

# CHP BASICS + RESOURCES

Tom Broderick

Intermountain CHP Center

[tbroderick@swenergy.org](mailto:tbroderick@swenergy.org)

928-527-8036



WELCOME  
COMBINED HEAT AND POWER  
WORKSHOP  
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SOUTHWEST GAS  
INTERMOUNTAIN CHP CENTER  
DEAA

# Intermountain CHP Center

- One of 8 regional centers
- Serves 5 states-AZ, NM, CO, UT, WY
- Funded primarily from US DOE to promote and provide information on CHP

# Intermountain CHP Center

- Analyze projects, technology, applications
- Case studies and project database
- Workshops
- Technical Briefs, Application Guides
- Facilitate local industry communication
- Information input to regulatory actions and policy development
- Website: [www.intermountainchp.org](http://www.intermountainchp.org)

# CHP BASICS

Combined Heat and Power (CHP)

Simultaneous Production of

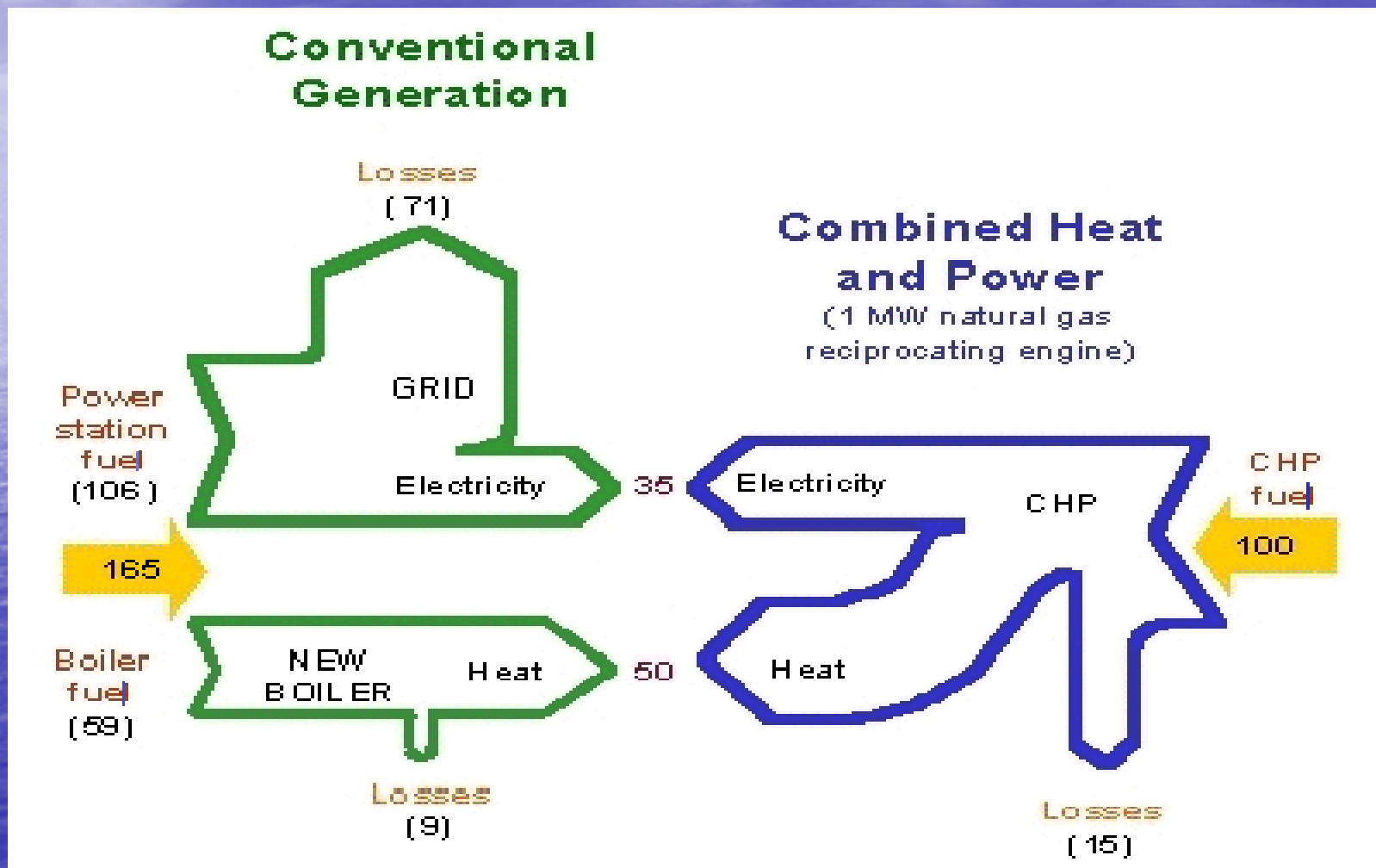
Electricity/Mechanical Power and Heat

- Benefits: Global (energy policy) and End User (economic + other)
- Technologies
- Characteristics of favorable sites
- Evaluation steps

# CHP Benefits-Energy Policy

- Higher Efficiency of fuel usage
  - Up to 85% w/CHP
    - Eliminate transmission & distribution losses (~6%)
  - About 50% with conventional electric generation combined with local boiler
    - Base-load coal generation ~ 33%
    - Combined-cycle natural gas generation 45-50%
    - Boiler 80-92%

# CHP System Efficiency



# CHP Benefits-Energy Policy

- Emissions reduction
  - Over 50% reduction of CO<sub>2</sub> to provide same electricity and thermal outputs
  - Other emissions also reduced due to efficiency
  - EPA CHP Partnership developed an Emissions Calculator-rigorous, but easy to use, emissions benefit calculator
    - [www.epa.gov/chp](http://www.epa.gov/chp)

# CHP Benefits-User

- Energy Savings
- Reliability/Security of electric supply
- Power Quality

# CHP Fuels

- Traditionally, natural gas
- In West, with low coal-based electricity and rising gas prices, other fuels possible
- “Opportunity fuels”: non-traditional fuels usually a by-product or waste product
  - Example: wood waste from forests or sawmills, industrial compounds with energy content, but little other value

# CHP Equipment Types

- Engines (generation or direct drive)
- Gas Turbines (generation or direct drive)
- Steam Turbines (generation or direct drive)
- Microturbines \*
- Fuel Cells \*

\* Not eligible for Southwest Gas program

# CHP Equipment Types

- Engines 200 kW to 2000 kW
  - Electrical efficiency: 24-38%
  - Heat produced: 4-5000 BtuH/kW
  - Load-follows well
  - Good match for under 200F heating loads

# CHP Equipment Types

- Gas Turbines 1,000 kW- 50,000 kW
  - Electrical efficiency: 24-36%
  - Heat produced: 5-6000 BtuH/kW
  - A little more heat, a little less electricity
  - Better match for steady base loads
  - Good match for steam heating loads
  - Lower capital and operating cost than engines

# CHP Equipment Types

- Steam Turbines 200 kW to 10,000 kW
  - Electrical efficiency: 15-40%
    - Condensing higher, backpressure lower
  - Heat produced: Varies widely
  - Load-follows well
  - Good match for existing steam system or when fuels are combusted in boiler (Need high pressure steam.)

# CHP Equipment Types

- Microturbines 30 kW to 200 kW
  - Electrical efficiency 25-30%
  - Heat produced 6-7000 BtuH/kW
  - A little more heat, a little less electricity than turbines or engines
  - Good match for hot water heating loads
  - Higher capital cost per kW, similar operating cost to engines

# CHP Equipment Types

- Fuel Cells 5 kW to over 1000 kW
  - Electrical efficiency 33-60%
  - Heat produced varies
  - No combustion, very low emissions
  - Very expensive, 3 times capital cost of engines/turbines

# CHP Applications

- Two major characteristics of favorable applications for CHP
  1. High electric costs compared to CHP fuel cost
    - Large "Spark Spread"
  2. CHP waste heat is usable through nearly all the year

# CHP Evaluations

- Initial Screening
- Detailed Screening
- Engineering

# CHP Evaluations

- Initial Screening
  - Determine whether “peak shaving” or “base load” operation is more favorable
    - Based on CHP fuel cost, electric energy (not demand) cost, and maintenance
  - Select largest CHP system sized for high utilization for electric and thermal loads
  - Estimate operating costs and savings, capital costs

# CHP Evaluations

- Initial Screening (con't)
  - Qualitatively value other benefits
    - Reliability, emissions reductions, power quality
  - Screen in or out for further analysis

# CHP Evaluations

- Detailed Screening
  - Can be done in multiple steps, with progressively more detailed and site-specific inputs
  - More accurately specify:
    - Load profiles, operating schedule, operating costs and savings, capital costs, non-economic benefits
  - Sensitivity and risk analysis on assumptions

# CHP Evaluations

- Detailed Engineering
  - If detailed screening indicates favorable project, then expense of detailed engineering makes sense
  - Confirms or alters detailed screening
  - Produces drawings and specifications for bids

# CHP Resources

- Intermountain CHP Center
- Southwest Gas
- CHP Resource Guide-Midwest CHP Center  
[www.chpcentermw.org](http://www.chpcentermw.org)
- US EPA CHP Partnership  
[www.epa.gov/chp](http://www.epa.gov/chp)
- USCHPA [www.uschpa.org](http://www.uschpa.org)