Sierra Club meeting
June 14, 2012

Combined Heat and Power

Basics and Texas Outlook

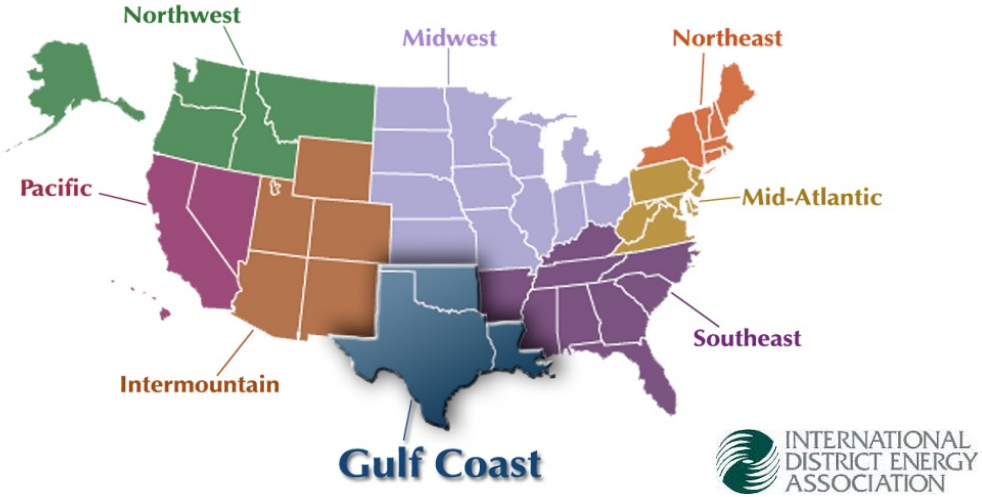
U.S. DOE
GULF COAST
Clean Energy Application Center

Ross Tomlin
U.S. DOE Gulf Coast Clean Energy Application Center

U.S. DOE Clean Energy Application Centers

Providing support for:

- ***Combined Heat and Power***
- ***Waste Heat Recovery***
- ***District Energy***



1) **EDUCATION AND OUTREACH**
   State & local policy makers, regulators, energy end-users, trade associations

2) **MARKET ASSESSMENTS**
   Critical infrastructure, health care, industrial

3) **TECHNICAL ASSISTANCE**
   Site assessments, feasibility studies, analyses

Gulf Coast Partners:

HARC

TX CHPI

PPP

Energy and Environmental Strategies LLC

U.S. Department of Energy
Gulf Coast Clean Energy Application Center

U.S. DOE CHP Goal (2012)

40 Additional GW of new, cost-effective CHP by 2020

Achieving the goal would yield:

- 1 quad savings
- 150 mmt CO2 savings
- 78% of McKinsey CHP economic potential*
- $10 billion/yr savings for energy users relative to typical use of energy

**Unlocking Energy Efficiency in the US Economy, McKinsey & Co, July 2009.*
http://www.mckinsey.com/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy

CHP Overview

Simultaneous production of power and heat on-site of a host facility

Methodist Hospital (Houston, TX)
Rooftop 4.5 MW CHP

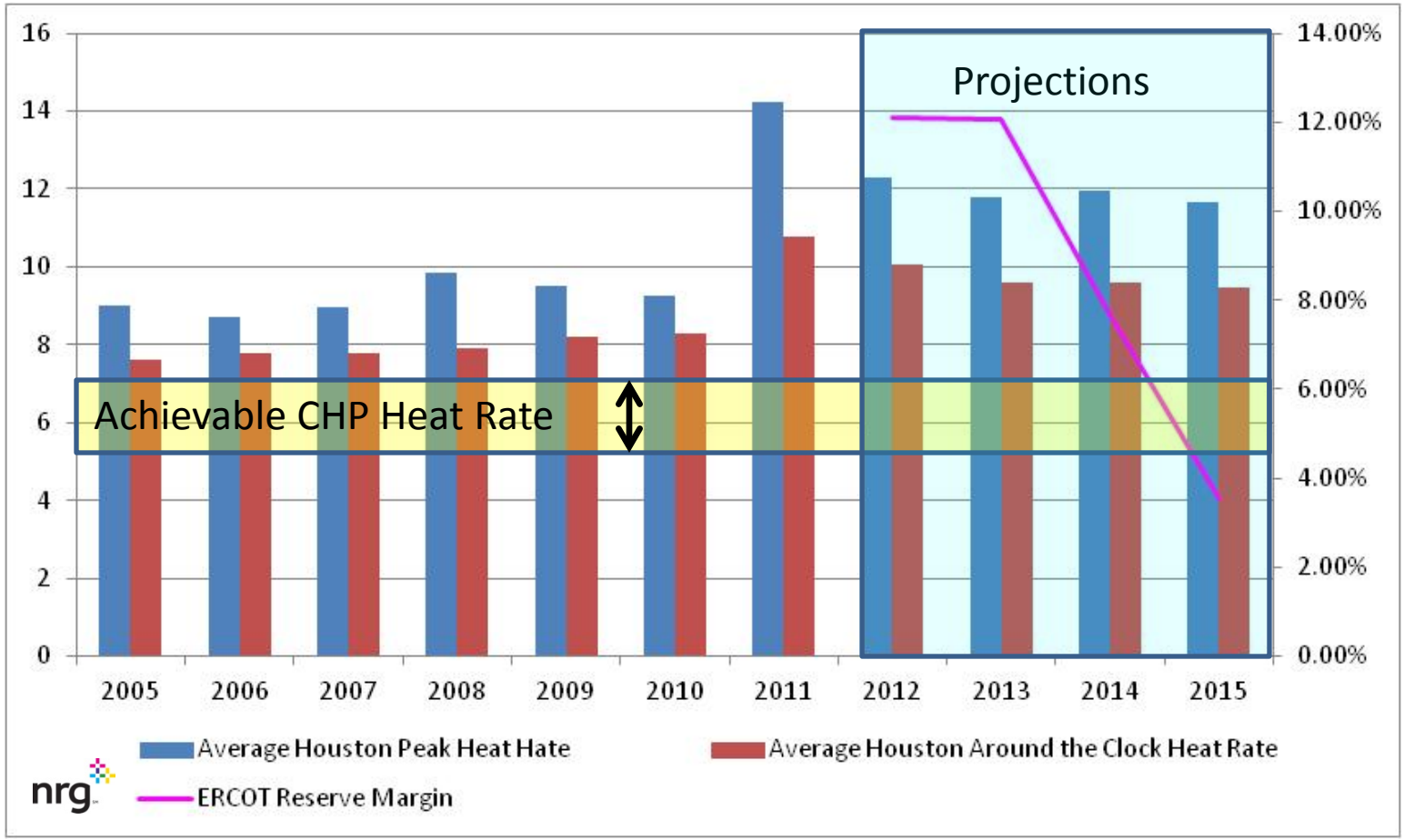
Numerous benefits

- **EFFICIENCY**
- **ENVIRONMENTAL**
- **ECONOMIC**
- **ENERGY SECURITY**

CHP Drivers in Texas

- Texas power crunch -- Need for more cheap, firm, clean electrical capacity
- Very high market heat rates
- Growing attention on water conservation
- Growing desire for energy security
- EPA: Boiler MACT, MATS, CSAPR
- ERCOT: EILS rulemaking >> Emergency Response Service (ERS)
- TCEQ: HB 3268 rulemaking

Market Heat Rates in ERCOT

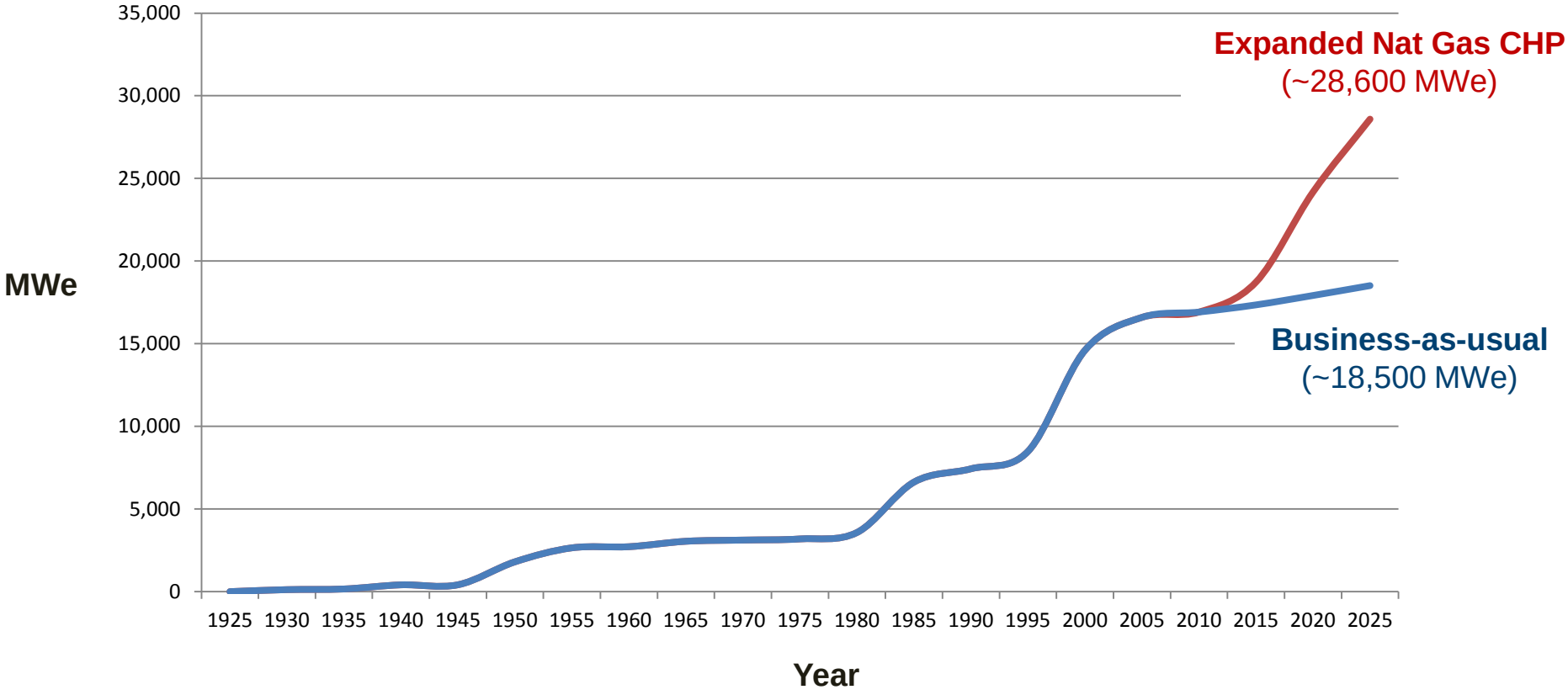


1) Historic and Projected Heat rate based on Retail Electricity Broker data aggregated by NRG Energy, Inc.
2) ERCOT Reserve Margin Data from: *"Report on the Capacity, Demand, and Reserves in the ERCOT Region, December 2011" Page 6* *http://www.ercot.com/content/news/presentations/2011/CDR_2011WinterUpdate.pdf accessed 23 March 2012*

Texas CHP's Future?

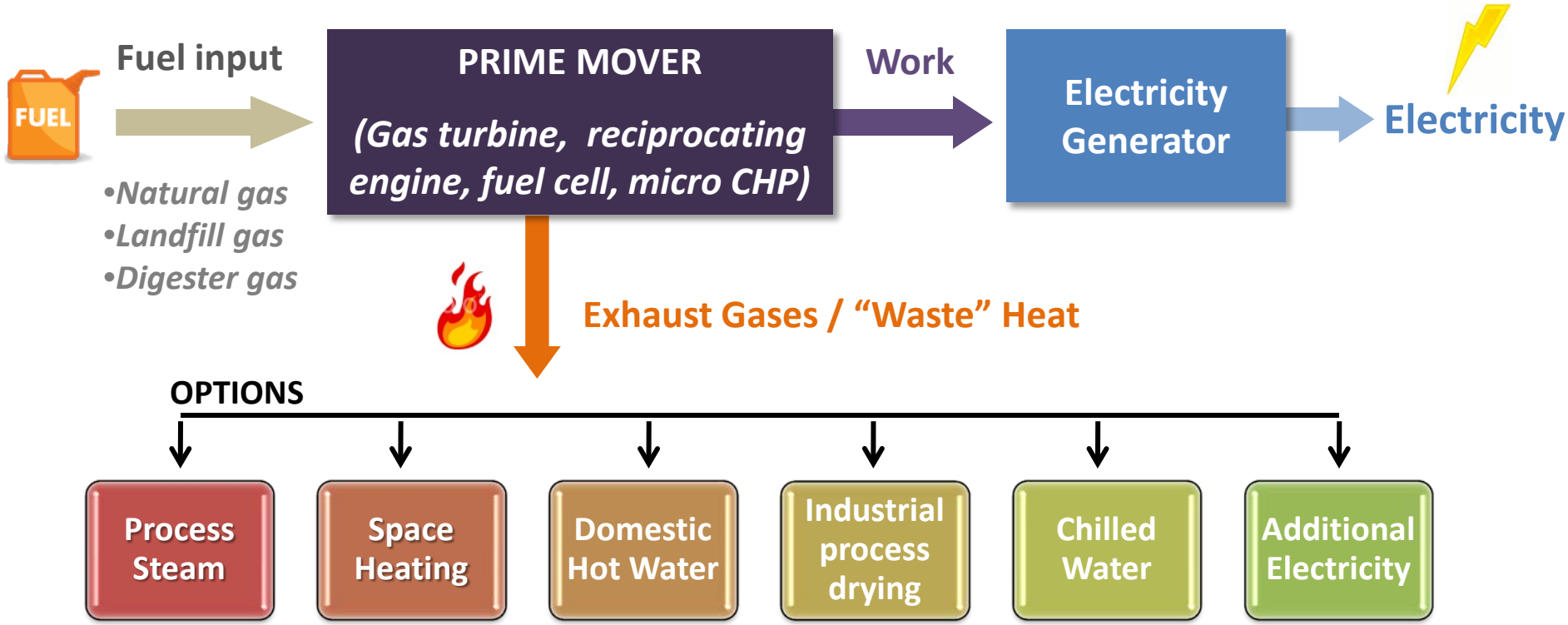
Source: Bullock and Cauduro, "Texas Power Crunch..." COSPP Magazine (Jan./Feb. 2012)

Cumulative CHP Capacity in Texas:
Past, present, and projected



CHP Overview

Thermal energy and electricity are generated



CHP Overview

A variety of technologies, fuels, and applications are possible.

Gas Turbine

Reciprocating Engine

Fuel Cell

CHP Overview

A variety of technologies, fuels, and applications are possible

Industrial

Commercial

Institutional

Residential

Implementation

Best User Profile

- Good coincidence between electric and thermal needs
- Favorable spark spread
  - Large cost differential between utility's electricity prices and CHP fuel costs
- Long operating hours
- Central heating/cooling system
- Renovation and/or expansion of existing facilities
- Economic value of power reliability is high

Markets

INSTITUTIONAL (~5-75 MW)

- Universities
- Hospitals
- Wastewater treatment
- Emergency management facilities
- Homeland security and sanctuary sites
- Prisons

Markets

OFFICE BUILDING: BP Helios Plaza data center *(Houston, TX)*

- **4.3 MW CHP Plant**
  - Gas Turbine
  - Heat Recovery Steam Generator
  - 1350 ton absorption chiller
  - 4,000 ton-hr thermal energy storage
- **Dual electrical feeds**
  - Base load from Gas Turbine
  - 100 kW from utility
- **First LEED Platinum Bldg - Houston**

Markets

INSTITUTIONAL: The University of Texas *(Austin, TX)*

- **137 MW (65 MW peak) natural gas CHP**
  - 2 gas turbines – 77MW
  - 4 steam turbines – 62MW
  - 4 chiller plants – 48,000 tons
  - TES tank – 4 million gallons
  - 90+% efficiency
  - 99.9998% reliability in last 35 years

- **Emissions**
  - Eliminates 91,267 tons/yr.
  - Carbon emission levels reduced to 1977 levels despite 89% increase in campus size and load

Markets

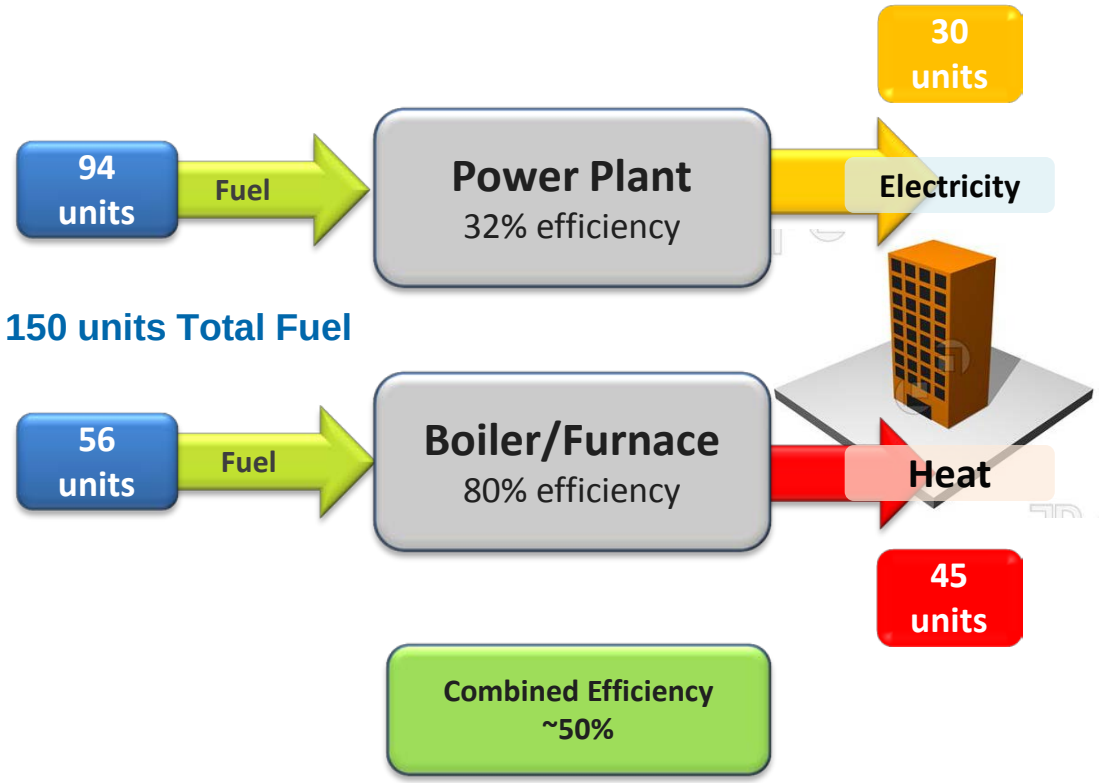
EMERGING – Small (50-1,000 kW) and Micro -CHP* (< 50 kW)

- Homes
- Small office buildings
- Rural hospitals
- Health Clubs
- High Schools
- Grocery Stores
- Hotels
- Prisons

ASHRAE definition for micro-CHP is less than 50 kW:
http://spc204.ashraepcs.org/

Benefits | EFFICIENCY

CHP recaptures much of that heat, increasing overall efficiency of energy services …



Benefits | EFFICIENCY

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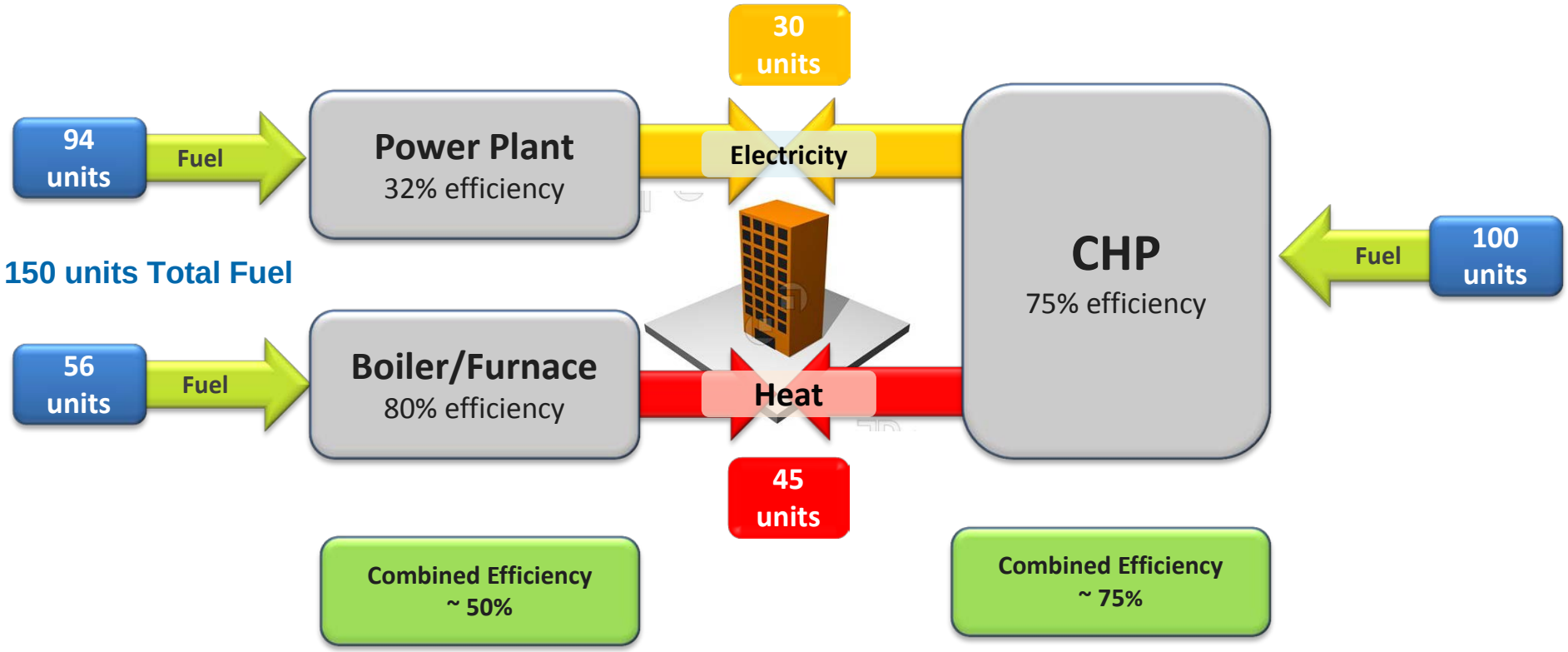
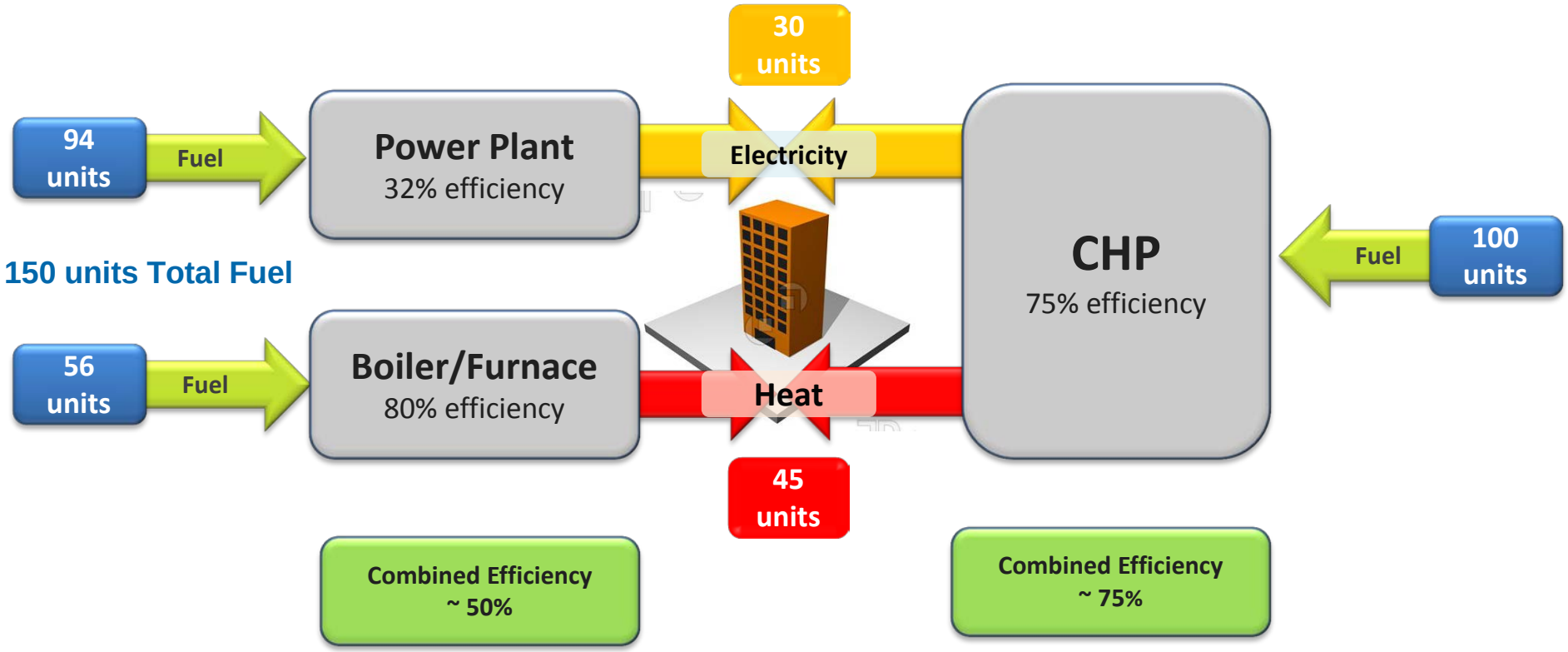


Benefits | EFFICIENCY

… and reducing greenhouse gas emissions



30 to 55% less greenhouse gas emissions

Benefits | ENERGY SECURITY

CASE STUDY: Mississippi Baptist Medical Center (Jackson, MS)

- 624 bed urban hospital, 3000 employees
- 3.2 MW gas turbine CHP system – installed 1994
- Steam used for hot water, sterilization and absorption chillers
- Grid down for 52 hours starting August 29, 2005 due to Katrina
- CHP system ran islanded and provided power, hot water and air conditioning

CHP Application : Houston Hotel

- Current Energy Consumption
  - Electricity
    - 1,000 MW summer peak load
    - 5765 MWh annually
  - Natural Gas
    - 13,400 MMBtu annually
- Current Energy Costs
  - Electricity: $436,000
  - Natural Gas: $84,000
  - Total Cost: $520,000

CHP Solution

- Design Strategy is to meet 100% of annual electricity and thermal loads
- CHP Equipment
  - 800 kW pre-packaged recip. engines (2 x 400 kW)
  - 143 ton absorption chiller
- CHP on-site energy production
  - 5215 MWh + 567 MWh = 5,782 MWh
  - 13,400 MMBtu

Utility Cost Savings

Total Electric Cost w/o CHP	$436,000
Total Electric Cost with CHP	$23,000
Change in Electric Cost	$413,000
Total Gas Cost w/o CHP	$84,000
Total Gas Cost with CHP	$163,000 ($6.26 to $3.5/MMBtu)
Change in Gas Cost	$79,000
Gross Savings from CHP	$334,000

Simple Payback

- Gross Savings $334,000
- O&M Expense $100,000
- Net Savings $234,000

- Capital Cost $1,500,000

- Simple payback 6.4 yrs

- LoanStar Payment $175,000 year (3%, 10 years)

- Note: Financials improve when accounting for incentives and tax benefits such as Investment Tax Credit (ITC), Depreciation, EEIP/Utility SOP, ERCOT ERS, MCPE sales

Resources

U.S. DOE Gulf Coast Clean Energy Application Center
www.gulfcoastcleanenergy.org

U.S. Department of Energy CHP Program
www.eere.energy.gov/de/

U.S. Environmental Protection Agency CHP Partnership
www.epa.gov/chp

Texas CHP Initiative (TXCHPI)
www.txchpi.org

U.S. Clean Heat and Power Association (USCHPA)
http://uschpa.admgt.com

International District Energy Association (IDEA)
www.districtenergy.org

Save the Date!

COGENERATION • TRIGENERATION • WASTE HEAT RECOVERY

CHP2012

COMBINED HEAT AND POWER

CONFERENCE & TRADE SHOW

October 15-16

Houston, Texas

U.S. Department of Energy
Gulf Coast Clean Energy Application Center

Contact

U.S. Department of Energy

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