CHP Baseline Analysis for the Iowa Market

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Executive Summary

The purpose of this baseline analysis is to assess the status and prevailing environment for Combined Heat and Power (CHP) systems in Iowa from a regulatory, private-market and technology perspective. This information will be used to identify target markets for CHP systems as well as to develop educational and market transformation programs.

The Midwest CHP Application Center (MAC) has identified a total of 26 CHP systems and sites that produce about 372,800 kW in Iowa. Food processing industry in Iowa accounts for the largest percentage (67%) of the total CHP capacity, followed colleges/university campuses. The power generation capacities of these systems range from 60 kW to 155,000 kW. The most predominant power generation technology used in the existing systems is steam turbines that account for over 92% of the total generation capacity, followed by reciprocating engines that account for over 7% of the capacity. The predominant (95%) fuel used in the existing CHP power generation systems is coal, followed by biomass (4%) and natural gas (1%).

Capital costs as well as fuel costs are generally viewed as some of the major hurdles to utilize CHP technologies. For smaller generating capacity units, the initial cost can have a long payback period, unless electric costs are very high, fuel costs are low, and there is good match between the electric and thermal loads. The installed costs of power generation technologies for CHP range from around $600/kW for large gas turbines to up to $5,000/kW for fuel cells. Natural gas reciprocating engines are the predominate technology, and can range in price from $1,000 to $1,800/kW (installed). 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 systems will soon be available for a wide range of applications and will significantly reduce in the installed costs of CHP systems.

For the smaller capacity CHP systems, in the range of 60 kW to 4,000 kW, natural gas or biogas are the fuels of choice. Systems that use natural gas, fuel cost constitutes the majority of the variable/operating cost. Volatile and high prices of natural gas in recent years could have negative effects on the CHP market development.

The average year-to-date (YTD) price of natural gas in Iowa for commercial customers has gone up from $7.95/1000 cu. ft. in May 2004 to $9.18/1000 cu ft. in May 2005. These prices are lower than those for the Midwest and the US averages of $8.41/1000 cu. ft. and $8.91/1000 cu. ft. in May 2004, and $9.37/1000 cu. ft. and $9.98/1000 cu. ft. in May 2005, respectively. The average price of electricity for commercial customers in the state has gone up from $0.0631/kWh in YTD April 2004 to $0.0649/kWh in YTD April 2005. The average YTD April 2005 electricity price in Iowa is also below the YTD April 2005 average prices in the Midwest ($0.0679/kWh) and the U.S. ($0.082/kWh). Even though these average energy prices, in general, might not appear very attractive for CHP systems, many opportunities still might exist for specific CHP system applications in which, power demand charges and/or on-peak prices are high, and/or the annual utilization of thermal energy from power generation is high, and/or the economic or safety value of higher power reliability of CHP system is high. In addition, many CHP opportunities may also exist where fuels, such as biogas produced from a variety of

wastes including from, agriculture, food processing, wood processing, hog farms, and wastewater treatment plants and landfills, are available at low or "no cost."

On the regulatory side in Iowa, the state and the Iowa Utility Board (IUB) are still in the process of developing uniform policy for CHP interconnection to the grid and net metering. The rules of IUB define interconnection costs. In addition to charging reasonable interconnection costs, a utility may require engineering studies of the proposed interconnection and the costs for these studies will be borne by the CHP system applicant. These costs may run from hundreds of dollars to ten-of-thousands of dollars. In addition, the Midwest Independent System Operator (MISO) may also require additional studies of a proposed interconnection. These costs, of $5,000 or more, may be borne by the CHP system applicant. In addition, the utilities also require insurance coverage, ranging from $300,000 to $2,000,000 depending upon the power generation capacity of <20 kW to 1000,000 kW. The state does not yet offer any financial incentives for CHP systems. Currently no exit fees are charged to facilities that elect to generate their own electricity.

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. A CHP facility with backup power needs in the service territory of the Interstate Power Company's (n/k/a Interstate Power & Light Company), one of Iowa's largest electric utility company, would be subject to Rider 1S, that requires a monthly charge $2.17/kW of standby capacity. The company also has provisions (Rider 1CG) to purchase power from "qualifying' cogeneration facilities of capacities up to 100 kW. However, the purchase rate for electric power is low (only $0.0242/kWh to $0.0205/kWh depending on the generation period: on-peak, off-peak, summer, or winter).

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 MAC has identified that could assist with the development and/or deployment of CHP in Iowa are:

- Governor's Energy Coordinating Council
- Iowa Department of Natural Resources Energy Center
- Iowa Utilities Board
- Iowa Energy Center
- Midwest CHP Initiative

Iowa's Governor Thomas Vilsack has established the Energy Coordinating Council to serve as an advisory capacity to the Governor. This Council's report of March 2005 report recommends establishing a standard system for net metering and utility interconnection. The report also recommends establishing tax incentives for renewable electric generation.

The state has completed studies investigating restructuring investor-owned utilities (power providers) and has decided not to pursue further action so far. Iowa is currently pursuing legislation, regulations, or programs to implement natural gas restructuring. Unbundled service is available for large commercial and industrial customers throughout the state. However, restructuring for small commercial and residential customers varies throughout the state.

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." For Iowa, ONSITE estimated a total market potential for electric production to be nearly 682,000 kW. This study estimates the top four potential markets to be office buildings, schools, hospitals and colleges/universities. The market in these sectors accounts for more than 68% of the total potential market.

Iowa has also a significant potential for biomass based CHP applications. The state is home to many ethanol facilities that produce millions of gallon of ethanol annually. Ethanol facilities are good candidates for CHP since they have high energy demands, both thermal and electric, and the rejected heat in the exhaust from the electric generation equipment can be used in the ethanol production process or the waste gas from the ethanol production process potentially may be "burned" in the prime mover to reduce volatile organic compounds (VOCs) formed as part of the ethanol production process.

These market potentials may only be realized if the regulatory and policy issues become more supportive of CHP installations.

In November 2004, the MAC, in cooperation with the Iowa Department of Natural Resources, organized and implemented two one-day workshops, in Cedar Rapids and Sioux City, to inform and educate Iowa swine producers on the issues and benefits of both methane recovery from hog waste and the integration of methane recovery with CHP. The workshop was co-sponsored by US Department of Energy, Midwest Regional Office, Iowa Department of Natural Resources, Iowa Agriculture Innovation Center, Iowa Energy Center, Iowa Pork Producers Association, Iowa Farm Bureau, Kirkwood Community College, Western Iowa Tech Community College, Alliant Energy, and Iowa State University. In April 2004, The Iowa Farm Bureau Federation hosted a CHP workshop for the benefit of ethanol facilities in Iowa. The Iowa Department of Natural Resources (DNR), the Iowa Renewable Fuels Association, the Iowa Agriculture Innovation Center, the U.S. Department of Energy, and the U.S. Environmental Protection Agency had sponsored the workshop. The workshop was organized by the Midwest CHP Application Center.

This report concludes with recommendations, which address the need to work with state regulators and 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 Energy Council, the Iowa Department of Natural Resources, Alliant Energy, 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 baseline analysis is to assess the status and prevailing environment for Combined Heat and Power (CHP) systems in Iowa from regulatory, private-market and technology perspectives. This information will be used to identify target markets for CHP systems as well as to develop educational and market transformation programs, which will foster CHP applications.

In order to assess the current status of CHP in Iowa, 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, surveys of existing and potential CHP installations were conducted.

In this report, the initial cost of current CHP related technologies were evaluated to assess their impact on the marketability of CHP.

A status assessment of policy-related issues pertaining to CHP was conducted. The assessment was performed for several policy areas: grid interconnection, CHP stand-by rate provisions, exit fees, net metering, general status of electric deregulation/restructuring in the state, emerging legislation, and potential partners/advocates of CHP.

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

2. CHP Contacts in Iowa

2.1 Key Iowa Firms 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 can be allied with the Midwest CHP Application Center to promote the deployment of CHP in Iowa.

Several companies in Iowa that are engaged in CHP system applications or have CHP system capabilities. Interest in CHP applications in the state has increased significantly over the last few year through the activities of the MAC and 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 planning and design stages of a new building or during an extensive renovation, when the central heating and cooling plant is being initially planned 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 planning, 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 Iowa.

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 “package” integrated power, heating, and cooling systems. In the mean time, it is still important to strive to find technically and financially suitable applications where manufactures can work with engineering and architectural firms to install “custom” systems. Appendix B provides information on manufacturers that promote CHP installations in Iowa. There are several manufactures/sales offices involved in deployment of CHP related technologies in Iowa. For example, Unison Solutions, Inc. is a distributor of several CHP systems. They are actively marketing a whole line of distributed energy technologies, working with such manufacturers as:

- Capstone Microturbines
- Kohler Power Systems
- STM Power (Sterling Cycle systems)

Property management firms are also 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 again smaller and easier to justify. The two main organizations that represent property management firms in Iowa are BOMA (Building Owners and Managers Association) and IREM (Institute of Real Estate Managers), which accredits recognized real estate management organizations. Information on the Iowa BOMA chapter and IREM accredited Iowa property management companies can be found in 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 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 Iowa is provided in Appendix D.

Energy Services companies (ESCOs) are just beginning to become interested in CHP technologies. In the past they have not been interested because it is 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 E lists ESCO's that are active in Iowa. According to the National Association of Energy Service Companies (NAESCO), none of its members have registered offices in Iowa. The companies listed in Appendix E have offices in neighboring states and provide their services in Iowa.

2.2 Associations and Organizations Involved with CHP Deployment

Federal, State, and regional governmental entities are becoming more and more interested in CHP systems because of the energy savings potential and reduction in emissions from this technology. While the Federal government, through the Department of Energy, 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.

Within the State of Iowa, Department of Natural Resources, Iowa Agriculture Innovation Center, Iowa Energy Center (University of Iowa), Iowa State University, Iowa Pork Producers Association, Iowa Farm Bureau, and the Iowa Renewable Fuels Association have the potential to be strong allies in the deployment of CHP. A list of these associations and organizations and their web-addresses, where available, is provided in Appendix F.

3. Survey of CHP Installations and CHP Targets in Iowa

3.1 Survey Summary

This survey was conducted to identify existing CHP installations in order to assess the current statute of CHP in Iowa; to establish where we are today and to identify those facility types where CHP are 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 (EEA) Web site (http://www.eea-inc.com/chpdata/index.html) and that of the Energy Information Administration (EIA)'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). The EEA database lists only the CHP facilities and the EIA report lists all on-site generation facilities including CHP. 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 26 CHP systems, producing about 372,000 kW, are known to be in operation in Iowa. Appendix G categorizes and lists the known CHP installations based on the facility type in which the system is installed and provides the size of the installed generation capacity. According to the EIA report, total capacity of on-site generation (including CHP) for the commercial and industrial sectors in Iowa is 601,000 kW.

3.2 Sector Analysis of the Survey Data

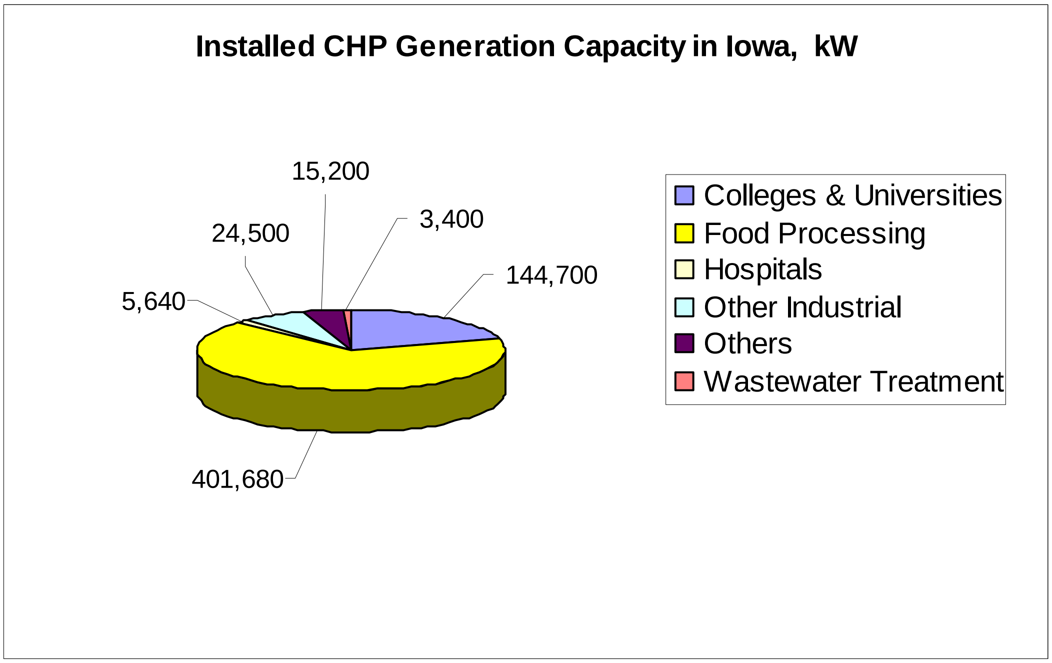
The sites identified during the survey represent the best efforts of the Midwest CHP Application Center to identify actual and potential CHP installations in Iowa. Other existing or candidate CHP sites may exist. An analysis of the survey information for the commercial and light industrial sectors is provided in Table 3-1 and Figures 3-1 and 3-2.

Table 3-1 CHP Capacity Installed by Sector in Iowa

Business Sector	Installed Generation Capacity, kW	% of Total
Colleges & Universities	76,100	20.47
Food Processing	246,680	66.35
Hospitals	5,640	1.52
Other Industrial	24,779	6.66
Others	15,200	4.09
Wastewater Treatment	3,400	0.91
Total	**371,799**	**100.00**

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

Figure 3-1 Installed CHP Capacity by Market Sector in Iowa



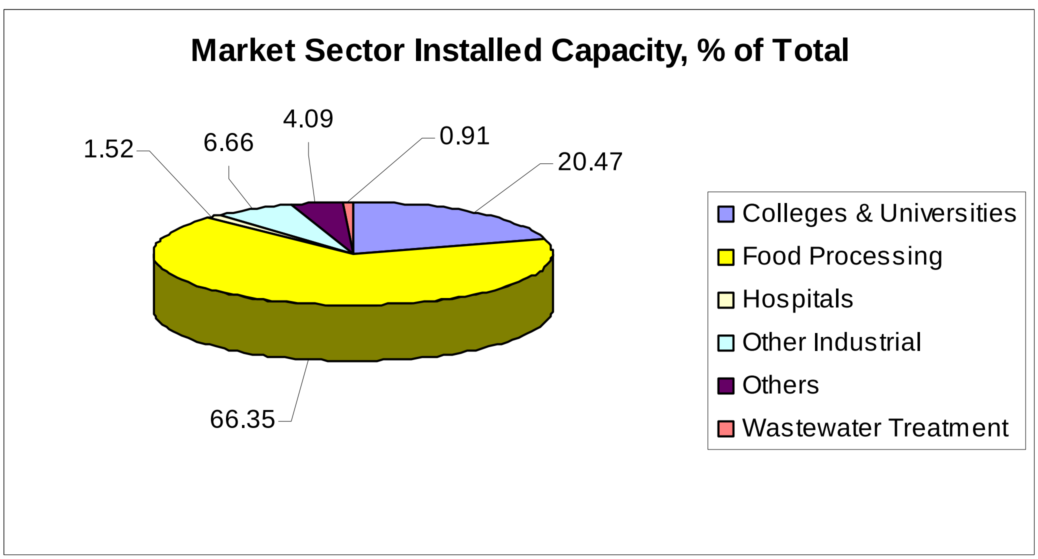


Figure 3-2 Installed CHP Capacity Share by Market Sector in Iowa

Food processing industry in Iowa accounts for the largest percentage (67%) of the total CHP installed capacity, followed by colleges/university campuses. The power generation capacities of these systems range from 60 kW to 155,000 kW. The most pre-dominant power generation technology used in the existing systems is steam turbines that account for over 89% of the total generation capacity, followed by reciprocating engines that account for over 10% of the capacity. The predominant (over 95%) fuel used in the existing in CHP power generation systems is coal, followed by biomass (4%) and natural gas (1%). Detailed listing of each installation is shown in Appendix G.

4. Equipment Cost and Energy Price Issues

Capital costs as well as operating costs are generally viewed as some of the major hurdles to utilize CHP technologies. This section addresses 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. Absorption chillers convert the waste heat stream from prime movers into cooling.

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

Table 4-1 CHP Technologies and Costs

	Gas Engine		Gas Turbine - Simple Cycle		Micoturbines	Fuel Cells
Size Range (kWe)	100 - 500	500 - 2,000	1,000 - 10,000	10,000 - 50,000	100 - 500	30 - 3,000
Efficiency (LHV)						
Btu/kWh	12,000 - 14,000	10,000 - 12,000	12,000 - 14,000	9,500 - 11,000		
%	24 - 28	28 - 34	24 - 28	31 - 36	14 - 40	40 - 57
Installed Cost ($/kWe)* *(with Heat Recovery)*	$1,400 - $1,800	$1,000 -$1,500	$1,000 - $1,500	$600 - $1,000	$1,000 - $1,500	$2,000 - $5,000
O & M Costs ($/kWh)	$0.012 - $0.015	$0.010 - $0.012	$0.003 - $0.006	$0.003 - $0.006	$0.005 - $0.010	$0.002 - $0.05
Recoverable Heat						
Steam (lb/h/kWe)	4 - 5 *(15 - 30 psi)*	4 - 5 *(15 - 30 psi)*	5 - 6 *(300 - 600 psi)*	5 - 6 *(300 - 600 psi)*		
Hot Water (Btu/kWe/h)	4,000 - 4,500	4,000 - 4,500	4,500 - 5,00	4,500 - 5,00		
Absorption Cooling						
Single ($/RT)	$500 - $1,000	$250 - $500	$200 - $250	$200 - $250		
Double ($/RT)	N/A	N/A	$400 - $500	$350 - $400		
RT/kWe	0.22 - 0.28	0.22 - 0.28	0.28 - 0.33	0.28 - 0.33		
Electric Chillers ($/RT)	$200 - $300	$200 - $300	$180 - $250	$180 - $250		

** Costs can vary significantly due to interconnection and other siteing requirements.*

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 new 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 year-to-date (YTD) price of electricity for commercial customers in Iowa has gone up from $0.0631/kWh in April 2004 to $0.0649/kWh in April 2005. The 2005 electricity price in Iowa is 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 2 cents/kWh) than those for the commercial consumers. However, the relative industrial prices in the state with respect to the averages for the Midwest and the U.S. are similar to those of the commercial customers.

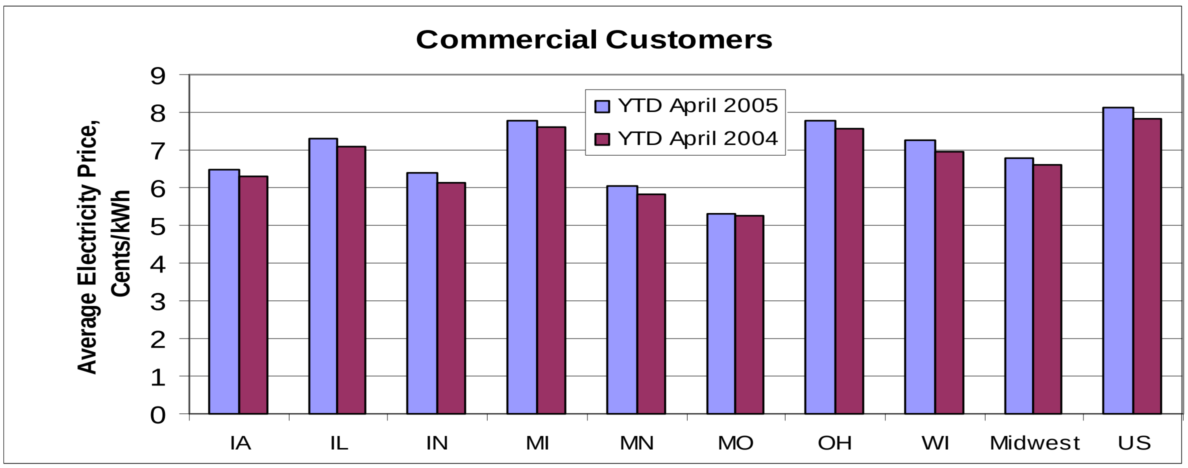


Figure 4-1 Average Price of Electricity for Commercial Customers/Consumers

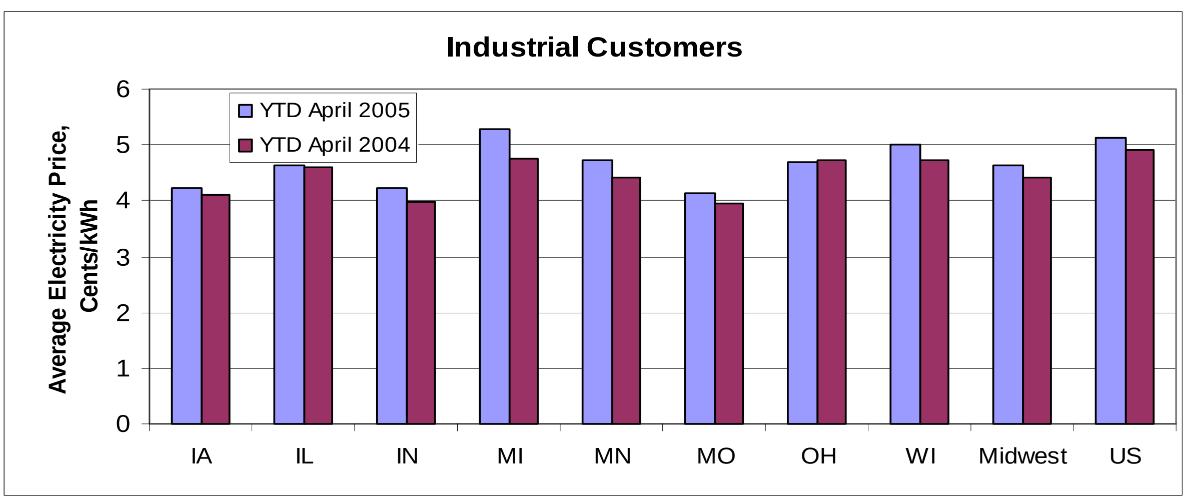


Figure 4-2 Average Price of Electricity for Industrial Consumers/Customers

Source: Energy Information Administration (Table 5.6.B):

http://www.eia.doe.gov/cneaf/electricity/epm/epm_ex_tabs.html

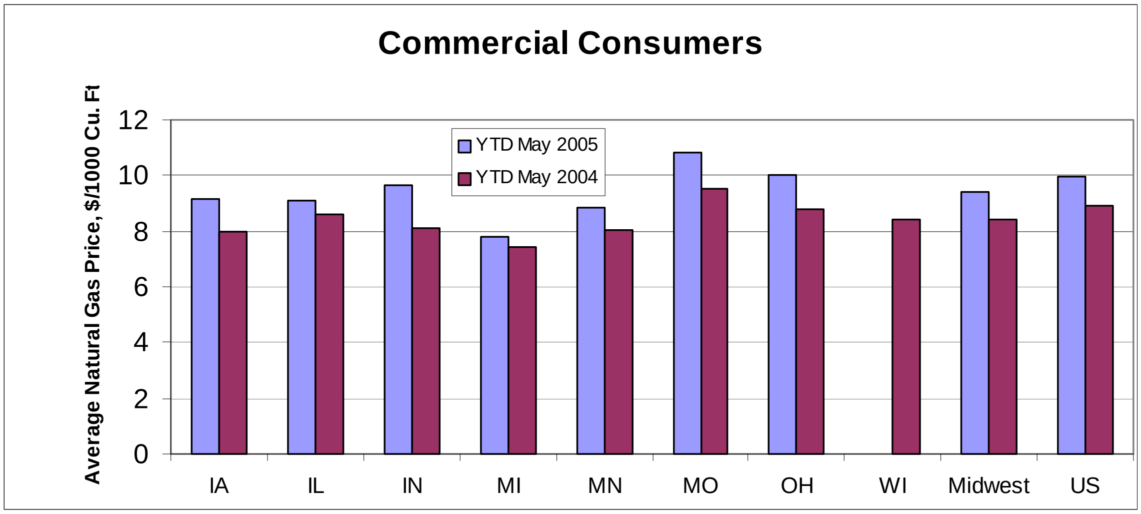


Figure 4-3 Average Price of Natural Gas for Commercial Customers/Consumers

Source: http://www.eia.doe.gov/neic/historic/hngas2.htm#Price (EIA Natural Gas Monthly May 2005 Table 22 Page 55)

Commercial and industrial consumers of electricity may also pay a monthly power demand (kW) charge in addition to electric energy (kWh) consumed. Those consumers must calculate their "true electricity" cost per kWh, which could be much higher than the electric energy cost alone paid by the consumer. Appendix H discusses the methodology, developed by the MAC, for calculating true electric cost.

The average YTD price of natural gas in Iowa for commercial customers has gone up from $7.95/1000 cu. ft. in May 2004 to $9.18/1000 cu ft. in May 2005 (Figure 4-3). These prices are lower than those for the Midwest and the US averages of $8.41/1000 cu. ft. and $8.91/1000 cu. ft. in May 2004, and $9.37/1000 cu. ft. and $9.98/1000 cu. ft. in May 2005, respectively.

Even though thee average energy prices, in general, might not appear very attractive for CHP systems, many opportunities still might exist for specific CHP system applications in which, power demand charges and/or on-peak prices are high, and/or the annual utilization of thermal energy from power generation is high, and/or the economic or safety value of higher reliability of CHP system is high. In addition, many CHP opportunities may also exist where fuels, such as biogas produced from food processing waste, wastewater treatment plants, and landfills, wood or agricultural wastes are available at low or "no cost."

The information in Appendix H also addresses another concern expressed by the end-users about the effect of natural gas prices on the breakeven cost of CHP systems.

4.3 Standby Rates

Standby rates can be a disincentive for CHP, since customers have to pay utilities for power "just in case" they need it. Example of a standby rate (Rider 1S) for the Interstate Power Company in Iowa is shown in Appendix I.

The complexity of the standby rate structures and the uncertainty of the cost of maintaining standby power "just in case" underscores one of the major barriers in determining the actual economics of the installation and operation of larger CHP installations.

4.4 Financial Incentives for CHP Systems

In Iowa, there are no financial incentives specifically for CHP systems. On June 15, 2005, Iowa Governor, Tom Vilsack signed a bill that provides tax credits for up to 10 years for renewable energy facilities.

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 policies related issues pertaining to the advancement of CHP in the State of Iowa. 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

In Iowa there is no State standard for the interconnection process and related fees.

The utilities may charge an Alternative Energy Producer (AEP) or a QF a resonable cost for interconnection. The rules of the Iowa Utilities Board define interconnection costs and also provide a process for resolving disputes that may arise over interconnection costs. A utility may charge a fee to review an interconnection application. A utility may require engineering studies of a proposed interconnection. The costs of these studies will be borne by the potential power producer and may run from hundreds of dollars to tens-of-thousands of dollars.

The Midwest Independent System Operator (MISO) may also require additional studies of a proposed interconnection project. Pursuant to MISO's procedures, for generating facilities of less than 20 MW that intend to interconnect with the transmission system, the potential power producer may be required to pay MISO a deposit of $5,000 and submit an Interconnection Evaluation Study, which includes detailed and technical information about the facility. The potential power producer may pay any costs borne by MISO above the $5,000, and MISO will report the results of its findings within 60 days, though it is usually less for smaller generators.

Iowa Utilities' Insurance Requirements

Utility	**Size of the Project**	**Coverage Required**
Alliant Energy	20 kW or less	$300,000
	Between 20 kW and 200 kW	$1,000,000
	Between 200 kW and 1 MW	$2,000,000
Electric Cooperatives	All sizes	$1,000,000
MidAmerican Energy	20 kW or less	$500,000
	20 kW to 100 kW	$1,000,000
	Greater than 100 kW	$2,000,000
Municipal Utilities	No standard insurance policy	

Many Iowa utilities require insurance for CHP interconnection to their grids. The above table shows the insurance coverage required by some of the utilities for various capacity CHP systems. The source for the above table 5-1: http://www.eea-inc.com/rrdb/DGRegProject/States/IA.html.

Iowa State policy is in the process of being developed. In 2004, the DNR Energy and Waste Management Bureau and its contractor, Resource Dynamics Corporation, developed a comprehensive assessment report of current interconnection procedures, including existing barriers and potential solutions. Several interested stakeholders, including the utilities and utility associations, the Office of Consumer Advocate, and the IUB, participated in the review of this document. Using this report as a tool, DNR staff developed a handbook about basic issues of interconnection. This handbook includes information about power purchase agreements, required safety practices and equipment, and legal requirements of and responsibilities in interconnection agreements. Again, the above-mentioned stakeholders participated in the review of this document.

5.2 Exit Fees

In the State of Iowa there are no exit fees charged to companies or others that decide to exit from the grid and produce their own electricity for on-site use.

5.3 General Status of Progress on Deregulation

The state has completed studies investigating restructuring investor-owned electric utilities (IOUs) and has decided not to pursue further action at this time.

Natural gas open access (unbundled service) is available throughout the Iowa state to large commercial and industrial customers. However, the extent of availability of these services for small commercial and residential customers varies throughout the state. in Iowa.

5.4 Emerging Legislation

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

5.5 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. Partners in Iowa include the University of Iowa and Iowa State University.

5.6 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 Iowa.

- Iowa Department of Natural Resources
- Iowa Agriculture Innovation Center
- Iowa Energy Center
- Iowa Pork Producers Association
- Iowa Farm Bureau,
- Alliant Energy
- Iowa State University
- Iowa Farm Bureau Federation, and
- Iowa Renewable Fuels Association

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. The office of the Iowa Governor or the leadership in the Iowa House or Senate could also help. However, they are likely to be more difficult to reach and/or influence.

6. Market Potential for CHP in Iowa

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 commercial and institutional sectors.

6.1 Commercial and Institutional Markets

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 MW.

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.

For Iowa, ONSITE estimated a total market potential for electric production to be nearly 682 MW (Figure 6-1). A breakdown of the total CHP potential among various market sectors is shown in Table 6-1, and Figures 6-2 and 6-3. These estimates show that the top four potential markets for CHP are office buildings, schools, hospitals and colleges/universities. These markets account for more than 68% of the total potential CHP market. Figure 6-4 shows the CHP market potential by plant capacity.

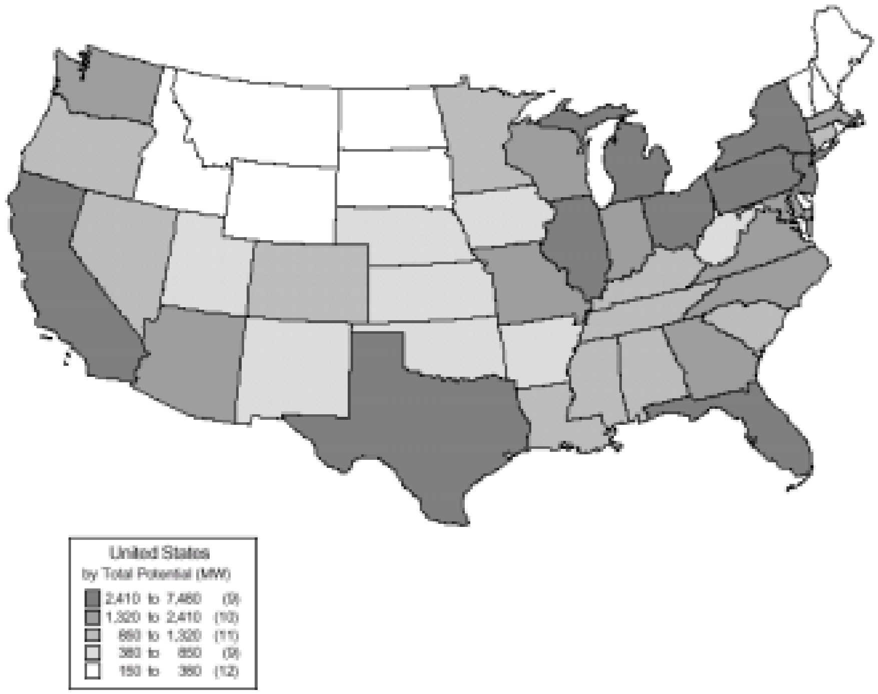


Figure 6-1 CHP Potential in the US at the State Level

Table 6-1 CHP Market Potential in Iowa

Business Sector	Potential Capacity, kW	% of Total
Car Washes	1,500	0.2
Colleges & Universities	67,600	9.9
Commercial Laundries	2,000	0.3
Correctional Facilities	16,000	2.3
Extended Service Restaurants	11,600	1.7
Golf Clubs	18,800	2.8
Health Clubs/Spas	16,900	2.5
Hospitals	86,500	12.7
Hotel/Motel	37,100	5.4
Museums	1,100	0.2
Nursing Homes	65,500	9.6
Office Buildings	159,400	23.4
Refrigerated Warehouses	22,000	3.2
Schools	153,100	22.5
Supermarkets	10,800	1.6
Water Treatment	11,800	1.7
Total	681,700	100.0

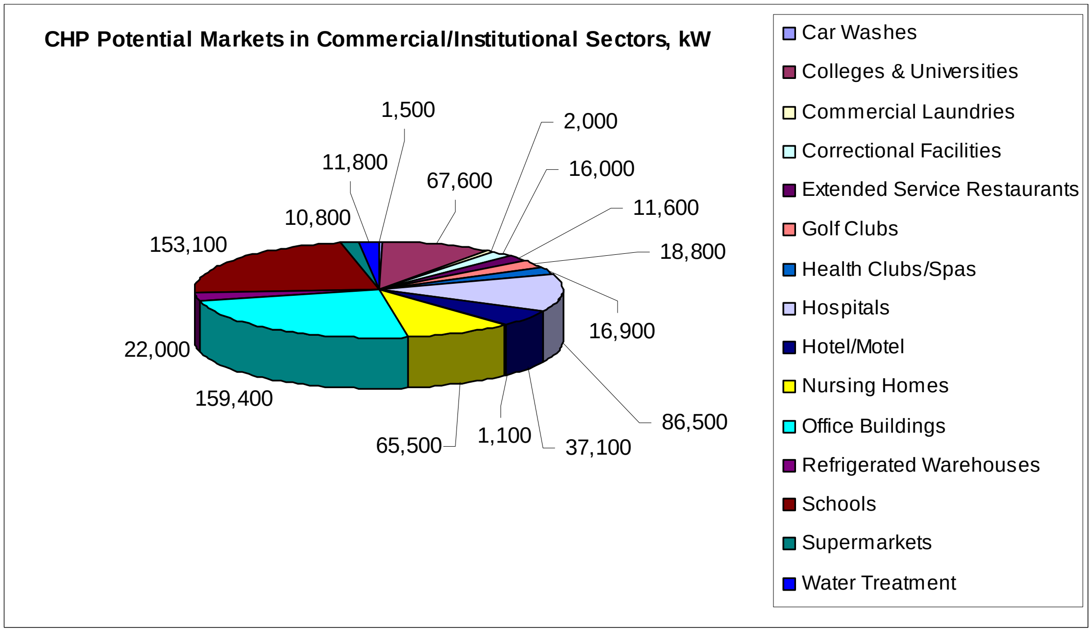


Figure 6-2 CHP Potential by Market Sectors in Iowa

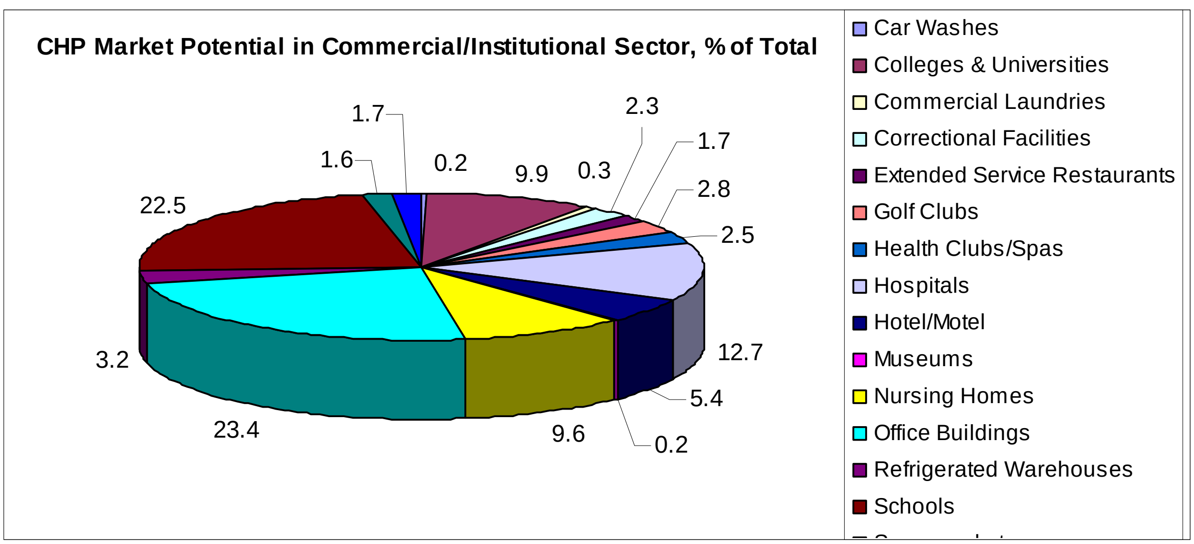


Figure 6-3 CHP Market Potential Share by Market Sectors in Iowa

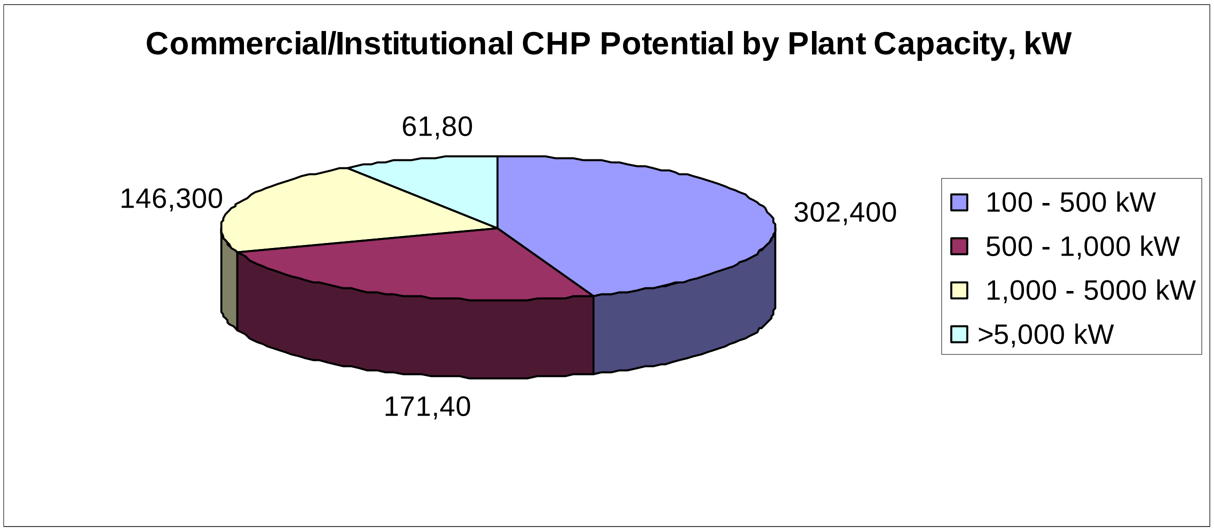


Figure 6-4 CHP Market Potential by Plant Capacity in Iowa

As discussed earlier in Section 3.1, the EIA data for 2000 published in January 2003, shows total non-utility generation (assumed all on-site generation) capacity in Iowa to be 601,000 kW. Since, the total installed CHP capacity in Iowa according to the EEA database is estimated to be about 372,000 kW, the remaining 229,000 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 Iowa to convert these on-site generation systems to CHP systems in the future.

The total CHP market potential in Iowa represents about 1.4% 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.

6.2 Biomass Based CHP Applications

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

- Food Processing waste
- Agricultural waste
- Wood processing waste
- Hog farms waste

- Landfills
- Wastewater treatment

According to the EEA database, over 13,500 kW of the installed CHP capacity is already using biomass as the primary source of fuel.

In November 2004, the MAC, in cooperation with the Iowa Department of Natural Resources, organized and implemented the two one-day workshops, in Cedar Rapid and Sioux City, to inform and educate Iowa swine producers and animal science students on the issues and benefits of both methane recovery from hog waste and the integration of methane recovery with CHP. The workshop was co-sponsored by US Department of Energy, Midwest Regional Office, Iowa Department of Natural Resources, Iowa Agriculture Innovation Center, Iowa Energy Center, Iowa Pork Producers Association, Iowa Farm Bureau, Kirkwood Community College, Western Iowa Tech Community College, Alliant Energy, and Iowa State University.

In April 2004, The Iowa Farm Bureau Federation hosted a CHP workshop for the benefit of ethanol facilities in Iowa. The Iowa Department of Natural Resources (DNR), the Iowa Renewable Fuels Association, the Iowa Agriculture Innovation Center, the U.S. Department of Energy, and the U.S. Environmental Protection Agency had sponsored the workshop. The workshop was organized by the Midwest CHP Application Center.

7. Iowa CHP Market Sector Feasibility Analysis

As referenced in Section 6.1, nearly 682 MW of CHP potential exists within the State of Iowa in commercial/institutional facilities according to the ONSITE SYCOM Energy Corporation study published in 2000. The successful application of a CHP system requires an in-depth analysis for each site due to the many site variables including climate conditions, operating hours, thermal & electrical loads, HVAC equipment, utility rates, and more.

The Iowa Department of Natural Resources expressed interest for the MAC to perform a market feasibility analysis on K-12 educational facilities incorporating microturbines as the prime mover technology. As discussed in Section 6.1, total potential for CHP generating capacity in Iowa for K-12 schools is estimated to be about 153 MW and represents the second highest CHP market potential in the commercial/institutional market sectors in Iowa. Utilizing the Building Energy Analyzer (BEA) modeling software created by InterEnergy Software, the MAC modeled an average typical grade school building in Davenport, Iowa to estimate the commercial feasibility of incorporating microturbines with heat recovery.

The average hypothetical K-12 school facility incorporates the following assumptions:

- Building Size: 165,025 sq. ft.
- Floors: 1 floors
- Occupancy: 25 sf/person
- Heating Equipment: Hot Water System
- Maximum Heating Load: 18 MMBtu/hr
- Cooling Equipment: Electric Chillers
- Maximum Cooling Load: 1,000 tons
- Occupied Hours: 2,600 hr/yr
- During the School Season: 7 am -7 pm, 5 days a week, 10 am-2 pm, on Saturday
- During the Summer Season: 9 am -1 pm, on Saturday
- Electric Rate: $0.052/kWh
    - Annual Electric Consumption: 1,965,000 kWh
    - Standby Charge (for CHP generator): $2.138/kW
- Demand Rate: $12.94/kW
- Electric Demand: 700-1,200 kW
- Natural Gas Rate: $6.00/MMBtu
- Annual Natural Gas Consumption: 15,000 MMBtu

The installation of multiple microturbines was considered. The generation capacity of each microturbine is 60 kW. Several heat recovery options were evaluated, including:

- heat recovery for building heat alone
- heat recovery for building heat and cooling
- no heat recovery (distributed generation)

Using heat recovery options allows for more use of the available energy from a CHP system. Systems without heat recovery do not payback in a reasonable amount of time because the thermal energy available from the generator is wasted. The least expensive method of heat recovery is to create hot water for building space heat. The second is to produce hot water for space heating in the winter and chilled water (through a hot water-heated absorption chiller) for cooling.

Installing six microturbines under the aforementioned building parameters yield the following results shown in Table 7-1

Table 7-1 Effect of Utilization of Recovered Heat on Payback Period

Prime Mover	Heat Recovery	Total Annual Cost Savings from Installing CHP ($)	Total Installed Cost ($)	Simple Payback (yrs)
6 - 60 kW Microturbines	Heating	$69,487	$480,000	6.9
	Heating and Cooling	$70,443	$570,000	8.1
	None	$35,851	$408,000	11.4

The results show that the shortest payback period is achieved with six 60 kW turbines using heat recovery for building heat alone. The use of absorption chilling does increase annual savings, however, the purchase of the cooling unit does not payback as quickly as the building space heating option.

The effect of the number of microturbines on payback periods is shown in Figure 7-1

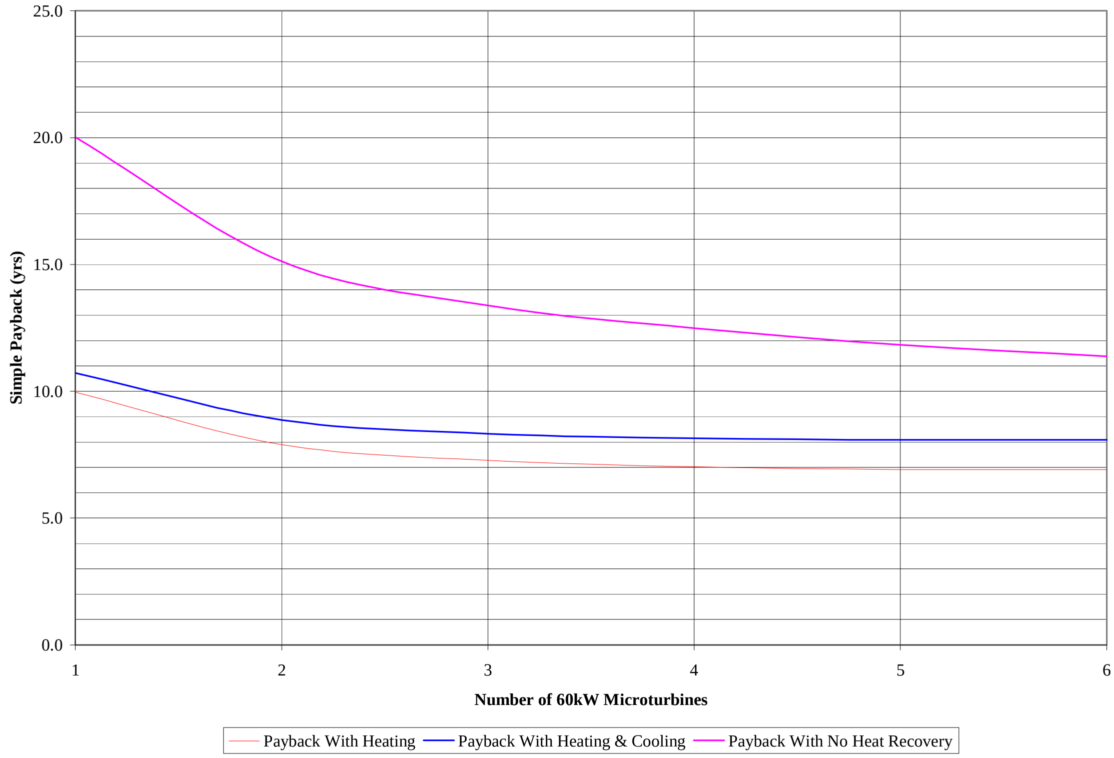


Figure 7-1 Effect of Number of Microturbines on Simple Payback Period

As seen from the above diagram, the payback decreases with increase in number of microturbines. The best payback is achieved with the building heat option. The heating and cooling option has a similar payback trend to the building heat option; however, due to the purchase of additional equipment, the payback is a little higher. The distributed generation option has the highest payback and is typically not feasible.

In the recent years, natural gas prices have been volatile. Figure 7-2 shows the effect of fuel price on payback period. As fuel price rises, the payback on a microturbine installation increases. One of the reasons multiple generators were used to increase capacity as opposed to using a larger generators is because the 60 kW generators chosen are capable of using biogas instead of natural gas. Biogas includes such gases as landfill gas and digester gas from animal farms or wastewater treatment plants. Using available biogases will save fuel cost and is better for the environment. Biogas can be purchase from nearby sources at lower costs than natural gas. The payback varies as fuel costs vary weather it is the rising natural gas prices or less expensive biogases. The payback as a function of fuel cost is as follows:

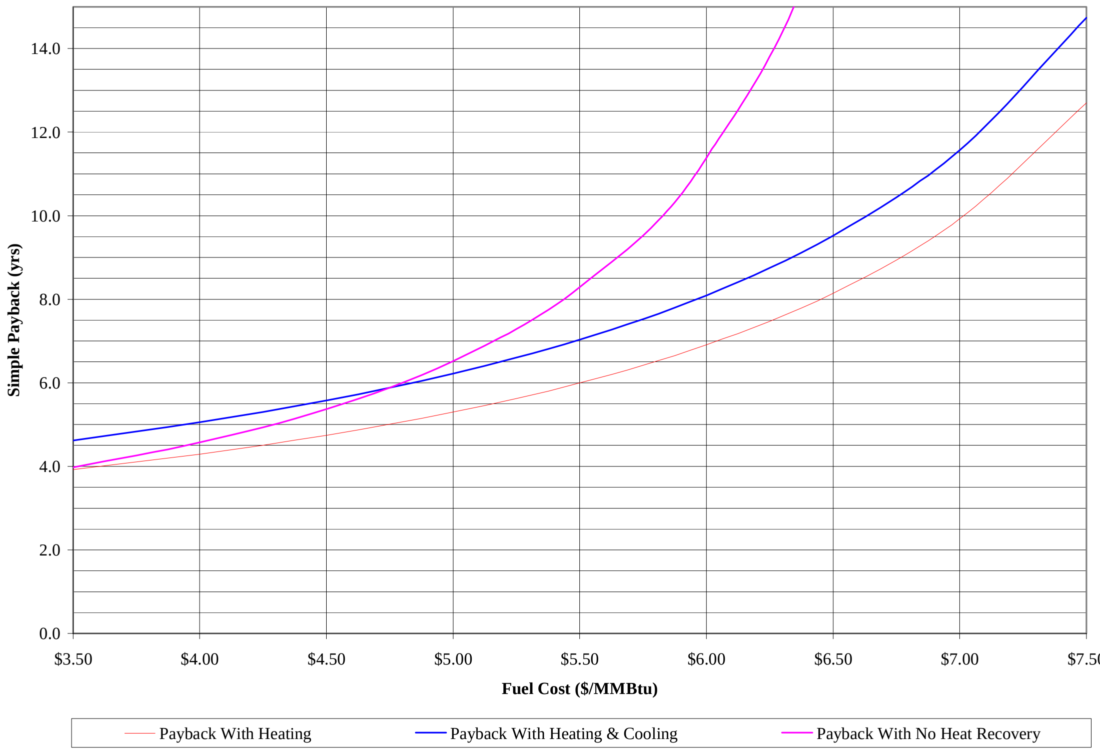


Figure 7-2. Effect of Fuel Cost on Simple Payback Period

8. <u>Conclusions and Recommendations</u>

8.1 Conclusions

8.1.1 Interest Level

There are several engineering firms, as well as equipment manufactures and distributors who are pursuing the CHP market in Iowa.

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

There is currently not a significant amount of CHP in Iowa; the Midwest Application Center identified a total of 26 CHP systems, producing a little nearly 372,000 kW in Iowa. Food processing industry in Iowa accounts for the largest percentage (67%) of the total CHP capacity, followed colleges/university campuses. The power generation capacities of these systems range from 60 kW to 155,000 kW. The top four potential markets for CHP are office buildings, schools, hospitals and colleges/universities. These markets account for more than 68% of the total potential CHP market.

Interconnection poses to be one of the biggest barriers to CHP in Iowa because there is no State standard for interconnection. This is compounded by the large number of electric suppliers within Iowa, each with its own interconnection requirements.

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. Prices are expected to decrease as the technologies and system designs become more common. For smaller generating capacity units, this initial cost can have a long payback period unless electric costs are very high, fuel prices are low, and thermal loads well matched.

Operating costs due to fluctuating and increasing natural gas prices as recently experienced, may be perceived as a concern, even though the average natural gas price in Iowa is lower than those for the Midwest and the U.S.

Standby charges and ***Electricity rates*** are also a factor in CHP because they affect the payback period. It can be a disincentive for CHP because it increases the true cost of electric energy from CHP systems.

Even though average prices of electricity and natural gas in Iowa are lower than those for the Midwest and the U.S, these energy prices are not very attractive for CHP systems. However, many opportunities still might exist for CHP systems for specific applications in which, power demand charges and/or on-peak prices are high, and/or the annual utilization of thermal energy from power generation is high, and/or the economic or safety value of higher reliability of CHP system is high. In addition, many CHP opportunities may also exist where fuels, such as biogas produced from food processing waste, wastewater treatment plants, and landfills, wood or agricultural wastes are available at low or "no cost."

8.1.3 Favorable Characteristics

Open access to the grid is available to all customers of utilities and large co-ops. Open access to natural gas is also available.

Exit fees do not apply to those decide to exit form the grid to provide their own electricity.

Favorable alliances exit in Iowa. The MAC is leading the way in promoting the deployment of CHP with the help and cooperation of such organizations as Iowa Department of Natural Resources, Iowa Agriculture Innovation Center, Iowa Energy Center, Iowa Pork Producers Association, Iowa Farm Bureau, Alliant Energy, Iowa State University, Iowa Farm Bureau Federation, and Iowa Renewable Fuels Association.

Market potential appears to be reasonable for CHP. ONSITE Energy Corporation estimates for Iowa a total market potential of nearly 682, 000 kW.

Availability of natural gas is good in Iowa.

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 Iowa Utility Board to

- Reduce or eliminate stand-by charges.

Work with the Legislative to

- Establish appropriate incentives for CHP such as tax breaks and environmental credits.

3) Build Alliances

Build alliances with potential partners such as:

- Large Architect/Engineering Firms with CHP capabilities
- Iowa Energy Center
- Alliant Energy

Appendix A Architect and Engineering Firms Promoting CHP Technologies in Iowa

1. Brooks Borg Skiles Architecture Engineering LLP
   317 Sixth Ave., Ste. 400
   Des Moines, IA 50309
   515.244.7167

2. Brown Engineering Company
   2570 106th St Ste D
   Des Moines, IA 50322-3742
   (515) 331-1325

3. Dewild Grant Reckert And Associates Co
   1302 S Union St, P.O. Box 511
   Rock Rapids, IA 51246-2090
   (712) 472-2531

4. HDR
   12345 University Ave Ste 313
   Des Moines, IA 50325-8245
   (515) 440-2373

5. Howard R. Green Company
   8710 Earhart Lane SW, PO Box 9009
   Cedar Rapids, IA 52409-9009
   (319) 841-4000

6. MWH
   11153 Aurora Ave
   Des Moines, IA 50322-7904
   (515) 253-0830

7. Stanley Consultants, Inc
   225 Iowa Ave
   Muscatine, IA 52761-3764
   (563) 264-6600

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 CHP Equipment Distributors/Manufactures in Iowa

1) Altorfer Power Systems (Caterpillar Distributor)
   2550 6th St SW
   Cedar Rapids, IA 52404-3502

2) Cummins
   Industrial Division
   5194 NE 17th
   Des Moines, IA 50313
   515-264-1650

3) Oconnor Company (Trane Distributor)
   4455 121st Street
   Urbandale, IA 50322

4) Unison Solutions, Inc.(Distributors for Capstone Microturbines, Kohler Power Systems, and STM Sterling Cycle Engines)
   2728 Ashbury Road, Suite 320
   Dubuque, IA 52001
   563-585-0968

5) Ziegler Inc.(Caterpillar Distributor)
   1500 Ziegler Dr NW
   Altoona, Iowa 50009-7200

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 Iowa

Building Owners and Managers Association, Iowa
http://www.bomaiowa.org

Terrus Real Estate Group
616 10th Street
Des Moines, IA 50392-2030
515-471-4302

Ryan Companies US, Inc.
1275 NW 128th Street, Suite 150
Clive, IA 50325-3857
515-267-3857

Continental Western Group
11201 Douglas Ave, PO Box 1594
Des Moines, IA 50306-1594

Magnum Resources
699 Walnut, Suite 1300
De Moines, IA 50309
515-362-3501

Grubb & Ellis/Mid-America Pacific
4500 Westown Parkway, Suite 150
Des Moines, IA
515-222-0605

Institute of Rea Estate Managers, Iowa
www.iremiowa.org

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 Major Energy Supply and Service Companies in Iowa

Natural Gas Providers

1) Aquila Network (f/k/a Peoples Natural Gas.), a utility subsidiary of Aquila, Inc.
2) Atmos Energy Company (f/k/a United Cities Gas Company)
3) Cornerstone Energy, Inc.
4) Interstate Power and Light, a utility subsidiary of Alliant Energy

Electricity Providers

Investor Owned Electric Utilities

1) Interstate Power and Light, a utility subsidiary of Alliant Energy
2) MidAmerica Energy
3) Muscatine Power and Water

Appendix E Energy Service Companies Serving Iowa

1) Burns & McDonnell
   9400 Ward Parkway
   Kansas City, MO 64114
   816-822-4367

2) Honeywell Technology Solutions
   St. Clair, MI
   Phone: 810-326-0642

3) Johnson Controls, Inc.
   Milwaukee, WI
   Phone: 414-524-7331

4) ORIX Public Finance LLC
   2690 Grand Elsa
   Suite 380
   Kansas City. MO 84109
   Phone: 770-970-2100

5) Siemens Building Technologies
   Buffalo Grove, IL
   Phone: 847-941-5070

NOTE: *This list represents only those firms that the MW BCHP Application Center was able to identify at the time of this report. Other firms may exist that promote BCHP; 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 Iowa

	Organization	Website
1.	American Institute of Architects	http://www.aiaiowa.org
2.	BOMA Building Owners and Managers Association	http://www.bomaiowa.org
3.	Center for Neighborhood Technology	http://www.cnt.org
4.	Delta Institute	http://www.delta-institute.org
5.	Energy Resources Center – University of Illinois at Chicago	http://www.erc.uic.edu
6.	Environmental Law and Policy Center	http://www.elpc.org
7.	Gas Technology Institute	http://www.gastechnology.org
8.	Interstate Renewable Energy Council (IREC)	http://www.eren.doe.gov/cro
9.	Iowa Energy Center	http://www.energy.iastate.edu
10.	Manufacturing Extension Program (MEP)	http://www.mep.nist.gov/index3.html
11.	Midwest CHP Application Center (MAC)	http://www.chpcentermw.org
12.	Midwest Cogeneration Association	http://www.cogeneration.org
13.	Midwest CHP Initiative (MWCHPI)	http://uschpa.admgt.com/regional.htm #midw
14.	Midwest Energy Efficiency Alliance (MEEA)	http://www.elpc.org/energy/index.htm

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

Federal Government Agencies

	Agency	Website/Contact Information
1.	DOE Combined Heat and Power (CHP) Initiative	http://www.eren.doe.gov/der/CHP/
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 CHP Partnership	http://www.epa.gov/chp/
12.	EPA Climate Protection Division (CPD)	http://www.epa.gov/cpd.html
13.	EPA Office of Air & Radiation	http://www.epa.gov/oar/
14.	EPA Office of Air Quality Planning and Standards	http://www.epa.gov/oar/oaqps/
15.	EPA-DOE Energy Star Program	http://www.energystar.gov
16.	Federal Energy Management Program (FEMP)	http://www.eren.doe.gov/femp/
17.	Federal Laboratory Consortium for Technology Transfer	http://www.fedlabs.org
18.	Manufacturing Extension Partnership (MEP)	http://www.mep.nist.gov/
19.	US Department of Energy (DOE)	http://www.energy.gov
20.	US Department of Housing & Urban Development (HUD)	http://www.hud.gov/

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

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.	Iowa Association of Electric Cooperatives	http://www.iowarec.org
11.	Iowa Association of Municipal Utilities	http://www.iamu.org
12.	National Association of Regulatory Utility Commissioners (NARUC)	http://www.naruc.org
13.	National Association of State Energy Officials (NASEO)	http://www.naseo.org
14.	National Energy Technology Laboratory	http://www.netl.doe.gov
15.	National Renewable Energy Laboratory	http://www.nrel.gov
16.	Natural Resources Defense Council (NRDC)	http://www.nrdc.org
17.	Northeast Midwest Institute	http://www.nemw.org
18.	Oak Ridge National Laboratory	http://www.ornl.gov
19.	Regulatory Assistance Project	http://www.rapmaine.org
20.	U.S. Combined Heat and Power Association (USCHPA)	http://uschpa.admgt.com

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Appendix G CHP Installation in Commercial, Institutional and Industrial Facilities in Iowa

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Ames	Iowa State University	Iowa State University	Colleges/Univ.	8221	61131	1949	B/ST	33,900	COAL
Ames	United States Department of Agriculture (USDA)	National Animal Disease Center	General Gov't	9100	92119	2002	CT	1,200	NG
Bettendorf	Jacobs Energy Corporation	Waste Wood Cogen Project	Wood Products	2400	321	1992	B/ST	3,500	WOOD
Cedar Falls	University Of Northern Iowa	University Of Northern Iowa	Colleges/Univ.	8221	61131	1982	B/ST	7,500	COAL
Cedar Rapids	Archer Daniels Midland Company	Cedar Rapids Corn Wet Milling	Food Processing	2046	311221	1988	B/ST	155,000	COAL
Clinton	Archer Daniels Midland Company	Clinton	Food Processing	2046	311221	1940	B/ST	31,400	COAL
Council Bluffs	Mercy Hospital	Mercy Hospital	Hospitals/Healthcare	8062	62211	1970	ERENG	1,840	NG
Davenport	Oscar Mayer	Oscar Mayer &	Food Processing	2011	311611	1959	B/ST	3,880	COAL

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
	Foods Corporation	Company, Inc.							
Davenport	City of Davenport	Davenport Water Pollution Control Plant	Wastewater Treatment	4952	22132	1995	ERENG	1,600	BIOMASS
Des Moines	Archer Daniels Midland Company	Des Moines	Food Processing	2046	311221	1988	B/ST	6,400	COAL
Des Moines	Des Moines Metro WRF	Des Moines Metro Wastewater Reclamation	Wastewater Treatment	4952	22132	1991	ERENG	1,800	BIOMASS
Des Moines	Heather Manor	Heather Manor	Nursing Homes	8051	62311	1988	ERENG	60	NG
Des Moines	Iowa Methodist Medical Center	Iowa Methodist Medical Center	Hospitals/Healthcare	8062	62211	1987	ERENG	3,500	NG
Dubuque	John Deere Corporation	John Deere Dubuque Works	Machinery	3569	333999	1994	ERENG	9,000	COAL
Dyersville	Mercy Health Center	Merch Health Center - St Mary'S Unit	Hospitals/Healthcare	8062	62211	1987	ERENG	60	NG
Eagle Grove	AG Processing	AG Processing	Food Processing	2041	311211	1983	B/ST	10,000	COAL

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
	Inc.	Inc.							
Eddyville	Cargill, Inc.	Cargill Inc.Corn Milling Division	Food Processing	2046	311221	1952	B/ST	40,000	COAL
Iowa City	University Of Iowa	University Of Iowa Main Power Plant	Colleges/Univ.	8221	61131	1947	B/ST	34,700	COAL
Manchester	Good Neighbor Home	Good Neighbor Home	Nursing Homes	8051	62311	1986	ERENG	60	NG
Manchester	Delaware County Memorial Hospital	Delaware County Memorial Hospital	Hospitals/Healthcare	8062	62211	1985	ERENG	120	NG
Mitchellville	Bio-Energy Partners	Metro Methane Recovery Facility	Solid Waste Facilities	4953	562212	1998	ERENG	6,400	BIOMASS
Rockford	City of Rockford	Rockford	General Gov't	9111	92111	1951	ERENG	2,900	OIL
Tama	Packaging Corporation Of America	Packaging Corporation Of America	Pulp and Paper	2631	32213	1941	B/ST	1,500	NG
Waterloo	Bertch Cabinet Manufacturing	Bertch Cabinet Manufacturing	Wood Products	2434	33711	1992	B/ST	279	WOOD

City	Organization Name	Facility Name	Application	SIC4	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Waterloo	John Deere Corporation	John Deere Waterloo Works	Machinery	3531	33312	1949	B/ST	14,000	COAL
Winnebago	City of Forest City	Forest City	General Gov't	9111	92111	1958	ERENG	1,200	OIL

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

Prime Mover Code	Sites	Capacity (kW)
Total	26	371,799
B/ST	13	342,059
CC	0	0
CT	1	1,200
FCEL	0	0
MT	0	0
OTR	0	0
ERENG	12	28,540

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 Effect of Gas Price Volatility on Breakeven Cost 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 H-1: Calculate True Cost of Electricity

Follow these steps:

- Calculate your true cost of electric power as shown in Table H-1
- Plot the true cost of electricity and your current gas cost on Figure H-1
- 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°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°F and below), use 6,000 Btu/kW.

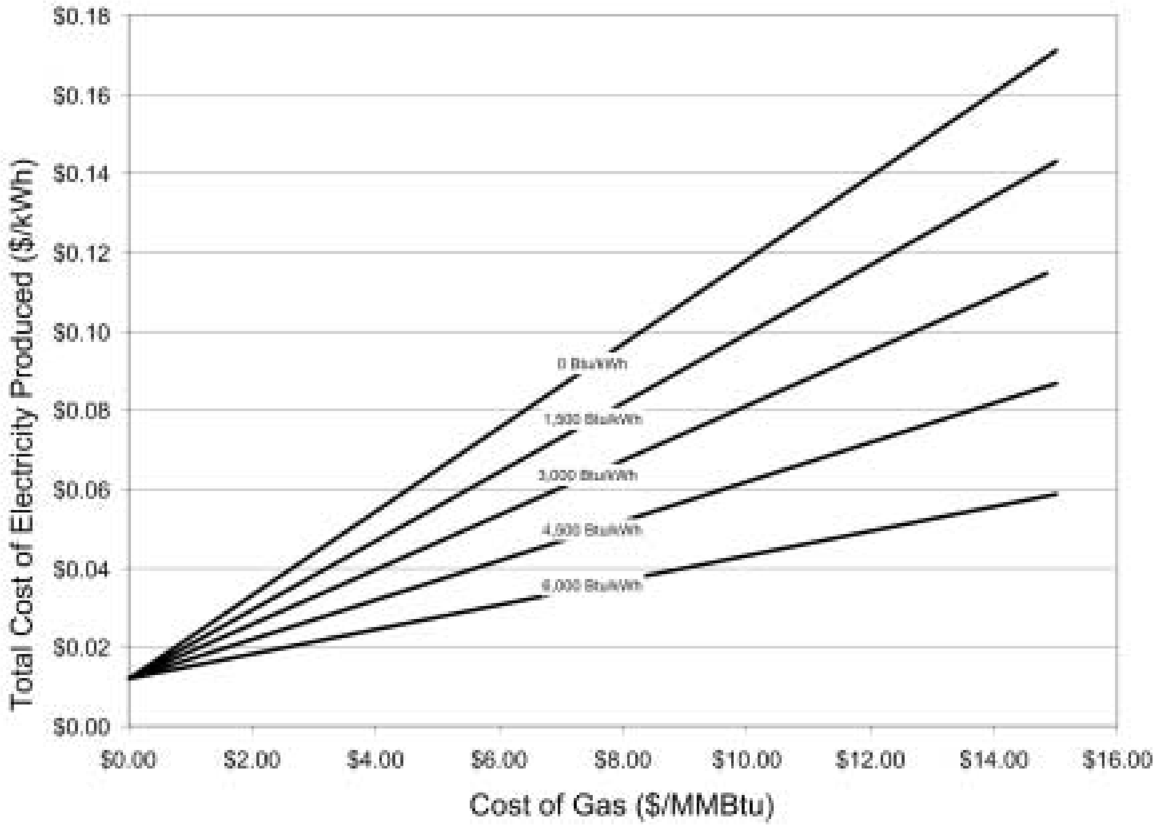


Figure H-1: Breakeven Chart

Example

Question

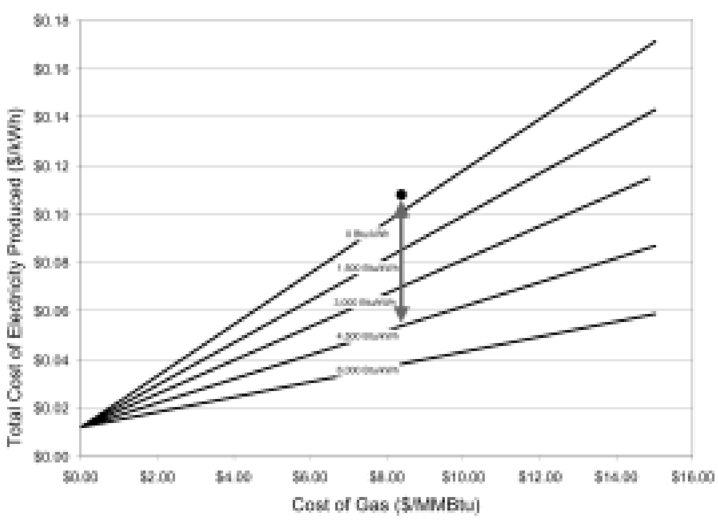
A cogeneration system provides power and heating to a commercial building. The owner's gas price spikes to $0.80/therm in January. Should the cogeneration system be run during this gas price spike?

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 H1 gives:



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

Appendix I Interstate Power Company Standby Service (Rider 1S)

IES UTILITIES (n/k/a Interstate Power and Light Company)
ELECTRIC TARIFF
Filed with the IOWA UTILITIES BOARD
ORIGINAL TARIFF NO. 1

SUBSTITUTE SECOND REVISED SHEET NO. 81
CANCELLING FIRST REVISED SHEET NO. 81

PRE-SCHEDULED ENERGY ONLY STANDBY SERVICE

1. Availability

Service under this tariff is available only under contract to Customers with behind-the-meter dispatchable generation. Service is available starting on June 1 of any year.

A notice of up to one year may be required before the Company will allow a Customer currently receiving firm service from the Company, for a load in excess of five thousand (5,000) kW, to begin service under this tariff. The term of any notice will be dependent on the Company's ability to adjust its generation capability, including reserve margin, for the reduced firm load due to self-generation installed by the Customer.

A Customer receiving standby service may terminate standby service and establish service under a firm service tariff schedule within the same time frame as would be required of a new Customer with a similar load to establish firm service under a Company firm service tariff schedule. The term of any notice required to switch from standby to firm service will be dependent on the Company's ability to adjust its generation capability, including reserve margin, for the increased firm load due to Customer's selection of firm service from the Company.

Energy provided to the Customer under this tariff is limited to energy scheduled during a forced outage or during planned maintenance of the Customer's self-generation. Customer shall operate self-generation to avoid taking energy from Company other than under a schedule, and to avoid energy flow to Company. An exception to scheduled purchases during a Customer's forced outage or planned maintenance will be allowed for sales scheduled to Customer for economic reasons. The price for such sales shall be based on the marginal cost of the energy to the Company plus a mark-up of 10%. Any inadvertent energy flow (flow not subject to a schedule) to Customer or to Company shall be subject to the provisions of balancing service.

2. Definitions

   a. Commercial Period.

   Commercial Period is defined as that period of time in which the Company can affect the delivery of a given energy product or service for the delivery period requested by the Customer. Commercial Period is defined by either the Transmission Provider (TP) or prevailing market practice. A Commercial Period for delivery of energy during a specific clock hour terminates when the opportunity for scheduling closes prior to the start of the delivery hour.

Date Issued: November 12, 2003

Effective Date: December 14, 2003

By: ______________________
David H. Berentsen, Manager – Regulatory Pricing, Iowa & Minnesota

Appendix J Interstate Power Company Rider for Parallel Operation and Cogeneration (Rider 1CG)

INTERSTATE POWER COMPANY
FILED WITH BOARD

ELECTRIC TARIFF

THIRD REVISED VOLUME NO. 1
FIRST REVISED SHEET NO. 25
Canceling
ORIGINAL SHEET NO. 25

RATE DESIGNATION:
RIDER 1 CG
CLASS OF SERVICE: ALL CLASSES
SERVICE AREA: ALL IOWA SERVICE AREA

Availability: Applicable to customers who have installed cogeneration or small power production facilities, referred to herein as "qualifying facilities", on or after May 20, 1981, which are rated at 100 kW or less and certified under the Public Utility Regulatory Policies Act of 1979 (PURPA), Title I, Section 201.

Other conditions for a qualifying facility to meet standards that provide for safety and operating reliability are as follows:

1. Qualifying facilities shall meet the applicable provisions currently in effect in the publications listed below pursuant to ISCC Chapter 15 of the Iowa Administrative Code (Ref. Section 15.10)

   a. General Requirements for Synchronous Machines, ANSI C50.10-1990. * T
   b. Requirements for Salient Pole Synchronous Generators and Condensers, ANSI 50.12-1982. T
   c. Requirements for Cylindrical-Rotor Synchronous Generators, ANSI C50.13-1982. T
   d. Requirements for Combustion Gas Turbine Driven Cylindrical-Rotor Synchronous Generators, ANSI C50.14-1977.
   e. Iowa Electrical Safety Code, as defined in 199-Chapter 25. T
   f. National Electrical Code, ANSI/NFPA No. 70-1993. T

   * Rule 8.1 is modified (as defined in ANSI C42.100-1972) to read: The deviation factor of the open-circuit terminal voltage wave and the current wave at all loads shall not exceed 0.1.

The Company shall require sufficient data from the customer to verify that the above standards have or will be complied with and such requirement shall need engineering department approval before interconnection is permitted.

For those qualifying facilities which are of such design as to not be subject to the standards noted in a., b., c., and d., above, data on the manufacturer, type of device, and output current wave form (at full load) and output voltage wave form (at no load and at full load) shall be submitted to the Iowa Utilities Board for review and approval prior to interconnection.

2. Interconnection facilities supplied by the Customer shall include the following:

   a. A switch that provides a visible break or opening that is capable of being padlocked in the open position by either the Company or the Customer with separate locks.
   b. An overcurrent device that will automatically disconnect the connection at all currents that exceed the full load current rating of the qualifying facility.
   c. An automatic disconnect device that opens the connection upon loss of voltage from the Company system.
   d. Those qualifying facilities that produce a terminal voltage prior to the closure of the interconnection shall be provided with synchronism-check devices to prevent closure of the interconnection under conditions other than a reasonable degree of synchronization between the voltages on each side of the interconnection switch.

Authorized: November 2, 1994 By: D. V. [signature]
Director of Rates

Proposed Effective: December 3, 1994 Effective: December 3, 1994

Docket No. RMU-94-3