



Combined Heat & Power (CHP): An Energy Option for the Healthcare Industry

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UIC University of Illinois
at Chicago

Presentation Outline

- Healthcare & the Energy Situation
- Potential Technology Solutions
- Hospitals & CHP – Is Their a Match?
- Case Study
- Next Steps



What are the Energy Management Concerns in Today's Hospitals?

Supply Side

- Electricity
- Natural Gas
- Steam
- Hot Water
- Chilled Water

Demand Side

- Lighting / Day-Lighting
- Windows
- Insulation
- Thermostat Setbacks
- Leaks / Infiltration
- More Efficient Motors

On Site / Off Site

On Site



What is the snapshot of the U.S. Healthcare Energy Situation?

- Large Users of Both Electrical & Thermal Energy on a Continuous Basis
- Total Energy Consumption (1999) – 258 trillion Btu
 - Approx. 13% of Total Commercial Consumption
- Natural Gas Utilized in 76% of Healthcare Floor Space
- Natural Gas Dominant in Space Heating (61.4% Floor Space), Water Heating (56.5%), and Laundry-Drying & Cooking Equipment
- Electricity Dominant in Space Cooling
- Forecast Large Growth in Hospital Construction (next 5 years)



What Energy Issues Affect Your Healthcare Facility?

- 1.) Growing Utility Costs
- 2.) Competing for Capital Dollars
- 3.) Facility Expansions / Renovations
- 4.) Power Reliability & Redundancy (Brownouts/Blackouts)
- 5.) Growing Environmental Requirements
- 6.) Aging HVAC / Energy Distribution Systems

Six of the Top Ten ASHE Identified Issues Facing Healthcare Facilities Today have Solution Opportunities with Combined Heat and Power (CHP)

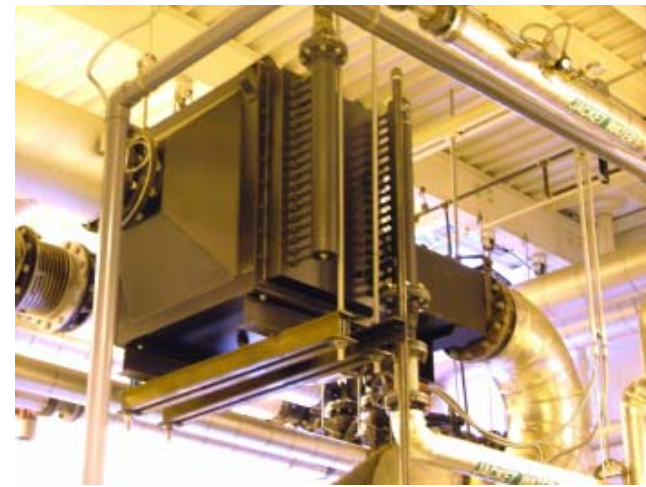
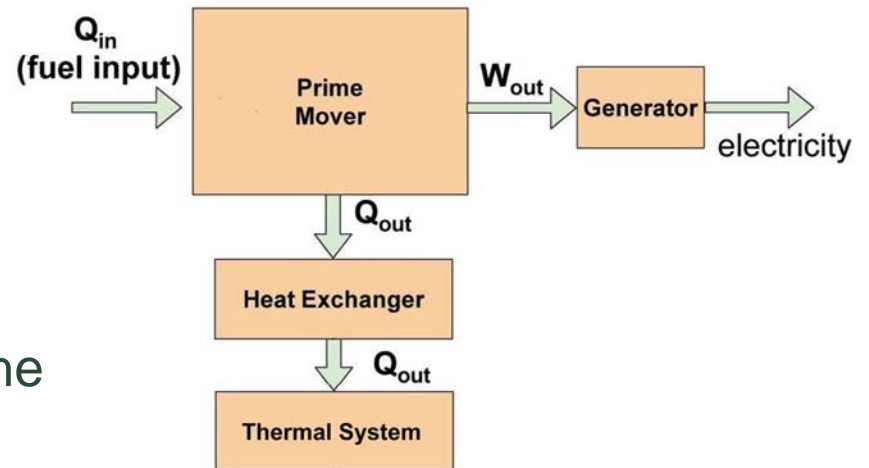
– Dale Woodin, ASHE Deputy Executive Manager



What is Combined Heat and Power?

CHP is ...

- An Integrated System
- Located At or Near a Building/Facility
- Provides at Least a Portion of the Electrical Load and
- Utilizes the Thermal Energy for
 - Heating
 - Cooling
 - Dehumidification
 - Process Heating



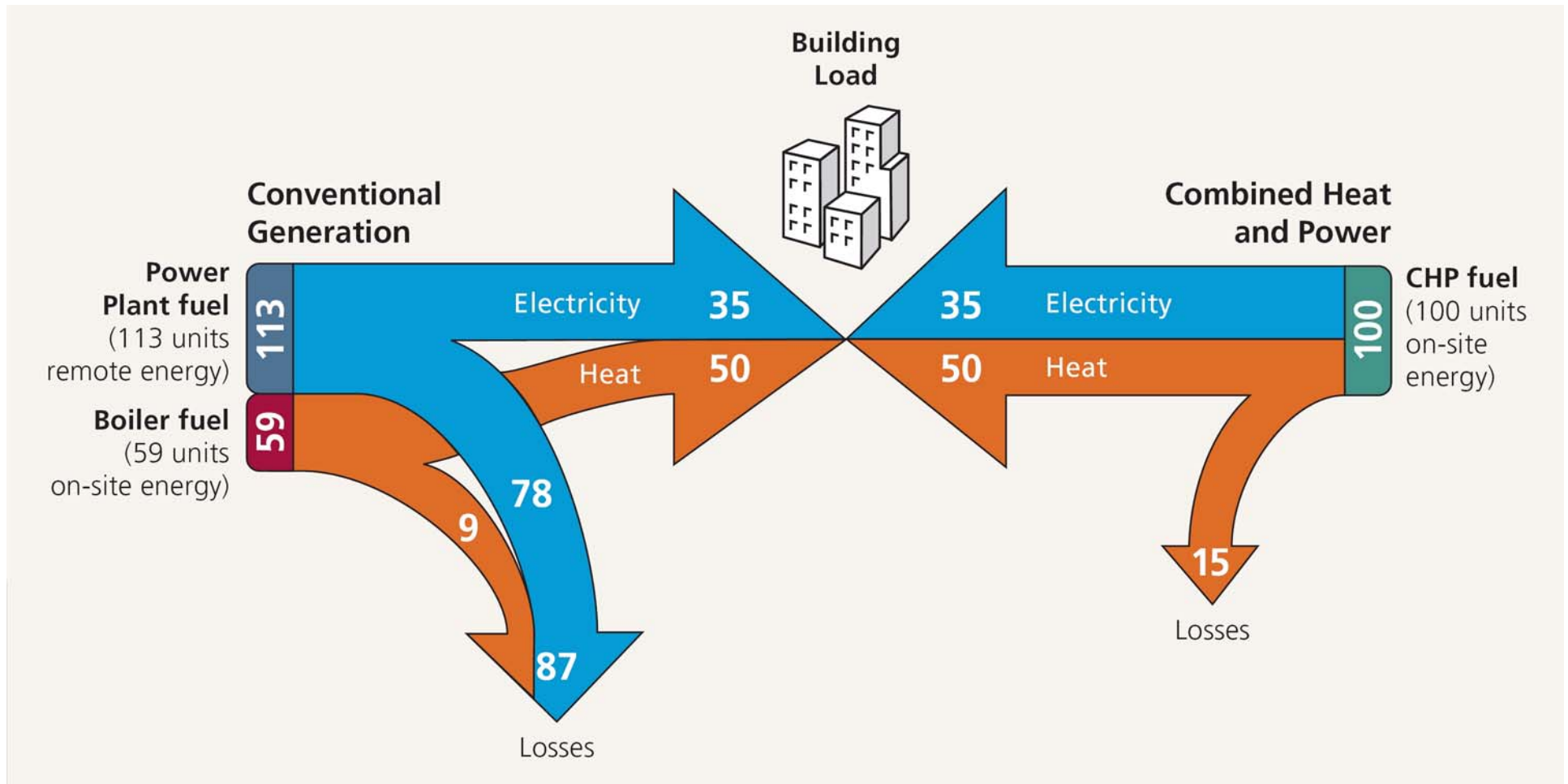
CHP Acronyms



- Combined Heat & Power (CHP)
- Buildings Cooling, Heating & Power (BCHP)
- CHP for Buildings (CHPB)
- Integrated Energy Systems (IES)
- Total Energy Systems (TES)
- Trigeneration (Trigen)
- CHP for Industry
- Cogeneration



Conventional Generation vs. CHP System (Power Plant) (Alternative)



CHP is NOT a new Technology...

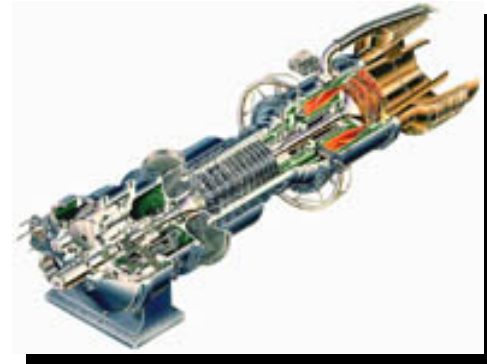
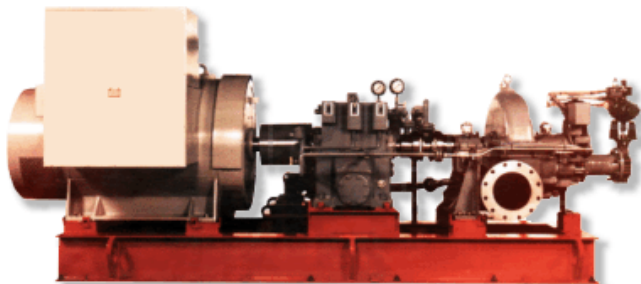
Combined Heat and Power systems have been operating for more than a century utilizing some of the following technologies:

- Electric Generation Equipment
- Heat Recovery Systems
- Thermally Activated Technologies



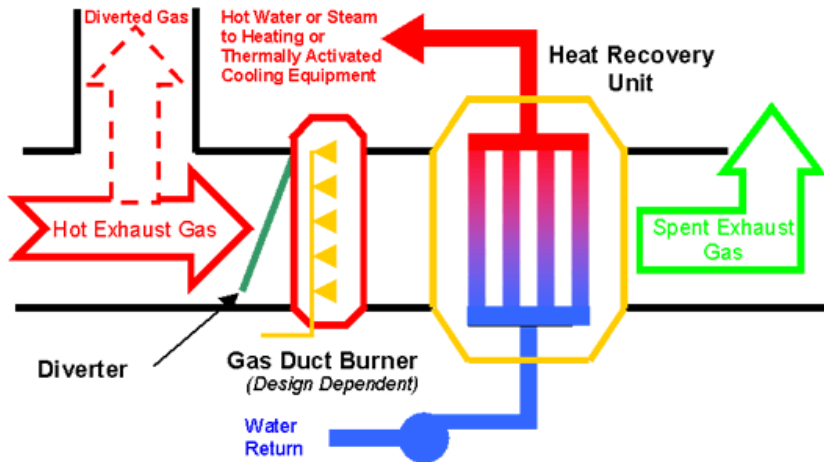
Reliable CHP Technologies

- Electric Generation Equipment
 - Gas Turbines
 - Reciprocating Engines
 - Steam Turbines



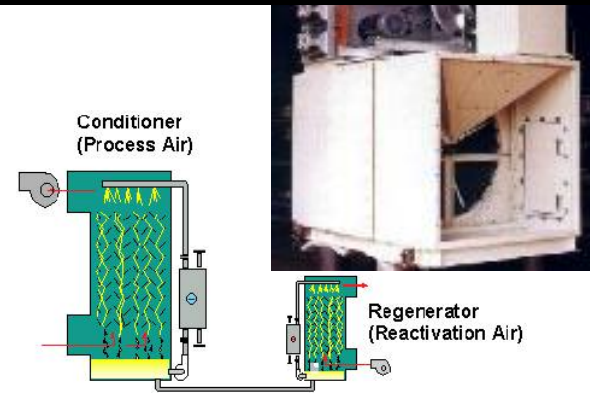
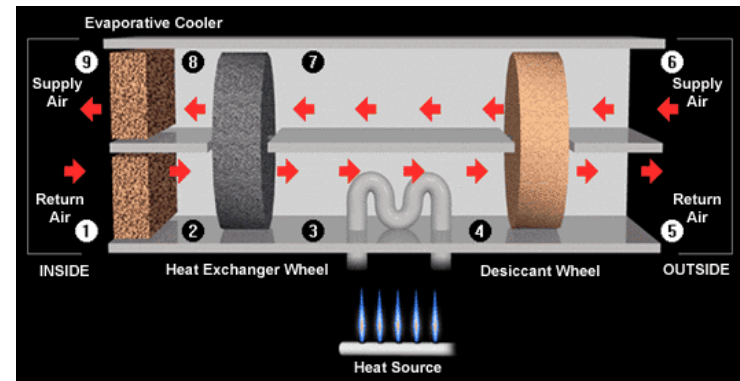
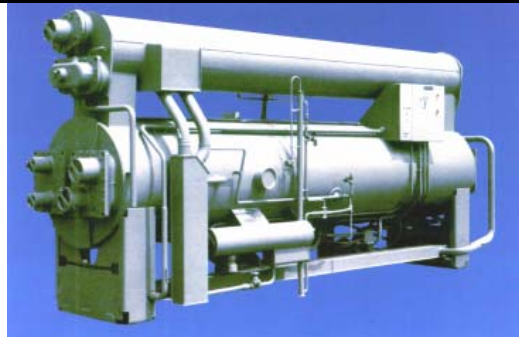
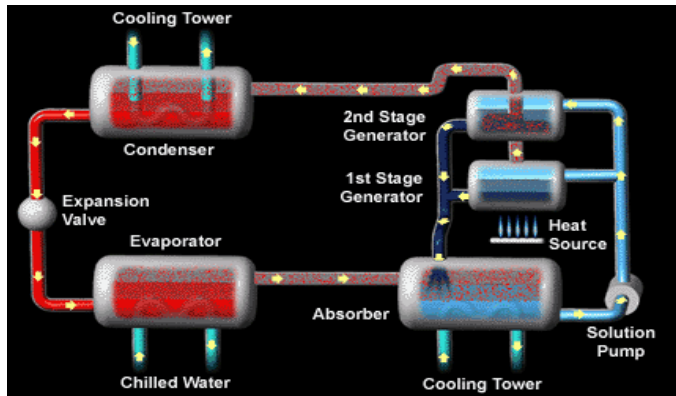
Reliable CHP Technologies

- Heat Recovery Systems
 - Steam and Hot Water
 - Exhaust Gases



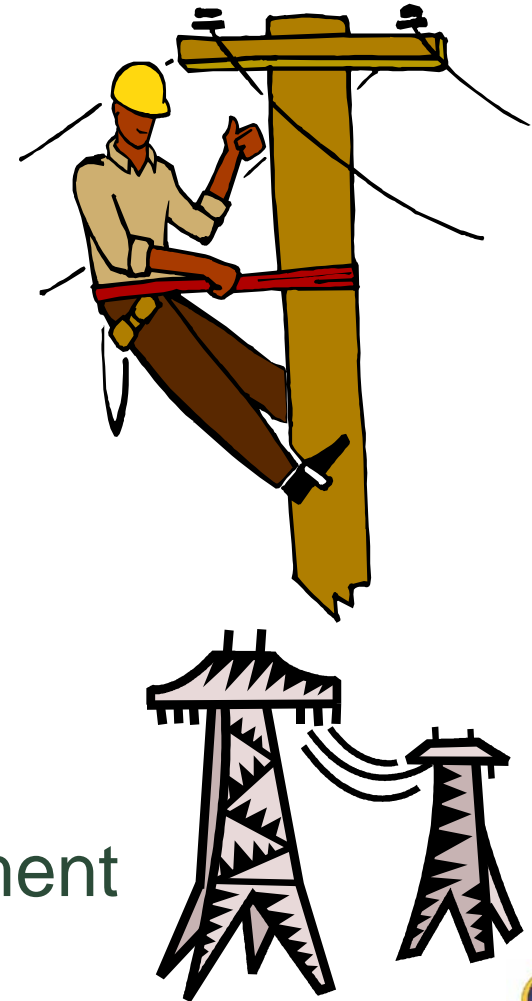
Reliable CHP Technologies

- Thermally Activated Technologies
 - Absorption Chillers
 - Desiccant Dehumidification



Other Components to CHP Installation

- Grid Interconnect:
 - Isolation Switch
 - Switchgear
 - Protection Relays
 - Synchronizing Equipment
- Installation:
 - Equipment Footprint
 - Floor Loading
 - Proximity To HVAC Equipment
 - Number of Electrical Feeds





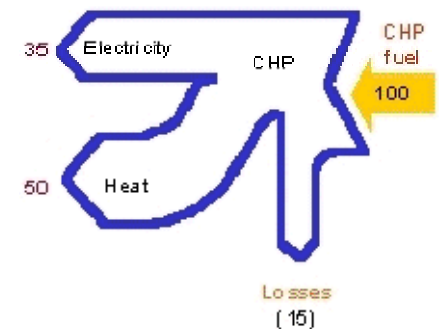
Hospitals & CHP



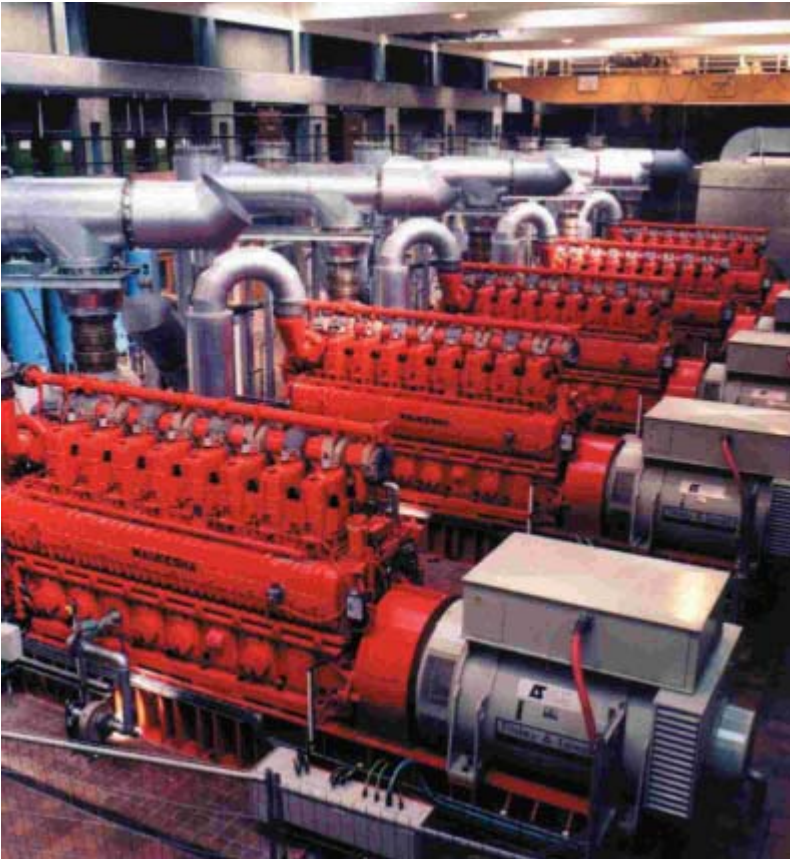
Is There A Match?



Combined Heat and Power
(1 MW natural gas reciprocating engine)



When Does CHP Make \$ense?



- High Thermal and Electric Loads that Occur Coincidentally
- Sufficient “Spark Spread”
- Long Operating Hours
- Central Heating and Cooling System
- Minimal Electric Distribution Connections
- Special Electrical, Cooling or Heating Needs



What are the benefits of CHP?



CHP does not make sense in all applications, but where it does, it can provide:

- Lower Energy Costs
- Reduced Energy Consumption
- Increased Reliability
- Improved Power Quality
- Provide Standby Power
- Lower Emissions



What are the Market Challenges Facing CHP Installations?

- Lack of a Critical Need (high energy prices??)
- Lack of Awareness of the Technology Concept, Status, Benefits, and Issues
- Need for Internal Champions: Technical & Financial
- Unstable / Uncertain Energy Prices (Deregulation?)
- Quantifying Non Utility Cost Benefits
- Competing for Capital Development \$
- Homeland Security – Keeping the Hospitals On Line



System Reliability

- Electric Grid Blackouts / Brownouts / Voltage Sags
- CHP Has the Capability to Ride Thru Outages
 - Ex. Lake Forest Hospital – From 50 Annual Voltage Sags Pre-CHP to 2 per year Post-CHP
 - Estimated \$500k/yr savings
- Backup Power
 - Grid Backs Up the CHP System
 - CHP System Backs Up the Grid
 - Emergency Gen Sets Further Back Up Life Critical Circuits



Emergency Generators vs. CHP Systems

What is the Difference?

Emergency Generators

- Sized to Meet Life Safety & Critical Loads
- Diesel Fueled
 - High Emissions
 - Meet Emergency Startup Requirements
- Instantaneous Outage When Started
- Not Capable of Continuous Operation – Rarely Runs
- No Financial Payback

CHP Systems

- Sized Based on Thermal & Electric Loads
- Natural Gas Fueled
 - Low Emissions
 - Cannot Meet Emergency Startup Requirements
- Reduces Size of Emergency Generation
- Emergency Generators are Backup to Backup
- Good Financial Return

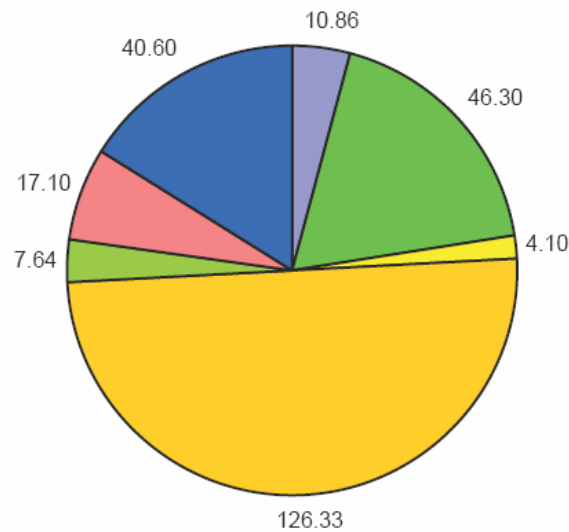
Technical Risk / Maintainability

- 200+ U.S. Hospital CHP Installations (Approx. 470 MW)
- Size Range: < 100 kW to > 50 MW
 - Average 2 MW - Median 230 kW
- Provided Project Profiles for Several Midwest Sites
- Hospitals Experienced in Maintaining HVAC and Emergency Generator Systems (CHP Prime Mover Maintenance Contracts Available)
- Low Technical Risk
 - More of a Financial & Regulatory Risk

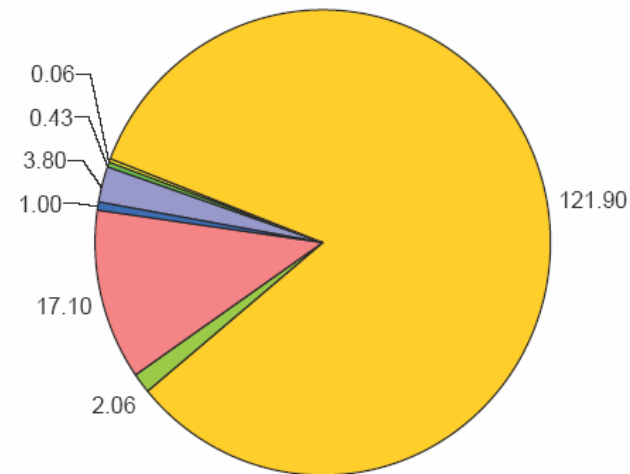


Michigan Installed Generating Capacity by Market Sector

Installed Generation
252.93 MWe



Installed Generation
w/ Heat Recovery
146.35 MWe



Data obtained from the BChP Baseline Analysis for the Michigan Market by the Midwest CHP Application Center, 2003



Michigan Hospitals with Installed Generation

Installed DG Generating Capacity - 10.86 MW
Installed CHP Generating Capacity - 3.8 MW

- Henry Ford Medical Center*
- Hutzel Hospital
- Oakwood Hospital
- Spectrum Hospital*
- St. Lawrence Hospital
- William Beaumont Hospital

* Designates CHP installation



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CHP
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In Partnership with
the US DOE

Data obtained from the BChP Baseline Analysis for the Michigan Market by the Midwest CHP Application Center, 2003

Michigan CHP Market Potential

Commercial/Institutional CHP Market Potential by Application

Total MI CHP Market Potential 2,560 MW



Top 5 Commercial/Institutional CHP Market Applications

1. Office Buildings 654.0 MW
2. Schools 459.2 MW
3. Hospitals 330.7 MW
4. Nursing Homes 297.9 MW
5. Colleges/Univ. 131.0 MW

628.6 MW
(Healthcare Industry)

- Data obtained from *The Market and Technical Potential for CHP in the Commercial/Institutional Sector*, prepared by Onsite SYCOM Energy for EIA (Jan 2000)



What are the Financial / Regulatory Risks?

- High and Volatile Natural Gas Prices
- Uncertain Electric Prices
 - Low Today
 - New Electric Capacity Tied To Natural Gas
 - Deregulation ? Higher / Volatile Prices ?
- Simple Paybacks (Approx 4 to 8 years)
- Quantifying Soft Benefits Significantly Impacts Pro Forma
- Competes with Other Capital Investments (Medical Equipment)
- Potential Uncooperative Electric Utility



What are the Emissions / Health Impacts?

- Natural Gas --- Clean Fuel
- High Fuel Use Efficiencies 80+%
- Replaces Older Boilers (less efficient more polluting)
- Patient / Staff Conditions
 - Better Indoor Air Quality
 - Good Dehumidification
 - Reduces Electric Outages
 - Improves Availability of Medical Diagnostic Equipment
 - Allows Backup for More Hospital Functions
- Increased Energy Security



Next Steps... What Tools are Available to Help Evaluate CHP at your Facility?

1.) Project Profiles

- Inform end-users of existing CHP applications
- Inform engineering companies of “basic” information
- Inform CHP advocates of a wide variety of CHP installations.

2.) CHP Resource Guidebook

- Ready reference for basic principles of CHP
- CHP “Rules-of-Thumb”
- Assists in performing a first level CHP screening.

3.) CHP Screening Handout

- Determine whether there is a clear opportunity before embarking on a protracted evaluation.
- A few simple questions and calculations can justify this decision.



*Please visit the **CHP Exhibit Booth** to pick up available tools that will help you evaluate CHP at your facility!*



Questions?

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