



**GRAND VALLEY  
STATE UNIVERSITY®**

**CLIMATE ACTION PLAN  
JANUARY 2010**

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## **EXECUTIVE SUMMARY**

As a signatory of the American College and University Presidents' Climate Commitment (ACUPCC) on October 4 2007, Grand Valley State University created the GVSU Climate Action Committee to determine the organization's carbon footprint. In addition, the Committee was tasked with analyzing the relevant data, projecting future greenhouse gas (GHG) emissions, and creating a plan to set the university on a path toward carbon neutrality.

Following two years of work, the Climate Action Committee has recommended a plan that includes three phases. Progress of each phase will be measured against the baseline year of 2006.

- Phase 1, Conservation and Reduction (2010-2020)
  - Goal: To reduce GHG emissions by 20% from the 2006 benchmark
- Phase 2, Renewable and Alternative Energy (2020-2030)
  - Goal: To reduce GHG emissions by 50% from the 2006 benchmark
- Phase 3, Innovation and Efficiency (2030-2050)
  - Goal: To achieve carbon neutrality via innovation and technology upgrades

The phases and primary (scope 1 and 2) GHG reduction goals were determined by the GVSU Climate Action Committee using Clean Air – Cool Planet software to analyze emissions -- both current and projected. While secondary (scope 3) GHG emissions, such as commuting and waste products, were not included in the inventory or goals, they are being monitored for inclusion when a standard protocol for measurement is established.

### **Carbon Footprint**

In the base year of 2006, the primary GHG emissions for GVSU were 56,778.4 MT eCO<sub>2</sub> (metric tons of carbon dioxide equivalent). In the following three years, the GVSU carbon footprint decreased to 55,502.5 MT eCO<sub>2</sub> despite adding almost 2,000 students and nearly 600,000 square feet of buildings, with emission reductions amounting to 9.6% per student and 13.9% per square foot. Preliminary measurements of scope 3 GHG emissions added about 30,000 MT eCO<sub>2</sub> to the inventory for a total of 85,535.4 MT eCO<sub>2</sub> for the 2009 fiscal year. From 2006, total (scopes 1, 2, and 3) GHG emissions fell 6.8% per student and 11.2% per square foot. Reductions can be attributed to previously enacted conservation, efficiency improvements, and behavior-changing programs, but without additional mitigation strategies, GHG emissions are projected to grow by 1% per year until 2050.

## **Going Forward**

While efforts to conserve resources and increase efficiencies at GVSU are not new, the decision-making process now has another variable. Each project must take into account the effect on the university's carbon footprint. Capital projects will not only consider long-term costs of energy but also carbon-offset purchases that could be avoided. Capital projects will be evaluated not only on the initial cost outlay and expected payback years, but also the project's impact on GHG emissions. Administrators need to think about the possibility of carbon emissions being regulated in the future. Most importantly, according to the Princeton Review's "College Hopes and Worries Survey", over two thirds of student applicants "said they would value having information about a college's commitment to the environment". The Climate Action Plan can provide the value they seek.

## INTRODUCTION

The roots of environmental sustainability at GVSU have been well recognized over the last few decades, as GVSU's main campus of about 1200 acres in Allendale, Michigan co-exists with nature in a suburban setting. Adjacent to the main campus are deep ravines, farmland, GVSU's golf course appropriately named The Meadows, the Grand River and Ottawa Creek, along with other open and green space.

Through the years, GVSU has developed and incorporated several campus master plans to help restore, care for, preserve, and accommodate for GVSU's growth in conjunction with being a good steward of the environment. GVSU has progressed and developed LEED building standards into a policy for all future new building design and construction. Currently, GVSU has about 1 million square feet of LEED certified, silver, and gold building square footage that represents about 19 percent of our total square footage. To date GVSU has 12 buildings that are either LEED certified or undergoing the LEED certification process.

GVSU has also developed an action plan centered around improving energy efficiency on campus. To date GVSU saves approximately \$1 million in energy costs annually through a number of facilities related programs and activities, including the purchase of Energy Star® appliances and equipment.

Over the last few years GVSU has also focused its efforts on improving its recycling rates and minimizing the overall generation of waste. GVSU has participated in the annual national RECYCLEMANIA competition, which has improved recycling rates dramatically in many categories. This year GVSU is adding a food composting trial in conjunction with campus dining.

With all of these ongoing environmental stewardship programs including improving the built environment; increasing energy efficiency; and reducing the amount of waste generated, the opportunity to develop a climate neutrality plan for GVSU was a logical next step for our campus sustainability programs and activities. During this timeframe GVSU has also participated in the Governor Appointed Michigan Climate Action Council and became a signatory to the Talloires Declaration establishing education for environmental sustainability curriculum and courses.

## **ACKNOWLEDGMENTS**

The Climate Action Committee at Grand Valley State University, who compiled this report, consists of a variety of departments and areas throughout the campus community. The acknowledged individuals have also relied on many others in their departments and throughout the university for essential information to complete this document.

### Climate Action Committee Members

- Erin Babson, Operations Manager, Pew Campus Operations
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- Elena Lioubimtseva, Associate Professor of Geography and Planning, Environmental Studies
- Jeff Musser, Assistant Vice President, University Budgets
- Terry Pahl, Engineer, Facilities Services
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## **PROJECT BACKGROUND**

Grand Valley State University attracts more than 24,000 students with academic excellence, first-rate faculty, and state-of-the-art facilities. Grand Valley is the comprehensive university for Michigan's second largest metropolitan area. It has campuses in Allendale, Grand Rapids, and Holland, and centers in Muskegon and Traverse City. Thomas J. Haas is the president of GVSU and signatory of the American College and University Presidents Climate Commitment (ACUPCC). The Commitment was signed October 14, 2007. As a signatory the university has committed to and fulfilled the following:

- Established a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent
- Adopted an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR® certified products in all areas for which such ratings exist
- Encouraged use of and provide access to public transportation for all faculty, staff, students and visitors at our institution
- Participated in the Waste Minimization component of the national RecycleMania competition in 2008 and 2009 with plans to participate annually, and adopt three or more associated measures to reduce waste. Composting, e-waste recycling, and a paperless pilot program for classrooms have all been established.
- Developed a CO<sub>2</sub>e baseline inventory for 2006 and established accompanying data from 2001 to 2009
- Developed a "business as usual" CO<sub>2</sub>e inventory projected to the year 2050

The Grand Valley State University Climate Action Plan is intended to clarify the path toward carbon neutrality. Grand Valley anticipates further planning and adjustments to its greenhouse gas inventory as new information and data become available. Inventory and project updates are scheduled to occur every other year going forward.

## **GRAND VALLEY STATE UNIVERSITY'S CARBON FOOTPRINT**

### **Campus Emissions**

The Climate Action Committee calculated a baseline greenhouse gas inventory of GVSU for the fiscal year 2006 and subsequent inventories until 2009. Greenhouse gas emissions are expressed in metric tons of carbon dioxide equivalent (MT eCO<sub>2</sub>). This is a common way to represent the six greenhouse gases regulated under the Kyoto Protocol (carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydro fluorocarbons, and per fluorocarbons). Signatories are expected to calculate the emissions of each gas separately and

aggregate them into carbon equivalent units based on each gas' global warming potential.

## **Inventory Methodologies**

The methodology used to calculate the GVSU greenhouse gas inventory primarily follows the ACUPCC implementation guide version 1.1, 2009. The ACUPCC guide also recommended the use of Clean Air –Cool Planet software to aid in the inventory calculation, which was used for the GVSU assessment. The Clean Air–Cool Planet calculator is consistent with the Greenhouse Gas Protocol put forth by the World Research Institute (WRI).

## **Scopes**

To help delineate direct and indirect emission sources, improve transparency, facilitate fair comparisons, and provide utility for different types of organizations and different climate policies and goals, the GHG Protocol defines three “scopes” for GHG accounting and reporting purposes.

Scope 1 refers to direct GHG emissions occurring from sources that are owned or controlled by the institution, including: on-campus stationary combustion of fossil fuels; mobile combustion of fossil fuels by institution owned/controlled vehicles; and "fugitive" emissions. Fugitive emissions result from intentional or unintentional releases of GHGs, including the leakage of HFCs from refrigeration and air conditioning equipment. Scope 2 refers to indirect emissions generated in the production of electricity consumed by the institution and thermal energy purchased. Scope 3 refers to all other indirect emissions -- those that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution.

Consistent with the standards for WRI GHG Protocol, ACUPCC signatories agree to account for and report on emissions from Scopes 1 and 2. In addition, as specified in the Commitment, signatories agree to report some Scope 3 emissions, specifically those from air travel paid for by or through the institution and regular commuting to and from campus, to the extent that data are available. For purposes of the Commitment, commuting is defined as travel to and from campus on a day-to-day basis by students, faculty, and staff. It does not include student travel to and from campus at the beginning and end of term or during break periods.<sup>1</sup>

## **GVSU CLIMATE ACTION PLAN METHODOLOGIES**

### **Scope 1**

#### **On Campus Stationary Sources**

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<sup>1</sup> ACUPCC Implementation Guide version 1.1, page 14

Stationary combustion sources on campus include dual-fueled boilers using distillate oil and natural gas to produce steam. There are also six relatively small users of propane on campus. The input data for the scope 1 emissions was rather straightforward and followed the implementation guide. Usage data was gathered from fuel purchasing records dating back to 2001.

### **University Fleet Vehicles**

Grand Valley owns a fleet of gasoline and diesel powered vehicles that are used for transportation and maintenance. Again the data input was rather straightforward as purchasing records were gathered dating back to 2001.

### **Refrigerants and Chemicals**

Consistent with the GHG Protocol, the release of emissions from refrigerants is considered less than 5% of the university's inventory, therefore chemical release was classified as de minimis and not included in the inventory.

### **Agriculture Sources**

Synthetic fertilizer has been purchased with 21% nitrogen content since 2001. The amount purchased has been documented according to the recommended protocol.

## **Scope 2**

### **Purchased Energy**

Emissions attributed to purchased electricity and thermal energy are specific to each region as the conversion factor of the local grid is taken into account. Grand Valley's data was gathered from purchasing records and then added to the Clean Air –Cool Planet calculator for the sub-region conversion.

## **Scope 3**

### **Air Travel**

Scope 3 emissions have proven to be more difficult to assess. Air travel for faculty has always been documented on a cost basis but not on a mileage basis. For that reason a sample of faculty air travel was reviewed from 2008. Each trip was researched to ascertain miles traveled. Miles traveled per dollar spent was then extrapolated over the faculty air travel from 2001 to 2009. Student air travel is predominately done by athletic teams. Travel information was gathered from 2009 for each athletic event with miles calculated from Grand Rapids to the destinations nearest commercial airports. Because GVSU athletic team event

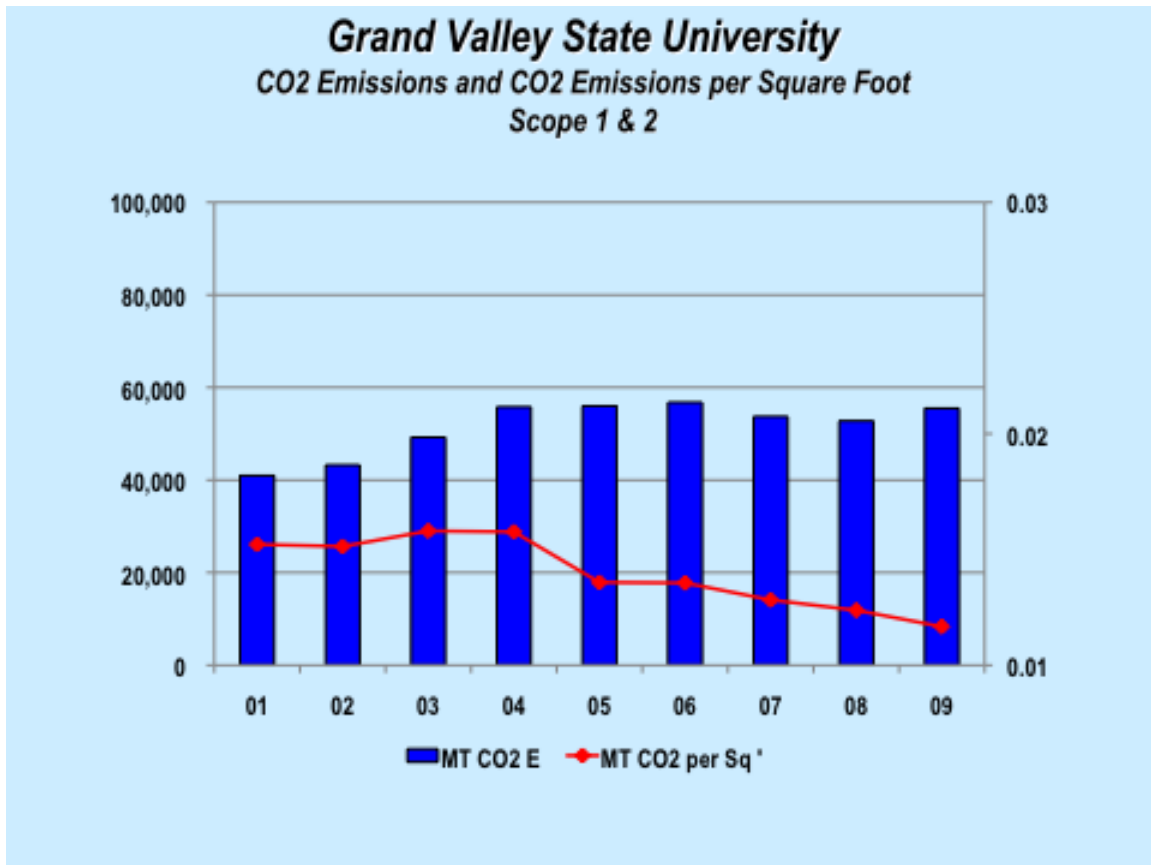
participation has remained relatively constant from year to year, the same student travel figures were used for every year since 2001. Because Study Abroad travel is not paid for, nor reimbursed by Grand Valley, implementation guidelines were followed and the corresponding emissions were not aggregated to the inventory. With clarification from the next WRI protocol and improved data collection, the Study Abroad miles may eventually be included.

## **Commuting**

Collecting data for an accurate commuter emission inventory can be challenging and after the work is completed, there is a great deal of subjectivity used in garnering a final tally. The methodology used to calculate student commuting started with a survey of bus riders. The survey revealed that 41% of student passengers also had commuting parking passes. In FY2009 there were 10,500 commuter parking passes issued and another 5,464 students lived on campus. Given these details, 1,845 students were deducted from the bus rider and parking pass totals to avoid duplication. The totals of 7,155 bus riders, 8,655 drivers, and 5,464 campus residents were then used in proportion to the student population to represent each category's commuting percentage (25% campus residents, 33% bus riders, 39% automobile drivers). The remaining 3% of the student body was assumed to be carpoolers. Bus ridership data also show the average trip covering slightly less than nine miles, with students participating twice a day, five times per week. Student drivers were estimated to take five round trips to campus during the week at an average distance of 10 miles each way. A school year consisting of 32 weeks was used. All staff and faculty parking pass holders were considered to be automobile driving commuters. Each pass holder was estimated to travel to campus and back five times with an average distance of 15 miles each way, over a period of 32 weeks.

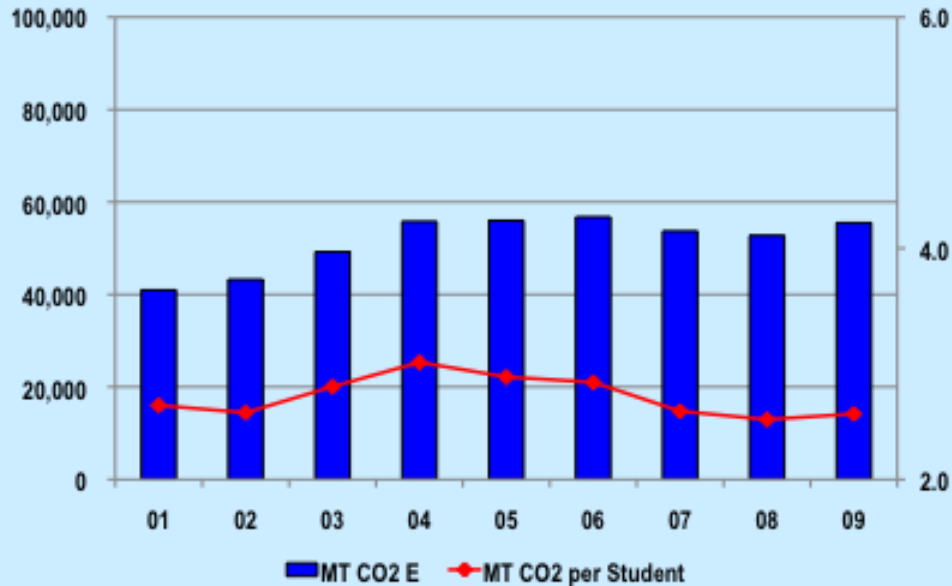
## SUMMARY OF INVENTORY

The 2009 scope 1 and 2 GHG emissions inventory reveals a 2.2% decrease from the base year of 2006 and 9.6% improvement on a per student basis. The 2009 GHG inventory for scope 1 and 2 emissions stands at 55,502 MT CO<sub>2</sub>e. This downward movement may be attributable to previously implemented energy efficiency and conservation projects.



The 2009 scope 1 and 2 emissions as a percentage of built square footage have fallen by 13.9% since 2006. LEED building standards have been followed on new construction and significant remodeling projects since 2004. When CO<sub>2</sub>e per square foot from fiscal year 2001 is compared to the fiscal year 2009, GHG emissions per foot have dropped by 23.3%.

**Grand Valley State University**  
**CO2 Emissions and CO2 Emissions per Student**  
**Scope 1 & 2**



**GREENHOUSE GAS MITIGATION PHASES**

As mentioned previously, Grand Valley has been a leader in sustainable efforts that address all facets of the university. Recycling, waste reduction, behavioral change programs and mass transit promotions have all made significant reductions to the overall carbon footprint of GVSU. These are just a few of the strategies that have already led to decreases in CO2e emissions based on per student and square footage basis. Indeed these successful programs will continue. Because the strategies cover an extensive period of time, the Climate Action Committee has decided to break up the projects into three phases. The first will start immediately and run until 2020. The second phase will then begin and conclude in the year 2030. The third phase runs from 2030 to 2050.

**Phase 1**

Phase 1 begins immediately with a list of projects, some of which are already under development. Even though all strategies listed are tentative, it is the

projects in this first phase that the committee is most confident. The university will also see emission reductions from state mandated increases in renewable energy from power companies.

- Behavioral Changes Campaign
- Energy Reduction Projects
- All new buildings to be LEED Silver compliant
- Mechanical Building Enhancements
- Lighting Replacement
- Novar Controls Replacement
- Utility company's renewable energy additions
- Installation of CO2/occupancy sensors
- Replace 1280 Trane chiller with electric chiller
- Purchase 10% wind power
- Campus wide composting
- Woodchip Boiler

PHASE 1 MITIGATION PROJECTS TIMELINE AND CARBON REDUCTIONS

TONS CO2e per year

Projects	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>University Emissions Prior to Mitigation</b>	<b>55,722</b>	<b>56,278</b>	<b>56,840</b>	<b>57,408</b>	<b>57,981</b>	<b>58,560</b>	<b>59,145</b>	<b>59,735</b>	<b>60,331</b>	<b>60,934</b>
Woodchip Boiler						5,599	5,599	5,599	5,599	5,599
Mechanical Building Enhancements Round 1	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198
Lighting Replacement	379	379	379	379	379	379	379	379	379	379
Novar Controls Replacement	170	170	170	170	170	170	170	170	170	170
Utility Co. Renewable Energy Purchases						4,243	4,243	4,243	4,243	4,243
Installation of CO2/Occupancy Sensors	269	269	269	269	269	269	269	269	269	269
Replace 1280 Trane Chiller						623	623	623	623	623
Purchase 10% Wind Energy						3,919	3,919	3,919	3,919	3,919
Behavioral Changes Campaign	207	207	207	207	207	207	207	207	207	207
Energy Reduction Projects	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079
<b>GVSU Emissions After Mitigation</b>	<b>49,400</b>	<b>49,956</b>	<b>50,518</b>	<b>51,086</b>	<b>51,659</b>	<b>37,854</b>	<b>38,439</b>	<b>39,029</b>	<b>39,625</b>	<b>40,228</b>

## Phase 2

The second phase will begin in 2020 and conclude at the end of 2029. This decade looks to usher in some ambitious capital projects. The State of Michigan requires energy producers to increase the percentage of renewable supply to 25% by 2025. This increase will assist GHG reduction efforts.

- Behavioral Changes Campaign
- Energy Reduction Projects
- Mechanical and building enhancements
- Upgrade all traditional buildings to LEED specifications
- Purchasing 10% Green Power
- Purchasing 10% Wind Power
- Purchasing an additional 20% alternative energy
- Utility company renewable energy additions
- 1.65 mW Wind Turbine
- Carbon Offsets

### PHASE 2 MITIGATION PROJECTS TIMELINE AND CARBON REDUCTIONS

TONS CO2e per year

Projects	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
<b>University Emissions Prior to Mitigation</b>	<b>61,542</b>	<b>62,157</b>	<b>62,577</b>	<b>63,404</b>	<b>64,037</b>	<b>64,677</b>	<b>65,323</b>	<b>65,975</b>	<b>66,634</b>	<b>67,299</b>
1.65 mW Wind Turbine <sup>2059</sup>	0	0	0	0	0	2,059	2,059	2,059	2,059	2,059
Mechanical Building Enhancements Round 2	0	0	0	0	0	2,617	2,617	2,617	2,617	2,617
Upgrade Traditional Buildings to LEED Silver	0	0	0	0	0	4,204	4,204	4,204	4,204	4,204
Woodchip Boiler	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599
Mechanical Building Enhancements Round 1	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198
Lighting Replacement	379	379	379	379	379	379	379	379	379	379
Novar Controls Replacement	170	170	170	170	170	170	170	170	170	170
Utility Co. Renewable Energy Purchases	4,243	4,243	4,243	4,243	4,243	10,122	10,122	10,122	10,122	10,122
Installation of CO2/Occupancy Sensors	269	269	269	269	269	269	269	269	269	269
Replace 1280 Trane Chiller	623	623	623	623	623	623	623	623	623	623

Purchase 10% Green Energy	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,489	4,489
Purchase 10% Wind Energy	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631
Purchase additional 20% Alternative Energy	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686
Behavioral Changes Campaign	207	207	207	207	207	207	207	207	207	207
Energy Reduction Projects	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079
Carbon Offsets	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
<b>GVSU Emissions After Mitigation</b>	<b>14,969</b>	<b>15,584</b>	<b>16,004</b>	<b>16,831</b>	<b>17,464</b>	<b>3,345</b>	<b>3,991</b>	<b>4,643</b>	<b>5,302</b>	<b>5,967</b>

### Phase 3

The third phase will start with 2030 and run through 2050. Key components include the assumption that innovations at that time will provide incentives to add a diverse array of renewable energy sources to the campus. It is anticipated that carbon neutrality can be accomplished during this phase by adding these renewable energy innovations and augmenting those reductions with carbon offsets.

- Energy Reduction Projects
- Behavioral Changes Projects
- Purchasing an additional 20% alternative energy
- Photovoltaic panels to supply 20% of university electricity
- Geo-thermal to provide 20% of heating and cooling needs
- Utility Company Increasing Purchases of Small Nuclear Power
- Traditional building upgrades to LEED Silver specifications

#### PHASE 3 MITIGATION PROJECTS TIMELINE AND CARBON REDUCTIONS

	TONS CO2e per year									
Projects	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
<b>University Emissions Prior to Mitigation</b>	<b>67,972</b>	<b>68,650</b>	<b>69,336</b>	<b>70,028</b>	<b>70,728</b>	<b>71,434</b>	<b>72,148</b>	<b>72,868</b>	<b>73,596</b>	<b>74,331</b>
Photovoltaic Panels reduce electricity purchases 20%	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575	10,575
Geo-thermal to provide 20% of heating and cooling	207	207	207	207	207	207	207	207	207	207

Utility Company increases nuclear output by 10%	5,288	5,288	5,288	5,288	5,288	5,288	5,288	5,288	5,288	5,288
1.65 mW Wind Turbine <sup>2059</sup>	2,059	2,059	2,059	2,059	2,059	2,059	2,059	2,059	2,059	2,059
Mechanical Building Enhancements Round 2	2,617	2,617	2,617	2,617	2,617	2,617	2,617	2,617	2,617	2,617
Upgrade Traditional Buildings to LEED Silver	4,204	4,204	4,204	4,204	4,204	4,204	4,204	4,204	4,204	4,204
Woodchip Boiler	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599	5,599
Mechanical Building Enhancements Round 1	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198
Lighting Replacement	379	379	379	379	379	379	379	379	379	379
Novar Controls Replacement	170	170	170	170	170	170	170	170	170	170
Utility Co. Renewable Energy Purchases	10,122	10,122	10,122	10,122	10,122	10,122	10,122	10,122	10,122	10,122
Installation of CO <sub>2</sub> /Occupancy Sensors	269	269	269	269	269	269	269	269	269	269
Replace 1280 Trane Chiller	623	623	623	623	623	623	623	623	623	623
Purchase 10% Wind Energy	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631	4,631
Purchase additional 20% Alternative Energy	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686	11,686
Behavioral Changes Campaign	207	207	207	207	207	207	207	207	207	207
Energy Reduction Projects	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079	2,079
Carbon Offsets	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
<b>GVSU Emissions After Mitigation</b>	<b>-4,941</b>	<b>-4,263</b>	<b>-3,577</b>	<b>-2,885</b>	<b>-2,185</b>	<b>-1,479</b>	<b>-765</b>	<b>-45</b>	<b>683</b>	<b>1,418</b>

## Goals

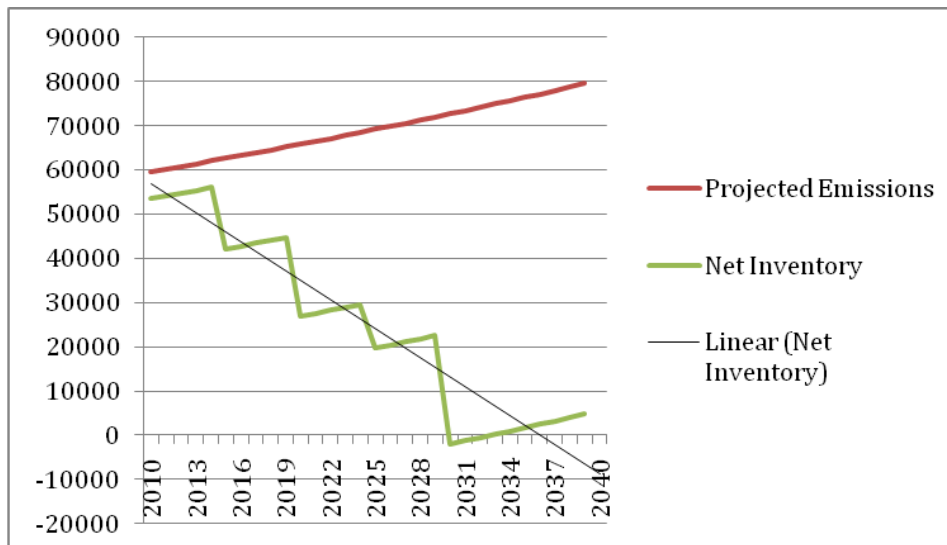
While the Climate Action Committee has set ambitious goals, the strategies listed are not exclusive. Goals of Grand Valley State University's Climate Action Plan may not address all ongoing programs. The reason for this is the previously described ambiguity toward measuring Scope 3 emissions. Because the World Resource Institute is expected to come out with a new protocol for Scope 3 methodology in the summer of 2010, we have focused our stated goals on the mitigation of only scope 1 and 2 emissions at this time. Goals to address scope 3

emissions may be added once methodologies are standardized. Until then, goals for GVSU scope 1 and 2 emissions are as follows:

1. Using 2006 as a baseline, reduce CO<sub>2</sub>e emissions by 20% of the 2006 total before the year 2020 (45,422.72 MT CO<sub>2</sub>e)
2. Reduce CO<sub>2</sub>e emissions to 50% of the 2006 levels by 2030 (28,389.2 MT CO<sub>2</sub>e)
3. Achieve Carbon Neutrality of scope 1 and scope 2 emissions before 2040 (projected year is 2037) by augmenting ongoing projects with carbon offsets

\*A potential fourth goal could be added to achieve total (scopes 1, 2, and 3) Carbon Neutrality by 2050 after scope 3 methodologies are released.

The following graph shows the projection of scope 1 and scope 2 emissions (red line) without the affects of mitigation strategies from 2010 to 2040. The downward trending steps indicate the MT CO<sub>2</sub>e reductions from mitigation strategies and a linear trend line indicates carbon neutrality in approximately the year 2037.



## Funding Mechanisms

In recent years the University has funded energy saving projects with one-time contingency budget dollars in order to benefit from permanent energy savings in

the utility budget. So, in effect, the energy savings projects were funded by the utility budget itself. Many of the projects in all three phases of the committee's plan will be funded in a similar manner. Some of the more costly projects, if they are undertaken, such as the Woodchip Boiler, Wind Turbine and new buildings to LEED Silver compliant, could be funded in a variety of ways, including use of University reserves, a dedicated fee assessed to students or debt financing.

## **GREENHOUSE GAS MITIGATION STRATEGIES**

### **Strategies to Affect Student Behavior**

- The Office of Housing and Residence Life will provide students with sustainability tips and informational materials on ways to reduce energy use. Examples: brochures, posted reminders in residence halls, a sustainability guide within the student handbook and tips and reminders on the department's Web site.
- Campus communities will continue to compete in an energy competition where communities compete to reduce energy consumption twice each academic year. The community that shows the greatest energy reduction per student selects a campus sustainability initiative to support or a community sustainability improvement.
- Housing and Residence Life will continue to participate along with the GVSU community in Recyclemania, a nation-wide collegiate recycling competition, to increase student awareness of recycling on campus and waste minimization.
- During move-out week, donation areas will continue to be designated for items ranging from clothing and cleaning products to furniture in order to reduce solid waste. Donated computers and other electronics will be recycled to reduce e-waste. Donations of food from student rooms to a local agency will also be sought.
- High efficiency washers and dryers will be installed in all on-campus housing laundry rooms Fall 2009 through Fall 2011. These machines can cut utility costs by as much as 60% and use 11.8 gallons of water on average compared to 40 gallons.
- During Phase 1 reductions real-time energy monitoring information will be posted in Niemeyer Honors Learning and Living Center to heighten students' awareness of their energy consumption. If the model succeeds

here the operation will be established in the 14 other communities on-campus.

- During Phase 1 reductions residents will be given reusable water bottles upon move-in. In conjunction with Campus Dining, filtered water systems will begin to be installed to provide an alternative to bottled water.
- During Phase 1 reductions the Office of Housing and Residence Life will support a sustainability contest (ex. Eco-Olympics, Eco-Room) where a sustainability related prize (ex. bicycle) can be won. This would occur during GVSU's Campus Sustainability Week to encourage students to incorporate sustainable behaviors in their everyday life.
- Various transportation options are promoted to students for travel on-campus and the greater community. These include the bus, bicycles, walking, car-sharing, and car-pooling.

### **Energy Reduction Projects for Campus Offices and Classrooms**

- Purchases (when available) will consist of:
  - High content from post-consumer recycled materials
  - Low embodied energy (consumed to extract, manufacture, distribute and dispose)
  - Non-toxic and recyclable materials
  - Durable and/or repairable appliances
  - Items that are produced in an environmentally and socially sustainable manner
  - Energy star certified products
- All computers and electronics will be set to energy saving specifications
- Desktop computers will be phased out and replaced by laptops (when feasible).
- All equipment will be shut down or turned off at the end of business days and over university breaks
- Lights will be turned off in offices that are not in use
- Equipment that is not in regular use will be unplugged
- Video conferences will be utilized in favor of traveling to conferences

- Offices will increase recycling
- Printing will be minimized
- Remaining printing will be two-sided when possible
- Paperless Pilot Program to incentivize paperless classrooms
- Offices use bicycles to circulate around campus for staff and student staff.

### **GHG Mitigation Strategies for Transportation**

- The transportation department is continually running promotions, giveaways, and other marketing strategies to encourage student use on and off campus
- Grand Valley is working with The Rapid to establish more “park and ride” locations
- More hybrid buses will be added to the Grand Valley routes
- Bus schedules are now only available online
- A website with information on bike trails and safety is currently being developed
- A bike awareness week will be sponsored in the spring of 2010, which will include a bike tour, safety events, promotions, and education on the benefits of biking

### **Mitigation Strategies for Campus Dining**

- Develop a food waste composting program for all pre- and post – consumer waste
- Annually increase local purchasing (currently 30%)
- Convert to reusable or compostable service ware
- Focus on reducing energy consumption in food service areas

### **CLIMATE EDUCATION AND RESEARCH**

GVSU faculty and students have demonstrated strong commitment to climate change studies and research through well developed interdisciplinary curriculum, faculty and student research, external grants and scholarly publications, and

community outreach. The recently created Environmental Studies Program at GVSU has brought together more than 50 environmental courses, dozens faculty and more than 20 departments and academic programs from six different Colleges.

**GVSU COURSES THAT ADDRESS CLIMATE CHANGE ISSUES:**

GPY 100 - Physical Geography. Explores the spatial patterns between landforms, natural systems of flora and fauna, and climate. Designed to increase awareness of the physical environment, its landscape, controls, and processes, and the interrelationships of natural phenomena.

GEO 100 - Environmental Geology. The relationship between people and their physical geological environment. Topics include geologic hazards, hydrology and human health, mineral and energy resources, and land use planning.

GEO 111 - Exploring the Earth. Introduction to the study of Earth materials and processes, including minerals, rocks, mineral deposits, weathering, erosion, volcanism, and mountain building. Lectures, laboratories, and field trips.

GEO 112 - Earth History. Introduction to geological structures, stratigraphic relations, and fossils as instruments for studying the physical and biological events of Earth history. Lecture, laboratories, and field trips.

ECO 100 - Current Economic Issues. Examination of current social issues from an economic perspective, such as drugs, rent control, environmental pollution, poverty, crime, and the distribution of medical care. Recommended for students interested in current issues.

BIO 105 - Environmental Science. Study of natural ecosystems, their interrelationships, and human impacts and evolution of humans and environmental determinants of their cultures. Land use, resource and energy utilization, population trends and causative factors, air and water pollution, and economic factors influencing decision-making are emphasized.

NRM 140 – The Climate Factor. A study of the atmosphere, broad aspects of weather and climate, microclimatology, and the geography of climate and effects on terrain, vegetation, and people.

NRM 150 - Introduction to Natural Resources. Survey of natural resource issues and environmental problems. The course will use an integrated approach involving concepts from natural and social sciences to provide a foundation for understanding past, present, and future natural resource issues including biodiversity, land use, water and air pollution, human population, energy use, and waste management.

ENS 201 - Introduction to Environmental Studies and Sustainability.

ENS 201 is an interdisciplinary exploration of the multiple ways by which human society influences, and is influenced by, its natural environment. Economic, political, and socio-cultural dimensions of environmental studies are presented through an interdisciplinary approach. Principles of sustainability are examined.

GPY 235 - World Regional Geography. A survey of geography followed by an examination of specific geographic concepts. Physical, cultural, economic, and related factors will be given more emphasis than place-name geography.

NRM 240 - Principles of Climatology. The atmosphere, broad aspects of weather and climate, microclimatology, and paleoclimatology. Instrumentation, data presentation, ecoclimate, and microclimatological field observations. Lecture, laboratory, and field trips.

HNR 241 - The Earth, A Global View. Course has two objectives: (1) understanding Earth as one global, holistic, delicately balanced dynamic system; and (2) understanding the critical interdependence between humans and Earth systems.

GEO 300 - Geology and the Environment. Detailed examination of interactions and connections between people and their geologic environment from an Earth Systems perspective. Using case studies and current events, students investigate complex environmental processes and issues related to the lithosphere, hydrosphere, atmosphere, and biosphere. Students will reach and defend decisions concerning personal, corporate, and governmental actions.

PLS 313 - International Organization. Analysis of the major global and regional institutions that promote order and cooperation in the international system, including the United Nations, World Bank, European Union, and NATO. Explores the theory and practice of government and nongovernment organizations in addressing issues such as poverty, human rights, and the environment.

PLS 314 - International Law. A study of the general principles of international law with emphasis on the role of law in political and economic relations of nations.

PLS 321 - The European Union. An examination of politics and policies in the European Union that includes participation in an international political simulation. Students spend three days in Indianapolis in April to take part in the Midwest Model EU. Topics include: integration theory, institutional reform, enlargement, and economic, social, environmental, and security policies.

NRM 330 - Environmental Pollution. Investigation of causes and effects of water, soil and air pollution. Prevention and management of pollution will be discussed and examined from natural and social science perspectives. Design of impact

assessment studies, data interpretation and laboratory methods. Topics may include waste disposal, acid deposition, climate change, toxicology, and risk assessment.

GPY 335 - Geographic Patterns-Global Development. Development involves positive and negative social, political, economic, cultural, and environmental changes for people living in a region or a country. GPY 335 explores the complex geography of the processes associated with development and in particular global development. Part of Global Change theme.

ECO 345 - Environmental and Resource Economics. Develops a systematic economic framework to analyze market and government allocations of natural and environmental resources. Topics include relationships between population growth, land development, and environmental quality; regulatory versus market oriented environmental policies; supplies and prices of mineral and energy resources; harvest and protection of forests and fisheries.

CHM 321 - Environmental Chemistry. A study of the chemistry of our environment and the chemistry underlying our environmental problems. The sources, transport, reactions, and fates of chemical species in the water, air, and soil will be discussed, and the health effects associated with these pollutants on humans, animals, and the environment will be addressed.

ENS 401 - Environmental Problem Solving. A problem-solving seminar in Environmental Studies. Attention will be given to vulnerabilities to environmental change, sustainable development, impact and risk assessment, adaptations to and mitigation of environmental problems at various scales. Multidisciplinary student teams will conduct original research and design sustainable practices and solutions for real-life environmental problems.

GPY 410 - Landscape Analysis. Landscape analysis is a broadly interdisciplinary study that includes concepts and methods of physical and human geography, ecology, planning, and architecture. It includes the biophysical and societal causes and consequences of landscape heterogeneity, processes and evolution. Conceptual and theoretical core of this course links natural sciences with related human disciplines. Part of the Earth and Environment theme.

GPY 412 - Global Environmental Change. The main theme of this course is the changing nature of our environment and human-environmental interactions. Topics include climatic fluctuations, environmental reconstructions, the interaction between humankind and the environment since the prehistoric times, and human-induced environmental change of the last century at the global, continental and regional scales. Part of the Earth and Environment theme.

## **GVSU FACULTY GRANT AWARDS IN CLIMATE CHANGE RESEARCH**

- Bopi Biddanda of the Annis Water resources Institute was awarded the following grants: NOAA-OE 2008-2010: Observatories for submerged sinkhole ecosystems in the Great Lakes; NSF- Microbial Observatories/Microbial Interactions and Processes 2006-2008: Lake Huron's sinkholes- biogeochemical hotspots; NOAA-Ocean Exploration 2003-2005: Exploration of a submerged sinkhole ecosystem in Lake Huron, Michigan Space Grants Consortium-NASA 2003-2004: What happens to terrigenous carbon in the aquatic environment?; NSF-NOAA 1998-2002: Episodic Events Great lakes Experiment.
- Fegin Mekik of the Geology Department was awarded \$84,029 from the National Science Foundation for a multi-proxy search for the deglacial deep sea carbonate preservation maximum in Antarctic ice.
- Karen Meyers of the Regional Math and Science Center (RMSC) was awarded \$5,000 from the Michigan Space Grant Consortium to provide a two-day workshop for middle- and high school teachers for professional development and training in the area of Earth Systems Science, specifically in the area of climate change.
- Mary Ann Sheline, former director of RMSC and GVSU representative to the Michigan Space Grant Consortium, received \$2,504 for the Michigan Space Grant Consortium. She provided leadership that resulted in over \$610,891 in graduate and undergraduate fellowships, faculty seed, and program grants since 1993.
- Michael Chu of the Annis Water Resources Institute was awarded \$241,911 from the National Science Foundation to develop improved methods to quantify multi-scale puddle-filling and puddle-merging (P2P) overland flow processes under control of microtopography. Chu transferred \$101,007 to North Dakota State University when he left GVSU in 2008.
- John Koches of the Annis Water Resources Institute was awarded \$19,500 from the West Michigan Strategic Alliance as a partner to work on the West Michigan Regional Indicators Project. He received the same award but a different amount--\$31,000--in 2008.
- John Koches of the Annis Water Resources Institute was granted a \$15,000 subcontract with JRR, LLC to develop an urban canopy GIS data layer, model the ecological services the urban forest provides, and create a map portfolio and summary report for the City of Grand Rapids, Michigan.

- John Koches of the Annis Water Resources Institute was awarded \$96,844 from the U.S. Environmental Protection Agency to produce an inventory and analysis of historic wetlands and their functions in the Lower Grand River Watershed.
- Al Steinman of the Annis Water Resources Institute was awarded \$2,520 from the Grand Haven Area Community Foundation to conduct a field-based inventory of the Spring Lake, Michigan shoreline to identify the locations of stormwater runoff and the most suitable areas for recommended best management practices (BMPs).
- Erik Nordman of the Biology Department was awarded \$243,455 (in a sub-award with the University of Michigan) from the U.S. Department of Commerce-National Oceanic and Atmospheric Administration to assess the potential for wind energy facilities in West Michigan.
- Carol Griffin of the Biology Department was awarded \$10,000 from the National Forest Foundation as part of a \$69,505 project to bring the Nordhouse Dunes Wilderness (Huron-Manistee National Forest, Michigan) up to and to exceed the minimum levels for wilderness stewardship established in the National Forest Foundation Wilderness Stewardship Challenge.
- Shaily Menon of the Biology Department was awarded NSF-ROA (Research Opportunity Award) 2005-2006 - for work with ORNIS project in Peterson Lab, The University of Kansas Natural History Museum, (\$32,554)
- The Michigan Alternative and Renewable Energy Center (MAREC) at Grand Valley State University-Muskegon was awarded \$1,250 by the Michigan Department of Labor & Economic Development, Bureau of Energy Systems in support of a pilot half-day workshop to help identify opportunities to develop energy or fuel and compost from locally available biomass resources.
- Elena Lioubimtseva of the Geography and Planning Department was awarded \$128,677 over three years to evaluate the effects of institutional change on regional hydrometeorology, specifically to assess the vulnerability of the Eurasian semi-arid grain belt.
- Robert Hollister of the Biology Department is closing-out a three-year \$158,152 National Science Foundation-International Polar Year grant to study arctic ecosystem changes.

- Dalila Kovacs of the Chemistry Department was awarded \$24,395 from the Michigan Department of Environmental Quality to build a Green Chemistry Education Network to foster higher education curriculum development in green chemistry.
- Claudia Sowa of the College of Education was awarded \$17,537 from the Great Lakes Fishery Trust to establish an environmental stewardship and education network of university, school and community partners who will work together for environmental sustainability in the Lower Grand River Watershed.

### **GVSU FACULTY PUBLICATIONS RELATED TO CLIMATE CHANGE ISSUES**

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## **GVSU FACULTY COMMUNITY OUTREACH PROJECTS RELATED TO CLIMATE CHANGE.**

### **Global Warming Course**

John Gabrosek taught Community education course titled Global warming: changing CO<sub>2</sub>course, where the 2 was a clever subscript.

Global Warming: Changing CO<sub>2</sub>course is a four-session course exploring the history and science of global warming, personal values and habits as they relate to climate change, and personal actions to curb the effects of global warming. The course gave staff and faculty a chance to exchange ideas as related to climate change and investigate mankind's impacts on climate change. (First line taken verbatim from [http://www.nwei.org/discussion\\_courses/course-offerings/global-warming-changing-co2course](http://www.nwei.org/discussion_courses/course-offerings/global-warming-changing-co2course).) )

### **Collaborative Effort with Grand Rapids**

As GVSU has signed the American College and University President's Climate Agreement, the City of Grand Rapids has signed the US Mayor's Climate Protection Agreement as well. These two compliance and signatory agreements are similar in nature and have allowed the City of GVSU for work together and share best practices for reducing CO<sub>2</sub> and GHG emissions. Significant efforts are being put on the use of renewable and alternative energy technologies; green and LEED buildings, energy conservation and efficiency, alternative transportation, and green environment strategies.

### **Green Town Conferences**

GVSU and the City have been participants and contributors to several Green Town Conferences that have been held in Illinois and Grand Rapids. The purpose of these Greentown Conferences is to bring together the public, private, and academic sectors as sustainable community stakeholders. Issues concerning public policy, governance, environmental stewardship, the built environment, local food, and sustainable development best practices are shared in collaborative workshops. GVSU has openly discussed the elements of climate action planning with other colleges and universities.

### **MAREC**

GVSU has the Michigan Alternative Renewable Energy Center (MAREC) in Muskegon, MI. The mission of MAREC is to help demonstrated applied renewable and alternative energy technologies such as wind, solar PV, fuel cell, biomass, energy storage etc. MAREC is located in a Smartzone, has business incubator space, and works with other colleges and universities on research grants, training, and education for sustainable development.

## **Community Organizations**

GVSU has also worked with many other organizations to help host, create awareness, promote renewable energy, energy efficiency, and conservation within the greater Grand Rapids Community. Some of these organizations include the West Michigan Strategic Alliance, The Right Place Inc., Michigan Department of Environmental Quality, Next Energy; Michigan Economic Development Corporation etc. GVSU was also appointed by the governor to the Michigan Climate Action Council.

**Appendix A (can be viewed in a larger format at <http://www.gvsu.edu/sustainability/>)**

MODULE Project Calculator															
WORKSHEET Project Calculator Executive Summary															
UNIVERSITY Grand Valley State University															
Project Name	Start Year	Duration (years)	Units	Total Capital Cost	Total Capital Cost Including Incentives	Average Discounted Annual Cash Flow	NPV	IRR	Discounted Payback Time (years)	Annual Reductions (MT eCO2)	Total Lifetime Reductions (MT eCO2)	% of Start Year Emissions	% of End Year Emissions	Discounted Cost per Reduction	Rank
<b>All Projects</b>	2010	45	N/A	(\$27,066,925)	(\$27,066,925)	\$2,634,106	\$121,168,888	#DIV/0!	N/A	(44,264.5)	(1,991,903.7)	N/A	N/A	\$60.83	N/A
<b>Projects with positive NPV</b>	2010	45	N/A	(\$27,066,925)	(\$27,066,925)	\$2,653,149	\$122,044,866	#DIV/0!	N/A	(40,264.5)	(1,811,903.7)	N/A	N/A	\$67.36	N/A
Woodchip boiler	2015	25	1	(\$8,648,400)	(\$8,648,400)	\$826,383	\$21,485,962	21.64%	5.22	(5,599.9)	(139,998.6)	8.85%	6.97%	\$153.47	11
Mechanical/Building Enhancements	2015	30	1	(\$2,162,100)	(\$2,162,100)	\$415,176	\$12,870,444	39.16%	2.77	(3,198.0)	(95,941.4)	5.05%	3.79%	\$134.15	17
Lighting Replacement MAN, PAC, LAT, CDC, LSH LHH, LSH, DeVos,	2015	25	1	(\$540,120)	(\$540,120)	\$52,726	\$1,370,880	22.23%	5.05	(379.5)	(9,487.1)	0.60%	0.47%	\$144.50	12
Novar Controls Replacement	2015	30	1	(\$397,826)	(\$397,826)	\$44,044	\$1,365,352	25.25%	4.41	(170.1)	(5,103.0)	0.27%	0.20%	\$267.56	1
Wind Turbine 1.65 mW	2025	30	1	(\$3,567,465)	(\$3,567,465)	\$172,505	\$5,347,669	13.99%	8.48	(2,059.9)	(61,797.0)	2.95%	2.21%	\$86.54	20
Install CO2 sensors/Occupancy sensors	2015	30	1	(\$129,726)	(\$129,726)	\$37,050	\$1,148,560	55.36%	1.93	(269.1)	(8,072.7)	0.43%	0.32%	\$142.28	13
Purchase 10% Wind Power	2010	10	1	-	-	\$437,544	\$4,812,979	-	0.00	(3,919.3)	(39,193.0)	6.51%	5.95%	\$122.80	18
Replace 1280 Trane Chiller with 1200 ton electric chiller	2015	30	1	(\$810,788)	(\$810,788)	\$84,785	\$2,628,343	24.10%	4.65	(623.6)	(18,708.9)	0.99%	0.74%	\$140.49	14
Mechanical/Building Systems Enhancements	2025	30	1	(\$10,810,500)	(\$10,810,500)	\$228,584	\$7,086,106	8.76%	13.99	(2,617.6)	(78,527.9)	3.74%	2.81%	\$90.24	19
Purchasing 10% Green Power (Utility Company)	2020	10	1	-	-	\$549,832	\$6,048,147	-	0.00	(4,489.5)	(44,894.7)	6.75%	6.17%	\$134.72	16
Carbon Offsets	2020	10	1	-	-	(\$64,566)	(\$710,231)	-	N/A	(9,000.0)	(90,000.0)	13.53%	12.37%	(\$7.89)	23
Purchasing 10% Wind Power	2020	30	1	-	-	\$155,886	\$4,832,480	-	0.00	(4,631.9)	(138,957.2)	6.96%	5.22%	\$34.78	22
Purchasing additional 20% Alternative Energy	2030	20	1	-	-	\$498,938	\$10,477,691	-	0.00	(11,686.7)	(233,733.9)	15.91%	13.17%	\$44.83	21
Renewable additions to the grid per State of MI	2015	10	1	-	-	\$746,001	\$8,206,016	-	0.00	(4,243.0)	(42,430.3)	6.70%	6.13%	\$193.40	8
Renewable additions to the grid per State of MI	2025	30	1	-	-	\$2,013,230	\$62,410,138	-	0.00	(10,122.1)	(303,662.7)	14.48%	10.85%	\$205.52	5
Utility Companies producing 10 % more nuclear energy	2030	25	1	-	-	\$1,053,132	\$27,381,423	-	0.00	(5,287.9)	(132,197.6)	7.20%	5.67%	\$207.12	2
Behavioral Campaign to reduce electricity and natural gas purchases by .5% per year (2010 - 2019 detailed projection averages)	2010	10	1	-	-	\$3,609	\$39,698	-	0.00	(20.8)	(207.9)	0.03%	0.03%	\$190.94	9
Photovoltaic Energy Project to reduce Electricity purchases by 20%	2030	25	1	-	-	\$2,106,263	\$54,762,847	-	0.00	(10,575.8)	(264,395.2)	14.39%	11.34%	\$207.12	3
Geothermal Energy Project to reduce Natural Gas Purchases by 20%	2030	25	1	-	-	\$27,165	\$706,300	-	0.00	(207.3)	(5,183.5)	0.28%	0.22%	\$136.26	15
Behavioral Campaign to reduce electricity and natural gas consumption by .5% per year (2020 - 2029 detailed Projection averages)	2020	10	1	-	-	\$4,072	\$44,787	-	0.00	(23.0)	(229.6)	0.03%	0.03%	\$195.03	7
Behavioral Campaign to reduce electricity and natural gas consumption by .5% (2030-2050 detailed projection averages)	2030	25	1	-	-	\$5,281	\$137,316	-	0.00	(26.7)	(667.4)	0.04%	0.03%	\$205.75	4
LEED Silver building upgrades to all traditional buildings (10% efficiency improvement on 80% of the 2009 square footage)	2020	30	1	-	-	\$735,842	\$22,811,116	-	0.00	(4,204.7)	(126,141.0)	6.32%	4.74%	\$180.84	10
Carbon Offsets	2030	10	1	-	-	(\$97,295)	(\$1,070,240)	-	N/A	(9,000.0)	(90,000.0)	12.25%	11.20%	(\$11.89)	24
Energy Reduction Projects	2010	30	1	-	-	\$393,618	\$12,202,146	-	0.00	(2,079.1)	(62,373.1)	3.45%	2.59%	\$195.63	6