

BCHP Baseline Analysis for the Minnesota Market

**Prepared by:
Midwest CHP Application Center**

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Table of Contents

Executive Summary	1
1. Introduction and Purpose	4
2. BCHP Contacts in Minnesota	5
2.1 Key Firms in Minnesota with BCHP Project Experience or Capabilities	5
2.2 Associations and Organizations Involved with BCHP Deployment	6
3. Survey of BCHP Installations and BCHP Targets in Minnesota.....	7
3.1 Survey Summary.....	7
3.2 Sector Analysis of the Survey Data	8
4. Current Pricing Issues	10
4.1 Equipment and Maintenance Costs.....	10
4.2 Energy Pricing	11
4.3 Financial Incentives for BCHP Systems.....	13
5. Summary and Status of BCHP Policy Issues.....	14
5.1 Distributed Generation Working Group Proceedings.....	14
5.2 Exit Fees.....	14
5.3 General Status of Progress on Deregulation	15
5.4 Emerging Legislation and Regulations.....	16
5.5 Potential Political Partners or Advocates of BCHP	16
6. The Market Capacity Potential of BCHP in Minnesota.....	17
6.1 Industrial and Commercial Market	17
6.2 Multi-Family Residential Market	18
6.3 Biomass Based CHP Applications.....	19
7. Conclusions and Recommendations	20
7.1 Conclusions.....	20
7.1.1 Interest Level	20
7.1.2 Installation Status.....	20
7.1.3 Barriers.....	20
7.1.4 Favorable Characteristics.....	20
7.2 Recommendations.....	21
Appendix A Architect and Engineering Firms Promoting BCHP Technologies in Minnesota	22
Appendix B Equipment Distributors/Manufactures That Promote BCHP Technologies in Minnesota	24

Appendix C	Property Management Organizations and Firms in Minnesota	26
Appendix D	Energy Supply and Service Companies in Minnesota.....	32
Appendix E	Energy Service Companies listed by National Association of Energy Service Companies	35
Appendix F	Associations/Organizations Associated with BCHP Deployment in Minnesota.....	36
<i>Appendix G</i>	Distributed Generation – Commercial/Light CHP Facilities in Minnesota.....	39
Appendix H	Cogeneration Systems and Gas Price Volatility.....	40

Executive Summary

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

In Minnesota there are currently about 22 technical companies actively pursuing BCHP deployment and installations. There are several large well-known engineering firms, as well as equipment manufactures and distributors who are aggressively pursuing the BCHP market in Minnesota. Companies that are leading the way for BCHP in Minnesota are Cummins NPower, Interstate Power Systems, and Minnegasco/CenterPoint Energy.

Focusing on BCHP systems in commercial installations, the Midwest CHP Application Center (MAC) identified a total of 19 BCHP systems and BCHP target sites, producing over 268,000 kW in Minnesota. District Energy systems seem to be a particularly attractive application for BCHP systems in Minnesota with over 115,000 kW installed, followed by installations at universities (47,000 kW), and then hospitals (34,000 kW).

Capital costs as well as operating costs are generally viewed as some of the major hurdles to utilize BCHP technologies. The predominant technologies in BCHP power generation utilize natural gas. They range in size from reciprocating engines and microturbines in the tens of kilowatts to gas turbines in the tens of megawatts range. The least expensive technologies (large natural gas turbines) installed start around \$600/kW and increase in cost up to fuel cell technologies that may cost up to \$5,000/kW. Natural gas reciprocating engines are the predominate technology, and can range in price from \$1,000 to \$1,800/kW (installed). Although prices of all of these technologies 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 and thermal loads well matched.

For most BCHP systems natural gas constitutes the majority of the variable/operating cost. Volatile natural gas prices, such as those experienced in the winters of 2000/2001 and 2002/2003, could have negative affects on the BCHP market development. However, the average price paid for natural gas by commercial customers in Minnesota was \$7.85/MMBtu in 2001, which is relatively low compared to other Midwestern states. At 5.5¢/kWh (in year 2002) the utility revenue from electricity for commercial customers is below average for the Midwestern Region.

On the regulatory side in Minnesota net metering is available for qualifying CHP facilities with a capacity of less than 40 kW. Exemptions for stand-by rates for Distributed Generation (DG) facilities were recently recommended by the Minnesota Department of Commerce's DG Working Group efforts and may be enacted in the near future.

The most effective deployment of BCHP 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 BCHP in Minnesota are:

- Sustainable Minnesota
- Minnesota Department of Commerce
- Minnesota Environmental Quality Board
- Minnesota Public Utilities Commission
- Midwest CHP Application Center
- Midwest CHP Initiative

Sustainable Minnesota, a non-profit organization, promotes clean and efficient energy systems through legislative interventions and by providing informational resources on its website (including CHP/Cogeneration resources).

The Minnesota Department of Commerce State Energy Office is a particularly active advocate of CHP technology. The State Energy Office last year lead two working groups to recommend statewide standards for interconnection and tariffs for distributed generation projects in the state.

In November 2002 the State Energy Office also sponsored a one-day CHP training course taught by the Midwest CHP Application Center. Approximately 30 participants interested in CHP development attended the training course.

The State Energy Office also hosted a distributed generation tariff workshop on May 14, 2003 in St. Paul, which was conducted by the Midwest CHP Applications Center and co-sponsored by the Department of Energy – Chicago Regional Office. The workshop brought together public utility regulators and state energy officials from 7 Midwestern states to discuss current DG tariff proceedings in the Midwest and nationally. Also in May, 2003, the Department of Energy Chicago Regional Office together with Minnegasco/CenterPoint Energy hosted a “DER Roadshow” in Minneapolis. This event was aimed at educating local code officials about distributed generation technologies.

The Minnesota Environmental Quality Board and Minnesota Planning in 2001 issued a “Regulatory Handbook for Cogeneration Projects in Minnesota.” This handbook summarizes the regulatory requirements such as air permitting, water permitting, siting requirements, and local permitting requirements for CHP systems in Minnesota.

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 Minnesota, ONSITE estimated a total market potential for electric production to be in the range of 850 to 1,320 MW. This potential may only be realized if the regulatory and policy issues become more supportive of BCHP installations.

Minnesota has also a significant potential for biomass based CHP applications. A report issued by the Minnesota Department of Commerce (January 2002) estimates that potentially 816,000 MWh of electricity (or 1.5% of the statewide energy production) could be produced from biomass based on the available amount of “feedstock.”

This report concludes with recommendations, which address the need to work with state regulators to educate private market participants on BCHP benefits. Case studies are needed which show the tremendous economic and environmental

benefits of BCHP systems. As mentioned above alliances have to be formed with already influential companies in the BCHP field such as Sustainable Minnesota, Minnesota Department of Commerce, and others to develop synergies between these companies and the Midwest CHP Application Center to promote the use of BCHP.

1. Introduction and Purpose

The purpose of this analysis is to assess the current status of the Cooling, Heating, and Power for Buildings (BCHP) sector in Minnesota and identify current hurdles that prevent the widespread use of BCHP systems. This information will be used to identify target markets for BCHP systems as well as development of education and market transformation programs, which will foster BCHP applications. Finally, an action plan will be developed to further BCHP deployment in Minnesota.

Cooling, Heating, and Power for Buildings (BCHP) refers to technologies which generate electricity at or near the point of use, such as a building or building complex, while simultaneously recovering upwards of 80% of the waste heat for heating, cooling and/or dehumidification purposes.

In order to assess the current state of BCHP in Minnesota, 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 BCHP installations was conducted.

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

A status assessment of policy related issues pertaining to BCHP was conducted. The assessment was performed for five policy areas; CHP interconnection and tariff provisions (as developed by the Minnesota DG Working Group Proceedings), exit fees, general progress with state electric deregulation, emerging legislation, and potential partners/advocates of BCHP.

The market capacity potential for BCHP in Minnesota was evaluated to identify the best target sectors for deployment.

This report concludes with recommendations to effectively promote the deployment of BCHP in Minnesota.

2. BCHP Contacts in Minnesota

2.1 Key Firms in Minnesota with BCHP Project Experience or Capabilities

One of the major methods to promoting market acceptability of BCHP technologies is to engage the efforts of commercial firms that can promote the installation of BCHP technologies. Besides those that can benefit directly through profits and savings from BCHP, there are other firms which have the interest and capability to get involved with BCHP applications either because they promote energy efficiency, green building technologies, or have other BCHP 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 BCHP in Minnesota.

There are about 22 companies in Minnesota that are engaged in BCHP system applications or have BCHP system capabilities. Hopefully in the near future interest in BCHP applications will increase even more through the activities of a multitude of local and regional organizations that are involved with the promotion of BCHP applications.

Architectural and Engineering firms are important to promoting BCHP technologies because the most economical time to install a BCHP 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 BCHP system need only be justified on the cost differential between the BCHP 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 BCHP installation in Minnesota. There are currently about 13 architectural and engineering firms that have developed or have the capabilities to develop BCHP systems in Minnesota.

Manufacturers of power generation equipment, absorption chillers, and desiccant dehumidification equipment, and their sales representatives are important to promoting BCHP 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 BCHP technologies. 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 BCHP installations in Minnesota. There are currently approximately 8 manufactures/sales offices involved in deployment of BCHP related technologies in Minnesota.

Property management firms are important in promoting BCHP technologies because they are the operators of many commercial buildings for which BCHP 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 back-up-generation equipment, the cost differential to install BCHP over a conventional central heating/cooling system is again smaller and easier to justify. The two main organizations that represent property management firms in Minnesota are BOMA (Building Owners and Managers Association) and IREM (Institute of Real Estate

Managers), which accredits recognized real estate management organizations. Information on the Minnesota BOMA chapter and IREM accredited Minnesota property management companies can be found in Appendix C.

Local energy suppliers are also important to promoting B 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 additional profit potential for gas supply companies. A list of energy supply companies in Minnesota is provided in Appendix D.

Energy Services companies (ESCOs) are also interested in B CHP technologies. In the recent past they have not been that interested in CHP because it is easier for them to find other cost saving measures in commercial and light industrial applications like lighting retrofits and energy control systems, and in many cases regulations and siting requirements served as a disincentive for them (as a third party) to install B CHP. However, end-user interest in providing high-reliability electric service and overall increased energy efficiency in buildings, coupled with end-user restricted capital has recently piqued interest by ESCo's in B CHP. Appendix E lists ESCO's which are active in Minnesota.

2.2 Associations and Organizations Involved with B CHP Deployment

Federal, State, and regional entities are becoming more and more interested in B 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 B 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 B CHP. In fact the Midwest appears to be leading the way in promoting the deployment of B CHP. Within the State of Minnesota, Sustainable Minnesota, a non-profit organization, promotes clean and efficient energy systems through legislative interventions and by hosting informational resources on its website (including CHP/Cogeneration resources).

The Minnesota Department of Commerce State Energy Office is a particularly active advocate of CHP technology. The State Energy Office hosted several CHP related workshops last year and lead two working groups to recommend statewide standards for interconnection and tariffs for distributed generation projects in the state.

A list of these associations and organizations and their web-addresses, where available, is provided in Appendix F.

3. Survey of BCHP Installations and BCHP Targets in Minnesota

3.1 Survey Summary

This survey identifies existing and pending BCHP installations in order to assess the current statutes of BCHP in Minnesota; to establish a baseline and to identify those facility types where BCHP was most prevalent.

The information in this section is based on input from various sources including; personal interviews, manufactures and distributors, websites, associated organizations, and journals. The survey of BCHP installations and potential BCHP candidates is primarily based on personal interviews as well as the use of published data. Published data consisted of the Energy Information Administration's "Inventory of Nonutility Electric Power Plants in the United States" (<http://tonto.eia.doe.gov/FTPROOT/electricity/0095992.pdf>), dated November 2000 and a report titled "Opportunities to Expand Cogeneration in Minnesota" by the Center for Energy and Environment, dated August 1996. The remaining sites identified represent the best efforts of the Midwest CHP Application Center to identify actual and potential BCHP installations in Minnesota at the time of this report. Other existing or potential BCHP sites may exist; they will be added to the database and will be available over the website in the future as they are identified.

A total of 19 BCHP systems and BCHP candidates, producing over 268,000 kW, are known to be in operation in Minnesota. 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. Where it is known, thermal heat recovery has been noted.

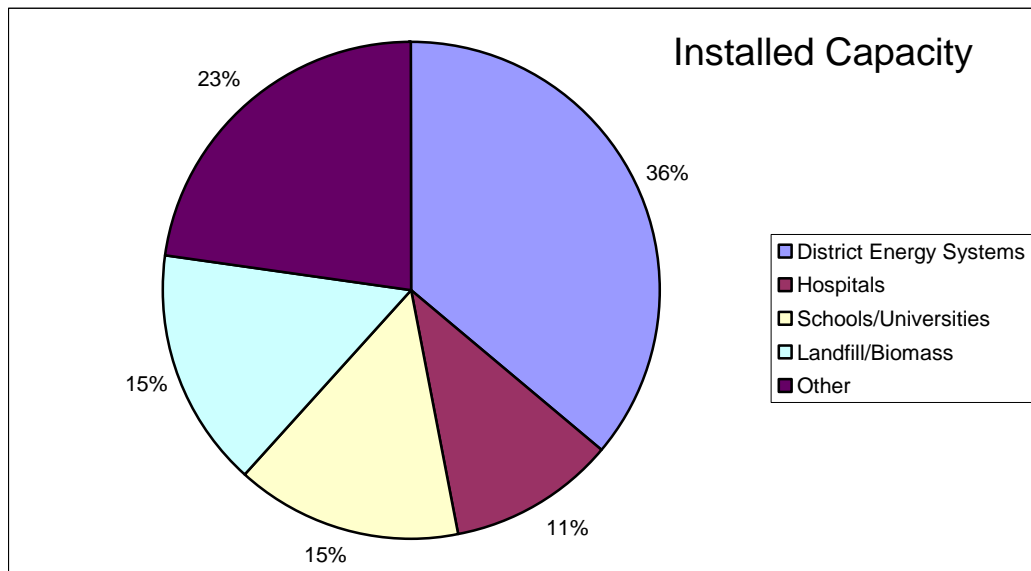
3.2 Sector Analysis of the Survey Data

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

Table 3—1 BCHP Capacity and Candidates Installed by Sector in Minnesota

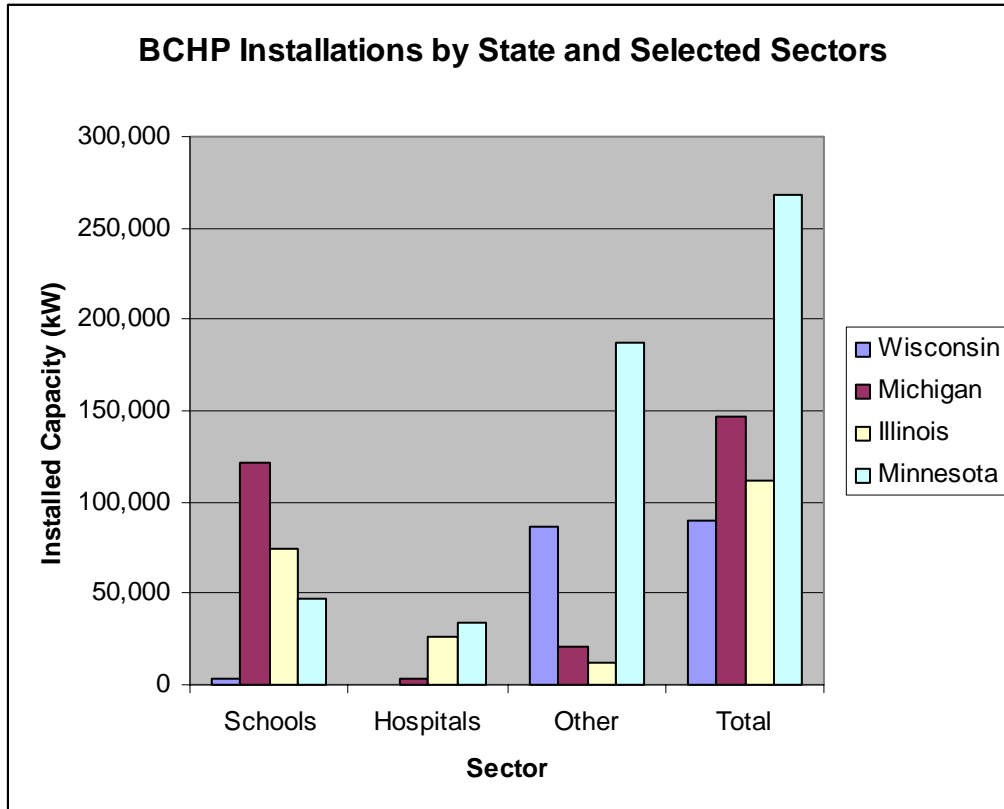
Business Sector	Installed Capacity (kW)
District Energy Systems	115,000
Hospitals	33,950
Schools/Universities	47,100
Landfill/Biomass	48,600
Other	72,600
Total:	268,650

Figure 3-1 BCHP Capacity and Candidates Installed by Sector in Minnesota



As can be seen District Energy Systems constitute the biggest installed BCHP market segment in Minnesota followed by Schools/Universities, and then Hospitals. As indicated in the Table in Appendix G landfills/resource recovery facilities generally do not utilize the waste heat and therefore constitute a good target for BCHP applications because of the relative low cost to add heat recovery to the prime mover that is already installed.

When compared to other Midwestern States, Minnesota has a relatively large installed base of BCHP capacity. This is mostly due to several large district energy systems in the state, totaling 150,000 kW. The following graph shows the installed BCHP capacity by state and selected business sectors (hospitals, schools, other).



Source: Midwest CHP Application Center – BCHP Baseline Studies

4. Current Pricing Issues

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

4.1 Equipment and Maintenance Costs

The predominant prime mover technologies in BCHP applications are reciprocating engines, combustion turbines, and microturbines. In the near future fuel cell technology is expected to become a prevalent BCHP 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 CHP Application Center indicates the cost and other relevant technical data for the various equipment types.

Table 4—1 CHP Technologies

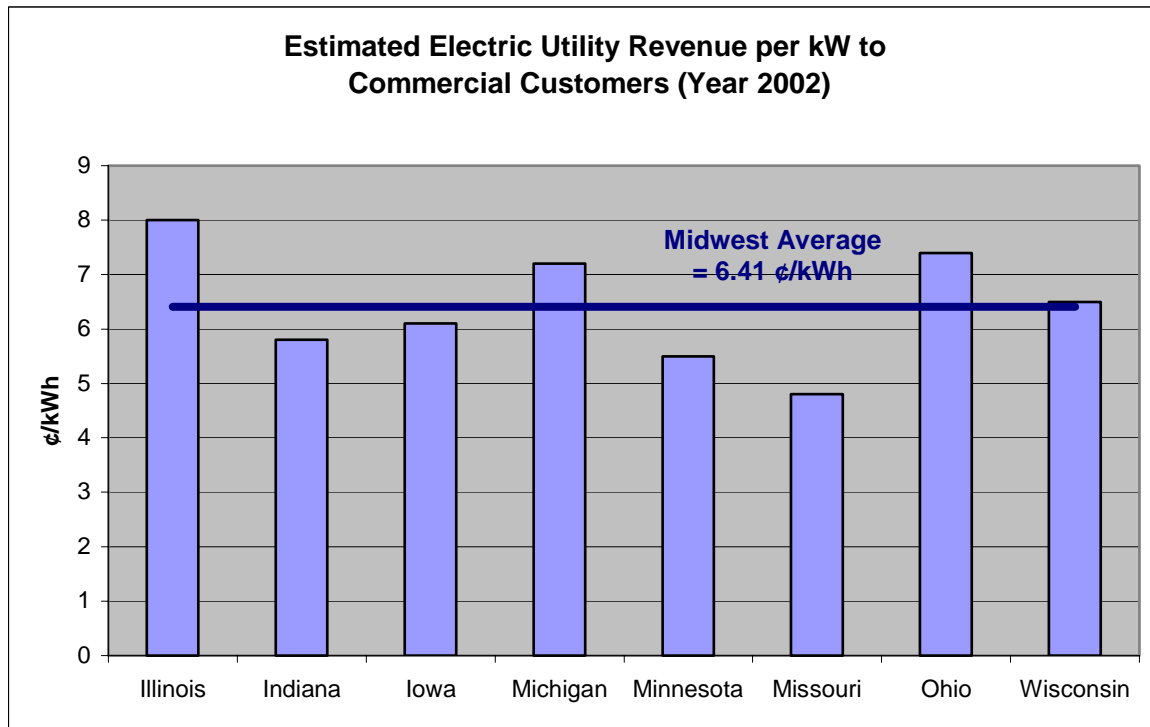
Size Range (kWe)	Gas Engine		Gas Turbine - Simple Cycle		Micoturbines	Fuel Cells
	100 - 500	500 - 2,000	1,000 - 10,000	10,000 - 50,000	100 - 500	30 - 3,000
Efficiency (LHV) Btu/kWh %	12,000 - 14,000 24 - 28	10,000 - 12,000 28 - 34	12,000 - 14,000 24 - 28	9,500 - 11,000 31 - 36	14 - 40	40 - 57
Installed 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) Hot Water (Btu/kWe/h)	4 - 5 (15 - 30 psi) 4,000 - 4,500	4 - 5 (15 - 30 psi) 4,000 - 4,500	5 - 6 (300 - 600 psi) 4,500 - 5,00	5 - 6 (300 - 600 psi) 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 siting requirements.

4.2 Energy Pricing

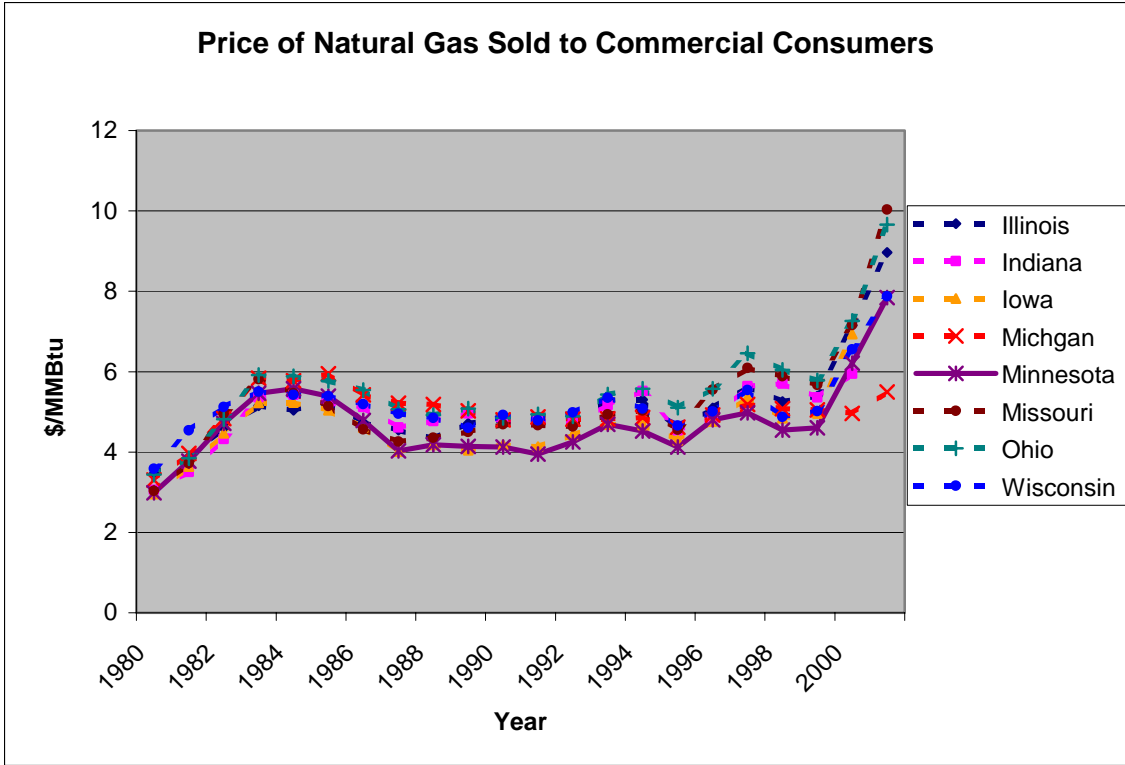
The potential for BCHP in a state depends largely on the prevailing electricity prices as well as on the prevailing natural gas prices, since natural gas is the fuel of choice for many BCHP systems. Relatively high electricity prices and low natural gas prices, for example, result in favorable economics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

The graph below shows the electric utility revenue from commercial customers (EIA estimate) for the eight states in the Midwestern Region. As can be seen Minnesota exhibits below average electricity prices in the Midwest at 5.5¢/kWh (in year 2002).



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

Natural gas prices in Minnesota are also comparatively low (\$7.85/MMBtu in 2001).



Source: <http://www.eia.doe.gov/neic/historic/hngas2.htm#Price>

Relatively low natural gas prices in Minnesota compared to neighboring Midwestern states should result in an attractive environment for CHP.

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 B CHP applications based on effective electric price per kWh and natural gas prices in MMBTUs. This methodology is presented in Appendix H.

4.3 Financial Incentives for BCHP Systems

The Minnesota Department of Commerce website summarizes renewable energy production incentives. The following production incentives may be relevant to CHP since CHP technologies can be installed at biomass or ethanol facilities.

Biomass

	Federal Incentives	State Incentives
Production Incentive	For non-taxable entities (government, non-profit, education, etc.), payment of 1.8¢/kWh, as funding permits for projects generating by Sept. 30, 2003. http://www.eren.doe.gov/power/rep.html	Payment of 1.5¢/kWh for 10 years for generation from an on-farm anaerobic manure digester system. (Minn. Stat. § 216C.41 (2001))
Tax Credit	Business tax credit of 1.8¢/kWh for projects installed by December 31, 2003 for 10 years (may be renewed). IRS Tax Form 8835(www.irs.gov).	
Depreciation	Double-declining balance, five-year depreciation schedule (I.R.C. Subtitle A, Ch. 1, Subch. B, Part VI, Sec 168 (1994)) (accelerated cost recovery system).	Minnesota uses same depreciation schedule as the federal government.
Net Energy Billing		Qualifying facilities smaller than 40 kW are paid utility's average retail rate for excess energy (Minn. Rules 7835 and MN Stat. §216B.164).

Ethanol

	Federal Incentives	State Incentives
Production Incentive		Payment of 20¢/gallon for ethanol produced in Minnesota and produced at plants that begin production by June 30, 2000; annual payments limited to \$3 million for any one producer and \$34 million in total (Minn. Stat. § 41A.09 (1998)).
Tax Credit	Benefit of 45¢/gallon (95% or below) or 60¢/gallon (96% or above) for ethanol used as transportation fuel (1994) (credit for producing fuel from a nonconventional source). IRS Tax Forms 378 and 6478.	

5. Summary and Status of BCHP Policy Issues

Policy issues at the State level play an important role in the deployment of BCHP within a State. The purpose of this section is to provide a summary and status of policy related issues pertaining to the advancement of BCHP in the State of Minnesota. The following policy areas are summarized below: Interconnection Rules and Stand-by Tariffs (as addressed by the Minnesota DG Working Group Proceedings), General Status on Progress of Deregulation, Emerging Legislation, and Political Partners.

5.1 Distributed Generation Working Group Proceedings

During the last year there have been several developments in Minnesota, which are favorable for BCHP installations. Most notably the Minnesota Department of Commerce lead two working groups to recommend standards for interconnection and tariffs for distributed generation projects in the state. This project was conducted in response to an order by the Minnesota Public Utilities Commission. On February 3, 2003 the Minnesota Department of Commerce submitted its final report to the Minnesota Public Utilities Commission. The working groups report covers installations from 40 kW to 10 MW. The interconnection working group recommends minimum technical standards and metering requirements to connect a distributed generation system to the transmission/distribution system. The report includes detailed technical specifications (which closely reflect IEEE 1547) such as metering and testing requirements, which reduce the uncertainties associated with installing BCHP systems.

The rate working group established guidelines for DG tariffs for utilities in Minnesota. The goal of the rate working group is that “the proposed rates should reflect the value of the distributed generation to the utility.” As a result, the working group recommended that DG stand-by tariffs should take into account the benefits of DG systems to the transmission/distribution system and that these benefits should be reflected as a credit against stand-by rates. The following credits are recommended:

- a) Distribution credits equal to the utility’s avoided distribution costs resulting from the installation of a DG facility.
- b) Renewable credits if the DG facility allows a utility to avoid the need to purchase “green power” as part of its green pricing program (currently in place for all Minnesota utilities).
- c) Emissions credits if a DG facility allows the utility to capture the value of the emission credit.

The working group also recommended an exception for all stand-by charges for facilities of 100 kW or less.

5.2 Exit Fees

There appear to be no exit fees imposed by any of the Minnesota utility companies on distributed generation projects.

PUC will develop program by January 2001, and present it to the Legislature for consideration. Progress reports will be given to the Legislature on October 1, 1999, March 1, 2000 and September 1, 2000.

September 2000: A report by the Minnesota Department of Commerce recommended changes in the State's power industry but not full electric competition. The report, entitled "Keeping the Lights On: Securing Minnesota's Energy Future" stated that the Department would not recommend implementation of full retail electric competition because of potential shortfalls in available energy. The Department estimates that by 2006 the Midwest could encounter an energy shortfall of 5,000 MW, and in its report proposes a change in the tax structure to promote the building of new power plants. The report also includes suggestions for mandated statewide energy planning, increased energy conservation, and competition on the wholesale level. Fourteen public meetings on the proposal were conducted across the state through the end of October 2002.

(Source: *Energy Information Administration: "Status of State Electric Industry Restructuring Activity;* http://www.eia.doe.gov/cneaf/electricity/chg_str/minnesota.html)

5.4 Emerging Legislation and Regulations

The reports from the DG Working Group Proceedings are currently under review by the Minnesota Public Utilities Commission. It is expected that all or partial recommendations from these proceedings will be enacted by late summer 2003.

5.5 Potential Political Partners or Advocates of BCHP

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

- Sustainable Minnesota
- Minnesota Department of Commerce State Energy Office
- Minnesota Environmental Quality Board
- Minnesota Public Utilities Commission
- Midwest CHP Initiative

Obviously, the Minnesota Governor, the Mayor of Minneapolis and St. Paul, or the leadership in the Minnesota House or Senate could also help, however, they are likely to be more difficult to reach and/or influence. Members of their staffs may be better targets with any BCHP 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.

6. The Market Capacity Potential of BCHP in Minnesota

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

Estimates for the Industrial/Commercial Sector were derived from a previous study conducted by ONSITE-SYCOM Energy Corporation (ONSITE). Estimates for the Multi-family Residential Sector are based on Midwest CHP Application Center research.

6.1 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 BCHP 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 BCHP applications requiring a capacity of 77,281 MW.

This 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:

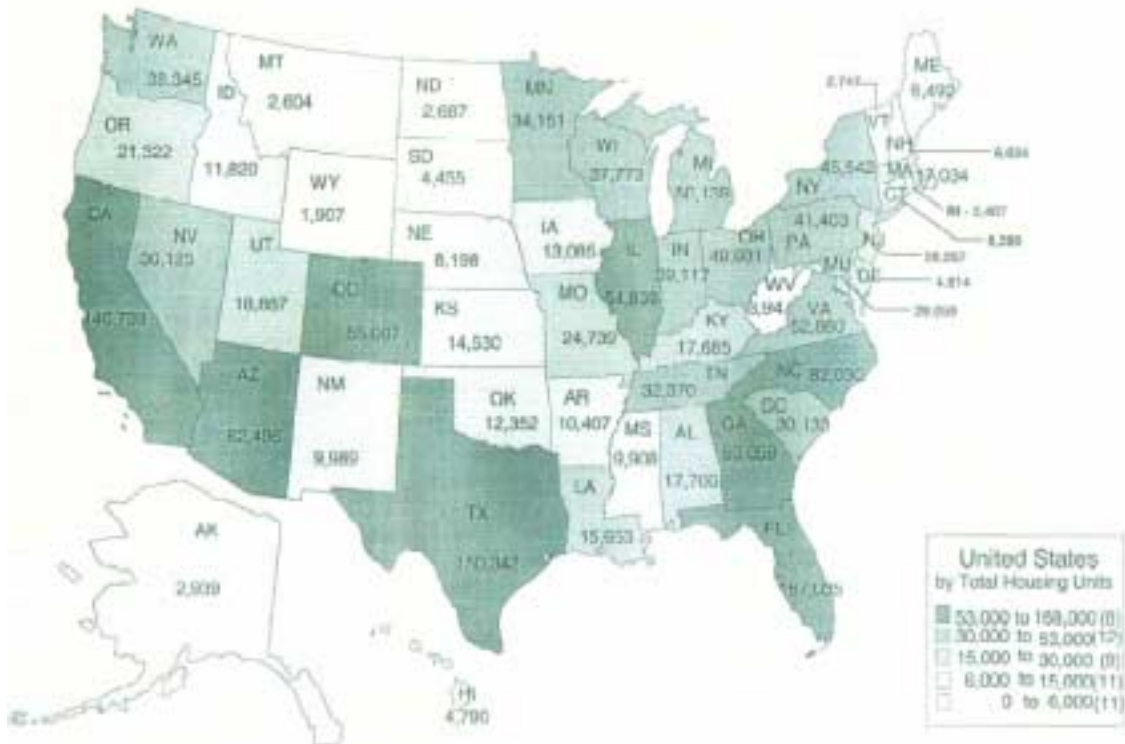


For Minnesota, ONSITE estimated a total market potential for electric production to be in the range of 850 to 1,320 MW. This represents 2 to 3% of the projected DOE long-term goal of 47 gigawatts of installed BCHP capacity that was developed as part of the BCHP Roadmap Workshop. This potential may only be realized if the regulatory and policy issues become more supportive of BCHP installations. Also if incentives are provided, additional market potential capacity could be realized.

6.2 Multi-Family Residential Market

Besides commercial and industrial applications BCHP systems also have potential market viability for multi-unit residences (those with 2 or more units). Compared to conventional HVAC systems BCHP installations are particularly competitive when it comes to new construction or complete replacement of old HVAC systems. Since all new and replacement HVAC systems need to be permitted in Minnesota, permitting data provides a good estimate of buildings where BCHP systems may be a potential alternative. As the map below indicates, overall privately owned construction activities in the State of Minnesota are fairly high (Source: U.S. Census Bureau).

U.S. New Privately Owned Housing Units Authorized by State: 2001



Applying the following assumptions the potential market for BCHP applications for multi-unit residences can be estimated:

- New construction remains at or near the same level as in the year 2001 (7,569 units, excludes single-family units),
- HVAC systems need to be replaced every 20 years, therefore units installed in 1981 would need to be replaced in the year 2001, and
- The number of HVAC units replaced in 2001 is consistent with the number of units installed in 1981 (6,032 units).

Applying these assumptions the new building permit data for multi-unit residences was obtained for 1981 and 2001. Therefore the market potential for multi-unit residential BCHP installation in Minnesota for 2002 is estimated to be about 13,600 units (replacement plus new construction units).

6.3 Biomass Based CHP Applications

Minnesota has also a significant potential for biomass based CHP applications. A report issued by the Minnesota Department of Commerce (January 2002) estimates that potentially 816,000 MWh of electricity (or 1.5% of the statewide energy production) could be produced from biomass based on the available “feedstock.”

7. Conclusions and Recommendations

7.1 Conclusions

7.1.1 Interest Level

In Minnesota approximately 22 technical companies are actively involved in B CHP deployment in the State. There are several large well-known engineering firms, as well as equipment manufactures and distributors who are aggressively pursuing the B CHP market in Minnesota.

The Midwest is home to many non-profit organizations and associations that have come forward to support the deployment of B CHP, in fact the Midwest appears to be leading the way in promoting the deployment of B CHP with such organizations as the Midwest CHP Application Center and the Midwest CHP Initiative.

7.1.2 Installation Status

There is a significant amount of B CHP based district heating systems operating in Minnesota (115,000 kW). B CHP systems are also prevalent in the School/University sector with 47,000 kW installed capacity. There is also a large potential market for an additional 49,000 kW at landfills/resource recovery facilities where thermal heat recovery technologies could be added.

7.1.3 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. 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 and thermal loads well matched.

Operating costs due to volatile gas prices as seen in the winter of 2000/2001 and 2002/2003 may be perceived as a concern.

7.1.4 Favorable Characteristics

Uniform Interconnection and stand-by tariffs for B CHP systems will most likely be enacted by the end of the summer 2003 following the recommendations made by the Minnesota DG Working Group Proceedings.

Exit fees are not imposed on distributed generating projects in Minnesota.

Financial support for biomass and ethanol facilities may be used to support B CHP facilities at these types of sites.

Favorable alliances exist in Minnesota. The Minnesota Department of Commerce and the non-profit group Sustainable Minnesota are active proponents of B CHP in the state.

Market potential appears to be reasonable for B CHP. ONSITE Energy Corporation estimates for Minnesota a total market potential of between 850 to 1,320 MW. Besides commercial and industrial estimates by ONSITE the MAC estimated that the potential Minnesota market for B CHP installations in the multi-unit residential sector to be about

13,600 units. Furthermore Minnesota has a good potential for biomass based CHP applications. The Minnesota Department of Commerce estimates that biomass could produce approximately 1.5% of the State's energy needs.

Natural gas prices in Minnesota are relatively low compared to other Midwestern states. The average price paid for natural gas by commercial customers in Minnesota was \$7.85 /MMBtu (in 2001).

7.2 Recommendations

1) Increase Interest and Market Penetration

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

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

2) Influence the Removal of Regulatory Barriers

- Work with the Minnesota Public Service Commission to help facilitate the implementation of the DG Working Group Proceedings.
- Work with the Legislative to establish further incentives for B CHP such as tax breaks and environmental credits.

3) Build Alliances

Build alliances with additional potential partners such as:

- Large Architect/Engineering Firms with B CHP capabilities
- Sustainable Minnesota

Appendix A Architect and Engineering Firms Promoting BHP Technologies in Minnesota

- 1) American Institute of Architects Minnesota
275 Market Street
Minneapolis, MN 55405
(612) 338-6763
- 2) Abrham & Associates, Architects, L.L.C.
12181 Margo Avenue South
Suite 400
Hastings, MN 55033-9437
Tel: 651-480-2237
- 3) Ballard Engineering
3555 Electric Avenue
Rockford, IL 61125
(815) 229-1800
Capabilities: BHP Turnkey Systems
- 4) CAI Commonwealth Associates, Inc.
P.O. Box 1124
Jackson, MI 49204
(517) 788-3474
Capabilities: Consulting Engineers and Construction Management
- 5) Cogentrix
9405 Arrowpoint Boulevard
Charlotte, NC 28273-8110
- 6) GKC-EME
205 W. Wacker Drive
Chicago, IL 60606
Capabilities: BHP Turnkey Installations
- 7) Interstate Power Systems
2501 East 80th Street
Minneapolis, MN 55425
952-854-5511
Capabilities: Waukesha Distributor, Capstone Distributor, Kohler Engines Distributor
- 8) La Salle Associates
3700 North Southport
Chicago, IL 60613
Capabilities: BHP Turnkey Installations

- 9) Perkins & Will
84 Tenth Street South
Suite 200
Minneapolis, MN 55403
Tel: 612-851-5000
Web site: www.perkinswill.com
- 10) Primera Engineering
25 E. Washington St.
Suite 510
Chicago, IL 60602
Contact: Ken Panunci
(312) 606-0629
Capabilities: HVAC Engineering, BCHP Potential
- 11) Stanley Consultants, Inc.
225 Iowa Avenue
Muscatine, IA 52761
(563) 264-6457
Capabilities: BCHP Engineering, Environmental and Construction Services
- 12) Trigen Energy Corporation
Three Barker Avenue
White Plains, NY 10601
Phone: (877) 894-0880
Capabilities: District heating design engineering
- 13) The Wendt Group Inc.
5800 Baker Road
Suite 100
Minnetonka, MN 55345
Tel: 952-938-1588
Email: info@twgi.com
Web site: www.theweidtgroup.com

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 B Equipment Distributors/Manufactures That Promote BHP Technologies in Minnesota

- 1) ADA Systems
955 North Lively Boulevard
Wood Dale, IL 60191
Capabilities: Evaporative Cooling Systems, Energy Recovery
- 2) Caterpillar
Distributor: ZIEGLER INC.
901 W 94TH ST
Minneapolis, MN 55420-4299
Tel. 952 888-4121
- 3) Cummins Npower
Corporate Office
1600 Buerkle Road
White Bear Lake, MN 55110
(651) 636-1000
Capabilities: Distributor for Cummins and Onan Power Generation Equipment
- 4) Eisenmann
150 E. Dartmoor Dr.
Crystal Lake, IL 60014
Contact: Mark West
(815) 455-4100
Capabilities: Air Purification Equipment
- 5) Generac Power Systems
DTE Energy Technologies, Inc
Ultimate Service Dealer
1715 Lake Drive West
Chanhassen, MN, 55317
Phone: 952-448-6313
Capability: Electric Generation Equipment Manufacturer
- 6) Hess Microgen
12 Industrial Parkway, Unit B-1
Carson City, NV 89706
(775) 884-1000
Capabilities: Generators Equipment with Heat Recovery
- 7) Huntington Environmental Systems, Inc.
707C West Algonquin Road
Arlington Heights, IL 60005
Capabilities: Emissions Control Equipment

- 8) Solar Turbines Incorporated
40 Shuman Blvd. Suite 350
Naperville, IL 60563
(630) 527-1700
Capabilities: Electric Generation Equipment Manufacturer
- 9) Trane
5916 Pleasant Avenue S.
Minneapolis, MN 55419
(612) 861-7232
Capabilities: HVAC Systems, Air Handling Products

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 C Property Management Organizations and Firms in Minnesota

- 1) BOMA Duluth
306 West Superior Street
Suite 1605
Duluth, MN 55802-1887
(218) 722-0816
FAX: (218) 720-6879
E-mail: oneida@cpinternet.com
- 2) BOMA Minneapolis
121 South 8th Street
Suite 610
Minneapolis, MN 55402-2841
(612) 338-8627
FAX: (612) 340-9744
World Wide Web: <http://www.bomampls.org>
- 3) BOMA St. Paul
332 Minnesota Street
W2950 First National Bank Building
St Paul, MN 55101-1379
(651) 291-8888
FAX: (651) 291-1031
E-mail: bill.buth@bomastpaul.org
World Wide Web: <http://www.bomastpaul.org>

IREP Accredited Real Estate Management Firms:

- 1) American Investment Management Services (AIMS)
7000 57th Ave. North, No. 120,
Minneapolis, MN 55428
Phone: 763/533-7193
FAX: 763/533-7298
- 2) Asset Management Group, Inc.
5353 Wayzata Blvd., No. 602,
Minneapolis, MN 55416
Phone: 952/546-3385
FAX: 952/546-3440
Web: www.amgproperties.com
- 3) Bayport Properties, U.S. Inc.
300 South Highway 169, Ste. 120,
St. Louis Park, MN 55426
Phone: 952/548-6202
FAX: 952/548-6200

- 4) BDC Management Co.
428 N. First St.,
Minneapolis, MN 55401
Phone: 612/371-0766
FAX: 612/371-1834
- 5) CB Richard Ellis, Inc.
527 Marquette Ave., Ste. 1414,
Minneapolis, MN 55402
Phone: 612/333-5938
FAX: 612/333-5937
Web: www.cbre.com
- 6) CB Richard Ellis, Inc.
88 S. 6th St., Ste. 350,
Minneapolis, MN 55402
Phone: 612/395-2620
FAX: 612/630-9646
Web: www.cbre.com
- 7) CB Richard Ellis, Inc.
5500 Wayzata Blvd., Ste. 125,
Minneapolis, MN 55416
Phone: 763/591-2212
FAX: 763/591-2210
Web: www.cbre.com
- 8) CB Richard Ellis, Inc.
7760 Frances Ave. South, Ste. 770,
Minneapolis, MN 55435
Phone: 612/924-4690
FAX: 612/831-8023
Web: www.cbre.com
- 9) Colliers Turley Martin Tucker
200 S. Sixth St., Ste. 1400,
Minneapolis, MN 55402
Phone: 612/341-4444
FAX: 612/347-9389
- 10) Colonnade Properties, LLC
4900 Viking Dr.,
Edina, MN 55435
Phone: 952/820-1600
FAX: 952/820-1620

- 11) Colonnade Properties, LLC
Southdale Medical Center,
6545 France Ave. South,
Edina, MN 55435
Phone: 952/922-5399
FAX: 952/922-0640
- 12) Colonnade Properties, LLC
4900 Viking Dr.,
Edina, MN 55435
Phone: 952/820-1600
FAX: 952/820-1620
Web: www.colonnadeproperties.com
- 13) Colonnade Properties, LLC
701 4th Ave. S., Ste. 1200,
Minneapolis, MN 55415-1800
Phone: 612/337-5333
FAX: 612/337-5306
- 14) Colonnade Properties, LLC
The Parkdales/Parkdale Plaza,
1660 S. Hwy. 100,
St. Louis Park, MN 55416
Phone: 952/545-1209
FAX: 952/545-8952
- 15) Dominion Management Services, Inc.
2355 Polaris Ln., Ste. 100,
Plymouth, MN 55447
Phone: 763/354-5500
FAX: 763/354-5519
Web: www.dominiumapartments.com
- 16) Durand & Associates Property Management, Inc.
222 Grand Ave. West,
South St. Paul, MN 55075-2059
Phone: 651/450-2300
FAX: 651/450-4871
- 17) Goldmark Property Management, Inc.
5001 W. 80th St. South, Ste. 675,
Bloomington, MN 55437
Phone: 612/832-0658
FAX: 612/832-5412
Web: www.goldmark.com

- 18) Grace Management, Inc.
6225 42nd Ave. North,
Minneapolis, MN 55422
Phone: 763/544-9934
FAX: 763/544-9858
Web: www.gracemanagement.com
- 19) Grubb & Ellis Management Services, Inc.
Pondview Plaza,
5850 Opus Pkwy., Ste. 150,
Minnetonka, MN 55343
Phone: 952/912-8500
FAX: 952/912-0123
- 20) GSR Real Estate Services, LLC
615 1st. Ave. NE, Ste. 500,
Minneapolis, MN 55413-2211
Phone: 612/338-2828
FAX: 612/338-5288
Web: www.gsr-re.com
- 21) Heartland Realty Investors, Inc.
4802 Nicollet Ave. South,
Minneapolis, MN 55409
Phone: 612/823-6275
FAX: 612/823-3210
- 22) Kleinman Realty Co.
5301 E. River Rd., Ste. 101,
Minneapolis, MN 55421-3744
Phone: 763/572-9400
FAX: 763/572-9404
Web: www.kleinmanrealty.com
- 23) KMS Management, Inc.
5801 S. Cedar Lake Rd., Ste. A,
St. Louis Park, MN 55416
Phone: 612/593-9930
FAX: 612/544-0599
Web: www.kmsgmtinc.com
- 24) LaSalle Management Group, Ltd.
2001 Killebrew Dr., Ste. 308,
Minneapolis, MN 55425-1864
Phone: 952/854-8800
FAX: 952/854-4434
Web: www.lasallegrp.com

- 25) Oakbrook Corp.
7201 Walker St., Ste. 30,
St. Louis Park, MN 55426
Phone: 952/351-4555
FAX: 952/931-3066
- 26) Opus Northwest Management, LLC
10350 Bren Rd. West,
Minnetonka, MN 55343
Phone: 952/656-4550
FAX: 952/656-4550
Web: www.opuscorp.com
- 27) PEMBCO
7133 Washington Ave. South,
Minneapolis, MN 55439
Phone: 952/943-1100
FAX: 952/943-1116
Web: www.pembco.com
- 28) Pinnacle Realty Management Co.
5353 Wayzata Blvd., Ste. 608,
Minneapolis, MN 55416
Phone: 952/544-1117
FAX: 952/544-4781
Web: www.pinnaclerealty.com
- 29) Rockford, Inc.
7025 France Ave. South,
Edina, MN 55435
Phone: 952/929-5154
FAX: 952/925-4841
Web: www.rockfordmanagement.com
- 30) United Properties, LLC
3500 W. 80th St., No. 200,
Bloomington, MN 55431
Phone: 952/831-1000
FAX: 952/893-8813
Web: www.uproperties.com
- 31) Village Green Management Co.
Meridian Crossings Center,
2 Meridian Crossing, Ste. 200,
Richfield, MN 55423
Phone: 612/243-2520
FAX: 612/243-2522

- 32) VIP Properties
11300 Minnetonka Mills Rd.,
Minnetonka, MN 55305
Phone: 952/938-4452
FAX: 952/938-2163
- 33) Weis Management Corp.
2227 Seventh St., N.W.,
Rochester, MN 55901
Phone: 507/288-7980
FAX: 507/288-7979
Web: www.weismanagement.com

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

Appendix D Energy Supply and Service Companies in Minnesota

Natural Gas Providers:

- 1) Aurora Gas Company
7038 Black River Road
Onaway, MI 49765
- 2) Citizens Gas Fuel Company
127 North Main Street
Adrian, MI 49221-0040
- 3) Consumers Energy Company
212 West Minnesota Avenue
Jackson, MI 49201-2277
- 4) Minnesota Consolidated Gas Company
500 Griswold Street
Detroit, MI 48226
- 5) Minnesota Gas Utilities, a Division of UtiliCorp United, Inc.
899 S. Telegraph Road
Monroe, MI 48161
- 6) Peninsular Gas Company
4205 S. 94th Street
Omaha, NE 68127
- 7) Peoples' Natural Gas Company, a Division of UtiliCorp United, Inc.
1815 Capitol Avenue
Omaha, NE 68102
- 8) Presque Isle Electric & Gas Coop., Inc.
19831 M-68 Onaway, MI 49765
- 9) SEMCO Energy Gas Company a division of SEMCO Energy, Inc.
405 Water Street P.O. Box 5026
Port Huron, MI 48061-5026
- 10) Superior Energy Company|
14428 Wuoski
Kaleva, MI 49645
- 11) Wisconsin Public Service Corp.
700 N. Adams St. P.O. Box 19001
Green Bay, WI 54307-9001
- 12) Xcel Energy
1414 W. Hamilton
P.O. Box 8
Eau Claire, WI 54702-0008

Electricity Providers:

Investor Owned Electric Utilities

- 1) Xcel Energy (NSP)
414 Nicollet Mall
Minneapolis, MN 55401
(612) 330-5500

- 2) Allete - Minnesota Power
30 West Superior Street
Duluth, MN 55802
(218) 722-2641

- 3) Alliant Energy - Interstate Power
1000 Main Street
P.O. Box 769
Dubuque, IA 52004-0769
(319) 582-5421

- 4) Otter Tail Power Company
215 South Cascade Street
P.O. Box 496
Fergus Falls, MN 56538-0496
(218) 739-8200

Natural Gas Utilities

- 5) CenterPoint Energy Minnegasco
800 LaSalle Avenue, Floor 11
P.O. box 59038
Minneapolis, MN 55459-0038
(612) 32104809

- 6) Xcel Energy (NSP)
414 Nicollet Mall
Minneapolis, MN 55401
(612) 330-5500

- 7) Aquila Networks (formerly Peoples Natural Gas - MN)
1815 Capitol Avenue
Omaha, NE 68102
(800)-303-0752

- 8) Aquila Networks (formerly Northern Minnesota Utilities)
1815 Capitol Avenue
Omaha, NE 68102
(800)-303-0752

- 9) Alliant Energy - Interstate Power
1000 Main Street
P.O. Box 769
Dubuque, IA 52004-0769
(319) 582-5421

- 10) Great Plains Natural Gas Company
105 West Lincoln
P.O. Box 176
Fergus Falls, MN 56538-0176
(218) 736-6935

For Minnesota's 126 Municipal Electric Utilities and 31 Municipal Gas Utilities contact:

Minnesota Municipal Utilities Association
12805 Highway 55
Suite 212
Plymouth, MN 55441-3859
Phone: 763-551-1230
Fax: 763-551-0459
<http://www.mmua.org/utilities.html>

For Minnesota's 51 Rural Electric Cooperatives contact:

Minnesota Rural Electric Association
11640 73rd Avenue North
Maple Grove, MN 55369
Phone: 763.424.1020
Fax: 763.424.5820
<http://www.mrea.org/>

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

AEC Engineering, Inc.
John Buzek
President
Minneapolis, MN

***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 BCHP Deployment in Minnesota

Minnesota/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 Energy and Environment	
4.	Center for Neighborhood Technology	http://www.cnt.org
5.	Delta Institute	http://www.delta-institute.org
6.	Energy Resources Center – University of Illinois at Chicago	http://www.erc.uic.edu
7.	Environmental Law and Policy Center	http://www.elpc.org
8.	Gas Technology Institute	http://www.gastechnology.org
9.	Great Lakes Renewable Energy Association	http://glrea.org
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.	Minnesota Environmental Quality Board/Minnesota Planning	
15.	Minnesota Department of Commerce	http://www.commerce.state.mn.us
16.	State of Minnesota Public Utilities Commission	http://www.puc.state.mn.us
17.	Sustainable Minesota	http://www.me3.org

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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/

NOTE: *This list represents only those organizations that the MW BCHP Application Center was able to identify at the time of this report. Other organizations 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 G Distributed Generation – Commercial/Light CHP Facilities in Minnesota

Project Name	Capacity (kW)	Generator Type	Primary Fuel Source	Heat Recovery Type
St. Paul District Energy System	25,000	Boiler/Steam Turbine	Coal/Biomass	Hot Water/Heating/Cooling
Willmar District Energy System	30,000	Boiler/Steam Turbine		Hot Water
Hibbing District Energy System	30,000	Boiler/Steam Turbine	Coal	Heating
Virginia District Energy System	30,000	Boiler/Steam Turbine	Coal	Heating
New Ulm District Energy System		Boiler/Steam Turbine	Coal	Heating
Franklin Station/Mayo Clinic/Kahler Hotel	15,000	Boiler/Steam Turbine	Natural Gas/Fuel Oil	Heating and Cooling
Mayo Clinic	6,000	Combustion Turbine	Natural Gas	Heating and Cooling
St. Mary's Hospital	12,800	Recip Engine/Gas Turbine	Natural Gas/Fuel Oil	Heating
Fairview Ridges Hospital	150	Recip Engine	Natural Gas	Hot Water
St. Johns University	1,100	Boiler/Steam Turbine	Coal/Waste Wood	Heating
Totino Grace High School	1,000	Recip Engine	Natural Gas	Heating
University of Minnesota	45,000			Heating
Olmsted County	5,000		Refuse	Heating
Minnesota Methane/EKS Landfill	4,200	Recip Engine	Landfill Gas	
Landfill Power /Woodlake Sanitary Services Inc	4,800	Recip Engine	Landfill Gas	
Phillips Biomass/Trillium Planning and Development Inc.				In Planning
Ogden Energy Group/Hennepin Energy Resource Co	39,600		Natural Gas	
The Thomson Corp/West Group Data Center	19,000	Recip Engine	Fuel Oil	
Total BCHP Systems plus BCHP Targets:	268,650			
BCHP Systems with Heat Recovery:	201,050			

NOTE: This list represents only those commercial and light industrial facilities that the MW BCHP 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 Cogeneration Systems and Gas Price Volatility

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)	<i>From Electric Bill</i>		kwh/Mo
2	Electric Energy Charge (On-Peak)	<i>From Electric Bill</i>		\$
3	Average Energy Charge	<i>Divide Line 2 by Line 1</i>		\$/kWh
4	Monthly Demand	<i>From Electric Bill</i>		kW
5	Demand Charges	<i>From Electric Bill</i>		\$
6	Allocated Demand Charge	<i>Divide Line 5 by Line 1</i>		\$/kWh
	Total Cost of Utility Electricity	<i>Add Lines 3 and 6</i>		\$/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
- 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.

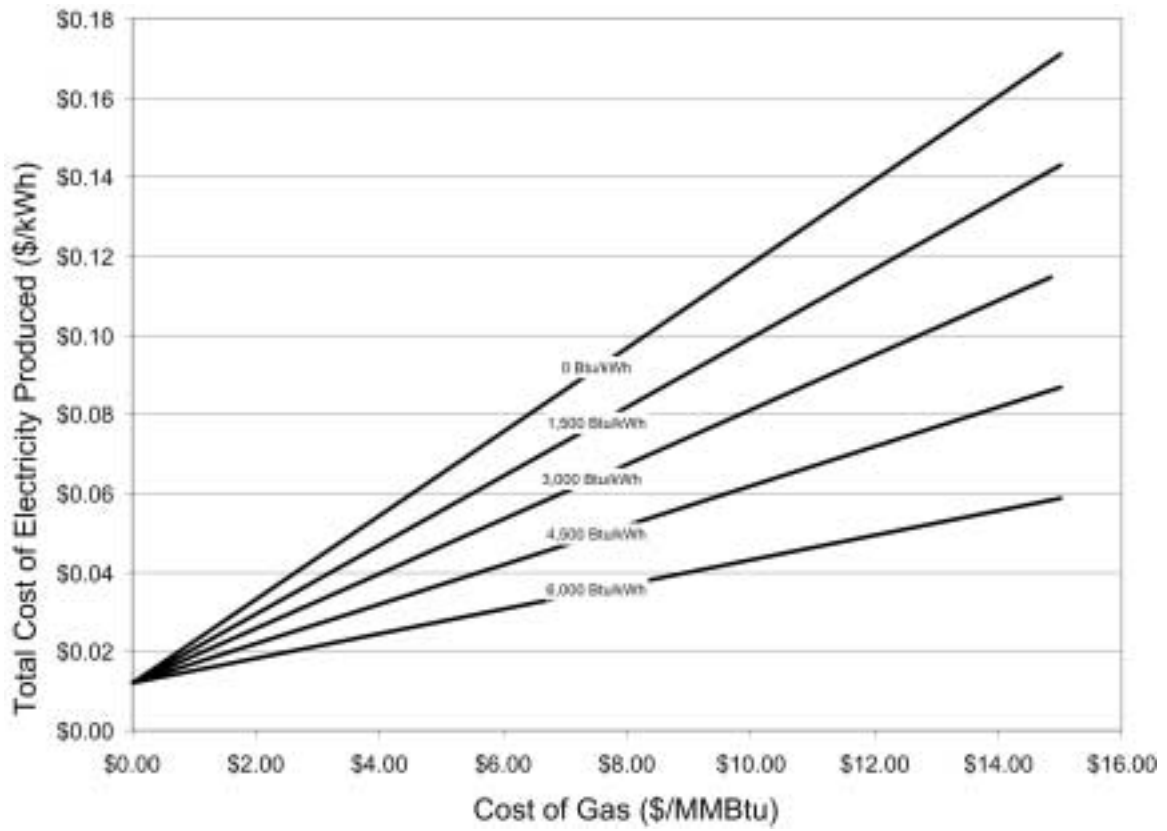


Figure H.1: Breakeven Chart

Example

Question

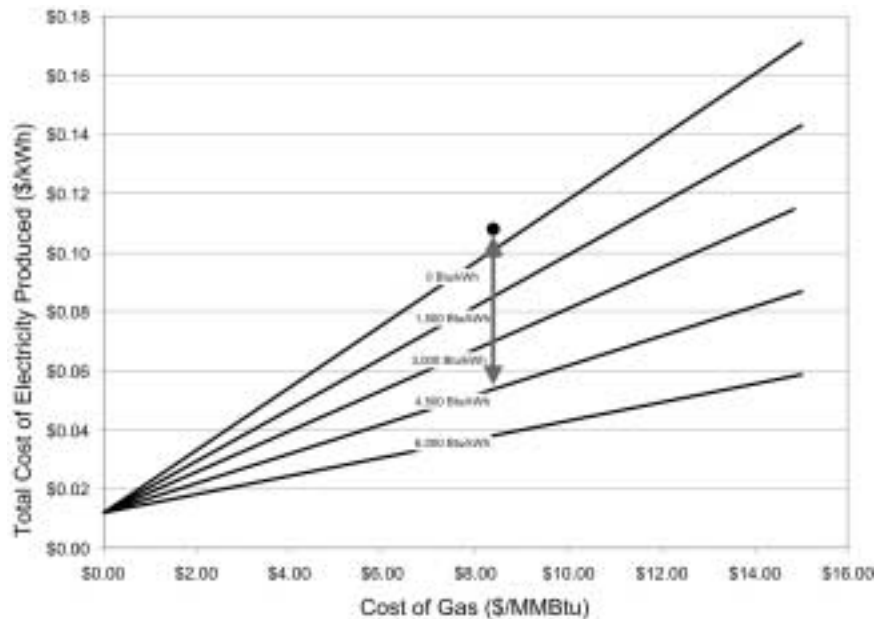
A cogeneration system provides power and heating to a commercial building. The owner's gas price spikes to \$0.80/therm in January. Should the cogeneration system be run during this gas price spike?

Answer

The owner's electric bill gives the following information:

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

Plotting this on Figure H.1 gives:



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