Commercial Cogeneration

W B Healy
Cogent Energy
Presentation

• What is Cogeneration?
• Cogeneration in the EU
• Cogeneration in Australia
• Commercial Cogeneration not Viable?
• Making Commercial Cogeneration Viable!
• Commercial Building Cogeneration Solution
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• Cogeneration Solution Advantages
• Summary
What is Cogeneration?

- Simultaneous production and use of electricity and heat energy to provide high energy efficiencies (> 80%). In Australia will usually involve an absorption chiller (waste heat chiller) to generate cooling.

- In Europe called “Trigeneration”, CCHP if absorption chiller is involved (electricity, heating and cooling from a single plant).
Cogeneration in the EU

- 2006 penetration of cogeneration in EU at about 14%
  - 6% commercial – includes “district heating”
  - 8% industrial
- Cogeneration target for 2010 set at 20%
Cogeneration in Australia

- 2006 penetration of cogeneration in Australia - 4%.
  - 4.0 % - Industrial
  - 0.1% - Commercial

- Industrial cogeneration in Australia has primarily been developed in the sugar industry – 80%.

- Commercial cogeneration restricted to a few commercial buildings and hospitals in Melbourne and Sydney – but this is starting to change!

So why is commercial cogeneration successful in the EU and not in Australia?
Commercial cogeneration dismissed as a viable source of energy generation in Australia because:

1. High capital cost of installed cogeneration plant,

2. Narrow margin between retail cost of gas and electricity,

3. High ongoing cost of operating and maintaining cogeneration plant, and

4. Inability to get high efficiencies as heat energy cannot be used as effectively as in Europe because most Australian cities require cooling for most months of the year.
Distributed cogeneration network model can be viable for commercial buildings in Australia because:

- Lower plant cost - buying volumes of common “cogeneration modules”.
- Lower gas cost - buying gas wholesale for a number of sites.
- Lower maintenance cost – central maint & ops for a number of sites.
- Recent double effect absorption chiller technology (COP ~ 1.3) means that waste heat can be used more effectively for summer cooling.
Commercial Building Cogeneration Solution

- **cogeneration plant** – for electricity and heat to meet building demand load
- **switch gear** – to distribute energy to building load & switch to grid for back-up/off peak
- **metering equipment** – to record and bill energy usage
- **control equipment** – monitoring & manage plant operations & maintenance
- **absorption chillers** – convert waste heat into cooling
Cogeneration Operation

- Cogen plant will run in grid parallel import mode and operate for the 16 hour peak 5 days a week - operation time about 4,000 hours per year.

- If grid fails, cogen plant will disconnect from grid and operate in island mode.

- Grid will be used for:
  - peak top-up
  - emergency back up if cogen fails during peak period
  - off peak
Cogeneration Plant Operation Profile

Load Profile - Summary

Grid/Engine Split

- Demand Apparent Power - Sliding (Total)
- Demand Reactive Power - Sliding (Total)
- Demand Real Power - Sliding (Total)
- Cogen Total Demand Real Power - Sliding

- Grid - Demand Real Power - Sliding
- Cogen Total Demand Real Power - Sliding
Characteristics of Gas Engines

• Similar technology to diesel engines (from same production line)

• Costs about 2-3 times more than diesel engines

• Less maintenance than diesel engines – gas clearer burning

• Not as load tolerant:
  • Diesel – 60% instantaneous load
  • Gas – 35% instantaneous load

• Similar ventilation, noise, vibration and space requirements

• Environmentally friendly:
  • Grid – 1,300 kg CO2/MWh
  • Gas engine – 500 kg CO2/MWh (assuming about 40% efficiency)
Important Technical Considerations

• Control Considerations
  • Integrated control
  • Parallel import/export operation
  • Load shedding/build-up for island mode operation
  • Plant room auxiliaries
  • Remote monitoring & maintenance

• Grid Considerations
  • grid protection
  • grid synchronization
  • grid fault current – biggest issue today!

• Emergency Back-up Considerations
  • Gas engines don’t have same load capability as diesel engines
  • Main switch boards & BMS will need to be set-up for load build-up & shedding
  • Operate engines below max rated load for building load variation
Potential building owner benefits:

• competitively priced energy

• emergency backup – cogeneration plant uses grid for emergency back-up.

• more efficient energy – improves Green Star rating (1-1.5 stars)

• environment friendly (reduces CO2 emissions) – improves NABERS (1-2 stars)

• minimal capital outlay (if using energy company)

• future proof against emission trading schemes or carbon tax
Summary

• EU has a high penetration of commercial building cogeneration.

• Australia has low penetration of commercial building cogeneration because previous models for implementation have been financially questionable.

• A distributed cogeneration network can achieve economy of scale in cost of plant, gas & maintenance making cogen viable. New absorption chiller technologies also helps.

• Sound benefits for building owner to use commercial cogeneration.