
**The Energy Savings and
Emission Reduction Benefits
Delivered by Johnson Controls
and Its Customers In the
State of Wisconsin**

Case Study: UW-Madison

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**A Cleaner and GreenerSM
Environment Program Report
by Leonardo Academy Inc.**

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Executive Summary

This report assessed the economic, environmental, public health, and other quality-of-life impacts on the University of Wisconsin Madison (UW-Madison) campus from Energy Performance Projects, implemented by Johnson Controls, Inc. (JCI). The analysis shows that these energy efficiency projects provide major short term and long term environmental, energy supply and financial benefits.

The analysis indicates that as a result of energy efficiency projects implemented since 1995 at UW-Madison, Johnson Controls has already made a major contribution to saving energy and reducing a wide range of types of emissions in Wisconsin. The actual carbon dioxide emission reductions from these projects have already reached 884,000 tons and have produced \$12.7 million in total energy savings.

UW-Madison energy performance contracts implemented through March of 2004 will continue to produce energy and emission savings over the next 10 to 25 years. These projects are expected to produce over \$75 million in total energy savings and significantly reduce air emissions in Wisconsin. Emission reductions include carbon dioxide emissions by 8.9 million tons, nitrogen oxide emissions by 20,000 tons and sulfur dioxide emissions by 69,000 tons. These projects will also result in over 1.7 billion gallons of water savings. The study also indicates tremendous benefits to public health for Wisconsin residents as a result of the reduced emissions.

Background

The international debate about the potential impacts of global climate change is increasingly moving beyond science into the economics of emission reduction strategies and the policies that are needed to best mitigate potential impacts. Both the 1997 Kyoto accords and the 1992 Rio Earth Summit promoted international efforts to reduce greenhouse gas (GHG) emissions. The U.S. chose not to ratify the Kyoto Protocol, but under the Agreement, the U.S. would have been required to limit greenhouse gas emissions to 7 percent below 1990 levels on average between the years 2008 - 2012. Most climate change experts agree that significant actions are necessary to achieve this goal since total U.S. GHG emissions continue to rise. In 1999, carbon dioxide emissions were 11.7% above the 1990 emission level of 1,349 million metric tons and projected by 2010 and 2020 to reach levels 34 % and 51 % higher, respectively, than 1990.¹

While ultimately an international issue, state government agencies and private companies are increasingly active in climate change discussions. The key reason is that the federal government is seeking to limit “command and control” measures and encourage marketplace leadership as a way of implementing initiatives to reduce GHG and other emissions. Energy Service Companies (ESCOs) play an active role in researching, developing and implementing mitigation strategies to reduce GHG and other emissions. This report shows the important contribution energy efficiency improvements and performance contracting can make towards reducing all types of emissions in Wisconsin.

Findings

Johnson Controls’ efforts to make UW-Madison buildings more useful, productive and energy efficient have resulted in substantial energy and cost savings for the University of Wisconsin. These efforts have also produced added environmental and health benefits from the resulting pollution reductions.

The benefits to date (1995-2003) from JCI UW-Madison efficiency projects include:

- Energy cost savings of \$12.7 million

- Electric energy savings of 228,143 MWh (enough to power 26,665 Wisconsin households for one year)⁷
- Reduced carbon dioxide emissions of 884,400 tons (equivalent to planting 2.7 million trees or offsetting the annual emissions of over 174,000 mid-sized automobiles for one year)⁴

The cumulative benefits from JCI UW-Madison efficiency projects through their useful lives (1995-2026) include:

- Energy cost savings of \$75.1 million
- Electric energy savings of 796,730 MWh (enough to power over 93,120 Wisconsin households for one year)⁷
- Electric demand reductions equal to 10 MW
- Reduced carbon dioxide emissions of 8.9 million tons (equivalent to planting 27 million trees or offsetting the annual emissions of 1.7 million mid-sized automobiles for one year)⁴

Reducing emissions positively impacts the general health of the public. Environmental emissions cause significant health problems among children, the elderly and people with compromised immune systems. Air pollution has also been linked to increased incidence of asthma in children. Cutting energy consumption reduces the emissions that heighten these health problems.

Reducing the demand for electricity increases the reliability of the power supply in Wisconsin. In addition, investments in cost-effective energy efficiency measures have been shown to deliver local employment and income benefits. Businesses in Wisconsin are able to spend less on imported fuels and electricity and this lowers their cost of delivering products and services to Wisconsin residents and businesses. This results in increased competitiveness, productivity, and profitability for Wisconsin businesses.

Project Participants

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Leonardo Academy, Inc. is an independent non-profit organization, which runs the national *Cleaner and Greener Environment Program*. Leonardo Academy is funded by grants from foundations, government contracts and private donations. Leonardo Academy provides independent analysis and recognition for companies and their customers who implement energy efficiency improvements. Leonardo Academy helps businesses and organizations equate energy savings to equivalent emission reductions in an effort to promote the development of markets and financial rewards for the emission reductions that result from energy efficiency and other emission reduction actions. For more information about Leonardo Academy or the *Cleaner and Greener Environment Program* visit their website at www.cleanerandgreener.org.

Johnson Controls is a Fortune 150 company that develops and implements cost-effective strategies to make buildings more useful, productive and energy efficient. Performance contracting is a funding mechanism that pays for these strategies through the energy savings realized by the plan. Close measurement and verification of energy use is key to determining savings, thus the company's figures are very reliable.

The company's primary customers include K-12 schools, commercial and industrial buildings, retail chain stores, and local and federal government buildings. This study provides an independent assessment of the energy, environmental, economic, and public health benefits Johnson Controls delivers through its business practices in Wisconsin.

Project Overview

Introduction

Johnson Controls is a leading provider of energy management systems and services. It has also taken a leadership position in building green. For example, the company's corporate headquarters, the Brengel Technology Center, was recognized by the U.S. Green Building Council as a model of green building design when it was completed in 2000.

Johnson Controls' efforts to make buildings more useful, productive and energy efficient have produced substantial energy use savings. Since 1990, the company's customers have realized these savings as a result of implementing improvement projects designed to optimize their buildings for energy efficiency. Johnson Controls has lowered its own facilities operating costs, too.

This study reports the energy savings impacts of Johnson Controls energy efficiency projects at the University of Wisconsin-Madison implemented as part of the Wisconsin Energy Initiative. The improvement projects contribute to reductions in energy use, demand for electricity, direct fuel use and environmental emissions. Benefits are measured and recognized on three levels:

- (1) As savings on direct energy costs, realized by UW-Madison
- (2) As reduced demand for both total energy and load capacity, realized by utilities or other energy providers
- (3) As reduced environmental emissions, the result of reductions in demand for generated power

The methodology and project data used for calculating the emission reduction benefits delivered by these projects are discussed in Appendix A. While a majority of a project's dollar investments are made upfront, the energy savings resulting from these investments continue to accrue for many years. Cost savings continue well beyond the project's payback period and are the result of yearly electricity and fuel savings. Actual contract lengths from 10 to 25 years were used to determine realized and projected savings on projects implemented from 1995 through 2004. Contracts implemented in this study include projected savings through 2026.

Do Energy Efficiency Projects Make a Difference

Johnson Controls offers a number of services to help building owners and facilities managers develop energy efficiency goals and action plans. The company works with customers to develop and implement cost-effective projects that upgrade buildings and increase their energy efficiency. For more than 10 years, the company has been a leader in helping industries throughout North America boost their bottom lines by using energy more efficiently.

According to the U.S. Department of Energy (DOE) and industry experts, nearly every organization can identify opportunities to further improve energy efficiency. And the impact of energy savings projects goes beyond an individual firm's bottom line.

By saving energy and improving the bottom line, companies are also helping the environment.

The value of environmental stewardship

As a by-product of energy production, power plants produce emissions harmful to individuals and the environment. Electricity reductions not only save money for customers but also result in substantial

emission reductions, which leads to environmental and health benefits from the resulting pollution reductions.

Reducing harmful greenhouse gas emissions is an international goal. Most participants in the 1997 Kyoto conference on International Climate Control committed themselves to reducing their combined annual greenhouse-gas emissions over the next decade to five percent below 1990 levels. Energy efficiency measures are a key component of a strategic approach to limit greenhouse gas emissions related to energy use.

Leonardo Academy is dedicated to raising awareness about the need to reduce all types of emissions including greenhouse gas emissions. A primary goal of the organization is to develop and provide better information on energy use and market trends. Since 1998, Leonardo Academy has been helping Johnson Controls and its customers track their participation in energy efficiency programs in order to benchmark how they make their operations more efficient, lower their energy costs and significantly reduce their demand for energy. By equating their energy savings directly into a reduction in emissions, it has helped Johnson Controls and its customers realize the value their energy-savings investments provide for the environment.

This report, published in January 2004, details Johnson Controls and University of Wisconsin-Madison efforts to make energy efficiency investments throughout campus operations in order to lower UW-Madison energy costs. Realized reductions in energy demand are converted into equivalent reductions in emissions. As of now, except for efforts in a few eastern-U.S. states, companies making investments to improve the energy efficiency of their operations receive no monetary benefit for reducing emissions. But the type of analysis in this report shows that the energy savings are real and quantifiable. Understanding the significance and value of reduced emissions is a first step in the process of lobbying regulatory authorities to give private companies emission reduction credits, which could eventually be used to benefit the environment or to offset investment in new energy efficiency technologies and services.

Project Results

The Wisconsin Energy Initiative and the University of Wisconsin-Madison Connection

In April of 1992, the State of Wisconsin announced the “*Wisconsin Energy Initiative*” (WEI), an ambitious \$50 million dollar six-year energy conservation program that would significantly reduce the energy consumption in state facilities and result in cost savings to Wisconsin taxpayers. The WEI involves comprehensive audits and upgrades to the State’s 6,800 buildings at 34 major facilities. By developing the WEI, the state is saving energy and taxpayer dollars, increasing employment and protecting the environment. It is the largest, most comprehensive energy efficiency program for state facilities in Wisconsin history.

Johnson Controls was selected as the coordinator of the WEI program. The audits concentrated on 1000 of the largest buildings to identify 20% of the opportunities that would produce 80% of the savings. In April of 1998, the State expanded WEI to include energy conservation opportunities beyond traditional lighting retrofits. Johnson Controls’ WEI team has audited over 35 million ft² of building space to identify energy efficiencies in heating, ventilating and air conditioning systems, building automation systems, and waterside savings. A significant portion of the JCI WEI program work was implemented on the UW-Madison Campus. An analysis of this work shows that Johnson Controls’ efforts to make UW-Madison buildings more useful, productive and energy efficient have provided major short term and long term environmental, energy supply and financial benefits for the University of Wisconsin.

Summary of UW-Madison Energy Savings and Emission Reduction Impacts from Johnson Controls Energy Efficiency Projects

JCI energy efficiency efforts have already produced substantial energy use savings in UW-Madison buildings. This has contributed a great deal towards reducing energy costs for these facilities. The electricity and fuel reductions not only save money for the and taxpayers but also result in substantial emission reductions and environmental and health benefits from the resulting pollution reductions.

Johnson Controls’ involvement with the University of Wisconsin will continue to make UW-Madison buildings more useful, productive and energy efficient and produce substantial energy use savings for years to come. This will contribute a great deal towards reducing energy costs for the University. This is vital in times of ever-tightening budgets and the current climate of large federal and state budget deficits.

Part 1 - The Benefits to Date from Johnson Controls UW-Madison Energy Efficiency Projects

Johnson Controls efforts to make buildings more useful, productive and energy efficient have already produced substantial energy use savings on the UW-Madison Campus. These energy savings have contributed a great deal towards reducing energy costs for the University. The electricity and fuel reductions not only save money for customers but also result in substantial emission and pollution reductions and environmental and health benefits.

Energy and Water Savings

The study indicates that as a result of energy efficiency projects implemented from 1995 through 2002, Johnson Controls has already made a major contribution to saving energy and reducing a wide range of types of emissions. The UW-Madison energy efficiency projects have produced guaranteed energy cost

savings of \$12.7 million, water savings of 40 million gallons, and electric energy savings of over 228,000 MWh, enough electric energy savings to power 26,665 Wisconsin households for one year (Table 1).⁷

Table 1. Energy and Water Savings to Date of JCI UW-Madison Energy Efficiency Projects

Savings Category	Project Impacts to Date (December 2003)
Energy Savings (Million \$)	\$12.7
Electricity Savings (MWh)	228,143
Reduction in Steam Use (Mlbs)	5,765,926
Natural Gas Reductions (therms) Resulting from Steam Savings	11,888,040
Coal Reductions (tons) Resulting from Steam Savings	223,926
Reduction in Water Use (Million Gallons)	40

Emission Reductions

The emission reduction estimates, which were developed using standard industry calculations and emission factors, show that the Johnson Controls energy efficient projects have already resulted in large emission reductions. Energy efficiency measures also have an added benefit in that the individual efficiency actions reduce multiple pollutants.

The study indicates that, to date, energy efficiency projects implemented by the JCI UW-Madison energy efficient projects have reduced U.S. carbon dioxide emissions by over 884,000 tons (Table 2). NO_x and SO₂ emissions also were reduced by roughly 2,000 and 6,100 tons respectively.

Table 2. Emission Reduction Impacts to Date from JCI UW-Madison Efficiency Projects

Emission Type	Project Impacts to Date (December 2003)
Carbon Dioxides (CO ₂) - Short Tons	884,400
Nitrogen Oxides (NO _x) - Short Tons	1,989
Sulfur Dioxides (SO ₂) - Short Tons	6,097
Particulates (PM ₁₀) - Short Tons	292
Mercury (Hg) – lbs.	490

Environmental Benefits⁴

Energy and emissions savings from the JCI UW-Madison energy efficiency projects to date have also produced significant benefits for the environment. The reduction of energy and emissions provided environmental benefits equivalent to:

- Offsetting the effects of 174,000 mid-sized automobiles from the environment for one year
- Planting over 2.6 million trees

Part 2 - The Cumulative and Annual Benefits from Johnson Controls UW-Madison Energy Efficiency Projects

Johnson Controls' efforts to make buildings more useful, productive and energy efficient produce substantial energy use savings in the State of Wisconsin. This contributes a great deal towards reducing

energy costs for state businesses. While a majority of the project dollar investments are made upfront, the energy savings resulting from these investments continue to accumulate over many years. These energy savings continue well beyond the project's payback period and are the result of yearly electricity and fuel savings. The electricity and fuel reductions not only save money for customers but also result in substantial emission and pollution reductions and environmental and health benefits.

Energy and Demand Savings

Johnson Controls' UW-Madison performance contracts implemented through 2004 will continue to produce energy and emission savings over the next 10 to 25 years. The UW-Madison projects are expected to produce energy cost savings of over \$75 million, electric energy savings of 797,000 MWh (enough electric energy savings to power over 93,000 Wisconsin households for one year) and electric demand reductions equal to 10 MW (Table 3).⁷

Table 3. Energy and Demand Savings from JCI UW-Madison Energy Efficiency Projects

Savings Category	Combined Annual Impacts of All Projects	Cumulative Impacts of Projects
Energy Savings (Million \$)	\$4.4	\$75.1
Electricity Savings (MWh)	53,438	796,730
Electric Demand Reduction (MW)	10	N/A
Dollar Value of Demand Reduction (Million \$)	\$5.1	N/A
Reduction in Direct Natural Gas Use (therms)	337,248	5,058,714
Reduction in Steam Use (Mlbs)	3,018,996	73,622,620
Additional Natural Gas Reductions (therms) Resulting from Steam Savings	6,205,991	149,910,355
Coal Reductions (tons) Resulting from Steam Savings	117,310	2,865,724
Reduction in Water Use (Million Gallons)	126	1,766

Emission Reductions

The emission reduction estimates show that the JCI energy efficient projects result in tremendous emission reductions through the life of the projects. Energy efficiency measures also have an added benefit in that individual efficiency actions reduce multiple pollutants.

The study indicates that UW-Madison energy efficiency projects implemented by JCI are expected to reduce U.S. carbon dioxide emissions by 8.9 million tons (Table 4). NO_x and SO₂ emissions also are reduced by roughly 20,000 and 69,000 tons respectively.

Table 4. Emission Reduction Impacts from JCI UW-Madison Efficiency Projects

Emission Type	Combined Annual Impacts of All Projects	Cumulative Impacts of Projects
Carbon Dioxides (CO ₂) - Short Tons	388,772	8,880,581
Nitrogen Oxides (NO _x) - Short Tons	883	20,300
Sulfur Dioxides (SO ₂) - Short Tons	2,907	68,805
Particulates (PM ₁₀) - Short Tons	143	3,428
Mercury (Hg) – lbs.	253	6,151

Environmental Benefits⁴

The cumulative energy and emissions savings from the JCI UW-Madison energy efficiency projects produce significant environmental benefits equivalent to:

- Offsetting the effects of 1.7 million mid-sized automobiles from the environment for one year
- Planting over 26 million trees

Conclusion

Johnson Controls, Inc. and the University of Wisconsin-Madison are proof that energy efficient building design and improvements can play a substantial role in lowering overall energy and operations costs and reducing pollution leading to environmental and health benefits.

Reducing emissions positively impacts the general health of Wisconsin. Environmental emissions cause significant health problems among children, the elderly and people with compromised immune systems. Air pollution has also been linked to increased incidence of asthma in children. Cutting energy consumption reduces the emissions that heighten these health problems.

In addition, investments in cost-effective energy efficiency measures have been shown to deliver local employment and income benefits. Johnson Controls and their Wisconsin customers are able to spend less on imported fuels and electricity and this lowers their cost of producing goods and delivering services. This results in increased competitiveness, productivity, and profitability for these businesses.

By working to meet its Wisconsin customers' needs, Johnson Controls makes a major contribution to the local quality of life and reduction of energy use and emissions. Since the UW-Madison projects are in State-owned facilities, Wisconsin taxpayers also benefit from the resulting energy savings. Investments in more efficient technology consume less energy yet delivers a similar and often improved level of comfort, light, motion, and power. These projects, encouraged through Johnson Controls' involvement, provide significant contributions to economic development, a cleaner environment, and improved public health.

References

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- 2 Emission Factors and Energy Prices for the Cleaner and Greener Environmental Program, Leonardo Academy, Jan. 2003.
- 3 U.S. DOE / EIA 1605(b) Voluntary Reporting of Greenhouse Gases Appendix G. Adjusted Electricity Emission Factors by State, February, 2002
- 4 EPA's National Emission Trends (NET) database, October 2001 version, EPA Office of Air and Radiation – AIRDATA
- 5 American Forests Web Site: <http://www.americanforests.org/resources/ccc/>; 1 ton CO₂ = 3 trees planted, 1 Mid-sized car = 10,168.3 lbs. CO₂ per year (Annual: 509 gallons, 22.2 mpg, 11,300 miles)
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Appendix A

Methodology for University of Wisconsin-Madison Energy Performance Contracts

The energy savings and emission reduction benefits delivered by the UW-Madison Energy Performance Contract Projects were based on guaranteed annual dollar, electricity and fuel energy savings within each of the individual projects. The Johnson Controls–Appleton, Wisconsin Office provided source project energy and cost data used in the analysis (Tables A1 and A2).

The Analysis was based on the following assumptions:

- The length of Guaranteed Performance Contracts ranged from 10 to 25 years.
- Electric Demand Reduction (kW) from New Investment was calculated using annual electricity savings (kWh per year) divided by the hours in a year. The annual kW savings were divided by a capacity factor of 60% to calculate the kW demand reduction.
- Applicable Wisconsin state average emission factors were applied to the electricity (kWh) to calculate emission reductions.
- U.S. EPA and U.S. DOE standard emission factors were applied to natural gas (therms), and steam (Mlbs) savings to calculate emission reductions. Steam savings were converted to coal or natural gas savings based on the source fuel for the specific project's steam generation.
- Wisconsin average monthly consumption per residential consumer is equal to 713 kWh per month
- The analysis considered four different time frames of project impacts:
 - Project Impacts to Date – equals the sum of the annual energy, economic, and environmental impacts of projects for every year from their implementation date through the end of 2003
 - Average Annual Project Impacts – equals the cumulative energy, economic, and environmental impacts of projects divided by the total number of years in the study period (not shown in the project results section)
 - Combined Annual Impacts of All Projects - the sum of the annual impact for when all of the projects overlap in the same year (the year 2005 was used for this analysis)
 - Cumulative Impacts of Projects - equals the sum of all of the project's cumulative energy, economic, and environmental impacts over their contract period (10 to 25 years in length)

Johnson Controls UW-Madison Energy Performance Contracting Project Data

Table A1. Installation Date By UW-Madison Project

Name of Project	Project Installation Date (completed)
WEI 1 UW Madison I	March 1995
WEI 1 UW Madison II	September 1995
WEI 1 UW Madison III	March 1996
WEI UW-Madison Charter I	October 2001
WEI UW-Madison Charter II	October 2001
WEI UW Madison Biotron	November 2001
WEI UW Madison 1	March 2002
WEI UW Madison 2	March 2002
WEI UW Madison 3	September 2002
WEI UW Madison 4	September 2003
WEI UW Madison 5	September 2003
WEI UW-Madison 6	March 2004

Table A2. Projected Annual Energy Savings By JCI Energy Performance Contracting Project

Project Name	Annual Energy Savings				
	Dollars (\$)	Electricity (kWh)	Natural Gas (Therms)	Steam (Mlbs)	Water (gallons)
WEI 1 UW Madison I	\$382,555	7,092,629			
WEI 1 UW Madison II	\$493,251	11,470,965			
WEI 1 UW Madison III	\$431,972	10,045,860			
WEI UW-Madison Charter I	\$312,000			2,847,123	
WEI UW-Madison Charter II	\$730,000	999,999			
WEI UW Madison Biotron	\$38,149	754,367		2,795	
WEI UW Madison 1	\$145,196	1,410,891		22,200	11,847,958
WEI UW Madison 2	\$102,097	1,558,032		4,510	11,464,001
WEI UW Madison 3	\$278,482	2,835,805		39,380	16,765,000
WEI UW Madison 4	\$503,239	5,508,401		52,807	48,808,530
WEI UW Madison 5	\$567,185	7,320,949		50,181	36,630,195
WEI UW-Madison 6	\$411,162	4,440,444	337,248		
Total JCI UW-Madison Project Annual Energy Savings	\$4,395,288	53,438,342	337,248	3,018,996	125,515,684