

# CHAPTER 5A

## Estimate of CHP Potential – Alternative Technologies Workgroup

### 1. Introduction and Methodology

#### 1.1 Introduction

The purpose of this supplemental document is to describe the methodology used to estimate the potential achievable new supply of electricity that could be reasonably developed over the next 10 years at Michigan's large industrial, institutional and commercial facilities.

#### 1.2 Methodology

During the prior CNF process, the combined heat and power (CHP) Team was able to use boiler permit data from the Department of Labor and Economic Growth (DLEG) to identify the scope of Michigan's large and medium sized boilers. Unfortunately, the boiler permit database did not indicate the degrees to which boilers were actually in use, making it difficult to accurately calculate the capacity factors of the selected boilers. The CHP Team therefore had to rely on ad hoc information regarding which steam boilers were actually available to potentially add CHP systems.

Fortunately, during the 21st Century Energy Planning process, the CHP Team was able to obtain better data from the Michigan Department of Environmental Quality (MDEQ), Michigan Air Emissions Reporting System (MAERS) Database. This database not only has a comprehensive universe of industrial, institutional, and commercial boilers in its system, but it also indicates the type and amount of fuel they consumed in 2005. Using this fuel data, the CHP Team could calculate capacity factors for all boilers in use in 2005 – providing a major improvement in accuracy of the projected results.

Using the boilers database supplied by MDEQ, the CHP Team went through the following steps:

**Step 1: Calculate Capacity Factors** - The CHP Team calculated capacity factors for each boiler where both capacity and fuel usage was available in the MAERS database.

**Step 2: Categorize Boilers by Size (MMBTUHR Capacity)** – All boilers were first classified into the following categories:

- Industrial boilers
  - Large boilers (100+ MMBTUHR)
  - Medium boilers (26-99 MMBTUHR)
  - Small boilers (20-25 MMBTUHR)
  - Very small boilers (<20 MMBTUHR)
- Commercial boilers (including institutional and municipal)
- Other boilers (all boilers for which capacity factors could not be calculated)

A total of 884 boilers were considered as a result of Step 2.

**Step 3: Sort Out Non-CHP Candidates Based on Location** - The CHP Team reviewed each category and removed boilers located at:

- existing utilities, merchant plants or independent power producer facilities;
- known CHP sites; or
- steel mills.

Those boilers that used wood as a fuel were also excluded in this step, since these biomass fueled boilers are included in the state’s renewable standard. A total of 228 boilers were excluded as a result of Step 3.

**Step 4: Sort Out Non-CHP Candidates Based on Usage** - Next, the CHP Team excluded most boilers that had one or more of the following concerns:

- questionable data;
- low pressures (<150 PSI);
- capacity factors less than 25 percent;
- consumed less than 50 MCF of natural gas (if capacity factor was unknown); and
- fueled with wood (this was transferred to the Renewable Energy Subgroup for inclusion in their analysis.

A total of 431 boilers were excluded as a result of Step 4.

**Step 5: Sort for Economic Suitability** - The CHP Team conducted a “positive sort” to select boilers that were located at businesses thought to be likely to adopt CHP due to business factors, or due to prior feasibility studies known to members of the Team. Rejected boilers were moved to the “Excluded” worksheet. A total of 225 industrial boilers were kept.

**Step 6: Conducted CHP Supply Analysis** - Once a dataset was established of potential boilers that were established in suitably located facilities and businesses considered more likely adopters of CHP, the Team summarized key information as presented in Table 1.

The CHP Team began to evaluate CHP electrical production potential. In this effort, it was assumed that natural gas boilers would be equipped with higher efficiency gas turbines, while boilers fueled with coal, oil, or other fuels would be equipped with steam turbines. It was further assumed that design megawatt (MW) capacity would exceed calculated output by 35 percent. The estimated kilowatt hours (kWh) of each category of boilers was then calculated at CHP “penetration rates” of 100 percent, 50 percent, and 27 percent. Effective heat rates and average MW/boiler estimates were also calculated for each category of boilers. The results of this analysis are provided in Table 1.

Estimates of additional CHP potential from three additional specific sources: new ethanol plants, steel mills, and cement kilns, were then added to Table 1 and this data is provided in Table 2. The CHP Team realizes each of these three sectors represent significant CHP potential, but the team was able to make only preliminary estimates of this potential, based upon prior knowledge of group members.

**Table 1: Summary of Michigan Industrial Boiler Capacities – 2005**

<b>Industrial Boiler Type<sup>1</sup></b>	<b>Size (MMBtu/Hr)</b>	<b>Number of Boilers</b>	<b>Average Design Capacity (MMBtu/Hr)</b>	<b>Average Hourly Output (MMBtu/Hr)</b>	<b>Estimated Capacity Factor (%)</b>	<b>Average Annual Throughput (MMBtu/Yr)</b>
<b>Large Boilers</b>	100+	35	161.24	56.60	35.10%	495,792
<b>Medium Boilers</b>	25-100	75	57.26	19.50	34.05%	170,787
<b>Small Boilers</b>	20- 25	17	21.30	7.40	34.76%	64,848
<b>Very Small Boilers</b>	<20	33	12.88	8.56	66.43%	74,962
<b>Commercial</b>		18	18.00	13.42	52.57%	117,599
<b>Other Boilers</b>		47		15.18		133,010
Source: Michigan Department of Environmental Quality, Michigan Air Emissions Reporting System (MAERS) Database.						
Note: <sup>1</sup> Excludes all wood-fired boilers (wood-fired boilers are discussed in the renewable energy resource assessment). Also excludes boilers that are reported in the MAERS database as: (a) operating under 150 PSI pressure; (b) with capacity factors 15 percent or less; (c) reporting low or no 2005 fuel usage; (d) located at non-functional sites; or (e) located at facilities with already existing CHP or utility/merchant power plant electricity production.						

With the latter considerations in the forefront of the minds of the CHP Team, the Team projected that a 27 percent penetration, or, of 182 MW of new CHP was a reasonable and achievable as a 10 year CHP target if the economic, financial, and regulatory barriers become favorable. Until these barriers to CHP are addressed, more robust projections of CHP supply, especially units fueled by natural gas, would likely be unduly optimistic.

**Table 2: CHP Potential (kW) from Michigan Industrial Boilers and Other Facilities**

	CHP Potential		
	100% Market Penetration (kW)	50% Market Penetration (kW)	27% Market Penetration (kW)
<b>Industrial Boilers<sup>1</sup></b>			
Large Boilers	160,337	80,168	43,291
Medium Boilers	113,217	56,608	30,569
Small Boilers	10,127	5,064	2,734
Very Small Boilers	25,702	12,851	6,940
Commercial	21,919	10,959	5,918
Other Boilers	57,874	28,937	15,626
<b>Subtotal</b>	<b>389,176</b>	<b>194,588</b>	<b>105,078</b>
<b>135% Subtotal</b>	<b>525,388</b>	<b>262,694</b>	<b>141,855</b>
<b>Other Facilities</b>			
Ethanol Facilities <sup>2</sup>	25,000	12,500	6,750
Steel Facilities <sup>3</sup>	100,000	50,000	27,000
Cement Kilns <sup>4</sup>	25,000	12,500	6,750
<b>Subtotal</b>	<b>150,000</b>	<b>75,000</b>	<b>40,500</b>
<b>Total Michigan CHP Potential (kW)</b>	<b>675,388</b>	<b>337,694</b>	<b>182,355</b>
Source: Michigan Department of Environmental Quality, Michigan Air Emissions Reporting System (MAERS) Database.			
Notes: <sup>1</sup> CHP potential for boilers assumes a heat rate of 25,787 Btu/kWh.			
<sup>2</sup> An average of 5 MW of CHP capacity is estimated for each of the five ethanol plants in operation or development.			
<sup>3</sup> Data for steel facilities suggests nearly 94 MW of CHP capacity based on fuel usage, with a built ceiling of 125 MW.			
<sup>4</sup> Data for cement kilns suggests nearly 58 MW of CHP capacity based on fuel usage, with a built ceiling of 80 MW.			

## 2. Summary of CHP Industrial Survey

The CHP Team conducted a survey questionnaire of potential CHP candidates in order to assess the barriers and issues to implementation of such CHP projects, and hence the market potential for future CHP. Of the 24 questionnaires mailed, 13 completed forms were returned. The answers are compiled below in the format of the actual survey.

The summary of the results indicate that cost of natural gas fuel and utility standby power charges are a major prohibiting factor for CHP projects.

## Alternative Technology CHP Industrial Survey Results

### 1. **Has a business case analysis for CHP ever been performed for this location?**

Of the 13 completed forms 10 have replied that there has been some sort of analysis or building performed on their site. The overall response indicates that due to the price of gas this is a costly project. Four of the companies have shutdown their CHP project due to this high project cost. However, one company's utility system is based on CHP and has been since 1965.

Of the 13 completed forms two have replied that there has not been a CHP case analysis done. Responses indicated current contracts do not allow this to happen.

**If yes, would you be willing to share the approximate cost (\$/MW) of the project and a copy of the report? (Note: if provided, this will be kept confidential by the MPSC).**

One company provided information. In 1993 their cost was approximately \$7,000,000 for 3.8 MW

### 2. **Please identify any of the following that were identified or would likely be obstacles to developing a CHP project at this site.** (The number of responses is shown to the left of the given obstacles and some companies have offered more than one obstacle.)

- 3 - Insufficient steam demand on a year around basis
- 2 - Length of contract or financing commitment required
- 3 - Cost of new electric infrastructure at the site (including interconnections)
- 2 - Environmental permitting issues for boiler modifications or other reasons
- 4 - Cost of electric tariff and/or standby charges
- 3 - Low cost of purchased price of electricity from utility or market
- 0 - Personnel issues (hiring additional operators, increased O&M etc.)
- 3 - Reliability issues associated with operating a CHP
- 7 - Fuel price risk (volatility of natural gas or coal price)
- 1 - Contractually prohibited (exclusive electric supplier, etc.)
- 0 - Other

### 3. **If the site does not have sufficient steam demand year around to support a CHP project, are there any processes that could be converted to steam usage (i.e. chillers, etc.) to increase steam demand?**

Of the 13 completed questionnaires one company has responded "yes" to this question. Their response indicates that they use air conditioning to increase steam demand.

Of the 13 completed questionnaires three companies have replied "no" to this question, while eight had no response.

4. **What approximate hurdle rate (internal rate of return) would your company require in order to implement a CHP project?**

Of the 13 completed questionnaires five companies have responded. The approximate hurdle rate for these companies ranges from 15 - 45 percent.

5. **If all roadblocks were removed and a favorable business case could be developed for CHP, would your company likely move forward with the project?**

Of the 13 completed questionnaires eight have replied that they would move forward with the CHP project.

Of the 13 completed questionnaires one has replied that they would not continue with the project.

Of the 13 completed questionnaires four have offered no response to this question.