Onsite Power Generation

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Why Combined Heat & Power?

- Separate production of power and heat is not efficient
  - Conventional system – 45% to 65% efficient
  - CHP systems – Greater than 80%
- Economics
  - Lower utility cost
  - Operational savings and budget stability
- Security of Supply
  - Reduce disturbances and improve power system quality
  - Improve reliability and meet redundancy requirements
- Environmental
  - Environmental sensitivity and compliance
  - Reduce carbon footprint and emissions

Design Considerations

- Power density and utilization factors
- Load profile
  - One shift, two shifts, 24 hours
  - 5 day week, 7 day week
  - Summer, Winter, Shoulder seasons
- Turbines versus Engines
- Thermal end use
  - Steam versus Hot Water
  - Chilled water
- Heat Recovery Systems
  - Fired versus Unfired
- Need for utility upgrades
  - Gas line capacity and pressure
  - Electrical system capacity and interconnection requirements
  - Backup power and standby charges

Case Study 1 – Banking/Data Center
PSECU Headquarters

- Configuration
  - Capstone C800 Microturbine (800 KW)
  - 288 tons of chilled water – direct exhaust fired with gas backup system
  - 5 MMBTU of hot water – winter heating load for remainder of facility
- Drivers
  - Reliability and redundancy
  - Savings
- First 18 months of operation
  - Availability of >95%
  - Payback period
    - Original – payback of less than 6 years
    - Based on 1st year true up – less than 5 years
- Next Steps
  - Evaluating fifth microturbine

Case Study 2 – Higher Education
Messiah College

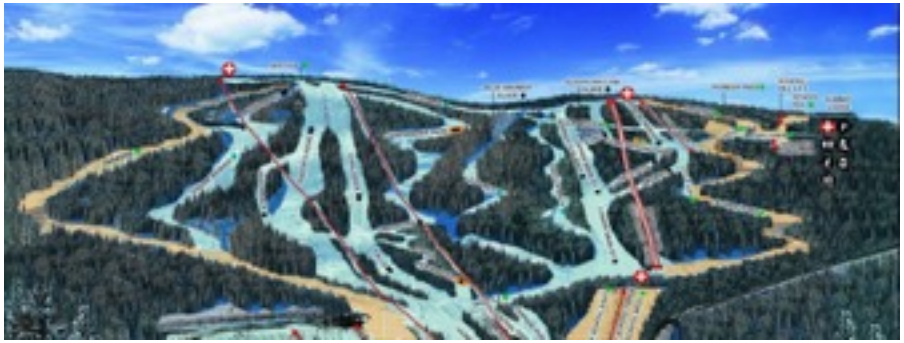
- Configuration
  - Capstone C1000 Microturbine (1 MW)
  - 280 tons of chilled water
  - 5 MMBTU of hot water
- Drivers
  - Natural Gas onsite – eliminate propane
  - Savings
    - $800K per year (original)
    - $1,000K per year (new gas contract)
    - Net metering
  - Safe Haven for students during power outage
  - Currently in Startup and Commissioning

Case Study 3 – Casino

- Configuration
  - Guascor 828 KW IC Engine
  - 4 MMBTU of hot water heat recovery
  - 4 UPS systems to protect slot machines
- Drivers
  - Reliability, outage losses and power quality for slot machines
    - Minor – $15K to $30K / incident (8-10 per year)
    - Major– $80K to $120K / incident (1 every 2-3 years)
  - Savings
    - Utility savings – <4.0 year payback
  - Currently in Construction

Case Study 4 –Ski Resort

- Configuration
  - 3 each 800 KW IC Engine (2.4 MW)
  - 18 MMBTU of hot water
  - Net Metering
- Drivers
  - Natural Gas onsite
  - Electric Savings
    - Winter peak of 13 MW
    - Summer peak of 250 KW
  - Support expansion and being a year round facility
    - Water Park
    - Hotel
  - Currently in design



Case Study 5 –Industrial Properties

- Configuration
  - 1 – 6 MW of CHP generation
  - Multiple units to improve reliability
  - Duct fired HRSG to produce more steam
- Drivers
  - Support expansion and changes to process
  - Saves on new boiler
  - Reduces electric service upgrades from utility
- Currently in design

Final Thought

One CHP client is using 70% more fuel, with no increase in natural gas cost.

1 MW of electricity every hour is free.

Questions and Discussion

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