System Optimization

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2006 Energy

Burns & McDonnell
SINCE 1898

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CHP It's time

System Optimization

Body Shop: Building Strategies

Op·ti·mize

To make the most of;

develop or realize to the utmost extent;

obtain the most efficient or optimal use of – optimization *BINGO!*

Types of Systems

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- Energy Plant *(generation)*
  - Chillers, boilers, air compressors
- Interconnects *(distribution)*
  - Pumps, supply and return piping
- Buildings *(demand)*
  - Pumping, HVAC, controls

System Efficiency

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Equipment efficiency + pumping efficiency + building efficiency + controls + operations…

Each can dramatically effect the *efficiency* of the overall system.

Cost of Generation - Traditional Power Delivery

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1 BTU In

.65 BTU Loss

.35 BTU In

.06 BTU Loss

.29 BTU In

Power Plant: About 35% of BTU input converts to electricity (65% wasted!!)

Transmission and distribution system loses about 6%.

About 29% of all power input at the power plant is delivered to the customer.

Integrated Energy System - Conservation and Delivery

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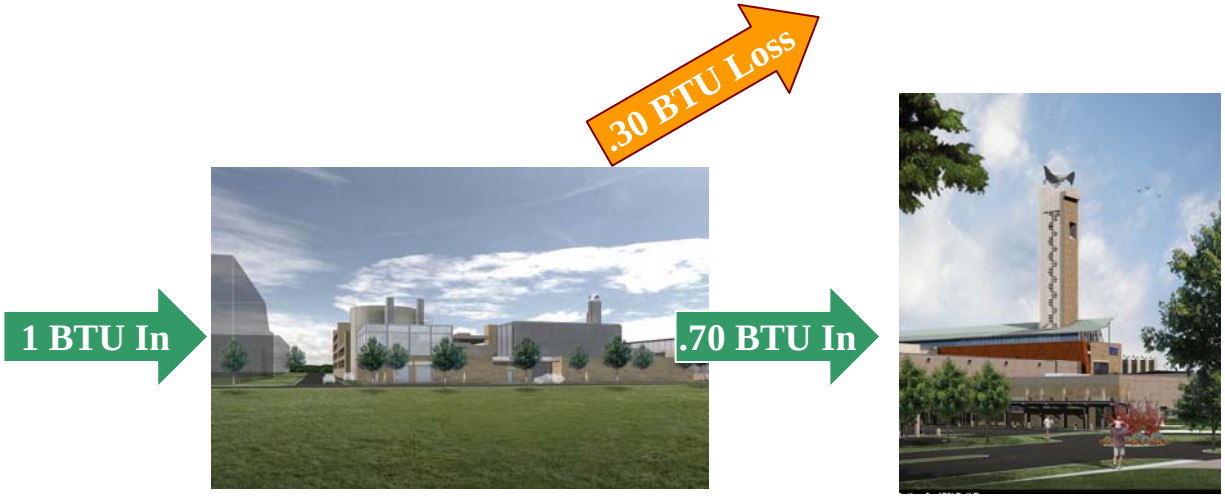

IES Plant **End User**

IES can be 70% *efficient at primary fuel conversion to useful energy.*

As a result, emissions are less also reduced by 70% ***and even further***, due to the equipment itself, which produce lower emissions than most State emissions standards.

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Four cost components of *hydronic* efficiency

1. Cost of *energy*
2. Cost of *generation* – kW/BTU
3. Cost of *distribution* – GPM/BTU
4. Cost of *demand* – CFM/BTU

What is an Integrated Energy System?

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Integrated Energy System

- combinations of dissimilar subsystems designed or assembled so they work together with *higher efficiency* and/or *lower cost* than they would operate individually

Packaged Modular IES Energy Plant – Overview

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- Packaged hybrid IES energy plant is comprised of modules or standard pre-manufactured components
- B&McD provided system integration such that all modules or components operate seamlessly
- GOAL: Improved reliability, flexibility, efficiency with reduced installation cost and schedule

DOE IES Demonstration Project – Case Study

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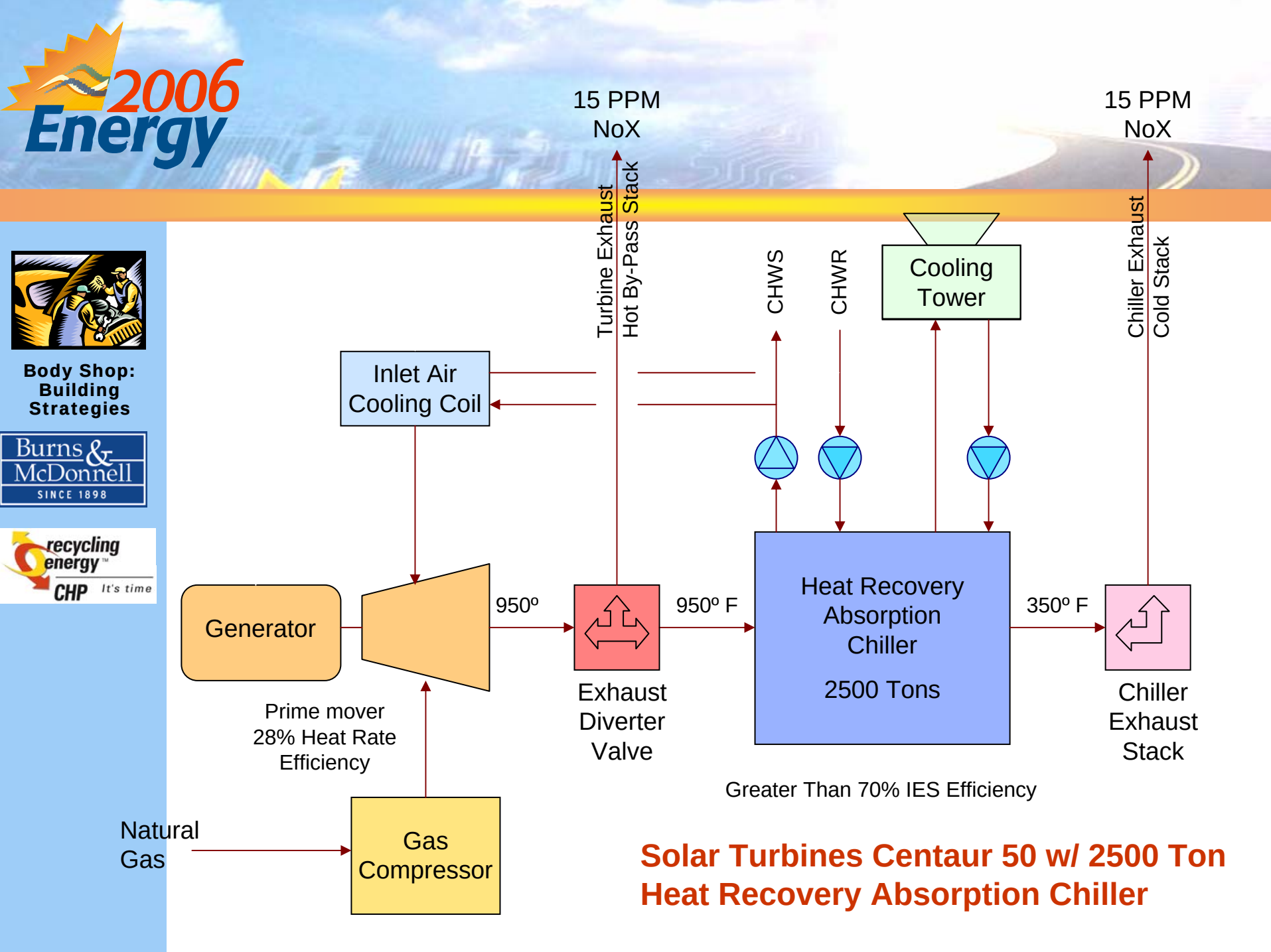
4.5 MW Combustion Turbine Generator Module

Turbine Exhaust Diverter Valve Module

Heat Recovery Absorption Chiller & Exhaust Module

Inlet Cooling Module

Condenser Water Pump & CHP Control Room Module



Solar Turbines Centaur 50 w/ 2500 Ton Heat Recovery Absorption Chiller

DOE IES Demonstrated Improved System Efficiency

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Integrated energy systems can provide combined efficiencies greater than those of the individual components

Turbine-Generator Site Output	4,329 kWe*
Chilled-Water Production	2,632 tons at 44 F
Turbine Fuel Consumption	51.7 MMBtu/hr (LHV)
Fuel-Gas Compressor Load	89 kWe
Turbine Parasitic Loads	5 kWe
Chiller Parasitic Loads	37 kWe
Overall Net Plant Efficiency	88.8% (LHV)
Overall Net Plant Efficiency	80.4% (HHV)
Chiller COP	1.35

*Full-load continuous duty rating *Source:* Burns & McDonnell

DCMCCT IES Demonstration Project – Case Study

1500 Ton Packaged Chiller Plant Module

1.5 MW Emergency Engine Generator Module

Distribution Pump Skid Modules

4.3 MW Combustion Turbine Generator Module

DCMCCT IES Hybrid Energy Plant – Modular Components

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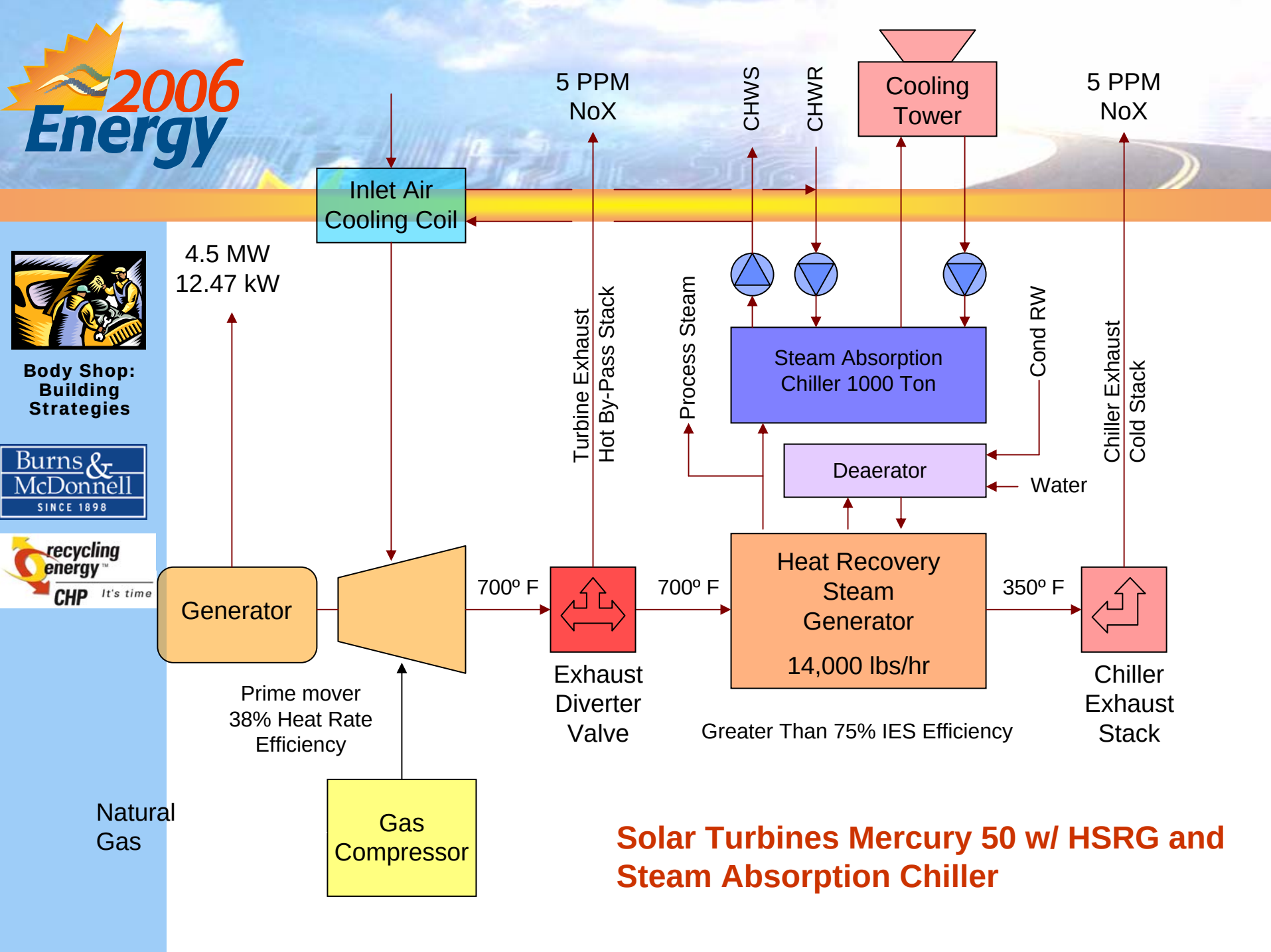
- Natural Gas Compressor
- 4.3 MW Combustion Turbine – Mercury 50
- Turbine Exhaust Diverter Valve
- Heat Recovery Steam Generator - w/burner
- Thermal Device Exhaust Stack
- Steam Absorption Chiller – 1000 ton
- Chiller Water Primary and Secondary Pumps
- Packaged Electrical Centrifugal Duplex Chiller Plant – 1500 ton
- Packaged Boiler – 20000 lbs/hr
- Thermal Energy Storage Tank – 8000 ton-hours
- Black Start Engine Generator – 1500 kW



Solar Turbines Mercury 50 w/ HSRG and Steam Absorption Chiller

Optimization Summary

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1. It is possible to integrate individual components and get *higher system efficiencies* than the efficiency of individual components

2. In order to optimize efficiency, you need to take in consideration the *entire* system – *generation, distribution, and demand*

Thank you for your attention!

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