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Efficient power, good jobs

Energy strategy for Ohio manufacturing

By Amanda K. Woodrum

Ohio needs a more sustainable energy strategy for its industrial sector. There is growing recognition this energy strategy should revolve around greater deployment of combined heat and power ("CHP") technology — a much more efficient and reliable way to meet both the heat and power needs of manufacturers.

The industrial sector consumes one-third of all energy used in the state, more so even than the transportation sector.[1] Manufacturers burn fossil fuels on-site to heat metals and chemicals and – separately – purchase electricity from the grid to light their factories and power electric motors, welding tools, conveyer belts, and the like. In 2014, Ohio manufacturers spent $8.9 billion on energy, including $3.3 billion for electricity.

Electricity purchased from the grid, however, is generated and distributed inefficiently by electric monopolies relying on outdated coal-fired power plants and an antiquated grid. Ohio's electric utility companies waste two out of every three lumps of coal they burn — the energy lost during generation, transmission and distribution of electric power.

Inflated electric prices, due to massive energy waste in the electric power sector, hurts Ohio manufacturers' ability to compete in the new global economy. And because Ohio's electric utilities burn three times more coal than is needed, the electric power sector is responsible for almost half of all carbon pollution in the state (45 percent).[2] In fact, Ohio's electric power sector emits more sulfur dioxide pollution than electric utilities of any other state. Ohio ranks fourth in the nation for nitrous oxide emissions and fifth for carbon dioxide.

Key findings

- Ohio needs an industrial energy strategy. Manufacturers spent $8.9 billion on energy in 2014, including $3.3 billion to buy electricity.
- Waste in the electric power sector inflates costs (two of every three lumps of coal is lost), making it more difficult for manufacturers to compete. It also pollutes.
- Ohio's electric power sector is responsible for half of the carbon pollution in the state and is worst in the nation for sulfur dioxide.
- Combined heat and power technology meets manufacturers' needs for both heat and power from a single source. It is more efficient and reliable, and less expensive and polluting.
- Ohio ranks in the top five states for its technical potential to deploy combined heat and power technology, but 42nd in the nation for adoption of the technology.
- If Ohio took advantage of just 20 percent of our potential for CHP, we would lower operating costs, meet significant portions of the federal Clean Power Plan and state clean-energy requirements, and create an estimated 4,400 net permanent or full-time equivalent jobs in construction, manufacturing and natural gas distribution.

[1] Energy Information Administration, *Total Energy Price, Consumption and Expenditure Estimates, 2014* at http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_prices/ind/pr_ind_OH.html&sid=Ohio

[2] Energy Information Administration, *Electric Power Industry Emissions*, http://www.eia.gov/state/data.cfm?sid=OH#Environment

In addition to carbon pollution's contribution to climate change, pollutants from Ohio power plants are responsible for thousands of cases of respiratory disease, asthma attacks, and premature deaths. These disproportionately burden the poor. [3] Eight out of every ten coal-fired power plants in Ohio are in communities with high concentrations of low-income families.

Our antiquated electric grid is also subject to rolling blackouts that result in large economic losses. In 2003, for instance, the Northeast Blackout hit large portions of the Midwest and Northeast, causing power system failures that cost billions of dollars in lost sales, goods and work hours. To avoid power failures, electric utilities routinely contract with manufacturers for the right to shut down facilities in times of heavy grid congestion. This is an unproductive way to ensure electric system reliability.

There is a better way. Instead of purchasing electricity from the grid and separately burning fuels in an on-site boiler for heat, combined heat and power technology (CHP) meets manufacturers' needs for both heat and power, from a single source, and does so more efficiently, reliably, and cheaply, with less pollution. CHP generates electricity on or near the industrial site and simultaneously captures heat during the electric generation process that would otherwise be wasted — putting it to productive use heating metals, chemicals and/or building space.

Combined heat and power can reduce by half the amount of energy needed to generate the same heat and power. Greater deployment of CHP will increase the competitiveness of Ohio's manufacturing base by lowering energy operating costs and improving electric system reliability. As a more distributed form of generation located close to manufacturing facilities — versus the current approach of centralized generation in remote locations — CHP also enables better energy management by manufacturers.

CHP is also a proven, cost-effective strategy to reduce greenhouse gas emissions and energy waste. The federal Clean Power Plan and Ohio's energy-efficiency requirements for electric utilities can drive increased federal, state and electric utility investment in CHP. In addition to the energy-saving opportunities, if Ohio's Clean Power Plan and state-level efficiency requirements are designed correctly, manufacturers could earn additional revenue for the role their CHP projects play in helping electric utilities meet emission reduction and efficiency requirements.[4]

As an energy-intensive manufacturing state, Ohio has enormous CHP potential. Ohio ranks in the top five states in the nation for its technical potential to employ combined heat and power. However, it ranks 42nd in the nation for the share of CHP in our electric capacity portfolio.

If, as part of our Clean Power Plan, Ohio set a goal of achieving 20 percent of our technical potential for CHP, we would save $320 million in energy-related expenses each year, meet an equivalent of 27 percent of Ohio's carbon-reduction requirements under the federal Clean Power Plan, achieve nearly 40 percent of energy-saving requirements under Ohio's efficiency standards, and create an estimated 4,400 net permanent full-time equivalent jobs in construction, manufacturing, and electrical system upgrades.

[3] PSE Healthy Energy, *The Clean Power Plan in Ohio: Analyzing power generation for health and equity* (2016) at https://nextgenamerica.org/wp-content/uploads/2016/07/Our-Air-Ohio-Technical.pdf

[4] Meegan Kelly, ACEEE, *How energy-intensive manufacturers an be winners under EPA's Clean Power Plan.*

Ohio's untapped CHP potential

Ohio ranks in the top five states for CHP investment opportunity with roughly 9,800 MW of CHP potential, an amount equal to the generation capacity of six of Ohio's eight biggest coal-fired power plant – one-third of Ohio's total power-generating capacity. Table 1 shows that most of Ohio's potential for CHP lies in manufacturing (68 percent). The Department of Energy defines technical potential as an estimation of the CHP market potential — the ability of CHP to meet customer energy needs — constrained only by technological limitations (without regard to market conditions).[5]

Table 1

Most of Ohio's CHP potential lies in the Manufacturing sector (68%)

	Market Sector	MW	% Capacity
Manufacturing	Paper	2,329	68%
	Chemicals	2,838	
	Primary metals	430	
	Food	310	
	Other industrial	767	
Commercial / Institutional	Hospitals, Universities, Schools, Public Sector	3,082	32%
Total CHP Potential		**9,756**	100%

Source: U.S. DOE Midwest Clean Energy Application Center

[5] U.S. Department of Energy, *Combined Heat and Power (CHP) Technical Potential in the United States* (March 2016).

Despite potential, Ohio has low rate of CHP adoption

Despite Ohio's vast potential for CHP deployment, Table 2 shows Ohio ranks 42nd in the nation for adoption of CHP technology relative to overall electric power capacity in the state, getting only 1.6 percent of our power from this more efficient form of electricity generation. Nationally, by way of comparison, combined heat and power accounts for nearly 8 percent of total capacity.[6]

Louisiana ranks first in the nation for existing deployment, with over 23 percent of its electric capacity made up of combined heat and power, where it is heavily used by the petroleum industry.

Other nearby states do much better than Ohio — 14.5 percent of New York's electric power capacity is in CHP technology; 11.5 percent in Michigan, 9.4 percent in Wisconsin, 8.5 percent in Indiana, and 7.6 percent in Pennsylvania.

Table 2

Ohio ranks 42nd for CHP adoption, far behind neighbors MI, PA and NY

State	Electric Capacity (MW)	CHP Capacity (MW)	% CHP Capacity	Rank
Louisiana	26,227.9	6,106.3	23.3%	**1**
Maine	4,494.9	935.5	20.8%	**2**
Alaska	2,430.2	482.7	19.9%	**3**
Oregon	15,664.9	2,712.1	17.3%	**4**
Hawaii	2,663.0	435.9	16.4%	**5**
NJ	18,742.7	3,049.1	16.3%	**6**
Texas	109,919.3	17,557.3	16.0%	**7**
NY	39,918.2	5,775.2	14.5%	**8**
Michigan	30,104.8	3,452.9	11.5%	**11**
Wisconsin	17,351.5	1,629.2	9.4%	**13**
Indiana	27,216.0	2,323.1	8.5%	**14**
PA	43,029.8	3,269.0	7.6%	**16**
Illinois	44,950.3	1,328.7	3.0%	**34**
WV	16,276.5	371.2	2.3%	**38**
Ohio	**32,335.5**	**517.0**	**1.6%**	**42**
Kentucky	21,005.6	134.9	0.6%	**48**
U.S. Total	**1,061,651.9**	**82,727.9**	**7.8%**	

Source: U.S. DOE Combined Heat & Power Installation Database; Energy Information Administration Net Summer Capacity

[6] *Combined Heat and Power (CHP) as a Compliance Option under the Clean Power Plan* (2015), Prepared by David Gardiner and Associations & Institute for Industrial Productivity.

Electric market barriers limit sustainable energy choice for manufacturers

Given all the benefits to investing in combined heat and power for the manufacturing sector, why are we not doing more of it? To further CHP development, manufacturers need energy partners. Electric utility companies or third-party energy suppliers can provide energy-related expertise, shoulder some of the inherent risks, provide upfront capital, participate in project development, and handle operations and maintenance. However, electric utility companies, to date, have lacked incentive to do so and have put up barriers for third-party energy providers since they are seen as competitors.

1. **Lack of competition in the electricity market, dominated by monopolies, removes incentive for utilities to produce power more efficiently.** Ohio's mostly centralized system of producing electricity in remote locations from antiquated coal-fired power plants yields an electric power sector that operates at very low levels of efficiency. Nearly 70 percent of the energy from coal burned at these facilities is lost during generation, transmission and distribution.
2. **Electric monopolies put up barriers to competition from Independent Power Providers (IPP).**[7] Ohio's electric utilities impede efforts of third-party energy providers working with manufacturers to install CHP. The three biggest barriers to competition come in the form of 1) utility rate structures that integrate power-generation charges from the utility into unavoidable distribution charges for all customers; 2) exorbitant charges by utilities to manufacturers for back-up power that may be needed during routine maintenance of CHP facilities or unplanned outages ("stand-by charges"), and 3) side deals with manufacturers for below-market prices subsidized by residential and commercial ratepayers that render independent power producers unable to compete.
3. **Without assistance from an energy partner, there is limited interest from manufacturers in self-generating power.** Many manufacturers are not inclined to self-generate for their power needs in the absence of an energy partner because most manufacturers are not in the energy business and do not have the expertise or desire to become experts. Plus, manufacturers have many competing needs for capital and tend to put the money they have into projects with short payback periods, thwarting a more long-term investment approach like CHP that requires sizeable upfront capital.

Standards for electric monopolies help overcome barriers

Both the federal Clean Power Plan and the state of Ohio's energy-efficiency requirements for investor-owned electric utilities force electric monopolies to change the outmoded way they produce electricity and become partners in more innovative and efficient generation. The Clean Power Plan requires electric utilities to reduce carbon pollution. Similarly, Ohio's efficiency standard for investor-owned electric utilities requires utility investment in more efficient generation, distribution and consumption of power.

The best way for utilities to reduce pollution while increasing efficiency is to invest in more innovative forms of energy generation. Combined heat and power technology tackles the biggest energy inefficiency of all by capturing heat typically wasted in the electric generation process and putting it to good use in the manufacturing sector.

Unfortunately, Ohio's attorney general joined a lawsuit against the federal government to thwart implementation of the Clean Power Plan, and the Ohio General Assembly put on hold the state's efficiency requirements for electric utilities. These moves are bad for Ohio's environment and economy.

[7] Thomas, Lendel, & Park, CSU Maxine Goodman Levin College of Urban Affairs, *Electricity Markets in Ohio* (2014) at http://cua6.urban.csuohio.edu/publications/center/center_for_economic_development/ElectricityMarketsInOhio.

Ohio's Clean Power Plan can reduce CHP barriers for manufacturers.[8]

The Clean Power Plan can drive new investment in combined heat and power to benefit Ohio's manufacturing sector if designed properly. Not only would manufacturers gain from energy-saving opportunities, they could also receive additional revenues from utility companies for the emission reduction attributes of the project, in the form of state or utility rebates and/or tradeable commodities such as allowances or Emissions Reductions Credits (ERCs) issued by the state, depending on how Ohio designs its plan.[9] The federal rule specifically identifies Combined Heat and Power as a cost-effective compliance option.[10] So, Ohio's compliance plan can make CHP a priority. The diagram below discusses how to design a compliance approach to accomplish this purpose.

1. Mass-Based Approach: Decrease total tons of CO_2 emitted by power plant, utility, or state.

Allocation of Emission "Allowances": Under a mass-based approach, the federal EPA will allot each state a specified number of carbon emission allowances. Ohio can auction off some or all of the allowances and use the proceeds to invest in CHP projects. Alternatively, Ohio could choose to give away the allowances. This latter route requires the state to devise a plan on how best to distribute them.

Under a mass-based approach, **no financial benefits** will accrue to manufacturers for CHP **UNLESS**: 1) the state directly allocates allowances to CHP projects or sets aside a pool of allowances for them; or, 2) state or utility programs grant incentives for CHP contributions toward compliance requirements.

The State of Ohio should distribute allowances "off the top," directly, to any priority project that meet pre-determined, strict criteria published early in the process (such as highly-efficient CHP facilities located on or near manufacturing facilities). Remaining allowances can then be distributed to utilities with affected units. Allowances received by manufacturers can be sold to affected utilities, proving additional revenues each year.

OR

2. Rate-Based Approach: Reduce the number of CO_2 pounds per MWh

Adopt Emission Standards for Electric Generating Units (EGUs)—unit by unit or fleet-wide.

Create an ERC Market. To decrease CO_2 per MWh, utilities invest directly in renewable energy/energy efficiency, and/or purchase Emission Reduction Credits (ERCs) through a market-based system. An ERC market would work similar to the existing Renewable Energy Credit market (or, REC market, where the PUCO houses a registry of verified RECs).

Benefit to Manufacturers. Under a rate-based approach, a manufacturer can earn ERCs for CHP projects that follow procedures established by the state, or more likely, the Public Utilities Commission of Ohio. Electric utilities then pay manufacturers to acquire these Emission Reduction Credits.

3. Multi-State Emissions Trading program (versus Ohio going it alone): Under either a rate- or mass-based approach, Ohio would benefit from participating in a trading program with other states. Given Ohio's enormous potential for CHP, Ohio utilities investing in CHP could easily achieve enough cost-effective emissions reductions earning direct emissions allowances or ERCs, depending on which approach the state takes above, that could then be sold to other Ohio utilities or utilities in other states in need of them.

[8] David Gardiner and Assoc., Institute for Industrial Productivity & Wooley Energy & Environment, *Combined Heat and Power (CHP) as a Compliance Option under the Clean Power Plan* (April 2016).
[9] Meegan Kelly, ACEEE, *How energy-intensive manufacturers can be winners under EPA's Clean Power Plan.*
[10] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Generating Units, Federal Register, Volume 80, No. 205, pp. 64756-57, 64902 (October 2015)(https://www.gpo.gov/fdsys/pkg/FR-2015-10-23/pdf/2015-22842.pdf).

Increased adoption of CHP technology would go a long way towards meeting Ohio's carbon reduction requirements in the federal Clean Power Plan. CHP systems burn fewer fossil fuels to produced the same amount of energy as our conventional energy system. In addition to reducing waste and saving money, that also means fewer related emissions.

Table 4 shows that taking advantage of 20 percent of Ohio's technical potential for CHP, for instance, would get us 27 percent of the way towards meeting Ohio's 2030 carbon-reduction requirements.

More ambitious deployment scenarios would lead to even greater reductions.

Table 4

Ohio could achieve 27% of its clean power plan requirements by taking advantage of just 20 percent of its CHP potential

	Rate of adoption of Ohio's technical potential for CHP			
	10%	**20%**	**30%**	**40%**
CHP Electric Capacity (in MW)	980	1,960	2,940	3,920
Annual GWh from CHP (est.)	6,868	13,736	20,604	27,471
Emissions reduction estimate (in million short tons)	4.1	8.1	12.2	16.3
% Ohio's carbon reduction goal met by tapping CHP potential	**13%**	**27%**	**40%**	**54%**

Source: Based on mass-based goals from EPA Clean Power Plan: [Ohio] at a Glance, Emissions reduction formula from Oakridge National Research Laboratory, *Combined Heat & Power: Effective Energy Solutions for a Sustainable Future* (2008)(CHP produces 72% percent fewer emissions than coal-fired power plant); projections from Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014).

CHP can help utilities meet state-level efficiency requirements

If Ohio's energy-efficiency standard is allowed to resume—current limitations are set to expire at the end of 2016—the state of Ohio will require investor-owned electric utilities to reduce retail sales of electricity 22 percent by 2027. Electric utilities can easily meet these requirements by investing in combined heat and power in partnership with Ohio's industrial and commercial sectors.

Table 5 shows how far Ohio's CHP potential can get electric utilities towards meeting their requirements.

Taking advantage of just 20 percent of Ohio's CHP potential, would help achieve nearly 40 percent of the state's energy-efficiency standards for investor-owned electric utilities operating in Ohio.

Table 5

If Ohio achieved 20% of its CHP potential, we would reach nearly 40% of Ohio's efficiency requirements.

		% Adoption of Ohio's technical potential for CHP			
		10%	**20%**	**30%**	**40%**
CHP Capacity	MW	980	1,960	2,940	3,920
CHP Generation, annual	GWh	6,868	13,736	20,604	27,471
	Trillion Btu	23.4	46.9	70.3	93.8
% of Ohio energy savings requirement met	119.6 trillion Btu by 2027	**20%**	**39%**	**59%**	**78%**

Source: Based on projections from Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014). Assumption: each GWh of CHP displaces GWh from affected unit.

CHP Saves Industrial, Commercial & Residential Energy Consumers Money

As Table 3 shows, if Ohio took advantage of 20 percent of its technical potential, or 13,736 gigawatt-hours, Ohio industrial, commercial and residential consumers, together, would save $320 million each year, including $54 million in annual savings for the manufacturing sector.

Table 3

If Ohio achieved 20% of technical potential for CHP, Ohioans would save $320 million each year on heat and power

		% Ohio Adopts of its technical potential for CHP			
	Per GWh	**10%**	**20%**	**30%**	**40%**
MW Capacity		980	1,960	2,940	3,920
Annual GWh (est.)		6,868	13,736	20,604	27,471
Annual Net Industrial Spending Change (in millions)	**$-3.9 m.**	**$(27)**	**$(54)**	**$(80)**	**$(107)**
Electricity Purchased	$-43.4 m.	*(298)*	*(596)*	*(894)*	*(1,192)*
Electricity Sales	$-13.6 m.	*(93)*	*(187)*	*(280)*	*(374)*
Gas	$ 40.1 m.	*275*	*551*	*826*	*1,102*
O&M	$ 5 m.	*34*	*69*	*103*	*137*
Amortization	$ 8 m.	*55*	*110*	*165*	*220*
Commercial Savings	$(13)	$(88)	$(176)	$(264)	$(352)
Residential Savings	$(7)	$(45)	$(91)	$(136)	$(181)
Total Net Savings (in millions)	**$(23)**	**$(160)**	**$(320)**	**$(480)**	**$(640)**

Source: Based on projections from Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014)

For every gigawatt-hour generated by new combined heat and power technology, manufacturers would reduce their electricity purchases by an estimated $43.4 million and increase their income from sale of electricity to the grid by $13.6 million.[11] Some of these savings would be displaced by costs associated with the investment. To produce heat and electricity on site they would also increase their spending on natural gas by $40.1 million per gigawatt-hour, pay $5 million for operations and maintenance of CHP facilities, and pay $8 million for loan amortization to build these facilities.[12] After accounting for loan amortization, operations and maintenance, and increased expenditures on natural gas, net industrial savings amounts to $3.9 million per gigawatt-hour generated.

Price suppression benefits from reduced industrial demand for electricity also help commercial and residential consumers. Reduced demand for electricity creates downward pressure, lowering electric prices for all consumers, as does the associated reduction in grid congestion.[13] For every gigawatt-hour generated from industrial CHP facilities, the commercial sector saves $13 million, while households save $7 million due to lower electric prices.

[11] Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014)
[12] *Id.*
[13] Thomas, Lendel, & Park, CSU Maxine Goodman Levin College of Urban Affairs, *Electricity Markets in Ohio* (2014) at http://cua6.urban.csuohio.edu/publications/center/center_for_economic_development/ElectricityMarketsInOhio.

Distributed CHP generation improves electric system reliability

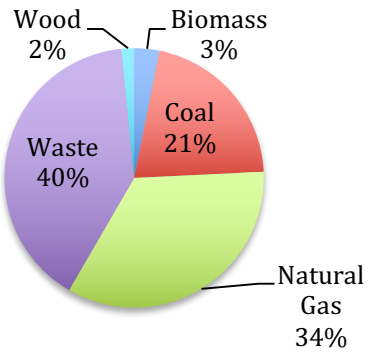
Distributed generation, versus centralized production, locates power generation at or near the point of use. This reduces instances of grid congestion, avoids electric system losses from long-distance generation, promotes grid stability, and improves local energy-management capabilities. In the case of combined heat and power, it also captures waste heat created during electricity generation for use in manufacturing (i.e. bending metals, heating chemicals). For manufacturers with large energy needs for both heat and power, combined heat and power technology at or near the industrial site, enables them to better manage their need for high quality, reliable, secure and efficient power while lowering costs and greenhouse gas emissions.

In Ohio, a manufacturing hub at the epicenter of the 2003 Northeast Blackout that spread from Ohio to large portions of the Midwest and Northeast, reliability concerns are very real. During electric grid outages, like the 2003 rolling blackout, combined heat and power enables manufacturers to continue production even when power is out almost everywhere else. The 2003 blackout, lasting as much as four days in some areas, caused the United States billions of dollars in economic losses in the form of lost sales, goods, and work hours. During the massive grid outage, however, some facilities were able to continue operation because of their CHP units.[14] To avoid massive outages like this one, manufacturers routinely contract with utilities to stop production during times of high grid use, like very hot summer days when air conditioning units are operating at maximum. This is not the most productive solution.

CHP systems not only generate power more efficiently and reliably than existing coal-fired power facilities, they can do so from a diverse array of energy resources. A diverse energy portfolio reduces economic risk inherent in relying too heavily on any one fuel source.

Figure 2

Ohio CHP runs on a diverse array of sources, including 40% from waste products



Source: U.S. DOE CHP Installation Database

Figure 2 shows, the diverse fuel inputs for Ohio CHP systems. Waste products from industrial processes are the biggest energy source for Ohio CHP, with natural gas and coal making up most of the remaining amount. Wood and biomass, represent five percent of CHP's fuel input in Ohio.

Nationally, 70 percent of CHP capacity is fueled by natural gas.[15]

[14] Anne Carlson, *Experiences with Combined Heat and Power during the August 14, 2003 Northeast Blackout* (2004).
[15] David Gardiner and Assoc., Institute for Industrial Productivity & Wooley Energy & Environment, *Combined Heat and Power (CHP) as a Compliance Option under the Clean Power Plan* (April 2016).

CHP investments generate good jobs

If Ohio were to invest in 20 percent of its technical potential for CHP, we would create approximately 4,400 net permanent jobs or their full-time equivalent, as demonstrated in Table 8. While there would be fewer jobs in traditional electricity, new jobs in natural gas, CHP operations and maintenance, and construction more than make up for this loss.

Table 8

If Ohio took advantage of 20% of its technical potential for CHP, we would create 4,395 net new jobs (permanent or full-time equivalent).

		% Adoption of Ohio's Technical Potential			
		10%	**20%**	**30%**	**40%**
MW Capacity		980	1,960	2,940	3,920
Annual GWh (est.)		6,868	13,736	20,604	27,471
First-Order Job Impacts	0.09 Jobs per GWh	**618**	**1,236**	**1,854**	**2,472**
Construction FTE	0.08	549	1,099	1,648	2,198
O&M	0.09	618	1,236	1,854	2,472
Electricity	-0.33	(2,266)	(4,533)	(6,799)	(9,066)
Natural Gas	0.25	1,717	3,434	5,151	6,868
Second-Order Jobs Impacts	0.23 Jobs per GWh	**1,580**	**3,159**	**4,739**	**6,318**
Electricity	-0.11	(755)	(1,511)	(2,266)	(3,022)
Natural Gas	0.014	96	192	288	385
Consumer Re-spending	0.33	2,266	4,533	6,799	9,066
Total Net Jobs	0.31 jobs per GWh	**2,198**	**4,395**	**6,593**	**8,791**

Source: Based on projections from Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014). A full-time equivalent position means enough work to keep a construction worker employed for 20 years.

CHP - Operations and Maintenance. Investments in combined heat and power create permanent jobs. Table 7 shows that for every $1 million spent on operation and maintenance of CHP facilities, for instance, nearly 20 workers are employed to operate and maintain CHP facilities, equipment and machinery.

Table 7

Long-term CHP Operations & Maintenance

	Jobs per $1 million spent
Operation & Maintenance (facilities, equipment, machinery)	19.8
Natural gas distribution	6.6
Electric power generation, transmission, distribution	5.7
Mining coal, refining petroleum	7.4

Source: Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014)

CHP can be an important strategy for transitioning the existing workforce and communities negatively affected by movement towards a more competitive and efficient electric power market.

Due to skill overlap between operations and maintenance of CHP facilities and traditional electric power sector work — related to running boilers and turbines — workers currently employed at coal-fired power plants or recently laid off could do the work needed at CHP facilities, with some skill upgrades.

CHP Construction: Bill of Sale. Direct and indirect jobs are also created during the construction phase. Table 6 shows that every $1 million spent to increase our combined heat and power capacity generates 14.5 full-time equivalent jobs in the design, construction, and installation of equipment.

Nearly 40 percent of every CHP project dollar goes towards manufacturing the necessary turbines and boilers; 20 percent to construct facilities; 9 percent to fabricate metals and machines, and a combined 11 percent to manufacture electrical equipment and computer components.

Engineering and other technical services are needed, as well as plastic, pipe, hose and cement manufacturing.

Table 6

The equipment used in CHP systems needs to be manufactured, creating work in the CHP supply chain.

CHP Bill of Sale	Investment Allocation	Jobs per $1 million spent
Manuf. Of Turbines & Boilers	39%	12.6
Construction	20%	18
Electrical Equip manufacturing	7%	11.6
Fabricating metal & machinery (i.e. pipes, pumps)	9%	13.7
Computer component manuf.	4%	11.1
Air purification and condition equipment	6%	13.1
Plastic and rubber pipes, hoses, paint, and cement manuf.	3%	11.3
Engineering and technical services	8%	22.1
Insurance and financial services	4%	14.8
Weighted Average		**14.5**

Source: Reprinted from Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration* (2014)

Prime Examples: AEP-Ohio, Solvay, DTE Energy Services, & Kraton[16]

Ohio requires investor-owned electric utilities to achieve certain levels of efficiency. In 2012, Ohio amended its energy-efficiency standard to allow combined heat and power projects to qualify as a mechanism for utilities to achieve their efficiency requirements (Senate Bill 315). As a direct result, AEP-Ohio — an electric utility with 1.5 million customers in Ohio — adopted an incentive program designed to encourage CHP project development.

AEP-Ohio provides a performance-based incentive for CHP projects. Electric sales to industry represent 37 percent of AEP-Ohio's retail sales, and CHP a highly cost-effective way to help the company meet its efficiency requirements. To qualify for AEPs incentive program, CHP projects must pass a basic cost-effectiveness test showing a net benefit to the utility and its customers (i.e. costs avoided from having to generate and deliver the energy to the customer must be greater than incentive program costs). The utility recovers costs from its customer base via a rider on all electric bills. CHP projects also improve customer satisfaction and build better customer relationships, since customers are looking for these types of programs.

AEP-Ohio also sees CHP as an economic development strategy that results in new customers locating in the area. Plus, it leads to better retention of existing customers who are able to reduce their energy use,

[16] Ohio Environmental Council Webcast, *Case Studies in Ohio CHP Success*, https://attendee.gotowebinar.com/recording/1559191424972564995

save money, tout sustainability, become more globally competitive and expand production. For the two projects detailed in this report, below, AEP pays ½ cent for every kilowatt-hour generated that displaces demand for power from the grid, and does so for a period of five years.

Solvay Specialty Polymers and DTE Energy Services. The Solvay site in Marietta, Ohio — an industrial complex built in 1950 — is one business unit within a larger Solvay group based in Belgium. The site specializes in high-performance polymers called Udel and Radel found in plumbing, walter filtration, medical and cell phone components, the aviation market and kidney dialysis filters. There are 310 full-time employees at the site, a number that continues to grow.

Solvay was driven to CHP technology from a need for a more reliable supply of steam and electricity, following outages that caused the plant to shut down. Some parts of the plant were down for weeks and months while employees chiseled out polymers that permanently congealed inside their machines. Prior to launching its CHP facility, the company purchased electricity from the grid through AEP Ohio, and got its steam from a coal plant owned and operated by AMP-Ohio.

During Hurricane Ivan, Solvay Marietta went down for four days when the AEP power substation flooded. Within five months, it found itself again within inches of having to shut down due to a flood of the Ohio River. Then, in 2010, with six month's notice, the company lost its steam supply that had long been provided by AMP-Ohio. Part of the industrial complex on which the Solvay site is located was the Gorsuch station, an AMP-Ohio coal-fired plant with four large boilers, that provided steam to Solvay as a heat source for its polymer process.

In February 2015, however, in partnership with DTE Energy Services and AEP-Ohio, the company successfully launched a brand new combined heat and power plant in order to increase energy reliability and reduce costs. DTE Energy Services, a third-party publicly traded energy company headquartered in Ann Arbor, Michigan, designed, built, owns, operates and maintains the CHP facilities (DBOOM), in close partnership with Solvay. In fact, Solvay provides the natural gas, back-up electric and water supply, and wastewater treatment for the CHP facility, and developed a favorable power purchase agreement with natural gas providers in Southeast Ohio where the natural gas market is strong. Solvay employed DTE Energy Services because it did not have the expertise within its organization for steam and power production, and wanted to keep its focus on their core business of producing polymers. Plus, as with any manufacturer, Solvay did not have the capital set aside for utility-related investments.

The overall project cost was $37 million. The AEP incentive — AEP pays ½ cent for every kilowatt-hour generated for the first five years in operation — will amount to more than $1 million over the five-year life of the incentive program, and was a significant and very important justification for the project, enabling them to continue on with the project despite other setbacks. Solvay Marietta competes with Solvay's sites across the globe for capital outlays and expense funds. In this very competitive scenario, it is extremely important to seek all opportunities to improve a projects financials. DTE Energy Services also took advantage of a federal investment tax credit for efficiency projects.

The CHP facility consists of a gas turbine with a large heat recovery steam generator that serves 100 percent of Solvay Marietta's steam needs and 97 percent of its electric requirements. Solvay remains an AEP-Ohio customer, and AEP provides the balance of its electricity from the grid while also serving as back-up power. The CHP plant also provides steam to an adjacent industrial plant Americas Styrenics. To ensure reliability of both steam and power, there are back up systems for their back up systems (redundancies in the process). There are two standby boilers ready to go should anything happen. The

CHP system also has a 750kW generator that provides "black start" capability to its gas turbine should the AEP-Ohio supply go down.

At the time the project was launched, Solvay Marietta estimated it would see $6 million in savings over the 20-year life of its supply agreement with DTE. However, natural gas prices have declined further since the start of the project, and the company now expects to save substantially more. Another positive is DTE Energy Services hired nine employees previously laid off from the AMP-Ohio Gorsuch coal-fired power station that shut down (including experienced boiler and turbine operators). The CHP facility also helped save more than 300 jobs at Solvay-Marietta and 50 or so jobs at neighboring industrial plant, Americas Styrenics.

Kraton. Health, safety, and environmental performance is a core value at Kraton Polymers. Being globally competitive is also important since 30 percent of its products are exported worldwide. The company is a staple of its community, providing millions in tax revenues for the local tax base.

Kraton had aging energy and utility infrastructure. Their coal boilers — the heart of the facility — were 50 years old and very inefficient, with a lot of energy being wasted. Kraton took a long-term approach to replacing their energy system, looking to keep this site viable for next 50 years and for something more reliable. During the 2014 polar vortex, prior to adoption of the CHP system, the company had lost steam to their site and was forced to shut down production. They did not was to see a repeat of this.

After considering a number of possible solutions, Kraton replaced its steam plant with an eight megawatt steam turbine generator system, at a cost of $52 million (including $8 million for CHP capacity), a capital investment that was lower than its alternatives. For Kraton, the role of utility incentive — AEP pays ½ cent for every kilowatt-hour generated for the first five years in operation — was an important piece of the overall payback of the project.

The project is considered a win all the way around. The company was able to solve its infrastructure needs with new natural gas boilers while also recovering energy to produce enough electricity to meet 27 percent of its needs, essentially for free, all while meeting new environmental standards and improving system reliability. Kraton will save more than $10 million every year, enabling long-term growth for the company and stable employment for employees and contractors, by reducing the company's energy and maintenance costs. The project also simplified the logistics of its fuel supply. What came as a surprise to the company were the far fewer handling and safety concerns associated with piping in natural gas versus hauling coal via barge, rail or truck, and dealing with coal's solid and liquid waste (i.e. coal ash). Piping in natural gas is also more reliable.

As a benefit to the community, the Kraton CHP project put a number of contractors and subcontractors to work, taking 250,000 person-hours to complete the project, and employing a diverse array of skill sets. AEP-Ohio and their customers also benefit from the project in the form of lower energy costs since the project displaces the need for electric generation from higher-cost facilities. An added benefit to both Solvay employees and the surrounding community was the 97 percent reduction in hazardous air pollutants released by the company's energy facilities and a 50 percent decline in greenhouse gases. It also reduced both solid and liquid waste produced by the plant.

To hear more about these examples, go to Ohio Environmental Council Webcast, *Case Studies in Ohio CHP Success*, https://attendee.gotowebinar.com/recording/1559191424972564995

Recommendations to promote energy choice in manufacturing

As part of Ohio's Clean Power compliance plan, the state of Ohio should make adoption of combined heat and power a priority. If Ohio chooses to adopt a mass-based approach to meeting Clean Power Plan requirements it should distribute allowances "off the top," directly, to any priority project that meet pre-determined, strict criteria published early on in the process (such as highly-efficient CHP facilities located on site or near manufacturing facilities). Remaining allowances can then be distributed to utilities with affected units. Manufacturers can their allowances to affected utilities, proving additional revenues each year for their CHP project. Alternatively, if Ohio adopts of a rate-based approach, they will drive the creation of a market for Emission Reduction Credits (ERC market). An ERC market will help enable Independent Power Producers finance combined heat and power projects at manufacturing facilities.

The state of Ohio should also:

1. **Develop a transition program for workers negatively affected by the transition to a clean-energy economy.** Existing coal plant workers and coal miners negatively affected by the changing energy economy should be given priority in the hiring process for the new energy economy. Ohio can create a pool of existing energy workers that employers can consider prior to engaging in a more intensive search. This sort of "first source referral system" creates a pipeline of qualified workers prepared to meet employer demand. Whenever possible, workers at outdated coal plants slated for closure should be moved to new energy economy jobs. We can start the process by identifying any skills overlap between building, operating and maintaining conventional power plants with the skills required to build, operate and maintain CHP facilities, install solar and wind technologies, or retrofit existing buildings into green buildings. Foundational skills acquired by journeyman electricians remain very relevant to the needs in the new-energy economy. However, electricians may need a few new skills such as those related to waste heat recovery, the unique mechanics involved in capturing solar and wind power, and a growing familiarity with efficient building technologies. So, we will also need to upgrade some skills of existing energy workers to match new skills needed.
2. **Work with nearby states to engage in a multi-state carbon trading program**. Since Ohio has so much potential for CHP development, CHP project developers in the state would benefit from being able to sell allowances or ERCs to utilities in other states.
3. **Fully reinstate Ohio's energy-efficiency standard.** Because CHP is the most cost-effective way for Ohio's electric utility companies to meet efficiency requirements, restoring the standard will drive continued utility investments in combined heat and power and force Ohio's electric monopolies to become better energy partners to Ohio manufacturers. In addition, Ohio should require any large manufacturer opting out of utility-efficiency programs to invest in combined heat and power and make it a stipulation to engaging in any side deals for lower electric rates subsidized by residential and commercial consumers. These side deals should also be fully transparent.
4. **Stop electric monopolies from engaging in anti-competitive behavior.** Eliminate the ability of electric utilities to engage in secretive side deals with manufacturers. These side deals thwart efforts of Independent Power Producers to work with manufacturers to develop CHP projects. Also, enable the Public Utilities Commission of Ohio to develop a statewide, uniform system for reasonable stand-by charges from electric utilities. Manufacturers need a back-up plan for emergency power should their CHP system go down, or when it undergoes routine maintenance. Utility companies should not be allowed to take advantage of this and charge exorbitant rates designed to hinder competition.