



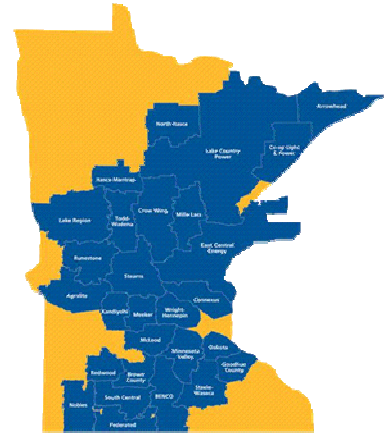
Green IT at Great River Energy

Company Profile

Great River Energy is a not-for-profit electric cooperative owned by 28 member cooperatives. We generate and transmit electricity for those members, who are located in the outer-ring suburbs of the Twin Cities up to the Arrowhead region of Minnesota and down to the farmland region in southwestern Minnesota.

Collectively, our member cooperatives serve nearly 645,000 member-consumers — or about 1.7 million people. We are the second largest electric power supplier in Minnesota. Great River Energy owns and operates 11 power plants which generate more than 2,500 megawatts (MW) of electricity, plus we purchase additional power from several wind farms and other generating facilities. Our generation capability consists of a diverse mix of base-load and peaking power plants — including coal, biomass, natural gas and oil plants.

Great River Energy owns and operates nearly 4,500 miles of transmission line and owns or partly owns more than 100 transmission substations. Great River Energy’s approximately 900 employees are dedicated to serving our member cooperatives with integrity and accountability in an environmentally sensitive manner. It’s the nature of being a cooperative.



2,800 MW
generating capacity



4,500 miles
transmission line



11
power plants



900
employees



28
member cooperatives



\$3.1 billion
assets



\$789 million
2009 revenues

Principles & Vision

Great River Energy completed construction of its corporate headquarters in Maple Grove, Minnesota, in early spring of 2008. The grand opening on Earth Day represented the culmination of an involved process during which Great River Energy's board of directors and leadership team worked closely with architects and contractors to ensure that the headquarters building would embody the highest standards of sustainable design.



No specific "Green IT" recipe guided this project. The IT project team instead focused on incremental and directed efforts to improve, innovate, and implement in areas such as:

- Green data center
- Green work place
- Reduce / reuse / recycle
- Culture of sustainability

Ultimately, the project team succeeded in constructing a 166,000 square foot building which was awarded the LEED platinum designation, the highest tier sustainability certification offered by the United States Green Building Council.

Gartner, one of the world's leading information technology research and advisory companies, defines Green IT as: *"The optimal use of information and communication technology for managing the environmental sustainability of enterprise operations and the supply chain, as well as that of its products, services and resources throughout their lifecycles."*

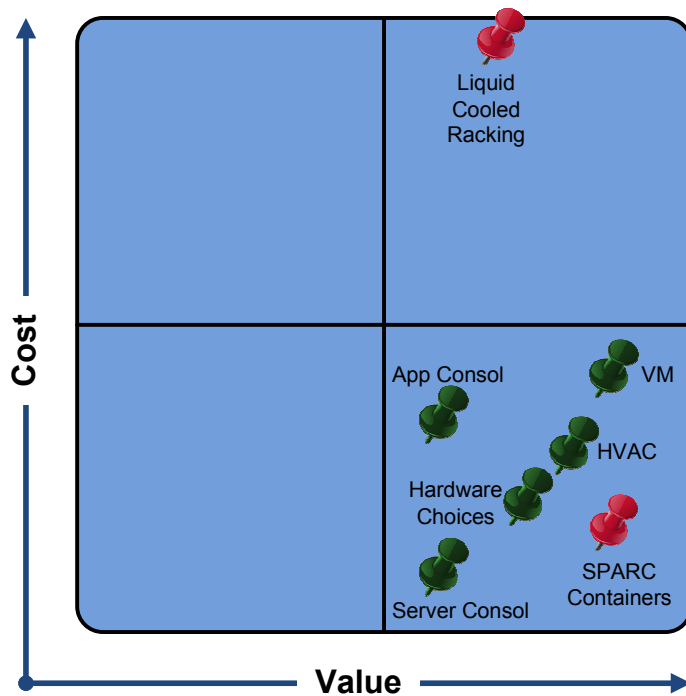
The interest of most North American corporations in Green IT is driven by economic rather than environmental concerns.

"The LEED green building rating system is designed to promote design and construction practices that increase profitability while reducing the negative environmental impacts of buildings and improving occupant health and well-being."

US Green Building Council

Green Data Center

In 2008, Gartner’s research estimated that the average enterprise data center would grow by a factor of 650% in the next five years, and that 80% of that growth would be unstructured. When Great River Energy’s IT leadership examined opportunities to minimize costs and environmental impacts, a sustainable data center stood out as the single most beneficial option.



In evaluating available options, the project team focused on those technologies with targeted high value and estimated low to medium relative cost. The Great River Energy Maple Grove data center incorporates efficient planning using a hot-aisle, cold-aisle layout. Optimally placed HVAC equipment, 24” raised floors, and Energy Star® rated equipment complement this data center approach to minimize energy usage.

Gartner research has shown that 65% of the power consumed by a typical x86 server is used to DO NOTHING!

“At current pricing, the operating expense (energy) to support an x86 server will exceed the cost of that server within three years!” Gartner

The hot-aisle, cold-aisle data center layout was conceived by Dr. Robert Sullivan of IBM’s Storage Systems Division in 1992. This approach couples HVAC equipment and raised floors with the goal of separating incoming cold air and exhaust hot air, and is considered an accepted best practice for cabinet layout within the data center.

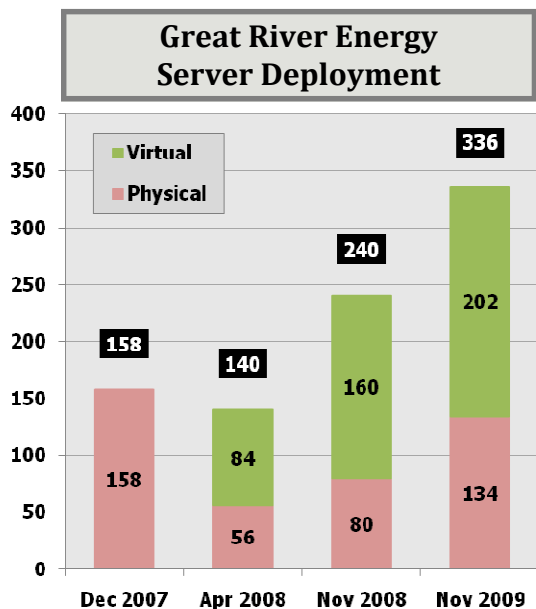
Server virtualization has allowed Great River Energy to realize benefits beyond those afforded by improvements to the physical layout and construction of the data center. The IT project team realized that reduced power consumption would not be the only advantage of reigning in the proliferation of physical servers. A holistic approach to server management leveraging virtualization technology would provide additional advantages, including:




- Avoided hardware purchase and maintenance costs
- Improved infrastructure manageability
- Increased application availability

In late 2007, the IT project team deployed a virtualized server environment supported by VMware's ESX infrastructure platform. The project team identified opportunities to optimize the use of available processing power in the server environment. From December 2007 through November 2009, the total number of physical servers decreased from 158 to 134, while the total number of all servers has increased from 158 to 336, representing a total virtualized footprint of about 60%.

In planning the data center move, the project team examined opportunities to retire applications. As a result of this analysis, two applications and 16 database instances were retired. An additional 12 applications and services were consolidated onto a different platform, allowing for the removal of the physical hardware which had supported those services.

"Server virtualization is the main mechanism through which data centers and IT managers are lowering their data center energy costs."
Gartner




-  **2**
Business applications retired
-  **16**
Database instances removed
-  **12**
Services consolidated

Power consumption for the remaining physical server pool is managed by VMware's Distributed Power Management (PDM) application, which monitors utilization across the data center and powers off unneeded physical servers without visible impact to applications or users. A modern and scalable physical layout complements and enhances the intelligent software management of the data center. Servers are racked and deployed in pods which are conducive to vertical growth.

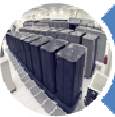
The entire headquarters utilizes power-over-Ethernet for electricity delivery to IP telephones, an approach which requires fewer circuits and reduces cabling.

Green Work Place

Great River Energy's green IT strategy extends far beyond the data center. The project team recognized that certain IT investments could be dovetailed with the headquarters project which would provide immediate and recurrent benefits to the company. One such investment was the deployment of Cisco's Unified MeetingPlace virtual meeting infrastructure, a platform which allows content sharing, voice conferencing, and real-time collaboration. This system is paired with video conference capabilities at all primary locations. Various remote access options include the Microsoft Exchange web portal, Citrix application virtualization, and a secure virtual private network (VPN) solution.




18
Physical servers retired



10
Physical ESX host servers




60%
Total virtual servers




36%
Reduction in disk space



\$3500 - \$3800
Cost per virtual server




\$400
Seat cost on corporate jet



\$18,000
Former annual outside teleconference cost



4,500
MeetingPlace meetings in 2009



600
Video conferences in 2009

All server, desktop, and mobile computers purchased by Great River Energy carry the Energy Star® designation for energy efficiency. These devices are subject to management by corporate policies which ensure that electricity usage for inactive machines is minimized.

Since the beginning of 2007, all CRT monitor displays at non-plant user work stations have been replaced with energy-efficient LCD flat-screen monitors. These slim-line monitors save space on the desk top and the drastic reduction of the amount of waste heat ejected into the air lowers the amount of energy needed to provide air conditioning. The devices have proven durable and user-friendly. The most pronounced benefit of this transition has been reduced energy usage. Because each LCD monitor uses about 80% less energy than a comparable CRT, the retirement of 1,300 CRT monitors has conserved an estimated 260,000 kWh of electricity annually with a resultant annual savings of over \$18,000.

Reduce, Reuse, and Recycle

During the Maple Grove move, the IT division worked with business units to consolidate and standardize printers and document reproduction devices. Multi-function printers with copy, scan, and fax capabilities are located in shared copy centers. The print queues for these devices specify duplex printing as the default setting, resulting in an annual savings of 2,500 reams of paper and \$10,000.

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.



1,300
CRT monitors replaced



80%
Approximate energy savings per LCD monitor



\$18,000
Estimated total annual savings across the company

Benefits of Flat-Panel Displays

- Use less energy
- Produce less waste heat
- Better space usage
- Better display quality



2,500 reams
Avoided annual paper usage



\$10,000
Estimated total annual savings across the company



The consolidation of desktop printers resulted in the elimination of 65 individual printers, four scanners, and three fax machines. Efforts to standardize the deployed models for the remaining printers has allowed the business operations department to reduce toner inventory and purchases. Each year, the organization purchases about 130 fewer toner cartridges, a savings of about \$13,000.

In tandem with the copy center project, Great River Energy began purchasing copy paper produced from 100% post consumer content. This single action avoids about 18 tons of carbon dioxide emissions each year and results in other tangible environmental benefits, including less wastewater, solid waste, and energy usage.

Sustainable cradle-to-grave IT asset management practices at Great River Energy begin with the purchase of energy efficient computer equipment and end with environmentally friendly disposal practices. The majority of computer, server and network equipment is donated to Minnesota Computers for Schools, a non-profit organization which aggregates and processes used PC equipment for resale to school districts and educational organizations within the state of Minnesota. Equipment which cannot be refurbished is processed to remove salvageable parts and any remaining components are recycled. In 2009, Great River Energy avoided almost \$3,600 in disposal costs by donating 6,826 pounds of IT equipment.



290
Trees saved annually



2 homes per year
Energy savings



18 tons
Avoided carbon emissions



190,000 gallons
Less wastewater used



7 tons or 1/2 garbage truck
Avoided solid waste

Minnesota Computers for Schools' mission is to "improve student success by transforming donated computer technology into greater educational opportunity for K-12 students in Minnesota."



584
Computers donated in 2009



6,826 pounds
Equipment donated in 2009



\$3,574
Avoided disposal costs

Culture of Sustainability

The deployment of green IT technologies at the Maple Grove headquarters underpins and complements Great River Energy’s culture of sustainability. Although targeted efforts to improve efficiency are beneficial, a comprehensive approach to green IT provides a return on investment which is greater than the sum of its parts. Great River Energy IT leadership continues to drive the organization’s progress towards a more sustainable approach to information technology.

Strengths

Great River Energy’s green IT approach has a demonstrated record of success, embodied by the implementation of many green IT design and lifecycle principles, including the following:

Use of renewable energy—The sustainability of Great River Energy’s green data center is complemented by the presence of on-site renewable energy sources (wind and solar generation) which provide approximately 11% of the headquarters’ annual electricity usage. The data center air conditioning system utilizes a lake-source geothermal cooling pump.

Server virtualization technologies—The technical evaluation phase of every IT project examines the feasibility and economics of leveraging the existing virtualization platforms for both application and storage needs.

"Green IT is the study and practice of designing, manufacturing, using, and disposing of [IT systems] efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership."
San Murugesan
IEEE Computer Society

- ### Green IT—Design Aspects
- Use of renewable energy
 - Green data center
 - Server consolidation and virtualization
 - Energy efficient hardware
 - SAN infrastructure
 - Power management
 - Thin client workstations
 - Telecommuting



Infrastructure energy efficiency—Server-side power management systems work in tandem with Energy Star® rated equipment to reduce the total energy usage of infrastructure equipment in both idle and load situations. The SAN and backup infrastructure employs data de-duplication to improve the efficiency of storage systems.

Telecommuting technologies—The Cisco MeetingPlace system and video conferencing have revolutionized collaboration and communication within the organization. Employees also have access to other technologies which support working from remote locations, including application virtualization from Citrix and a virtual private network (VPN) infrastructure with enterprise-grade security.

Responsible lifecycle management—The seriousness with which we view our role as stewards of the environment is reflected in the way in which we manage our IT equipment. The mantra "reduce, reuse, recycle" is reflected in all stages of the equipment lifecycle from the purchase of energy-efficient equipment, to the deployment of energy-efficient technologies, to the responsible donation and disposal of retired equipment.

Focus on Business Improvement—Great River Energy's leadership emphasizes the role of each employee in thoughtfully analyzing current practices and in proposing improvements which further sustainable business and technology management practices.

Green IT—Life Cycle Aspects

- Regulatory compliance
- Responsible disposal & recycling
- Eco-labeling of IT products
- Green metrics and methodology
- Culture of sustainability

"Enterprises can no longer view programs that improve environmental performance across the PC fleet as optional. Organizations increasingly need to establish a plan that contributes to an overall corporate environmental strategy, without disrupting end users' operations." Gartner

Great River Energy

"Everything we do as a company is for the good of our members ... and our world."

Opportunities

Client hardware energy efficiency—Great River Energy’s IT division periodically evaluates available technologies to increase management and improve the efficiency of client devices throughout the organization. Although current computer usage patterns are not conducive to rigorous centralized power management approaches, opportunities for improvement do exist in the client and application virtualization space. As the company’s virtual application platforms are broadened, flexibility in conferencing and telecommuting will increase.

Green IT service management—Continued efforts to expand the scope of IT asset lifecycle and usage management will enable the company to gather and collate detailed information about the environmental impacts of technology at Great River Energy. This information will provide the foundation for further audits, improvements, and communications to stakeholders.

The Future

As the IT division continues to forge strong partnerships and directs its passion for the business towards initiatives that leverage improvements in technology, processes and practices, the Great River Energy IT division will continue to actively contribute to our company’s sustainability efforts by providing innovative solutions and support.

Great River Energy

Our three highest priorities [are] affordable rates, reliable service and environmental stewardship—it’s called our triple bottom line...



Competitive Rates



Reliable Service



Environmental Stewardship

These priorities serve as guiding principles for all of our actions. Our organization will do nothing for rates and reliability without assessing environmental implications. But, by the same token, we won’t do anything for the environment without fully considering the impact on rates and reliability. Ultimately, it is about conducting business in a way that benefits both sustainability and the bottom-line.