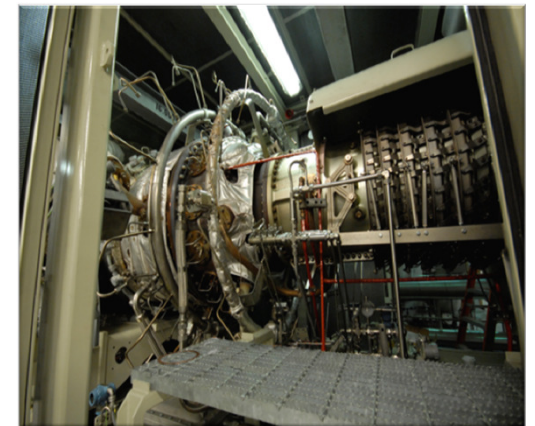


CIBO 34th Annual Meeting

Combined Heat & Power (CHP) Application Panel

October 11, 2012



Panel Introductions

- Paul Howland – University of California/Cal State University - ret (Owner/Operator)
- Leslie Witherspoon – Solar Turbines (Prime Mover Supplier)
- Kevin Slepicka – Rentech Boiler Systems (Boiler/Heat Recovery Steam Generator Supplier)
- Jeff Duncan – Vanderweil Engineers (Engineer/Project Consulting)



Topic – Changing Boiler Operations

- Reasons:
 - MACT
 - Fuel Switching
 - Age / Capacity
 - Reliability Concerns
 - Emissions
 - Operating Costs
 - Asset Location
 - Seismic Upgrade Costs
- **When Faced with Boiler Upgrade or Replacement, What Should an Owner Consider?**



Technology Options

- Business-As-Usual – Steam Production
 - Boiler Replacement
 - Burner/Boiler Modification
 - Do Nothing
- Modify Process Requirements
- Outsource to Third-Party
- Combined Heat & Power (CHP)



Who Should Participate in Decision?

- Organization Senior Leadership
- Facility Management
- Environmental, Health & Safety
- Finance
- Planning
- In-House or Consulting Engineer
- Plant O&M Staff



Drivers for CHP

- Fuel Cost
- Rising Electricity Costs
- Emissions Reductions
- Reduction in Overall Utility Budgets
- Increased Reliability of Electricity Supply
- Flexibility of Energy Production
- Risk Mitigation

Elements in Assessment

- Loads Analysis
- Technology Screening / Selection
- Ownership / Funding Project
- Utility Interconnect/Excess Power Sales
- Environmental Impacts / Permitting
- Fuel Supply & Procurement
- Project Delivery Options
- O&M



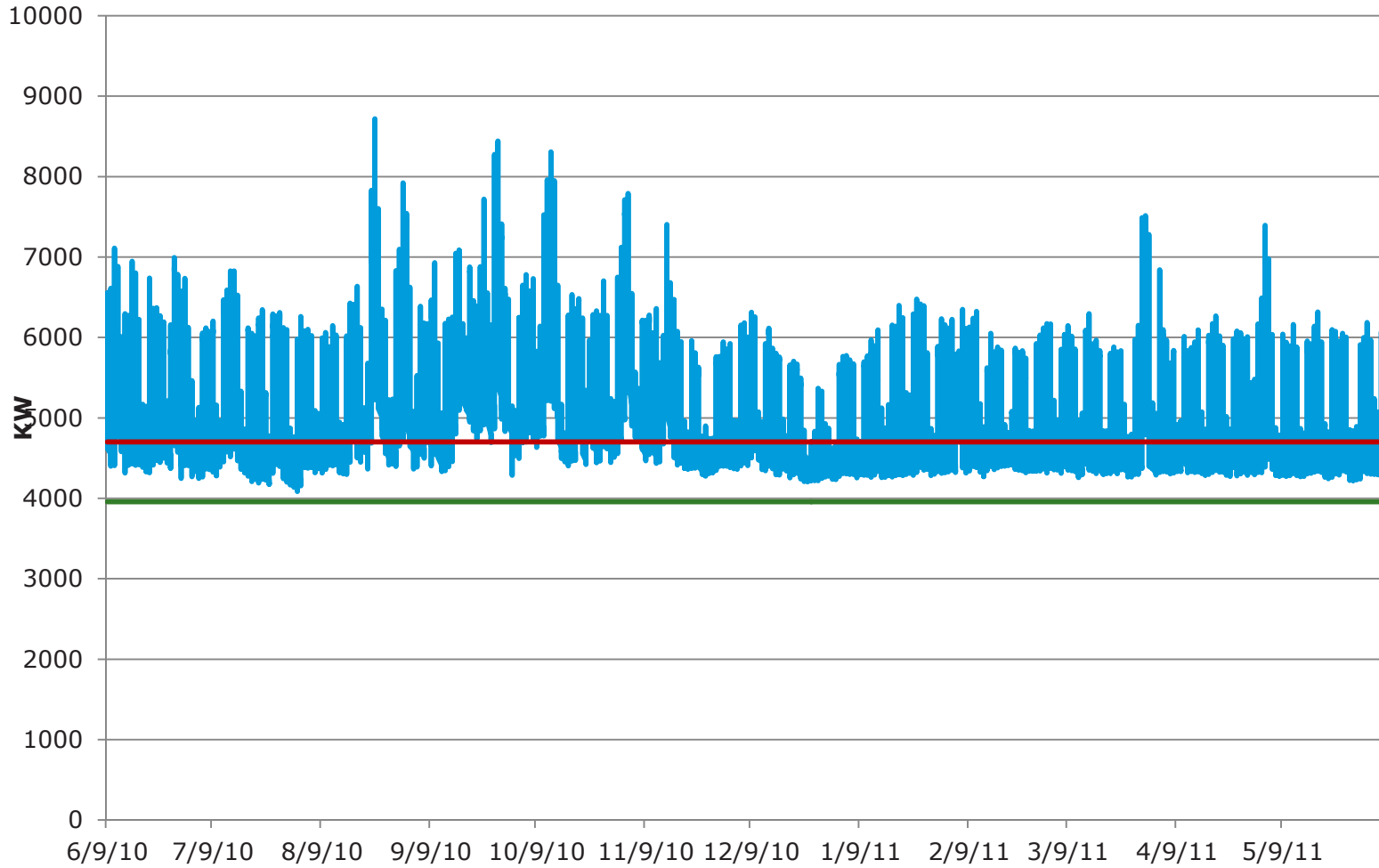
Loads Analysis

- Capture available Load Data
- Metering, if available
- Utility Bills for Electric, Gas (Steam) and Chilled Water, if Applicable
- More data the better, 15 min (8,760)
- Importance of Gathering All Energy Loads
- Diversity – Know yours!



Historical Data

Electrical Demand

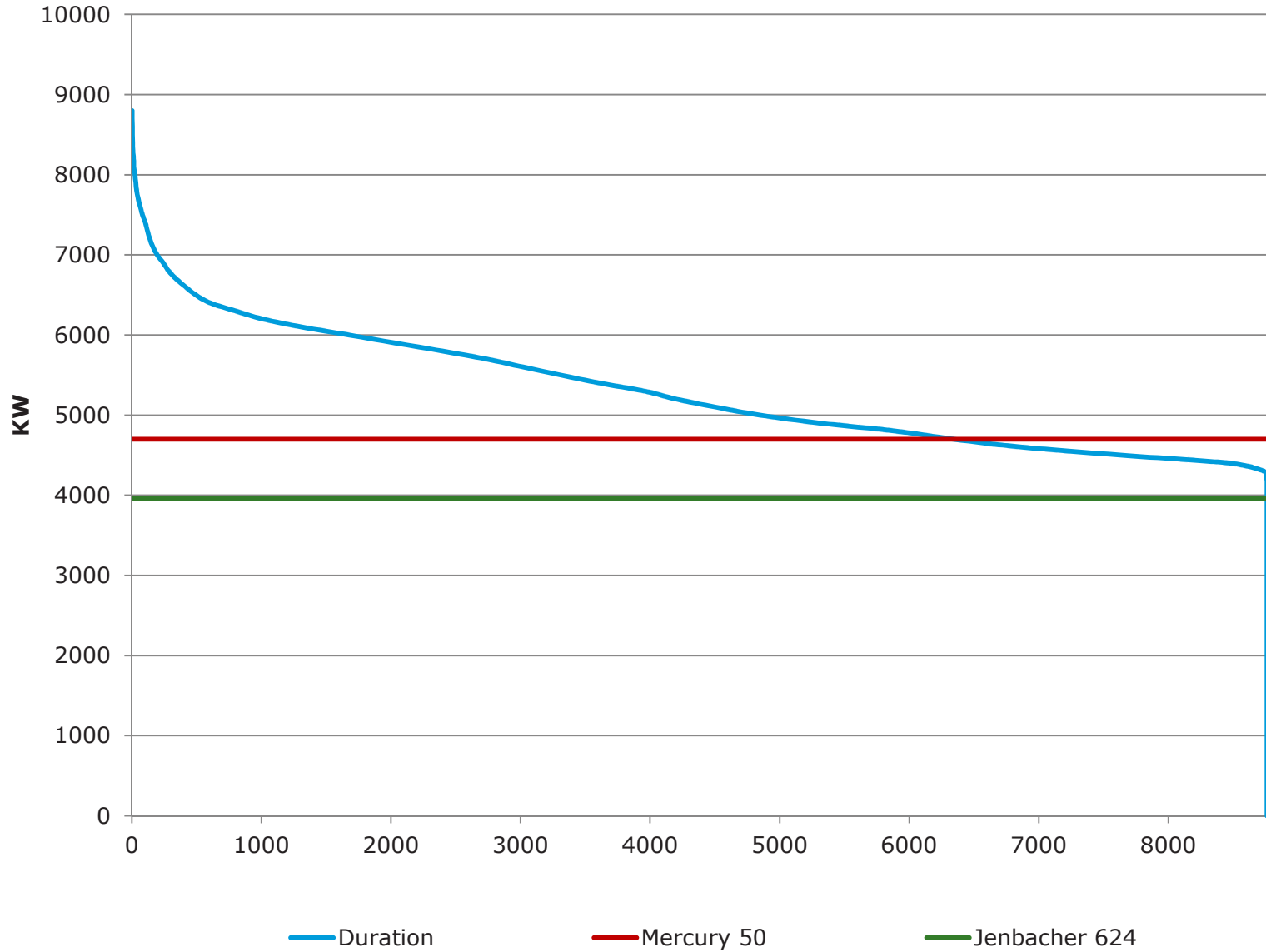


— UCSF Mission Bay Electrical Demand

— Solar Mercury 50 CT

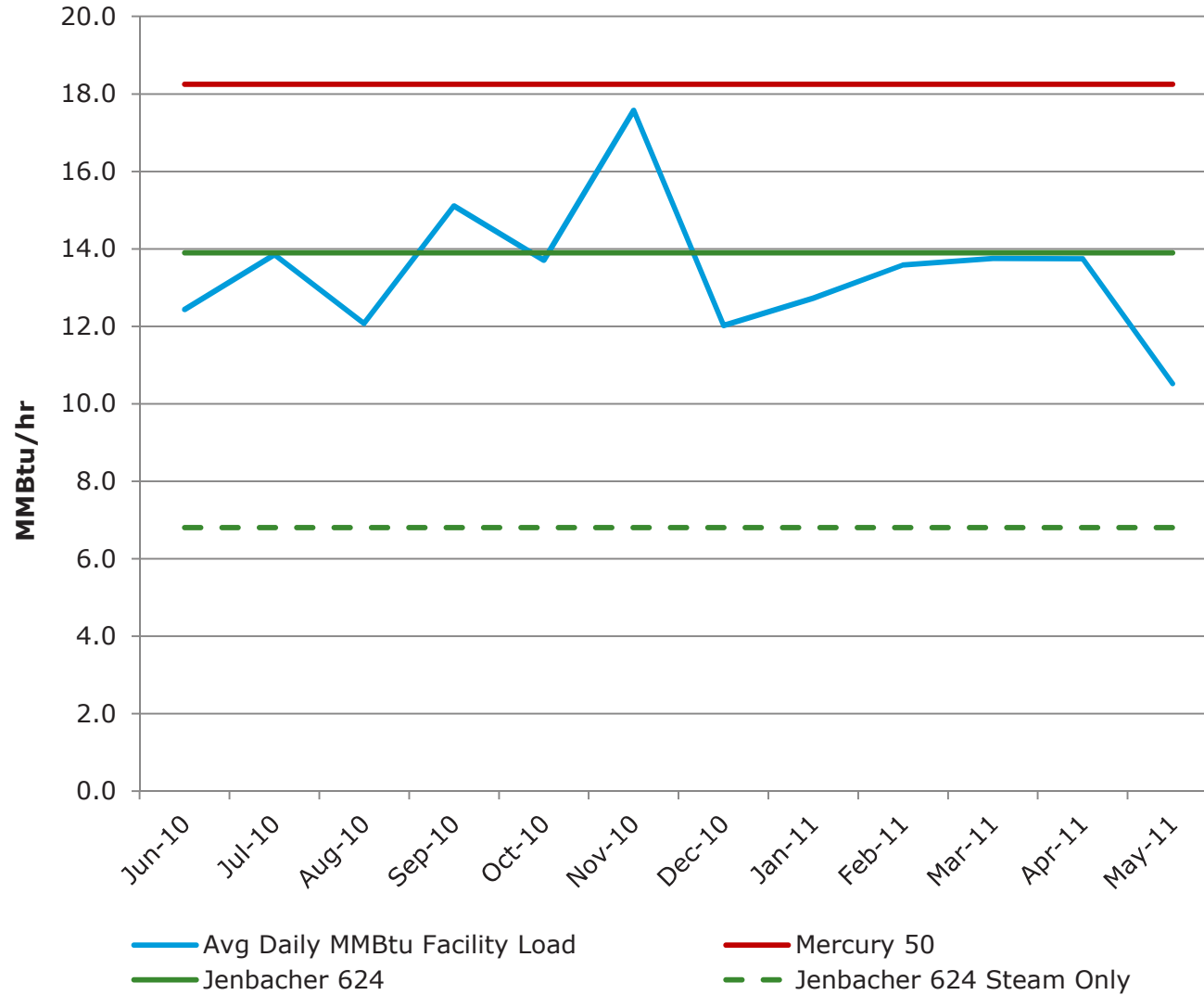
— GE Jenbacher 624

Electrical Usage



Load Charts – Electrical Duration Curve

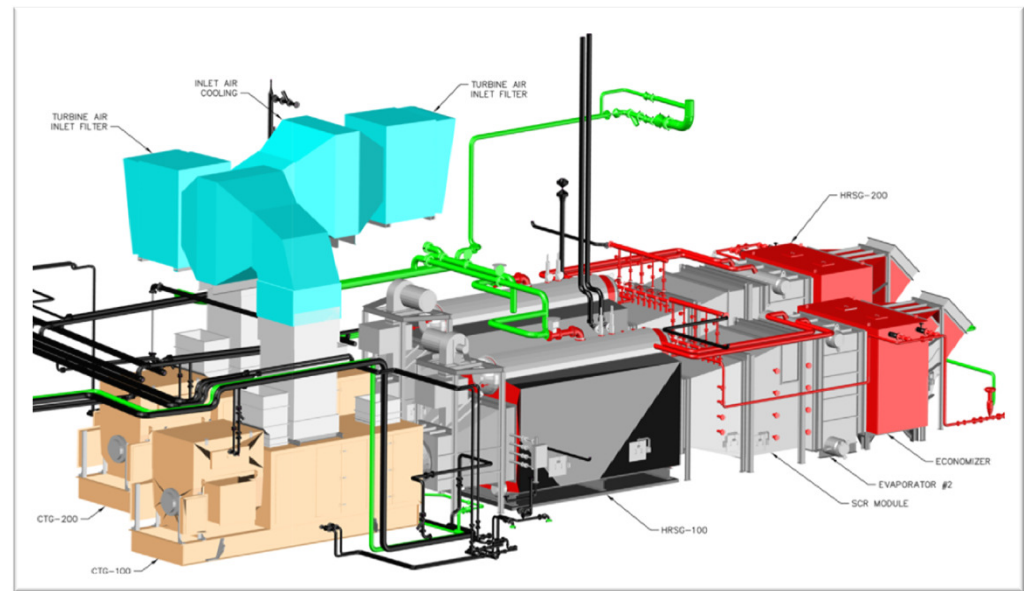
Steam & Hot Water Usage



Load Charts – Steam & Hot Water

Technology Screening


- Boiler with Steam Turbine Generator
- Cogeneration
- Combined-Cycle
- Engines with Waste Heat Recovery
- CHP
- Fuel Cells



Boiler Options

- Stand Alone Fired Boiler
 - HRSG unfired
 - HRSG with duct burners
 - HRSG with fresh air firing
 - Single, Dual and Triple Pressure
 - Space Concerns
 - Emissions Controls & BACT
 - NH₃: Anhydrous, Aqueous or UREA for NOX
 - Optimize Performance to match CTG/STG
-

Funding Considerations

- Owner (vs Third Party) 
 - Internal Funding
 - Project Finance
 - Lease Finance
 - Federal Investment Tax Credits (ITC)
 - CHP Rebates & Utility Incentives
- Asset Monetization of existing assets
- Get Outside Help to evaluate best option
- Develop Project Proforma & Test Sensitivities

Utility Interconnection

- BAU Utility Tariff and Cost
- Interconnect Application Process
- Potential for Excess Power Sales?
- Rate Tariff for Standby Power
- Available Incentives
- Ability to “Island” & Load Shed
- Off-Grid



CHP Permitting

- Solar Turbines Perspectives



Environmental Impacts of CHP

- Burning more fuel
 - The Good:
 - Get more Energy for kW, Steam and Chilled Water
 - More efficient / Lower Cost
 - The Not so Good:
 - More site emissions
- Hazardous Materials
- Water Use
- Sewer Discharge
- Exhaust Gas Dispersion
- CHP Project Example vs Utility



CHP Results



The results generated by the CHP Emissions Calculator are intended for educational and outreach purposes only; it is not designed for use in developing emission inventories or preparing air permit applications.

Annual Emissions Analysis					
	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions/Fuel Reduction	Percent Reduction
NO _x (tons/year)	3.43	46.36	6.05	48.97	93%
SO ₂ (tons/year)	0.00	95.13	0.16	95.28	100%
CO ₂ (tons/year)	22,139	28,135	7,074	13,071	37%
Carbon (metric tons/year)	6,038	7,673	1,929	3,565	37%
Fuel Consumption (MMBtu/year)	378,437	301,643	120,922	44,128	10%
Acres of Forest Equivalent				3,565	
Number of Cars Removed				2,228	

Displaced Electricity Generation Profile: Egrid State Average All Sources 2005

Region Selected: US Average

This CHP project will reduce emissions of Carbon Dioxide (CO₂) by 13,071 tons per year

This is equal to 3,565 metric tons of carbon equivalent (MTCE) per year

This reduction is equal to removing the carbon that would be absorbed by 3,565 acres of forest



OR

This reduction is equal to removing the carbon emissions of 2,228 cars



Environmental Debate

Federal:

- Executive Order to Promote CHP/District Energy +
- GSA Regions do not advocate CHP -
- DOE / EPA Actively Promote +
- DOD Required but zero additional funds +/-
- Cap & Trade – DOA for now

State/Local:

- Varies from State to State
- California:
 - Gov, CEC, CPUC – Pro
 - CARB (AB32) and IOU - Neg



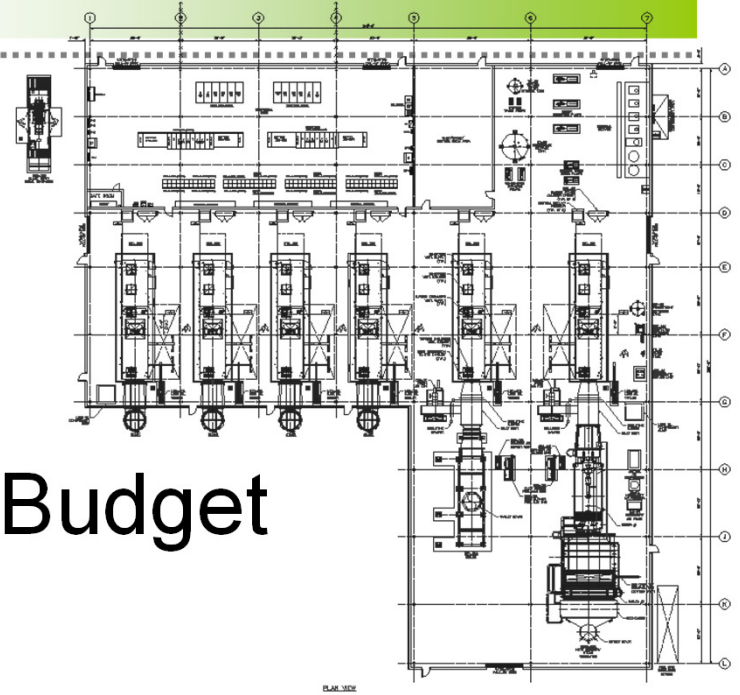
Fuel Supply & Procurement

- Determine gas supply, location, volume and pressure
- Alternate fuel availability? LFG, Di-Gas, Syn-gas
- Seek unbiased advise on procurement options
- Pool vs direct procurement
- Gas portfolio development – not for the inexperienced
- What helps you sleep at night? Predictable fuel budget or lowest cost?



Phased Assessment

1. Feasibility
2. Validation
3. Preliminary Engineering and Budget Confirmation
4. Permitting and utility Interconnect
5. Engineering
6. Major Long-Lead Equipment Procurement
7. Construction & Construction Management
8. Commissioning and Training



Project Delivery Options & Keys

- Design-Bid-Build
- Design/Pre-Construction Services
- Design-Build
- Hybrid Variations of Above
- Demand similar experience for company and specific team members for design & install
- Check References
- Comprehensive Commissioning is part of all options



O&M Updates & Options

- Myth: CHP's are difficult to operate.
- Reality: Typically, CHP is easier to operate than traditional Boiler Plant"
- Solution:
 - Documentation and detailed Seq. of Ops.
 - Training: classroom, vendor and O-J-T
 - Participate in design; equipment selection; construction and Cx



Sources of Best Practices

- Other CHP Owners/Operators
- Associations
- Major Equipment Suppliers
- Specialty Engineers



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Q&A

