PROJECT EVALUATION

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Agenda

- Basics
- Case Studies
- Lessons Learned

On-Site Power Operating Modes

On-site generation effect on facility energy requirements is dependent on operating mode:

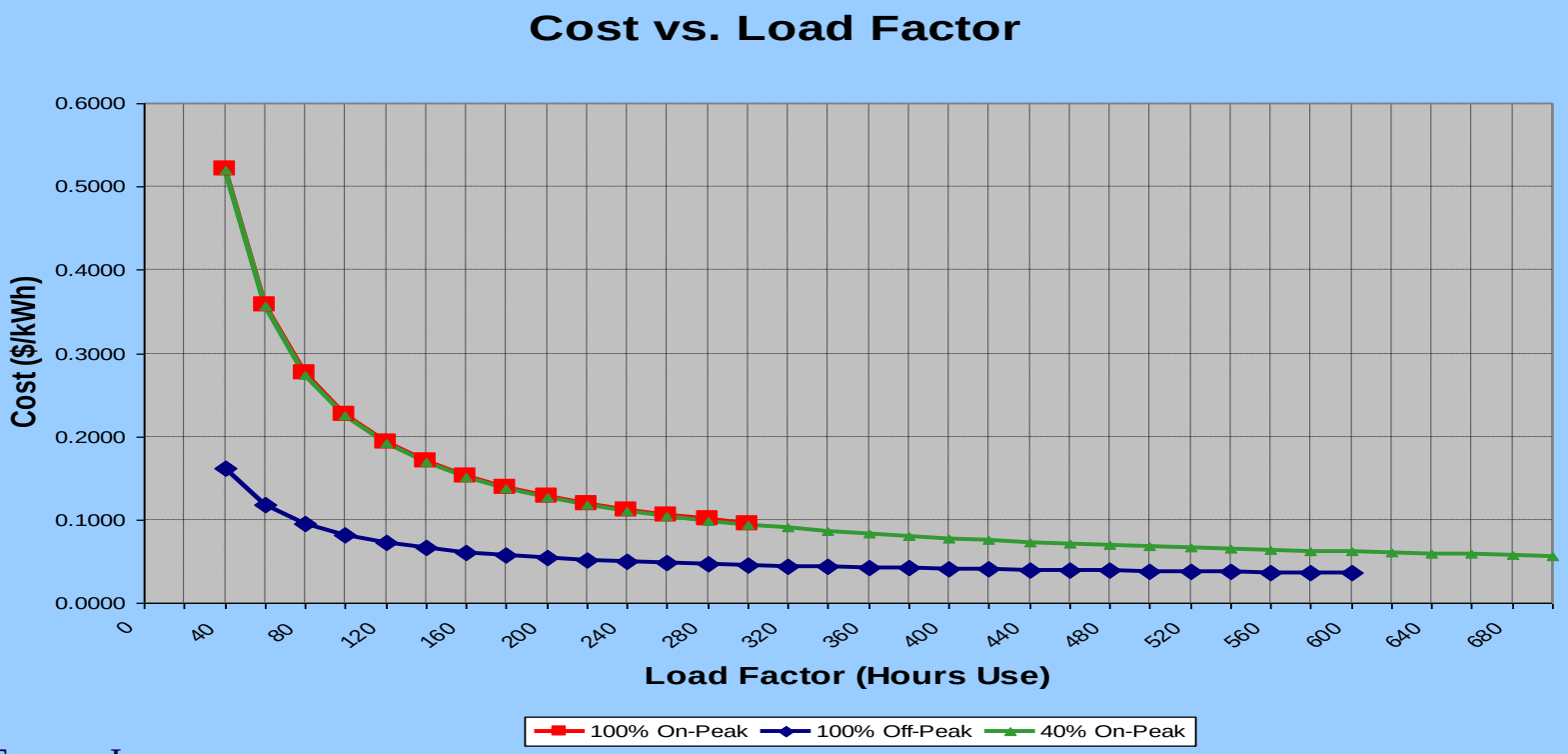
- Baseloaded
- Electric or thermal tracking
- Peak Shaving
- Emergency and/or load interruption requirements

Heat recovery - incremental decision for each mode.

Absorption cooling - incremental decision based on electric or mechanical cooling as an alternative.

Time of Day Rate

Time of day rates produce high value for CHP produced electricity, however, limited on-peak hours reduce cost savings.



Economic Measures

Simple payback is the total project cost divided by the project's annual savings.

- Doesn't consider time value of money.
- **Meaningless for projects where no equity is required as is typical for institutional applications.**

Net Present Value (NPV) or Present Worth (PW) is the present value of a series of future expenses and revenues.

- Decision maker must establish the time value of money or discount rate as a function of interest rates and risk.

Internal Rate of Return (IRR) is more typically used when equity in on-site generation is required.

Back-up Power

Electric power that is purchased when on-site generation is unavailable:

- Scheduled (maintenance) and unscheduled outages
- Firm or interruptible

2005 Energy Policy Act removes mandatory backup service if that service is available in the competitive market place.

Third Party Financing/Performance Contracting

Performance contracting is not to be confused with third party financing;

- Performance contracting establishes design and operational requirements as basis for design/build contract.
  - » Can be end user or third party financed.
  - » Assignment of risks is key to viable performance contract.
- Third party financing or third party ownership is frequently combined with performance contracting.
  - » Very limited benefit for most institutional end users. Tax exempt entity e.g. university or hospital realizes 33% of net savings.

Some Illustrative Case Studies

Boston Area CHP Project

Office building, with computer center, located in NSTAR, Trigen and Boston Gas service areas:

- Peak load of 5,500 kW, 24.1 million kWh and annual electric cost of $2,697,000 averaging $.112/kWh.
- Requirement for 26,900 Mlb of steam at cost of $448,000.
- Baseloaded 1,045 kW CHP system using reciprocating engine generator set with SCR @ $2,67 million
  - Operating cost decrease of $83,000.
  - Simple payback of 26.7 years
  - Pretax IRR of 4.2%, after tax return is negative
  - Pretax NPV of -$658,000, after tax NPV is -$327,000
- Significant fraction of cost reduction results from avoidance of Trigen steam and not CHP.

Philadelphia Area CHP Project

Hospital located in Philadelphia Electric and PGW service areas:

- Peak load of 1,500 kW, 8.5 million kWh and annual electric cost of $656,000 for average cost of $.077/kWh
- Requirement for 39.6 MMBtu of No. 6 fuel oil at cost of $280,000.
- Baseloaded 900 kW CHP system using reciprocating engine generator set based on site loads @ $1.56 million
  - » Operating cost increase of $603,000.
  - » Both natural gas fueled and diesel fueled systems produce “losses”.
- Peak shaving 375 kW system without heat recovery and no standby backup service @ $385,000.
  - » Operating cost saving of $20,000.

Bethesda, Maryland CHP Project

Condominium located in Pepco and Washington Gas service areas:

- Peak load of 2,050 kW, 9.7 million kWh and annual electric cost of $830,000 averaging $.086/kWh.
- Requirement for 39,800 MCF of gas at cost of $358,000.
- Load following 1,800 kW reciprocating engine CHP system with one 900 kW backup engine generator set @ $2.96 million
  - » Operating cost decrease of $150,000. Use of engine heat in swimming pool valued at almost $100,000.
  - » Simple payback of 19.7 years
  - » Pretax IRR of 2.6%, after tax return is negative
  - » Pretax NPV of -$976,000, after tax NPV is -$1,180,000

Detroit Area CHP Project

University located in Detroit Edison and MichCon service areas with operating 4,500 kW cogeneration system.

- Peak load of 8,500 kW, 59.0 million kWh. Supplemental purchases of 21.7 million kWh and annual electric cost of $1,379,000 averaging $.064/kWh.
- Requirement for 278,000 MCF of boiler gas at cost of $1,354,000 @ 4.96/MMBtu.
- Baseloaded 4,050 kW CHP system using combustion turbine generator set @ $4.93 million
  - Operating cost decrease of $263,000.
  - Simple payback of 18.7 years
  - Pretax IRR of 3.1%, after tax return is negative
  - Pretax NPV of -$1,424,000, after tax NPV is -$452,000

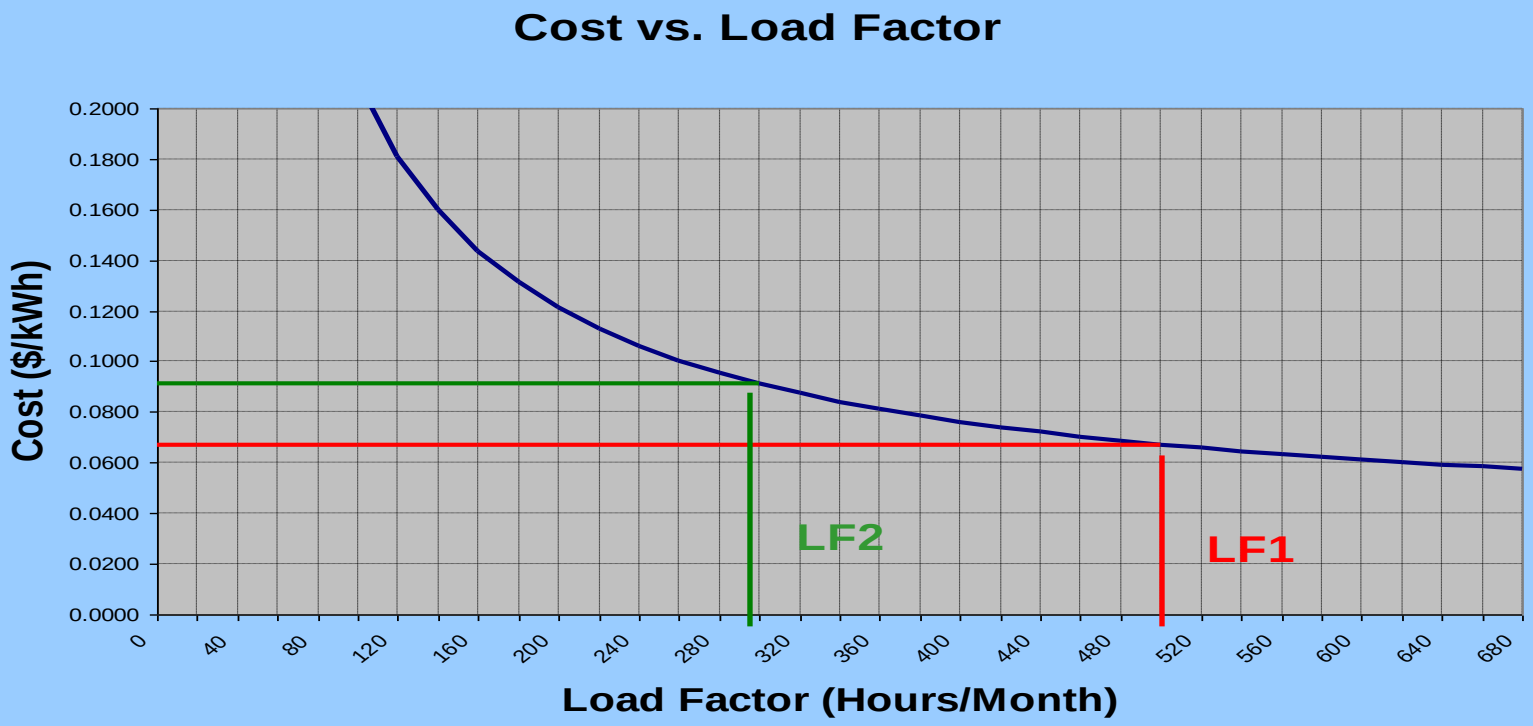
Decision made to shutdown existing cogeneration system January 1, 2005 due to high fuel costs.

University in western Michigan shut down 10,000 kW in summer 2005 due to high fuel costs.

Lessons Learned

Lower Value of On-Site Generated Power

On-site generation is typically valued at less than the average cost of electricity.



Utility Backup

All projects included utility supplied backup power for both schedule and unscheduled outages.

Projects had ability to operate in stand alone mode if grid deenergized, however, primary source of backup was the utility grid with existing T&D.

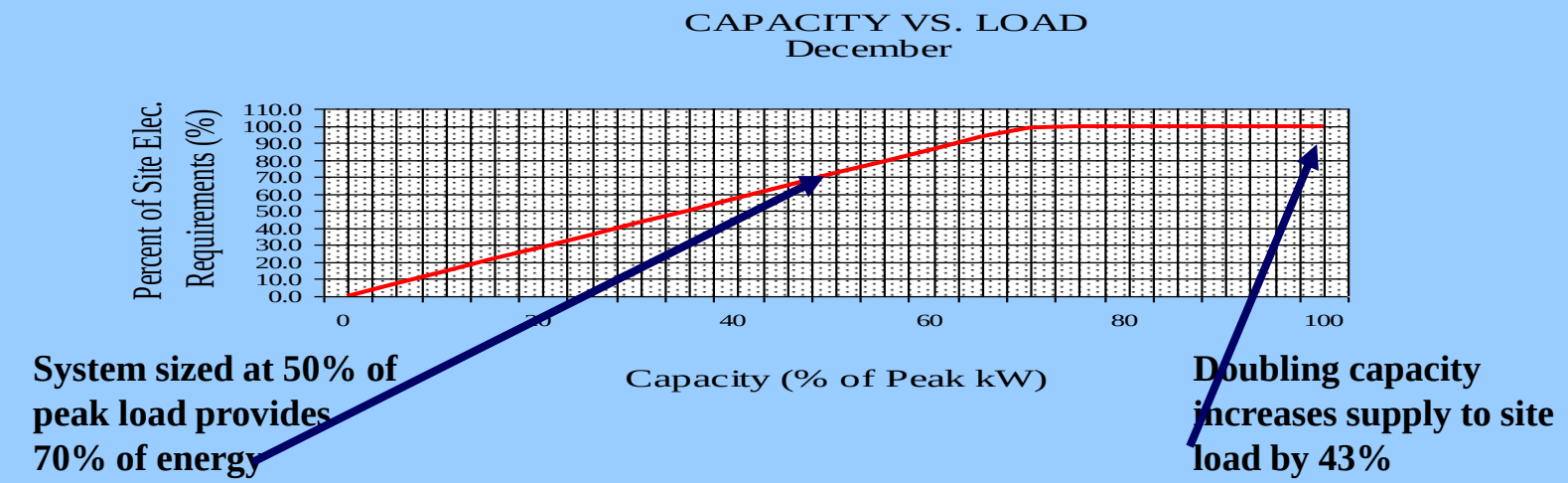
Cost of standby ranges from 1.4% to 3.7% of annual operating cost of CHP system.

- On-site backup with redundant engine generator set would increase capital cost by 50% or more.
- Redundant capacity is not cost effective as compared to utility supplied backup power.

Diseconomies of Scale

Increasing baseloaded capacity does not result in one for one increase in amount of on-site generation that can displace retail purchases.

- There is such a thing as “too much generation” even for projects that are viable.



Fuel Costs

Case studies were performed prior to Katrina run-up in oil and natural gas prices.

- While long term trend for natural gas prices is negative, they are not projected to drop to levels that support CHP.
- No. 2 fuel oil prices are projected to increase over time, eroding savings from CHP.

Conclusions

With diesel fuel and natural gas prices in current ranges ($9.00 to $13.00/MMBtu) baseloaded cogeneration based on displacement of retail purchases is not viable.

Peak shaving systems may be viable depending on rate structure. Most peak shaving systems cannot justify investment in heat recovery and are less efficient than purchased power.

Institutional clients require backup. Availability of backup at reasonable costs is uncertain under 2005 Energy Policy Act.

Questions