The Energy Savings and Environmental Emission Reduction Benefits Delivered by Johnson Controls Energy Savings Performance Contracting Projects

A Cleaner and Greener Program Report

by

Leonardo Academy Inc.

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Preface

Introduction to Leonardo Academy's Cleaner and Greener Environment Program

This report on the environmental benefits of the energy efficiency delivered by Johnson Controls for its customers in USA was prepared as part of Leonardo Academy's Cleaner and Greener Environment Program. Leonardo Academy is an independent 501c(3) energy efficiency and environmental nonprofit organization funded by grants from foundations, government contracts and donations. Leonardo Academy works to reduce environmental emissions by reporting emission reductions, promoting the development of markets for the emission reductions that result from energy efficiency and other emission reduction actions, and making it easy for consumers to contribute directly to reducing environmental emissions.

Leonardo Academy's Cleaner and Greener Environment Program is designed to help move market based energy efficiency and renewable energy into its appropriate role at the center of emission reduction and environmental improvement.

The Cleaner and Greener Environment Program has four components:

1. Making environmental regulation safe for energy efficiency and renewable energy. Today, most environmental regulation excludes these important sources of environmental emission reduction. The Cleaner and Greener Environment Program is working to have efficiency and renewable energy recognized as full players in achieving emission reductions by structuring environmental regulation so all energy efficiency and renewable energy projects can receive the economic value of their contribution to emission reductions in the marketplace.

2. Providing recognition for businesses, organizations, and individuals that contribute to emission reductions by implementing energy efficiency and renewable energy projects. To accomplish this the Cleaner and Greener Environment Program carries out analyses of environmental and other benefits delivered by companies, organizations, and individuals that implement energy efficiency and renewable energy projects, and also presents awards for outstanding achievements.

3. Demonstrate that low cost environmental emission reductions are available from energy efficiency and renewable energy.

4. Demonstrate that people, organizations, and businesses want the low cost emission reductions provided by energy efficiency and renewable energy. To accomplish this the Cleaner and Greener Environment Program makes it easy for individuals, organizations and businesses to acquire emission reductions to offset the environmental emissions caused by their direct and indirect energy use.

Invitation to Participate

Individuals, organizations and businesses are invited to participate in the Leonardo Academy's Cleaner and Greener Environment Program and help us move market based energy efficiency and renewable energy into the center of the environmental improvement actions where it belongs. Please contact us using the information on the inside of the front cover or visit our web site at http://www.cleanerandgreener.org/.

Michael Arny, Director, Leonardo Academy, Madison, Wisconsin July 24, 1998

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Section 1: Study Results

Overview

This report from Leonardo Academy's Cleaner and Greener™ Program assesses energy efficiency, environmental emissions reductions, and other the quality-of-life impacts (economic, public health and environmental) of energy efficiency projects implemented by Johnson Controls, Inc. for its customers in a competitive marketplace without government subsidies. The report indicates that the increased energy efficiency delivered by the projects that Johnson Controls implements for its customers between 1990 and 2010 would reduce U.S. carbon dioxide emissions by 352 million tons. It also indicates that these projects will also deliver benefits to public health because of the reduced emissions, and increased economic development.

Leonardo Academy is an independent 501c(3) energy efficiency and environmental nonprofit organization funded by grants from foundations, government contracts and donations. Leonardo Academy works to reduce environmental emissions by reporting emission reductions, promoting the development of markets for the emission reductions that result from energy efficiency and other emission reduction actions, and making it easy for consumers to contribute directly to reducing environmental emissions. It runs the national Cleaner and Greener™ Program that provides independent analysis and recognition for companies and their customers that work to increase energy efficiency and reduce environmental emissions.

This report on Johnson Controls' quality-of-life impacts (economic, public health and environmental) follows an earlier study prepared by Leonardo Academy for the Department of Energy's Energy Fitness Program, a part of DOE's Rebuild America. That earlier report provided an initial assessment of the economic and environmental impact of members of the National Association of Energy Service Companies (NAESCO).

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. Additionally, the United States Climate Change Action Plan established the goal of reducing GHG emissions to their 1990 levels by the year 2000. Most climate change experts agree that significant actions are necessary to achieve this goal since U.S. GHG emissions already have risen 8% between 1990 and 1996, as strong economic growth and declining energy prices caused energy use to increase.

While ultimately an international issue, private companies are increasingly active in climate change discussions. The key reason is that the federal government is seeking to use market-based approaches for implementing initiatives to reduce environmental emissions including greenhouse gases. If well designed, these market-based approaches to emission reductions will create competitive markets where energy efficiency based emission reductions can compete directly with other sources. These markets will give emission reductions from energy efficiency a market value and create an added revenue stream for energy efficiency projects. This added revenue steam will allow more energy efficiency measures to be included in energy savings performance contracting projects.

Johnson Controls, like other ESCOs, plays an active role in researching, developing and implementing energy efficiency projects as part its energy savings performance contracting business. Johnson Controls is already making a major contribution to reducing environmental emissions including greenhouse gases. Johnson Controls can do a lot more to reduce environmental emissions including greenhouse gases if environmental regulations for pollutants like NOx, small particulates and greenhouse gases are designed to fully incorporate efficiency based emission reductions. To fully incorporate efficiency based emission reductions these regulation needed to be structured so that they create fully competitive emission reduction markets and so that they allow emission reductions from energy efficiency to be full players in these competitive markets.

This report has several purposes:

1. To provide recognition of the major contribution that energy efficiency projects of Johnson Controls and its customers are making to environmental emission reduction.
    - One company and its customers working to reduce U.S. carbon dioxide emissions by 352 million tons are a tremendous achievement.
    - One company and its customers working to reduce U.S. carbon dioxide emissions in 2010 by 17.6 million tons or one percent of what is needed to reduce emissions in 2010 from projected levels back to 1990 levels is also a tremendous achievement. If just 105 other companies and their customers step up to the plate and make an equally large contribution to emission reduction in 2010, the US will have achieved the Kyoto emission reduction goals.
2. To demonstrate that low cost environmental emission reductions are available from energy efficiency and renewable energy.
    - All the Johnson Controls energy savings performance-contracting projects analyzed here are designed so that energy savings pays for the efficiency improvements.
    - Johnson Controls guarantees that these savings will be delivered.
    - This means that emission reductions from these energy efficiency projects have a low net production cost.
3. To demonstrate the importance of opening environmental regulation so that it fully incorporates energy efficiency and renewable energy as sources of environmental emission reduction. Opening environmental regulation so that it creates competitive emission reduction markets that fully incorporate energy efficiency and renewable energy as sources of environmental emission reduction will:
    - Draw the low cost emissions reductions available from energy efficiency and renewable energy into the pool of emission reductions available in the marketplace.
    - Create increased competition among sources of emission reductions.
    - Increase the supply of sources of emission reductions, add low cost sources of emission reductions, and increase the competition among sources of emission reductions. All together this will work to reduce the total cost of reaching emission reduction objectives.

Description of Johnson Controls

Johnson Controls is a Fortune 200 company that develops and implements cost-effective strategies to make buildings more useful, productive and energy efficient. Johnson Controls works in three business areas that deliver energy efficiency to customers. It has a performance contracting business, which is addressed in this report, it also has a building automation systems business and an integrated facility management business. The company's primary customers

include K-12 schools, commercial and industrial buildings, retail chain stores, and local and federal government buildings.

Performance contracting is a funding mechanism that pays for the energy efficiency improvements and building upgrades that customers want and need with the energy savings delivered by the efficiency improvements. Close measurement and verification of energy use is key to determining savings, thus the company needs to gather very reliable performance information on its projects.

Findings

This study provides an initial and independent assessment of the energy, environmental, economic, and public health benefits Johnson Controls delivers, based on some 1,400 current long-term, multiple-year performance contracts with customers.

Energy Savings

According to Leonardo Academy's calculations, the cumulative total lifetime energy and demand savings from efficiency projects implemented by Johnson Controls between 1990 and 2010 will produce:

- $18 billion in total energy savings
- 270,000 Gigawatt hours (GWh) in electricity savings
- 3,425 Megawatts (MW) in electric demand reduction
- 1.5 billion (MMBTU) reduction in direct fuel use

Emissions Reductions

The emission reduction estimates, which were developed using standard industry calculations, show that these energy efficient retrofits will result in tremendous environmental emission reductions during the life of the contracts.

The Johnson Controls projects initiated between 1990 and 2010 will eliminate from our atmosphere approximately:

- 352 million tons of carbon dioxide
- 1.4 million tons nitrous oxide
- 1.9 million tons sulfur dioxide
- 34,000 tons of particulates (PM 10)
- 19,000 pounds of mercury
- 1,800 pounds of cadmium
- 33,300 pounds of lead emissions

Putting these Total Carbon Dioxide Emission Reductions in Perspective

The reductions in carbon dioxide emissions provides environmental benefits equivalent to:

- Removing 4 million gas-combustion motor vehicles from the environment
- Removing 9 new power plants with 400 megawatt capacity
- Planting 29 million acres of trees.

The study also indicates that, because energy efficient projects from Johnson Controls have 10- to 15-year project lives, more than half of the emission reduction will be delivered before 2010 and the balance will be delivered during the remaining life span of the projects following 2010.

These figures are conservative because they assume a constant rate of project implementation through 2010, while in fact, Johnson Controls rate of project implementation is increasing. These numbers also only include the performance contracting business, thus leaving out the impacts of Johnson Controls other businesses, including building automation systems and integrated facility management.

Global Climate Change and Kyoto Accords on Greenhouse Gas Emission Reduction
Carbon dioxide emissions in the year 2010 are the benchmark for measuring progress toward achieving the Kyoto Protocol goals. The study indicates that energy efficiency projects implemented by Johnson Controls in the competitive marketplace will reduce U.S. carbon dioxide emissions in 2010 by 17.6 million tons. This is one percent of the reductions necessary to decrease potential U.S. carbon dioxide emissions in 2010 to 1990 levels, clearly showing that performance contracting can significantly and positively impact environmental improvement.

Public Health and Jobs Benefits of Energy Efficiency
Environmental emissions cause significant health problems among children, the elderly and people with compromised immune systems. For example, environmental emissions increase the incidence of asthma. Reducing environmental emissions positively impacts the overall general health of the public. Additionally, the investment in energy efficiency provides economic development benefits. It is estimated that between 1990 and 2010, Johnson Controls efficiency projects will create some 9,000 jobs nationally. The projects create a variety of local employment opportunities, from electricians and pipeline installations to architects and engineers.

Conclusion
By working to meet its customers needs, Johnson Controls also makes a major contribution in the local quality of life, reduction of energy use and environmental emissions. Projects encouraged through Johnson Controls' performance contracts provide through the competitive-marketplace significant contributions to economic development, a cleaner environment, and improved public health.

Section 2: Analysis

Johnson Controls makes a major contribution to the reduction in electric energy use, electricity demand, direct fuel use and environmental emissions. Johnson Controls makes these contributions to increased energy efficiency and emission reduction by working with customers to develop and implement cost effective projects that upgrade buildings and increase their energy efficiency. This report is based on estimates of Johnson Controls performance contracting project activity. The emission reduction estimates were developed using standard industry calculations. Leonardo Academy is now working with Johnson Controls to develop reporting for the emission reductions from its projects on a project by project basis.

Energy and emission reduction savings resulting from each Johnson Controls project continue to accumulate over many years. In 1996, the cumulative reportable impacts from investments made from 1991 through 1996 were:

Reduction in electric energy use:	18,900 GWh
Reduction in demand for electricity:	1,027 MW
Reduction in direct fuel use:	105,000,000 MMBTU

Reduction in environmental emissions:

NOx:	100,806 short tons
CO2:	24,668,700 short tons
Mercury:	1,332 lbs.

This report used the conservative assumption that the amount of energy efficiency delivered by Johnson Controls efficiency projects would continue at a rate of 300 projects per year with an average project investment of $1 million from 1991 through 2010. These numbers also only include the Johnson Controls performance contracting business, thus leaving out the impacts of Johnson Controls other businesses that deliver energy efficiency, the building automation systems business and the integrated facility management business.

From 1991 through 2010, the cumulative reductions at the end of 2010 would be the following:

Reduction in electric energy use:	175,500 GWh
Reduction in demand for electricity:	3,425 MW
Reduction in direct fuel use:	975,000,000 MMBTU

Reduction in environmental emissions:

NOx:	936,060 short tons
CO2:	229,066,500 short tons
Mercury:	12,367 lbs.

Cumulative reductions measured at the end of 2010 do not take into account the energy and emission savings from the remainder of project lifetimes that occur after 2010 from investments made during and previous to the year 2010. Total lifetime energy savings from Johnson Controls efficiency projects implemented between 1991 and 2010 would be 270,000 GWh. Additional lifetime impact measurements can be found in Tables 6 and 7 in Section 3.

From these results it is clear that Johnson Controls makes a major contribution to the reduction in energy use and the reduction of environmental emissions. Johnson Controls delivers this energy efficiency in the competitive marketplace.

Removing the barriers to increased delivery of energy efficiency by Energy Service Companies will allow Johnson Controls to deliver even more building upgrades, energy savings, and reductions in environmental emissions for their customers.

Section 3: Tables and Figures

There are many different ways to measure the energy savings impacts of Johnson Controls efficiency projects. While a majority of the 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 reduction.

The impacts of Johnson Controls efficiency project investments were measured in two different ways. Tables 1 and 2 look at the cummulative impacts from Johnson Controls efficiency project investments from 1991 through 1996 measured at the end of the year in 1996. For example, in Table 1, projects implemented in 1992 would include 5 years of energy savings while projects implemented in 1995 would only include two years of savings. This allows us to look at the energy saving impacts up to one point in time. A second method of measuring Johnson Controls efficiency project investments over the entire project lives is described with Tables 5 and 6.

Table 1
Cumulative Energy and Demand Savings through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 1996

Impacts	Cumulative Impacts from 1991 through 1996
Electricity Savings (GWh)	18,900
Electric Demand Reduction (MW)	1,027
Reduction in Direct Fuel Use (MMBTU)	105,000,000

Table 2
Reportable Cumulative Environmental Emission Reduction through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 1996

	Cumulative Impacts from 1991 through 1996
Pollutants	
CO2 (short tons)	24,668,700
NOx (short tons)	100,806
SO2 (short tons)	138,236
PM10 (short tons)	2,390
Toxic Metals	
Mercury (lbs.)	1,332
Cadmium (lbs.)	123
Lead (lbs.)	2,329

Figure 1
Cumulative Reportable Toxic Metal Emission Reductions (lbs.) through 2010
Johnson Controls Efficiency Projects Implemented from 1991 through 1996

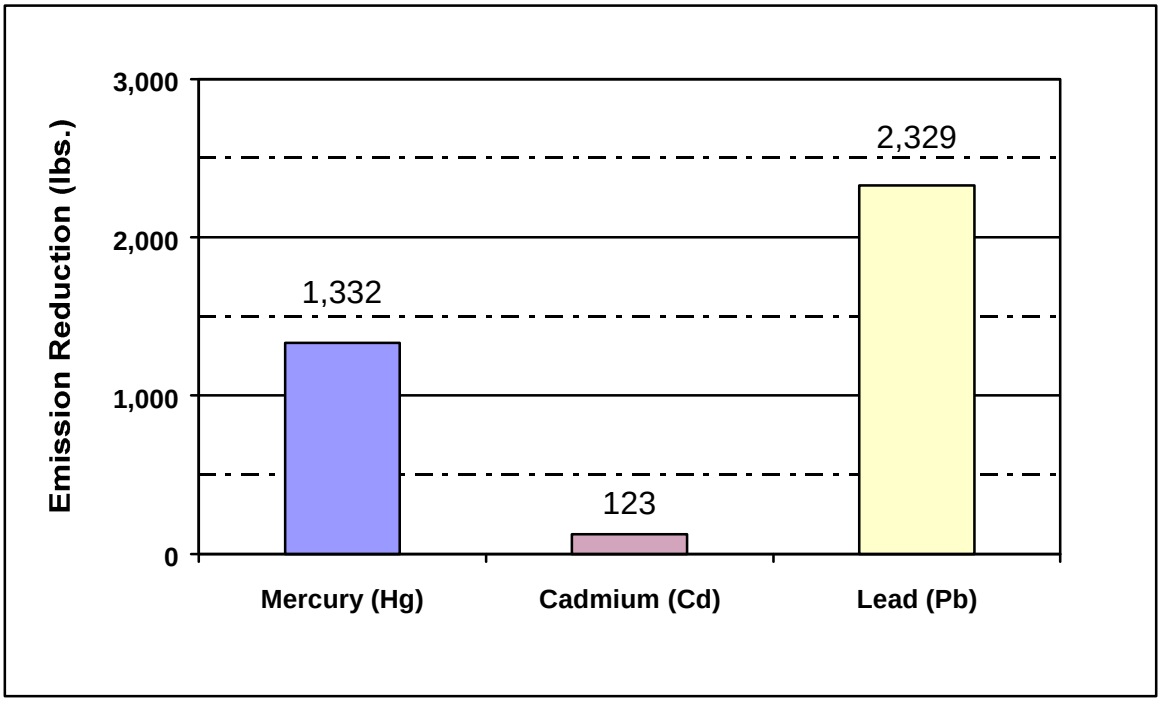


Table 3
Cumulative Energy and Demand Savings through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 2010

Impacts	Cumulative Impacts from 1991 through 2010
Total Investment (M$)	$6,000
Energy Savings (M$)	$11,700
Electricity Savings (GWh)	175,500
Electric Demand Reduction (MW)	3,425
Reduction in Direct Fuel Use (MMBTU)	975,000,000

Table 4
Cumulative Environmental Emission Reduction through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 2010

	Cumulative Impacts from 1991 through 2010
Pollutants	
CO2 (short tons)	229,066,500
NOx (short tons)	936,060
SO2 (short tons)	1,283,619
PM10 (short tons)	22,189
Toxic Metals	
Mercury (lbs.)	12,367
Cadmium (lbs.)	1,142
Lead (lbs.)	21,622

Figure 2
Cumulative Electric Energy (GWh) Savings through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 2010

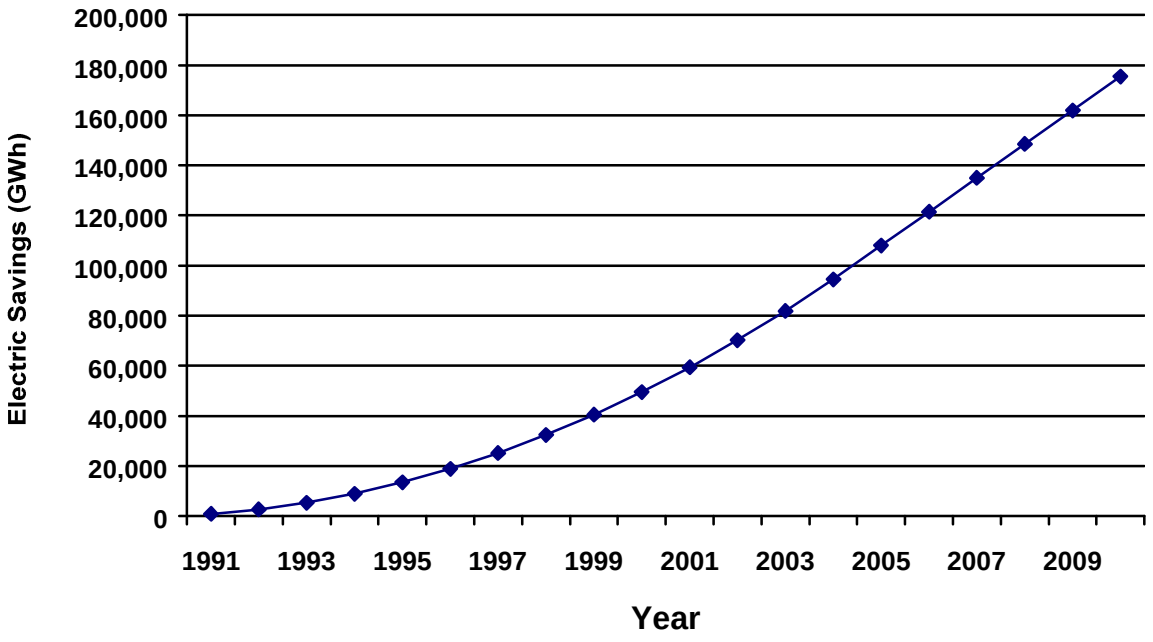


Figure 3
Cumulative Demand Savings (MW) through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 2010

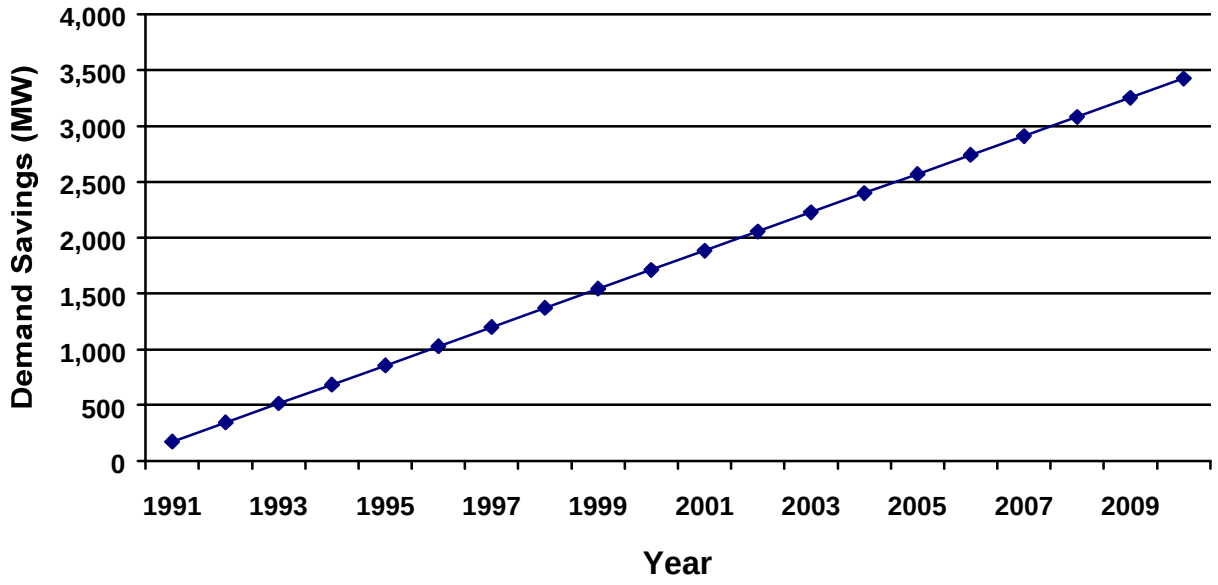


Figure 4
Cumulative Natural Gas Savings (MMBTU) through 2010 of Johnson Controls Efficiency Projects Implemented from 1991 through 2010

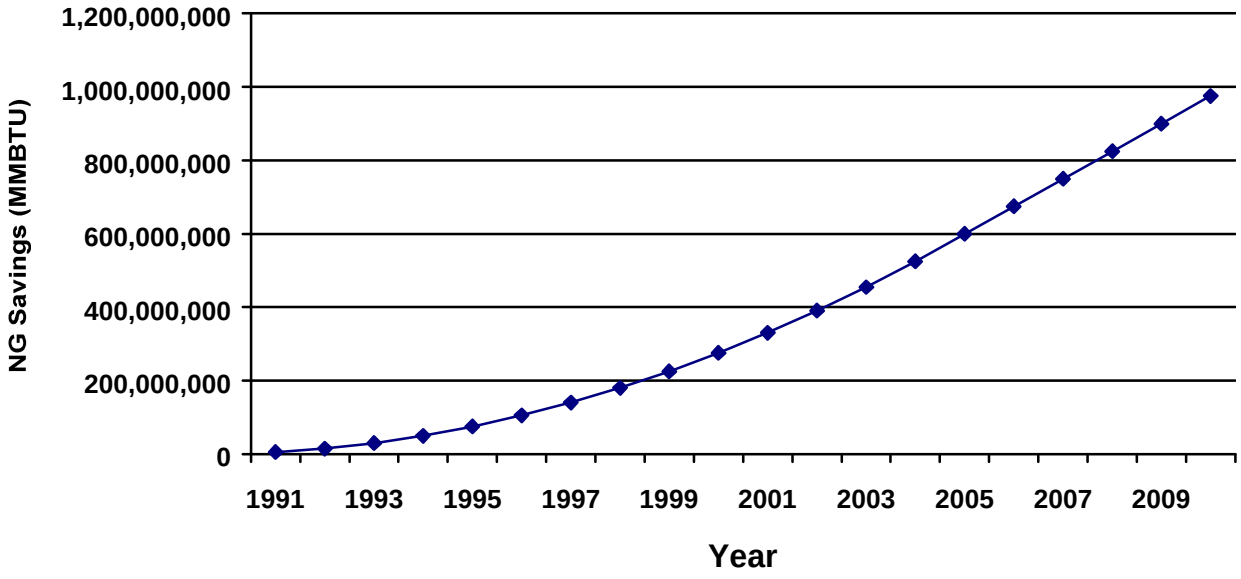


Figure 5
Cumulative NOx Emission Reduction (Short Tons) Delivered through 2010 by Johnson Controls Energy Efficiency Projects Implemented from 1991 through 2010

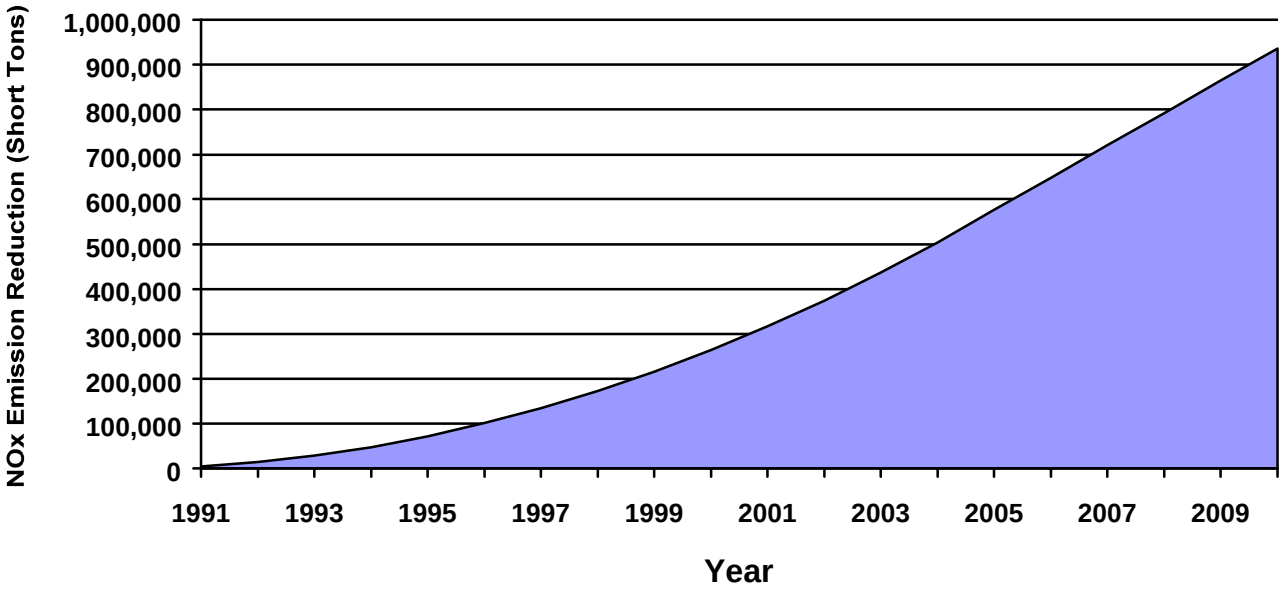


Figure 6
Cumulative Carbon Dioxide (CO_2) Emission Reduction (Short Tons) Delivered through 2010 by
Johnson Controls Energy Efficiency Projects Implemented from 1991 through 2010

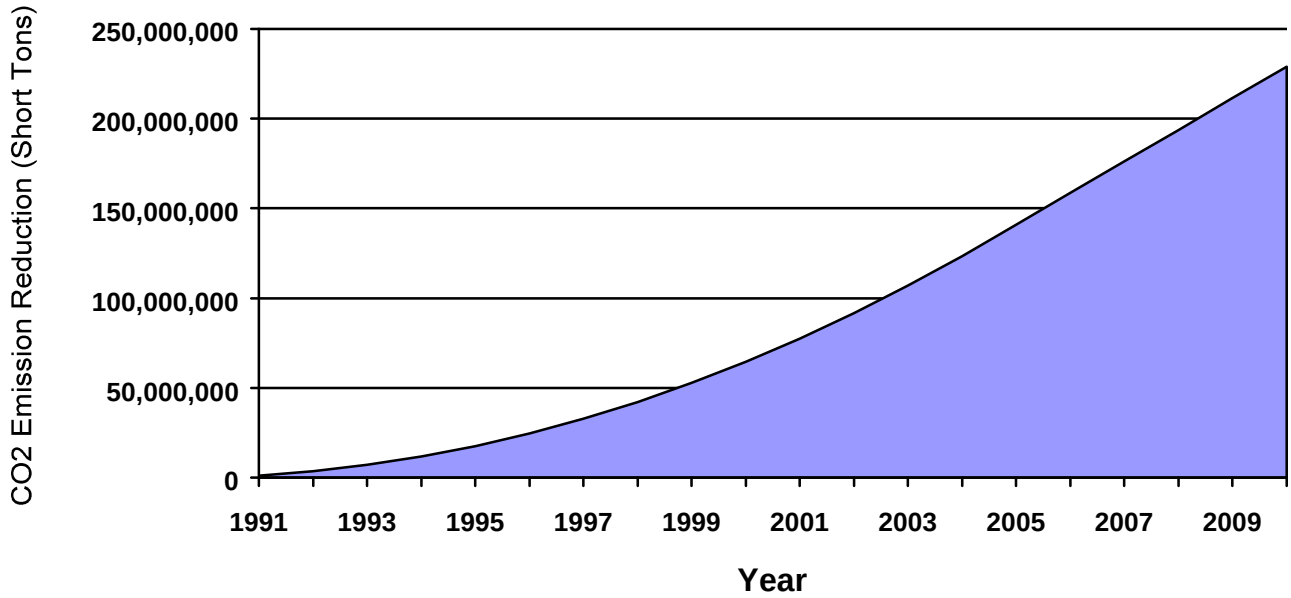
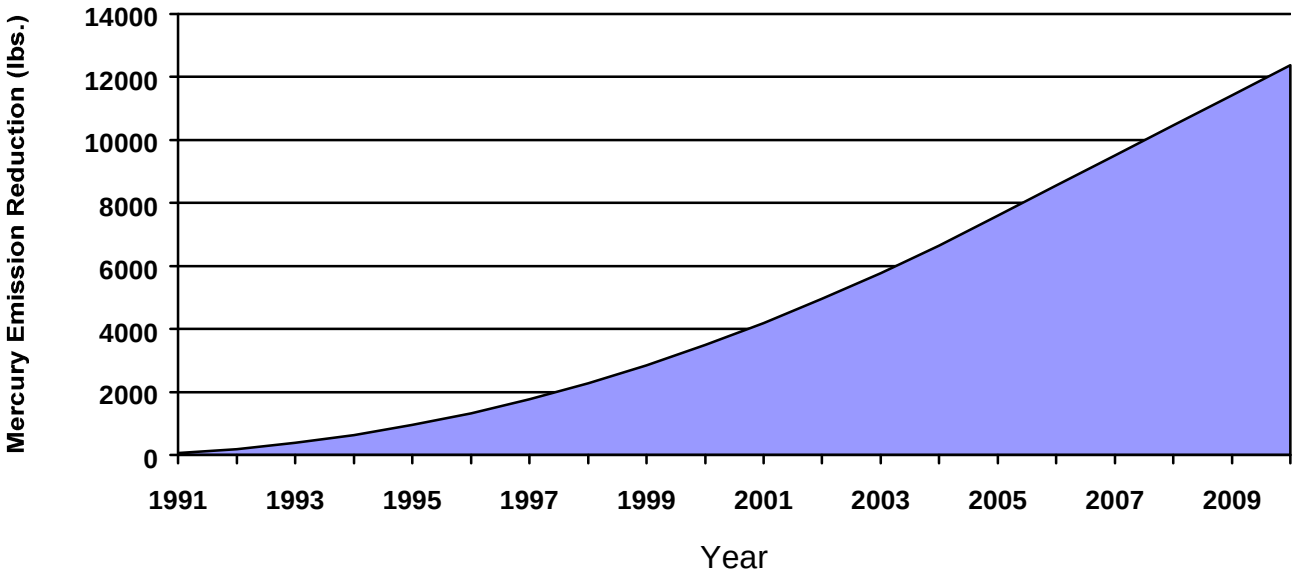


Figure 7
Cumulative Mercury Emission Reduction (lbs.) Delivered through 2010 by Johnson Controls Energy Efficiency Projects Implemented from 1991 through 2010



A second method of measuring the impacts of Johnson Controls efficiency project investments is shown in Tables 6 and 7. In these two tables we looked at the lifetime impacts of all projects implemented between the years 1991 through 2010. Cumulative reductions measured at the end of 2010 do not take into account the energy and emission savings from the remainder of project lifetimes that occur after 2010 from investments made during and previous to the year 2010. This method allows us to capture all of the energy savings over the lives of the projects for all projects implemented through the year 2010. An average project lifetime of 15 years was used in both scenarios.

Table 5
Total Lifetime Energy and Demand Savings from Johnson Controls Efficiency Projects Implemented Between 1991 and 2010

Impacts	Lifetime Impacts for Projects Implemented Between 1991 and 2010
Total Investment (M$)	$6,000
Energy Savings (M$)	$18,000
Electricity Savings (GWh)	270,000
Electric Demand Reduction (MW)	3,425
Reduction in Direct Fuel Use (MMBTU)	1,500,000,000

Table 6
Total Lifetime Environmental Emission Reduction from Johnson Controls Efficiency Projects Implemented Between 1991 and 2010

Impacts	Lifetime Impacts for Projects Implemented Between 1991 and 2010
Pollutants	
CO2 (short tons)	352,410,000
NOx (short tons)	1,440,092
SO2 (short tons)	1,974,799
PM10 (short tons)	34,138
Toxic Metals	
Mercury (lbs.)	19,026
Cadmium (lbs.)	1,756
Lead (lbs.)	33,265

Appendix A

Information about Leonardo Academy

Leonardo Academy Inc. is a 501(c)3 nonprofit organization founded in January of 1997 in Madison, Wisconsin. Leonardo Academy works on energy and environmental issues. The Academy is supported by contributions from individuals, organizations and grants.

Leonardo Academy uses an integrated interdisciplinary approach to addressing environmental and energy issues. This approach includes addressing the public policy objectives, the technical issues and potential role that competitive markets can play in public policy objectives. This approach leads to practical solutions to energy and environmental problems.

Leonardo Academy recognizes the importance of building the use of competitive markets into strategies for achieving environmental and energy objectives. The use of competitive markets can both drive down the costs of achievement of the objectives and stimulate innovation in how the objectives are achieved. The more that markets can contribute to solving energy and environmental problems, the more thoroughly regulation and other measures can address the remaining problems.

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Current Leonardo Academy Projects

1. Leonardo Academy supports delivery of the DOE Energy Fitness Program. The DOE Energy Fitness Program is part of the DOE Rebuild America Program. The DOE Energy Fitness Program is working to remove the barriers to increased delivery of energy efficiency by performance contractors. This work includes efforts on making the economic value of emission reduction from energy efficiency projects available to the owners of the energy efficiency projects. This work is carried out under contract with Oak Ridge National Laboratory.

2. Leonardo Academy is working with the Wisconsin Department of Natural Resources, the Wisconsin Energy Bureau, the USEPA, and the USDOE on developing a comprehensive emission reduction (including energy efficiency and renewable based reductions) reporting system that covers all greenhouse gases, NOx, particulates, mercury and other toxics. This work is being funded by the USEPA.

3. Leonardo Academy is developing an analysis of the cost and environmental emission reduction tradeoffs of various types of reduced emission (green) electricity. Leonardo Academy is also surveying the public on the willingness to pay incremental amounts for reduction in emissions. Leonardo Academy will use this information to help national and

local environmental and consumer groups decide, based on their own particular objectives and membership, the level and type of reduced emission electricity they want to recommend to their members. This work is being carried out with the support of a grant from the Joyce Foundation.

4. Leonardo Academy is working with the Minnesota Pollution Control Agency, Wisconsin Department of Natural Resources, Illinois Environmental Protection Agency, Michigan Department of Environmental Quality, and other state environmental protection agencies in the Great Lakes region to develop a market-based approach to regional mercury emissions reductions. Leonardo Academy has recruited the participation of the other states in the Great Lakes Region and is facilitating the Committee of the States, which is coordinating the involvement of the states in the region. The Committee of the States is made up of representatives from the environmental protection agencies in all of the states in the Great Lakes Region. The scope of this project includes the consideration of regional emission reduction programs such as a regional cap and trade program.

5. Leonardo Academy is an active participant on the USEPA Energy Efficiency-SIP Committee. This Committee is developing guidelines for states to include energy efficiency measures as part of their NOx SIP. This Committee includes representatives from state environmental protection agencies, state energy offices, the USEPA and USDOE.

6. Leonardo Academy is developing and distributing information about what restructuring needs to include in order to benefit consumers and the environment. Leonardo Academy has developed a comprehensive plan for restructuring from the perspective of what would be good for consumers, energy efficiency, renewable energy and the environment. Leonardo Academy is also advising three counties in Hawaii on these restructuring issues.

7. Leonardo Academy's Cleaner and Greener Environment Program
   This program is designed to help move market based energy efficiency and renewable energy into its appropriate role at the center of emission reductions and environmental improvement. The Program has Four components:
   a. Making environmental regulation safe for energy efficiency and renewable energy. Today, most environmental regulation excludes these important sources of environmental emission reduction. Leonardo Academy is working to opening environmental regulation so that it creates competitive emission reduction markets that fully incorporate energy efficiency and renewable energy as sources of environmental emission reduction.
   b. Providing recognition of businesses, organizations, and individuals that contribute to emission reductions by implementing energy efficiency and renewable energy projects.
   c. Demonstrating that low cost environmental emissions reductions are available from energy efficiency and renewable energy.
   d. Demonstrating that people, organizations, and businesses want the low cost emission reductions provided by energy efficiency and renewable energy.

Recently Completed Projects

1. The Wisconsin Greenhouse Gas Emission Reduction Studies that were chaired by the Director of Leonardo Academy. These studies received support from the USEPA and one received support from the USDOE. These studies included:

- Wisconsin Greenhouse Gas Emission Reduction Cost Study - This study shows that significant emission reductions can be achieved through actions that save more money that they cost. This study also identified the lowest cost ways to achieve higher levels of emission reductions.
- The Economic and Environmental Impacts of Investments in Energy Efficiency for Wisconsin - This study shows that reducing greenhouse gas emissions through increased energy efficiency saves money, increases employment, and increases economic activity in Wisconsin.

2. Leonardo Academy has participated actively with the Wisconsin Department of Natural Resources and the Wisconsin Energy Bureau in the development and drafting of the proposed Wisconsin State Action Plan.

3. Leonardo Academy prepared a report with support from the DOE Energy Fitness Program, on the overall impact of the ESCO industry on the delivery of energy efficiency and reductions in environmental emissions from 1990 - 2010.