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COMMENTS OF HOOSIER ENVIRONMENTAL COUNCIL ON 2014 INTEGRATED RESOURCES PLANS

January 30, 2015

Hoosier Environmental Council (HEC) submits these comments as part of the Integrated Resource Planning process informally followed by Indiana generating utilities. That process is outlined in a rule that is currently proposed by the Indiana Utility Regulatory Commission (IURC or Commission); however, the IURC is forbidden from formally adopting it pursuant to an Executive Order of the current Governor.[1]

Prior to the November 2014 IRP filings, utilities in Indiana worked through a new stakeholder-invited process designed to engage stakeholders early in the IRP process. The intent of this process was to include stakeholder comments and thoughts into the IRP process to better meet the needs and demands of electric utility customers. The process was also intended to direct disagreements concerning specific methodologies employed in the IRP process to the front end of the development of the IRP in hopes utilities would be responsive to the needs and wishes of concerned customers.

Vectren, Indianapolis Power and Light ("IPL"), and Northern Indiana Public Service Company ("NIPSCO") all held several stakeholder meetings as part of this process. In each meeting, the companies listened to comments and concerns of interested stakeholders. However, the IRPs filed by Vectren, NIPSCO, and IPL do not reflect a response to the concerns raised by stakeholders in the sessions. Specifically, the IRPs were deficient in assumptions regarding the contribution of energy efficiency, demand response, combined heat and power ("CHP"), and distributed generation.

Inclusion of Energy Efficiency and Demand Side Management in an IRP

The IRP rule in Indiana requires demand side resources to be evaluated on a consistent and comparable basis to supply side resources. Energy efficiency has been found to be the lowest cost resource among traditional alternatives analyzed in utility integrated resource planning. A recent report released by the American Council for an Energy Efficient Economy (ACEEE) estimated the average cost of energy efficiency to program administrators to be approximately three cents per kilowatt-hour (kWh)[2]. The Lawrence Berkeley National Laboratory also released a comprehensive analysis in 2014 of energy efficiency program costs and estimated a similar national average[3]. In another recent study, energy efficiency was also found to be the lowest risk strategy for an electric utility in evaluating resource

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[1] As HEC has voiced previously, this rulemaking moratorium is a short-sighted and contrived political gesture that prevents the Commission (and other agencies) from fully and effectively performing their responsibilities on behalf of Indiana consumers.

[2] Molina, Maggie, 2014. *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs*. ACEEE Research Report No. U1402. Washington, D.C.: American Council for an Energy-Efficient Economy.

[3] LBNL (Lawrence Berkeley National Laboratory). 2014. *The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs in the United States.* Berkeley: LBNL.

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options for meeting future needs[4]. Efficiency can also play a significant role in Indiana as the state prepares to meet the requirements of EPA's Clean Power Plan later this year. Clearly, demand side energy efficiency resources hold significant potential as a least-cost, least-risk strategy for Indiana electricity customers. It is therefore in the interest of all stakeholders to improve transparency in assumptions and to carefully review the reasonableness of assumptions about energy efficiency in each of the IRPs.

In the Vectren IRP, the company included a chapter on the evaluation of demand side resources with a strong emphasis on energy efficiency programs. Vectren discussed the details of a recent market potential study used to determine the programs to be offered moving forward into 2015. Finally, Vectren used 0.5% DSM "blocks" in the resource alternative section of the IRP to model DSM resources in various scenarios. From reading the IRP, it is unclear how a DSM "block" is defined. To better understand how DSM is modeled in the Vectren IRP, it would be useful to know the assumptions regarding cost of each "block" and how energy efficiency compares with other resource options in a net present value of revenue requirements analysis. Also, we strongly encourage Vectren to model higher penetrations of DSM in the base scenario to offset the operation of higher cost, inefficient units. Most of Vectren's existing units are inefficient with high heat rates (page 189, Vectren IRP).

Unlike Vectren, IPL has redacted avoided cost information used to screen energy efficiency programs using traditional cost effectiveness tests. This is a departure from previous versions of the IPL IRP, which contain all avoided cost information unredacted. The omission of avoided cost data presents challenges in attempting to determine if the cost effectiveness screening of IPL's programs is accurate. If the historical avoided costs presented on page 110 of the IRP were used to determine cost effectiveness of future programs, the IRP should be rerun with updated avoided costs reflective of today's conditions and IPL's current generation fleet.

IPL's IRP also demonstrates the company's failure to capture cost effective energy savings. As Figure 4B.6 illustrates, IPL has substantially more economic potential for efficiency. Instead of modeling the economic potential into the IRP as a resource at different cost points, IPL nets the achievable efficiency from the demand forecast leaving nearly 1000 MW of economic efficiency out of the optimization analysis. Netting potential energy efficiency from a demand forecast does not allow energy efficiency to compete with other supply side resources in an optimization process and produces a supply resource mix which is likely not the least cost possible outcome. We strongly encourage IPL to model energy efficiency as a resource, and to consider a higher penetration of cost-effective energy efficiency.

While NIPSCO did model efficiency programs competitively with supply side options in the IRP, the company unfortunately reduced the energy efficiency contribution to energy needs by half from 2014 to 2015. Given NIPSCO was operating cost effective programs in 2014, it is likely NIPSCO discontinued cost effective programs which could have reduced the need for market purchases in future years. The capacity shortfalls outlined in Table 11-1 from 2020 to 2023 could be met with cost effective energy efficiency. We strongly encourage NIPSCO to consider a higher penetration of cost-effective energy efficiency in its modeling.

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[4] Binz, Ron, Dan Mullen, Richard Sedano and Denise Furey. 2014. *Practicing Risk-Aware Electricity Regulation: 2014 Update*. Ceres Report. November. Boston, MA: Ceres.

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Like IPL, Vectren and NIPSCO relied on recent market potential studies to determine the appropriate level of efficiency in future years. In all three studies, a distinction was made between achievable potential and economic potential. Economic potential is defined as the cost effective efficiency based on commercially available measures and the company avoided cost. Achievable potential is considered to be the potential available given utility budgetary limits and other regulatory constraints. All three companies based future assumptions of energy efficiency on the achievable potential leaving substantial cost effective energy and summer peak demand savings on the table. For example, NIPSCO's market potential study stated the achievable potential summer peak savings for 2020 were 125 MW while the economic potential is 635 MW (NIPSCO IRP Appendix G page 6). The difference of 510 MW is substantial and equates to the size of a medium sized generation plant. All three IRPs should model all economic potential to determine how the resource compares with other supply side resources. Failure to capture the economic savings potential can cost utility ratepayers more dollars over the life of the measures.

Combined Heat and Power[5]

As Indiana utilities plan for the next twenty years, they should give greater consideration to the inclusion of customer-sited distributed generation in their integrated resource plans (IRPs). In their respective IRP filings, NIPSCO, Vectren, and IPL did not give full consideration to the use of customer sited distributed generation. While there was awareness of investments by customers of photo voltaic (PV) systems and the potential for those systems to reduce peak load, the utilities' respective plans did not explore the potential for other types of customer-site distributed generation, specifically combined heat and power (CHP), to meet future base load and peak load needs. This is surprising given that Indiana is already home to three dozen facilities with over 2200 MW of installed capacity and that the benefits of these systems to the grid are well established.

Not only do the plans not recognize the value of CHP already realized in Indiana, they do not consider or even discuss the future contributions CHP systems can make. With 21st Century technologies and market structures, it is now possible for distributed generation facilities to provide almost all of the services that historically could only be provided by utility owned assets. The shared costs and benefits of these distributed resources translate to lower system costs and lower operating costs, and by extension, lower bills for utility customers.

Potential in Indiana

Several of the submissions argued that the economics for CHP are not favorable in Indiana. These findings are contrary to a 2012 ACEEE analysis[6] that found that Indiana could replace up to 21 percent of the 1957-2966 MW of projected coal retirement capacity with CHP if utilities and large customers are provided the proper incentives. In its analysis, ACEEE determined that there exists approximately 56 MW of CHP that is currently economically viable and up to 611 MW with a market structured to encourage such investments.

The lower number is possible with proper signals from utilities ***such as inclusion in resource planning***, favorable interconnection standards and standby rates, and natural gas price stability. The larger

[5] In further support of its discussion here, HEC attaches its policy paper, "*Combined Heat and Power: Creating Energy Solutions for Indiana* (2014).

[6] Anna Chittum and Terry Sullivan. 2013 *Coal Retirements and CHP Investment Opportunity*, ACEEE Research Report IE 123, http://www.aceee.org/sites/default/files/publications/researchreports/ie123.pdf

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number requires policies that put CHP on par with other generation assets a utility or power generation company might pursue[7].

Opportunities in Indiana for Investments in Energy Efficiency and CHP

Large industrial and commercial facilities represent some of the greatest opportunities to mitigate future investments in new generation and transmission. Because many of the facilities are energy-intensive, economies of scale can be realized. As energy costs are often part of a manufacturing facility's variable cost of production, there are existing motivations to leverage. 31% of the nation's energy use is in manufacturing[8] much of it concentrated in energy-intensive industries such as the primary metals, chemical, forest products, and automotive sectors that have significant representation in Indiana. While the cost of energy efficiency overall ranges from about 2 to 6 cents per kWh[9], the cost of investments in energy efficiency in the industrial sector tended to be at the lower end of that range[10]. This cost effectiveness presents an opportunity to avoid more costly investments in utility infrastructure in the future.

As the Indiana economy recovers and old commercial and industrial facilities are updated and new ones built, now is the time to encourage investments in energy efficiency. Investments today lock in savings for many years to come. Many facilities in Indiana also have an opportunity to improve their energy efficiency and reliability through investments in high-efficiency distributed generation. Customer-sited distributed generation, especially CHP, can provide to Indiana reduced energy consumption and associated emissions, reduced peak demand and grid congestion, deferred or avoided investments in generation and distribution infrastructure, improved system reliability[11] and enhanced energy security[12]. CHP facilities can also help Indiana utilities with Indiana's NO_x SIP and compliance strategy for the Clean Power Plan.

Utility ownership of CHP

There is an assumption in the IRP filings that the CHP systems will be owned by customers. This is certainly not a requirement. There are multiple models for the ownership and operation of CHP systems and one that has great promise for a state with integrated and combination electricity and gas utilities is ownership, operation and dispatch by a utility. For example, Southern Company owns and dispatches

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[7] Ibid.

[8] U.S. DOE Energy Information Agency (EIA). 2014. *Annual Energy Outlook 2014*. Washington, D.C.: U.S. Energy Information Administration. http://www.eia.gov/forecasts/aeo/.

[9] Molina, Maggie, 2014. *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs*. ACEEE Research Report No. U1402. Washington, D.C.: American Council for an Energy-Efficient Economy.

[10] Anna Chittum and Seth Nowak. 2012. *Money Well Spent: 2010 Industrial Energy Efficiency Program Spending.* ACEEE Report No. IE121.

[11] Anna Chittum, 2012, "How CHP Stepped Up When the Power Went Out During Hurricane Sandy," ACEEE Blog, http://aceee.org/blog/2012/12/how-chp-stepped-when-power-went-out-d

[12] DOE SEE Action. 2013. *Guide to Successful Implementation of State Combined Heat and Power Policies*. http://www1.eere.energy.gov/seeaction/chp_policies_guide.html

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about 700MW of CHP capacity across its various service territories in the Southeast[13],[14] . In the Alabama Power service territory, the costs of its systems have been integrated into the utility's rate base, thus allowing the utility to earn a return on investment equivalent to that which it receives from other types of capital investments[15]. These systems are treated as normal part of the generation fleet and are dispatched in the same manner as other generation assets to meet system load.

In Austin, Texas, a CHP system serving the Dell Children's Medical Center is owned by Austin Energy, the local municipal utility. The CHP system is sized to meet all the electric and thermal needs of the hospital. The utility signed a 30-year contract with the hospital, thus offering the hospital increased reliability while offering the utility the assurance that it won't be stuck with stranded assets in the future. The 4.3 MW system generates more electricity than the hospital requires, allowing the utility to sell the remaining power to customers within its distribution system. Due to the presence of a district cooling system, the utility can take advantage of any excess thermal energy by storing it as chilled water[16],[17],[18]. As peak hedging practice, Austin Energy stores energy as chilled water so that it can cool the hospital during the day. This frees up generation capacity that would normally be needed to run the hospital's air conditioning to meet local peak electrical demands. Austin Energy has avoided having to purchase hundreds of thousands of dollars of electricity on the wholesale market as a result of this practice.

Grid Reliability and Ancillary Services

In Massachusetts and New Jersey, customer sited CHP systems are not only operating as Independent Power Producers (IPPs) providing power and peak reduction, they are also participating in the provision of ancillary services such as frequency control and spinning reserve. New, more flexible technologies allow system owners to tailor the design and use of their CHP systems to respond to real time market conditions. For example, Princeton University's 15MW CHP system is specifically designed to respond to real-time price signals from the PJM wholesale energy market. Massachusetts Institute of Technology (MIT) has a very similar system that operates in the same manner bidding power and ancillary services into the New England ISO. When the price of power rises, the Universities ramps up their CHP systems and consequently buys less of the more expensive grid power. In the summer, when the nighttime price of power is low, the universities generate power to chill water which they then store to be used during the day to keep students and faculty cool. The CHP systems offers the universities flexibility and allows

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[13] Cofield, C.A. Skip, "Federal Utility Partnership Working Group, Combined Heat and Power." Southern Company. October 16. http://www1.eere.energy.gov/femp/pdfs/fupwg_fall12_cofield.pdf.

[14] [SEEAction] State & Local Energy Efficiency Action Network. 2013. *Guide to the Successful Implementation of State Combined Heat and Power Policies*. March. http://www1.eere.energy.gov/seeaction/pdfs/see_action_chp_policies_guide.pdf.

[15] Ibid

[16] Corum, Lyn. 2007. "Backing Up the Grid." *Distributed Energy*. September-October 2007. http://forester.xodev01.com/DE/Articles/Backing_Up_the_Grid_1727.aspx.

[17] Takahashi, Kenji. 2010. "Review of Utility Owned DG Business Models." Synapse Energy Economics. April 13. http://www.synapse-energy.com/Downloads/SynapsePresentation.2010-04.0.DG-NY-Models.S0060.pdf.

[18] TAS. 2013. "Dell Children's Medical Center Combined Heat & Power Solution." case study. Accessed April. http://files.harc.edu/Sites/GulfCoastCHP/CaseStudies/DellChildrenHospital.pdf.

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them to take maximum advantage of the benefits of efficiently generating its own power. Princeton saves $2.5 million to $3.5 million in energy costs annually by using its CHP system to power its campus[19].

The New England ISO and PJM markets enable customers to reduce their energy costs while also increasing the reliability of the electric system. And while such markets make such advantages easier to implement, they are not required. Utilities in fully integrated markets can establish bilateral contracts with their customers to the same effect.

For example, in Fernandia Beach on Amelia Island, Florida, Chesapeake Utilities Corporation and its subsidiary Eight Flags Energy, LLC are building a 20MW CHP facility on the site of a Rayonier Performance Fibers, LLC paper pulp plant. The plant's power will be sold to Chesapeake's wholly-owned subsidiary, Florida Public Utilities Company (FPU) for distribution to its retail electric customers and the thermal output will be used by the pulp mill. Because the mill is near the end of a transmission line, its location will stabilize the grid on the island and provide all of the residents and businesses on the island a more reliable electric system. Ownership by a utility simplifies the risks and benefits that would normally suffer from split agency challenges[20].

CHP to supply Peak Capacity

As described in the Austin Energy example, CHP can also alleviate the need to use peaker plants or purchase power in wholesale markets by reducing peak demand. Peaker plants tend to be some of the most expensive resources connected to the grid, performing at low load factors and running only when the prices for power justify their operation. For instance, in 2011, Texas' ERCOT market was settling contracts for about $2,000/MWh during the early morning of its peak summer demand day in August. By 4:00pm, at the peak demand period, it was settling agreements at $3,000/MWh, almost entirely with natural gas peaker plants[21]. Avoiding the use of peaker plants can provide an economic benefit to all ratepayers. As described in previous paragraphs, with proper signals and technology, CHP systems can contribute to system peak and reduce costs for the owners of the cogeneration systems and for all utility customers.

Reduce line losses

On a national level, lost power over transmission and distribution lines cost power users about $24 billion in 2010[22]. Line losses are often discussed as averages, but as the grid nears its peak capacity, its

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[19] Nyquist, Tom, Randy Preston, and Mike Webster. 2013. "New Market Opportunities for CHP." presentation to the IDEA 26th Annual Campus Energy Conference & Distribution Workshop. February 18-22. http://www.districtenergy.org/assets/pdfs/2013CampConference/Wednesday/Track-C/1C.1NYQUISTWEBSTERPRESTONIDEA-Presentation-2013-Princeton-MIT-Icetec-session-1C.pdf.

[20] Chesapeake Utilities Corporation. 2014. "Chesapeake Utilities Corporation to Build Combined Heat and Power Plant in Florida". Press Release. September 19.

[21] Doggett, Trip. 2012. "ERCOT's Challenges & Opportunities." Presentation to Texas Public Power Association. August 1.

[22] Casten, Thomas. 2012. "Not all megawatts are created equal." *Cogeneration and On-site Power Production*. January 7. http://www.cospp.com/articles/print/volume-13/issue-4/features/not-all-megawatts-are-created-equal.html.

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line losses rise exponentially and the marginal line losses can equal 3 times the average losses[23]. For example, in 2006 the Ontario Power Authority analyzed the marginal cost of providing power from a gas turbine during the system's summer peak. They found the cost of fuel was about $57 per MWh, while line losses added a cost of $115/MWh. Thus line losses represented over 65% of the total cost during that time[24].

On average, about 7% of the electricity generated at centralized plants is lost in the transmission and distribution to its final destination[25]. When CHP-using facilities rely on their CHP system for power and rely less on the grid, it reduces the amount of power needing to be generated, but it also reduces the amount of electricity sent over and then lost in transmission and distribution wires. This frees up capacity for other customers. To Wit, a 2012 analysis found that, due in large part to avoided line losses, "80 GW of strategically-placed [distributed generation]" could reduce the actual "peak US generation and transmission requirements by 100-120 GW"[26]. Such investments would provide economic benefit to all system users and customers.

CHP as a compliance mechanism for NO_x SiP and Clean Power Plan compliance strategy

As CHP is a cleaner technology than conventional generation, it is also a potential mechanism to meet the requirements of the State Implementation Plan (SIP) for reducing NO_x levels. Indiana's SIP includes energy efficiency set-asides that provide credits to projects that reduce electricity consumption. Since CHP is at least 40 percent more efficient than central generation, it could be an eligible technology for the energy efficiency set-asides. Credits for CHP system could be developed using an output-based measurement system and provided to CHP installations on a net NO_x reduction basis.

CHP has the potential to be a compliance mechanism for Indiana to meet the requirements of the Clean Power Plan. In setting the targets for each state, EPA identified four mechanisms by which states could reduce their carbon emissions. Each of these can be met in part with CHP.

Heat-rate improvements – CHP is a more efficient method of combusting fuel and making electricity and therefore the effective heat-rate of CHP systems is lower than conventional generation. An existing power plant can improve its heat-rate, regardless of fuel, through conversion to cogeneration.

Shifting dispatch – A greater percentage of kWh delivered can be sourced from CHP facilities.

Renewables – Some CHP facilities use fuels (wood waste, landfill methane) that qualify as renewable energy. Utilities can source more of their power from such facilities.

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[23] Lazar, Jim. 2011. "Line Losses and Reserves: Often Undervalued Benefits of Energy Efficiency Investments." presentation to ACEEE Energy Efficiency as a Resource Conference. Denver, CO. September 27.

[24] [OPA] Ontario Power Authority. 2007. EB-2006-0233 Supplemental Settlement Proposal, Exhibit S-1-2, Issue 1, Item 1.6. March 16. http://www.fit.powerauthority.on.ca/Storage/43/3908_OPA_Settlement_Issue_1,_Item_1.6_2007-03-16.pdf.

[25] [EIA] 2012. Energy Information Administration. "How much electricity is lost in transmission and distribution in the United States?" July 9. http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3.

[26] Casten, Thomas. 2012. "Not all megawatts are created equal." *Cogeneration and On-site Power Production*.

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Demand-side energy efficiency – Utilities can create or alter existing programs to treat CHP systems as investments in energy efficiency. The energy savings these systems provide customers can be can be included in the net electricity savings for the programs.

Conclusion

The discussion above outlines the many benefits of combined heat and power and energy efficiency as reliable, economically beneficial resources to meet future energy demand in Indiana. In conclusion, any resource that has the potential to provide base load, peak, and ancillary services should be included in an IRP and given equal consideration with utility scale fossil fuel generation. Energy efficiency and distributed generation have that potential. As studies have shown, energy efficiency is the least cost resource for an electric utility and has been proved to reduce peak load and drive down system costs.

The benefits of customer-sited distributed generation, especially CHP, to utilities and the electrical system include: reduced system energy consumption and overall emissions, reduced demand and grid congestion, deferred or avoided investments in generation and distribution infrastructure, improved system reliability[27] and diversity, and enhanced energy security[28]. CHP can also help Indiana utilities with Indiana's NOx SIP and compliance strategy for the Clean Power Plan.

As electric utilities in Indiana consider the future resource mix in the IRP process, greater consideration should be given to cost effective energy efficiency, combined heat and power, distributed generation, and other renewable technologies. Current and future environmental regulations will continue to increase the cost of the utility scale fossil generation. The increasing reliance on utility scale natural gas generation due to a recent drop in prices is also a risky strategy for Indiana utilities and Hoosiers. Instead, companies should take full advantage of 21st Century technologies and markets in order to create the most robust and reliable electric system possible. These same resources will also result in lower utility bills for Indiana's customers and a stronger economy for the state. These resources should be included and fully explored in each utility's integrated resource plan.

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[27] Anna Chittum, 2012, "How CHP Stepped Up When the Power Went Out During Hurricane Sandy," ACEEE Blog, http://aceee.org/blog/2012/12/how-chp-stepped-when-power-went-out-d

[28] DOE SEE Action. 2013. *Guide to Successful Implementation of State Combined Heat and Power Policies*. http://www1.eere.energy.gov/seeaction/chp_policies_guide.html

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COMBINED HEAT AND POWER

CREATING ENERGY SOLUTIONS FOR INDIANA

Hoosier Environmental Council

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INTRODUCTION

Hoosiers are entering a time of critical decisions with respect to our energy future. Historically, affordable energy has been the centerpiece of Indiana's economic development assets, but a number of factors are converging to erode that competitive advantage if we continue with a business-as-usual attitude toward energy policy.

- **Shifting fuel costs.** Stricter regulation and other economic factors are driving the cost of coal upward. From 2008-2013, coal prices in Indiana climbed nearly 38%.[1] Compounding coal's price problem is the stabilization of natural gas prices with the boom in shale gas mining. From 2008-2013, natural gas prices have dropped by over 50% and stabilized at this level.[2] Growth in shale gas, though entailing an array of its own environmental risks that need to be addressed, is considered to be on a strong growth path for the foreseeable future.

- **Disproportionately rising electricity prices.** Largely because of the state's greater historical reliance on fossil fuels, as noted above, the rate of increase in electricity prices hits especially hard. Since 2001, electricity prices have risen by 60% in Indiana compared to 35% on average in the United States.[3] This presents a particular challenge to Indiana as energy-intensive industries make up a large part of Indiana's economy and job base. It also slowly eats away at the disposable incomes of every Hoosier.

- **Aging infrastructure.** Nearly 70% of coal-fired generation units in Indiana are over 40 years old. In 2013, the Indiana Utility Regulatory Commission estimated that by 2015, given current regulatory trends and the age of many plants, "Indiana will need to retrofit or retire an unprecedented wave of coal-fired generation units."[4] The changing economics of coal compound this problem as some retrofits to older units become economically untenable.

- **Climate change and pollution.** In 2010, according to the EPA Toxic Release Inventory, Indiana ranked 4th in the nation for the most toxic pollution emitted. Of that, 65% came from the electric sector. With respect to carbon dioxide, Indiana ranks 7th in carbon intensity of the economy.[5] Emissions levels are due in large part to heavy coal use, inefficiency in fuel conversion, and the strong presence of energy-intensive industry in Indiana. Charting an aggressive long-term strategy for reducing emissions from the electricity sector is the only way to meaningfully address climate change and pollution in Indiana and comply with new federal regulation.

- **Increased security and resilience concerns.** Much attention has been drawn recently to the strength of the electricity grid to withstand both natural and manmade disasters. Concerns about the grid's vulnerability to cyberterrorism are also on the rise. Some critics attribute some of the vulnerabilities to our highly centralized electricity generation infrastructure. A recent grid security report prepared by the Federal Energy Regulatory Commission (FERC) indicated that nationwide grid integrity could theoretically be

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1 Energy Information Administration. "Coal Data Browser." Based on percent change in price of coal delivered to electric power sector. Accessed 8/4/14.
2 Energy Information Administration Annual Energy Outlook 2014. Accessed 8/4/14.
3 Energy Information Administration. "Electricity Data Browser: Retail Electricity Price." Accessed 7/1/14.
4 2013 IURC Annual Report to the Regulatory Flexibility Committee. Accessed 7/2/14. IURC estimates units projected to retire represent 2,070 MW of generation capacity, or nearly 15% of summer-rated coal generation.
5 Metric tons of energy-related carbon dioxide emissions per million dollars of GDP. Source: Energy Information Administration. "Table 8. Carbon Intensity of the economy by state (2000-2010)."

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compromised by simultaneous attacks on as little as nine critical substations and one transformer manufacturing facility.[6]

- **Persistent waste.** Inefficiency is not a new problem, but it represents the single biggest opportunity to address many of the above energy challenges. Much attention is deservedly paid to helping consumers consume less electricity through demand-side management,[7] but supply-side efficiency at the point where electricity is generated is often overlooked and under-supported by policymakers.

- **State regulatory policy.** Accelerated and guaranteed cost recovery mechanisms, through more than a dozen trackers, provide generating utilities with a strong incentive to construct new generation and associated transmission, largely free of market risks. At the same time, artificial cost constraints keep renewable and conservation resources from the market, or at least do not provide the same incentives. These factors, coupled with an Integrated Resource Planning process that does not include all resources equally,[8] create a persistent discrimination against distributed, renewable and/or efficiency resources.

Combined heat and power (CHP) is an important, well-established, and highly efficient generation technology to address each of these challenges. Indiana is perfectly suited to deepen its CHP investment given its high concentration of energy intense industry.

Since the 1960s, efficiency in utility generation has been generally stagnant at around 33% for coal plants.[9] For every one unit of energy delivered as electricity to the consumer, two more units are wasted through exhausted heat and energy lost in transmission and distribution.[10] CHP is a family of technologies that leverages combined generation of electricity and thermal energy to increase efficiencies to up to 85%. Through the aggressive adoption of policies and regulations to support CHP development in Indiana, we can lower energy costs, lower emissions, and create jobs – well beyond a business-as-usual scenario.

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[6] Savenjie, Davide. "Could terrorists really black out the power grid?" Utility Dive, 3/24/14. http://www.utilitydive.com/news/could-terrorists-really-black-out-the-power-grid/241192/.

[7] According to the American Council for an Energy-Efficient Economy, demand-side efficiency is 2 to 3 times cheaper than building new generating capacity. Source: "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs." March 2014.

[8] "REPORT OF THE INDIANA UTILITY REGULATORY COMMISSION ELECTRICITY DIVISION DIRECTOR DR. BRADLEY K. BORUM REGARDING 2013 INTEGRATED RESOURCE PLANS," 4/30/14, at 4-6, e.g. "I&M did not allow EE to compete with supply-side resources in an optimization process over the full planning horizon."

[9] "Energy Research at DOE: Was It Worth It?" By Commission on Engineering and Technical Systems, Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, Board on Energy and Environmental Systems, National Research Council, Division on Engineering and Physical Sciences, (National Academies Press 2001) at p. 123.

[10] "Power Plant Efficiency," released by the National Petroleum Council, 7/18/07. "The US fuel diversity, relative abundance of various fuels, competitive landscape, the age of industry, and focus on reliability has lead [sic] to less efficiency in our coal fleet relative to other countries..." Id. at 1.

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COMBINED HEAT & POWER: AN OVERVIEW

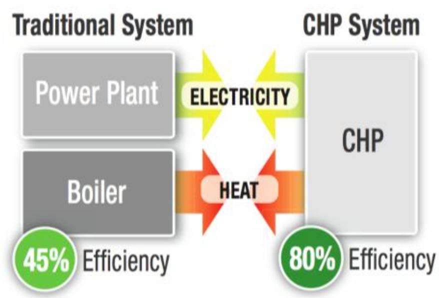
Typically, consumers who need electricity and thermal energy (in the form of steam or process heat) will acquire electricity from a local utility and fire a conventional boiler with its own fuel supply to create thermal energy. This process is used in a variety of industrial, commercial, and institutional settings.

Combined heat and power (CHP) – also known as *cogeneration* – is a suite of energy technologies that utilize one fuel source to efficiently and cleanly generate electricity and thermal energy at the same time. Most CHP installations are onsite at facilities that require a relatively constant and predictable flow of both electricity and thermal energy. Energy generated is most commonly consumed entirely onsite, though in the right regulatory environment CHP can provide clean energy to the electricity grid.

Generating electricity and thermal energy separately incorporates a number of inefficiencies that cost money and unnecessarily add more greenhouse gases to our atmosphere:

- Two sources of fuel must be utilized, one at the utility level and one to fire the boiler at the consumer's own facility. Both will generate heat that is exhausted and never put to productive use. While boilers can reach 80% efficiency, even the most efficient power plant can only convert 45% of the energy contained in the fuel to electricity.
- An average of almost 6% of electricity generated in Indiana is lost to the electricity grid during transmission and distribution (T&D). In 2012, 5.79 million megawatt hours (MWh) were lost.[11] This is equivalent to the amount of power needed for over 480,000 homes in Indiana.[12]

Figure 1: CHP Process Flow Diagram



Source: Oak Ridge National Laboratory

These inefficiencies add up to a lot of waste. When electricity and thermal energy are generated separately, the system achieves 45% efficiency at best. In other words, over half of the energy contained in the fuels employed in the separate processes is wasted. However, when utilizing a CHP system, waste heat is utilized to achieve as high as 80% or higher efficiency .

BENEFITS OF COMBINED HEAT & POWER

The efficiency of CHP translates to benefits for all stakeholders in the electricity market:

END USERS OF CHP

- Reduced purchases of electricity from a local utility, which can lower net energy costs
- Cost-effective alternative to back-up generators, which are rarely used but must be always ready to come online and therefore cost money to maintain.[13]

[11] U.S. Energy Information Administration. "Indiana Electricity Profile 2012 – Table 10: Supply and Disposition of Electricity, 1990- 2012". Accessed 6/24/14.
[12] U.S. Energy Information Administration. "Average monthly residential electricity consumption, prices, and bills by state." Accessed 6/24/14.

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- Additional revenue stream: if the amount of electricity generated exceeds what the facility requires to operate, additional electricity can be sold back to the grid through power purchasing agreements (PPA) feed-in tariffs, or by tapping into net metering.[14]
- Increased resiliency and reliability: during Hurricane Sandy, many of the functioning buildings with power were insulated from outages because they used CHP.

UTILITIES AND TRANSMISSION INFRASTRUCTURE

- Reduce peak load and reduce need for new generating capacity.
- As demand grows and transmission lines age, infrastructure upgrades are inevitable in order to maintain infrastructure and relieve congestion. CHP can help defray some of the cost by reducing and distributing demand on that grid. For example, Connecticut has successfully used CHP to relieve congestion in key parts of the grid where new large-scale generation was not feasible.[15]
- CHP installations can be self-sufficient, providing power to critical facilities in the event of system-wide outages. Important examples include hospital systems and university campuses.

ALL RESIDENTS AND BUSINESSES OF INDIANA

- Lower cost energy solutions mean lower energy prices for everyone, including residential customers.
- Because most CHP solutions utilize natural gas and do it more efficiently than any other generation technology, expanding CHP will help reduce coal-related pollution of Indiana's air and waterways. This means long-term health benefits for everyone, especially Indiana's children.
- Commitment to the growth of CHP in Indiana will create jobs to support the manufacture, installation, and maintenance of CHP systems. Indiana is already home to firms that manufacture CHP equipment, including Cummins, Rolls Royce, and Caterpillar. Driving demand here will be a tool for attracting more of their business and jobs to our state.

ENVIRONMENTAL BENEFITS

In addition to economic and resilience benefits, higher efficiency through CHP results in avoided emissions of CO_2 and other toxic air pollutants (TAPs) such as mercury, sulfur dioxide, and NO_x.

Because of Indiana's dependence on coal, which makes up over 85% of Indiana's electricity supply[16], Indiana has some of the highest emissions levels in the United States. In 2010, according to the EPA Toxic Release Inventory, Indiana had the 4th highest emissions levels in the nation. Of that, 65% came from the electric sector. With respect to carbon dioxide, Indiana has the 4th most carbon-intensive energy supply in the country.[17]

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[14] It is important to note that this capability is just as much a function of the capacity of the system and the user's needs as it is a function of a regulatory environment that is supportive of CHP.
[15] Hampson, Anne and Jessica Rackley. "From Threat to Asset – How CHP Can Benefit Utilities." p. 7, 2014.
[16] Energy Information Administration. "State Energy Profile – Indiana Net Electricity Generation by Source, April 2014." Accessed 7/20/14.
[17] Energy Information Administration. "Table 7: Carbon intensity of the energy supply by state 2000-2010." Accessed 07/10/14.

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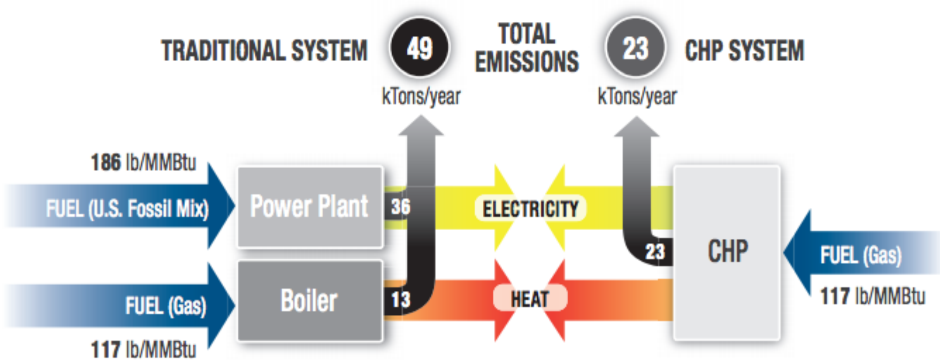
CHP has the potential to not only accelerate a shift away from coal, but also drastically reduce users' fuel consumption. Figure 2 illustrates a substantial savings in fuel and emissions when replacing a typical separate heat and power generation scenario with natural gas-fired CHP. The emissions reductions rise substantially when replacing fossil fuels with renewable fuels such as landfill gas or biogas created in an anaerobic digester.

Firgure 2: Increased Efficiency Results in Reduced Carbon Emissions



Example of the CO_2 savings potential of CHP based on a 5 MW gas turbine CHP system with 75% overall efficiency operating at 8,500 hours per year providing steam and power on-site compared to separate heat and power comprised of an 80% efficient on-site natural gas boiler and average fossil based electricity generation with 7% T&D losses.

Source: ICF International

TARGET MARKETS FOR COMBINED HEAT & POWER

CHP can be implemented in a wide variety of settings, including[18]:

INDUSTRIAL
- Chemical manufacturing
- Ethanol
- Food processing
- Natural gas pipelines
- Petrochemicals
- Pharmaceuticals
- Pulp and paper
- Refining
- Rubber and plastics

COMMERCIAL
- Data centers
- Hotels and casinos
- Multi-family housing
- Laundries
- Apartments
- Office buildings
- Refrigerated warehouses
- Restaurants
- Supermarkets
- Green buildings

INSTITUTIONAL
- Hospitals
- Landfills
- Universities & colleges
- Wastewater treatment plants
- Correctional facilities
- Wood waste (biomass)

Industrial facilities are the primary users of CHP currently and also have the largest potential for growth. This is particularly true in Indiana, where industry occupies a larger share of energy consumption and the economy relative to other states.

Outside of industry, heat generated in a CHP system can be applied to:

- Space heating/cooling
- Hot water or chilled water
- Steam for sterilization (in hospitals or kitchens)
- Food processing, where reliable power and hot water are essential to food safety.[19]

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[18] Department of Energy Midwest CHP Technical Assistance Partnerships. http://www.midwestchptap.org/markets/.
[19] See http://chpassociation.org/uses-of-chp/

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Generally speaking, the CHP market exists in three categories[20]:

- **Small-scale thermally matched CHP (less than 20 MW):** CHP that meets onsite needs for steam and electricity. At this scale, adopters are less energy-intense industry, commercial facilities (e.g. office parks) and institutions such as universities.
- **Heavy Industrial:** Energy-intense industry is historically the biggest market for CHP and includes sectors such as chemical manufacturing, metals manufacturing, and fossil fuel refining. Onsite use is the primary focus.
- **Export scale:** Changes in electricity prices, electricity market deregulation, and environmental regulation are driving increased interest in CHP facilities that generate excess electricity to be sold on the grid.

COMBINED HEAT & POWER TECHNOLOGY

CHP is not new or untested technology; in fact, the first commercial power plant built by Thomas Edison in 1892 generated electricity and heated surrounding buildings using waste heat from the plant's exhaust.[21]

One of the primary benefits of CHP is that it is flexible and scalable to meet the specific needs of the user and that it integrates with existing facilities. While most systems use natural gas, CHP can also take a variety of different fuels including biomass, biogas, landfill gas,[22] other waste products, propane, steam, and coal[23].

TOPPING CYCLE CHP

In a *topping cycle* CHP configuration, fuel is combusted in a prime mover (the device that powers the generator, for example, a gas turbine or reciprocating engine) to generate electricity. Excess heat is then routed through a heat recovery unit to generate steam or hot water rather than releasing it through exhaust or some cooling process.

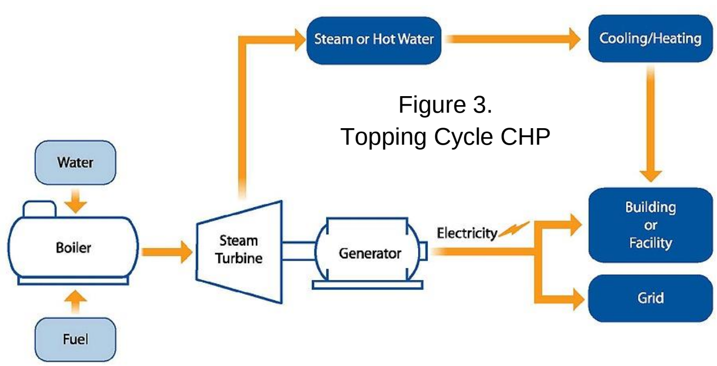

Figure 3.
Topping Cycle CHP

Source: EPA Combined Heat and Power Partnership

There are alternative topping cycle configurations, such as using fuel to fire a boiler and employ a steam turbine to generate electricity. The end result of recycling the excess heat is the same, to wit: capturing and using energy that otherwise would be lost.

[20] ICF International. "CHP Industry – Status Update." CHPA Annual Meeting, 12/10/13.
[21] Department of Energy. "Top 10 Things You Didn't Know About Combined Heat and Power." Accessed 6/24/14.
[22] The three terms have sometimes overlapping meaning. Biomass refers to raw materials produced directly for energy use, such as sawgrass or wood residue. Biogas refers to gas produced from plant or animal waste through a digestion or fermentation process. Landfill gas is a type of biogas produced from landfills.
[23] These examples do not constitute a wholesale endorsement of these fuels.

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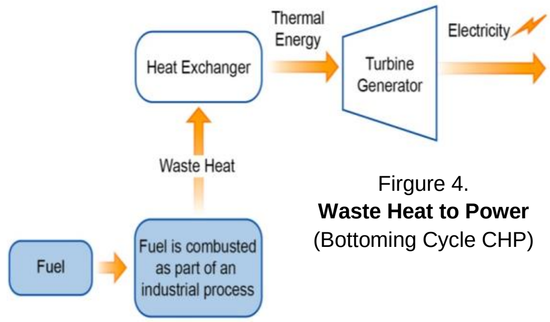
WASTE HEAT TO POWER

Unlike topping cycle CHP, in which electricity generation comes first, *waste heat to power* (WHP), also known as *bottoming cycle CHP*, starts with heat generated as part of an industrial process. Waste heat that would normally be lost to exhaust or a cooling process is channeled into a generator to produce electricity.

Industrial electricity consumers are ideally suited for WHP, where approximately 30% of all energy consumed is lost to waste heat. While waste heat is generated in other sectors of the economy, generally industrial facilities produce heat at the temperature and volume needed to implement WHP successfully.[24] Fortunately, this is also where demand for electricity is greatest and most consistent. In 2012, industrial users consumed 47% of all electricity generated in the state of Indiana.[25]



Source: EPA Combined Heat and Power Partnership

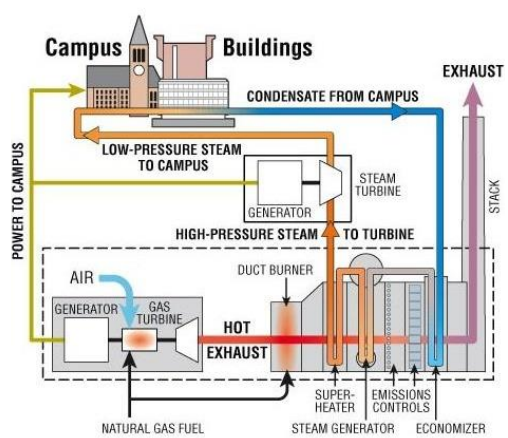
Firgure 4.
Waste Heat to Power
(Bottoming Cycle CHP)

While the opportunity is large, challenges remain:

- Technologies that can take advantage of lower temperature steam are still largely in development.
- Because WHP usually involves integration with existing equipment, design and implementation is unique to each project and can therefore be complex.
- Complexities in design and implementation are a roadblock to financing.[26]
- Large industries often have the capacity to export to the grid with WHP, but regulatory barriers make it unprofitable to do so.

DISTRICT ENERGY SYSTEMS

Figure 5. District Energy in a University Setting



Source: Cornell University

District energy is an aggregate approach to providing heating and cooling services to a large number of buildings. By aggregating the needs of many structures, district energy benefits from economies of scale to improve energy efficiency, which reduces fuel inputs and lowers both costs and emissions. Centralized heating and cooling services also create more architectural flexibility because infrastructure is centralized rather than needing to be accommodated in each individual building.

In addition to the efficiency gains of centralized services, the scale of district energy provides a perfect environment for integrating CHP for

[24] Environmental Protection Agency. "Waste Heat to Power Systems." pp. 1-2.
[25] Energy Information Administration. "Indiana State Profile Overview."
[26] Environmental Protection Agency. "Waste Heat to Power Systems." pp. 7.

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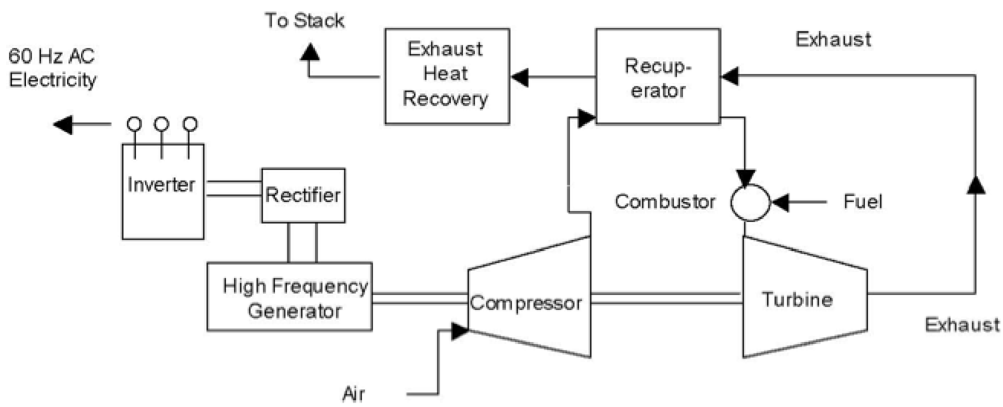
generating electricity with waste heat, realizing further savings for users.

District energy is well suited to a variety of applications such as downtown business districts, university campuses, and hospitals. According to the International District Energy Association, there are 23 district energy systems operating in Indiana today. However, only 5 incorporate CHP technology.[27] Targeting adoption of CHP in existing district energy systems and incentivizing the development of new district energy is one opportunity for CHP growth outside of the industrial sector.

MICROTURBINES

Microturbines are a relatively new type of natural gas turbine that operate at capacity levels of 30 to 250 kW, whereas conventional turbine sizes range from 500 kW to 250 megawatts (MW). Microturbines are well suited for distributed CHP applications due to their ability to accept a variety of fuels and connection methods, their ability to link in parallel to manage larger loads, their reliability, and their relatively low emissions.[28]

Figure 6. Microturbine-base CHP (Single-Shaft Design)



Source: EPA Combined Heat and Power Partnership

Because of these advantages and compatibility with small capacity needs, microturbines have made up40% of new CHP installations in Indiana since becoming commercially available in 2000. The disadvantages of microturbines come with higher cost and lower efficiency relative to reciprocating engines (described below).

RECIPROCATING COMBUSTION ENGINES

Reciprocating engines are used in a variety of applications from automobiles to lawn care equipment and power generation, including CHP. Though they can accept a variety of fuels, reciprocating engines are – due to emissions concerns – ones that generally use natural gas-powered spark ignition. Engine sizes range from a few kilowatts up to 5 MW. This allows CHP to be deployed efficiently in smaller installations where other technologies may not be successful. It has been utilized, for instance, in landfill gas operations.[29]

Fast installation, reliability, black start capability, high efficiency, and cost are the primary advantages of reciprocating engines. Start-up costs are cheaper than microturbines and conventional gas turbines.

[27] International District Energy Association provided a detailed DE locations spreadsheet.
[28] Environmental Protection Agency. "Catalog of CHP Technologies." p. 45.
[29] http://energy.gov/sites/prod/files/2013/11/f5/chp_engine.pdf

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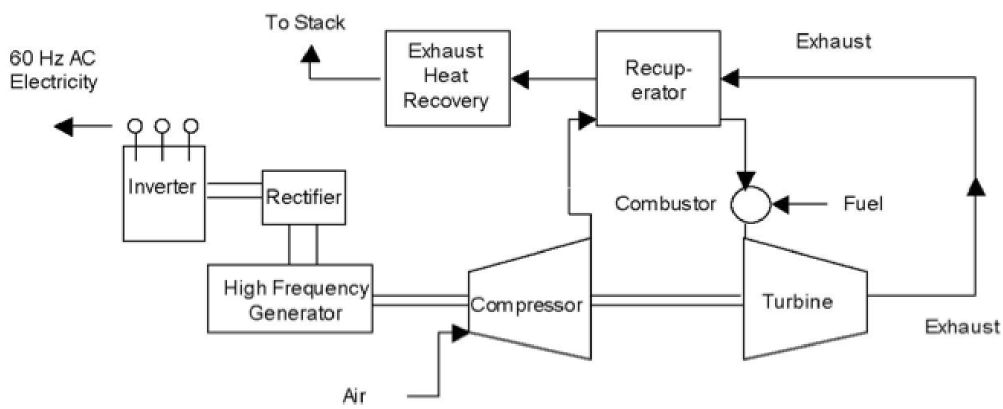
Additionally, at capacities below 1 MW, reciprocating engines can regularly achieve 75-80% efficiency, some of the highest levels possible for CHP.[30]

Figure 6. Microturbine-base CHP (Single-Shaft Design)



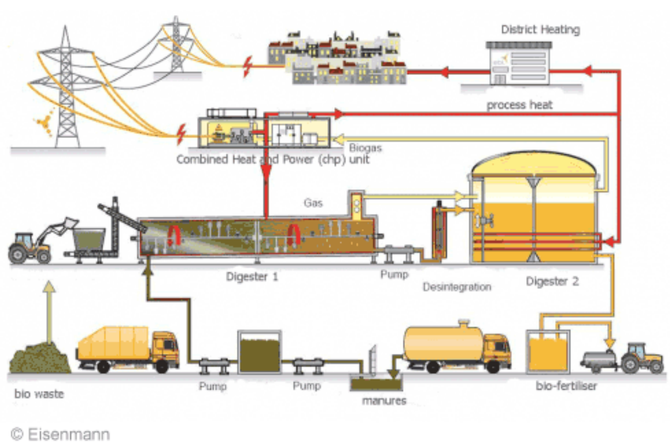
Source: EPA Combined Heat and Power Partnership

BIOMASS OPPORTUNITY FUELS

Because CHP is centered on generating both electricity and thermal energy at high temperatures, it is incompatible or impractical with most renewable energy sources. The primary class of renewable fuels are *biomass opportunity fuels*, which are processed waste materials resulting from some industrial or agricultural process. This includes:

- Biogas created from processed agriculture waste through anaerobic digestion
- Black liquor (pulping process byproduct).
- Municipal solid waste
- Food processing waste
- Landfill gas
- Wastewater sludge[31]

Figure 7. Anaerobic Digester, CHP, and District Heating



Indiana businesses have already recognized the potential for sustainable biomass CHP in Indiana. In the last decade, 70% of new CHP installations in Indiana were biomass, employing agricultural waste, landfill gas, wastewater sludge, and food processing waste. In total, biomass CHP totals 23 MW of capacity in Indiana, with another 14 MW in the final stages of development.[32]

[30] Environmental Protection Agency. "Catalog of CHP Technologies." pp. 69-71.
[31] Environmental Protection Agency. "Combined Heat and Power Partnership: Biomass CHP." Accessed 6/25/14.
[32] GM News. "GM Announces $24 million Landfill Gas Investment: Will be first automaker in North America to generate its own electricity." Accessed 6/25/14.

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THE ECONOMICS OF COMBINED HEAT & POWER

Combined heat and power is not only cleaner and efficient, but also cost-effective for new generation capacity and for the purposes of emissions reduction. Additionally, fostering CHP growth will open up new economic development opportunities and jobs for the state of Indiana.

COST-EFFECTIVE FOR NEW GENERATION

As imminent coal generation retirements come due in the next decade, Indiana utilities will need to build new generation in the most cost-effective manner available. While coal is still plentiful in Indiana, its use will continue to decrease. Costs of construction for traditional coal generation continue to rise due to high construction levels globally, tightness in equipment and engineering markets, high prices for raw materials, and pollution control requirements.[33] At the same time, new coal technologies such as carbon capture and sequestration remain limited to a few utility-scale projects and are therefore prohibitively expensive.

Table 1. Levelized Cost of Generation

Generation Type	Capital Costs ($/kW)	Levelized Cost of Electricity (cents/kWh)
Dual Unit Advanced PC	$3,246	9.6
Dual Unit IGCC	$2,934	11.6
Single Unit IGCC with CCS	$6,599	14.7
Advanced NGCC	$1,023	6.4
Advanced NG CT	$676	12.8
NG CHP (> 40 MW)	**$1,300**	**6.0**
Onshore Wind	$2,213	8.0
Solar PV	$3,873	13.0

Source: EIA; Bloomberg New Energy Finance

Combined heat and power, however, becomes especially cost-effective at larger capacity. As Table 1 illustrates, initial construction costs are slightly more expensive than advanced natural gas (the most probable competitor to CHP), but higher efficiencies resulting in lower fuel use bring the levelized cost of delivered electricity down to be cheaper than natural gas power-only generation. CHP also has the additional advantage of being able to accept a variety of fuels, a feature that functions as a cushion should natural gas prices return to the volatility seen prior to the shale gas boom.

CHP depends on a number of technical and economic factors to be competitive:

TECHNICAL FACTORS

- **Scale.** CHP is especially competitive at larger capacities of 10 MW or greater, generally speaking.
- **Capacity Factor.** For CHP to compete at small scale, capacity factors must be fairly high (above 60%).
- **Load parity.** Any CHP system derives its maximum efficiency from matching as closely as possible the demand for thermal energy and electricity. If a user needs much more of one or the other, it will produce excess steam or excess electricity. While this problem can be mitigated through supplying excess steam or electricity to another party (such as a neighboring facility or the grid), this entails another layer of complexity and therefore is an important consideration.

[33] Oak Ridge National Laboratory. "Combined Heat and Power: Effective Energy Solutions for a Sustainable Future." 2008.

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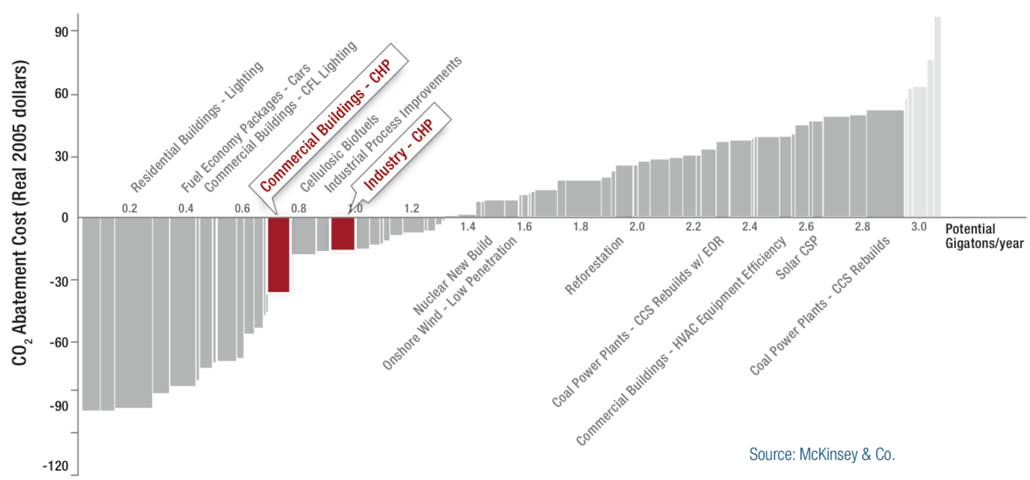
ECONOMIC FACTORS

- **High retail price of electricity.** While Indiana continues to have affordable electricity relative to many states, we find ourselves in a rising cost environment. Since 2001, Indiana has fallen from 6th to 15th in the energy price rankings, eroding some of our competitive edge. In that time, electricity prices have risen by over 60% compared to 35% overall in the United States. Rising prices, of course, impact every sector of our economy and residential consumers, not just industrial users.[34]
- **Longer payback periods.** While utilities have a long history of accepting a 15 or 20-year payback period, industrial users look for a much shorter payback period, which proves to be a barrier for CHP. Policies that help industrial users reduce their payback period or encourage the growth of CHP installations owned by utilities or private generators can lower this barrier.

COST-EFFECTIVE FOR EMISSIONS REDUCTION

Given current regulatory trends, cost-effective solutions for emissions reduction are becoming increasingly important. While demand-side efficiency is still by far the cheapest form of clean energy, CHP also exhibits a negative cost of abatement, which means that, in the long term, an investment in CHP is a profitable investment for the user, with the added bonus of being a source of emissions reduction.

Figure 8. Cost of CO_2 Reduction Technologies



Importantly, as Figure 8 illustrates, CHP is more cost-effective than many CO_2 abatement technologies that get much more attention in the mainstream, including on-shore wind, concentrated solar (Solar CSP), nuclear, and coal with carbon capture and sequestration (CCS).[35] While multiple resources have a place in a robust, diverse energy portfolio, Table 2 sheds light on the particular generation and emissions reduction capabilities of CHP and several other generation technologies.

The effectiveness of CHP for emissions reduction is partially due to the high capacity factor of a cost-effective CHP installation. Because a CHP system operates almost constantly (up to 85% of the time),

[34] Energy Information Administration. "Electricity Data Browser - Average retail price of electricity dataset." http://www.eia.gov/electricity/data/browser/. Accessed 6/23/14.
[35] Oak Ridge National Laboratory. "Combined Heat and Power: Effective Energy Solutions for a Sustainable Future." 2008. Original Data Source: McKinsey & Co. CO_2 Abatement Cost Curve.

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it can result in much higher emissions reductions than similarly-sized solar and wind installations, which only generate power 25-35% of the time, [36] as seen in Table 2.

Table 2: CHP Energy and CO_2 Savings Potential

Category	10 MW CHP	10 MW PV	10 MW Wind	Combined Cycle (10 MW Portion)
Annual Capacity Factor	85%	22%	34%	70%
Annual Electricity	74,446 MWh	19,272 MWh	29,784 MWh	61,320 MWh
Annual Useful Heat	103,417 MWh_t	None	None	None
Footprint Required	6,000 sq ft	1,740,000 sq ft	76,000 sq ft	N/A
Capital Costs	$20 million	$60.5 million	$24.4 million	$10 million
Annual Energy Savings	308,100 MMBTU	196,462 MMBTU	303,623 MMBTU	154,649 MMBTU
Annual CO_2 Savings	42,751 Tons	17,887 Tons	27,644 Tons	28,172 Tons
Annual NO_x Savings	59.4 Tons	16.2 Tons	24.9 Tons	39.3 Tons

The values in TABLE 2 are based on:

- 10 MW Gas Turbine CHP - 28% electric efficiency, 68% total CHP efficiency, 15 ppm NO_x emissions
- Capacity factors and capital costs for PV and Wind based on utility systems in DOE's Advanced Energy Outlook 2011
- Capital cost and efficiency for natural gas combined cycle system based on Advanced Energy Outlook 2011 (540 MW system proportioned to 10 MW of output), NGCC 48% electric efficiency, NO_x emissions 9 ppm
- CHP, PV, Wind and NGCC electricity displaces National All Fossil Average Generation resources (eGRID 2012) - 9,572 Btu/kWh, 1,743 lbs CO_2/MWh, 1.5708 lbs NO_x/MWh, 6.5% T&D losses; CHP thermal output displaces 80% efficient on-site natural gas boiler with 0.1 lb/MMBTU NO_x emissions

AN ECONOMIC DEVELOPMENT OPPORTUNITY

CHP presents an opportunity to lower costs for existing businesses and drive the creation of new jobs to support a growing CHP industry.

Implementing CHP is first and foremost a business decision. In the right economic conditions, a properly configured CHP system will save the user money by efficiently and reliably producing electricity onsite at a lower price than the local utility. This frees up money for firms to stay in business, expand operations, or hire more employees. In the right regulatory environment, businesses can even create a new revenue stream by selling excess electricity to the grid or excess steam to a neighboring facility.

In addition to being a boon to the end consumers of energy, investing in the growth of CHP will drive growth of firms that manufacture, construct, operate, and maintain CHP systems. A national study of the CHP opportunity in 2008 predicted that increasing CHP from 9% to 20% as a share of total national capacity could create as many as 1 million new jobs.[37]. Indiana is already home to several firms, including Caterpillar, which manufactures a large portion of their CHP product line in Indiana. Given its strong manufacturing base and ample opportunity for CHP within the state itself, Indiana is ideally positioned to capitalize on a growing CHP industry and create more quality jobs for Hoosiers.

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[36] Department of Energy and Environmental Protection Agency. "Combined Heat and Power: A Clean Energy Solution." Accessed 6/22/14 (DOE/EPA CHP Report)/
[37] DOE/EPA CHP Report.

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COMBINED HEAT & POWER IN INDIANA

CURRENT CAPACITY

Combined heat and power has been used in Indiana in some form since at least 1925 when Indianapolis began utilizing district energy, with CHP, for heating and cooling downtown. Today, Indiana has nearly 2,300 MW of capacity installed[38], accounting for 8.4%[39] of capacity and 9.3%[40] of generation.

While 71% of CHP in the United States uses natural gas as its primary fuel, Indiana's fuel mix relies in almost equal parts on coal (38%), natural gas (34%), and waste products (27%).[41] The heavier reliance on fuels other than natural gas can be explained primarily by two factors:

Table 3. Indiana CHP Capacity by Sector

Sector	Capacity (GW)	# of Facilities	% of Total
Metals	1431840	9	63.17%
Refining	665600	1	29.37%
Educational Institutions	81730	6	3.61%
Food Processing	26600	4	1.17%
District Energy	20000	1	0.88%
Manufacturing	19070	3	0.84%
Waste	6760	3	0.30%
Agriculture	6350	5	0.28%
Chemicals	4875	1	0.22%
Healthcare	3493	2	0.15%
Commercial	250	3	0.01%

- **Age of CHP fleet.** 85% of capacity in Indiana is over 30 years old. Given historically volatile natural gas prices, the abundance of cheap, locally mined coal, and more lax environmental requirements, coal was likely the more economically competitive fuel in Indiana for CHP when most of these systems came online. The last CHP facility to be designed for coal came online in 1985.[42]
- **Steel industry CHP use.** In Indiana, 63% of CHP is deployed in the metals industry.[43] 70% of steel production worldwide uses coal converted to coke as an essential step in the fabrication process.[44] Additionally, several steps in the steelmaking process generate large amounts of excess heat and other waste byproducts, which are ideal fuels for CHP integration.

While early CHP development in Indiana was dominated by deployments in industrial settings with large thermal loads, the last decade in CHP development in Indiana has seen a strong shift toward small- and medium-scale CHP using biomass as fuel. 70% of new CHP deployments in the last decade have been biomass.[45]

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[38] ICF International. "Combined Heat and Power Installation Database." http://www.eea-inc.com/chpdata/. Accessed 7/11/14.
[39] Energy Information Administration. "Indiana State Electricity Profile." Accessed 8/5/14.
[40] Energy Information Administration. "Electricity Data Browser: Net Generation." Accessed 8/5/14.
[41] All data sourced from ICF International's Installed CHP Database. *Waste products* include: Waste, Waste Heat, MSW, Black Liquor, Blast Furnace Gas, Petroleum Coke, Process Gas.
[42] ICF International. "Combined Heat and Power Installation Database." http://www.eea-inc.com/chpdata/. Accessed 7/11/14.
[43] ICF International. "Combined Heat and Power Installation Database." http://www.eea-inc.com/chpdata/. Accessed 7/11/14.
[44] World Coal Association. http://www.worldcoal.org/coal/uses-of-coal/coal-steel/. Accessed 7/14/14.
[45] ICF International. "Combined Heat and Power Installation Database." http://www.eea-inc.com/chpdata/. Accessed 7/11/14.

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Looking ahead, Indiana has at least 80 MW of CHP capacity coming online in the next several years. **SABIC Innovative Plastics** is constructing an 80 MW CHP natural gas facility at their Mount Vernon manufacturing plant. According to the company, SABIC has been considering cogeneration for some time, but it began to make economic sense with the introduction of new EPA rules limiting emissions from industrial boilers.[46]

See Appendix A for a detailed table of every CHP installation in Indiana.

Fort Wayne Landfill gas CHP facility (Photo credit: wane.com)

In December 2013, **General Motors** announced a $24 million investment to expand its use of landfill gas CHP at its Fort Wayne, Indiana and Orion, Michigan manufacturing plants. This investment was part of a larger GM commitment to increase renewable energy use to 125 MW by 2020. The expansion in Fort Wayne came online in June; the CHP plants will save $10 million a year in energy costs and reduce carbon dioxide emissions by over 89,000 metric tons a year (equivalent to the emissions of 18,542 passenger vehicles).[1]

POTENTIAL CAPACITY

The potential capacity for CHP in Indiana is a subject of some confusion and debate. Different sources cite a wide range of estimates depending on the assumptions and constraints that are applied to the analysis. Generally speaking, all estimates agree that technical potential in the industrial and commercial sectors amounts to over 2700 MW.[47]

In comparing the variety of CHP potential estimates in current literature, it is valuable to keep in mind the following key points:

- Almost all CHP potential estimates in literature today are sourced from ICF International, which uses a proprietary suite of analytics tools. Most estimates, therefore, come from the same source, but vary based on assumptions and constraints.
    - *Technical* capacity only considers the technical compatibility of a facility with CHP technology based on the site's thermal and electricity needs. This type of analysis ignores the economic feasibility of the capacity.
    - Most analyses only estimate potential capacity based on onsite electricity needs. For example, if the thermal load of a facility could potentially generate power in excess of the facility's electrical needs, the potential capacity estimate is constrained to the electrical needs of the facility.

For the purpose of this paper, we consider ICF internal estimates from 2014 as the most current and comprehensive estimate of CHP potential in Indiana. This data includes analysis that allows for export of power to the grid, which greatly increases estimated potential capacity. Appendix B contains this data as well as a summary of other estimates that can be found in current literature.

[46] Evansville Courier & Press. "SABIC's power plans will cost Vectren some business." Published 12/3/2013. Accessed 7/14/14.
[47] See Appendix B for detailed data. This potential capacity is based on technical feasibility and only considers onsite use of generation.

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EPA BOILER MACT COMPLIANCE OPPORTUNITIES

In addition to overall CHP potential capacity estimates, we also consider current literature that analyzes potential for CHP as an EPA Boiler MACT (Maximum Available Control Technology) compliance strategy.

On December 20, 2012, the EPA finalized new rules regulating air pollution from industrial boilers. Operators of boilers have until January 31, 2016 to comply, with the option to request an additional year extension.

Table 4. CHP as a Compliance Strategy for EPA's Boiler MACT

Fuel Type	# of Boilers	Total Capacity (MMBTU/hr)	CHP Potential (MW)*	CO_2 Emissions Savings (MMT)**	Equivalent to # of cars taken off the road
Coal	38	10,128	1012	6.4	1,347,368
Oil	29	5058	506	2.4	505,263
Total	**67**	**15,186**	**1518**	**8.8**	**1,852,631**

* CHP potential based on average efficiency of affected boilers of 75%; Average annual load factor of 65%, and simple cycle gas turbine CHP performance (power to heat ratio = 0.7)
** GHG emissions savings based on 8000 operating hours for coal and 6000 hours for oil, with a CHP electric efficiency of 32%, and displacing average fossil fuel central station generation
*** Calculated using EPA's Greenhouse Gas Equivalencies Calculator (http://www.epa.gov/cleanenergy/energy-resources/calculator.html).

The EPA Boiler MACT allows for a number of different compliance strategies and will be most challenging and expensive for owners of coal and oil-fired boilers. In this scenario, conversion to natural gas is an attractive option. Though the capital investment is high for this approach, it brings the boiler immediately into compliance, requiring no further action on the part of the owner other than periodic tune-ups.

For firms considering a switch to natural gas, implementing CHP at the same time represents a potential opportunity to turn compliance costs into an investment with a decent payback. The Department of Energy's Midwest CHP Technical Assistance Partnership assists affected boiler operators in assessing whether CHP is a feasible investment as part of their Boiler MACT Compliance strategy. Additionally, private CHP developers[48] often offer a free screening.

In Indiana, it is estimated that 67 coal and oil boilers totaling 15,186 MMBTU/hr are affected by the regulation.[49] Replacing the affected boiler units with natural gas boilers and waste heat recovery CHP would avoid 8.8 million metric tons of CO_2. [50]

ECONOMICALLY FEASIBLE POTENTIAL

Understanding technical potential for CHP is useful for characterizing the full scope of the CHP market, but does not consider the many factors that affect the feasibility of a CHP project, including:

- Payback period
- Availability of capital within a corporate or institutional system[51]

[48] Rolls-Royce, Cummins and Caterpillar are corporations with Indiana ties that are active in CHP development.
[49] Cuttica, John. "Combined Heat and Power as a Boiler MACT Compliance Strategy." *Midwest Energy Efficiency Alliance Webinar Series.* 1/30/13. http://www.midwestchptap.org/events/PDF/MEEA_Cuttica2013Jan30.pdf. Accessed 7/22/14. Data source: ICF International.
[50] Id.
[51] "Combined Heat and Power for Industrial Revitalization," Center for Clean Air Policy, July 2013. The up-front capital expenditures to install CHP systems can pose a barrier even when the investment is expected to be

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- State incentive programs and regulatory structures
- Local availability and cost of fuel
- Cost of utility generation
- Utility standby rates, interconnection rules, and avoided cost rates
- Permitting

The combination of each of the above factors creates a complicated evaluation process. In fact, according to one Indiana utility lawyer interviewed for this paper, the preliminary process of conducting a feasibility study alone can be very resource-intensive and out of reach for smaller firms that might benefit from CHP.

ArcelorMittal's new WHR boiler under construction. (Photo courtesy of ArcelorMittal)

ArcelorMittal, with a matching grant from the Department of Energy through the American Recovery and Reinvestment Act, added a new waste heat recovery boiler in 2012 to generate 333,000 megawatt-hours of electricity annually. The project will save $20 million in energy costs annually and help the Indiana Harbor steel manufacturing facility sustain its nearly 6,000 jobs and remain competitive in the global steel market.

The primary metals industry in Indiana is the biggest contributor to CHP capacity with almost 1.5 GW of capacity.

Because economic feasibility of a CHP project is extremely site-specific, truly accurate estimates of economic potential do not exist. Treated with a heavy dose of context, however, general estimates that are available can be useful and instructive.

In May 2013, ICF International prepared a report for the American Gas Association including estimates of the economic potential of CHP. Though Indiana is estimated in this report to have over 2700 MW of technical potential, the report estimates there was no capacity in the state at that time with strong or even moderate economic potential.[52] Under two alternate scenarios posited then (a 25% drop in capital costs or a 15% rise in electricity prices[53]), Indiana is estimated to have 356 MW of available capacity with moderate economic potential (5-10 year payback period). In the 18 months since that report, though, those economics are turning around. The most recent forecast of Indiana's State Utility Forecasting Group, incorporating the impact of EPA's Clean Power Plan, projects increases in excess of 15% within the next three years.[54] Instead of being a deathblow to CHP market development in Indiana, this data and its limitations as noted in the paper highlight important points about barriers to CHP growth and ongoing economic trends that are changing the economics around CHP.

- **Rising electricity prices make CHP an attractive choice.** Indiana has historically had very low electricity prices, but prices are rising. The ICF estimates of economic potential use

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cash positive within a longer period. In some instances, a firm would be able to meet the costs of a CHP project, but the investment in CHP may be competing with other possible investments. In other cases, the company may not have access to capital or financing.

[52] Hedman, Bruce et al. "The Opportunity for CHP in the United States." ICF International. May 2013. Note: Economic potential based on estimated payback period. Moderate payback is considered 5-10 years and Strong payback is considered less than 5 years.

[53] Electricity prices are based on 2011 annual average rates.

[54] http://www.purdue.edu/discoverypark/energy/assets/pdfs/SUFG/publications/2013%20SUFG%20Forecast.pdf. See Table 3-4.

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late 2011 and early 2012 energy data. Since then, industrial electricity prices in Indiana have risen nearly 7%[55] and the SUFG projects that prices (in inflation-adjusted terms?) will continue by over 28% by 2030.[56] Under a 15% electricity price increase in this study, 356 MW becomes economically viable; rising prices, therefore, have potentially already opened up some projects to feasible development.

- **The implementation of state incentives can catalyze growth.** In ICF's analysis, they do not consider the presence of state policies or incentives to drive CHP growth, but note that this can have significant impact. For example, the analysis determined that Oregon, like Indiana, had no strong or moderate potential for CHP, but in-state incentives have catalyzed CHP development in the state.

POTENTIAL FOR EXPORT

As previously noted, one serious limitation of most CHP potential studies is that capacity estimates are scoped solely for *onsite* usage based on a facility's electricity needs. If a facility has a thermal load that could feasibly produce more electricity than the facility needs, the additional electricity generation capacity is not considered as it cannot be used onsite.

The decision to calculate estimates in this way is partly practical. A CHP system operates most efficiently and captures the full benefits of CHP when thermal and electric loads are matched and when the energy generated is used onsite. Additionally, in many states, including Indiana, the prospect of selling capacity back to the local utility is seldom a profitable enterprise.

Despite these practicalities, in the appropriate regulatory environment, tapping the potential for export of electricity to the grid is an attractive way to provide for growing electricity demand, reduce costly new generation costs, create a new revenue stream for industrial facilities with export capacity, and relieve grid congestion. Most facilities with export capacity participate in energy intensive sectors that face stiff competition overseas; the added revenue from the export of energy may make a critical difference in their ability to operate in the United States. While this is but one factor among many in plant longevity and success, it is the same of energy incentives that has led to the development of special energy contracts for a system's larger customers. ICF International data provided by the Alliance for Industrial Efficiency estimates that accounting for export capacity could add an additional 2000 MW of technical capacity to industrial CHP potential in Indiana.[57]

BARRIERS TO GROWTH

Historically, Indiana has done little to specifically encourage CHP development. This can be explained at least in part by the strong influence of the coal industry and utilities in Indiana. Most importantly, though, low electricity prices have made CHP economically infeasible. Each year the American Council for an Energy-Efficient Economy (ACEEE) releases a state-by-state Energy Efficiency Scorecard broken down by topic. In 2013, Indiana scored poorly for support of CHP in every category, with the exception of interconnection rules, which streamlines the process of connecting to

[55] Energy Information Administration. "Electricity Data Browser: Average retail price of electricity." Accessed 8/12/14.
[56] Phillips, Timothy et al. "Indiana Electricity Projections: The 2013 Forecast." State Utility Forecasting Group, December 2013. Note: Percentage reflects % change between projected industrial prices for electricity in 2014 and 2030.
[57] ICF International internal estimates for Indiana, 2014. See Appendix B for data.

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the electricity grid (Table 5).

As noted in the introduction, however, the trends are reversing. In addition to rising prices, federal policy and national attitudes are leading to increased efforts to restrain climate-altering emissions, most recently marked by the EPAs Clean Power Plan, in which Indiana will be required to cut CO_2 emissions from power plants by 20%[58] by 2030. These changes will necessitate looking at how to make clean energy more affordable and competitive. It is productive, therefore, to consider the barriers that are preventing Indiana from leveraging the potential of CHP as a source of clean energy.

Table 5. ACEEE CHP Scorecard

Category	Score
Interconnection	1
RPS/EERS Treatment	0
Net Metering	0
Incentives	0
Emissions	0.5
Financing	0
Additional Policies	0
Total	**1.5/5**

FRANCHISE LAWS

While many states have moved forward with steps to deregulate their utility markets and create competition to bring down electricity prices, Indiana has debated deregulation on and off over the years with little progress. Although initial deregulation efforts in some states failed (most notably California in the 1990s), deregulation has since helped neighboring states such as Ohio and Illinois achieve lower electricity prices, even as Indiana rates have steadily risen[59] (60% since 2001).[60]

Even without deregulation, there is policy and legislation in place in Indiana to allow for the development of private generation projects, including conventional combined heat and power as well as waste heat to power facilities. While making these kinds of projects available to non-utilities is a critical first step, CHP in Indiana is still hindered by outdated utility regulations that afford utilities monopoly control over their service franchise areas.

Franchise laws (in particular the Service Area Assignments Act)[61] require that any non-utility wishing to access the grid must "obtain regulatory compliance as well as contractual rights,"[62] which add an extra layer of cost and complexity that often prevent energy consumers from:

- Selling excess generation to a neighboring facility
- Working with other end users or other facilities within the same firm but at a different site to aggregate demand for increased efficiency
- Locating CHP facilities off-site from where the electricity is consumed[63]

The end result is that CHP projects are often limited to onsite generation and use. Perhaps of greatest concern is that franchise laws eliminate competition almost entirely, giving the local utility an inappropriate amount of influence over the ability of an energy consumer to acquire energy in the most cost-effective manner available.

[58] EPA Clean Power Plan Maps. http://cleanpowerplanmaps.epa.gov/CleanPowerPlan/. Accessed 8/5/14.
[59] INDIEC. "Position Paper of Industrial Consumers on Electric Reform." September 2013, pp. 6-8.
[60] Energy Information Administration. "Electricity Data Browser: Retail Electricity Price." Accessed 7/1/14.
[61] INDIEC. "Position Paper of Industrial Consumers on Electric Reform." September 2013, p. 17.
[62] INDIEC. "Position Paper of Industrial Consumers on Electric Reform." September 2013, p. 10.
[63] INDIEC. "Position Paper of Industrial Consumers on Electric Reform." September 2013, p. 16.

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STANDBY RATES

As noted above, the utility regulatory structure in Indiana creates problems for unfettered CHP development. At the broadest level, rate of return regulation pits the utility against any project that reduces the amount of power they sell to their consumers. It is understandable, in the traditional approach to revenue generation, that utilities are not enthusiastic supporters of CHP development.

While a utility cannot prevent a consumer from constructing its own private generation, supporters of CHP contend that many utilities charge unreasonable standby rates to a private generator, which can often make or break the economics of a project. Most facilities with CHP onsite still need to interconnect with the electric grid to provide backup power in case of a power failure onsite. *Standby rates* are charged by the utility to reserve enough generation capacity for the purposes of providing supplemental power, power during planned maintenance, and power during an unanticipated outage. While standby rates are necessary for utilities to recoup their costs for providing such services, the charges are often inflated by several factors:

- A practice known as "demand ratcheting" unduly penalizes the user by setting standby rates based on the peak capacity demanded by a customer during an outage. When an outage occurs, standby rates will be "ratcheted up" based on that incident, often for as many as 12 months following the incident.[64]
- Utilities will treat each private generator separately under the hypothetical assumption that all could theoretically demand power at the same time. This maximizes the amount of revenue the utility can collect, but does not reflect the truly low probability that multiple consumers will be requiring standby power at the same time.

The end result is an unfair burden placed on all distributed generation projects, but is particularly onerous to CHP/WHP projects, which often operate free of grid support 96% of the time.[65]

AVOIDED COST RATES

Under current federal and state legislation, utilities are required to buy any excess generation that a private generator wishes to sell to the grid. However, the utility is only obligated to pay the generator *avoided cost*, "the incremental costs to an electric utility of electric energy or capacity or both which, but for the purchase from the qualifying facility or qualifying facilities, such utility would generate itself or purchase from another source."[66] Given the economies of scale at which utilities operate, it is no surprise that this amount is too small to make it a worthwhile venture for most CHP operators. In fact, the avoided cost is generally estimated by the Indiana State Utility Forecasting Group to be one-third to one-fourth the retail electricity price.[67] Combined with the added complexities created by franchise laws, this effectively kills nearly 2000 MW of potential export generation that CHP could provide to the grid.

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[64] "Guide to Successful Implementation of State Combined Heat and Power Policies." SEE Action, March 2013.
[65] Midwest Cogeneration Association: Comments submitted to Indiana Utility Regulatory Commission regarding Energy Efficiency and DSM submitted to IURC, 6/9/14.
[66] 18 C.F.R. § 292.101(b)(6)
[67] Giraldo, Juan et al. "An Assessment of the Potential for Electricity Generation in Indiana from Biogas Resources." State Utility Forecasting Group, June 2013.

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LACK OF END-USER AWARENESS & EXPERTISE

While the federal government has regional technical assistance programs through the Department of Energy, Indiana has no state-level effort to raise awareness about this technology.

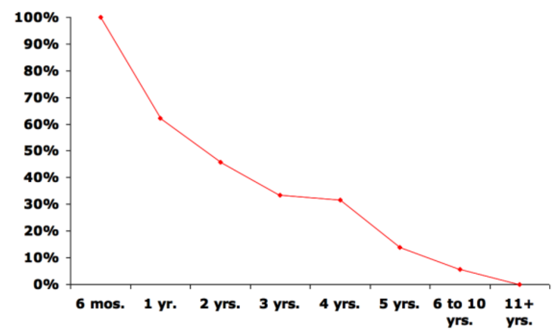
Lack of expertise is also a barrier. Because CHP is intended to be installed onsite, most potential users are steeped in their own industry and have little or no expertise with electricity generation. This in turn raises the perception of risk on the part of the potential CHP operator and increases the complexity involved in evaluating and implementing a CHP project.

ECONOMIC DECISION-MAKING AND RISK THRESHOLDS

As an energy technology that is typically employed by non-utilities, CHP often faces the problem of mismatched priorities and payback expectations. While minimizing energy costs—particularly in energy-intensive industries such as metals manufacturing—is of value to consumers, it is often secondary to their core business. CHP is therefore often passed over for other investment opportunities that are perceived to be more critical to their core business model.

Additionally, while utilities routinely make investments that they will recoup over a long period of time (often well over a decade), most private firms do not make investments that have a payback period of longer than a few years. Other factors that raise the perceived risk level include the variability in natural gas prices and utility generation prices. As such, most CHP projects fall outside of a firm's typical "comfort zone." In fact, a survey of California businesses conducted in 2003 by Primen, a developer of renewable energy projects, indicates that even just a 1-year payback period would eliminate 40% of prospective CHP users from making the investment (see Figure 8). Anecdotal accounts obtained from energy managers for several Indiana industrial companies confirm that dynamic still exists.

Figure 8. CHP Market Acceptance Curve



Source: *Primen's 2003 Distributed Energy Market Survey*

ABSENCE OF MANDATORY PORTFOLIO STANDARDS

CHP growth benefits greatly from a policy environment that includes mandatory portfolio standards that recognize the emissions savings of CHP technology through reductions in overall fuel use. Waste heat to power, because the electricity generation often does not require any additional fuel (just waste thermal energy), is more commonly recognized in such programs than conventional CHP.

While Indiana does have a clean energy portfolio standard that recognizes both conventional CHP and waste heat to power, it is voluntary and has not seen any participation from utilities since its inception in 2012. Reference to the latest Integrated Resource Plans filed by Indiana's five Investor-Owned Electric Utilities indicates that none included and documented CHP as an available resource.[68]

[68] http://in.gov/iurc/2630.htm, accessed 12/1/14.

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CONCLUSIONS & RECOMMENDATIONS

Indiana, along with the rest of the world, is facing an energy future dramatically different from the one in which it originally thrived. Some things will not change—fossil fuels will still be the dominant source of energy in the short-to-medium term—but sustainable, efficient, and zero carbon energy must be central in our focus as we plan for the next 50 years of energy policy and beyond.

Given our historic dependence on cheap coal, this transition may be especially challenging for Indiana relative to other states with a more diverse energy mix. The good news is that Indiana is rich in resources to power a clean future. One of these resources is combined heat and power technology. CHP already makes up 8.4% (2300 MW) of installed capacity, but potential exists to more than double this source of clean energy if we take intentional action to embrace this opportunity through policies and regulations designed to drive CHP growth.[69] This growth will catalyze economic development in our state, creating clean energy jobs and a demand for equipment, which Indiana is well suited to produce locally.

CHP can help Indiana to tackle the following growing energy challenges in our state:

- Rising electricity prices due to aging power plants and the rising cost of coal.
- The need for new generation in the face of the upcoming wave of coal plant retirements.
- Increasing concern about the resiliency and security of our electricity infrastructure given increased extreme weather events and the rise of cyberterrorism, which poses a real threat to the grid.[70]
- The need to lower greenhouse gas emissions to comply with federal legislation and to mitigate climate change in the long term.

In order to usher in a new wave of CHP development, Indiana policymakers and regulators should consider the following strategies that have been shown to be successful in other states:

The Indiana Utility Regulatory Commission (IURC) must support combined heat and power and waste heat-to-power technology in Indiana's new energy efficiency program. As the state works to replace the prematurely cancelled Energizing Indiana program, policymakers are presented with their first opportunity to make CHP development more attractive to utilities. The Alliance for Industrial Efficiency (AIE) argues that a revitalized plan should include:

- *Net metering for CHP and WHP*: net metering would make generating excess capacity for the grid economically feasible for CHP users and would benefit utilities by displacing the need to new generation capital expenditures.
- *Streamlined interconnection procedures*: While Indiana has received high marks from ACEEE for interconnection standards, as AIE notes[71], current rules overburden large industrial projects. The IURC should ensure that Indiana interconnections are in line with the Federal Energy Regulatory Commission's Order No. 792, which is modeled after California's interconnection rules, providing a fast track for clean energy development.[72]

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[69] ICF International internal estimates for Indiana, 2014. See Appendix B for data

[70] Finkle, Jim. "U.S. utility's control system was hacked, says Homeland Security." Reuters. 5/20/14. http://www.reuters.com/article/2014/05/21/us-usa-cybercrime-infrastructure-idUSBREA4J10D20140521.

[71] Alliance for Industrial Efficiency: Comments submitted to Indiana Utility Regulatory Commission regarding Energy Efficiency and DSM submitted to the IURC, 6/9/14.

[72] Hunt, Tam. "FERC's New 'Fast-Track' Rules Will Make Clean Energy Development Easier." http://www.greentechmedia.com/articles/read/ferc-adopts-new-california-fast-track-interconnection-rules-nationwide. 1/7/14.

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- *Reformed standby rates*: As noted in the previous section, standby rates often represent an insurmountable barrier to otherwise feasible CHP projects. See below for detailed recommendations regarding standby rates.

Require a CHP feasibility study for all state-owned institutions and critical facilities. CHP has proven a valuable asset for critical facilities in times of crisis and natural disaster. As the frequency of extreme weather increases, equipping facilities such as hospitals, data centers, and wastewater treatment facilities with resilient CHP that can operate during a grid outage is increasingly important.

Provide grants for CHP feasibility studies for privately owned critical facilities (e.g. private hospitals) or other target adopters (such as universities or landfills). In 2007, Indiana offered a grant covering up to 50% of the study costs for biomass feasibility studies. A CHP feasibility study grant could be modeled similarly.[73]

Launch state-level education and technical assistance efforts. Currently the Department of Energy funds technical assistance efforts through regional Clean Energy Application Centers. Indiana should augment these efforts with personnel dedicated to CHP in Indiana. While detailed financial analysis for every potential CHP site in the state is unrealistic, Indiana's Office of Energy Development could follow the DOE model of providing a basic free screening service that gives the client general guidance on whether CHP might be an appropriate strategy for their firm. Also, OED could be especially effective in leading a state effort to identify public facilities (such as correctional facilities, medical centers and educational institutions) that may be attractive CHP candidates.

Leverage special financing to lower risk for potential investors. Indiana should offer targeted incentives for clean energy development or CHP specifically. In the past there have been state incentives targeting alternative energy, distributed energy, and biomass projects. Unfortunately, all of these have expired. Today, some businesses have access to efficiency rebates through their utilities and can take advantage of federal investment tax credits, but Indiana as a state needs to lead with strong energy incentives. These projects could generically target distributed generation or make a stronger statement by specifically targeting CHP and waste heat-to-power.

One low-risk source of financing, primarily for public projects, is federal Qualified Energy Conservation Bonds, which can provide very low interest rates for qualified projects. While CHP and WHP are not explicitly covered, CHP utilizing renewable fuels (such as biomass or landfill gas) would qualify. Other examples of successful financing programs around the country include:

- California's Self-Generation Incentive Program was originally conceived as a peak load reduction effort. The incentive is paid out based on the capacity of the project, with a bonus for equipment that is sourced from California manufacturers. Incentives are also higher for renewable energy such as biomass.
- Massachusetts's Green Communities Act offers a rebate to cover up to 50 percent of capital costs. Utilities are incentivized to participate and invest; all kilowatt-hours generated are counted towards their energy efficiency goals. Rebate values are based on the quality of the project, including efficiency, cost-benefit ratio, and project risk, ensuring the best opportunities are exploited.

[73] OpenEI. "State Grant Program Database." http://en.openei.org/wiki/State_Grant_Program. Accessed 8/9/14.

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Implement a feed-in tariff (FIT) or net metering specifically for CHP projects with export capacity. In order to drive development of export CHP capacity, Indiana should offer a tiered FIT that ties rates to the price of natural gas and offers premiums based on emissions reductions and for siting projects in congested parts of the grid. This model has been successfully implemented in California as part of Governor Brown's Clean Energy Jobs Program.[74]

One example of a successful feed-in tariff that has already benefited CHP in Indiana is NIPSCO's Experimental Rate Tariff 665 – Renewable Feed-In Tariff. Since its inception, the Renewable FIT has driven 7,465 kW of biomass CHP capacity development with an additional 6,885 kW worth of projects currently in the pipeline.[75]

Reform regulations for avoided cost rates and standby charges. As noted previously, avoided cost rates are based on the marginal cost of a unit of electricity. The Midwest Cogeneration Association offers Oregon's avoided cost rates as an example to follow. Avoided cost rates in Oregon are contingent on whether a utility is considered to be resource deficient or resource sufficient. If a utility is resource deficient, avoided cost rates incorporate long-term capital expenditures that are avoided by purchasing electricity from a distributed generator.[76]

While avoided cost rates affect only the customers who are generating excess load for export, standby charges affect every CHP generator—indeed, every distributed generation project in the state. For this reason, reform in this area is especially needed. The State and Local Energy Efficiency Action Network offers some useful guidelines:

- Offer daily, or at least monthly, as-used demand charges for backup power and shared transmission and distribution facilities.
- Reflect load diversity of CHP customers in charges for shared delivery facilities.
- Allow the customer to provide the utility with a load reduction plan.
- Schedule maintenance service at nonpeak times.
- Provide an opportunity to purchase economic replacement power.

In states with retail competition:

- Allow customer-generators the option to buy all of their backup power at market prices.
- In states with retail competition, offer a self-supply option for reserves.[77]

For Indiana, the first two points are paramount, offering a way to alleviate the effect of ratcheted pricing and more accurately reflect the true cost of standby services to the utility.

Implement a mandatory portfolio standard that recognizes the efficiencies of CHP and WHP. Indiana should move quickly to make the current clean energy portfolio standard mandatory and recognize CHP and WHP as eligible technologies. Furthermore, Indiana needs a forward-thinking demand side management program to incentivize utilities to get on board and invest in CHP development.

[74] Department of Energy and Environmental Protection Agency. "Combined Heat and Power: A Clean Energy Solution." Accessed 6/22/14.
[75] Midwest Cogeneration Association: Comments submitted to Indiana Utility Regulatory Commission regarding Energy Efficiency and DSM submitted to IURC, 6/9/14.
[76] Midwest Cogeneration Association: Comments submitted to Indiana Utility Regulatory Commission regarding Energy Efficiency and DSM submitted to IURC, 6/9/14.
[77] "Guide to Successful Implementation of State Combined Heat and Power Policies." SEE Action, March 2013, p. 9.

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Take steps to reform Indiana's franchise laws to give CHP generators more flexibility in siting projects and using the energy. Franchise laws give inappropriate power and influence to utilities over where private generators site their facilities and what they do with that energy. Policymakers must find a middle ground to create space for competition and innovation while still protecting the utilities' ability to thrive.

As an example, Indiana Industrial Electric Consumers (INDIEC) advocates for distribution-only rate tariffs that would allow for CHP users to affordably access the utility distribution grid in order to sell power to a neighboring, affiliated facility. This type of rate tariff has been available in the natural gas market since 1987[78]; a similar measure for the electricity market would open the door for development of CHP export capacity.

Combined heat and power is an opportunity with something for everyone, benefiting industrial and commercial users, the electricity infrastructure, Hoosier job seekers, and the environment. This untapped potential is a critical component to Indiana's clean energy future.

[78] INDIEC. "Position Paper of Industrial Consumers on Electric Reform." September 2013, pp. 15-16.

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APPENDIX A: CURRENT CHP INSTALLATIONS IN INDIANA

Source: CHP Installation Database, compiled by ICF. Up to date, 2012.

Organization Name	Facility Name	Application	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Perry K	Citizens Thermal Energy	District Energy	1925	Boiler/Steam Turbine	20,000	COAL
BP Amoco Chemicals Company	Whiting Refinery	Refining	1928	Boiler/Steam Turbine	665,600	NG
Colgate-Palmolive Company	Colgate-Palmolive Company	Chemicals	1940	Boiler/Steam Turbine	4,875	NG
ArcelorMittal Steel	Indiana Harbor Works	Primary Metals	1946	Boiler/Steam Turbine	55,000	WAST
Central Soya Company, Inc.	Central Soya Decatur Plant	Food Processing	1950	Boiler/Steam Turbine	2,000	COAL
Lakeside Energy	US Steel - Gary Works	Primary Metals	1951	Boiler/Steam Turbine	161,000	WAST
Univ. of Notre Dame	Notre Dame Power Plant	Colleges/Univ.	1952	Boiler/Steam Turbine	23,100	COAL
Rolls Royce Corp	Rolls Royce Corp	Transportation Equipment	1963	Combustion Turbine	15,500	BIOMASS
Lewis Cass HS	Lewis Cass HS	Schools	1968	Reciprocating Eng.	1,750	NG
ArcelorMittal Steel	Burns Harbor Plant	Primary Metals	1969	Boiler/Steam Turbine	177,720	WAST
Purdue University	Purdue University Physical Plant	Colleges/Univ.	1969	Boiler/Steam Turbine	41,800	COAL
Alcoa Generating Corporation	Alcoa Smelting & Fabrication	Primary Metals	1970	Boiler/Steam Turbine	755,000	COAL
Caterpillar Tractor Company	Caterpillar Tractor Company	Machinery	1980	Reciprocating Eng.	3,500	OIL
Tate & Lyle Ingredients Americas	Sagamore Cogeneration Plant	Food Processing	1985	Boiler/Steam Turbine	7,400	COAL
Energy Group Inc	Covanta Indianapolis Inc	Solid Waste Facilities	1988	Boiler/Steam Turbine	6,500	WAST
St. Anthony's Medical Center	St. Anthony's Medical Center	Hospitals/Healthcare	1990	Combined Cycle	2,748	NG
Elkhart General Hospital	Elkhart General Hospital	Hospitals/Healthcare	1991	Reciprocating Eng.	745	NG
Culver Educational Foundation	Culver Educational Foundation Facility/ Culver Military Academy	Misc. Education	1996	Reciprocating Engine	1,050	NG
ArcelorMittal Steel	ArcelorMittal Steel / Sun Coke / North Lake Energy Corporation	Primary Metals	1996	Waste Heat to Power	75,000	WAST
US Steel	Midwest Steel (CHP owned by Portside Energy LLC / Primary Energy)	Primary Metals	1997	Combined Cycle	63,000	NG
ArcelorMittal Steel	Indiana Harbor	Primary Metals	1998	Waste Heat to	95,000	WAST

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	Works (CHP project owned by Cokenergy / Primary Energy)			Power		
Cargill, Inc.	Cargill - Cerestar	Food Processing	2000	Boiler/Steam Turbine	16,000	NG
Indiana State University	Indiana State University	Colleges/Univ.	2001	Combustion Turbine	14,000	NG
Breeden YMCA / NiSource Inc.	Breeden YMCA	Amusement/Recreation	2002	Microturbine	120	NG
ArcelorMittal Steel	Indiana Harbor Works (CHP project owned by Ironside Energy / Primary Energy)	Primary Metals	2002	Boiler/Steam Turbine	50,000	WAST
Stripco Inc / NiSource Inc.	Stripco Inc	Primary Metals	2003	Microturbine	120	NG
Fair Oaks Dairy	Fair Oaks Dairy	Agriculture	2004	Reciprocating Eng.	750	BIOMASS
Herrema Dairy	Herrema Dairy	Agriculture	2004	Reciprocating Eng.	700	BIOMASS
Manchester Tank / NiSource Inc.	Manchester Tank	Misc. Manufacturing	2005	Microturbine	70	NG
Boss #4 Dairy	Boss #4 Dairy	Agriculture	2005	Reciprocating Eng.	700	BIOMASS
Hidden View Dairy	Hidden View Dairy	Agriculture	2006	Reciprocating Eng.	900	BIOMASS
Town of Munster	Centenial Park	Amusement/Recreation	2008	Microturbine	130	BIOMASS
Munster Landfill	Munster Landfill	Solid Waste Facilities	2009	Microturbine	130	BIOMASS
Notre Dame	Energy Center in Stinson-Remick Hall	Colleges/Univ.	2009	Microturbine	30	NG
West Lafayette Wastewater Treatment Facility	West Lafayette Wastewater Treatment Facility	Wastewater Treatment	2009	Microturbine	130	BIOMASS
4 Thought Energy	McDonald's	Restaurants	2011	Reciprocating Eng.	.	NG
Bio Town Ag, Inc.	Bio Town Ag, Inc.	Agriculture	2011	Reciprocating Eng.	3,300	BIOMASS
2G Cenergy	Duck Farm	Food Processing	2013	Reciprocating Eng.	1,200	BIOMASS
Total: 38					2,266,568	

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APPENDIX B: INDIANA CHP TECHNICAL POTENTIAL

Source: ICF Internal Estimates, 2014.

Indiana Industrial CHP Technical Potential - Onsite

SIC	Application	50-500 kW (MW)	.5-1 MW (MW)	1-5 MW (MW)	5-20 MW (MW)	>20 MW (MW)	Total MW
20	Food	22	17	52	15	174	280
22	Textiles	3	3	3	0	0	9
24	Lumber and Wood	39	21	27	6	0	93
25	Furniture	1	0	0	0	0	1
26	Paper	19	13	54	110	23	220
27	Printing	4	1	0	0	0	4
28	Chemicals	27	19	165	166	181	558
29	Petroleum Refining	0	4	16	10	0	31
30	Rubber/Misc Plastics	46	19	30	15	0	110
32	Stone/Clay/Glass	0	0	8	6	0	15
33	Primary Metals	14	23	61	21	0	119
34	Fabricated Metals	9	1	0	0	0	9
35	Machinery/Computer Equip	2	3	5	0	0	9
37	Trasportation Equip.	21.6	19	71	90	0	202
38	Instruments	1	0	0	0	0	1
39	Misc. Manufacturing	2	0	0	0	0	2
49	Gas Processing	0	0	0	0	0	0
	Total	**211**	**143**	**492**	**439**	**378**	**1,663**

Indiana Industrial CHP Technical Potential - Export

SIC	Application	50-500 kW (MW)	.5-1 MW (MW)	1-5 MW (MW)	5-20 MW (MW)	>20 MW (MW)	Total MW
20	Food	20	19	66	81	364	550
22	Textiles	3	3	3	0	0	9
24	Lumber and Wood	39	21	53	13	0	126
25	Furniture	1	0	0	0	0	1
26	Paper	19	13	52	120	741	945
27	Printing	1	0	0	0	0	1
28	Chemicals	28	24	130	406	429	1,018
29	Petroleum Refining	0	4	16	0	398	418
30	Rubber/Misc Plastics	47	22	35	16	0	120
32	Stone/Clay/Glass	0	0	0	0	111	111
33	Primary Metals	14	23	61	21	0	119
34	Fabricated Metals	9	1	0	0	0	10
35	Machinery/Computer Equip	2	3	5	0	0	9
37	Trasportation Equip.	21.6	19	71	90	0	202
38	Instruments	1	0	0	0	0	1
39	Misc. Manufacturing	2	0	0	0	0	2
49	Gas Processing	0	0	0	0	0	0
	Total	**208**	**153**	**492**	**747**	**2,043**	**3,643**

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Indiana Commercial CHP Technical Potential

SIC	Application	50-500 kW (MW)	.5-1 MW (MW)	1-5 MW (MW)	5-20 MW (MW)	>20 MW (MW)	Total MW
43	Post Offices	1	1	0	0	0	2
52	Retail	44	22	6	0	0	71
4222	Refrigerated Warehouses	1	1	1	0	0	3
4581	Airports	0	2	0	10	0	12
4952	Water Treatment	4	2	0	0	0	6
5411	Food Stores	46	8	0	0	0	54
5812	Restaurants	72	3	1	0	0	75
6512	Commercial Buildings	77	270	116	0	0	463
6513	Multifamily Buildings	10	23	7	0	0	40
7011	Hotels	28	3	15	12	0	57
7211	Laundries	5	1	0	0	0	6
7374	Data Centers	4	3	3	0	0	10
7542	Car Washes	2	0	0	0	0	2
7832	Movie Theaters	0.1	0	0	0	0	0
7991	Health Clubs	6	1	0	0	0	6
7997	Golf/Country Clubs	9	0	0	0	0	9
8051	Nursing Homes	33	2	0	0	0	35
8062	Hospitals	20	22	83	16	0	141
8211	Schools	37	3	0	0	0	40
8221	College/Univ.	10	6	67	81	76	240
8412	Museums	2	1	0	0	0	3
9100	Government Buildings	26	12	16	5	0	60
9223	Prisons	2	1	36	13	0	52
9711	Military	1	1	8	14	0	24
	Total	**440**	**386**	**359**	**152**	**76**	**1,412**

Other Indiana CHP Potential Estimates

Source	Industrial Potential (MW)	Commercial Potential (MW)	Total (MW)	Year	Document
Midwest DOE CHP Technical Assistance Partnership*	N/A	949	N/A	2005	Indiana CHP Market Baseline (2005)
ICF International	1663	1412	3075	Oct. 2013	PPT, *Potential for CHP in Midwestern States*, October 2013
ACEEE (Sourced from ICF)	2829	238	3068	Sept. 2012	ACEEE Coal Plant Retirement Analysis** September 2012
AGA (ICF) – Technical Potential	N/A	N/A	2705	May 2013	AGA Report on CHP potential
Great Plains Institute/ACEEE (Sourced from ICF)	1480	1593	3073	2013	2013 - http://www.betterenergy.org/sites/gpisd.net/files/Indiana.pdf
Average	1991	1048	3039		

*Sourced from ONSITE Energy Corp.
**These estimates are of current potential. ACEEE also estimates potential out to 2020 based on projected growth.

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ABOUT HOOSIER ENVIRONMENTAL COUNCIL

The Hoosier Environmental Council (HEC) is devoted to identifying the biggest environmental challenges facing Indiana, and uniting people toward a solution. We use a combination of education, advocacy, and sometimes, litigation, to address those challenges. The result is a new vision of Indiana's future: one of cleaner air, safer water, more protected land, and ultimately, a healthier, higher quality of life.

HEC is uniquely prepared to help Indiana change its old ways. Our research has already yielded several influential policy papers on key environmental issues. We have the personnel, experience, and technological know-how to successfully advocate for the issues most crucial to our future: transitioning to a clean energy economy, modernizing transportation, preserving open spaces, making farming more sustainable and healthier, and protecting our public health.

Ultimately, together, we can create a new Indiana that we can be truly proud to call "home."

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