
Greenhouse Gas Reduction Plan

Executive Summary

July 18, 2017



Worcester Polytechnic Institute

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Introduction: WPI's Commitment to Sustainability

The mission of WPI includes the commitment “To create, to discover, and to convey knowledge at the frontiers of academic inquiry **for the betterment of society.**” This commitment to the importance of societal impacts led to the creation of our Plan for Sustainability, including the major goal of development and implementation of a Greenhouse Gas (GHG) Reduction Plan. Recognizing that the increase of carbon dioxide and other greenhouse gases in the atmosphere is a major contributor to climate change, and further recognizing that the emission of these gases due to human activities is a primary cause of this increase, WPI commits to taking responsible action to track our emissions and to minimize the quantity emitted.

Accomplishments to Date

While this formal GHG reduction plan is just being finalized, WPI has been active in minimizing its environmental impact for many years. Salient accomplishments include the following:

- Implementation of campus-wide recycling in 1990, with major enhancements, 2006;
- Replacement of the central power house boilers with efficient, natural gas units, 2006;
- Commitment by the WPI Board of Trustees to design all future buildings to LEED standards, 2007 (Four LEED-certified buildings have been completed and a fifth is under construction.);
- Creation of the President’s Task Force on Sustainability, co-chaired by the Provost and CFO, 2007;
- Development and acceptance by the Board of Trustees of the **WPI Sustainability Plan**, 2013;
- Investment of approximately \$500,000 annually in energy efficiency upgrade work, beginning in FY2014;
- Receipt of AASHE STARS Gold rating for overall performance in operational, educational, research, and community aspects of sustainability, 2017.
- Establishment of a Green Revolving Fund to institutionalize the commitment to continued work to reduce energy and other resource consumption, FY18;

All of these activities have had a positive impact on the reduction of our direct or indirect¹ GHG emissions. While this GHG Plan is important, it is just one component of our overall commitment to sustainability as documented in our **WPI Sustainability Plan**.

¹ Direct campus emissions, such as from our boilers and vehicles, are referred to as Scope 1; emissions due to production of the electricity used on campus are referred to as Scope 2; other emissions related to WPI operations, such as commuting and business travel, are referred to as Scope 3.

Emissions History and Current Status

In the period after FY07 and continuing to the present WPI has been in a period of substantial growth in floor space, student, faculty and staff population, and research activity. All of this is reflected in the growth in energy usage and greenhouse gas emissions depicted in the early years of Figure 1. By FY09 we were emitting a total of 17,710 metric tons of CO₂e annually. This represents the highpoint for campus energy usage and emissions. Thanks to aggressive energy conservation work, even in a period when WPI added 263,000 gross square feet of floor space, our usage and our emissions have decreased. Without these efforts our utility usage, and cost, would have been expected to increase by about 15%, corresponding to approximately an additional 4.4 million kWh and 22,300 million BTU annually, along with an additional utility cost of approximately \$840,000. Another major contribution to reduction of GHG emissions was the conversion of our central heating plant from fuel oil to natural gas in FY06. This

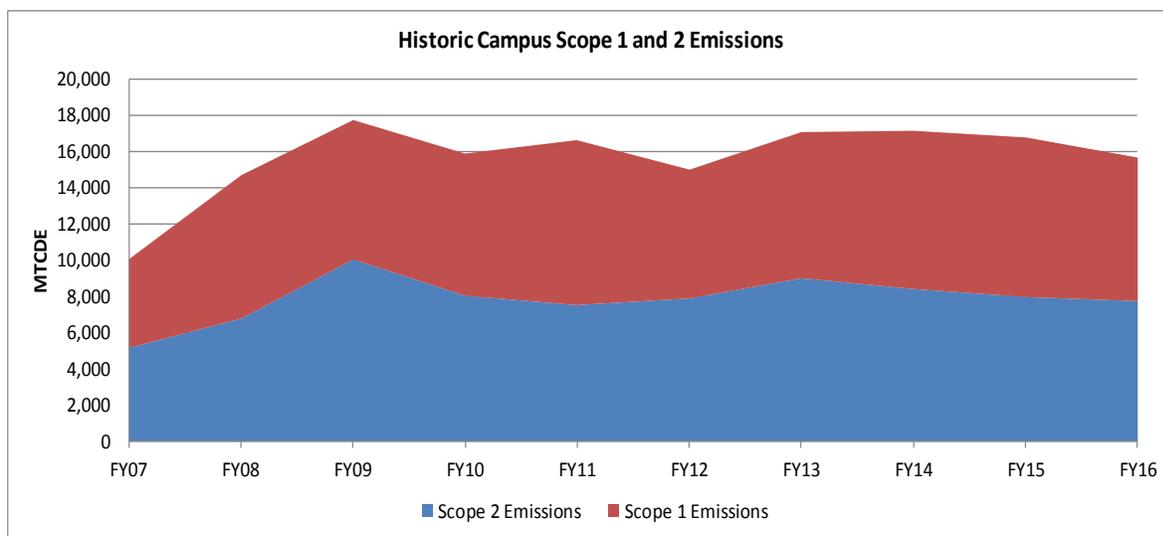


Figure 1 WPI Scope 1 and Scope 2 emissions. Scope 2 is due entirely to electricity use. Scope 1 is due primarily to natural gas for building heating with contributions from campus vehicles and power equipment.

conversion reduced our Scope 1 GHG production by approximately 25%.

Determination of GHG Reduction Actions

The cornerstone of essentially every GHG reduction plan is energy efficiency. Reduction of the amount of energy used by WPI reduces greenhouse gases, reduces the stress on the electric grid, and saves money. WPI has successfully implemented several major energy conservation efforts, targeting both electric and thermal energy. An extension of this program forms the basis for this Greenhouse Gas Reduction Plan. GreenerU, a firm with substantial experience in campus energy efficiency auditing and upgrades was engaged to continue previous work in auditing campus buildings for energy usage and efficiency upgrade potential.

Details of the building audit results are presented in the full report. These audits, together with previous, non-implemented building studies, demonstrate the potential for significant additional savings in energy, utility costs, and greenhouse gas emissions. If completely implemented, these specific projects would reduce WPI’s energy use by approximately 21.6 million BTU annually, or approximately 8.5% of total energy use. Further, an additional 38% of WPI’s building floor space appears feasible for energy upgrades.

Financial Aspects

An understanding of the financial as well as the energy and GHG implications of potential projects is essential. Figure 2 shows the simple payback periods for each studied project and Figure 3 shows the cumulative GHG savings as a function of project payback. This chart demonstrates that approximately 85% of the potential GHG savings can be realized with payback periods of 7.5 years or less.

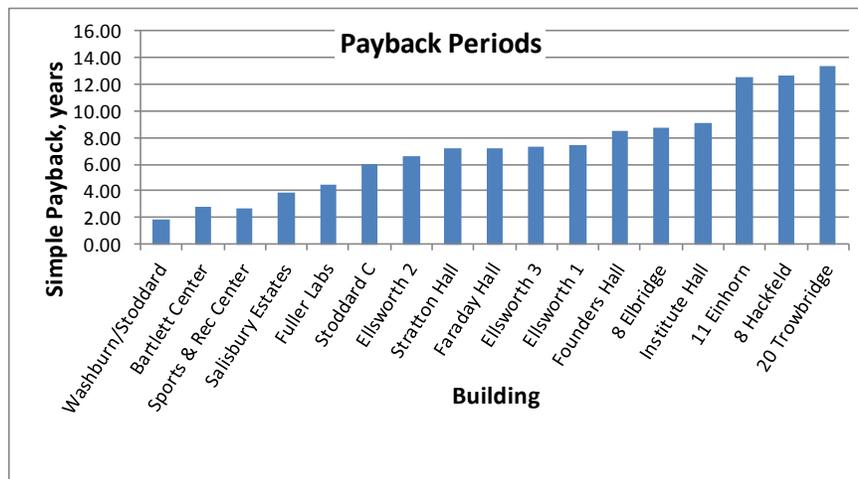


Figure 2. Simple payback periods for audited buildings, in order of increasing payback time.

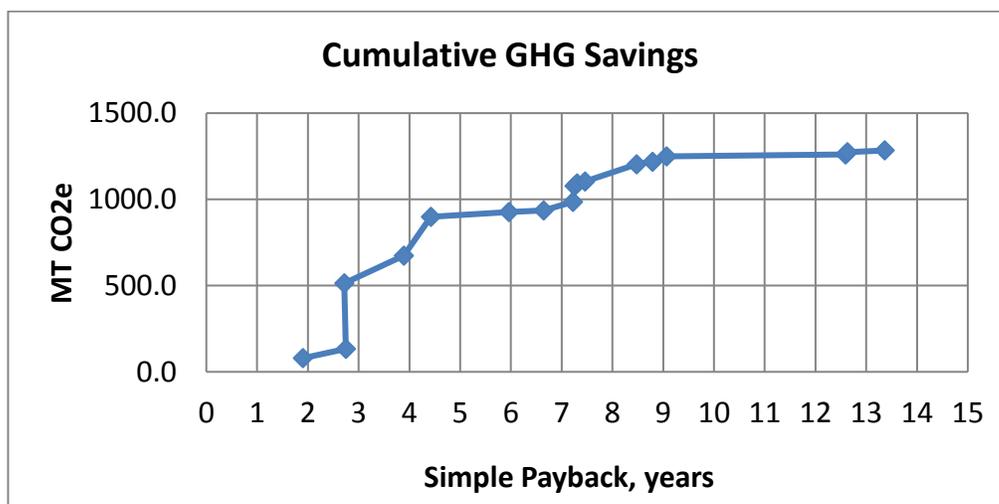


Figure 3. Total cumulative annual GHG savings achievable with multiple projects, ordered by project from the shortest payback period to the longest.

A key implication of the financial analysis is that all of these projects **pay back their implementation costs** in 7.5 years or fewer, and after the payback period, they provide an **annual savings in WPI's energy costs**. This is illustrated with the cash flow depicted in Figure 4 for one possible sequence of project implementation. It shows that in year seven the cumulative balance of WPI's investment cost and energy savings becomes positive, and continues to grow in future years. Of course this approximate analysis must be refined prior to project implementation.

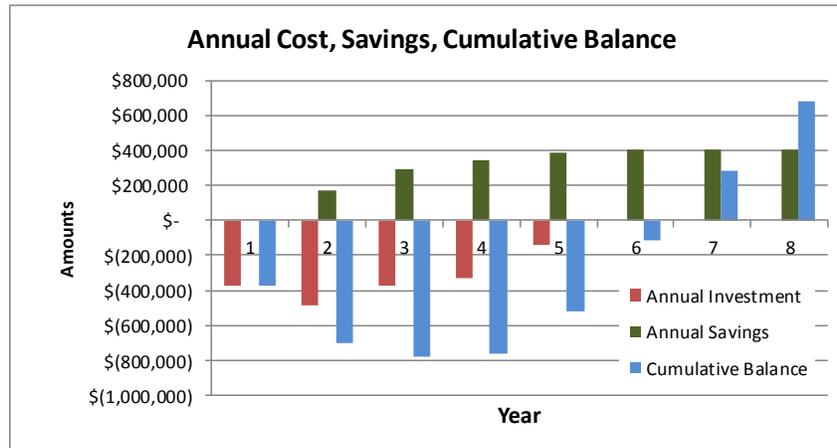


Figure 4. Illustration of one possible set of energy upgrades. The cumulative balance indicates the cumulative sum of investment costs (negative) and utility savings (positive), showing a net positive benefit in year 7 and beyond.

A common metric in GHG reduction studies is the **cost per metric ton of GHG reduced**. For the projects described here, that net cost over the payback period considering project investments balanced against utility savings will actually be **negative** – representing a **dollar savings** to WPI as well as a reduction in GHG emissions.

Goal and Related Commitments

WPI's goal, even as we grow in size, is to achieve a 20% reduction in gross Scope 1 and Scope 2 Greenhouse Gas emissions by FY25, relative to the benchmark year of FY14.

This goal can be achieved with implementation of the energy conservation plan presented in this report, together with small reductions due to additional efforts. To reach this goal WPI makes the following commitments:

1. WPI will strive to continue to reduce emissions at a rate that matches recent success, approximately 1.5% annually via continuation of the energy upgrade program. As has been demonstrated to date, continuation of these measures will yield net **financial savings** to WPI.

2. WPI will actively pursue the implementation of additional measures such as advanced energy conservation techniques, support for continued growth of “clean” electricity, and use of advanced heating/cooling technology.
3. WPI will undertake to measure and report those components of Scope 3 emissions (principally faculty/student/staff commuting and WPI-related travel) that are feasible to quantify, and to develop programs to reduce or compensate for these emissions.
4. WPI commits that its education will impart the knowledge and skills necessary for its graduates to bring about major reductions in greenhouse gas emissions through their careers.
5. Finally, WPI commits to continued support for its research programs that are advancing the scientific knowledge and the engineering implementations that will reduce greenhouse gas emissions globally.

Implementation Plan

The following strategies are recommended for implementation in the short (1-5 year) term for Scope 1 and 2 emissions:

- Energy Upgrades
 - Continuation of the program of thermal and electric energy efficiency upgrades to campus buildings at the rate of at least one major building per year, or the equivalent in some number of smaller buildings. It is recommended that this effort be implemented via a green Revolving Fund.
 - Upgrade of exterior campus lighting with more efficient LED fixtures and appropriate controls
 - Implementation of flexible controls for athletic field lighting and possible conversion to LED fixtures to minimize energy use while providing appropriate lighting for activities.
- Complementary efforts
 - Implementation of a “Green Labs” program including education and incentives on the many ways in which energy and other resources may be used more efficiently in the laboratory environment.
 - Implementation of an ongoing monitoring system as part of the building automation systems to minimize the degradation of energy performance of buildings over time and to document the actual energy savings achieved by upgrade and conservation work.
 - Inclusion of energy efficiency considerations in all major maintenance projects.
 - Conduct of a comprehensive study of campus water use, identifying waste, leaks, and opportunities for efficiency improvements, and implementation of the results. The GHG impact will be relatively small but the water resource conservation is worthwhile in itself.

- Implementation of building and space access policies and controls to concentrate the use of space, recognizing the dynamic nature of campus utilization, resulting in both electricity and heating/cooling savings.
- Conduct of an ongoing education program to support behaviors that conserve energy. Numerous studies report energy reduction results in the 5% range for targeted behavioral programs, but also caution that long term effects require ongoing programs.
- Verification that the state’s “no idle” policy is implemented for campus vehicles.
- Major purchases
 - Performance of an engineering study of the potential for further reduction of energy use in our information technology equipment, and implementation of the recommendations.
 - Attention to energy use in all new equipment purchases.
 - Consideration of fuel efficiency in all campus fleet and power equipment purchases, and purchase of hybrid, electric or biodiesel vehicles where feasible.