Baseline Analysis for the CHP Market in Indiana

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Executive Summary

The purpose of this baseline analysis is to assess the prevailing environment for Combined Heat and Power (CHP) systems from regulatory, private market and technology perspectives in the state. This information will be used to develop educational and market transformation programs, which will foster CHP applications.

Indiana currently has 30 known installations of CHP systems of various capacities at 26 locations. Power generation capacity of these systems totals about 2,129,000 kW. Individual capacities of these CHP systems range from 30 kW to 493, 800 kW. Large industrial facilities, schools and universities seem to be particularly attractive for CHP systems in Indiana, followed by hospitals, hotels and district heating systems.

About 41% of the installed CHP system capacity in Indiana is fueled by coal. Natural gas and waste fuel 33% and 19%, respectively, of the installed capacity CHP in the state.

Steam turbines are the prime movers in over 91% of the installed capacity of CHP systems in Indiana and combustion turbines are the prime movers for most (8.6%) of the remaining 9% capacity. Most of the recently installed CHP systems use microturbines.

Energy companies that are leading the way for CHP in Indiana are Primary energy, NiSource Energy Technologies (A NiSource Company), and Cinergy.

Capital costs as well as operating costs are generally viewed as some of the major hurdles to utilize CHP technologies. For smaller generating capacity units, initial cost can have a long payback period unless the electric costs are very high and thermal loads well matched. The generating capacities of the prime movers range in size from reciprocating engines and microturbines in the tens of kilowatts to gas turbines in the tens of megawatts range. The installed cost of the least expensive technologies (large natural gas turbines) start around $600/kW and increase in cost up to fuel cell technologies that may cost up to $5,000/kW. Installed costs of natural gas reciprocating engine costs can range in price from $1,000 to $1,800/kW. Prices of all of these technologies are expected to decrease as the technologies and system designs become more common. Pre-designed packaged CHP systems are beginning to enter the market. Hopefully these packaged design systems, which have been developed for a wide range of applications, will contribute to the reduction in the cost of installing a CHP system.

Volatile and current high prices of natural gas prices could have negative affects on the CHP market development. Natural gas prices in Indiana are already the second highest in the Midwest. The year-to-date (YTD) average price of natural gas in Indiana in May 2005 for commercial customers was $9.62/MMBtu, compared to those of $9.34/MMBtu for the Midwest and $9.98/MMBtu for the US. In contrast, in April 2005, average electricity price for commercial consumers in Indiana was 6.62¢/kWh, which is lower than the average prices in US (8.2 ¢/kWh) and the Midwest (6.98¢/kWh).

On the regulatory side, the Indiana Utility Regulatory Commission (IURC) is still in the process of developing grid interconnection standards and procedures. Indiana has a

Distributed Generation Grant Program in which businesses and institutions can receive from $5,000 up to $30,000 for studies and installations of several technologies, including, cogeneration systems.

A study conducted for the U.S. Department of Energy estimates potential for additional CHP installation capacity in Indiana to be about 949 MW for commercial and institutional facilties. Most of this potential for additional CHP capacity is estimated to be for schools (36%), hospitals (19%), nursing homes (16%), colleges/universities (10%) and hotels/motels (8%).

High backup/standby-fees by local electric utility companies can be particularly discouraging for CHP installations, since many CHP facilities prefer to remain interconnected to use the electric grid as a backup during equipment maintenance and outages. The Northern Public Service Company (NIPSCO), Indiana's largest electric utility company, does not yet have any standard standby rates and exit fees applicable to CHP systems. It has, however, established a rate schedule for purchasing electricity from cogeneration/CHP and small power production facilities.

The most effective deployment of CHP technology will come from regional and local activities. This is true because most of the barriers are due to local issues, such as site permitting, interconnection requirements and studies, local utility pricing, and local building codes and standards. These barriers can be overcome with support from regional and local entities. Some of the entities that the Midwest CHP Application Center (MAC) has identified that could assist with the development and/or deployment of CHP in Indiana are:

- Governor Office
- Indiana Department of Natural Resources (DNR)
- Indiana Department of Environmental Management (IDEM)
- Indiana Utility Regulatory Commission
- Midwest CHP Initiative

If the regulatory and policy issues become more supportive of CHP installations, Indiana should be able to achieve or even exceed the currently estimated market potential for CHP systems.

This report concludes with recommendations, which address the need to work with state regulators to educate private market participants on CHP benefits. Case studies are needed which show the tremendous economic and environmental benefits of CHP systems. As mentioned above alliances have to be formed with already influential groups in the CHP field such as the Governor's office, the Indiana Department of Natural Resources, NIPSCO, and others to develop synergies between these companies and the Midwest CHP Application Center to promote the use of CHP.

1. Introduction and Purpose

Combined heat and power (CHP) refers to technologies which generate electric power at or near the point of use, such as a facility or facility complex, while simultaneously recovering up to 80% of the heat rejected from the power generating equipment for heating, cooling and/or dehumidification purposes.

The purpose of this analysis is to assess the current status of the CHP sector in Indiana and identify current hurdles that prevent the widespread use of CHP systems. This information was used to identify target markets for CHP systems as well as development of education and market transformation programs, which will foster CHP applications. Finally, an action plan has been developed to further CHP deployment in Indiana.

In order to assess the current state of CHP in Indiana, a comprehensive survey of key players involved with this technology was conducted. Key engineering firms, manufacturers, distributors, architectural firms, energy suppliers and federal, state and local agencies were identified. Furthermore a survey of existing and pending CHP installations was conducted.

In this report, the initial cost of current CHP related technologies, the prevailing energy prices in the state, and the available financial incentives for CHP systems were evaluated to assess their impact on the marketability of CHP. An assessment of the status of policy related issues pertaining to CHP was conducted. The assessment was performed for several policy areas: CHP interconnection and stand-by rate provisions, net metering, general status of electric deregulation in the state, emerging legislation, and potential partners/advocates of CHP.

The market capacity potential for CHP in Indiana was evaluated to identify the best target sectors for its deployment. This report concludes with recommendations on how to effectively promote the deployment of CHP in Indiana.

2. CHP Contacts in Indiana

2.1 Key Firms in Indiana with CHP Project Experience or Capabilities

One of the major methods to promoting market acceptability of CHP technologies is to engage the efforts of commercial firms that can promote the installation of CHP technologies. Besides those that can benefit directly through profits and savings from CHP, there are other firms which have the interest and capability to get involved with CHP applications either because they promote energy efficiency, green building technologies, or have other CHP supporting missions. The purpose of this section is to identify those key firms that currently exist and that can be allied with the Midwest CHP Application Center to promote the deployment of CHP in Indiana.

There are many companies in Indiana that are engaged in CHP system applications or have CHP system capabilities. Interest in CHP applications in the State has increased slightly over the last few years through the activities of a multitude of local and regional organizations that are involved with the promotion of CHP applications.

Architectural and Engineering firms are important to promoting CHP technologies because the most economical time to install a CHP system is during the construction of a new building or during an extensive renovation, when the central heating and cooling plant is being initially installed or completely replaced. This is because the payback period associated with the cost to install a CHP system need only be justified on the cost differential between the CHP system and a conventional central cooling/heating system which otherwise would have to be installed. Architectural and engineering firms are generally engaged in the design and installation of such facilities in commercial and light industrial applications. Appendix A provides information on architectural firms and engineering firms that are potential allies in the promotion of CHP installation in Indiana.

Manufacturers of power generation equipment, absorption chillers, and desiccant dehumidification equipment, and their sales representatives are important to promoting CHP technologies for obvious reasons, to sell their equipment. In most cases these manufactures have established a market presence and have built relationships with those most likely to install CHP technologies. However, these manufactures are now just beginning to work together to develop “packaged” integrated power, heating, and cooling systems. The Department of Energy has awarded eleven contracts for the development of packaged CHP systems. NiSource Energy Technologies, Merrillville, Indiana has received one of those awards. These awards are for the accelerated development of CHP systems based on off-the-shelf components. The NiSource system will be a packaged system based on the new microturbines with advanced heat recovery system for hotels.

While the various packaged/modular CHP systems are at various stages of development, it is still important to strive to find technically and financially suitable applications where manufacturers can work with engineering and architectural firms to install “custom” systems. Appendix B provides information on manufacturers that promote CHP installations in Indiana.

Property management firms are important in promoting CHP technologies because they are the operators of many commercial buildings for which CHP technologies are suitable. Building codes for commercial buildings often times require emergency generation backup-power. Since property management firms may already be required to install

generation equipment, the cost differential to install CHP over a conventional central heating/cooling system is smaller and easier to justify. The two main organizations that represent property management firms in Indiana are BOMA (Building Owners and Managers Association) and IREM (Institute of Real Estate Managers), which accredits recognized real estate management organizations. Information on the Indiana BOMA chapter and IREM accredited Indiana property management companies can be found Appendix C.

Local energy suppliers are also important to promoting CHP. Many have formed subsidiary companies to promote distributed generation. Especially the gas supply companies, such as Northern Indiana Public Service Company (NIPSCO), are interested in CHP since natural gas constitutes an important fuel source for CHP systems and hence tremendous profit potential for gas supply companies. A list of energy supply companies in Indiana is provided in Appendix D. NiSource Energy Technologies, one of the sister companies of NIPSCO, is involved in one of the DOE packaged CHP awards. The NiSource system will be a packaged system based on microturbines with advanced heat recovery system for hotels. A fact sheet on this project and some of the other CHP installations in Indiana are shown in Appendix I.

Energy Services companies (ESCOs) are just beginning to become interested in CHP technologies. In the past they have not been interested because it was easier for them to find other cost saving measures like lighting retrofits and energy control systems in commercial and light industrial applications, and in many cases regulations and siting requirements served as a disincentive for them to install CHP. Appendix F lists ESCO's that are active in Indiana.

2.2 Associations and Organizations Involved with CHP Deployment

Federal, State, and regional governmental entities are becoming more interested in CHP systems because of the energy savings potential and reduction in emissions from this technology. While the Federal government, through the U.S. Department of Energy (DOE), has provided substantial support, the most effective deployment of CHP technology will come from regional and local activities. This is true because most of the barriers are due to local issues, such as site permitting, interconnection requirements and studies, local utility pricing, and local building codes and standards. These barriers can be overcome with support from regional and local entities.

The Midwest is home to many non-profit organizations and associations that have come forward to support the deployment of CHP. In fact the Midwest appears to be leading the way in promoting the deployment of CHP. A list of these associations and organizations and their web-addresses, where available, is provided in Appendix G.

3. Survey of CHP Installations in Indiana

3.1 Survey Summary

This survey was conducted to identify existing CHP installations in order to assess the current statutes of CHP in Indiana; to establish where we are today and to identify those facility types where CHP was most prevalent.

The information in this section is based on input from various sources including; personal interviews, manufactures and distributors, Web sites, associated organizations, and journals. The survey of CHP installations and potential CHP targets is primarily based on the use of published data as well as on some personal interviews. Published data consisted of the database of the Energy & Environmental Associates Web site (http://www.eea-inc.com/chpdata/index.html) and that of the Energy Information Administration's "Inventory of Non-utility Electric Power Plants in the United States" for 2000 published in 2003. (http://www.eia.doe.gov/cneaf/electricity/ipp). Sites that are greater than 1 MW are easier to identify because they must file siting reports with the Environmental Protection Agency (EPA). However, sites less than 1 MW may or may not have to file with the EPA, making them more difficult to identify.

A total of 30 CHP and distributed generation systems at 26 sites producing about 2,129,000 kW, are known to be in operation in Indiana. Appendix G categorizes and lists the known distributed generation installations based on the facility type in which the system is installed and provides the size of the installed generation capacity. . The sites identified represent the best efforts of the Midwest CHP Application Center to identify actual and potential CHP installations in Indiana at the time of this report. Other existing or potential CHP sites may exist; they will be added to the database and will be available over the website in the future as they are identified.

3.2 Sector Analysis of the Survey Data

The sites identified during the survey represent the best efforts of the Midwest CHP Application Center to identify actual and potential CHP installations in Indiana. Other existing or candidate CHP sites may exist. An analysis of the survey information for the commercial and light industrial sectors in Appendix G is provided in Table 3-1 and Figure 3-1.

As can be seen, industry and schools/universities constitute the biggest installed CHP market segment in Indiana followed by hospitals. There is a large potential market to add CHP, especially in the industrial and colleges/universities sector where there is a large percentage of installed generation without heat recovery.

According to the EIA data for 2000 published in January 2003, total non-utility generation capacity in Indiana was 3,780, 000 kW. Since, the total installed CHP capacity in Indiana is estimated to be about 2,129,000 kW (according to the EEA database), the remaining 1,651,000 kW (the difference between the EIA and the EEA data) represents on-site generation capacity in which heat from prime movers is not being utilized. Thus, potential exists in Indian to convert these on-site generation systems to CHP systems in the future.

Table 3-1 Installed CHP Capacity by Sector in Indiana

Business Sector	Installed Generation Capacity, kW	% of Total
Hotel/Motel	90	0.00
Hospitals	2,748	0.13
Schools	1,750	0.08
Colleges & Universities	144,850	6.80
Health Clubs/Spas	120	0.01
Others	6,530	0.31
Industrial	1,952,635	91.73
District Energy	20,000	0.94
Total	**2,128,723**	**100.00**

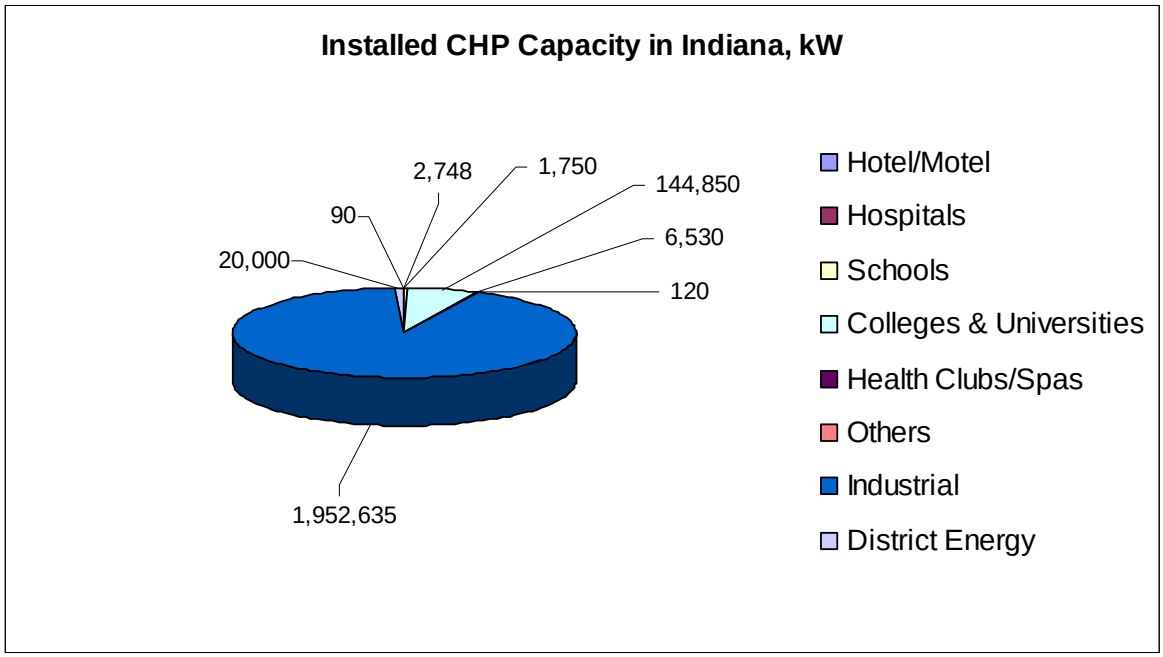

Figure 3-1 Installed CHP Capacity (kW) in Indiana by Business sector

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4. Current Pricing Issues

Capital costs as well as operating costs are generally viewed as some of the major hurdles to utilize CHP technologies. This section will address these issues.

4.1 Equipment and Maintenance Costs

The predominant prime mover technologies in CHP applications are reciprocating engines, combustion turbines, and microturbines. In the near future fuel cell technology is expected to become a prevalent CHP technology as well.

Each technology operates at different efficiency and capacity size levels. The following table compiled by the Midwest CHP Application Center indicates the cost and other relevant technical data for the various equipment types.

Table 4-1 CHP Technologies

Prime Mover Type	**Reciprocating Engines**		**Gas Turbines – Simple Cycle**		**Microturbines**	**Fuel Cell**
Capacity Rage *(kW)*	100 – 500	500 – 2,000	1,000 – 10,000	10,000 – 50,000	100 – 500	30 – 3,000
Electric Generation Efficiency LHV of Fuel *(%)* Heat Rate *(BTU/kWh)*	 24 – 28 14,000 – 12,000	 28 – 38+ 12,000 – 9,000	 24 – 28 14,000 – 12,000	 31 – 36 11,000 – 9,500	 25 – 30 13,700 – 11,400	 40 – 57
Installed Cost *(/kW)** *(with Heat Recovery)*	$1,800 – 1,400	$1,400 – $1,000	$1,500 – $1,000	$1,000 – $800	$2,000 – $1,000	$2,000 - $5,000
O & M Costs *(/kWh)*	$0.015 – $0.012	$0.012 – $0.010	$0.015 – 0.012	$0.012 – $0.010	$0.015 – $0.012	$0.002 - $0.005
Recoverable Useful Heat Hot Water *(BTU/h per kW)* Steam *(lbs/h per kW)*	 4,000 – 5,000 4 – 5 *(15 – 30 psig)*	 4,000 – 5,000 4-5 *(15 – 30 psig)*	 5,000 – 6,000 5 – 6 *(300 –600 psig)*	 5,000 – 6,000 5 – 6 *(300 –600 psig)*		
Absorption Chiller						
Single ($/RT)	$500 - $1,000	$250 - $500	$200 - $250	$200 - $250		
Double ($/RT)	N/A	N/A	$400 - $500	$350 - $400		
Cooling Capacity (RT/kWe)	0.22 - 0.28	0.22 - 0.28	0.28 – 0.33	0.28 – 0.33		
Electric Chiller ($/RT)	$200 - $300	$200 - $300	$180 -$250	$180 -$250		

4.2 Energy Pricing

The potential for CHP in a state depends largely on the prevailing electricity prices as well as on the prevailing natural gas prices, since natural gas is the fuel of choice for many CHP systems. Relatively high electricity prices and low natural gas prices result in favorable financial paybacks for CHP.

As shown in Figure 4-1, average price of electricity for commercial customers in the state has gone up from $0.0631/kWh in April 2004 to $0.0649/kWh in April 2005. These electricity prices are below the average prices in the Midwest ($0.0679/kWh) and the U.S. ($0.0811/kWh) in April 2005. As expected, average electricity prices for industrial consumers, shown in Figure 4-2, are lower by about $.02/kWh than those for the commercial consumers.

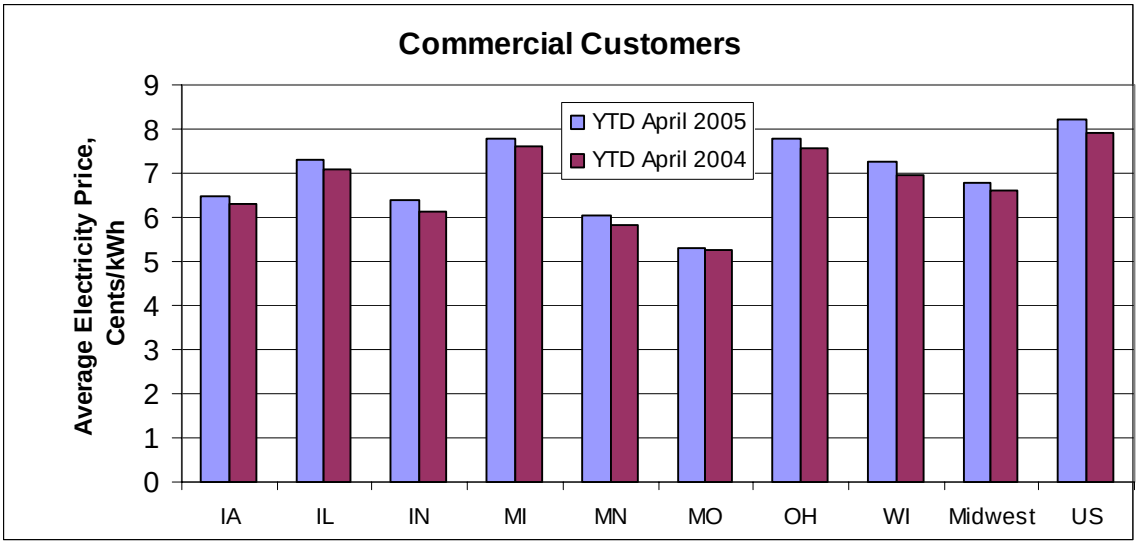

Figure 4-1 Average Price of Electricity for Commercial Customers

(Source: Energy Information Administration http://www.eia.doe.gov/cneaf/electricity/epm/epmt53p1.html)

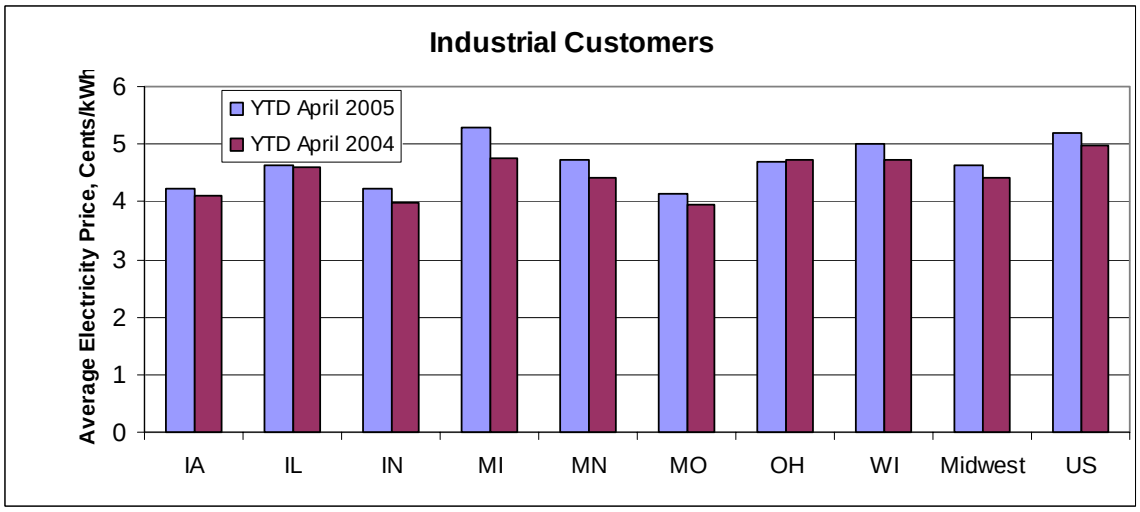

Figure 4-2 Average Price of Electricity for Industrial Customers

(Source: Energy Information Administration http://www.eia.doe.gov/cneaf/electricity/epm/epmt53p1.html)

On the other hand, average natural gas price of $9.62/1000 Cu.Ft. (YTD May 2005) for commercial consumers in Indiana is above the average price in the Midwest ($9.34/1000 Cu. Ft.) as shown in Figure 4-3. Therefore, the 'spark spread,' the difference between the prices of electricity and gas (both expressed in dollars per million Btu) is not very attractive.

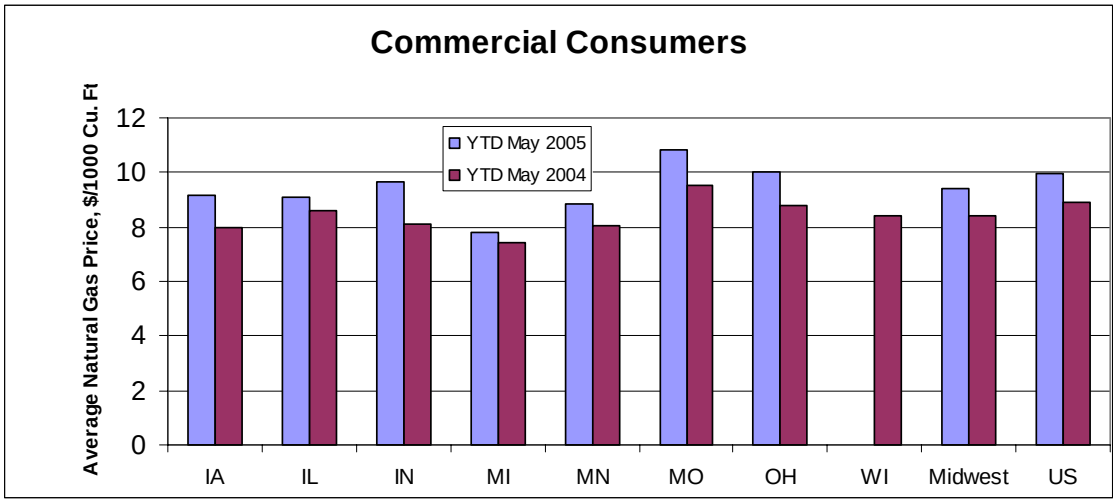

Figure 4-3 Average Price of Natural Gas for Commercial Consumers

(Source: Energy Information Administration/Natural Gas Monthly May 2005)

Relatively low electricity rates and high natural gas prices in Indiana compared to neighboring Midwest states may result in a less attractive environment for CHP in Indiana.

Opportunities for CHP are better in the Northern part of Indiana, where electricity prices are higher than the state average prices of electricity.

In response to concerns expressed by end-users on the recent fluctuations in natural gas pricing, the Midwest CHP Application Center has developed a methodology to evaluate the break even point for various CHP applications based on effective electric price per kWh and natural gas prices per MMBtu. This methodology is presented in Appendix I

5. Summary and Status of CHP Policy Issues

Policy issues at the State level play an important role in the deployment of CHP within a State. The purpose of this section is to provide a summary and status of policy related issues pertaining to the advancement of CHP in the State of Indiana. The following policy areas are summarized below: Access and Interconnection Rules, General Status on Progress of Deregulation, Emerging Legislation, Exit Fees, and Standby Charges.

5.1 Access and Interconnection Rules

Indiana has not yet established interconnection standards. There is no State standard for the interconnection process and related fees. The Indiana Utility Regulatory Commission (IURC) is working on developing such standards. As of May 2005, interconnection is based entirely on UL standard 1741.

In May 2005, the Federal Energy Regulator Commission issued Order 2006 for interconnection procedure. The Institute of Electrical and Electronics Engineers (IEEE) also has approved standard 1547 for interconnections.

5.2 Exit Fees and Standby Rates

Exit fees and Standby rates can be a disincentive for CHP, since customers have to pay utilities for power "just in case" they need it. Northern Indiana Public Service Company (NIPSCO), Indiana's largest utility has not yet established standby rates. The uncertainty and complexity of the exit fees and standby rate structures underscores one of the major barriers in determining the actual economics of the installation and operation of larger CHP installations.

5.3 Financial Incentives for CHP Systems

The State of Indiana has established an incentive plan for distributed generation using microturbines, fuel cells, landfill gas, and cogeneration. The program provides state grants up to $30,000. The Indiana Office of Energy Policy administers this program. If the thermal efficiency of the system is greater than 50%, the eligible amount is 20% of the equipment cost or $30,000, whichever is less. If the thermal efficiency is greater than 70% or the system uses renewable energy or zero-emission fuel cell, the eligible amount increases to 30% of the equipment cost or $30,000, whichever is less. Visit the Website (http://www.indianacommerce.com/Grants/grants.asp?SectionID=18&ProgramID=25) for more details.

5.4 Net Metering

In May 2005, IURC approved net-metering tariffs filed by all five investor-owned utilities operating in the state. A sample of the Net Metering information for the NIPSCO service territory is shown in Appendix J.

5.5 General Status of Progress on Deregulation

Deregulation in Indiana is not as certain as it seemed to be a few years ago. Power supply shortages in California and high electricity rates that resulted from the shortages put deregulation in California back on its heels. Their program has been a hot topic of the regulators there. Problems with deregulation, although not as severe as California, have also occurred in other state deregulation programs. More recent events involving the Enron scandal and charges of misconduct in other large energy companies has also caused state legislators to put deregulation plans on hold. It is still likely that the electrical utility industry is going to be deregulated or "re-regulated" in the future. If and

when deregulation does occur, it is still likely that the electric utility that currently serves a customer now will continue to deliver energy to the customer location, maintain the lines and repair outages. Customers will have the option to choose the company who provides the actual energy that they use. That choice could be a provider other than their present utility. This is why some refer to the restructuring of the industry as a "customer choice" initiative. No one is sure when restructuring or customer choice is going to unfold in Indiana.

5.6 Emerging Legislation and Regulations

There is currently no significant emerging legislation in Indiana that is relevant to CHP.

5.7 U.S. EPA CHP Partnership

The EPA CHP Partnership is a voluntary program designed to foster cost-effective CHP projects. Through the program EPA engages the CHP industry, state and local governments, and other stakeholders in cooperative relationships to expand the use of CHP. As part of the partnership program, state and local governments agree to host a CHP workshop and review EPA documents detailing state and local regulations that may affect CHP development. Industrial partners agree to work with EPA to evaluate the use of additional CHP at their facilities. The Indiana Department of Commerce-Energy & Recycling Office, and NiSource, Inc. (The parent company of NIPSCO) participate in EPA's CHP Partnership program.

5.8 Potential Political Partners or Advocates of CHP

Below is a list of groups, other than the Midwest Application Center, that could assist with the development and/or deployment of a CHP in Indiana.

- Office of Energy Policy of the Office of Lieutenant Governor
- Indiana Department of Natural Resources
- Indiana Senate Utility and Regulatory Affairs Committee
- Indiana Senate Economic Development and Technology Committee
- Indiana Department of Commerce-Energy/Recycling Programs
- State Utility Forecasting Group (SUFG Purdue University)

The office of the Indiana Governor, the Mayor of Indianapolis, or the leadership in the Indiana House or Senate could also help, however, they are likely to be more difficult to reach and/or influence. Members of their staff may be better targets with any CHP initiative. The groups listed above are not to be viewed as all-inclusive, as there are other groups and or organizations to be targeted. Those listed above, however, should make for a good starting point.

A very favorable partner for CHP is NiSource Energy Technologies. As mentioned earlier, they are participating in one of the DOE packaged CHP development projects and they are actively marketing distributed energy technologies.

6. The Market Capacity Potential of CHP in Indiana

All of the groups listed in the previous section could assist with the development and/or deployment of a CHP in Indiana.

The office of the Indiana Governor, the Mayor of Indianapolis, or the leadership in the Indiana House or Senate could also help, however, they are likely to be more difficult to reach and/or influence. Members of their staff's may be better targets with any CHP initiative. The groups listed above are not to be viewed as all-inclusive, as there are other groups and or organizations to be targeted. Those listed above, however, should make for a good starting point.

A very favorable partner for CHP is NiSource Energy Technologies. As mentioned earlier, they are participating in one of the DOE packaged CHP development projects and they are actively marketing distributed energy technologies.

7. The Market Capacity Potential of CHP in Indiana

The previous sections identified the key parties currently involved with CHP technology and detailed some of the areas preventing market transformation. However, market transformation in favor of CHP technologies is only viable if the market potential exists. Therefore this report discusses the market potential for each CHP category: industrial, and commercial.

Estimates for the Industrial/Commercial Sector were derived from a previous study conducted by ONSITE-SYCOM Energy Corporation (ONSITE).

7.1 Industrial and Commercial Market

ONSITE Energy Corporation in January 2000 prepared a study for the Energy Information Administration titled "The Market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector." This study identified potential CHP application sites using the iMarket, Inc. MarketPlace Database to select commercial/industrial building types based on SIC codes.

The potential buildings were: hotels/motels, nursing homes, hospitals, schools, colleges, commercial laundries, car washes, health clubs, golf clubs, museums, correctional facilities, water treatment plants, extended service restaurants, supermarkets and refrigerated warehouses. The buildings were divided into different groups based on their electric demand. The electric demand was estimated using data from Wharton Economic Forecasting. As a result ONSITE selected 1,431,805 buildings in the United States as suitable for CHP applications requiring a capacity of 77,281,000 kW.

There study focused on applications where thermal energy load was in the form of steam or hot water usage. It did not take into consideration the use of thermal activated technologies such as absorption chillers or desiccant dehumidifiers as potential candidates for thermal load. Taking into consideration these technologies will likely increase the market potential from their estimates. On a state-by-state basis, ONSITE estimated the following potential as shown in Figure 7-1 on the next page.

For Indiana, ONSITE estimated a total market potential for electric production to be about 949, 000 kW. The estimates of the potential for CHP in Indiana for commercial and institutional market sectors are shown in Figure 7-1 and Table 7-1. These estimates show that the highest potential for CHP market is in three sectors: schools, hospitals and nursing homes. This represents about 2% of the projected DOE long-term goal of 47 gigawatts of installed CHP capacity that was developed as part of the CHP Roadmap Workshop. This potential may only be realized if the regulatory and policy issues become more supportive of CHP installations. Also if incentives are provided, additional market potential capacity could be realized.

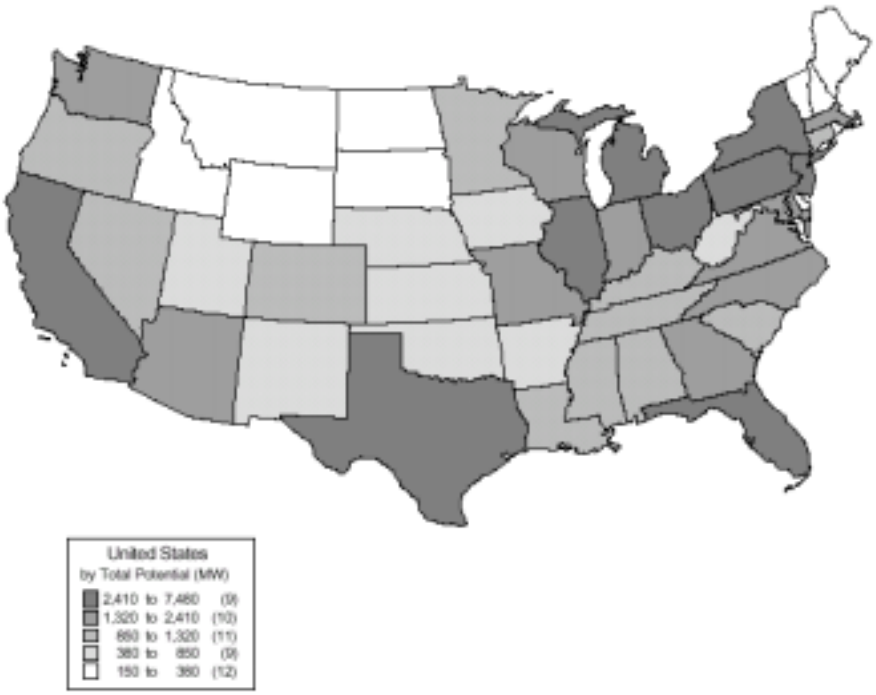

Figure 7-1 CHP Potential in the US at the State Level

Table 7-1 CHP Potential in Indiana For Commercial/Institutional Markets

Business Sector	Potential Capacity, kW	% of Total
Hotel/Motel	71,000	7.5
Nursing Homes	155,900	16.4
Hospitals	183,800	19.4
Schools	342,300	36.1
Colleges & Universities	91,300	9.6
Commercial Laundries	9,300	1.0
Car Washes	5,800	0.6
Health Clubs/Spas	60,600	6.4
Golf Clubs	28,700	3.0
Total	948,700	100.0

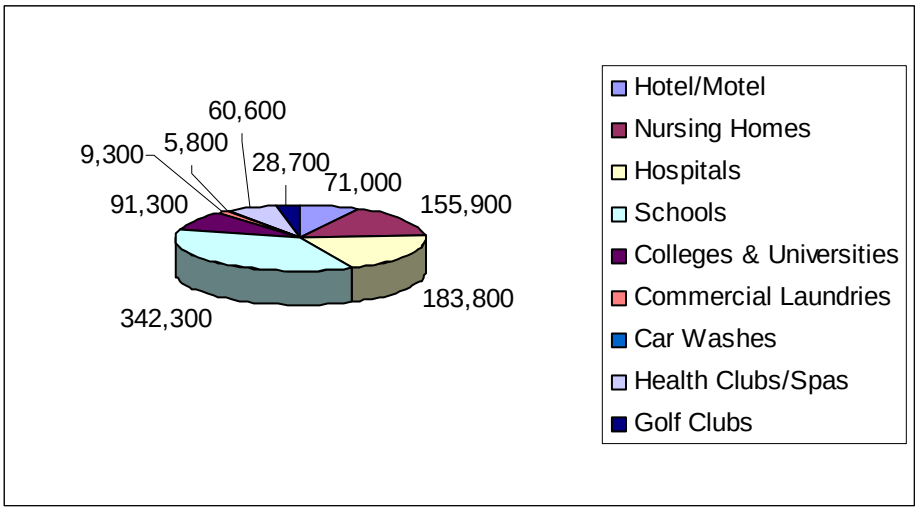

Figure 7-2 CHP Market Potential in Indiana

7.2 Biomass Based CHP Applications

Indiana has a significant resource of biomass. Total quantitative estimate of this resource is not yet known. The sources of biomass in Indiana include, but not limited to the following:

- Agricultural waste
- Industrial waste
- Wood processing waste
- Duck and hog farms
- Dairy Farms

In view of the current high prices of natural gas, biomass becomes a potentially attractive fuel for CHP applications. For example, about a year ago, Fair Oaks Dairy Farm (Fair Oaks, Indiana) installed a CHP system incorporating two 375-kW engines (total capacity of 750 kW) that utilize biogas from digesters that are fed by dairy and swine flush systems. The site of the CHP located houses 3000 milk cows. Thermal energy available from the engines is used for heating the digesters.

8. Conclusions and Recommendations

8.1 Conclusions

8.1.1 Interest Level

In Indian there are several energy companies, engineering firms, as well as equipment manufactures and distributors who are aggressively pursuing the CHP market in Indiana. The Midwest is home to many non-profit organizations and associations that have come forward to support the deployment of CHP, in fact the Midwest appears to be leading the way in promoting the deployment of CHP with such organizations as the Midwest CHP Initiative.

8.1.2 Installation Status

The Midwest Application Center identified a total of 30 CHP systems, producing a little over 2,128,700 kW in Indiana. Industry and colleges/universities constitute the biggest installed CHP market segment in Indiana. Total potential for CHP in commercial/institutional markets in Indiana is estimated to be 948,700 kW. The largest potential for adding CHP exists in schools, followed by hospitals and nursing homes. In Potential also exists for converting existing 1,651,000 kW on-site generation capacity to CHP systems.

8.1.3 Barriers

Capital costs and payback time frames are of concern. The least expensive electric generating technologies (large natural gas turbines) installed start around $600/kW and increase up in cost to fuel cell technologies that run up to $5,000/kW. Additional costs, associated with thermal recovery equipment and engineering costs further add to the cost of the project. For smaller generating capacity units, this initial cost can have a long payback period unless electric costs are very high and thermal loads well matched. Prices are expected to decrease as the technologies and "packaged" system designs become more common.

Operating costs due to fluctuating and high natural gas prices may be perceived as a concern.

Standby charges are also a factor in CHP because they affect the payback period. NIPSCO, the largest utility in Indiana has not yet established standby charges. These charges have to be negotiated on a case-by-case basis.

8.1.4 Favorable Characteristics

Exit fees do not yet exist.

Favorable political climate for energy efficient technologies appears to exist in Indiana. State grants are available for high-energy efficiency systems such as CHP.

Market potential appears to be reasonable for CHP. ONSITE Energy Corporation estimates for Indiana total market potential of 949 MW.

Availability of natural gas is good in Indiana. The state produces about 25% of their own gas needs and have substantial gas storage facilities.

Availability of opportunity fuels is good in Indiana. In view of the high gas prices, biogas produced from biomass waste produced in dairy farms, agriculture, wood processing, wastewater treatment could be attractive for implementing CHP projects.

8.2 Recommendations

1) Increase Interest and Market Penetration

   Develop a higher level of interest in CHP by providing information and education to Architects, Engineers, Property Management Firms on the

   - Technical and financial benefits of CHP.
   - Siting and permitting process.
   - Successful CHP installations (Case Studies).
   - Technical and financial assessments tools and resources available.

2) Influence the Removal of Regulatory Barriers

   Work with the Indiana Utility Regulatory Commission to
   - Reduce or eliminate stand-by charges.

   Work with the Legislative to
   - establish appropriate incentives for CHP such as tax breaks and environmental credits.
   - Promote net metering legislation

3) Build Alliances

   Build alliances with potential partners such as:
   - Large Architect/Engineering Firms with CHP capabilities
   - NiSource Energy Technologies

Appendix A Architect and Engineering Firms Promoting CHP Technologies in Indiana

ARCHITECT COMPANIES

American Institute of Architects-Indiana Chapter
47 S. Pennsylvania St., Suite #201
Indianapolis, IN 46204-3699
Phone: (317) 634-6993
E-mail: aiaindiana@ameritech.net ·

Dennis Kim & Associates
2120 Parkland Dr.
Fort Wayne, IN 46825-3929
Phone: (260) 484-3355
Building Types: Health Care, Retail

Design Collaborative, Inc.
825 Barr St. #100
Fort Wayne, IN 46802-2722
Phone: (260) 422-4241
Building Types: Commercial, Retail

Gerald E. Guy & Associates
214 South Adams St.
Marion, IN 46952-3836
Phone: (765) 662-8165
Building Types: Commercial, Community, Education, Government, Health Care, Recreation, Residential

K.R. Montgomery & Associates, Inc.
1020 Jackson St.
Anderson, IN 46016-1453
Phone: (765) 649-8477
www.krmontgomery.com
Building Types: Community, Education, Health Care, Recreation

Kato Smith & Associates, Inc.
7 East 12th St.
Anderson, IN 46016-1684
Phone: (765) 644-3712
www.katosmith.com
Building Types: Commercial, Community, Government, Health Care, Residential, Retail

Martin Riley Mock Architects Engineers
221 West Baker St.
Fort Wayne, IN 46802-3413
Phone: (260) 422-7994
Building Types: Commercial, Education, Government, Health Care, Industrial, Residential, Retail

Morrison Kattman Menze, Inc.
119 West Wayne St.
Fort Wayne, IN 46802-2503
Phone: (260) 422-0783
Building Types: Community, Education, Government, Health Care

Scearce Rudisel Architects, Inc.
120 South Buffalo St. #A
Warsaw, IN 46580-2801
Phone: (574) 269-1596
srarchitects.com
Building Types: Commercial, Community, Education, Government, Health Care, Retail

Signature Designs, LLC
12207 Illinois Rd.
Fort Wayne, IN 46814-9103
Phone: (260) 625-4403
www.signaturedesignsllc.com
Building Types: Commercial, Health Care, Recreation, Residential, Retail

Vintage Archonics Inc.
8205 Lima Rd.
Fort Wayne, IN 46818-2161
Phone: (260) 489-3543
www.vintagearchonics.com
Building Types: Commercial, Community, Education, Health Care, Industrial, Recreation, Residential, Retail

ENGINEERING COMPANIES

American Council of Engineering Companies (ACEC) - Indiana Chapter

One Virginia Avenue, Suite 250
Indianapolis, IN 46204
phone: 317-637-3563
fax: 317-637-9968
e-mail: staff@acecindiana.org

Applied Engineering Services, Inc.
7999 Knue Road, Suite 300
Indianapolis, IN 46250
Phone: (317) 585-8920
Fax: (317) 585-8921

Avalon Consulting, Inc.
427 Prairie Knoll Drive
Naperville, IL 60565
Phone: (630) 983-0883
Fax: (630) 357-1004
Capabilities: Technical and Economic Feasibility/Evaluation Services

Ballard Engineering
3555 Electric Avenue
Rockford, IL 61125
(815) 229-1800
Capabilities: CHP Turnkey Systems

Biagi, Chance, Cummins, London, Titzer, Inc.
300 N.W. Second Street
Evansville, IN 47708-1299
Phone: (812) 423-4407
Fax: (812) 421-2239
Email: office@BCCLT.com
Web: www.BCCLT.com

Boyd Engineering, Inc.
1044 White Ash Ct.
Mooresville, IN 46158
Phone: (317) 831-7666
Fax: (317) 831-7666

BSA LifeStructures
9365 Counselors Row, Suite 300
Indianapolis, IN 46240
Phone: (317) 819-7878
Fax: (317) 819-7288
Email: djacobs@bsalifestructures.com
Web: www.bsalifestructures.com

CEI Engineering Associates, Inc.
219 E. Griffin
R#2 Box 395
Jasonville, IN 47438
Phone: (812) 665-2556
Fax: (812) 665-4457

Christopher B. Burke Engineering, Ltd.
115 W. Washington, Suite 1368 South
Indianapolis, IN 46204
Phone: (317) 266-8000
Fax: (317) 632-3306
Email: cbbel@cbbel-in.com
Web: www.cbbel-in.com

Clark Dietz, Inc.
9000 Keystone Crossing, Suite 350
Indianapolis, IN 46240
Phone: (317) 582-0300
Fax: (317) 582-0305
Email: dalet@clark-dietz.com
Web: www.clark-dietz.com

Collins Engineers, Inc.
1496 Pope Ct. #3
Chesterton, IN 46304
Phone: (219) 921-0482
Fax: (219) 921-0485
Email: jsherman@collinsengr.com
Web: www.collinsengr.com

DLZ Indiana, LLC
2211 E. Jefferson Blvd.
South Bend, IN 46615
Phone: (574) 236-4400
Fax: (574) 236-4471
Email: chume@dlz.com
Web: www.dlz.com

GRW Engineers, Inc.
7112 Waldemar Drive
Indianapolis, IN 46268
Phone: (317) 347-3650
Fax: (317) 347-3656
Email: gwright@grwinc.com
Web: www.grwinc.com

LaSalle Associates
3700 North Southport
Chicago, IL 60613
Capabilities: CHP Turnkey Installations

Montgomery Watson Harza
175 West Jackson Blvd
Chicago, IL 60604-2814
Capabilities: CHP Turnkey Installations

Malcolm Pirnie, Inc.
5975 Castle Creek Pkwy N. Dr., Suite 355
Indianapolis, IN 46250-4346
Phone: (317) 594-0989
Fax: (317) 594-0185
Email: rerhardt@pirnie.com
Web: www.pirnie.com

Parsons Brinckerhoff Quade & Douglas
47 S. Pennsylvania, Suite 600
Indianapolis, IN 46204
Phone: (317) 972-1706
Fax: (317) 972-1708
Email: flemings@pbworld.com
Web: www.pbworld.com

Primera Engineering
25 E. Washington St.
Suite 510
Chicago, IL 60602
(312) 606-0629
Capabilities: HVAC Engineering, CHP Potential

Project Associates, Inc.
PO Box 15395
333-D N. Plaza East Blvd.
Evansville, IN 47716-0395
Phone: (812) 473-2424
Fax: (812) 473-8526
Email: Tboettcher@ProjectAssociatesInc.com
Web: www.ProjectAssociatesInc.com

Rotz Engineers, Inc.
PO Box 24357
2828 North High School Road
Indianapolis, IN 46224-2914
Phone: (317) 293-4310
Fax: (317) 293-1282
Email: rotz@rotzengineers.com
Web: www.rotzengineers.com

RQAW Corporation
4755 Kingsway Drive, Suite 400
Indianapolis, IN 46205-1547
Phone: (317) 255-6060
Fax: (317) 255-8354
Email: roconnor@rqaw.com
Web: www.rqaw.com

Stanley Consultants, Inc.
225 Iowa Avenue
Muscatine, IA 52761
(563) 264-6457
Capabilities: CHP Engineering, Environmental and Construction Services

Strand Associates, Inc.
PO Box 407 (47202)
629 Washington Street
Columbus, IN 47201-6231
Phone: (812) 372-9911
Fax: (812) 372-7190
Web: www.strand.com

Jones & Henry Engineers, Ltd.
2420 Coliseum Blvd. North, Suite 214
Fort Wayne, IN 46805
Phone: (260) 482-1920
Fax: (260) 484-7210
Email: jhengineers@jheng-ftw.com

Lawson-Fisher Associates, P.C.
525 West Washington Avenue
South Bend, IN 46601-1527
Phone: (574) 234-3167
Fax: (574) 236-1330
Email: LFA@Lawson-Fisher.com
Web: www.lawson-fisher.com

Woolpert LLP
7140 Waldemar Drive
Indianapolis, IN 46268-4194
Phone: (317) 299-7500
Fax: (317) 291-5805
Web: www.woolpert.com

NOTE: This list represents only those firms that the MW CHP Application Center was able to identify at the time of this report. Other firms may exist that promote CHP; they will be added to the database and will be available over the website in the future as they are identified.

Appendix B Equipment Distributors/Manufactures That Promote CHP Technologies in Indiana

Cummins Cumberland, Inc.
7901 Highway 41 North
Evansville IN 47725
Tel: (812) 867-4400
Fax: (812) 421-3282
www.cumberland.cummins.com
Capability: manufacturer of reciprocating engines

Cummins NPower, LLC
1440 Texas Street
Gary IN 46402
Tel: (219) 885-5591
Toll Free: (888) 230-6699
Fax: (219) 883-4817
www.npower.cummins.com
Capability: manufacturer of reciprocating engines

Cummins Mid-States Power, Inc.
3661 W Morris St
Indianapolis IN 46241
Tel: (317) 486-5287,(877) 755-1600
Fax: (317) 486-5281
www.midstatespower.cummins.com
Capability: manufacturer of reciprocating engines

Rolls-Royce Corporation
2001 South Tibbs Avenue
Indianapolis, IN 46206-0420
Phone: (317) 230-2000
Fax: (317) 230-4020
http://www.rolls-royce.com/northamerica/facilities/corporation.htm
Capability: manufacturer of reciprocating engines and combustion turbines

Robur Corp.
800 E Franklin St
Evansville, IN 47711
Phone: (812) 424-1800
www.robur.com
Capability: Manufacturer of absorption air conditioners

Solar Turbines Incorporated
40 Shuman Blvd. Suite 350
Naperville, IL 60563
(630) 527-1700
Capabilities: Combustion Turbine Equipment Manufacturer

ADA Systems
955 North Lively Boulevard
Wood Dale, IL 60191
Capabilities: Evaporative Cooling Systems, Energy Recovery

NOTE: This list represents only those firms that the MW CHP Application Center was able to identify at the time of this report. Other firms may exist that promote CHP; they will be added to the database and will be available over the website in the future as they are identified.

Appendix C Property Management Organizations and Firms in Indiana

Building Owners & Managers Association (BOMA)
151 North Delaware Street, Suite 125
Indianapolis, IN 46204
(317) 632-4104
FAX: (317) 632-4106
E-mail: lee@bomaindy.org

Institute of Real Estate Management (IREM)-Northern Indiana Chapter
Holladay Properties
227 S. Main St., Ste. 210
South Bend, IN 46601
Phone: (574) 234-2860
Fax: (574) 284-3799
E-mail: speach@holladayproperties.com

Institute of Real Estate Management (IREM)-Indianapolis Chapter
P.O. Box 90403
Indianapolis, IN 46290-0403
Phone: (317) 815-0163
Fax: (317) 706-0281
E-mail: iremoffice@aol.com

AIMCO Residential Properties, L.P
9200 keystone Crossing
Indianapolis, IN 46240-7602
Phone: 317-817-7500

Ameriplex
5757 Decatur Blvd.
Indianapolis, IN 46241-9536
Phone: 317-856-9000

CB Richard Ellis
115 W. Washington St.
Indianapolis, IN 46204
Phone: 317-261-3867

NOTE: This list represents only those firms that the MW CHP Application Center was able to identify at the time of this report.

Appendix D Energy Supply and Service Companies in Indiana

Natural Gas Providers:

- Citizens Gas & Coke Utility
- Community Natural Gas
- Indiana Natural Gas Corporation
- Kokomo Natural Gas
- Lawrenceburg Gas Company
- Midwest Natural Gas Company
- Northern Indiana Public Service Company (NIPSCO)
- Northern Indiana Fuel & Light Company, Inc. (NIFL)
- Ohio Valley Gas Corporation
- Peoples Gas & Power Company, Inc.
- Vectren Energy Delivery of Indiana (formerly SIGECO/Indiana Gas)

Electricity Providers:

- American Electric Power (Indiana-Michigan Power Company)
- Crawfordsville Electric Light & Power
- Indiana Electric Cooperatives
- Indiana Municipal Power Agency
- Indianapolis Power & Light Company (IPALCO)
- Mishawaka Utilities
- Northern Indiana Public Service Company (NIPSCO)
- PSI/CINERGY
- WINEnergy REMC
- Vectren Energy Delivery of Indiana (formerly SIGECO/Indiana Gas)

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Appendix E Energy Service Companies listed by National Association of Energy Service Companies

AMERESCO
8900 Keystone Crossing, Suite 1075
Indianapolis, IN 46240
Phone: 317-202-3232
Fax: 317-202-3233

Energy Systems Group
4655 Rosebud Lane
Newburgh, Indiana 47630
Phone: 812-471-5000
Fax: 812-475-2544

Johnson Controls
430 E. Sycamore
Evansville, IN
Phone: 812-424-1612
Fax: 812-424-2461

Siemens Building Technologies
6200 Technology Center Drive
Indianapolis, IN 46825
Phone: 46278
Phone: 317-293-8880
Fax: 317-293-0374

Honeywell Technology Solutions
3520 Westmore
South Bend, IN 46628
Phone: 574-231-2000
Fax: 574-231-2780

NOTE: This list represents only those firms that the MW CHP Application Center was able to identify at the time of this report. Other firms may exist that promote CHP; they will be added to the database and will be available over the website in the future as they are identified.

Appendix F Associations/Organizations Associated with CHP Deployment in Indiana

Indiana/Regional Organizations

	Organization	Website
1.	American Institute of Architects	http://www.aia.org
2.	BOMA Building Owners and Managers Association	http://www.boma.org
3.	Center for Neighborhood Technology	http://www.cnt.org
4.	Delta Institute	http://www.delta-institute.org
5.	Environmental Law and Policy Center	http://www.elpc.org
6.	Gas Technology Institute	http://www.gastechnology.org
7.	Great Lakes Renewable Energy Association	http://glrea.org
8.	Indian Energy Group	http://www.in.gov/lgov/issues/energy.html
9.	Indiana Utility Regulatory Commission	http://www.state.in.us/iurc
10.	Interstate Renewable Energy Council (IREC)	http://www.eren.doe.gov/cro
11.	Midwest CHP for Buildings Application Center	http://www.chpcentermw.org
12.	Midwest Cogeneration Association	http://www.cogeneration.org
13.	Midwest Energy Efficiency Alliance (MEEA)	http://www.elpc.org/energy/index.htm
14.	Indiana Department of Natural Resources	http://www.state.in.us/dnr
15.	Purdue University	http://www.purdue.edu

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Federal Government Agencies

	Agency	Website/Contact Information
1.	DOE Combined Heat and Power (BCHP) Initiative	http://www.eren.doe.gov/der/BCHP/
2.	DOE Distributed Energy Resources (DER) Taskforce	http://www.eren.doe.gov/der/
3.	DOE Distributed Power (DP) Program	http://www.eren.doe.gov/distributedpower/
4.	DOE Energy Efficiency and Renewable Energy Network (EREN)	http://www.eren.doe.gov/
5.	DOE Energy Information Administration	http://www.eia.doe.gov/
6.	DOE Industries of the Future (IOF)	http://www.oit.doe.gov/industries.shtml
7.	DOE Inventions & Innovation Program (I&I)	http://www.oit.doe.gov/inventions/
8.	DOE Office of Energy Efficiency and Renewable Energy (EERE)	http://www.eren.doe.gov/ee.html
9.	DOE Office of Industrial Technologies	http://www.oit.doe.gov/
10.	DOE Office of Power Technologies (OPT)	http://www.eren.doe.gov/power/
11.	EPA Climate Protection Division (CPD)	http://www.epa.gov/cpd.html
12.	EPA Office of Air & Radiation	http://www.epa.gov/oar/
13.	EPA Office of Air Quality Planning and Standards	http://www.epa.gov/oar/oaqps/
14.	EPA-DOE Energy Star Program	http://www.energystar.gov
15.	Federal Energy Management Program (FEMP)	http://www.eren.doe.gov/femp/
16.	Federal Laboratory Consortium for Technology Transfer	http://www.fedlabs.org
17.	Manufacturing Extension Partnership (MEP)	http://www.mep.nist.gov/
18.	US Department of Energy (DOE)	http://www.energy.gov
19.	US Department of Housing & Urban Development (HUD)	http://www.hud.gov/
20.	US Environmental Protection Agency (EPA)	http://www.epa.gov

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Others Associations and Organizations

	Organization/Association	Website/Contact Information
1.	Alliance to Save Energy	http://www.ase.org
2.	American Council for an Energy-Efficient Economy (ACEEE)	http://aceee.org
3.	American Planning Organization (APA)	http://www.apa.org
4.	Brookhaven National Laboratory	http://www.bnl.gov
5.	Consortium for Energy Efficiency (CEE)	http://www.ceeformt.org/
6.	Distributed Power Coalition of America (DPCA)	http://www.dpc.org
7.	Electric Power Research Institute (EPRI)	http://www.epri.com
8.	Electric Power Supply Association (EPSA)	http://www.epsa.org
9.	International District Energy Association (IDEA)	http://www.districtenergy.org/
10.	National Association of Regulatory Utility Commissioners (NARUC)	http://www.naruc.org
11.	National Association of State Energy Officials (NASEO)	http://www.naseo.org
12.	National Energy Technology Laboratory	http://www.netl.doe.gov
13.	National Renewable Energy Laboratory	http://www.nrel.gov
14.	Natural Resources Defense Council (NRDC)	http://www.nrdc.org
15.	Northeast Midwest Institute	http://www.nemw.org
16.	Oak Ridge National Laboratory	http://www.ornl.gov
17.	Regulatory Assistance Project	http://www.rapmaine.org
18.	U.S. Combined Heat and Power Association (USBCHPA)	http://www.nemw.org/usBCHPa/

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Appendix G Distributed Generation – Commercial/Light CHP Facilities in Indiana

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Angola	Breeden YMCA	Breeden YMCA	Amusement/Recreation	7991	71394	2002	MT	120	NG
Chesterton	Nisource Primary Energy	Walgreen	General Merch. Stores	5311	45299	1999	CT	30	NG
Chesterton	Hilton Garden Inn	Hilton Garden Inn	Hotels	7011	72111	2002	MT	90	OTR
Crown Point	St. Anthony's Medical Center	St. Anthony's Medical Center	Hospitals/Healthcare	8062	62211	1990	CC	2,748	NG
Culver	Culver Educational Foundation	Culver Educational Foundation Facility/ Culver Military Academy	Misc. Education	8299	611699	1996	ERENG	1,050	NG
Decatur	Central Soya Company, Inc.	Central Soya Decatur Plant	Food Processing	2075	311222	1950	B/ST	2,000	COAL

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
East Chicago	LTV Steel Company	Indiana Harbor Works	Primary Metals	3312	331111	1946	B/ST	161,000	WAST
East Chicago	Primary Energy / Nipsco Industries	Cokenergy-Indiana Harbor Facility	Primary Metals	3312	331111	1998	B/ST	94,000	OTR
East Chicago	Primary Energy / North Lake Energy Corporation	Ispat Inland Steel Harbor Works	Primary Metals	3312	331111	1996	B/ST	75,000	WAST
East Chicago	Primary Energy/ Ironside Energy LLC	International Steel Group	Primary Metals	3312	331111	2002	CT	50,000	NG
Gary	Primary Energy / Nisource-Lakeside Energy	US Steel - Gary Works	Primary Metals	3312	331111	1997	B/ST	161,000	WAST
Hammond	Cargill, Inc.	Cargill - Cerestar	Food Processing	2046	311221	2000	B/ST	16,000	NG
Indianapolis	Energy Group Inc	Covanta Indianapolis Inc	Solid Waste Facilities	4953	562212	1988	B/ST	6,500	WAST
Indianapolis	Perry K	Citizens Thermal Energy	District Energy	4961	22133	1925	B/ST	20,000	COAL

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Indiannapolis	Rolls Royce Corp	Rolls Royce Corp	Transportation Equip.	3711	336111	1963	CT	15,500	BIOMASS
Jeffersonville	Colgate-Palmolive Company	Colgate-Palmolive Company	Chemicals	2844	32562	1940	B/ST	4,875	NG
Lafayette	A.E. Staley Manufacturing Company	A. E. Staley Manufacturing Co.	Food Processing	2046	311221	1985	B/ST	7,400	COAL
Lafayette	Caterpillar Tractor Company	Caterpillar Tractor Company	Machinery	3519	333618	1980	ERENG	3,500	OIL
Mishawaka	Stripco Inc	Stripco Inc	Primary Metals	3312	331111	2003	MT	60	NG
Newburgh	Alcoa Generating Corporation	Alcoa Smelting & Fabrication	Primary Metals	3341	331314	1970	B/ST	755,000	COAL
Notre Dame	University Of Notre Dame	University Of Notre Dame Power Plant	Colleges/Univ.	8221	61131	1952	B/ST	23,100	COAL
Portage	Primary Energy / Portside Energy Corp	National Steel Midwest Finishing Plant	Primary Metals	3312	331111	1997	CC	82,000	NG

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Terra Haute	Indiana State University	Indiana State University	Colleges/Univ.	8221	61131	2001	CT	14,000	NG
Walton	Lewis Cass High School	Lewis Cass High School	Schools	8211	61111	1968	ERENG	1,750	NG
West Lafayette	Purdue University	Purdue University Physical Plant	Colleges/Univ.	8221	61131	1969	B/ST	41,800	COAL
Whiting	BP Amoco Chemicals Company	Whiting Refinery	Refining	2911	32411	1928	B/ST	493,800	NG

Source: http://www.eea-inc.com/chpdata/index.html

Explanations of Prime Mover and Fuel Codes Used in Appendix G

Prime Mover Code	Description		Fuel Code	Description
BS/T	Boiler/Steam Turbine		BIOMASS	Biomass, LFG, Digester Gas, Bagasse
CC	Combined Cycle		COAL	Coal
CT	Combustion Turbine		NG	Natural Gas, Propane
FCEL	Fuel Cell		OIL	Oil, Distillate Fuel Oil, Jet Fuel, Kerosene, RFO
MT	Microturbine		WAST	Waste, MSW, Black Liquor, Blast Furnace Gas, Petroleum Coke, Process Gas
ERENG	Reciprocating Engine		WOOD	Wood, Wood Waste
OTR	Other		OTR	Other

Summary of the CHP Installations Listed in Appendix G

Prime Mover Code	Sites	Capacity (kW)
Total	26	2,032,323
B/ST	14	1,861,475
CC	2	84,748
CT	4	79,530
FCEL	0	0
MT	3	270
OTR	0	0
ERENG	3	6,300

NOTE: *This list represents only those commercial and light industrial facilities that the MW CHP Application Center was able to identify at the time of this report. Other commercial and light industrial facilities may exist that have distributed generation; they will be added to the database and will be available over the website in the future as they are identified.*

Appendix H Project Profiles of Some of the CHP Installations in Indiana

MIDWEST CHP APPLICATION CENTER

combined heat & power in healthcare

Elkhart General Hospital
745 kW CHP Application

Project Profile

Quick Facts

- **Location:** Elkhart, Indiana
- **Facility Size:** 700,000 square feet
- **Number of Staffed Beds:** 337 Beds
- **Facility Type:** Medical Campus – Multiple Buildings
- **Maximum Electric Demand:** 3,500 kilowatts
- **Generating Equipment:** Caterpillar Model 3516 Reciprocating Engine
- **Generating Capacity:** 745 kilowatts (kW)
- **Primary Fuel:** Natural Gas
- **Heat Recovery:** Domestic Hot Water
- **Operation Schedule:** Peak Shaving during On Peak Hours of Spring, Summer, & Fall Months
- **Local Electric Utility:** American Electric Power (AEP)
- **Begin Operation:** 1991

Project Overview

Elkhart General Hospital (EGH) of Elkhart, Indiana operates a 745 kW Combined Heat and Power (CHP) System that provides electric peak shaving and domestic hot water to the 700,000 sq. ft. hospital campus. The prime mover of the CHP system is a 745 kW Natural Gas Caterpillar Model 3516 Reciprocating Engine that is operated during the spring, summer and fall months to avoid the high demand charges associated with the local utility's on peak period. With an electric demand price of $16.02 per kilowatt, the hospital saves nearly $12,000 per month on demand charges alone when operating the CHP system.

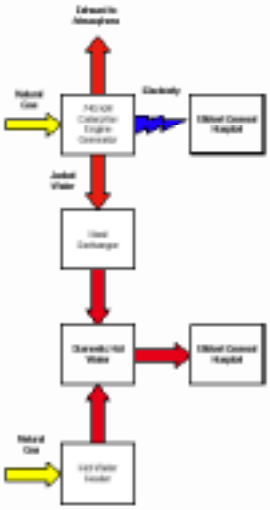
Elkhart General Hospital West Wing.

CHP Operation

In 1991, the hospital began operation of the CHP system. The motivating factors of potential energy savings and government energy awareness efforts aided in persuading the EGH staff to pursue the benefits of combined heat and power at their medical campus. The primary parties involved in the CHP installation process included Caterpillar, Inc., the equipment supplier, and Enercon, the electrical contractor and engineering firm.

The CHP system, located in the hospital's Energy Center (central heating and cooling plant) operates in parallel with the local electric utility - American Electric Power (AEP). The system is activated during the spring, summer, and fall months to combat the high electric demand charges associated with the operation of the hospital's electric centrifugal chillers. During these months, the system is operated 16 hours per weekday in conjunction with AEP's "on peak energy" period.

CHP Configuration



Additional Facts

- When in operation, the CHP system supplies nearly 20% of the maximum 3,500 kW facility electric demand.
- The Elkhart General Hospital engineering staff provides the daily maintenance of the CHP system, checking the oil, battery and standard operation of the system.
- Mac Allister Machinery Company of South Bend, Indiana (Caterpillar dealer supporting most of Indiana) provides a maintenance and check-up of the Caterpillar engine twice a year.
- Elkhart General Hospital has been satisfied overall with the operation of the CHP system and the benefits and savings that are provided to the hospital via the CHP system.
- Major maintenance and repairs of the CHP system have included repairing the radiators twice, addressing computer control issues during the '04 summer, a top end overhaul, typical for the number of hours the engine generator has operated, and minor maintenance issues.

Monthly electric demand savings near $12,000

20% of the electric demand is met by the CHP system

745 kW Caterpillar Model 3516 Recip. Engine

Engine Control Panel

Energy Center Equipment

The following equipment is housed in the hospital's Energy Center in addition to the 745 kW CHP System:

- Three (3) Johnston 600 HP Firetube Boilers (80 psig steam)
- Two (2) 900 RT York Centrifugal Chillers
- One (1) 500 RT York Centrifugal Chiller
- One (1) 750 kW Diesel CAT Backup Genset
- One (1) 700 kW Diesel CAT Backup Genset
- One (1) 600 kW Diesel CAT Backup Genset

For further information, contact:

Midwest CHP Application Center
851 S. Morgan Street
Chicago, IL 60607-7054

Phone: (312) 413-3835
Fax: (312) 996-5620

www.CHPCenterMW.org

MIDWEST CHP APPLICATION CENTER
In Partnership with the US DOE

combined heat & power in health clubs

Breeden YMCA

Angola, IN

120 kW CHP Application

Project Profile

CHP Quick Facts

Location:
Angola, Indiana

Design Engineering Firm:
NiSource Energy Technologies (NET), Merrillville, IN

Equipment:
(2) Capstone® C60 Microturbines (120 kW)
(1) Unifin Heat Exchanger (750,000 btu/hr @ 190°F Hot Water)
(1) Copeland Gas Booster (77 psi)

Installed Cost:
- CHP System - $177,000 ($1,475 /kW)
- 400 sq ft showroom floor and instrumentation - $103,000

Total Efficiency:
64.7%

System Operational:
December 2002

Project Overview

In December of 2002, a 120 kW microturbine based combined heat and power (CHP) system went into full service at the Breeden YMCA facility located in Angola, Indiana. The project was the result of a collaborative effort of business, community, government (both state & federal), and university commitments & contributions. NiSource Energy Technologies (NET), an unregulated subsidiary of NiSource Inc., designed the system. The US Department of Energy (DOE) was a partner.

The Microturbines and Heat Exchanger

CHP Concept

The CHP system includes two Capstone® C60 microturbines, one Unifin heat exchanger, and a novel thermal priority control scheme that has assisted in reaching system efficiencies of 64.7%. During normal operation, the system operates in sync with the electric grid. In 2003, the 120 kW CHP system provided 629,820 kWh of electricity, or 45.8% of the total electricity used by the YMCA. Should the utility grid experience a power outage, the microturbine CHP system will automatically disconnect from the grid, operate in stand-alone mode, and power the critical loads in the building. As a result of this high reliability of electric service, the Breeden YMCA now serves as a disaster relief center – a facility open to serve the public even during a utility power outage.

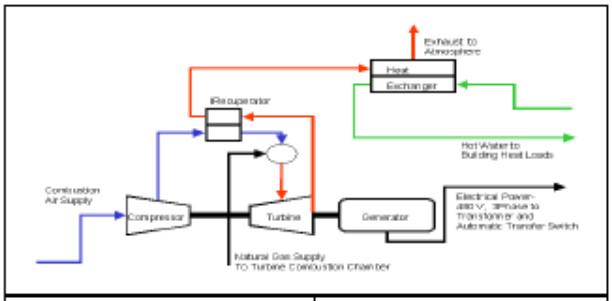
The hot exhaust from the microturbines passes through a heat exchanger that transfers up to 750,000 btu/hr of thermal energy from the exhaust gas to the building's hot water heating loop (190 °F hot water). The heat exchanger is piped in prior to the existing boilers, making the recycled heat from the CHP system the first priority heat source. The existing facility boilers only have to operate on extreme cold days when the building requires more heat than is available from the microturbines. An added benefit of this system is that during the summer months, the facility boilers do not turn on, which keeps the mechanical room from overheating – a problem experienced prior to installing the CHP system.

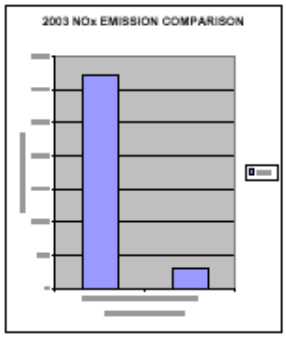
Environmental Benefits

As part of this project, a comparison of the NO_X emissions generated by the microturbine based CHP system to the NO_X emissions that would have been generated from the local conventional coal fired electric generating plant, was conducted. The amount of electricity displaced by the CHP system in 2003 was 629,820 kWh. The calculated NO_X emissions from the Breeden YMCA CHP system in 2003 were 309.24 lbs of NO_X. This compares with 3,215.86 lbs of NO_X that would have been generated if that amount of electricity were supplied by the local utility generating plant. This is a 90.38% reduction in NO_X emissions.

Educational Opportunities

The CHP installation included the design and construction of a 400 square foot showroom that houses the microturbines, the generator, the heat recovery equipment, and the data collection / control system. The added installation expense allows the CHP system to be utilized as an educational tool for students and visitors to the YMCA facility. The Tri-State University students can track the system operation in real time, and utilize the data collected to connect academic work to cutting-edge technology.





CHP Benefits

- Provides increased electric reliability
- YMCA now serves as a disaster relief center.
- Reduces the amount of atmospheric pollutants (NO_X) per kWh produced by 90% compared to the local coal fired power plant
- Provides a real time educational tool for the Tri-State University in the area of alternative energy sources
- Reduces both energy consumption and total energy costs

"The community and our members, as a whole, have benefited as a result of this installation. During times when the facility experiences a grid outage the back up power from the CHP system allows us to maintain member services and in the event of a natural disaster the YMCA can be utilized as a Red Cross disaster center. The system has allowed the YMCA to stabilize their energy costs and minimize their exposure to energy price fluctuations."

George Tatarchuk,
CEO, Breeden YMCA

For further information contact

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NiSource
Energy Technologies
A NiSource Company

801 E. 86th Avenue
Merrillville, IN 46410
Phone: (219) 647-4153
Fax: (219) 647-4163

Customer:

MANCHESTER TANK

Location:
Elkhart, Indiana

Customer Description: Manchester Tank, Elkhart, Indiana, is a privately-held leading manufacturer of low-pressure vessels for propane, air, refrigerant, and industrial applications in North America and Australia.

CHP Application:

System features a natural gas-fueled power source, operating in parallel with the utility grid and offsetting an average of 70 kW of monthly billing demand and 16,000 kW-hr of plant power consumption each month. To boost CHP system efficiency, the 450°F engine exhaust stream is routed directly to the intake plenum of the circulating blower inside the 330°F powder coat cure oven. In order to provide the customer with emergency standby power to critical plant processes, a 130 kW natural gas-fueled backup generator is installed at the main electric distribution panel.

Major Equipment:

(1) 70 kW Ingersoll-Rand Microturbine
(1) Direct Vent Heat Recovery
(1) 130 kW Ingersoll-Rand Backup Generator

Benefits:

Electrical energy savings aside—the routing of excess heat from the generator to the cure oven substantially reduces fuel consumption at the existing process burner. Backup generator provides reliable continuous power to critical loads in the event of grid outages and disturbances.

NiSource
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Customer:
Stripco Inc.

Location:
Mishawaka, Indiana

Plant Description:
Manufacturer of production-ready steel coils and strips. The company produces hot rolled, hot rolled pickled and oiled, precision cold rolled and galvanized steel products in thickness from .018 to .312 and widths from .375 to 26.000.

CHP Application:
The CHP system generates electricity for use throughout the building. The site maximizes the use of recovered heat energy from the microturbine by replacing a large portion of the current electrical heating requirements to maintain the temperature of the process oils used during production, providing space heat in the plant, warming the used oil recovery system, and supplying hot water for a clean and safe work environment. In normal operating conditions, the turbine output is controlled to maintain the proper heating loop temperature. In the event of an extended electrical grid power failure, the microturbine will provide power to the administration building and critical stations in the mill.

Major Equipment:
(1) 60 kW Capstone Microturbine
(1) Unifin Heat Exchanger
(1) Copeland Gas Booster (77 psi)
(1) Thermal Priority Control System
(1) Emergency Electrical Back-Up System

Benefits:
Stripco Inc. calculates savings of approximately 10 percent in electrical costs and a decrease of 3-1/2 percent in prorated annual energy costs adjusting for increased loads added to the system. By adopting this innovative technology, Stripco has increased safety conditions and is producing a higher quality finished product. The thermal recovery time of the process oils is greatly reduced as a function of the increased thermal mass. This helps Stripco to maintain the exacting tolerances required by their customers. CHP systems help the environment through reduced emissions of climate changing pollutants. Employee comfort is improved by delivering space heating to the employee's work areas. Emergency power enables the plant to provide sales and services to customers even when the utility grid is down.

NiSource
Energy Technologies
A NiSource Company

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Customer:
Utilimaster©, Inc.

Location:
Wakarusa, Indiana

Customer Description:
Utilimaster© is a world leader in custom van and truck bodies, building quality custom commercial vehicles (walk-ins/step-vans, parcel delivery vans, truck bodies) and is ISO 90001 certified.

CHP Application:
The CHP system supplies regeneration for a desiccant drying system in the wash line, auxiliary heating for the small parts painting line, and building space heat, all dispatched by a control system for optimum energy utilization. This system utilizes thermal fluid transfer loop and direct vent application for heat recovery.

Major Equipment::

(1) 70 kW IR microturbines
(1) Dryomatic Desiccant Unit
(2) Custom Designed Heat Exchangers
(1) Control System
(1) Thermal Fluid Loop
(1) Direct Vent Heat Recovery

Benefits:
Advantages will be realized in energy savings, pollution reduction, process improvement and energy management options. The system was designed to be flexible enough to accommodate the existing production scheduling and possible future growth.

NiSource
Energy Technologies
A NiSource Company

801 E. 86th Avenue
Merrillville, IN 46410
Phone: (219) 647-4153
Fax: (219) 647-4163

Customer:
Vestil Manufacturing

Location:
Angola, Indiana

Customer Description: Vestil Manufacturing is an industry leader in the manufacturing and distributing of materials-handling equipment, providing a complete product range at competitive pricing. They offer a wide variety of Dock Equipment, Ergonomic Solutions, Drum Handling Equipment, Material Handling Equipment and much more to help fit their customers' applications. Vestil supplies an extensive line featuring over 5,000 different items—many of which are in-stock and ready for immediate shipment.

CHP Application:

This CHP system boasts two natural gas-fired power sources which operate in parallel with the utility grid, offsetting an average of 140 kW of monthly billing demand and 32,000 kW-hr of plant power consumption each month. To increase CHP system efficiency, the 450°F engine exhaust streams are routed directly to the intake plenum of the circulating blower inside the 350°F powder coat cure oven. In an effort to further improve plant efficiency, additional heat energy from the cure oven and dryoff oven exhaust streams is being captured for use at adjacent plant processes.

Major Equipment:

(2) 70 kW Ingersoll-Rand Microturbines
(2) Direct Vent Heat Recovery Systems
(1) Thermal Fluid Loop
(1) Custom Designed Heat Exchanger

Benefits:

Operation of this system results in decreased electrical energy costs and pollution reduction. Recycling of waste heat from the generator, as well as from the cure and drying ovens, substantially reduces fuel consumption at existing process burners.

Integrated Energy System at Hilton Garden Inn

NiSource Energy Technologies has installed a combined heat and power distributed generation system at the Hilton Garden Inn in Chesterton, Indiana. The installation of this advanced technology is the first step of a larger Department of Energy contract to develop a modular-packaged IES for the hotel/motel segment.

Combined heat and power packages, also referred to as cogeneration systems, provide increased energy and environmental efficiency over traditional electric production and provide customers with energy choice and flexibility. The systems generate heat and electricity simultaneously at the site of use and increase energy efficiency by utilizing the waste heat created by the production of electricity for productive purposes.

The IES, which will generate electricity for the hotel, will initially include three microturbines, heat recovery heat exchangers, and an advanced control system. The waste heat will be utilized to supplement heat for the water supply, spa, and swimming pool, as well as provide space heat for the hotel's common areas. The microturbines, housed in a separate building on the hotel's property, currently generate approximately half of the four-story hotel's average electrical load requirement.

As part of the three-year development process, additional equipment and functions including a fuel cell, solar cells, an absorption chiller, a desiccant unit, a dehumidifier and advanced energy controls will be added to provide the hotel with greater energy efficiency.

Appendix I Effect of Natural Gas Prices on the Economics of CHP Systems

Given variations in natural gas prices, owners of cogeneration systems may occasionally contemplate turning their systems off during periods of gas high prices and reverting to their pre-existing boiler systems. At what gas price is such a move warranted? This question can be quickly answered with the help of the following calculation and chart.

This should be done with the most recent electric bill. The results will vary with the season and should be repeated during each season.

Line	From a Recent Electric Bill - Input			
1	Electric Consumption (On-Peak)	*From Electric Bill*		kwh/Mo
2	Electric Energy Charge (On-Peak)	*From Electric Bill*		$
3	Average Energy Charge	*Divide Line 2 by Line 1*		$/kWh
4	Monthly Demand	*From Electric Bill*		kW
5	Demand Charges	*From Electric Bill*		$
6	Allocated Demand Charge	*Divide Line 5 by Line 1*		$/kWh
	Total Cost of Utility Electricity	*Add Lines 3 and 6*		$/kWh

Table I.1: Calculate True Cost of Electricity

Follow these steps:

- Calculate your true cost of electric power as shown in Table I.1.
- Plot the true cost of electricity and your current gas cost on
- If your point is above the appropriate breakeven line – the cogeneration system should continue to operate

If your cogeneration system operates during off-peak power periods, repeat the calculation using the off-peak numbers. If this point is below your breakeven line, consider running your cogeneration system during on-peak hours only.

Your breakeven line is selected in the following manner:

- For generation systems with no heat recovery, use the 0 Btu/kW line

- For an engine cogeneration systems with high-pressure steam (125 psig) heat recovery from the exhaust heat only, use the 1,500 Btu/kW line. This assumes that you have a load that equals or exceeds the engines steam producing capacity at all times. If less than full steam capacity is used, correct the value down. For example, if only 50% of the engines steam capacity is used, plot the value at 750 Btu/kW.

- For a gas turbine cogeneration systems with high pressure steam (125 psig) heat recovery from the exhaust heat only, use the 4,500 Btu/kW line. This assumes that you have a load that equals or exceeds the engines steam producing capacity at all times. Otherwise correct as above.

- For cogeneration systems with low temperature hydronic heat recovery (180-250^{o}F) on the jacket and engine exhaust system, use 3,000 in the spring and fall and 4,500 in the winter. In the summer use 4,500 if you have an absorption chiller and 3,000 if not.

- For cogeneration systems feeding low temperature processes or hot water loads (140^{o}F and below), use 6,000 Btu/kW.

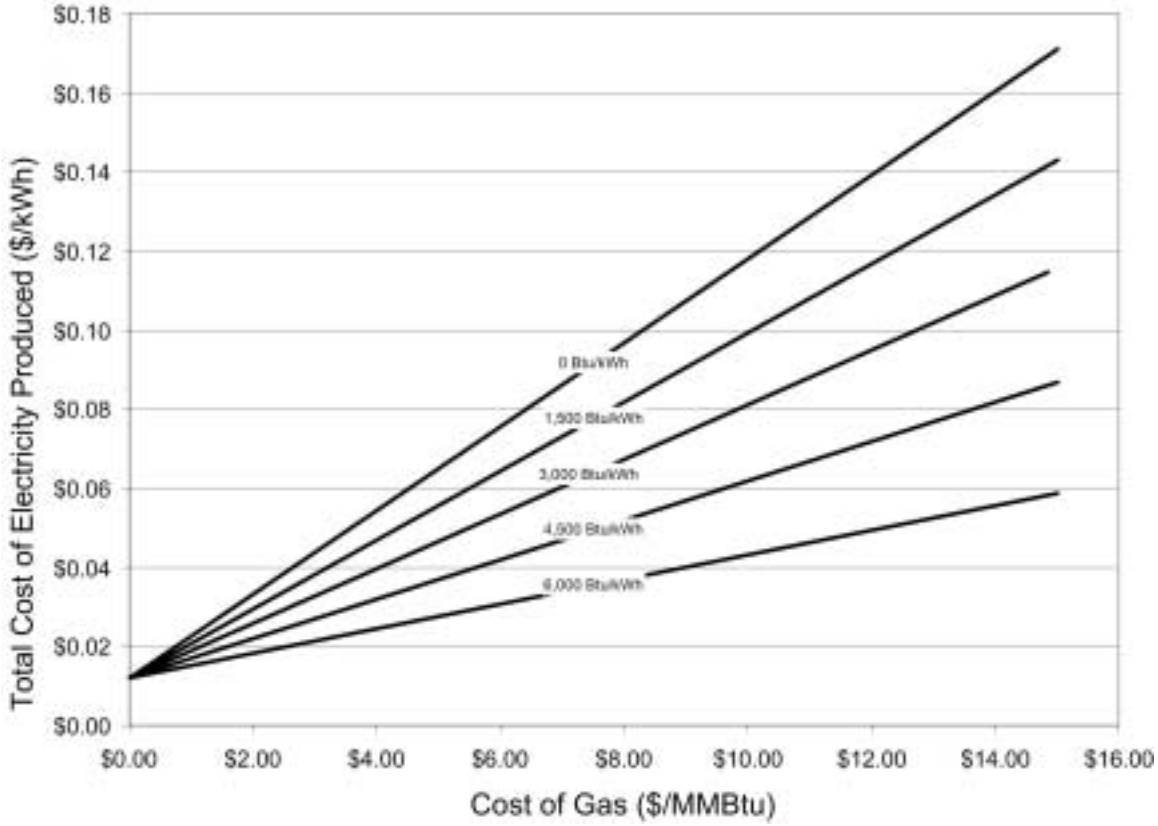


Figure I.1: Breakeven Chart

Example

Question

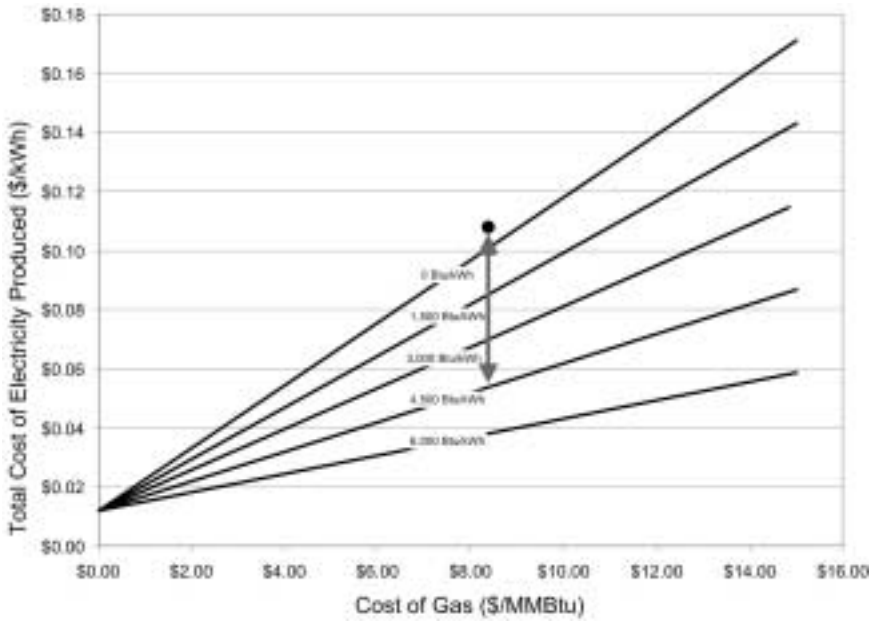
A cogeneration system provides power and heating to a commercial building. The owner's gas price spikes to $0.80/therm in January. Should the cogeneration system be run during this gas price spike?

Answer

The owner's electric bill gives the following information:

Line	From a Recent Electric Bill - Input			
1	Electric Consumption (On-Peak)	*From Electric Bill*	340,000	kwh/Mo
2	Electric Energy Charge (On-Peak)	*From Electric Bill*	20,400	$
3	Average Energy Charge	*Divide Line 2 by Line 1*	0.0600	$/kWh
4	Monthly Demand	*From Electric Bill*	1,123	kW
5	Demand Charges	*From Electric Bill*	16,387	$
6	Allocated Demand Charge	*Divide Line 5 by Line 1*	0.0482	$/kWh
	Total Cost of Utility Electricity	*Add Lines 3 and 6*	0.1082	$/kWh

Plotting this on Figure I.1 gives:



The point is well above the 4,500 Btu/kW line and the system should be left on.

Appendix J NIPSCO Rates for Power Purchase from Cogeneration Facilities

NORTHERN INDIANA PUBLIC SERVICE COMPANY
RATE SCHEDULE FOR PURCHASES FROM COGENERATION
AND SMALL POWER PRODUCTION FACILITIES

Nineteenth Revised

PURCHASE RATES	2005 Rate Per KWH
Summer Period (May - Sept.)	
On-Peak (1)	3.583 cents
Off-Peak (2) (5)	1.710 cents
Winter Period (Oct. - Apr.)	
On-Peak (3)	4.377 cents
Off-Peak (4) (5)	2.210 cents

(1) Monday through Saturday 8 a.m. to 11 p.m.
(2) Monday through Saturday 11 p.m. to midnight and midnight to 8 a.m. and all day Sunday.
(3) Monday through Friday 8 a.m. to 11 p.m.
(4) Monday through Friday 11 p.m. to midnight and midnight to 8 a.m. and all day Saturday and Sunday.
(5) The twenty-four (24) hours of New Year's Day, Memorial Day, Independence Day, Labor Day,
Thanksgiving Day and Christmas Day will be included in the Off-Peak period.

B. For those qualifying facilities for whom metering not capable of recognizing different rating periods is installed:

	2005 Rate Per KWH
Summer Period	2.712 cents
Winter Period	3.177 cents

Energy metered during any billing period more than half of which is in any month of May to September, inclusive, shall be calculated under the summer rate schedule. Energy credited during other periods of the year shall be calculated under the winter rate schedule.

2005 Capacity Component

$5.22 per KW per month.
The monthly capacity component shall be adjusted by the following factor:

$$F = \frac{Ep}{(K)\,(Tp)}$$

Where F = Capacity component adjustment factor.
Ep = Kilowatt-hours delivered to the Company during the On-Peak period defined as:

Issued Date	Issued By Effective Date	
	Mark T. Maassel President – NIPSCO	
April 27, 2005	Merrillville, Indiana	May 1, 2005