPA, Aug. 2012, *Combined Heat and Power: A Clean Energy Solution*, at 13 (reaffirming these findings) (http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf); personal communication with Anne Hampson, ICF Consulting, Nov. 22, 2013 (noting that their current estimates for CHP on-site technical potential are 126 gigawatts).

[13] U.S. EPA, CHP Partnership, May 2012, *Waste Heat to Power Systems,"* at 2.

[14] DOE, EPA, Aug. 2012, at 3.

[15] *See, e.g.,* U.S. EPA, Office of Air and Radiation, EPA–HQ–OAR–2010–0841; FRL–9228–2, Nov. 2010, *PSD and Title V Permitting Guidance for Greenhouse Gases*, March 2011, "PSD and Title V Permitting Guidance for Greenhouse Gases," at 29, 30 & 31 (hereinafter "BACT Guidance") ("Applying the most energy efficient technologies at a source should in most cases translate into fewer overall emissions of all air pollutants per unit of energy produced"; "The second category of energy efficiency improvements includes options that could reduce emissions from a new greenfield facility by improving the utilization of thermal energy and electricity that is generated and used on site." and "For example, an applicant proposing to build a new facility that will generate its own energy with a boiler could also consider ways to optimize the thermal efficiency of a new heat exchanger that uses the steam from the new boiler.").

[16] U.S. EPA, *BACT Guidance*, Appendix H ("BACT Example – Petroleum Refinery Hydrogen Plant") ("In this example, the permitting authority determined that BACT was a combination of furnace

the accompanying white papers explicitly mentions CHP/ WHP as available technologies for the covered sectors.[17]

Similarly, the Proposed Rule for New Electric Utility Generating Units (42 USC §7411(b)) incorporates a number of provisions that recognize the benefits of CHP.[18] As an initial matter, the proposed rule establishes an output-based emissions limit, where compliance is based on emissions per unit of energy generated, rather than the amount of fuel used. In contrast, traditional "input-based" regulations set emission limits based on the amount of fuel used (e.g., pounds of pollutant per million BTUs). The input-based approach has contributed to the inefficiency of our electrical production system by discriminating against energy efficiency. In contrast, the output-based standard in the proposed rule is expressed as emissions per unit of useful energy output (i.e., pounds per megawatt hour). CHP and WHP systems fare better under such an approach because they can produce two forms of useful output (thermal energy and electricity). The output-based standard credits both of these products, thereby rewarding generators that have the highest "output" of megawatt hours and the lowest "output" of pollutants. We are grateful that the emission limit for the new source rule is written as an output-based standard, and hope that EPA continues to adopt this approach in future rulemakings. In addition, the rule proposes a modest line-loss credit to recognize the avoided transmission and distribution line losses associated with CHP facilities,[19] and a thermal credit to

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combustion control and integrated waste heat recovery.") (http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf).

[17] *See, e.g.,* U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Industrial Commercial, and Institutional Boilers*, at 10 (Table 1) (identifying Combined heat and power as an "applicable" technology for all boilers) (http://www.epa.gov/nsr/ghgdocs/iciboilers.pdf); U.S. EPA, Office of Air and Radiation, Oct 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Pulp and Paper Manufacturing Industry*, at 11 (Table 3) ("List of Control Measures and Energy Efficiency Options" identifies various heat recovery technologies) (http://www.epa.gov/nsr/ghgdocs/pulpandpaper.pdf); U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Iron and Steel Industry*, at 9-10 (Table 1) (identifies heat recovery as a technology used in steel production) & 31 ("All steel plants require both electricity and steam to operate, which make them good candidates for combined heat and power (CHP), also known as cogeneration.") (http://www.epa.gov/nsr/ghgdocs/ironsteel.pdf); U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Coal-Fired Electric Generating Units*, at 28 (Exhibit 3-1) (identifying several heat-recovery technologies as a technology being used at existing utilities) (http://www.epa.gov/nsr/ghgdocs/electricgeneration.pdf); U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Portland Cement Industry*, at 10 (Table 3) (listing "Heat recovery for power – cogeneration" as an available control measure) (http://www.epa.gov/nsr/ghgdocs/cement.pdf); U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Petroleum Refining Industry*, 14-19 (Table 1) & 27 ("The large steam requirements for refining operations and the continuous operations make refineries excellent candidates for combined heat and power (CHP) generation.") (http://www.epa.gov/nsr/ghgdocs/refineries.pdf); U.S. EPA, Office of Air and Radiation, Oct. 2010, *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Nitric Acid Production Industry*, at 13 & 14 ("energy recovery is a valuable resource for these facilities"; "bottoming cycle combined heat and power (CHP) could also be used for energy recovery at nitric acid plants.") (http://www.epa.gov/nsr/ghgdocs/nitricacid.pdf).

[18] U.S. EPA, Sept. 20, 2013, *Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units* (http://www2.epa.gov/sites/production/files/2013-09/documents/20130920proposal.pdf)

[19] *See, e.g., id.* at 97-98

account for both the heat and electricity produced by a CHP system.[20] While these provisions could be strengthened to more fully account for avoided line losses and thermal energy of CHP systems, they nonetheless demonstrate EPA's recognition of these benefits.

PART II: CHP and WHP Are Cost Effective and Adequately Demonstrated

Section 111(d) of the Clean Air Act requires EPA to set New Source Performance Standards that reflect the application of the "best system of emission reduction" that "has been adequately demonstrated," taking into account costs, environmental impacts, and energy requirements. CHP and WHP readily satisfy these requirements.

CHP and WHP are cost effective. These applications can lower energy costs for the user by displacing higher priced purchased electricity and boiler fuel with lower cost self-generated power and recovered thermal energy. Moreover, by reducing fuel costs, CHP and WHP have the additional economic benefit of enhancing manufacturing competitiveness. Because CHP and WHP hosts produce some of their own power, they are also insulated from volatile electric prices. These economic benefits are evident at the ArcelorMittal steel facility in East Chicago, Indiana, which reports $100-million in annual energy savings from CHP.[21]

In light of these savings, in 2007, McKinsey and Company found that CHP is one of the most cost-effective approaches for reducing GHG emissions. As illustrated below, it is substantially more economical than investments in wind or solar. (*see* Figure 4)

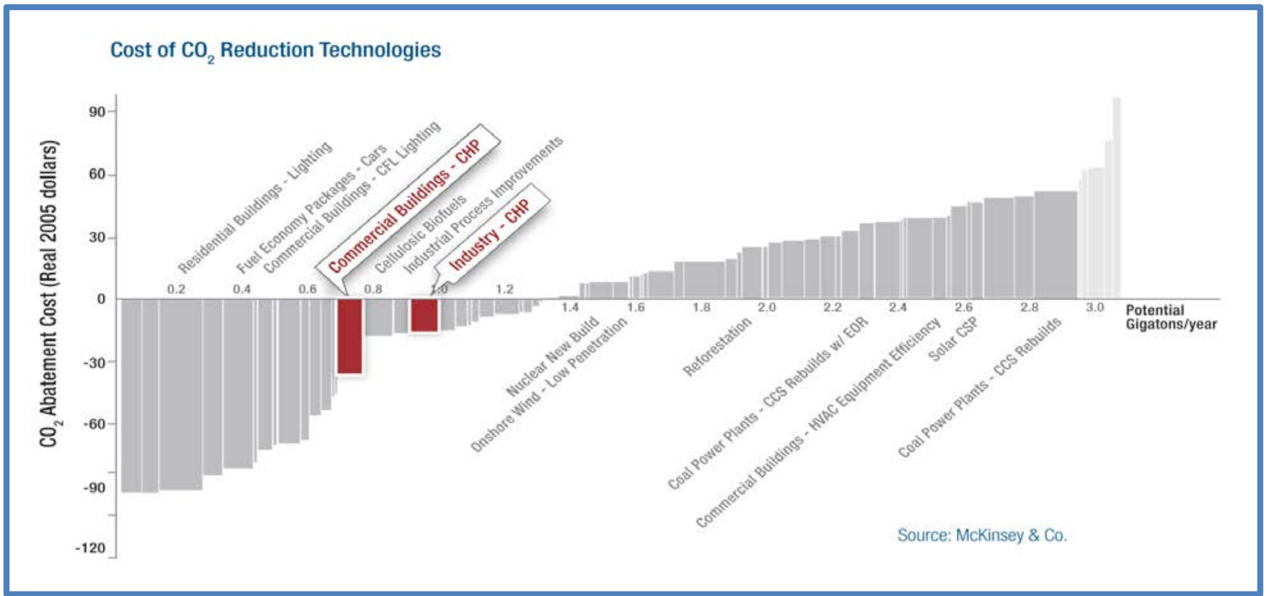

Figure 4 - Relative Cost of CO_2 Reduction Technologies[22]

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[20] *See, e.g. id.* at 95-96 (requesting comment on the "appropriate discount factor" for useful thermal output).

[21] Chris Steiner, Sept. 15, 2008, "Gray is the New Green," *Forbes* (http://www.forbes.com/forbes/2008/0915/054_2.html).

[22] Adapted from McKinsey and Co., Dec. 2007, *U.S. Greenhouse Gas Abatement Mapping Initiative*, at xiii (Exhibit B).

These projects are adequately demonstrated. Dating back to Thomas Edison, whose early power plants sold both electricity and steam to nearby buildings, today there are more than 4,000 installations throughout the United States.[23] (*see* Figure 5) CHP capacity outside the United States is even greater, supplying over one-half of the electricity in Denmark. This not only demonstrates that CHP is "adequately demonstrated," but that deployment can be expanded with favorable policies. Indeed, CHP supplies less than 9% of U.S. electric capacity, well below the levels in other industrialized economies like Germany (13%), Russia (31%) or Denmark (53%).[24] State implementation plans under 111(d) can stimulate further investment in the United States.

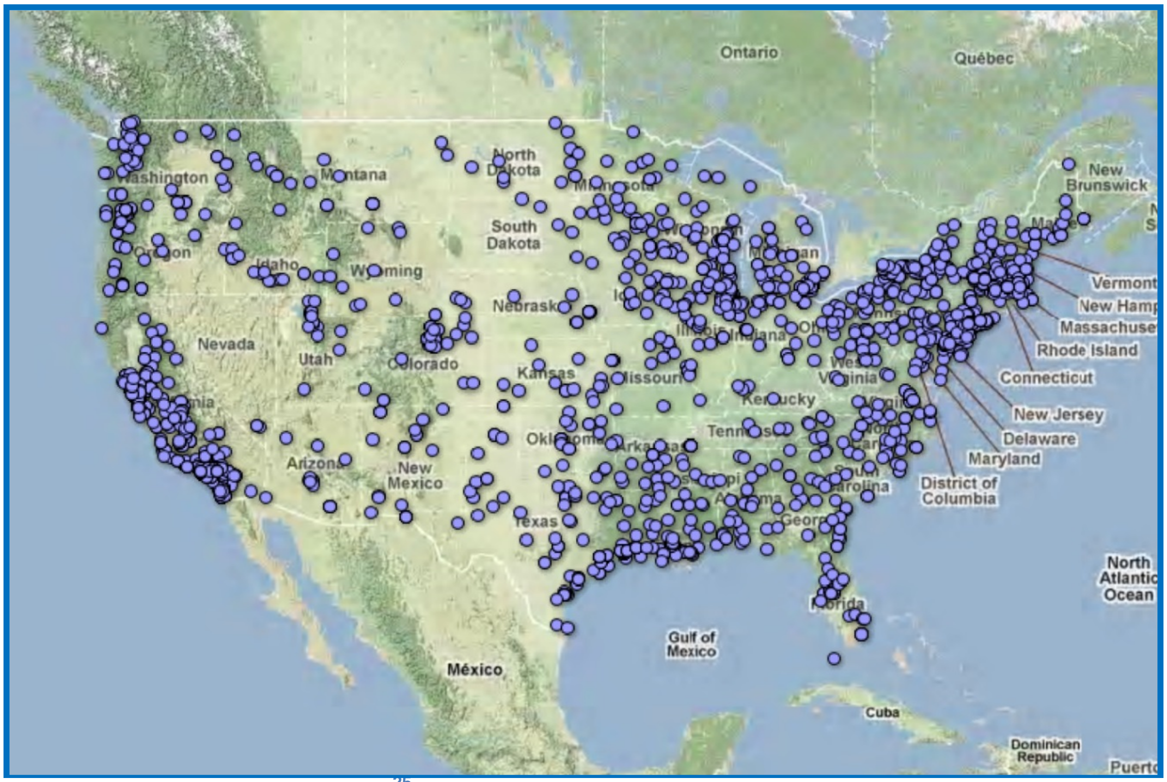

Figure 5 U.S. CHP Installations[25]

PART III: EPA Can Encourage CHP and WHP Deployment

Despite these benefits, a number of barriers have prevented CHP and WHP deployment from reaching their full potential.[26] EPA can help overcome these barriers by allowing affected

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[23] CHP Installation Database, ICF International (http://www.eea-inc.com/chpdata/).
[24] ORNL, *supra* note 6, at 22 and International Energy Agency, 2009, *Cogeneration and District Energy: Sustainable Energy Technologies for Today … and Tomorrow,* at 11 (http://www.iea.org/files/CHPbrochure09.pdf).
[25] CHP Installation Database developed by ICF for ORNL and DOE, 2012. http://www.eea-inc.com/chpdata/index.html
[26] Recognizing these issues, Section 7 of The American Energy Manufacturing Technical Corrections Act (H.R. 6582) requires the Department of Energy to prepare a report on "*Reducing Barriers to the Deployment of Industrial Energy Efficiency.*" This report will be completed by December 2014, and can inform the state planning process under 111d; *see also* Anna Chittum and Nate Kaufman, ACEEE, Sept. 28, 2011, *Challenges Facing Combined Heat and Power Today: A State-by-State Assessment* (http://aceee.org/research-report/ie111).

utilities to claim credit for deploying CHP and WHP in their service territories and encouraging states to adopt favorable policies.[27] This is appropriate because CHP and WHP projects have significantly lower greenhouse gas emissions than traditional central power generation. Moreover, because these projects use electricity and/or thermal energy on site, transmission and distribution losses are avoided entirely. Below, we highlight a number of policies that can help advance CHP and WHP. These policies have not yet been adopted in the vast majority of states. As such, the GHG Rule could incent those states that have not yet seized the opportunity to reduce emissions and increase manufacturing competitiveness through CHP to do so. Some favorable policies that can help advance CHP and WHP include:

1. Incorporating CHP and WHP in Energy Portfolio Standards;
2. Offering innovative financing to support projects;
3. Overcoming utility barriers through modified standby rates and simplified interconnection standards;
4. Requiring consideration of CHP in critical infrastructure; and
5. Offering a streamlined permitting process for relatively small CHP and WHP projects.

Each of these approaches is profiled below.

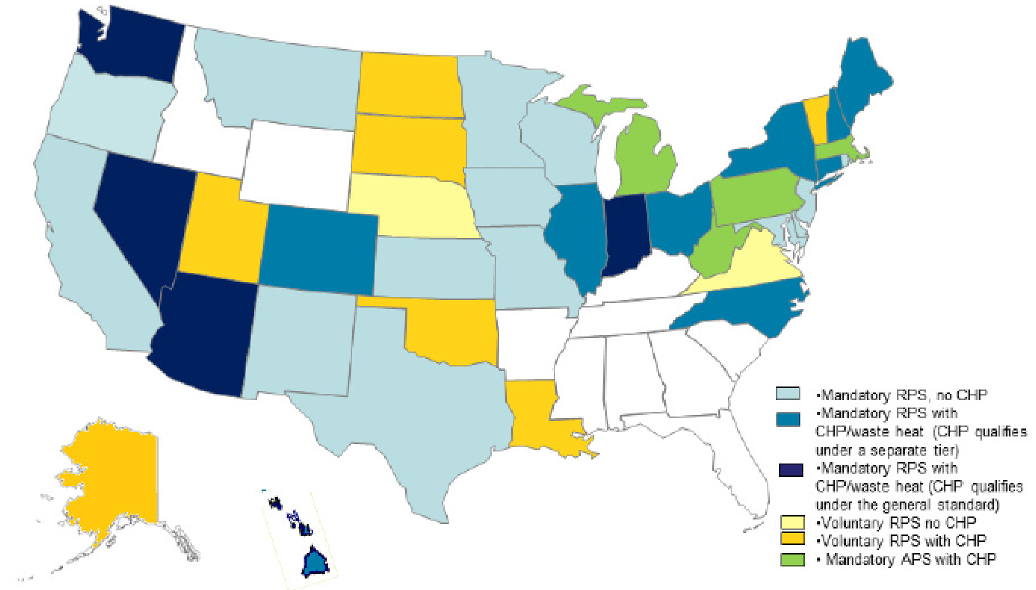
1. <u>Portfolio Standards</u>

Energy portfolio standards can be used to incent the development of additional CHP and WHP units. These standards come in a variety of forms: renewable portfolio standards (RPS), which are designed to increase the amount of renewable and clean energy contributing to a state's energy mix; energy efficiency resource standards (EERS), which are designed to reduce a state's demand for energy; and alternative energy portfolio standards (APS), which typically are targets for specific technologies that improve energy efficiency. In each case, states set a percentage or quantity target to be attained by regulated utilities by a certain year; they often set intermediate annual targets as well. These standards also specify which technologies qualify to help utilities meet the target. As of December 2012, 42 states and the District of Columbia had adopted some form of portfolio standards. (*see* Figure 6). Notably, one-half of these states (21) specify that CHP and WHP can be used for compliance.[28] (*see* Figure 7)

There are many different ways to include CHP and WHP in a portfolio standard. In some states, CHP and WHP are included in a separate tier of technologies—either alone or with a smaller subset of technologies—for which a specific target is set; in other states, CHP helps contribute to a broad, technology-agnostic standard. In some states, CHP and WHP are included in an energy efficiency resource standard but not in a renewable energy standard. Some states set minimum requirements for size, efficiency level, and fuel types of qualifying systems. WHP is

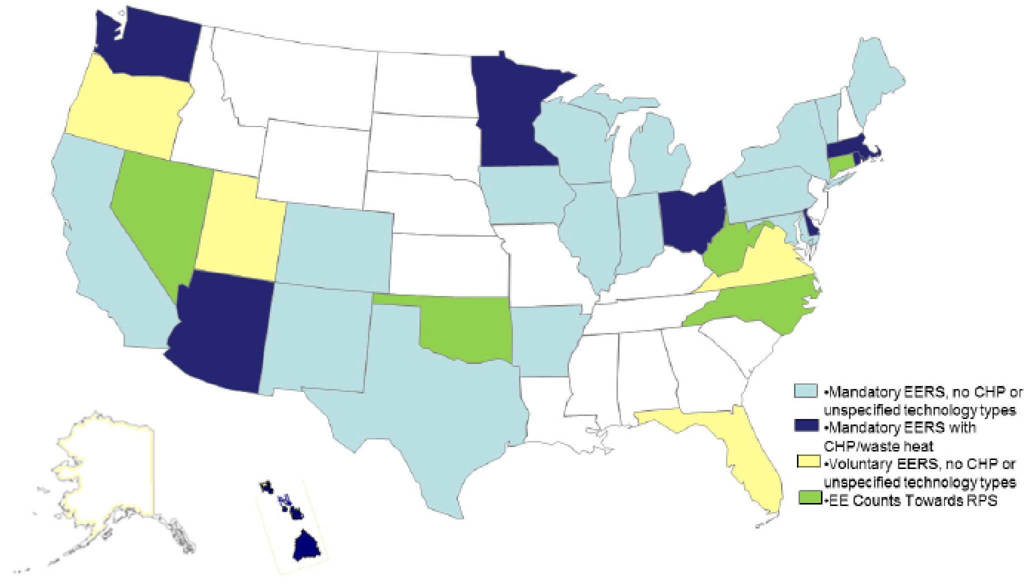
[27] *See* SEEAction, March 2013, *Guide to the Successful Implementation of State Combined Heat and Power Policies*, for additional details and case studies about supportive policies. *See also* National Ass'n of State Energy Officials, 2013, *Combined Heat and Power: A Resource Guide for State Energy Officials* (http://www.naseo.org/data/sites/1/documents/publications/CHP-for-State-Energy-Officials.pdf)
[28] EPA Combined Heat and Power Partnership, *Portfolio Standards and the Promotion of Combined Heat and Power*.

specifically incented in fifteen state renewable portfolio standards. Several states that have effectively incorporated CHP and WHP into their portfolio standards are profiled below.[29]



Source: ICF International, C2ES, and the DSIRE database.

Figure 6: States with RPS or Alternative Energy Portfolio Standard (APS) Reqs. for CHP/ WHP[30]



Source: ICF International, C2ES, and the DSIRE database.

Figure 7: States with EERS Programs for CHP[31]

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[29] For a complete listing of portfolio standards and CHP's incorporation into them, *see* EPA Combined Heat and Power Partnership, 2013, *Portfolio Standards and the Promotion of Combined Heat and Power*, (http://www.epa.gov/chp/documents/ps_paper.pdf).

[30] U.S. EPA Combined Heat and Power Partnership, 2013, *Portfolio Standards and the Promotion of Combined Heat and Power*, at 8 (http://www.epa.gov/chp/documents/ps_paper.pdf).

Massachusetts Alternative Energy Portfolio Standard

The Massachusetts Alternative Energy Portfolio Standard (APS) mandates that the state's utilities derive 5 percent of their electric load from alternative energy sources by 2020 (and sets intermediate goals along the way).[32] CHP is among the qualifying technologies to help utilities meet this standard, as are carbon capture and storage, flywheel energy storage, and other efficiency technologies. Since the standard was implemented in 2009, CHP has provided over 99 percent of compliance credits.[33] Critically, CHP is fairly broadly defined within the standard, with both renewable- and natural gas-fueled CHP systems qualifying. In other states (e.g., New Hampshire and Wisconsin),[34] only renewable-fueled CHP is eligible.[35] This alternative approach is very limiting, as over 70 percent of CHP installations are fueled by natural gas.[36] Under the Massachusetts APS, natural gas- and renewable-fueled CHP units are eligible to generate credits, which can subsequently be purchased by obligated utilities to achieve compliance under the APS.

Massachusetts's APS is different from most RPS policies in that it credits both thermal energy and electricity generated by CHP units. CHP units earn credits at the rate at which their unit exceeds the efficiency of grid-powered electricity and traditional thermal energy (i.e., the unit's Incremental Electrical Energy and Incremental Useful Thermal Energy).[37] Massachusetts also allows for small CHP units to aggregate under a single Statement of Qualification, removing a significant barrier to their participation in the credit market.

The results are illustrative. Figure 8 shows Massachusetts's current CHP fleet by year of installation. An average of four CHP units in the current fleet were installed per year from 2000 to 2007; from January 1, 2008 (the first date a CHP plant could come online and qualify under the APS) through 2012, an average of nearly 15 CHP units were installed annually – a 275 percent increase. Since the APS came into effect, 74 new CHP units have been installed in the state, compared to only 45 units in the ten years prior.

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[31] *Id.*, at 9.
[32] Massachusetts also has a RPS for solar, wind, and other renewable technologies, which does not include CHP and WHP. For more, *see* Database of State Incentives for Renewables and Efficiency ("DSIRE"), Ap. 17, 2013, *Massachusetts Renewable Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA05R&re=0&ee=0).
[33] DSIRE, Aug. 22, 2012, *Massachusetts Alternative Energy Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA21R&re=0&ee=0).
[34] DSIRE, Apr. 25, 2013, *New Hampshire Renewable Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NH09R); DSIRE, Dec. 14, 2012, *Wisconsin Renewable Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=WI05R).
[35] SEE Action, March 2013, *Guide to the Successful Implementation of State Combined Heat and Power Policies*, at 33.
[36] American Gas Association, Nov. 14, 2012, *AGA Commends NARUC for Continued Recognition of the Benefits of Natural Gas* (http://www.aga.org/Newsroom/news-releases/2012/Pages/AGA_Commends_NARUC_For_Continued_Recognition.aspx).
[37] 225 CMR 16.00

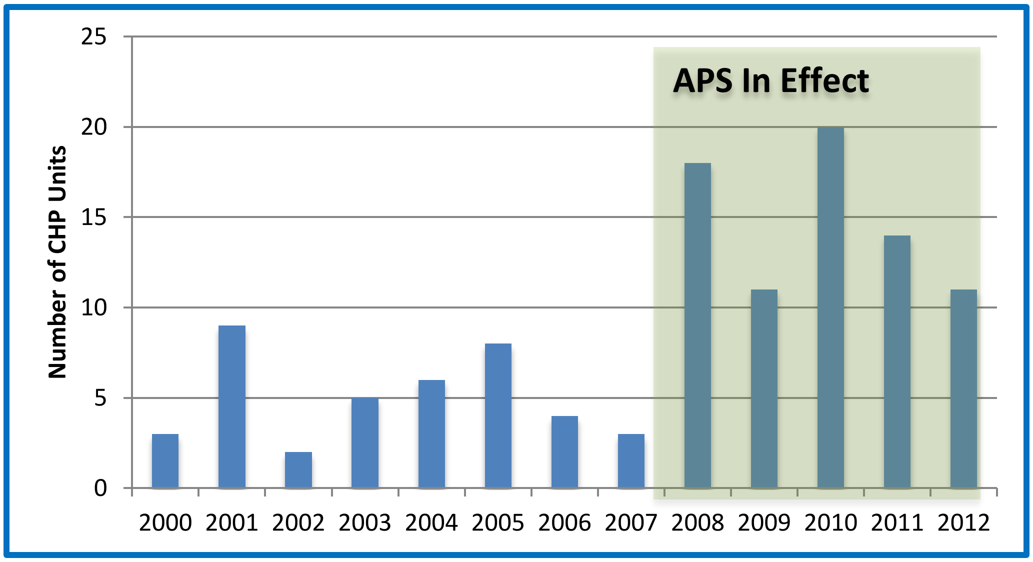

Figure 8: Massachusetts CHP Installations by Year[38]

The success of the Massachusetts APS is also apparent when looking at the reduction in the use of alternative compliance payments (ACP) during this time frame. State law allows a regulated utility to make an alternative compliance payment if it cannot meet its APS obligation through deployment of efficiency technology. As illustrated in Figure 9, in 2009, 73 percent of compliance was met through utilities making alternative compliance payments, in lieu of deploying one of the eligible technologies. By 2011, however, only 35 percent of compliance was met through alternative compliance payments. Strikingly, the stringency of the APS target doubled (from one percent to two percent) over that same time period. This indicates that utilities are finding it easier and more economical to purchase increasing amounts of energy from CHP units.

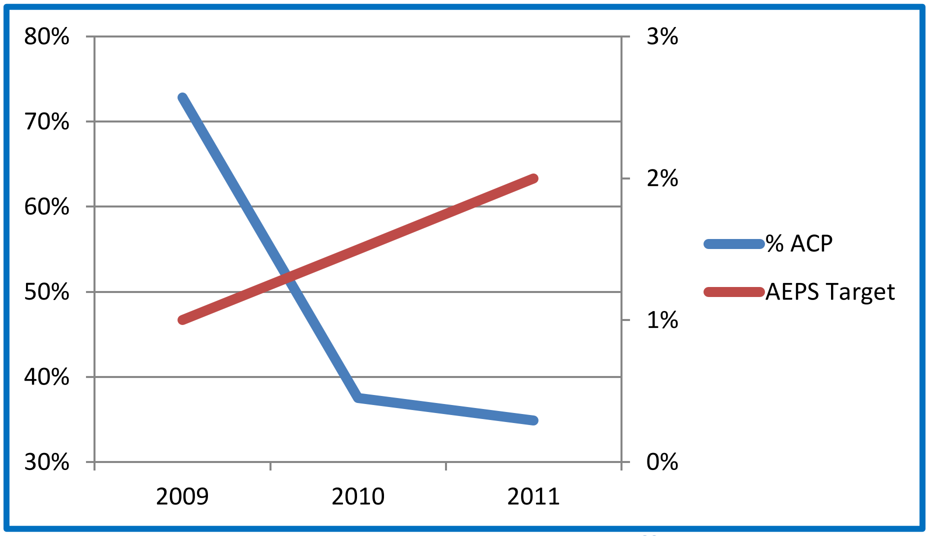

Figure 9: Massachusetts APS Compliance by Year[39]

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[38] ICF International, "Combined Heat and Power Units Located in Massachusetts," *Combined Heat and Power Database*, (http://www.eea-inc.com/chpdata/States/MA.html).

Incorporation of CHP and WHP in Standards in Other States
States have incorporated CHP and WHP into their renewable portfolio standards in a variety of ways. In Ohio, for instance, CHP and WHP are among a class of technologies termed "advanced energy resources," the use of which directly contribute to achieving the state's advanced energy goal of 25 percent by 2025. Ohio's Renewable Portfolio Standard classifies WHP systems, known as waste energy recovery systems in the state, as "renewable energy resources," which may be counted toward the state's 25 percent renewable energy goal.[40] CHP and WHP can also be used to help meet Ohio's energy efficiency target, though the same system cannot be used for both goals.[41]

Alternatively, some states put CHP and/or WHP in a separate class or tier of technologies. Connecticut, for instance, specifically includes WHP and CHP with a minimum operating efficiency of 50 percent among its Class III technologies (alongside other conservation and load-management programs).[42] Pennsylvania treats CHP as a Tier II technology (alongside demand-side management, municipal solid waste, wood byproducts, and several others).[43] In both cases, a separate target percentage is applied for each class or tier.

2. Financial Incentives

In a 2011 report based on conversations with over 50 individual CHP developers, hosts, and supporters, the American Council for an Energy-Efficient Economy (ACEEE) found that high upfront costs present one of the most significant barriers to wider CHP deployment nationwide, dubbing such costs "staggering."[44] EPA estimates that the average capital costs for a turnkey CHP system is $1,200 per kilowatt, translating to $12 million in capital costs for a 10-megawatt system.[45] Thus, any policies that lower the upfront cost of CHP deployment to either the developer or host can be very beneficial. These policies tend to take the form of loan programs, grants, tax credits, rebates, and bonds. A wide variety of such programs are offered at the state, local, and utility levels across the country. Several of these financial incentives are highlighted below.[46]

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[39] Commonwealth of Massachusetts Department of Energy Resources, April 9, 2013, *Massachusetts RPS & APS Annual Compliance Report for 2011*, at 21.
[40] DSIRE, Nov. 8, 2012, *Ohio Alternative Energy Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OH14R&re=0&ee=0).
[41] DSIRE, Aug. 14, 2013, *Ohio Energy Efficiency Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OH16R&re=0&ee=0).
[42] DSIRE, July 19, 2013, *Connecticut Renewable Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CT04R&re=0&ee=0).
[43] DSIRE, Aug. 9, 2012, *Massachusetts Alternative Energy Portfolio Standard* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=PA06R&re=0&ee=0).
[44] ACEEE, Sept. 2011, *Challenges Facing Combined Heat and Power Today: A State-by-State Assessment*, at iv and 6 (http://aceee.org/node/3078?id=3933).
[45] U.S. EPA, April 17, 2013, *Economic Benefits* (http://www.epa.gov/chp/basic/economics.html).
[46] For a comprehensive list of financial incentives available for CHP, *see* http://www.epa.gov/chp/policies/database.html and http://www1.eere.energy.gov/manufacturing/states/pdfs/incentives_boiler_mact.pdf.

New York State Energy Research and Development Authority Funding

Since 2006, New York State has provided more than $100 million in funding through a variety of programs to encourage the development and deployment of CHP.[47] As a result, more than 70 projects, amounting to over 150 megawatts of CHP capacity, have been brought online in New York during this period.[48] Grants have been awarded to CHP projects of a variety of sizes and sectors, including $360,000 to a packaging company in Brooklyn to help install a 300-kilowatt CHP unit and $2 million to the New York University Langone Medical Center to help fund the hospital's installation of a 7.megawatt CHP system.[49]

Of particular note is NYSERDA's $2 million grant to Co-Op City, the country's largest co-op housing development, to aid in installing a 40-megawatt CHP project. This project not only helped Co-Op City save $18 million a year in energy costs since its installation,[50] but has also improved the community's energy resilience. When Superstorm Sandy hit New York City in 2012, Co-Op City's 60,000 residents did not lose heat or electricity—one of the only places in the region that did not lose power.[51]

Seeing both the economic and resilience value of CHP units, NYSERDA announced two new incentive programs in 2013. Through the Combined Heat and Power Performance Program, the state is providing $40 million to promote the installation of CHP systems over 1.3 megawatts in size that reduce summer on-peak demand. The program provides up to $2.6 million per project (or up to 50 percent of total project cost) to facilities that meet minimum fuel conversion rates and air quality standards, among other criteria.[52] The state is also providing $20 million to promote the development of systems with capacities from 50 kilowatts to 1.3 megawatts in selected regions of the state, with individual projects receiving up to $1.5 million.[53]

New York State is also in the process of developing a "Green Bank," intended to help private capital flow into the clean energy market.[54] The Green Bank's stated approach to investment

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[47] NYSERDA, May 2, 2013, *Governor Cuomo Announces $40 Million for Large-Scale, Clean-Energy Power Systems to Guard Against Outages* (http://www.nyserda.ny.gov/About/Newsroom/2013-Announcements/2013-05-02-Governor-Cuomo-Announces-40-Million-for-Large-Scale-Clean-Energy-Power-Systems.aspx).
[48] NYSERDA, Aug. 2011, *Combined Heat and Power Program Guide*, at 2.
[49] *Id.*
[50] *Id.*
[51] William Pentland, Oct. 31, 2012, "Lessons From Where The Lights Stayed On During Sandy," *Forbes*, (http://www.forbes.com/sites/williampentland/2012/10/31/where-the-lights-stayed-on-during-hurricane-sandy/).
[52] NYSERDA, *PON 2701 Combined Heat and Power (CHP) Performance Program* (http://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-2701-Combined-Heat-and-Power-Performance-Program.aspx).
[53] NYSERDA, *PON 2568 CHP Acceleration Program* (http://www.nyserda.ny.gov/PON2568).
[54] NYSERDA, Sept. 10, 2013, *Governor Cuomo Launches New York Green Bank Initiative to Transform the State's Clean Energy Economy* (http://www.nyserda.ny.gov/About/Newsroom/2013-Announcements/2013-09-10-Governor-Launches-New-York-Green-Bank-Initiative.aspx).

includes “supporting mature clean energy technologies,”[55] and is expected to provide another source of funding for CHP and WHP in the state.

California Self-Generation Incentive Program and Feed-in Tariffs

Initially created in response to the state’s energy crisis in 2001, California’s Self-Generation Incentive Program (SGIP) provides a set incentive for a variety of peak-load reducing technologies based on their installed capacity (e.g., $0.48 per watt for non-renewable-fueled CHP; $1.19 per watt for WHP units). Though the program originally covered a wider array of technologies, including solar photovoltaic systems, today it focuses on wind power, CHP and WHP, and emerging technologies.[56]

California’s program has been remarkably successful. In 2011, SGIP projects generated over 760,000 megawatt-hours of electricity—enough to meet the annual electricity demand of 116,340 homes. Internal combustion engines and gas turbines using CHP accounted for 67 percent of this electricity.[57] Of the program’s 544 completed projects,[58] over 300 recovered waste heat to meet on-site heating needs, and 83 used recovered heat to meet on-site heating and cooling needs.[59]

California’s Public Utility Commission also offers a feed-in tariff (FiT) for CHP systems that are small (less than 20 megawatt), new (in operation after January 1, 2008), and highly efficient (operating above a 62% total efficiency).[60]

Financial Incentives in Other States

Through 2010, Ohio offered Advanced Energy Fund Grants that provided up to 25 percent of project costs for a variety of alternative energy projects, including CHP and WHP.[61] In 2010, the Ohio Department of Development, Energy Resources Division saw a “significant increase” in demand and awarded an “unprecedented number of grants”, ultimately prompting the state to close the program due to insufficient funds.[62] A 2012 Ohio Senate bill reopened the program by

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[55] NYSERDA, 2013, *Petition of the New York State Energy Research and Development Authority to Provide Initial Capitalization for the New York Green Bank*, before the State of New York Public Service Commission, at 7.

[56] California Public Utilities Commission (CPUC), 2011, *About the Self-Generation Incentive Program* (http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/aboutsgip.htm).

[57] CPUC, *SGIP Program Impacts* (http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/100105_sgipprogimpacts.htm).

[58] *See* NYSERDA, *supra* note 56.

[59] *See* CPUC, *supra* note 57.

[60] CPUC, Aug. 21, 2013, *CHP Feed-in Tariff* (http://www.cpuc.ca.gov/PUC/energy/CHP/feed-in+tariff.htm).

[61] ACEEE, *Policies and Resources for CHP Deployment: Financial Incentives*, (http://aceee.org/sector/state-policy/toolkit/chp/financial-incentives).

[62] Energize Ohio, *Ohio Department of Development - Advanced Energy Fund Grants*, (http://energizeohio.osu.edu/incentives/ohio-department-development-advanced-energy-fund-grants).

providing additional funding, and allowed it to offer loans in addition to grants.[63] New Jersey and Connecticut likewise offer low-interest loans for energy-efficiency projects.[64]

Tax exemptions and credits for CHP provide an alternative to direct funding. In Arizona, for instance, CHP systems are considered to add no value to the property on which they are installed, exempting the owner from having to pay property taxes on the system.[65] In Oregon, properties that generate electricity from unconventional forms of energy—which includes biomass-fired CHP—and are located in a Rural Renewable Energy Development Zone can be exempted from paying local property taxes for three to five years, with up to $250 million in tax revenues exempted from each zone.[66]

3. **Overcoming Utility Barriers**

In addition to the high upfront cost, another set of barriers to greater CHP and WHP deployment are those erected by utility companies. These barriers include high standby rates and ratchets. Utility rates are comprised of a fixed customer charge, energy charges for the actual energy consumed by the customer, and demand charges that account for the capital cost of delivering electricity to the customer. CHP and WHP users typically pay the fixed customer charge and whatever energy charges they incur (e.g., during planned maintenance, unplanned outages, when energy demand is greater than what the onsite unit can generate, etc), but often are also responsible for standby charges higher than actual demand charges.[67] In many instances, these standby rates are ratcheted, meaning that utilities apply demand charges based on a customer's highest monthly level of peak demand for up to a year after that peak level is achieved—regardless of the grid energy the customer uses in a given month, and even if the customer only uses grid energy for a single day. Utilities assert that these ratchets cover that customer's share of the distribution and transmission infrastructure that must be kept in place to service their planned or unplanned grid needs.[68]

The Department of Energy's State and Local Energy Efficiency Action Network ("SEE Action") outlines steps that both utilities and "customer-generators" (i.e., CHP/WHP hosts) can take to minimize costs and efficiently use grid electricity, including:[69]

- Reflecting load diversity of CHP customers in charges for shared delivery facilities;

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[63] DSIRE, Oct. 4, 2012, *Ohio Advanced Energy Fund* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OH11R&ee=0).
[64] EPA, 2013, *dCHPP* (CHP Policies and incentives database) (http://www.epa.gov/chp/policies/database.html)
[65] DSIRE, Aug. 7, 2012, *Arizona Energy Equipment Property Tax Exemption* (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ20F&currentpageid=3&EE=1&RE=1).
[66] EPA, June 18, 2013, *Local Option - Rural Renewable Energy Development Zones* (http://www.epa.gov/chp/policies/incentives/orlocaloptionruralrenewableenergydevelopmentzones.html).
[67] EPA, Dec. 2009, *Standby Rates for Customer-Sited Resources,* at 3-5 (http://www.epa.gov/chp/documents/standby_rates.pdf)
[68] *See* SEE Action, *supra* note 35, at 7.
[69] *See id.* at 8-9.

- Offering daily, or at least monthly, as-used demand charges for backup power and shared transmission and distribution;
- Allowing customer-generators the option to buy all of their backup power at market prices (in states with retail competition);
- Encouraging customer-generators to schedule maintenance at non-peak times to shrink peak demand.

Portland General Electric Demand Charges

A 2009 EPA report on standby charges profiles Portland General Electric (PGE) as an example of a reasonable rate structure. Under PGE's rates, energy charges account for more than 90 percent of the total cost to the customer, which makes the economics of CHP and WHP more favorable (since CHP and WHP help customers reduce the energy they purchase from the grid, ensuring utility bills track actual energy consumption is optimal). Additionally, this rate does not ratchet, so a brief dependence on grid power during an outage of a CHP or WHP system will not negatively impact costs in future months. Because PGE's standby fees reflect actual demand, a 46.9 percent reduction in electricity consumption in a given month (from bringing a CHP unit online, for example) would result in a 45.6 percent reduction in grid electricity costs for the facility.[70]

Minnesota Standby Rates

Some states are in the process of eliminating standby rates for projects below a certain size. In 2013, Minnesota passed a law making changes to that state's standby rates. Under the law, public utilities are blocked from imposing standby rates on any net-metered facility with a capacity of 40 to 100 kilowatts, and may only impose a standby rate on facilities with a capacity of 100 to 1,000 kilowatts "in accordance with an order of the commission establishing allowable costs to be recovered through standby charges."[71] These smaller units often operate on tight margins, and ensuring that standby charges are fair helps preserve the financial incentive to deploy CHP and WHP in the first place.

Interconnection Standards

CHP and WHP must connect to the electrical grid to draw backup power as well as to be able to sell excess generated power back to the grid where allowed. Interconnection standards establish policies and procedures for such connections and are critical for maintaining system safety and reliability. As of October 2013, 43 states and the District of Columbia have established interconnection standards or guidelines,[72] but not all standards are created equal. Many of these standards present undue obstacles like high fees and lengthy delays. Interconnection standards should incorporate a reasonable fee structure, streamlined procedures to avoid excessive delays, standardized technical requirements, and a defined process to address disputes. Such standards are not only needed for small distributed

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[70] *See* EPA 2009, *supra* note 67, at 9-11.
[71] Minnesota H.F. No. 729, 2013.
[72] DSIRE, "Rules, Regulations & Policies for Renewable Energy," 2013, (http://www.dsireusa.org/summarytables/rrpre.cfm).

generation projects, but should be applicable to medium and large CHP and WHP systems, which are even more likely to need to connect to the grid to sell surplus capacity.[73]

Maine Interconnection Standards

Maine's interconnection standards were designed with a goal of improving efficiency in the interconnection process and encouraging the deployment of more distributed generation. To facilitate this, the state has capped utility interconnection fees and provides a set timeline by which the process must be executed.[74] As a testament to the workability of this approach, almost one quarter of the state's current CHP fleet has come online since the 2009 passage of these standards.[75]

4. **Critical Government Infrastructure**

CHP and WHP are commonly identified as key ways of improving the resilience of the energy grid. Time and again, CHP has allowed facilities to stay operational despite central power disruptions. CHP's reliability benefits are visible across the country—from New Jersey to Louisiana to California—and in a variety of sectors, including health care, education, and the military.[76] These benefits have been highlighted in the wake of Hurricane Katrina and Superstorm Sandy, and the Obama administration has begun to recognize the reliability benefits of CHP during extreme weather events, prompting it to include recommendations for consideration of CHP in vulnerable regions in its Hurricane Sandy Rebuilding Task Force report.[77] Recognizing CHP's value in improving energy resilience, several states have taken steps to increase deployment of CHP at critical facilities.

Texas and Louisiana Critical Infrastructure Rules

In 2009, Texas passed a set of bills requiring government entities to obtain a feasibility study for CHP deployment during the construction or renovation of any government infrastructure designated as critical in an emergency situation. This requirement applies to all levels of government, including counties, cities, and school districts. The bills define infrastructure as critical if it is expected to safely function during a widespread power outage (e.g., prisons, fire

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[73] For a comprehensive review of interconnection standards and CHP, *see* SEE ACTION, *supra* note 35 at Chapter 3.

[74] Center for Clean Air Policy, "Combined Heat and Power for Industrial Revitalization: Policy Solutions to Overcome Barriers and Foster Greater Deployment," July 2013, at 23 (http://ccap.org/resource/combined-heat-and-power-for-industrial-revitalization/).

[75] ICF International, "Combined Heat and Power Units Located in Massachusetts," *Combined Heat and Power Database*, (http://www.eea-inc.com/chpdata/States/ME.html). Maine also adopted a voluntary energy efficiency target for utilities, which could explain a portion of this increase in CHP deployment as well.

[76] For a comprehensive review of CHP and energy resilience, *see* ICF International, *Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities*, March 2013, (http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_critical_facilities.pdf).

[77] Hurricane Sandy Rebuilding Task Force, *Hurricane Sandy Rebuilding Strategy*, August 2013, (http://portal.hud.gov/hudportal/documents/huddoc?id=HSRebuildingStrategy.pdf).

stations, water and wastewater facilities, hospitals, and shelters).[78] These requirements were strengthened in 2013, when the legislature added institutions of higher education to the list of eligible critical infrastructure and adopted new guidelines for determining the cost effectiveness of CHP installations.[79] Louisiana passed a similar measure requiring CHP feasibility studies during its 2012 legislative session.[80] Texas and Louisiana pursued these measures because of their history of outages during hurricanes and other severe weather events;[81] however, threats of power outages exist nationwide,[82] and we recommend that such policies be adopted elsewhere.

5. **Streamlined Permitting**

Another source of cost and delay in CHP and WHP deployment is navigating a state's cumbersome air-permitting process. Receiving these permits can often take as long as six to nine months,[83] lengthening the time before a facility can become operational and realize CHP's and WHP's financial benefits. State regulators should adopt a simple, predictable permitting process that incorporates output-based standards. Both Texas and Connecticut have adopted such a streamlined process in recent years.

Texas and Connecticut Permit By Rules

Texas adopted a "permit by rule" in 2012. Under this new rule, some smaller natural gas-fired CHP units (up to 8 MW, or up to 15 MW if the facility has certain pollution-control equipment) are exempted from the traditional permitting process. To qualify, the unit's recovered heat must equal at least 20 percent of its total heat energy output.[84] This thermal requirement is consistent with federal policy and prevents a facility from invoking the new rule for "sham" projects.

Prior to adoption of this rule, relatively small CHP units in Texas were facing an unnecessarily complicated planning and permitting phase, even though they did not include the sort of pollution-control equipment the permitting process was created to regulate. By exempting these smaller units from the permit requirements, state regulators helped eliminate a source of potential costly delays.

Following Texas's lead, Connecticut adopted a similar permit by rule in 2013 that exempts certain CHP units from traditional air permitting. As in Texas, the rule is limited to smaller units

[78] Texas HB 1831, 2009; Texas HB 4409, 2009.
[79] Texas HB 1864, 2013.
[80] Louisiana SR 171, 2012.
[81] *See* ICF International *supra* note 76, at 32-33.
[82] Executive Office of the President, *Economic Benefits of Increasing Electrical Grid Resilience to Weather Outages*, August 2013, at 4 (http://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf).
[83] Robinson & Cole, *Connecticut Combined Head and Power Programs*, September 2013, (http://www.rc.com/newsletters/Publications/2274.pdf).
[84] 30 Texas Administrative Code §106.513.

with certain efficiency levels (i.e., up to a 10 megawatt nameplate capacity and 55-percent overall system efficiency). The Connecticut rule also includes additional requirements on emission levels, monitoring, and reporting.[85]

Conclusion

As EPA moves forward with the GHG rule for existing sources, we urge the Agency to recognize the emission benefits of CHP and WHP. These applications provide a cost-effective, adequately demonstrated means of reducing GHG emissions from the electric power system, while enhancing manufacturing competitiveness. As highlighted in this paper, some states, utilities, and power plants are already taking action to encourage deployment of these technologies. EPA should clarify in its emission guidelines that policies such as these that support CHP and WHP would support an equivalency determination and states, in turn, should take steps to encourage CHP and WHP as part of their compliance plans.

Sincerely,

David Gardiner, Executive Director
Alliance for Industrial Efficiency

[85] 22a General Statutes of Connecticut §174-3d.