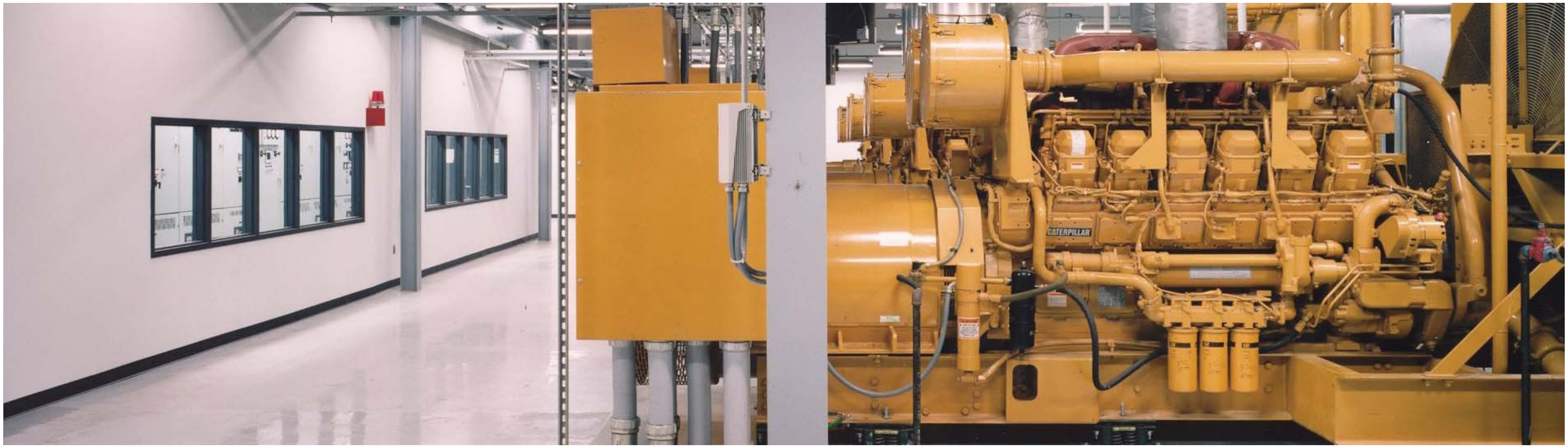

Data Centers Are Good Candidates For Cogeneration

idGroup
Integrated Design Group, Inc.
38 Chauncy Street
Boston, MA 02111
www.idgroupae.com

Data Centers Are Good Candidates For Cogeneration

A cogeneration facility satisfies three major requirements for a data center; it is cost effective, environmentally friendly and reliable.

A data center is a good candidate for a combined heat and power (CHP) or cogeneration facility because the thermal load and electricity use track each other closely and are relatively constant throughout the year. A CHP plant can provide an overall efficiency for site generated electricity and cooling of approximately 80%. This results in reduced total energy use, reduced carbon footprint and a reduction in greenhouse gas (GHG) emissions. Payback under 5 years is achievable but depends on fuel cost differential (the "spark spread"), availability of incentives and the ease of integrating the CHP plant into the facility.

In addition to reductions at the facility there is also a primary energy use reduction of 4-16% and a greenhouse gas reduction of 8-20% associated with the generation and transmission of energy to the site.

There could be a potential savings of $394,000 per year for a 1080kW reciprocating engine generator with heat recovery when the electrical costs are $0.12/kWh and $7.50/MMBtu for gas.

CHP is the concurrent production of electricity and useful thermal energy (heating and/or cooling) from a single source of energy. CHP is a type of distributed generation, which, unlike central station generation, is located at or near the point of consumption. Instead of purchasing electricity from a local utility and then burning fuel or electricity to produce thermal energy, consumers use CHP to provide these energy services in one energy-efficient step. As a result, CHP improves efficiency and reduces greenhouse gas emissions. For optimal efficiency, CHP systems typically are designed and sized to meet the users' thermal base load demand.

A data center CHP plant typically consists of a generator to produce electricity and the waste heat is captured to operate an absorption chiller to produce chilled water. Additional waste heat from the generator could be used to heat the building, generate hot water or other uses and drive up the total system efficiency. The generator can be driven by a steam turbine, diesel or natural gas engine, or a fuel cell. For environmental emissions reasons typically the fuel source will be natural gas.

For a CHP plant to be economical the spark spread between the cost of natural gas and electricity must be beneficial. The spread must be adequate to cover the cost of maintaining and operating the system.

An additional benefit of a CHP plant is that since the system operates continuously the likelihood of it being available during a utility outage is higher than for generators that are only occasionally tested and used.

The CHP plant can be used for the primary power and cooling source for the facility, as a supplement to the normal or backup systems or totally separate from the backup systems. The configuration will depend on the project budget and the level of operational reliability desired.

To determine if a CHP plant is feasible and beneficial a number of issues must be reviewed and studied. These include:

- Utility connection costs (additional requirements to allow parallel operation)
- Utility backup power charges (for when the CHP plant is not available)
- Availability and reliability of natural gas
- Cost of natural gas
- Utility programs to purchase surplus power delivered by CHP generators.
- Environmental or regulatory restrictions
- Anticipated operation and level of redundancy and reliability desired
- Construction costs for equipment and integration into the facility

A CHP project is typically broken into several stages:

1. Initial feasibility analysis – EPA Level 1 (may be partially funded from local utility company)

   a. The purpose of the initial feasibility analysis is to provide enough information on the economics of the project to allow an informed decision to be made about whether or not to continue exploring an investment in a CHP plant for that particular location, while minimizing time and money spent to obtain that information.

   b. At this stage a preliminary review of the proposed project would be performed. Electricity and thermal use would be reviewed and estimated.

   c. Barriers to the project would be identified and determined if they can be overcome (such as existing utility contracts, regulatory or utility policies, or environmental regulations).

d. Conceptual engineering would be developed including the level of redundancy and reliability required. Would the CHP plant replace, supplement or have no effect on the requirement for backup electrical and cooling capabilities should be considered.

e. Review of available utility rates for electricity and natural gas including any utility construction charges or backup availability charges that may be incurred.

f. Review of potential incentives, grants or funding programs.

g. A preliminary economic analysis including budgetary equipment and construction pricing and estimated operational and maintenance costs would be developed to allow a preliminary simple payback estimate to be developed.

2. Feasibility Analysis – EPA Level 2 (may be partially funded from local utility company)

a. The primary purpose of a Level 2 Feasibility Analysis is to replace all of the assumptions used in a Level 1 Feasibility Analysis with verified data and to use this information to optimize the CHP system design. It is imperative that all operational goals have been identified for the project before this stage begins; these goals should include control, monitoring, and maintenance needs.

b. The results of the Level 2 Feasibility Analysis should include: construction, operation, and maintenance pricing; calculations of final project economics with a simple payback schedule; and a life cycle cost analysis of the total investment. At the end of this stage, all information needed to make a decision about whether to proceed with the project should be available.

c. Multiple site visits and reviews of existing electrical, mechanical, and structural drawings would be required to complete this stage. Decision-makers need to ensure that important decisions are made at this stage in order to determine accurate system pricing. These might include decisions regarding CHP system specifics (e.g., size and location, prime mover type, heat applications), along with conceptual design drawings that include flow diagrams, equipment specifications, monitoring and control specification, piping and wiring, and tie-in to existing building systems.

d. The proximity and ease of electrical and thermal tie-in points, as well as the ease of the system's installation at the site heavily affect CHP system pricing. Unless budgetary pricing in the Level 1 Feasibility Analysis was very conservative, these site factors can result in substantial differences between budgetary pricing in the Level 1 and Level 2 Feasibility Analyses. Occasionally, this difference might lead to the project's ultimate cancellation. Unfortunately, there is no way to determine the impacts of the site on project costs without engaging in a fairly comprehensive review of site conditions.

e. What is a typical maintenance schedule, and how long are the units down? Does it make sense to have a redundant unit on site so that any maintenance window (8-16 hours) can be managed without having to depend on the utility source or backup generators and chillers?

3. Final Design and Procurement

a. The project proceeds to final design, bidding and construction. At this stage a decision is made to proceed in a traditional design bid build process, a design build process or a turnkey design build and operate model.

b. One of the decisions to be made is whether the owner will operate and maintain the CHP plant 24x7 or would it be more beneficial for this to be outsourced to a third party.

c. Negotiations with the electric and gas utilities for the most advantageous rates would be finalized.

A favorable spark spread combined with incentives from the local utility and the government will result in a successful project with a relatively short economic payback, and a long-term environmental and reliability benefit.

For more information on this topic please contact Dennis R. Julian, PE, by phone or email at djulian@idgroupae.com.

References and additional environmental and co-generation Information:

1. US EPA – Combined Heat and Power Partnership at www.epa.gov/chp/index.html

2. EPA CHP Project Development Handbook

3. Oak Ridge National Laboratory report "Opportunities for Combined Heat and Power in Data Centers". http://www1.eere.energy.gov/industry/saveenergynow/pdfs/chp_data_centers.pdf

4. The Association of Energy Engineers, www.aeecenter.org

5. Buildings Cooling, Heating, and Power (BCHP) Initiative, www.chpcentermw.org

6. Midwest Cogeneration Association, www.cogeneration.org

7. U.S. Clean Heat & Power Association, www.uschpa.org

8. U.S. Department of Energy (DOE), www.eere.energy.gov

9. Cogeneration – Combined Heat and Power (CHP) http://cumminspower.com/en/solutions/cogeneration/

10. Fuel Cells http://www.energyreinvented.com/

11. http://www.tecogen.com/cogen.htm

12. http://tas.com/Clean-Heat-and-Power-Systems.html

13. http://www.aircogen.com

14. http://www.capstoneturbine.com/