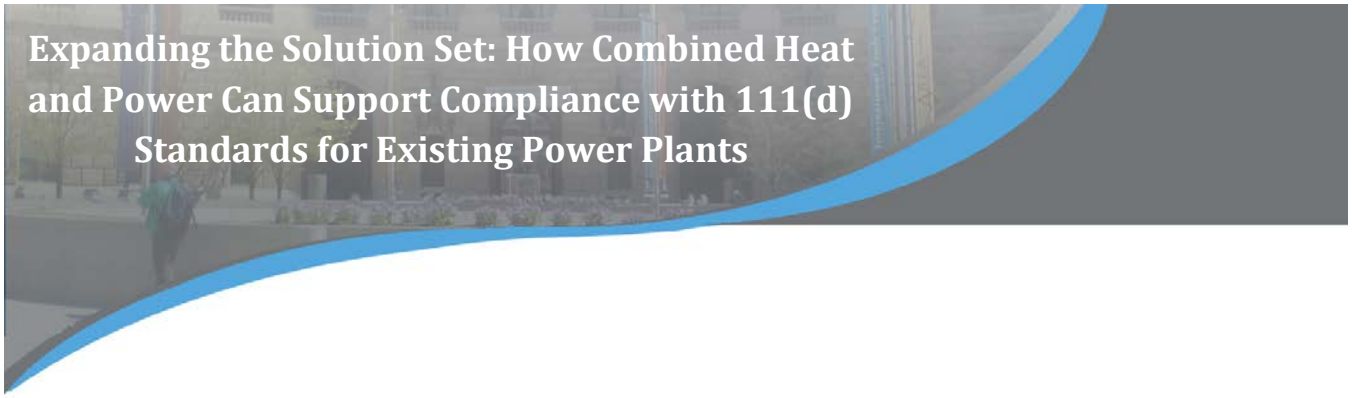


Expanding the Solution Set: How Combined Heat and Power Can Support Compliance with 111(d) Standards for Existing Power Plants

Key Findings

Breathing new life and urgency into EPA's mission, President Obama's June 2013 speech on climate policy included a call for the regulation of greenhouse gases from new and existing power plants. In his memorandum to the EPA, he directed the agency "to ensure, to the greatest extent possible, that [EPA]… develop[s] approaches that allow the use of market-based instruments, performance standards, and other regulatory flexibilities." Flexible compliance approaches that allow covered sources to use a broad set of clean energy solutions that reduce power sector carbon emissions can enable greater ambition at a lower cost while providing a new incentive for efficiency improvements.

Other recent assessments have evaluated the potential for shifts from inefficient coal to clean natural gas, and for demand-side energy efficiency to result in significant emissions reductions while achieving cost savings over inflexible source-based strategies. These studies did not look at the additional opportunity presented by combined heat and power (CHP) at industrial, commercial and institutional facilities.

The Center for Clean Air Policy undertook new modeling to assess the role that combined heat and power can play in supporting compliance with the power plant standards. This fact sheet summarizes the main findings. **Allowing emissions reductions from CHP to be credited towards power sector greenhouse gas compliance obligations can support greater efficiency in key manufacturing and coal-reliant states, particularly the Midwest**. The full report, *Expanding the Solution Set: How Combined Heat and Power Can Support Compliance with 111(d) Standards for Existing Power Plants* is available on CCAP's website.

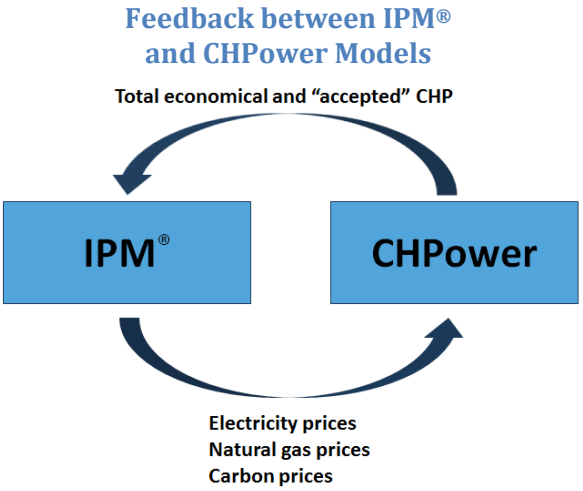
The CHP Advantage

- Combined heat and power conserves fuel by producing two energy streams—thermal energy and electricity—using the same fuel stock. Where such energy streams are currently produced separately—electricity from an electric generating unit and thermal energy from a boiler—CHP offers an opportunity to significantly lower emissions while also lowering energy costs for the energy end user.
- Improving the energy efficiency of the industrial sector with technologies like CHP can make U.S. industry more competitive in the global marketplace.

Method

- To understand how combined heat and power can support state compliance with EPA's forthcoming guidance on regulating existing power plants under section 111(d) of the Clean Air Act, this study combined two separate models, ICF International's Integrated Planning Model (IPM®) and CHPower model.

- IPM is a power sector dispatch model that solves for the least cost way of meeting generation and capacity requirements subject to constraints. The Environmental Protection Agency and other public and private entities use the IPM to evaluate the effects of environmental policies on the power system.
- The CHPower model forecasts the industrial, commercial and institutional facilities most likely to install or expand CHP systems over time.
- In each run, the IPM was run first, and the resulting electricity, natural gas and carbon prices (where applicable) were plugged into the CHPower model. The CHPower model was then run to determine the amount of economical and accepted CHP. This amount of CHP was input into model plants within IPM. IPM was rerun until there was virtually no change in the price outputs.

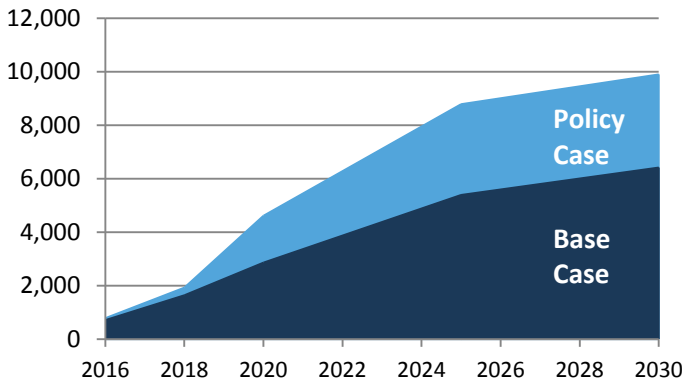


Assumptions

- Most of the IPM assumptions are the same as those in NRDC's Reference Case presented in the March 2014 issue brief, *Cleaner and Cheaper: Using the Clean Air Act to Sharply Reduce Carbon Pollution from Existing Power Plants, Delivering Health, Environmental and Economic Benefits*. The Reference Case assumptions are benchmarked to the Energy Information Administration's Annual Energy Outlook 2013, including natural gas prices.
- The CHP assumptions were based on ICF International's 48-state assessment of technical potential within 38 industry sectors and subsectors that have significant heat and electric demand. CHP costs were differentiated based on unit size.
- Our CHP modeling assumptions were conservative on a number of accounts that tend to underestimate the amount of CHP available, deemed economical, and ultimately accepted by the end user. In particular:
    - We assumed that CHP facilities do not export electricity to the power grid, limiting the size of the CHP units.
    - All new CHP units were assumed to be fueled by natural gas, even though some facilities might have access to lower cost fuels.
    - The opportunity for significant emissions reductions from switching from coal-fired boilers to natural gas-fired CHP was not considered; we assumed all business-as-usual boilers are fueled by natural gas.
    - CHP facilities were assumed to continue to pay their electric providers a fee equal to 15 percent of their historic electric charges to maintain back-up access to the electric grid.
    - Emissions credits for CHP were assumed to generate credit against a state emission rate standard, not emissions reduced. Crediting against emissions reduced would be expected to result in more credit in high-emitting states.
    - The investment tax credit was assumed to expire in 2016.
    - Only a fraction of the economical CHP was deemed to be accepted and deployed.
    - No value was assigned to secondary benefits of CHP, including business resiliency and reductions in grid congestion.
- Given these assumptions, the results of this research may be viewed as a lower estimate of possible new

- CHP capacity.
- Assumptions were reviewed by a multi-stakeholder advisory group, including experts from business, the federal government, and the environmental community.

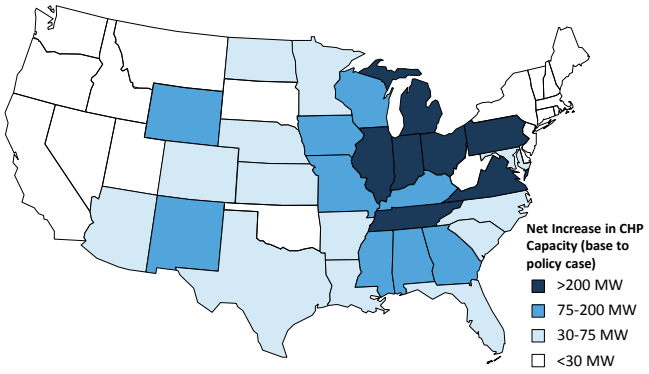
Cumulative CHP Market Penetration (MW)



Scenarios

- The study considered two scenarios: a business-as-usual "CHP Base Case," and a "CHP 111(d) Policy Case."
- The CHP Base Case built from the Reference Case developed by the Natural Resources Defense Council. Details on the NRDC assumptions and results can be found in the Technical Appendices on NRDC's website.
- The CHP 111(d) Policy Case was built from the NRDC study's Moderate, Constrained Efficiency policy case. Standards are set at the state level by applying benchmark emission rates based on the historic amounts of generation from coal- and gas-fired power plants over a baseline period (2008-2010). The initial benchmark emissions rates in 2020 were 1,500 lb/MWh and 1,000 lb/MWh for coal- and gas-fired power plants, respectively. For coal-fired power plants, these benchmark rates were lowered to 1,200 lb/MWh starting in 2025. The scenario allowed for deployment of demand-side energy efficiency (up to 1 percent per year by 2020 and thereafter) at rates of 2.3-3.2 cents per kWh.
- The main difference between the NRDC and CCAP scenarios was the addition of CHP as a compliance option.

Net Increase in CHP Capacity, Base to Policy Case, 2030



Results

- In total, nearly 10 GW of CHP came in by 2030, including CHP that deployed under the CHP Base Case and 111(d) Policy Case. This reflects CHP that was both economical and "accepted" by the host site. CHP's impact was greater in later model run years as the assumptions acknowledged that CHP projects can take time to deploy even after a decision is made to implement a CHP project; as such, CHP played a smaller role in 2020 (roughly 5 GW in total).
- Under the CHP Base Case, the models project that much of the new CHP capacity would be deployed in regions with higher than average retail electric rates and that are already subject to state or regional carbon cap-and-trade programs—California and the Northeast.
- Under the CHP 111(d) Policy Case, most of the incremental capacity is located in states with higher amounts of CHP technical potential and jurisdictions that are expected to see higher-than-average 111(d) compliance costs—regions that tend to have more coal-fired power generation and may also

have more limited compliance solutions. In these states, CHP investments were shown to help lower the cost of compliance with the carbon standards.

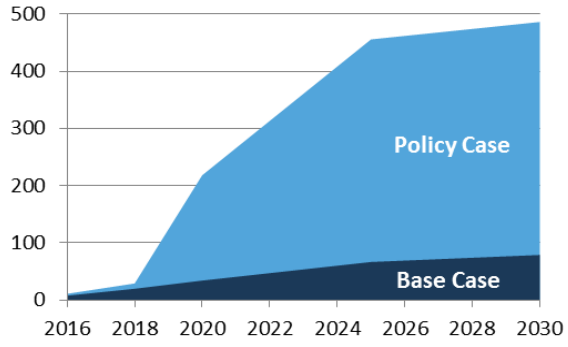
Conclusions and Discussion

- Allowing CHP as a means of compliance under a system-based approach can be particularly helpful to coal states that are projected to see higher-than-average compliance costs. This additional control option helps lower compliance costs while encouraging investments in more efficient industrial, commercial and institutional facilities. Including CHP as a compliance option presents a win-win solution that supports economic growth and creates new employment opportunities while still achieving significant emissions reductions.
- 111(d) policy that allows for compliance with CHP can be a bigger driver for CHP deployment than pursued policy approaches such as a 30 percent investment tax credit.
- Efforts to improve the rate at which otherwise economical CHP is accepted by the end user (e.g., through education or risk mitigation) and to establish policies and procedures for CHP to access the grid could further boost the potential of this win-win mitigation option.

Ohio: CHP Offers a Valuable Compliance Tool

Ohio presents a particularly strong prospect for advancing CHP as a means to comply with existing power plant carbon standards. The state's strong CHP potential and comparatively higher projected carbon price stemming from the region's reliance on coal-fired power result in an estimated 407 MW of CHP capacity in 2030 attributable to 111(d) carbon emission standards. Payments from covered sources for emissions reductions through investments in CHP would make a large number of technically viable projects become economically viable. Combined with projected 'business-as-usual' growth in CHP capacity in the state, Ohio would see a projected increase of 486 MW by 2030. This is despite the fact that the state is expected to see relatively unchanged natural gas prices while electricity prices drop – a change in 'spark spread' which would not normally favor CHP. The majority of Ohio's incremental new CHP capacity under the policy case is from large CHP units (greater than 20 MW) serving high thermal energy needs (predominantly larger industrial users), but some new markets for CHP are opened in high-load cooling applications.

Cumulative Additional CHP Capacity in Ohio (MW)



Since 1985, CCAP has been a recognized world leader in climate and air quality policy and is the only independent, nonprofit think tank working exclusively on those issues at the local, national and international levels. Headquartered in Washington, D.C., CCAP helps policymakers around the world to develop, promote and implement innovative, market-based solutions to major climate, air quality and energy problems that balance both environmental and economic interests.

For more information about CCAP's 111(d) and CHP modeling, please contact:
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