

DATA CENTER EFFICIENCY REPORT

<Study Provider>

*Presented to:
<Customer>
<Presentation Date>*

Funding by:



<Report Date>

This report is for sample purposes only. The customer's actual report will contain information and recommendations based upon the engineering firm's findings and may or may not reflect the format and recommendations contained in this sample report.

Instructions for Study Providers: This template is intended as a guide to content that Xcel Energy is expecting to review in order to approve a Data Center Efficiency study for a customer rebate. The italicized text in this document is instructional in nature and should be edited (deleted) as appropriate for each specific project. Please use the Table of Contents for easy navigation of your report. Formatting changes may affect the functionality of the Table.

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Executive Summary

General Summary

Describe what you found and what you suggest for solutions and improvements.

Describe the bundles of ECOs that are recommended and explain the concept and benefits of bundled savings. Bundling allows Xcel to combine short payback projects with long payback projects to offer rebates for measures that individually may not qualify for a rebate.

Table of recommended Energy Conservation Opportunities Energy Use, and Demand, and Savings

Show as a minimum the same details that are in the Xcel ECO Rebate form

This table is for example only; please replace it with a table appropriate to each study.

ECO#	Energy Conservation Opportunity	Est. Customer kW Savings	Est. Annual Energy Savings (kWh)	Est. Gas Energy Savings (Dth)	Est. Annual Electric Cost Savings	Est. Annual Gas Cost Savings	Est. Other Cost Savings	Est. Incremental Cost of Opportunity	Est. Total Cost of Opportunity	Simple Payback (years)	Rebate
1	Virtualize 8:1 ratio	200.0	1,314,000	0	\$41,043	0	\$12,000	\$-35,000	\$100,000	Immediate	0
2	Upgrade remaining servers	14.0	91,980	0	\$2,873	0	0	\$22,000	0	5.10	\$7,358
3	Airside management	100.0	657,000	0	\$20,521	0	0	\$40,000	0	1.00	\$19,479
4	Slow down chill water pump	25.0	164,250	0	\$5,130	0	0	\$1,000	0	0.19	0
5	Install VFD on chiller	0	0	0	0	0	0	\$20,000	0	0	0
6	Ultrasonic humidification	15.0	98,550	0	\$3,078	0	-\$2,300	\$18,000	0	13.00	\$7,884
7	Downsize UPS and transformer	30.0	262,800	0	\$8,048	0	\$4,000	\$80,000	0	4.90	\$21,024
	Total of Individual ECOs	384	2,588,580	0	\$80,693.00	0	\$13,700.00	\$216,000.00	\$100,000	384	\$55,745

Introduction

Purpose of Study

The purpose of the study is to perform an energy assessment of the customer's data center and to provide a business case justification for implementing energy efficiency improvements in the data center.

Objectives of Data Center Efficiency Program

The objectives of the Data Center Efficiency Program are to educate our customers and provide technical and financial assistance that will allow them to improve the operation and performance of their data centers and minimize life cycle costs, including energy use and costs.

Xcel Energy Disclaimer

The estimated costs shown for each opportunity are based on previous experience with comparable cost reduction plans in other facilities. While the energy conservation and load management measures contained in this report have been reviewed for technical accuracy, Xcel Energy and VENDOR do not guarantee the cost savings or reduction in total energy requirements presented in the recommendations. Xcel Energy and VENDOR shall, in no event, be liable to CUSTOMER in the event that the potential energy savings are not achieved.

The recommendations are based on an analysis of conditions observed at the time of the survey, information provided by Xcel Energy and costs based upon VENDOR experience on similar projects. Estimated savings are computed on the basis of research by government agencies product literature, and engineering associations. Actual savings will depend on many factors including: conservation measures implemented, seasonal weather variations, fuel price increases and specific energy use practices of the facility's occupants and workers. Performance guidelines provided in the report are for informational purposes only and are not to be construed as a design document. This report is written for energy saving purposes only and should not be used for bid specifications.

Xcel Energy will not benefit in any way from your decision to select a particular contractor or vendor to supply or install the products and measures recommended by VENDOR. You are encouraged to ask for the option of contractors or suppliers you have worked with in the past for further information on the suggested measures.

Disturbance, removal or replacement of building material, insulation system, high intensity discharge and fluorescent lamps, lamp ballasts, power factor correction capacitors, starting and running capacitors of motors and other potentially hazardous components that contain asbestos, mercury or PCB's will require proper handling and disposal in accordance with applicable federal and state laws and regulations. It is the customer's responsibility to ensure that the contractor follows such guidelines in implementing the recommendations of this report.

Xcel Energy advises that customers check with their Xcel Energy sales representative to determine the estimated value of their rebate and to verify that the equipment qualifies for Xcel Energy programs prior to

implementing any conservation measure. Some measures identified in this report may qualify for an Xcel Energy Custom Efficiency rebate. Custom Efficiency projects require pre-approval prior to purchase and installation. The customer is responsible for submitting project information to their Xcel Energy sales representative to obtain pre-approval for Custom Efficiency projects and to determine the eligible custom rebate amount.

Key Information

Contact Information

Service Address:	ABC Building 414 Nicollet Mall Minnesota City, MN 55403
Account numbers:	0123456789 electric 2345678910 gas
Customer Contact (at building):	John Smith, Facility Manager Phone: 612/330-1234 Fax: 612/330-5678
Alternate Customer Contact:	Jane Doe, President Phone: 763/263-1234 Fax: 763/265-6789
Engineering Firm:	XYZ Consultants
Principal Engineer:	John Doe
Xcel Energy Representative:	Jeff Jackson Phone: 612/337-1234 Fax: 612/337-5678
Date(s) study performed:	June 12, 2004
Electric Service Provided by:	Xcel Energy
Gas Service Provided by:	Xcel Energy
Primary Type of Building:	Office Building
Data Center Square Feet:	130,000 square feet
Peak Data Center Demand:	1,456 kW

Data Center Description

Diagram

Include a general physical description of the data center including square footage of the actual data center, room height, raised floor height (if applicable), room construction, etc. Include a drawing of the data center layout including support areas. The drawing should show rack layout, cooling equipment locations, UPS locations, PDU locations etc. Include a discussion about space available for projected growth.

IT Systems

Include a description of the types of IT work performed in the data center (web hosting, database, etc.). Include general descriptions of the IT hardware (# of servers, #of network switches, amount of storage, etc.) Include a discussion about operating systems in the data center (Windows, Unix, etc.) Include a discussion about the customer's "standard" hardware refresh and maintenance practices. Include a discussion about cable management practices in the data center if relevant. Include a discussion regarding the customer's projected growth of IT work and IT hardware in the data center.

Electrical Systems

Describe the existing generators, UPSs and PDUs in terms of capacity, technology, age, and current load on each piece of equipment. Describe the operational redundancy (N +1, 2N, 2N +1, etc.). Include the manufacturer's peak rated efficiency and operating efficiency based on the current operating loads observed. Include a discussion regarding the electrical system's potential to satisfy the customer's projected growth in IT load. Describe the existing lighting systems and lighting control systems and practices.

Mechanical Systems

Describe the existing cooling systems, air moving equipment, and humidification systems in terms of type of equipment, capacity of equipment, current load, age, and operating efficiency. Describe the customer's current airflow management practices (hot aisle/ cold aisle, aisle containment, penetration sealing, blanking panels in racks, etc). Describe the current equipment temperature and humidity set points. Include a discussion of the current temperature and humidity control systems and practices. If free cooling is present describe the capacity and operating conditions under which free cooling is available. If a central chilled water plant serves the data center areas and other areas in the facility include a discussion of the non-data center cooling loads served by the central chilled water plant including hours of operation of the non-data center loads. Include a discussion regarding the mechanical system's potential to satisfy the customer's projected growth in IT load.

Historic Data Center Energy Consumption

Describe what the historical energy use table below includes (data center only or the entire facility). Point out the customer's applicable Xcel Energy electric and gas rates. If the customer has a demand controlled rate, list the customer's PDL, describe how the customer reduces demand to the PDL, and how many times the customer has been curtailed in the last five years. If the table includes the entire facility and the data center is only a portion of the entire facility describe the functions of the non-data center portions of the facility and include an estimate of the annual peak demand (kW) and annual energy consumption (kWh) and (Dth if applicable) associated with only the data center.

Historic Energy Consumption Table

Show actual electric demand (kW), power factor (%), billed electric demand (kW), total electric energy (kWh), total electric cost, billed gas use (Dth), and total gas cost. Billing history is available from the Xcel Energy Account Manager.

Month	Demand (kW)	Power Factor (%)	Billed Demand (kW)	Electric Energy (kWh)	Electric Cost	Gas Use (Dth)	Gas Cost
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Total							

Table 1- Monthly Electric and Gas Use

IT Equipment Loads

Summarized in the table below is the average power (kW) for IT equipment

Data Center Areas	Area (sf)	IT equipment load (kW)	Power Density (W/sf)
Totals			

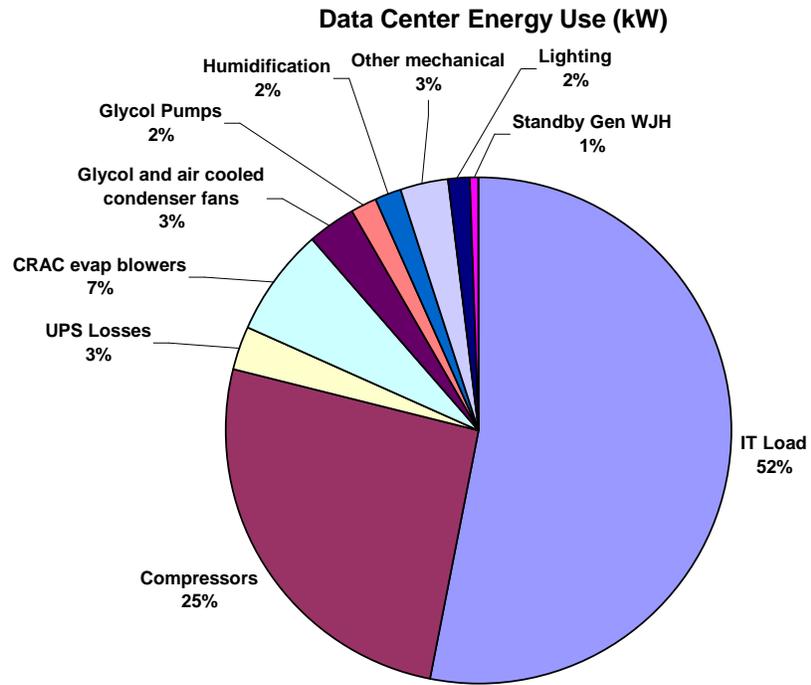
Table 2- IT Equipment Load

Data Center Energy End Use

Include descriptions of the systems consuming energy and the breakdown of energy use by system. When the data center includes multiple IT equipment rooms or is partitioned for specific end uses include the breakdown by room or end use.

Data Center End Use	Electrical Demand (kW)	Estimated Annual Energy Use (kWh)
IT Equipment	xxx	xxx,xxx
Power Delivery Losses	xx	x,xxx
Supply Fans	xx	x,xxx
Cooling Compressors	xxx	xxx,xxx
Pumps and drycooler, condenser, or tower fans	xx	x,xxx
Humidification	xx	x,xxx
Lighting	xx	x,xxx
Other	x	xxx
TOTALS:	x,xxx	x,xxx,xxx

Table 3 - Summary of Data Center Electrical End Use



Example Figure 1 –Electrical Breakout by End Use

Replace with actual breakdown

Data Center Metrics

Measuring the necessary parameters to determine the data center Power Utilization Efficiency (PUE), Data Center Infrastructure Efficiency (DCiE), Return Temperature Index (RTI), and Rack Cooling Index (RCI) is encouraged but not required.

Refer to http://www1.eere.energy.gov/industry/saveenergynow/dc_pro.html for more information.

Energy Conservation Opportunities (ECOs)

This section includes descriptions of the measures available for implementation that will reduce energy use in the data center. Include discussions regarding ECOs that were thoroughly analyzed and discussions of ECOs that were considered but not analyzed and the reasons for not analyzing each potential measure.

ECOs Considered but not Analyzed

This section would include efficiency improvement measures that may conserve energy but were not thoroughly analyzed. Include discussions of why the measures were not analyzed. Reasons to not analyze measures include the customer's unwillingness to consider a particular measure, the preliminary estimated payback is too long, the existing systems are already highly efficient, and physical limitations of the facility prohibit implementation.

Energy Conservation Opportunities

This section includes a detailed description of each ECO that was thoroughly analyzed and the results of the analysis. ECOs involving both the IT systems and the facilities systems should be included. For each ECO the appropriate baseline must be defined and well as the proposed efficient system. In cases where the baseline is the existing condition, an expanded description of the existing system is appropriate. In cases where the appropriate baseline is a new "standard" efficiency system, the baseline system must be adequately described. Tables showing the results of the analysis should be presented for each opportunity. Example tables that should be included with each ECO are shown below.

	Peak Demand (kW)	Annual Electric Energy Use (kWh)	Annual Gas Use (Dth)	Annual Electric Cost	Annual Gas Cost	Annual Non-Energy Operating Cost	Total Installed Cost
Baseline	<i>A</i>	<i>C</i>	<i>E</i>	<i>G</i>	<i>I</i>	<i>K</i>	<i>M</i>
Efficient	<i>B</i>	<i>D</i>	<i>F</i>	<i>H</i>	<i>J</i>	<i>L</i>	<i>N</i>
Difference	<i>A - B</i>	<i>C - D</i>	<i>E - F</i>	<i>G - H</i>	<i>I - J</i>	<i>K - L</i>	<i>M - N</i>

Incremental Cost	Annual Energy Cost Savings	Annual Non-Energy Operating Cost Savings:	Simple Payback:
<i>M - N</i>	<i>(G + I) - (H + J)</i>	<i>K - L</i>	<i>Incremental Cost / (Annual Energy Cost Savings + Annual Non-Energy Operating Cost Savings)</i>

ECO Examples

The following examples of common data center efficiency measures include a discussion of conditions and practices to consider in order to perform a complete and accurate analysis of each ECO.

IT Measures Including Server Virtualization and Consolidation, Network Switching Upgrades, and Storage Consolidation and Optimization

The single most important factor to consider when analyzing a server virtualization/consolidation measure is using an appropriate baseline. The appropriate baseline depends on several factors including the age of the existing servers to be virtualized or consolidated, the customer's practices/policies regarding hardware refresh cycles (typical life of the servers), and the customer's maintenance practices on hardware (does the customer typically have maintenance agreements in place on all hardware).

If, for example, a virtualization measure considered was to virtualize 100 existing servers to 10 virtual host servers, and the existing servers were 3 years old and the typical server life for that customer is 4 years old, the appropriate baseline would be new servers in a standard configuration, not the existing 100 servers. The baseline installation cost would be the cost of 100 (or the number of new servers to provide the equivalent capacity and performance of the existing servers) new servers plus installation, set up, cabling, and programming time.

In contrast, in the above scenario the existing servers were 1 year old the appropriate baseline would be the 100 existing servers and the baseline installation cost would be \$0.

Annual non-energy operating costs would typically be either internal labor costs to maintain the servers or the annual maintenance agreement costs.

Cooling demand and energy savings that result from IT measures must be included in the analysis of each IT measure. When calculating the annual cooling energy savings an average annual operating efficiency (kW/ton) must be determined through a bin analysis and economizer cooling, if present, must be considered. Simply using the cooling system efficiency at peak design conditions for 8760 hours per year to estimate the annual cooling energy for the baseline and efficient systems is usually not sufficient.

Power Delivery Improvements

Replacing, repairing, and sometimes eliminating transformers, UPSs and PDUs can often result in substantial energy savings. It is important to determine the actual operating efficiency of these components as opposed to simply looking up the peak rated efficiency. Particularly with UPSs, the efficiency often drops dramatically at loads less than 70% of rated capacity. Efficiency curves should be obtained at a minimum. Actually measuring the operating efficiency is preferred. Using the manufacturer's peak rated efficiency to estimate annual energy losses this equipment often underestimates the annual energy use of the existing equipment and underestimates the potential savings from upgrades.

Airflow Management Improvements

Multiple measures to improve the efficient utilization of the cool air supplied to cool the IT equipment are available. These include implementing hot aisle/ cold aisle arrangements, hot or cold aisle containment, perforated tile optimization, sealing cable and other raised floor penetrations, installing ducted returns, extending return plenums on downflow cooling units, utilizing a false ceiling as a return air plenum, and installing blanking panels in the rack. The goal of all of these measures is to get more of the cold supply air to flow through IT equipment racks without bypassing the racks and without recirculating warm air from the racks back through the racks. Accomplishing this goal will result in a need for less cool air (cfm) to be supplied and/ or allow the air to be supplied at a warmer temperature and/ or allow warmer air to be returned to the cooling units. Supplying less air to the Data Center will result in fan demand and energy savings and cooling energy savings. Supplying and returning warmer air will result in improved cooling system efficiency and cooling energy and demand savings.

The reduction in cooling air flow, the changes in supply air and return air temperature, the method of achieving the reductions in air flow (shutting units off, installing VFDs, etc.) and the methods of achieving the warmer supply and return airflow (changing setpoints at the individual cooling units, changing the temperature controls) assumed in the analysis must be clearly stated in the description of the ECO(s).

Humidification

Measures to improve humidification control or change humidification setpoints can result in significant energy savings in many data centers. Installing adiabatic humidification systems can result in even more energy savings.

Due to the common practice of multiple individually controlled cooling and humidification units, simultaneous humidification and dehumidification often occurs in data centers, resulting in wasted energy. Simultaneous humidification and dehumidification is often the result of poorly calibrated temperature and humidity sensors, differing temperature and humidity setpoints at the multiple units, and humidity set points that are too high or allowable humidity ranges that are too small.

When analyzing a humidification ECO it is important to determine the appropriate design conditions, the degree to which simultaneous humidification and dehumidification is occurring, and the actual humidification load based on the proper design conditions.

Actual calibrated temperature and humidity measurements at each cooling unit (at locations relative to the sensor locations) and comparing the calibrated measurements to the cooling unit readings will assist in determining the amount of simultaneous humidification and dehumidification that may be occurring.

Cooling System Improvements

Cooling system improvements that result in energy savings can result from simple setpoint adjustments, central control of multiple units, equipment upgrades and replacements, and installation or enhancement of air side and water side economizers. When estimating the demand and annual energy use of the cooling systems the actual cooling load should be used, not the peak cooling capacity of the cooling systems. Also it is important to consider the average operating efficiency based on the cooling load, indoor design conditions, and ambient weather conditions. The discussion should clearly state the cooling load, peak system efficiency, and average operating efficiency assumed in the analysis.

Appendices

Appendix A: Calculations

All demand and energy use, cost, and savings calculations must be submitted with the report. The preferred method is the actual spreadsheet files with the cell formulas visible. If the spreadsheet files cannot be provided, then the equations used to calculate the demand and energy use, costs, and savings must be written out. If a widely used, commercially available energy simulation software program is used, the name and version of the energy simulation software must be clearly identified and the software input and output reports for each analysis must be submitted. If proprietary software is used the software must be provided or the methodology used in the proprietary software must be clearly and precisely defined.

Appendix B: Measurement and Verification Plan

Xcel energy reserves the right to meter any project or portion of a project eligible for a rebate. Any individual measure with 1 GWh or 20,000 Dth or more in annual energy savings must be metered. Xcel energy may elect to meter measures with less savings when Xcel determines that the savings cannot be accurately estimated.

Study providers must present a proposed plan to meter each ECO analyzed in the Data Center Efficiency study. Metering locations, duration, and intervals are measure specific and typically pre and post measure implementation metering is required. Please contact the customer's Xcel Energy account manager with questions regarding metering requirements. Xcel Energy may contract with the study provider or another vendor to perform the metering.

Appendix C: ECO form

The current version of the ECO form is available from the customer's Xcel Energy account manager. Please contact the appropriate Xcel Energy Efficiency Engineer with questions regarding completing the ECO form.