Body Shop: Building Strategies

Combined Heat and Power: Enhancing Power Reliability While Reducing Operating Costs

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Combined Heat and Power (CHP)

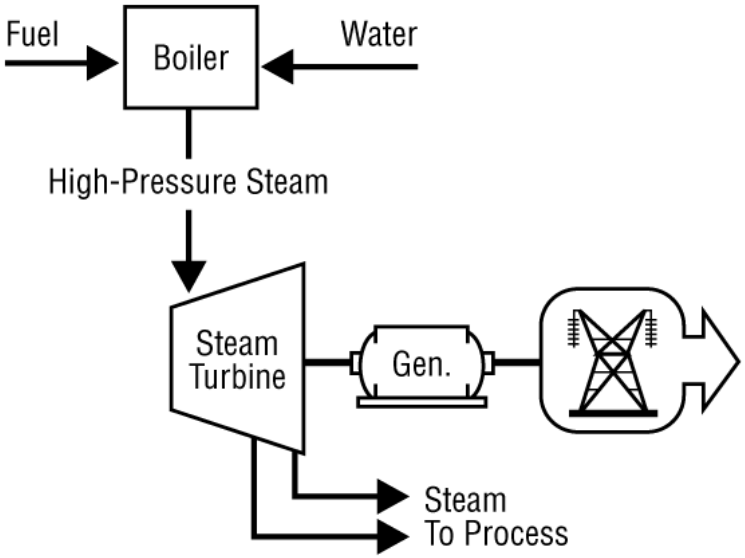
A Form of Distributed Generation

CHP is:

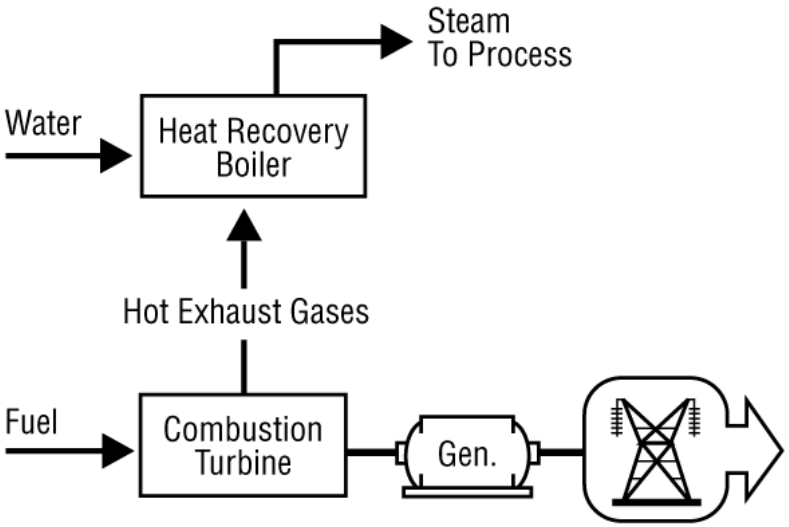
- An integrated system
- Located at or near a building/facility
- Provides at least a portion of the electrical load, and
- Recycles the waste heat:
  - Heating
  - Cooling
  - Dehumidification

Typical CHP Systems

Steam Boiler/Steam Turbine:



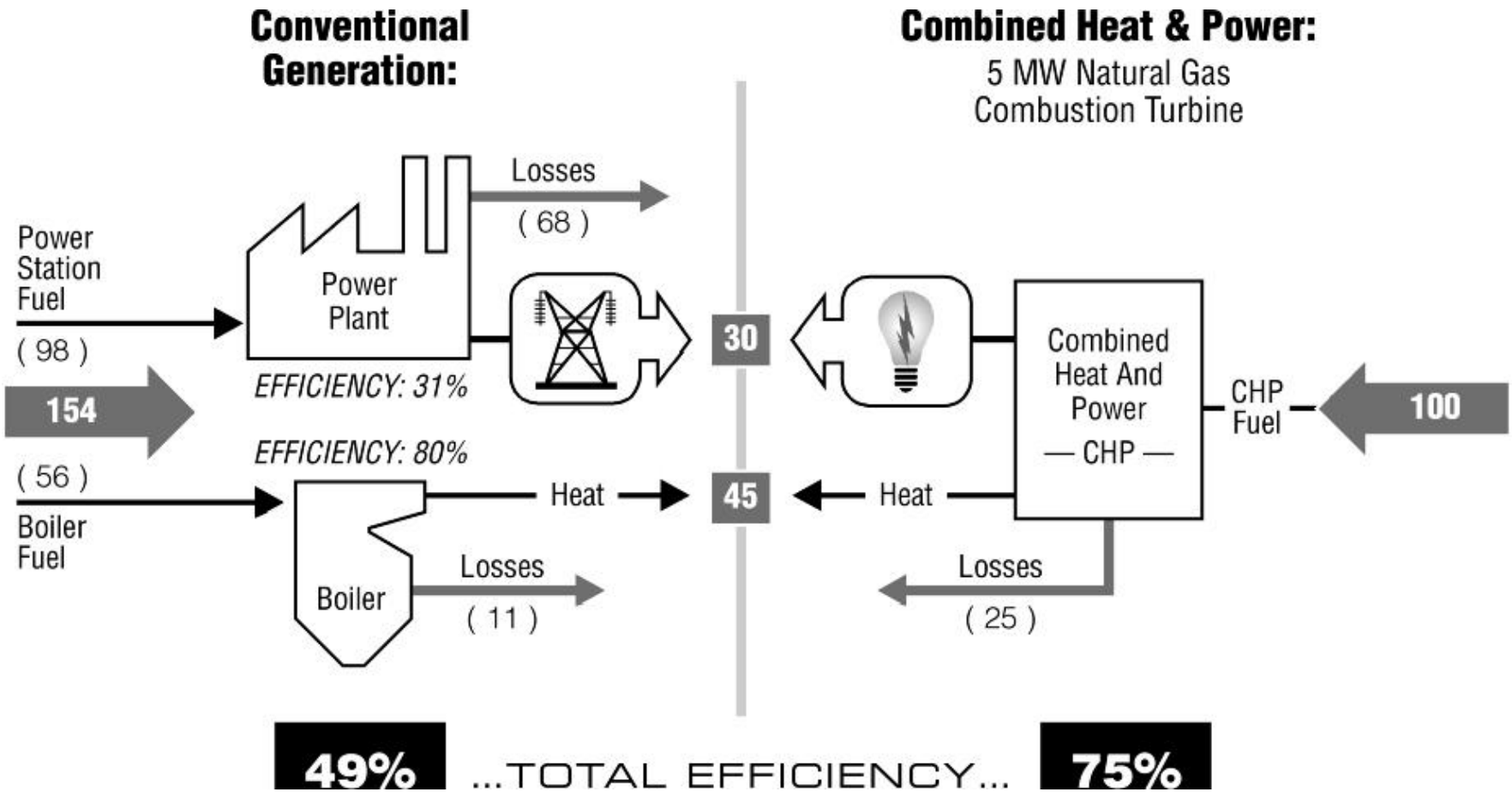
Gas Turbine or Engine/Heat Recovery Unit:



CHP Value Proposition

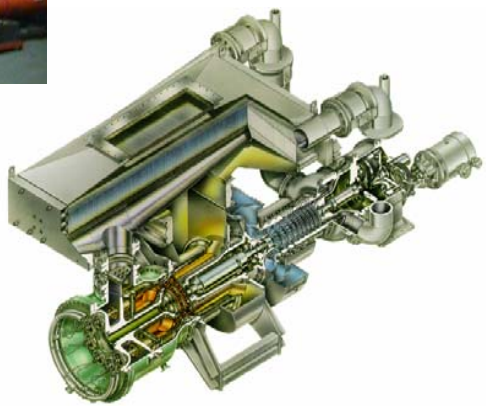
- CHP is *more efficient* than separate generation of electricity and heat.
- Higher efficiency translates to *lower operating cost,* but requires capital investment.
- Higher efficiency *reduces emissions of all pollutants*.
- Can also significantly *enhance power reliability*.

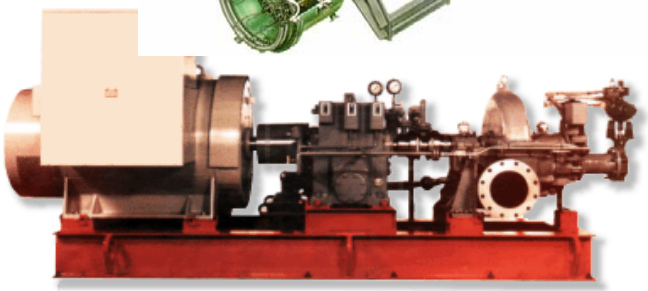
Efficiency Advantages of CHP



Examples of CHP Technologies

- Reciprocating engines
- Gas turbines
- Microturbines
- Fuel Cells
- Steam turbines
- Organic Rankine Cycles
- Stirling engines
- Supporting systems





Maintaining Reliable Power Supplies Is an Increasing Concern

- Increased incidences of Grid outages
- More intense and more frequent weather events
- Susceptibility to terrorism and other man-made disturbances
- Consequences for health and safety, and for business continuity

What Is Reliability

- Reliability is defined as how often and how long the electric power service is interrupted
- Momentary interruptions – lasting less than 2 to 5 minutes
- Sustained interruptions – lasting more than 5 minutes

How Does CHP Enhance Reliability?

- Already up and running at time of outage
- Can provide seamless load support during momentary interruptions
- Can maintain critical building or life support loads during sustained interruptions
- Provides a positive return on investment in assets
- Can stabilize local grid on “design days”

Typical CHP Configuration

- CHP systems are normally installed in parallel with the grid (CHP does not replace the grid)
- Both the CHP system and Grid supply power to the site
- Ability to operate with the grid down and how the system transitions depends on generator, controls and interconnection configuration

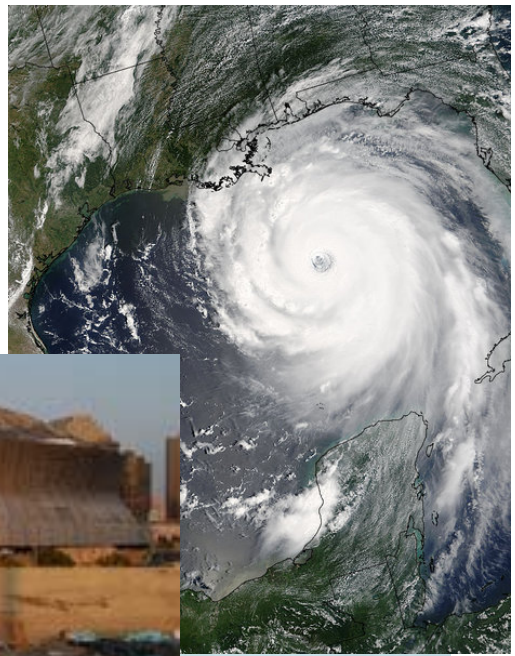
CHP Options for Enhanced Reliability

- Standard back-up (up and running after several minute interruption)
- Load shedding (10-30 cycles)
- Critical load support (3 to 5 cycles)
- UPS/CHP hybrid (seamless)

Best approach dependent on site characteristics, utility standards and customer needs

Examples of CHP in Energy Emergency Situations

August 2005 – Hurricane Katrina



Baptist Medical Center, Jackson, Mississippi

- 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

MBMC Response to Katrina

August 29, 2005
Hurricane Katrina
Hits Jackson, MS

-Connection to MPG Restored
-Load Shed performed (1.2 MW disconnected)
-Pumping Trucks Supply Water to Physical Plant

- Connection to MPG Restored

3 hr

57 hr

1 hr

5 hr

-Main Power Grid (MPG) Failed
-Alternate Power Grid Enabled
-City Water Lost

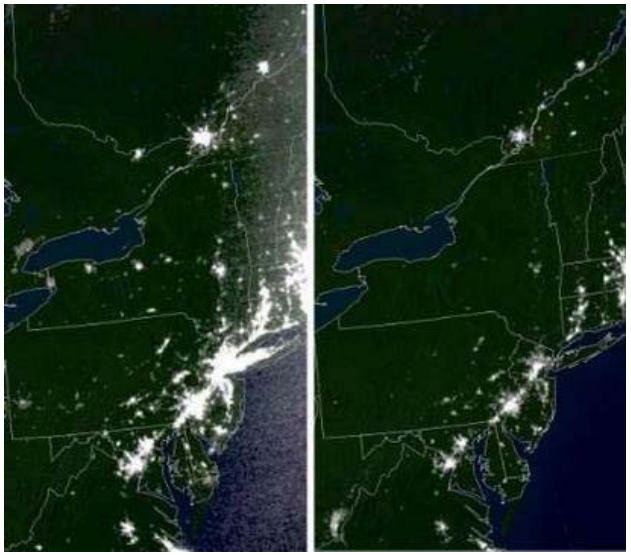
- 52 hrs of 100% operation on CHP
- Only Hospital in the Jackson Metro Area to be Nearly 100% Operational!!

-Power Reliability Problems
-Switched to CHP Operation Only
-Elevators on Emergency Generators
-Restricted use of MRI Equipment

The Value of CHP at Mississippi Baptist Medical Center

- Remained open and treated a high volume of patients
- Provided clothing, food and housing for displaced citizens during first night of the disaster
- Opened a round-the-clock day care center to allow employees to focus on patient care

The August 2003 Blackout



- Affected portions of the Midwest, Northeast, and Ontario, Canada
- Ohio, Michigan, New York, New Jersey, Pennsylvania, and Connecticut
- Power out for up to four days in some locations
- Over 50 million people affected

Traditional Emergency Generators Had Problems

- "Half of New York City's 58 hospitals suffered backup power failures during the blackout" – *New York Times, 8/16/2003*
- "Lack of backup power allowed 145 million gallons of raw sewage to be released from a Manhattan pumping station" – *Times Union, 8/29/2003*
- "Jail's emergency generator fails during blackout, again…" – *Times Union, 8/16/2003*
- "Generator failures at a Verizon office …caused communications gaps for 911 dispatchers…" – *Daily News, 8/17/2003*

Example CHP System Operations During the Blackout

- Montefiore Medical Center; New York City
  - Site down for 5 minutes, then fully operational throughout the duration of the outage
- Parke-Davis Pharmaceutical; Rochester, MI
  - CHP trips off line at first, shortly restored and operated successfully throughout the outage
- Spring Creek Towers, New York City
  - Independent of grid, never lost power and was able to provide for some needs of the community
- South Oaks Hospital, Amityville, NY
  - Seamless transfer to CHP system only; staff unaware of blackout until police call

The Type of Generator Is Important

Induction

- Requires external power source to operate (Grid)
- **When Grid goes down, CHP system goes down**
- Less complicated and less costly to interconnect
- Preferred by utilities

Synchronous

- Self excited (does not need Grid to operate)
- **CHP system can continue to operate thru Grid outages**
- More complicated and costly to interconnect (safety)
- Preferred by CHP users
- **Provides resilience for the customer (stay on-line**)

Requirements for Power Assurance with CHP

- Configured with synchronous (not induction) generators
- Grid-connected with stand-alone capabilities
  - Parallel to grid during normal operations
  - Ability to disconnect from grid and operate in an island mode when grid is down
- Sized to handle all or a major portion of the facility's electric loads

Requirements for Power Assurance with CHP

- Have “black start” capability (if CHP system shuts down when grid is down, it can restart without need for grid power)
- Have a continuous source of fuel (usually natural gas or dual fueled – natural gas and/or fuel oil)
- Recycle the waste heat for space heating, cooling and/or dehumidification

CHP Is a Competitive Alternative to Traditional Power Reliability Solutions

- Active CHP system is more reliable than a standby diesel generator
- More effective than dual feeds in a system-wide grid failure
- Flexible architecture to meet end-users' needs
- Provides a positive return on assets

Questions?

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