

Combined Heat and Power

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Overview

- **Introduction**
- **Benefits / Opportunity for CHP**
- **Government Commitment(s)**
- **CHP Market**
- **CHP Technology**
- **Market Challenges / New Thinking**
- **Regional CHP Initiatives and Activities**
- **Conclusions**

Introduction

- **EIA estimates 42% Growth in Electricity Demand over next 20 years**
- **Business Week #1 of 21 ideas for the 21st Century – Distributed Generation**
- **DG provides potential to recover the waste heat**
- **True Bi-Partisan Issue**
- **CHP / Cogeneration / BCHP / DG / DE / DER:**
- **Technology Right Here Right Now!**

What is CHP?

- **Integrated System**
- **Source of Generation Located At or Near the Point of Use**
- **Provides a Portion of the Electrical Load**
- **Utilizes the Thermal Energy**
 - **Cooling**
 - **Heating**
 - **Dehumidification**
 - **Process Heat**

Why is There an Opportunity?

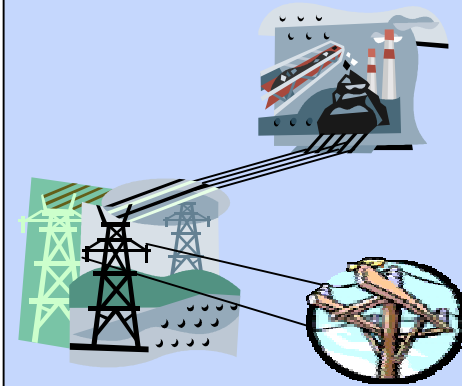
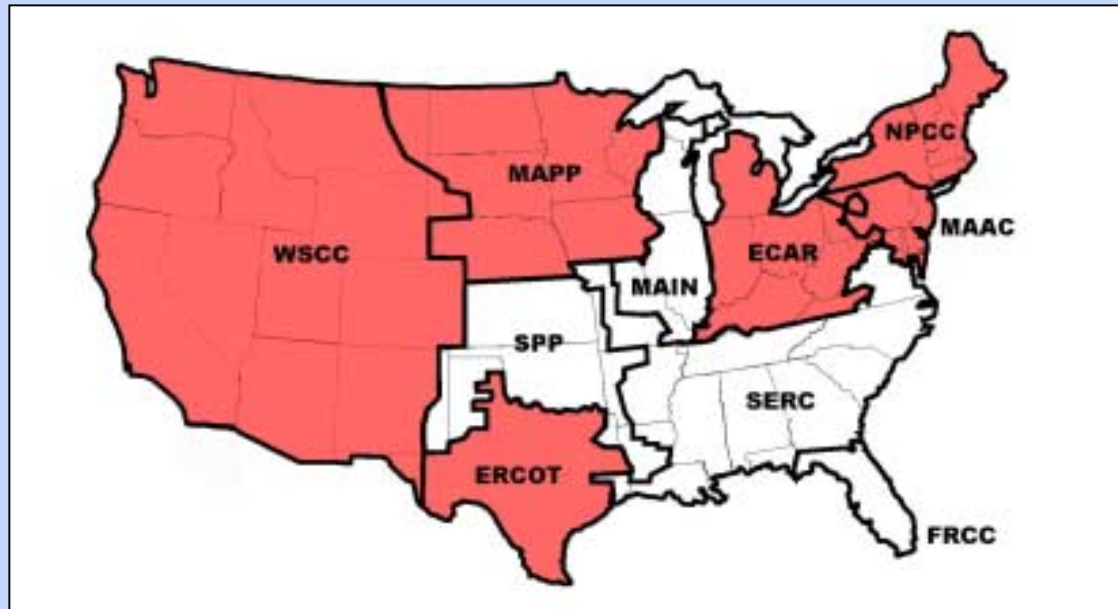
■ Rising Concerns Over


- Blackouts/Brownouts
- Power Supply Constraints (Aging infrastructure)
- Electricity Prices
- Environment
- Power Security

■ Selected Power Outage Costs

Industry	Avg. Cost of Downtime
Cellular Communications	\$41,000 per hour
Telephone Ticket Sales	\$72,000 per hour
Airline Reservations	\$90,000 per hour
Credit Card Operations	\$2,580,000 per hour
Brokerage Operations	\$6,480,000 per hour

Power Reliability Concerns 2009 Projections



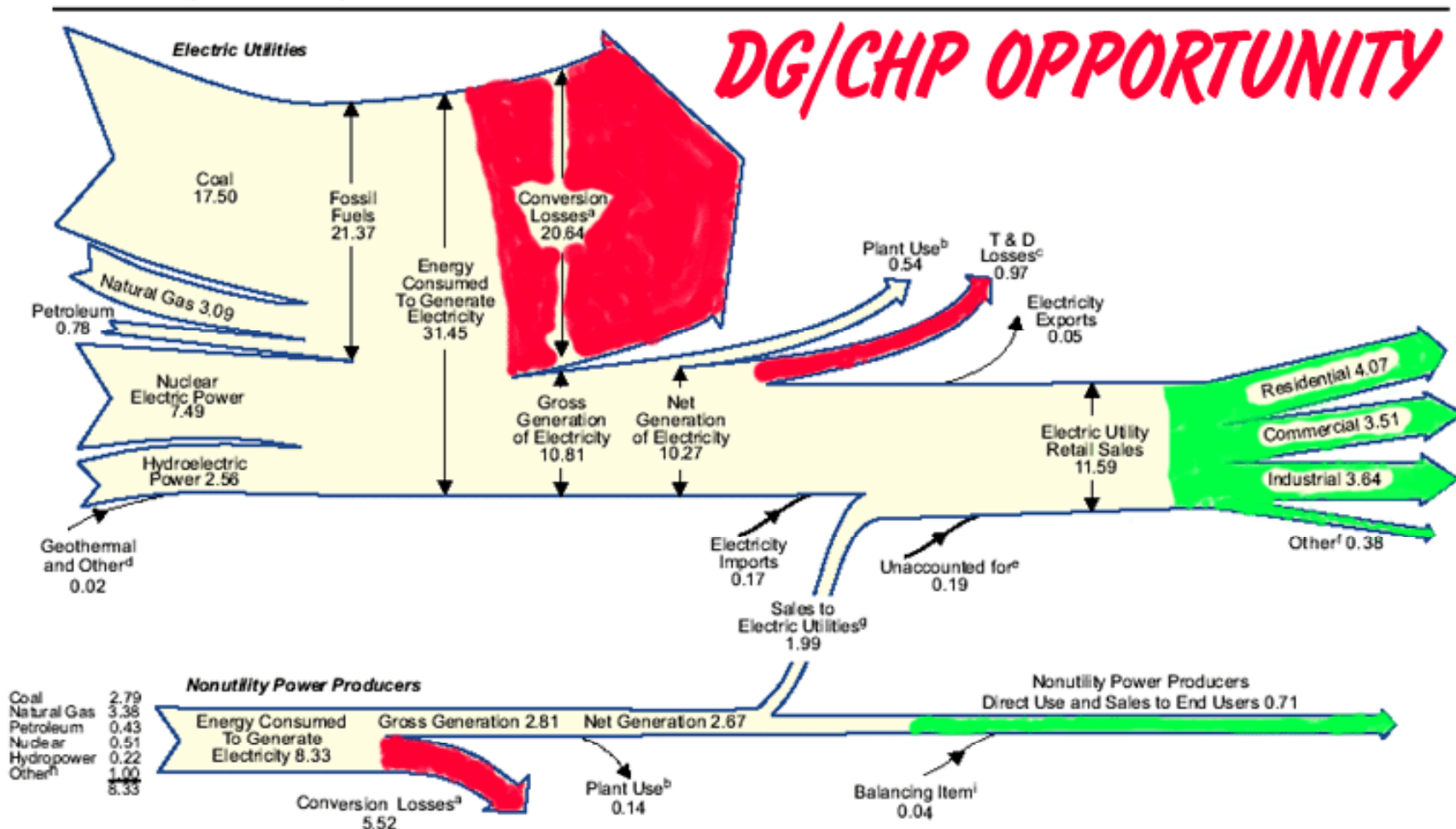
 **Areas with Capacity
Margins < 10 percent**

Source: National Electricity Reliability Council, 2000

Can this be true?

Diagram 5. Electricity Flow, 2000
(Quadrillion Btu)

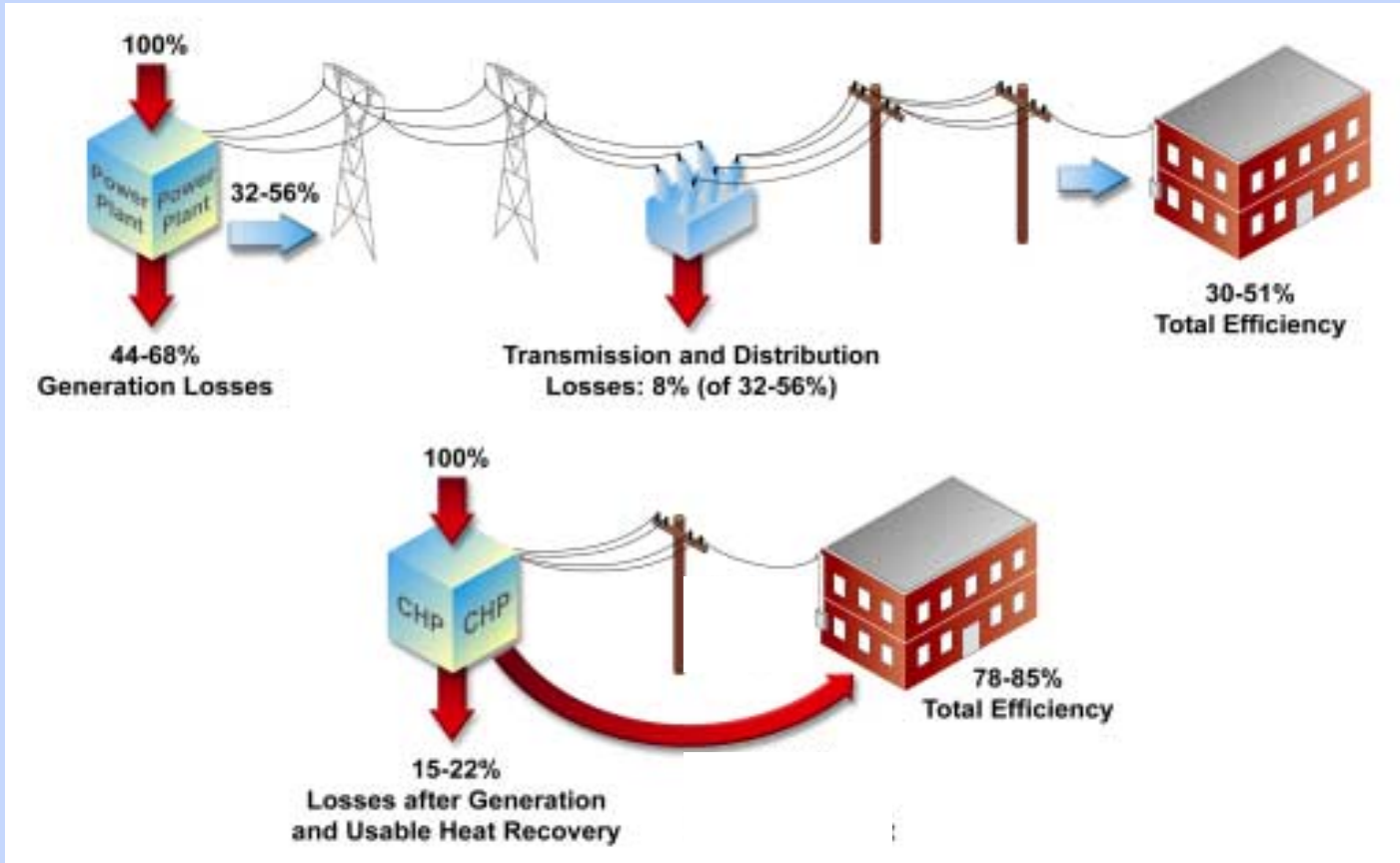
From Energy Information Agency, USDOE, 2000 Annual Energy Review



Benefits of CHP

- **Conservation of Natural Resources**
- **Addresses Environmental Concerns**
 - High efficiencies currently only existing way to reduce carbon emissions and work to meet Kyoto accords
 - Output from prime mover technologies can be less than that of average emissions from central power plants
 - Facilitates deployment of new clean energy technologies
 - For buildings, can use to improve indoor air quality
- **Can be used to improve grid utilization and**
 - Improve end-user power reliability
 - Improve grid reliability / supplement aging areas of grid
 - Reduce peak power load demand on grid
- **Lower overall energy costs**

How CHP Saves Energy



Government Commitment

- **President Bush's National Energy Policy**
- **U.S. DOE's CHP Challenge**
 - **Double CHP in U.S. by 2010**
 - **U.S. DOE / U.S. CHPA / U.S. EPA roadmap**
- **U.S. EPA CHP Partnership**

National Energy Policy

- **CHP plays a major role in the National Energy Plan**
 - **Advantages:**
 - **High efficiencies result in lowering carbon emissions**
 - **Eliminates need to construct power lines**
 - **Replaces old ineffective boilers**
 - **Recommendations**
 - **Encourage EE through CHP by shortening depreciation life or providing an investment tax credit**
 - **EPA to promote CHP through flexibility in environmental permitting (EPA CHP Partnership)**
 - **Secretary of Energy to propose comprehensive energy legislation that promotes competition, protects consumers, enhances reliability, improves efficiency, promotes renewable energy, etc...**

Bush Administration, "National Energy Policy Report," May 2001

U.S. DOE's CHP Challenge

- **Double CHP in U.S. from 46 to 92 GWs by 2020**
 - **Established in 1998 under Clinton Administration with DOE and EPA**
 - **Regional and National Roadmap workshops**
 - **Over 100 industrial, environmental, and government stakeholders involved to develop roadmap**
 - **Developed detailed action plans to achieve goals**
 - **November 1999, Chicago, IL: Great Lakes CHP Roadmap**
 - **October 2000: Baltimore, Md, National CHP Roadmap**
 - **October 23-25th, 2002, Boston, Mass – National CHP Roadmap update**

EPA CHP Partnership

- Voluntary program with Industry, States, and Local governments to promote the environmental and energy benefits of CHP (www.epa.gov/chp).

■ Abbott Labs	■ Verizon	■ International Paper
■ Dow Chemical	■ Texaco	■ US Steel
■ Exxon Mobil	■ Archer Daniels	■ Caterpillar
■ Solar Turbines	■ Bethlehem Steel	■ Real Energy

CHP Market

■ Industrial: Traditional CHP

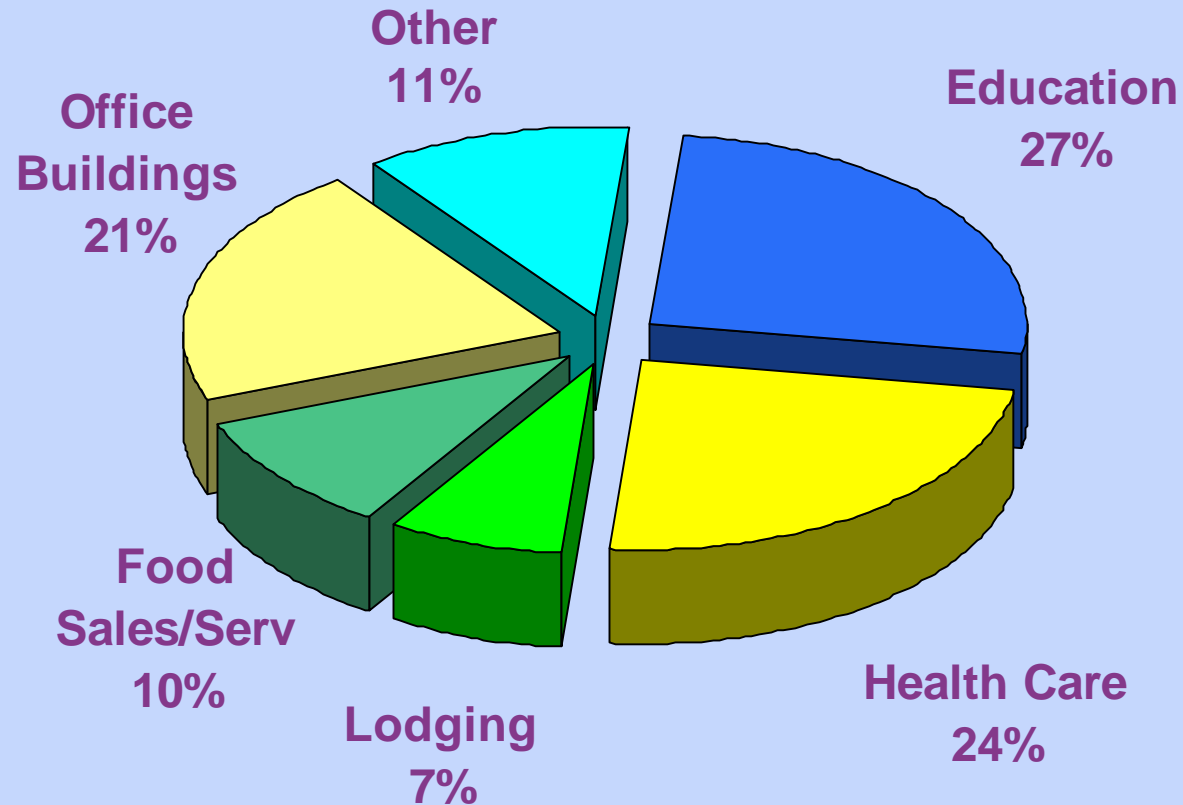
- Approximately 1000 installations, 45 GWs
- Average 45 MWs, Mean 25 MWs
- Remaining Potential: 88 GWs (30 % penetration)
- Key industries: Chemical, paper, oil refining, food, primary metals

■ Commercial: Emerging CHP

- Approximately 1000 installations, 5 GWs
- Average 5 MWs, Mean, .7 MWs
- Remaining Potential: 75 GWs (94%)
- Key applications: Colleges, District Energy, Government, Hospitals, Solid Waste, Offices, hotels

Potential for CHP in Commercial Applications Is Large

Estimated CHP Potential: 75 GW



Source: Nexus

CHP Technologies

- **Cooling Equipment**
 - Mechanical Chillers
 - Absorption Chillers
 - Thermal Storage
 - Desiccant Dehumidification
- **Heat Recovery Systems**
 - Hot Water
 - Steam
- **Electric Generation Equipment**
 - Reciprocating Engines
 - Turbines/Microturbines
 - Fuel Cells

CHP Technologies



Reciprocating Engines



Micro Turbines



Fuel Cells



Absorption Chillers



Dehumidification



Thermal Storage

DER “Thermally Activated”

Absorption Chillers



Humidification

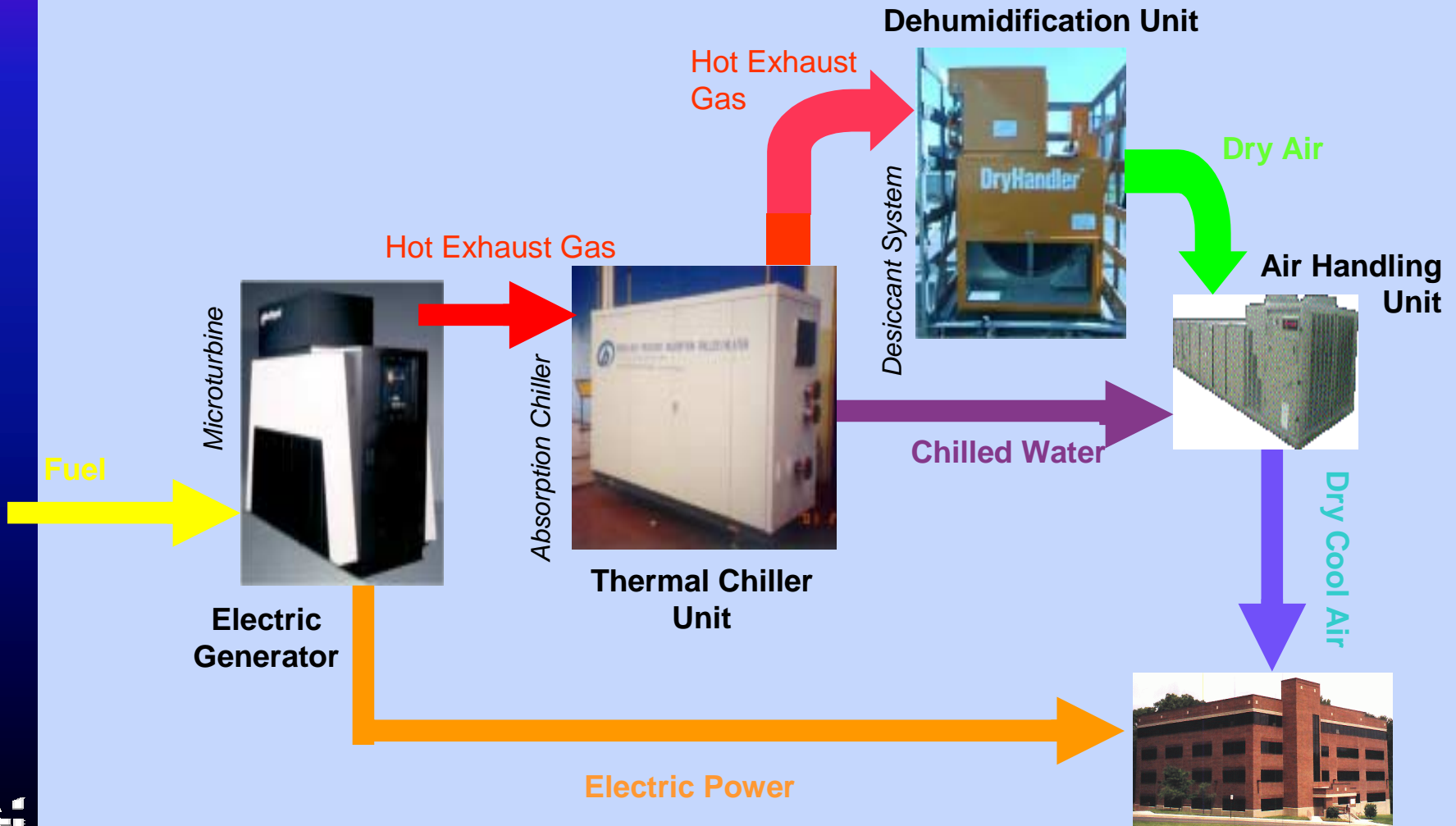


Dehumidification

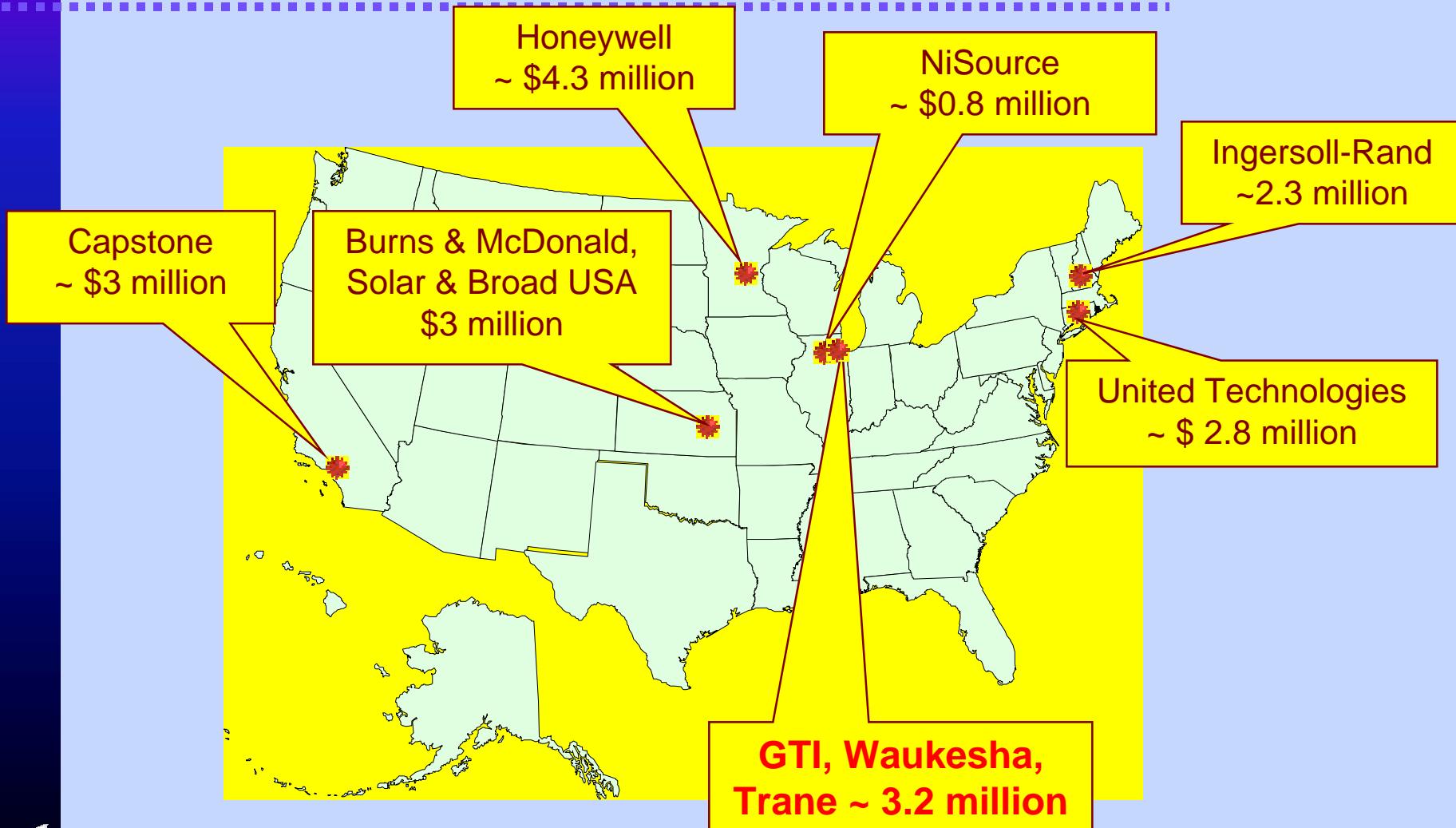


Thermal Storage

Typical Commercial CHP System



DOE Modular/Packaged System Awards



CHP Modular/Packaged System



CHP Characteristics

- **High Efficiency – Up to 80%**
- **Oppty for Improved Air Quality**
- **Further Reduction on Summer Peak Grid Load**
- **Significant Emissions Reductions**
 - **40% Less than Central Plants**

***CHP is a IMPORTANT Part of the BIG DE
Picture!***

Market Challenges

- **Policy / Institutional Barriers**
 - Electric Utility perceptions
 - Interconnection requirements and fees
 - Tariff Structures
 - Re-negotiated rates
 - Standby Charges
- **Education and Outreach**
 - Reduce perceived risk
 - Potential end-user communities
 - Architects and Engineers
 - Electric and environmental policy makers
- **Capital Cost Reduction**

New Thinking on DE /CHP

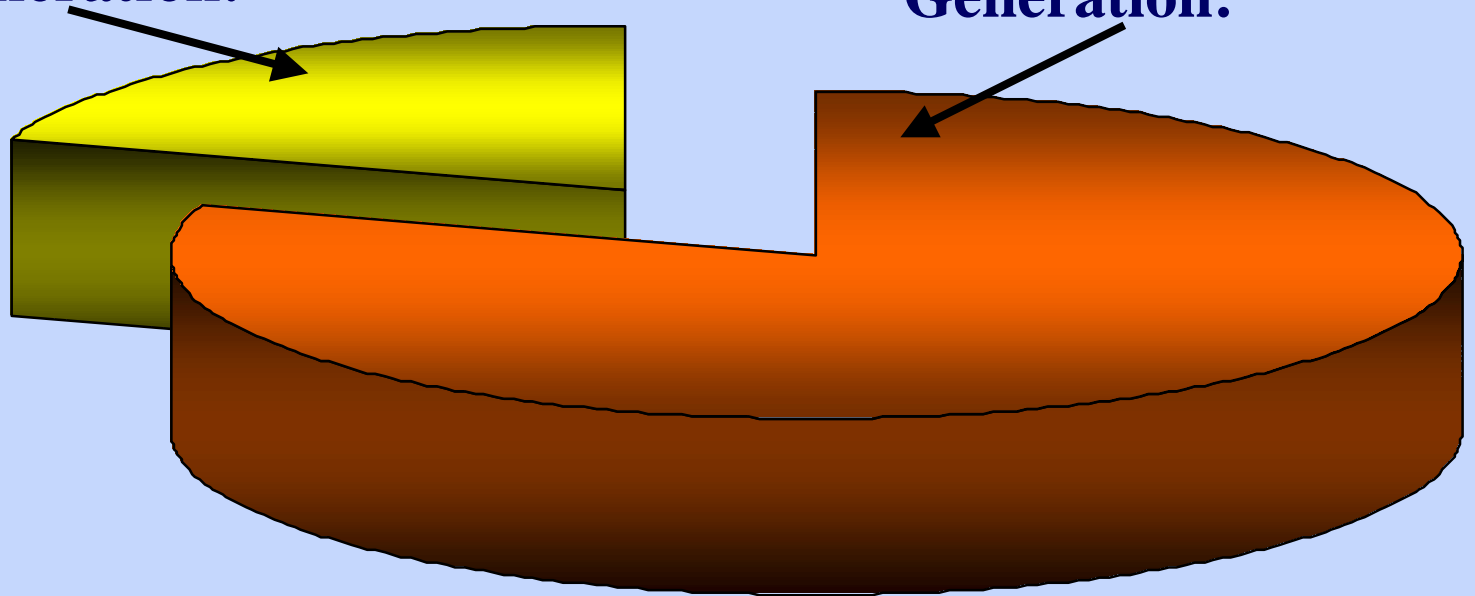
- **Answers to address myths concerning DE/CHP:**
 - **DE results in increased power costs for captive grid customers, most notably the poor**
 - **Answer: DE only represents portion of planned growth, and will serve to increase grid utilization and moderate electricity prices**
 - **Too much DE may cause instability to the grid**
 - **Answer: Recent GE study identified virtually no impact to 20%; Holland and Denmark utilizing over 40 and 50% DE.**
 - **DE / CHP is dirty**
 - **Answer: DE / CHP is not backup / standby diesel generators. See first slide on environmental benefits.**

New Thinking on DE /CHP

**By 2020, EIA forecasts a total of
403,000 MW new or replacement capacity**

**Distributed
Generation: 20%**

**Traditional
Generation: 80 %**



Regional Initiatives and Activities

Midwest CHP Initiative

- Ad-hoc group of industry, environmental, government, and educational representatives to:
 - Lead the Region in Encouraging the Use and in Implementation of CHP technologies;
 - Drive CHP Roadmap Actions Items in the Midwest
 - Provide a Central Point for Coordination and Communications Among the Various Stakeholders in the Midwest

Midwest CHP Application Center

- Develop Technology Application Knowledge and the Educational Infrastructure Necessary to:
 - Reduce Perceived Risks
 - Foster CHP for Buildings as a Viable:
 - Technical and Financial Option
 - Energy and Environmental Option

Midwest Cogeneration Association

- Trade group of key CHP practitioners (A/Es, component suppliers, etc.)

Regional Initiatives and Activities

All three groups in coordinated action to change marketplace – Key activities:

- **Completed 8 State Interconnection Workshop**
 - PUC working groups
 - State presentations
 - Industry Experts (Galdo, DeBlasio, Ethridge)
- **Engaging State PUCs**
 - Create new thinking / overcome myths
 - Policy Platform Development
- **Education and Outreach Workshops**
 - Illinois/EPA/DOE CHP End User Workshop
 - DOE DER Road shows (Detroit – September 13th)
 - Targetted market workshops (Hospitals, offices, etc.)
- **Permitting Guideline**
- **Baseline Studies for Illinois, Michigan, and Wisconsin**
- **Marketing Plan / State Assessments**
- **Input to Illinois Energy Policy**

Summary: The CHP Solution

- **CHP can present considerable benefits to environment, the electric grid, and to consumers**
- **Efforts needed to continue development and demonstrate of CHP systems for Commercial use**
- **Support needed for policy changes and educational and outreach efforts through:**
 - **National efforts with the U.S. Combined Heat and Power Association**
 - **Regional efforts with the MW CHP Initiative, Application Center, and Cogeneration Association.**
 - **U.S. Department of Energy's Chicago Regional Office**
- **Need to incorporate CHP goals into State Energy Plans and Metropolitan Energy Planning**

Questions / Contact Info

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- **Key websites**
 - www.nemw.org/uschpa/regional.htm#midw (MWCHP Initiative)
 - www.chpcentermw.org (MW CHP Application Center)
 - www.nemw.org/uschpa (USCHPA / National Roadmaps)
 - www.eren.doe.gov/der (U.S. DOE DER efforts)
 - www.epa.gov/uschpa (U.S. EPA CHP Partnership)