



CHP and the Public Power Industry

Presentation to:
Minnesota Municipal Utilities Association
March 30, 2006

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Topics covered are:

- What is CHP
 - The Concept
 - Equipment Types
 - Benefits of CHP (Customer & Public Power Co.)
 - Example Installations (Public Power and CHP)
 - Midwest CHP Application Center
 - Municipal Electric Utility CHP Project
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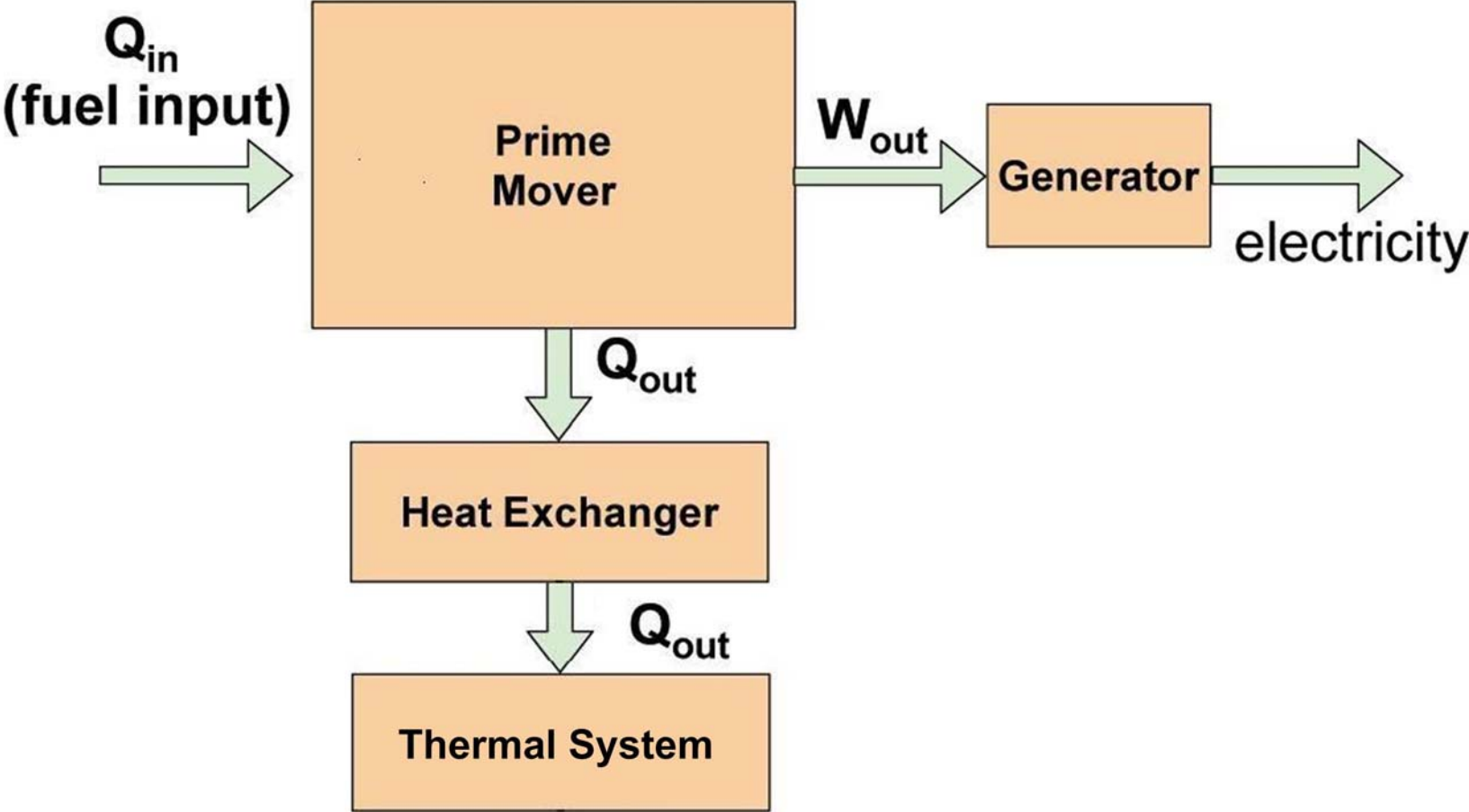
What is Combined Heat and Power?



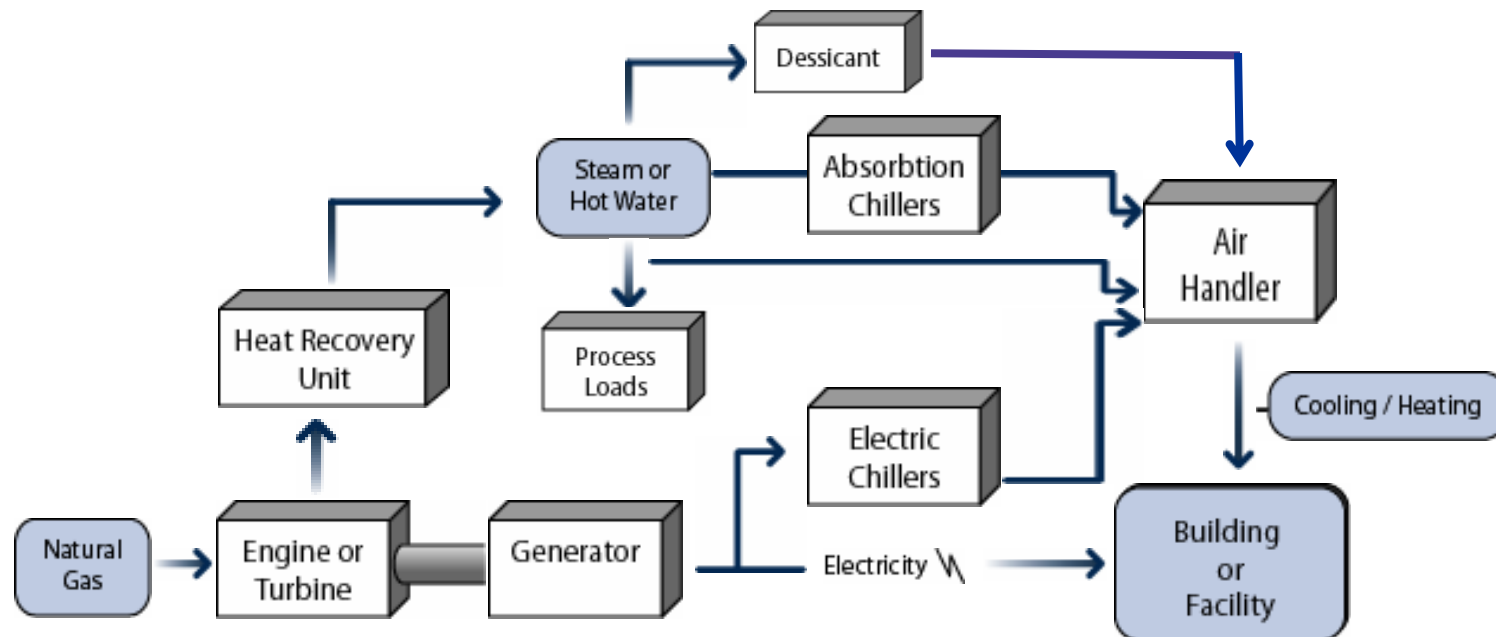
CHP is ...

- 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

Basic Components



Typical Commercial CHP Configuration



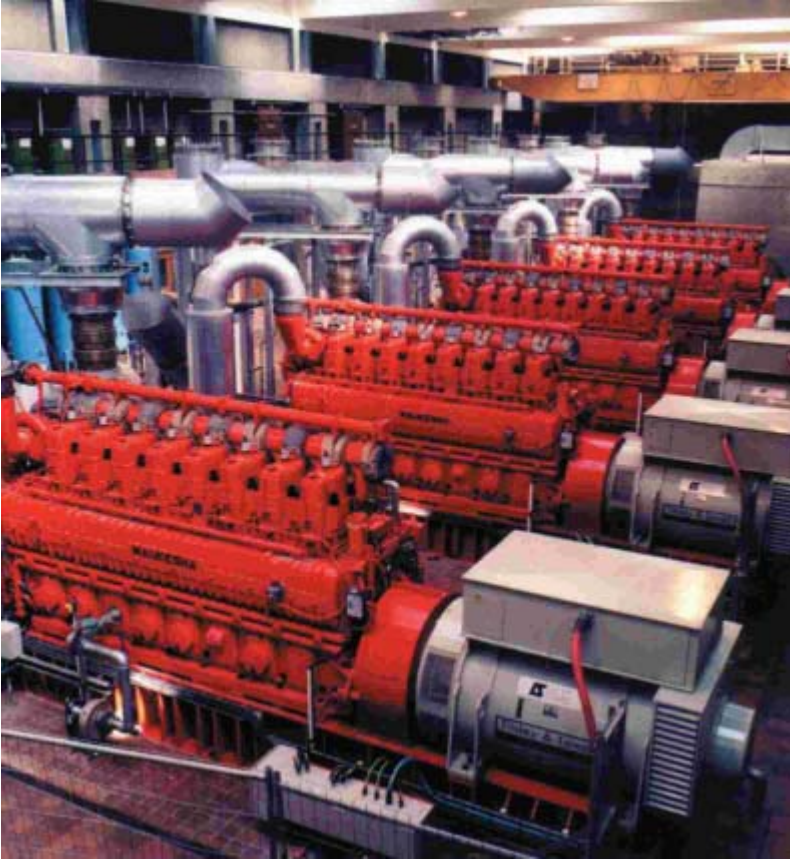
What are the Customer Benefits of CHP?



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 than Central Station Plants
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When Does CHP Make Sense?



- High Thermal and Electric Loads that Occur Coincidentally
- Sufficient “Spark Spread”
- Long Operating Hours
- Central Heating and Cooling System
- Added Needs (Reliability, Power Quality etc.)

Candidate Applications for CHP

- Hospitals
 - Colleges / Universities
 - High Schools
 - Residential Confinement
 - High Rise Hotels
 - Fitness Centers
 - Food Processing
 - Paper / Lumber Mills
 - Chemical Plants
 - Metal Fabrication
 - Ethanol Plants
 - Landfill / Water Treatment Plants
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CHP System Sizes (Terminology)

<u>System Designation</u>	<u>Size Range</u>	<u>Comments</u>
Mega	50 to 100+ MWe	Very Large Industrial Usually Multiple Smaller Units Custom Engineered Systems
Large	10's of MWe	Industrial & Large Commercial Usually Multiple Smaller Units Custom Engineered Systems
Mid	10's of kWe to Several MWe	Commercial & Light Industrial Single to Multiple Units Potential Packaged Units
Micro	<60 kWe	Small Commercial & Residential Appliance Like

Emergency Generators vs. CHP Systems

Emergency Generators

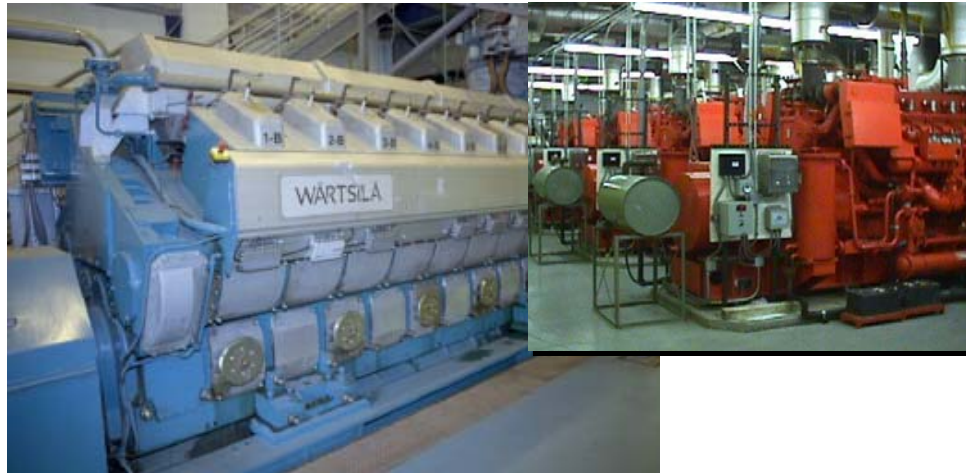
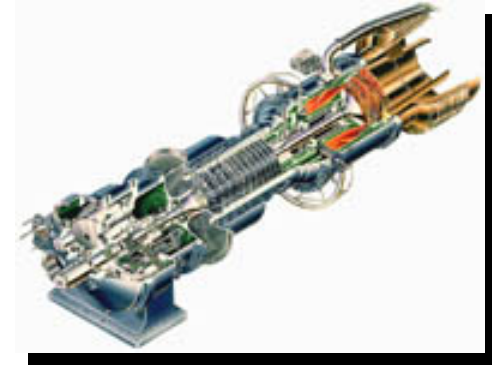
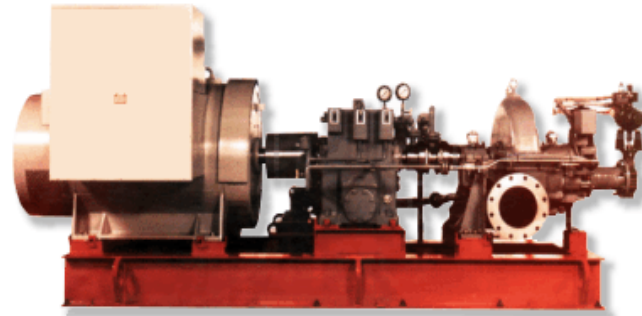
- Sized to Meet Critical Loads
- Diesel Fueled
 - High Emissions
- Instantaneous Outage When Started
- Not Capable of Continuous Operation – Rarely Runs
- No Financial Payback

CHP System

- Sized Based on Thermal & Electric Loads
 - Use Natural Gas or Opportunity Fuels
 - Low Emissions
 - Reduces Size of Emergency Generation
 - Emergency Gen are Backup to Backup
 - Good Financial Return
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CHP Prime Movers

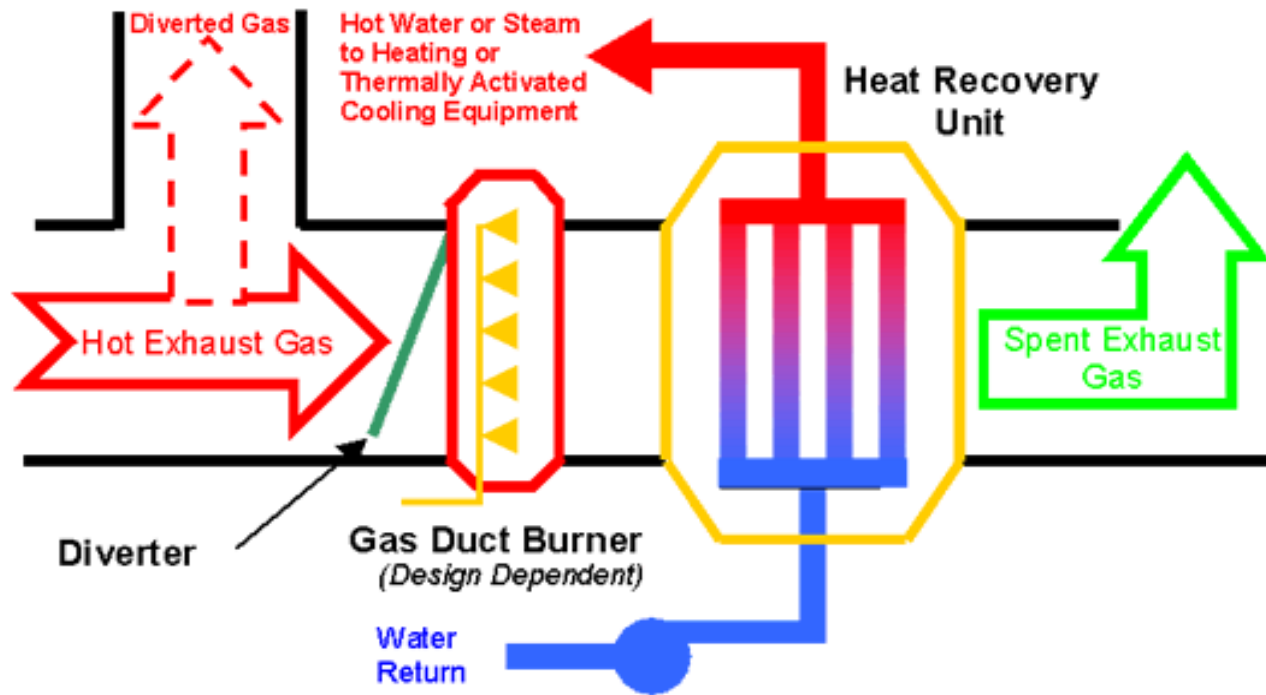
- Reciprocating Engines
- Industrial Gas Turbines
- Micro-turbines
- Steam Turbines
- Fuel Cells



Heat Recovery (Recycled Energy)

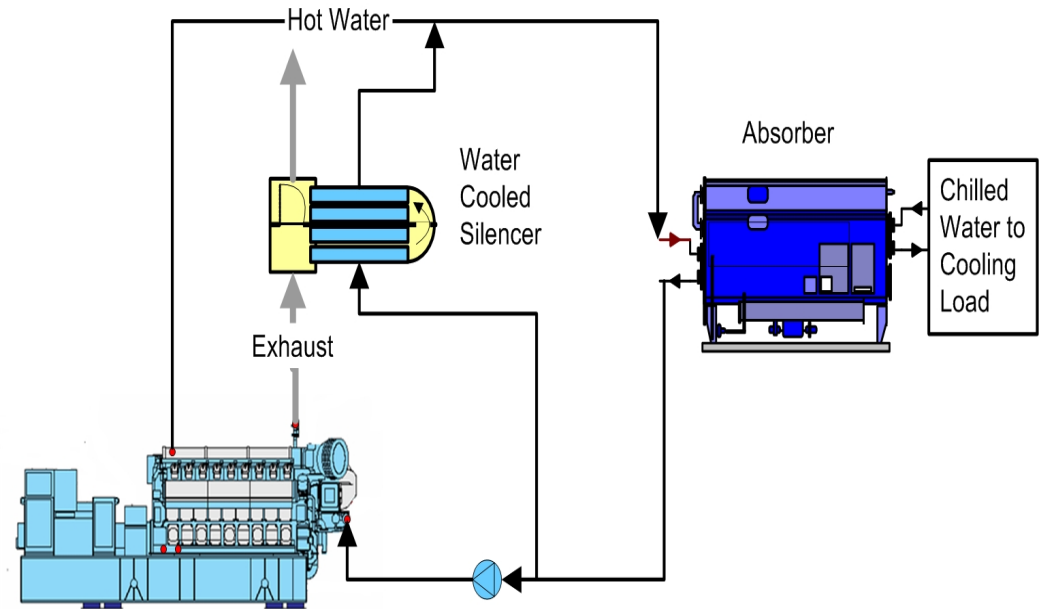


- Steam or Hot Water to Heating
- or
- Thermally Activated Technologies:
 - Absorption Chillers
 - Desiccant Dehumidification



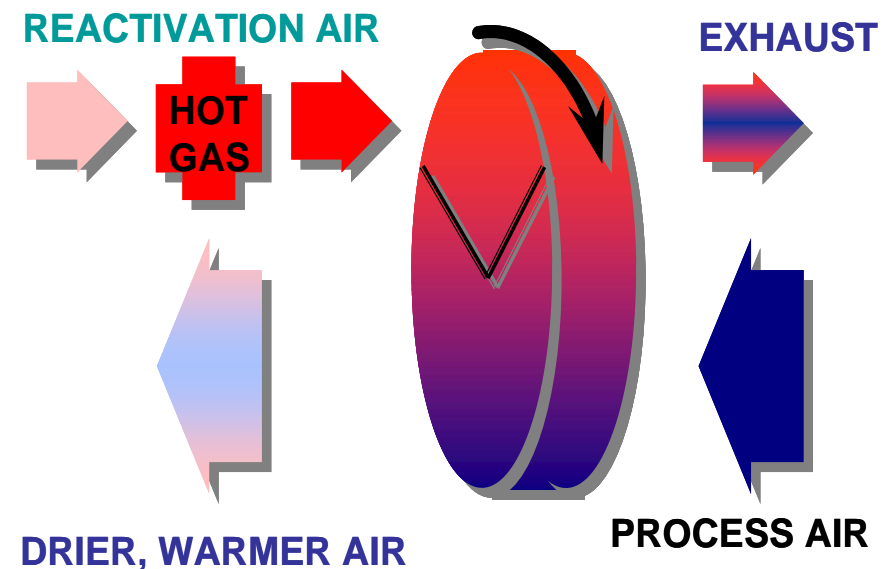
Absorption Chillers

- Use Waste Heat to Generate Chilled Water for Air Conditioning or Industrial Refrigeration
- Significant Advances in Absorption Technology
- Provides Waste Heat Load During the Cooling Season



Desiccant Dehumidification

- Removes Moisture From Air (Latent Load)
 - Reduces the Demand on the Cooling System to Reduce Humidity
 - Improves Indoor Air Quality
 - Reducing Mold Growth
 - Reducing “Over Cooling”
 - Allowing Higher Make-Up Air Rates for the Same Energy Usage



Preferred Generator Types

Induction

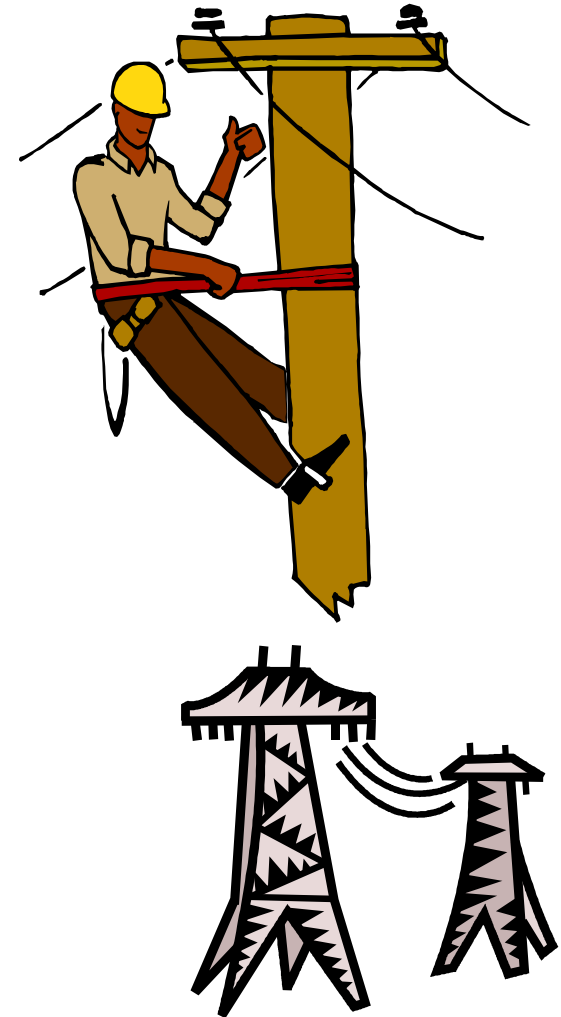
- Less Complicated & Potentially less costly to interconnect
- When Grid goes Down, CHP System goes Down
- Need Emergency Generator Sets

Synchronous

- More Complicated & Costly to interconnect
 - With Proper Protective Relays – CHP System can Continue to Operate Reliably & Safely Thru Blackouts & Brownouts
 - Depending on CHP Size/Configuration may not need Emergency Gen. Set
 - Preferred CHP Installation
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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

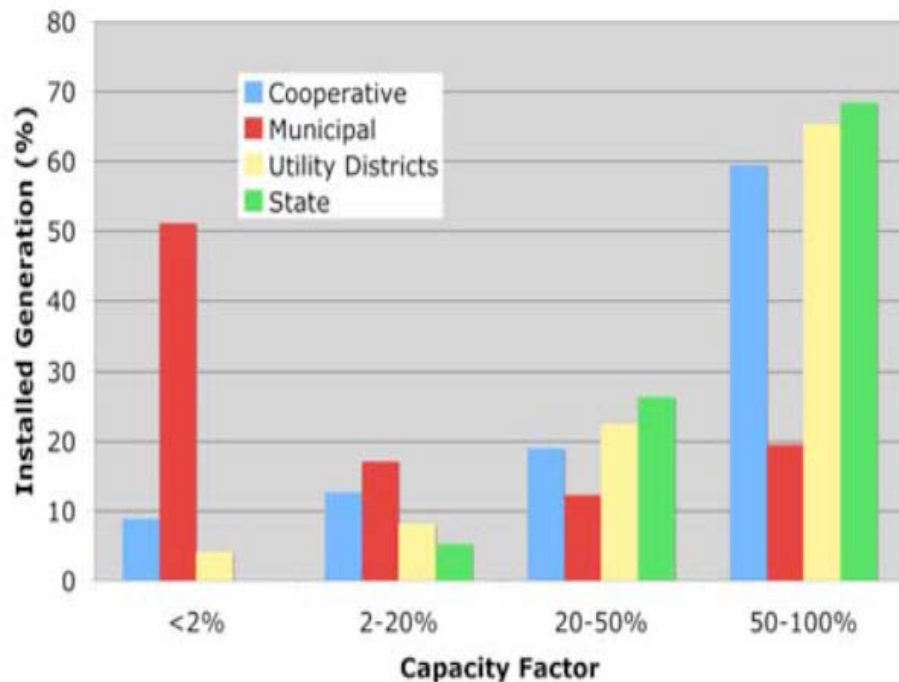


CHP in Minnesota

268 MW installed capacity in the
Commercial/Light Industrial Sector:

- 115 MW of District Energy Systems
 - 47 MW at Universities
 - 34 MW at Hospitals
 - 9 MW at Landfills
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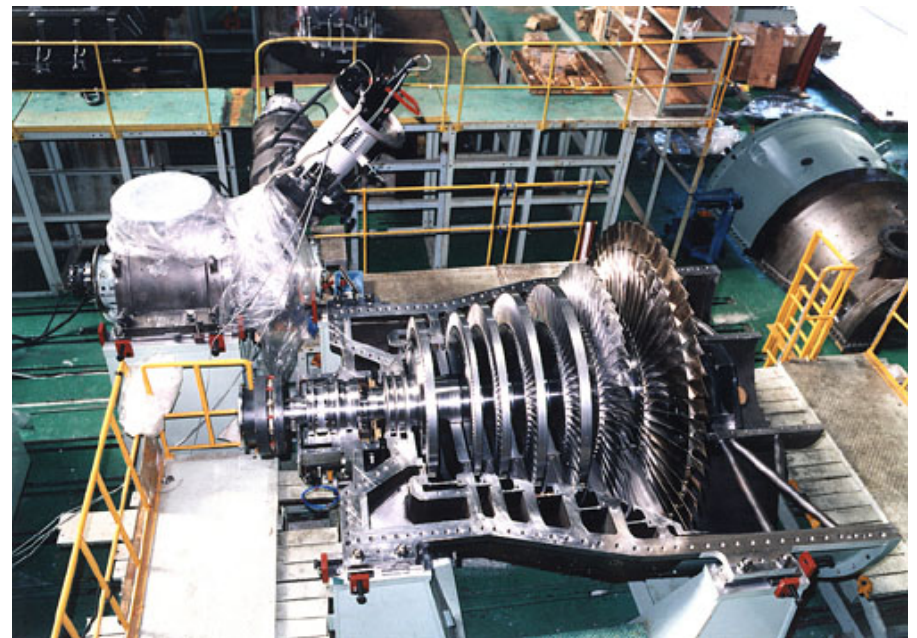
Current Municipal Power Generation



- 1850 municipal power companies in US
- Half of municipalities with generating assets have capacity factors less than 2%
- May use generation for peak-shaving or back-up power
- Utility districts and state agencies use their generating assets more for baseload power
- Clear opportunity for Municipals to include baseload assets into their generating mix.

CHP Can Help Public Power Organizations:

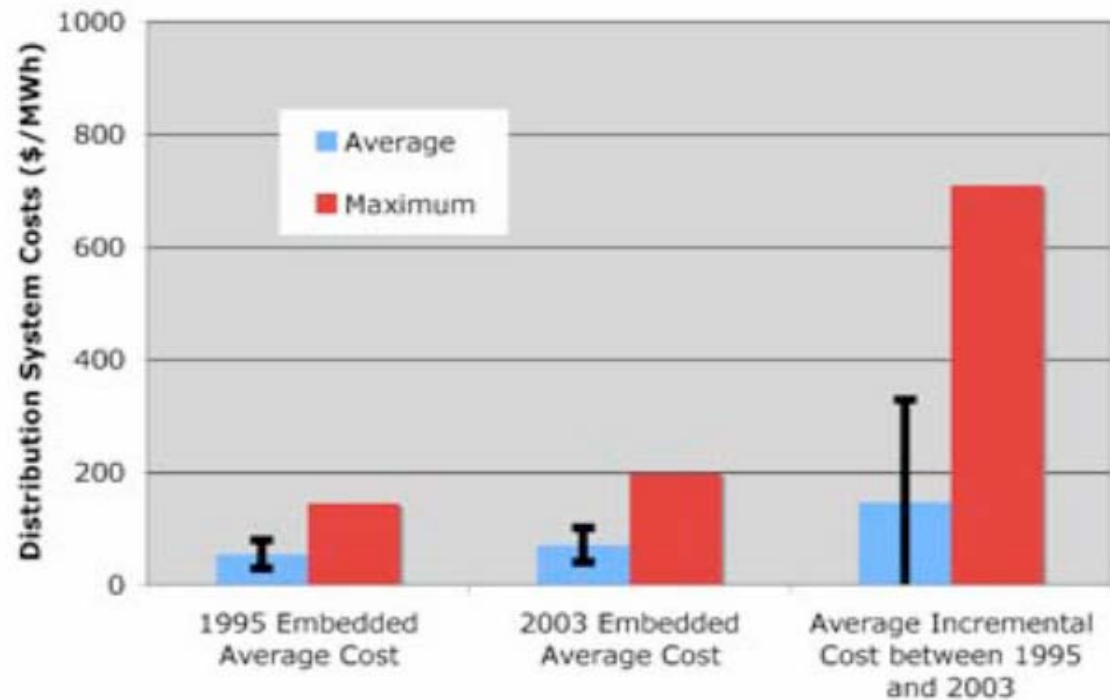
- Provide “Best Buy” Power
- Save Distribution Costs and Ensure Reliable Power
- Promote Energy Efficiency
- Establish Customer Partnerships
 - Contribute to Business Retention
 - Encourage Economic Development & Business Expansion
- Assist in Emergency Preparedness



Provide “Best Power”

- Franklin Heating Station in Rochester, MN
 - 11.75 MW CHP Application, fueled by natural gas, #2 and #6 fuel oil
 - Owned by Mayo Clinic, Rochester Methodist Hospital, Charter House, and Sunstone Corp.
 - Operated since 1928, continuously updated and expanded, most recent upgrade in 1999
 - Provides chilled water, soft tempered water, low and high pressure steam and electricity to 25 buildings in Rochester
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CHP Systems Save Distribution Costs



- Study examined the distribution system cost for 177 municipal utilities.
- Large cost increases for Distribution Systems
 - Average incremental cost for the distribution assets purchased over 8 year period to serve the incremental load was twice the embedded cost in 2003.
 - Large variation in average costs
- CHP Systems can defer and reduce investments in expansion and upgrades of distribution systems

Promote Energy Efficiency

- Dell's Children Medical Center – Austin, TX (Under Construction)
 - 470,000 sq. ft. - 169 Bed Facility
 - 35,500 sq. ft. CHP District Energy Plant
 - 4.3 MW Gas Turbine with Heat Recovery for Process Steam, Heating, and Cooling
 - Austin Energy, a Municipal Utility – Owns & Operates the CHP District Plant
 - **On track for LEED Platinum Certification**
 - Emergency Backup Generator Requirement Reduced
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Establish Customer Partnerships

- Example: U.S. Energy Partners and the City of Russell, Kansas
 - 15 MW Gas Turbine Located at Ethanol Plant
 - 3 MW for the Plant – 12 MW serves City residents
 - Economic Development – Attracted Ethanol Plant to the City
 - US Energy Paid for the Heat Recovery Equipment
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Assist in Emergency Preparedness

- One Responsibility of Municipalities is to provide emergency response in case of fire, storms, or other disasters (natural or man-made).
 - CHP can be located at critical infrastructures for ongoing operation of the municipality such as at:
 - Shelters, hospitals, police and fire stations, municipal water and sewage facilities.
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Albert Lea Waste Water Treatment Facility in MN

- 120 kW System Installed in 2003
- Four Capstone Microturbines with Heat Recovery Equipment
- Fueled by methane gas generated in the anaerobic digester of the waste water treatment plant
- Heat from generation process is recovered to maintain proper digester temperature and to provide space heating for the facility
- Implementation Cost: \$250,000
- Yearly Energy Savings: \$40,000 - \$60,000



Summary Messages

- CHP Is A Low Technology Risk
 - Utilize Proven Technologies
 - Employ Standard Design Practices
 - Incorporate Good Maintenance Practices
 - Each Application Must Be Evaluated
 - Initial Screening: Rules Of Thumb / Averages
 - Capital Investment Analysis: Detail Analysis Provides Accurate Estimates of Savings / Cash Flows
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Midwest CHP Application Center

Mission:

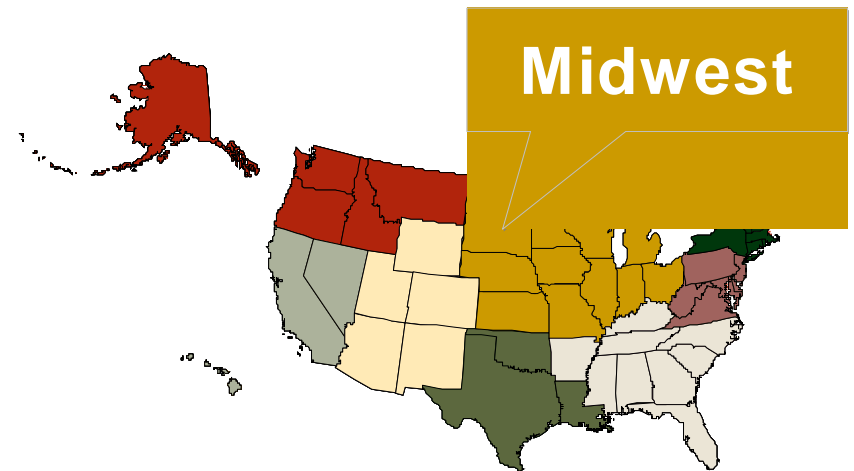
Develop Technology Application Knowledge and the Educational Infrastructure Necessary to:

- Reduce Perceived Risks
- Foster CHP as a Viable:
 - Technical and Financial Option
 - Energy and Environmental Option

Focus:

Foster Project Identification and Implementation through:

- Education
- Information
- Technical Assistance



Midwest CHP Application Center Partnership

- U.S. DOE Sponsored Center
 - With Support From 12 Midwest States

- Service Area Includes:
 - Illinois
 - Indiana
 - Iowa
 - Michigan
 - Nebraska
 - North Dakota
 - Minnesota
 - Missouri
 - Ohio
 - Wisconsin
 - Kansas
 - South Dakota



**MIDWEST
CHP
APPLICATION
CENTER**

*In Partnership with
the US DOE*

Midwest CHP Application Center Services

- Website with CHP Information
 - www.CHPCenterMW.org
- Full Gamut of Targeted Workshops / Courses
- Technical Assistance / Special Reports

Experience Base:

- Hospitals
 - Casinos
 - Hotels
 - Office Buildings
 - Industrial Facilities
 - Wastewater Facilities
 - Ethanol Facilities
 - Universities
 - Museums
 - Airports
 - High Schools
 - Farm / Food Waste
 - Landfill
 - 911 Centers
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Recent Center Activities / Accomplishments

- MEEA Inspiring Efficiency in Education Award
 - Regulatory Workshop Held – CHP Effect on Jobs and Economic Development
 - Database of 36 Project Profiles
 - Resource Guide Book (2005 Edition)
 - 2005 MAC Program – State Activities / Services
 - Municipal Electric Utility Effort
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Municipal Electric Utility Project

- Coordinate Efforts with State Energy Offices
 - AMP – Ohio Bob DeWitt
 - Iowa Assoc. of Municipal Utilities Ann Kimber
 - Minnesota Municipal Utilities Assoc. Steve Downer
 - Municipal Electric Utilities of Wisconsin Scott Meske
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For Further Information

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