

2012 Climate Action Plan

Western Michigan University

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This document represents the work of a large number of people at Western Michigan University (WMU) over the past several years. A formal committee was charged with this task at the end of 2010, and began a yearlong series of meetings in May of 2011 to develop the main recommendations contained in this plan. However, their work was supported along the way by many employees of the Facilities Management division of WMU, along with student interns and staff of the Office for Sustainability. As strategies and recommendations were developed, we profited by feedback received from the President's Universitywide Sustainability Committee, officers and members of the Faculty Senate, and the Vice President for Business and Finance, Jan Van Der Kley.

Members of the Climate Action Planning Committee were:

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Jeff Alexander	Transportation Services
Dave Barnes	Geosciences faculty
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Kate Binder	Graduate student, Office for Sustainability researcher
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Sarah Hill	Anthropology faculty
George Jarvis	Power Plant director
Steve Kohler	Environmental Studies faculty
John Miller	Chemistry faculty
Chris Pyzik	Facilities Management – Planning
Yusuke Saito	Undergraduate student, Office for Sustainability intern

We also wish to acknowledge the consistent support we received throughout the process from WMU president John Dunn, provost Timothy Greene, and associate VP of Facilities Management Peter Strazdas.

Executive Summary

This Climate Action Plan represents the efforts of many people at Western Michigan University over the past two years. After considerable preliminary work, both before and after president John Dunn signed the ACUPCC agreement, a committee was formed in early 2011 and met regularly for about a year. Early drafts and specific recommendations were shared with many stakeholder groups around campus, and the committee profited from generous feedback from faculty, students, staff, administrators, and emeriti.

Overall, we have chosen to take a conservative approach in recommending specific strategies to reduce greenhouse gas emissions. We acknowledge that the severe fiscal constraints our institution faces today are likely to continue for some years to come. And while we recognize that achieving the ACUPCC goals will require major changes to the way we do business and to the way we educate our students, we have assumed that the basic functions of Western Michigan University (WMU), as a learning institution, will continue through the time period encompassed by this report. We have tried to devise a scheme whereby WMU's net greenhouse gas emissions could realistically approach zero while we maintain our current scope of activities.

The geographic boundaries of this plan are set to include all Western Michigan University operations within the city of Kalamazoo, Michigan. WMU is a public Research University, as classified by the Carnegie Foundation, currently enrolling about 25,000 students, of whom roughly 23,000 fall within the boundaries of this plan. These bounds include a contiguous main campus hosting five academic colleges, and a separate campus where the College of Engineering and Applied Sciences is located. Several regional education centers and a College of Aviation are located in other cities in West Michigan and are not considered in this plan. Also not considered is a future medical school, planned as a public/private partnership separate from WMU. Our institution's implementation profile was submitted in December of 2009, and is posted on the ACUPCC reporting system.

Greenhouse gas inventories have been performed using the protocol suggested by the Clean Air Cool Planet Campus Carbon Calculator. We have chosen to include all three "scopes" in this plan to achieve zero net GHG emissions. The most recent complete inventories available at the time of this writing are for the calendar years 2008 and 2009. Our target date for climate neutrality is **2065**. As this date is so far in the future, we must assume a great deal of uncertainty in both the actual date of achieving this goal, the interim targets, and the specific technologies that may be utilized along the way. It is also extremely difficult to predict the cost of various mitigation strategies that far in the future. The major part of this report outlines specific strategies that, if employed, will reduce net GHG emissions to zero by 2065. We also include plans for research related to climate change, efforts to integrate climate change into the broad curriculum, and ideas for reaching out to and involving the local community in these efforts.

Introduction: Sustainability at Western Michigan University

WMU has a long history of showing concern for the environment and sustainability. Many, if not most, of the policies and procedures that have already reduced greenhouse gas emissions over the years were driven by economics. In the 1980s, WMU developed an innovative strategy for funding energy conservation projects, which has been recognized by the Sustainable Endowments Institute as the first Quasi-Green Revolving Fund in the nation.¹ WMU's impact on the climate is now significantly less than it would have been without these aggressive measures that were taken in years past. This section will briefly mention some of these measures. Additional information can be found on the campus sustainability website² and the web pages maintained by Facilities Management.³

On the academic side, an Environmental Studies Program was first established at WMU in 1972. This is an interdisciplinary program that offers a “coordinate major” and a minor option open to all undergraduate students. It currently has ten regular faculty who have dual appointments between Environmental Studies and other academic departments in the College of Arts & Sciences.

From the late 1920's until 1992, steam for space heating and most campus electricity was generated at a local coal-fired power plant. A very significant reduction in campus CO₂ emissions was realized when our central power plant was converted from coal to natural gas co-generation. This occurred over the period between 1992 and 1997.

WMU adopted Facility Life Cycle Design Guidelines in 2004, which have been updated and strengthened in 2011 to require that all major new buildings or renovations be LEED Silver certified, or better. An Environmental Mission Statement, which recommended that the president sign the Talloires Declaration, was developed by an ad-hoc committee appointed by then VP for Business and Finance Robert M. Beam. This Environmental Mission Statement was approved by the Faculty Senate and the Western Student Association in 2003, but the Talloires Declaration was not signed at that time.

The Talloires Declaration was signed by recently appointed president, John Dunn, in January of 2008. In that same year, president Dunn appointed Harold Glasser to create and chair a new university-wide standing committee to advise him on sustainability matters and take over the role of the Sustainability subcommittee of the Faculty Senate's Campus Planning and Finance Council. This new committee, the President's Universitywide Sustainability Committee,

¹Weisbord, Dano, et al., (2011). *Greening the Bottom Line: The Trend Toward Green Revolving Funds on Campus*, Cambridge, MA: Sustainable Endowments Institute. <http://greenbillion.org/wp-content/uploads/2011/10/GreeningTheBottomLine.pdf>
A detailed case study of WMU's Quasi-Revolving Fund is also available, see: Billingsley, Christina (2012) *Western Michigan University: Quasi-Revolving Fund*, Cambridge, MA: Sustainable Endowments Institute.

²<http://greenbillion.org/case-study/western-michigan-university-quasi-revolving-fund/>

³<http://www.wmich.edu/sustainability/>

³<http://www.pp.wmich.edu/ms/em/initiatives/index.html>

(PUSC) reports to the university president and has faculty representatives from all of the academic colleges, staff (including many areas of Facilities Management), administrators, and undergraduate and graduate students.

Large scale phaseout of incandescent lighting began in 2009. All major new construction over the past decade has observed LEED qualifying criteria. The College of Health and Human Services building was the first higher education building to achieve USGBC LEED Gold for Existing Buildings and five additional buildings are currently being LEED EB certified. Four apartment complexes completed in 2011 were LEED certified and the Lee Honors College renovation, currently underway, is slated to achieve LEED Silver or better. The new Sangren Hall, currently under construction, is projected to use approximately 33% less energy than the building it is replacing.

Facilities Management (and previously, Physical Plant) has actively pursued energy demand control measures since the 1970s, initially using time clocks to shut off HVAC systems at night. In 1996, a renewed and aggressive focus was put on energy management. Since then the university's main campus building square footage has increased by 8%, while total main campus utility consumption has decreased by 21% in the same period. This was done in large part through aggressive use of time-of-day scheduling of HVAC, occupancy sensors for lighting and HVAC, lighting source upgrades, converting constant volume HVAC systems to variable volume, installing variable volume pumping, heat recovery systems, a campus temperature policy, and advanced control sequences.

Preventive maintenance programs ensure that equipment is maintained in good working order and operates at peak efficiency. The most significant energy savings results from the steam trap program, which has been in place since 1988 and is used as a model for other institutions. This project alone has accounted for at least a 40% reduction in steam usage per building area serviced.⁴

WMU joined the Climate Savers Computing Initiative in 2010 and subsequently instituted policies to decrease the energy used by all university-owned computers, network servers, and peripheral devices. These policies include requirements to purchase energy efficient computing equipment along with policies governing modes of operation. Policies are also in place to require the purchase of "Energy Star" qualified items in other areas, such as appliances, audio-visual equipment, etc.

In an effort to reduce fuel used for commuting (scope III)—particularly by students—the university entered into an agreement in 2008 with the Indian Trails bus company to create "Bronco Transit", a free bus service among the main Kalamazoo, Parkview, and Oakland

⁴For details on WMU's Steam Trap Program, see the video produced by Armstrong International: <http://traction.armintl.com/traction - /single&proj=Steam&rec=251&brief=n>

Campuses. In addition to Bronco Transit, WMU has entered into a cooperative agreement with Metro Transit to provide free public transportation throughout Kalamazoo County to students and staff.

Projections for Future Growth

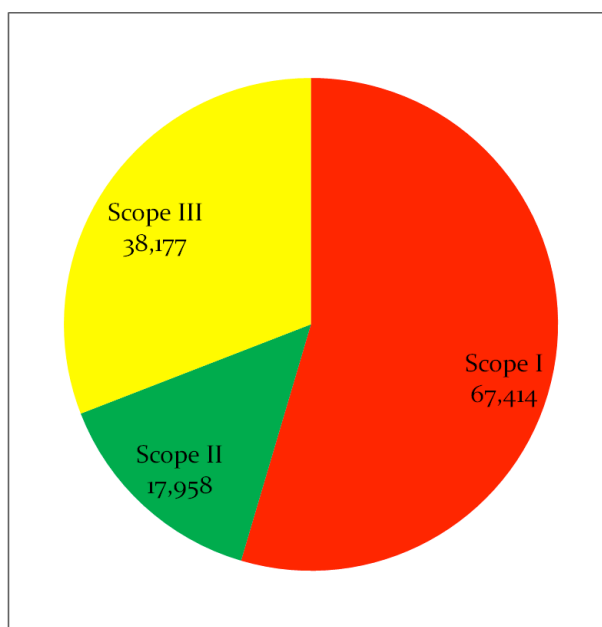
We currently anticipate very modest growth in the gross size of WMU operating facilities in Kalamazoo for the foreseeable future. WMU's long history of success with energy conservation and a slow shift to more online course delivery indicate that no major increase in the size of the physical plant will be needed. Demographic and economic trends suggest that the pool of students who will attend colleges and universities in Michigan is not likely to increase over the next decade or more, so that the current size of the physical plant will be adequate to serve the largest likely increase in enrollment.

Nevertheless, some additional facilities are anticipated, and older buildings will certainly be replaced over the time period of this report. Construction of a new multi-disciplinary research facility is a high institutional priority that currently awaits funding. For the purposes of this plan, we assume a slow increase of 3% - 4% in total building floor space in the next couple of decades, but that in the long run, most new construction will be balanced by demolition, decommissioning or transfer of older buildings outside of WMU control. Growth in the number of employees and students is assumed to be of the same order of magnitude.

Current Campus GHG Emissions and Recent Trends

These two figures show our latest data on the current magnitude and sources of greenhouse gas emissions within our operational boundaries. They are based on data from the 2009 calendar year, compiled and analyzed during 2010. They include greenhouse gases other than carbon dioxide, but these gases are converted by standard emissions factors to the equivalent effect of CO₂ before being combined.

Figure 1. GHG Emissions by Scope, in metric tons eCO₂. Data from the 2009 WMU GHG inventory



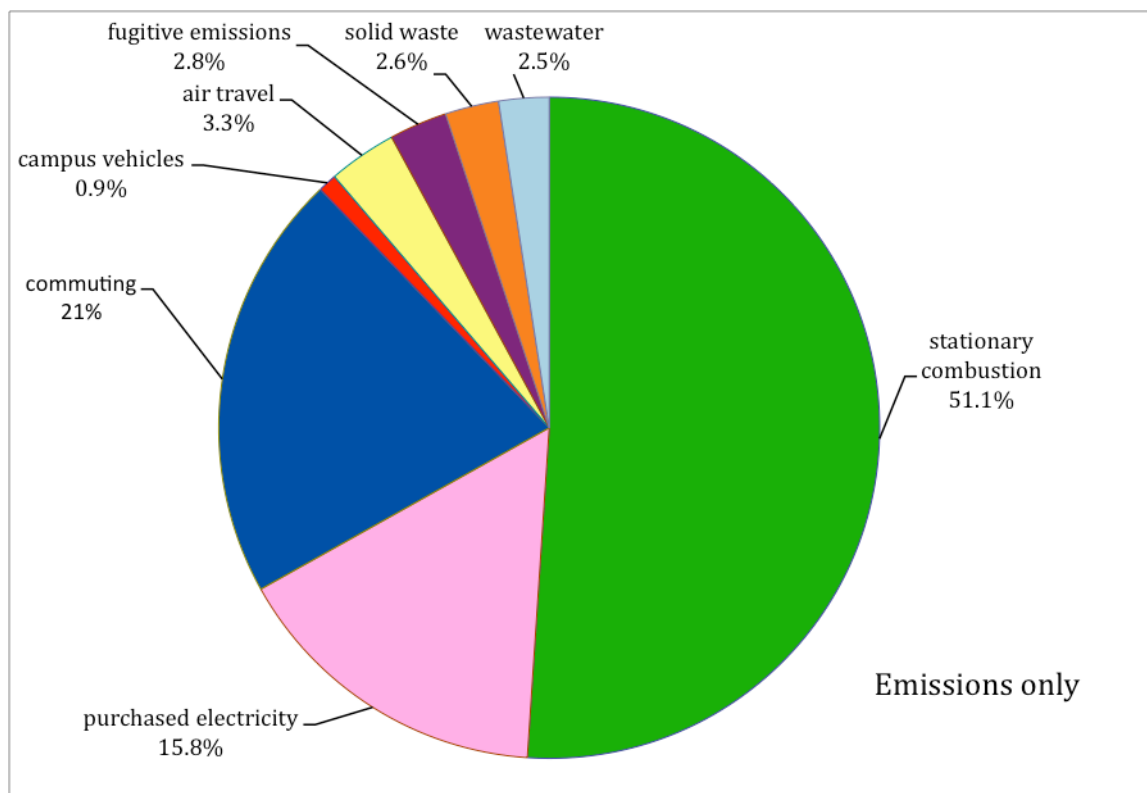


Figure 2. WMU GHG Emissions by source, as % of total emissions, data from 2009 GHG inventory

In figure 2, we have combined university-funded air travel for faculty and staff with air travel associated with study abroad, since our mitigation strategy will be the same in both cases. We have also disregarded some miscellaneous emissions that appear in our inventory (primarily associated with paper use), but which together account for less than 0.3% of the total.

Clearly, the bulk of our emissions are due to the energy required for routine operation of our physical plant, energy that is provided in the form of electricity and pressurized steam. Most of this energy now comes from a co-generating power plant located on the main campus, owned and operated by WMU, which is fueled by natural gas (stationary combustion). Additional electric power is purchased from the local utility when needed. We have been tracking this total energy use accurately for the last ten years, so that we can observe recent trends.

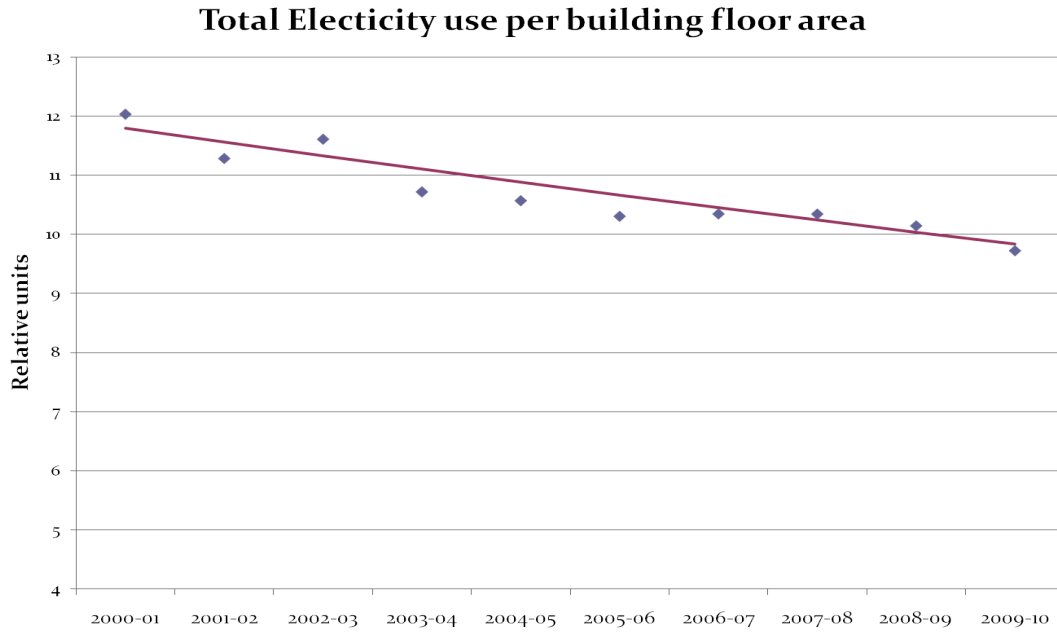


Figure 3. Trend in Electricity use per floor area, by academic year. The line represents a reduction of 2% every year, as best fit to the scattered data points. Vertical scale is relative, note the suppressed zero.

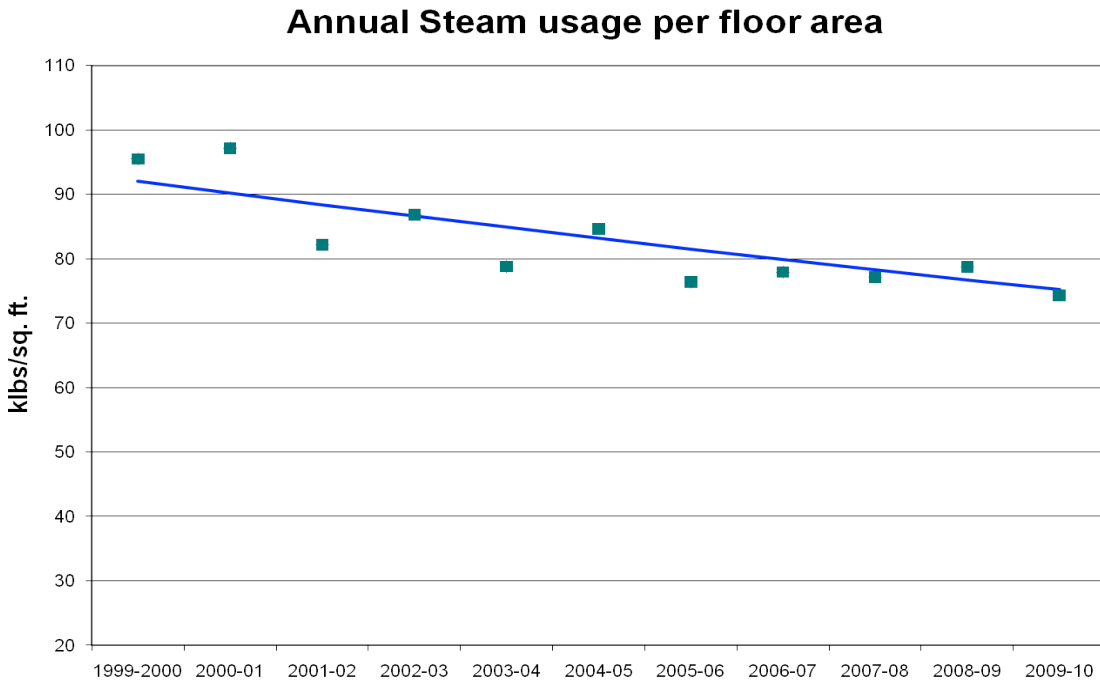


Figure 4. Pressurized steam use per building area, by academic year. Vertical scale is kilo-pounds of steam used per gross building floor area. The line is again a best fit to the data corresponding to a 2% reduction each year.

Recommended Strategies for Accomplishing Reductions

General Energy Demand Reduction

We believe that the current rate of decrease in energy use per building floor area (see figs. 3 & 4) can be maintained for the next 10-15 years. This will require continuing efforts on the part of Facilities Management and the cooperation of users all over campus. A campus-wide energy audit is currently underway for 66 buildings, which is intended to help us identify the next round of efficiency/conservation projects. We recommend that the findings of this energy audit be used to reduce demand with maintenance, renovation, and replacement projects, as has been the practice in recent years.

All planning and purchasing units should comply with recently revised Facilities Life Cycle Design Guidelines. Enforcing the Climate Savers Computing Initiative and Energy Star Purchasing policy will help maintain the pace of energy demand reductions. By maximizing energy performance credits and incorporating renewable energy credits where feasible, we can accelerate the payback time for certain innovations, freeing up funds to support further energy saving projects. We recommend decreasing or eliminating architectural lighting (exterior lighting not contributing to safety) as soon as possible.

Beyond the next 15 years, we believe it will become more difficult to reduce demand solely by increasing the efficiency of existing facilities. Older buildings will have to be removed from the system as they become obsolete or are replaced. We will have to do a better job of decommissioning underutilized buildings on East Campus and elsewhere. Farther into the future, the demand for power from the central power plant (both electricity and steam) will have to be reduced further by substituting carbon neutral sources of energy, such as geothermal heat capture and photovoltaics.

Stationary Combustion (Power Plant)

Since it is already a very efficient facility with a long useful life projected, no major changes in the operation of the central power plant are envisioned for the next 25-30 years. During this period, continued reduction in electricity demand will impact the amount of power purchased annually and the amount sold back to the utility. However, in the latter quarter of this period, extended shutdowns of one turbine may be possible during periods of lowest demand. Replacement of one turbine with a new unit with variable output capacity should be investigated if this technology becomes reliable and affordable.

Starting about 30 years from now, we recommend a major overhaul or replacement of equipment in order to reduce the GHG impact of supplying electricity to the campus by 50%. (By this time, it is assumed that our central power plant will also be able to supply the electricity needs of the Parkview campus.) After about another decade, we recommend that central power is produced

with little to no GHG emissions at all, via specific technology, such as biomass, yet to be determined. It is likely that one or both of these major changes will inhibit the delivery of steam to the campus, presently used for heating and some cooling. Provisions will have to be made to deal with remaining demand for the heat provided by steam before that time. The most likely means of accomplishing this are continuing to increase the thermal insulation of buildings, utilizing heat recovery from ventilation air at the building level, incorporating ground loop geothermal systems for climate control, and solar thermal collection.

At this time, we do not know which low-carbon, or carbon neutral technology will be most appropriate for producing centralized, base-load electrical power for the campus 30-40 years in the future. We do know of several potential sources that are likely to be economically feasible by then, and we expect that the electrical demand will be substantially less than it is now. Among the possibilities for centralized power production to replace our gas turbines are: combustion of waste biomass, bio-fuels cultivated on-site or off site, off-shore wind turbines in Lake Michigan, or renewable energy purchased from a third party such as the utility company. It is quite possible that a blend of two or more low- or no-carbon energy sources will be employed, supplemented by some de-centralized power generation (see below).

If a substantial fraction of campus power is to be provided by solar or wind sources, then we will also need to store a sufficient amount of energy locally in order to maintain any gains toward climate neutrality. Therefore, we recommend further study of practical means of energy storage on the appropriate scale, such as advanced battery banks, hydrogen electrolysis and storage, compressed air, or thermal storage in the underground aquifer. Such technology can also increase efficiency in the interim, by “load leveling”, ie., shifting electricity and steam demands from peak periods to off-peak times. As a result, investigation of energy storage options are already underway. These investigations should be accelerated and new initiatives created, well before major power plant changes take place.

Purchased Electricity

WMU currently purchases electric power from the local utility company (Consumers Energy) for two reasons: 1) To meet our needs when main campus demand exceeds the generating capacity of the power plant. At present, this occurs daily for a bit more than half of the year, depending on weather. 2) To supply power to the Parkview Campus, where the College of Engineering and Applied Science is located. This campus is separated from the power plant by about 2.5 miles, but there is currently no means by which power from the plant can be delivered directly to the Parkview Campus.

A large fraction of the purchased power is generated by the combustion of coal, hence its GHG impact is significantly greater per kilowatt-hour than the power generated by our own natural gas-fired turbines. Michigan has enacted a Renewable Portfolio Standard that will likely reduce the GHG impact of power purchased from the utility 10% by 2015, but even then, there will still

be a large discrepancy. Since this purchased power is also more expensive to WMU than the power we generate, reducing the amount of power we purchase is already a priority for our Facilities Management. The overall demand reduction strategies described above will gradually reduce the need for purchased power during periods of peak demand. We also recommend that some means be found to transmit power from our own generating station to the Parkview Campus by 2038 at the latest. After that date, there should be no further need to purchase utility power, unless power can be purchased that has much lower greenhouse gas emissions than we can generate locally.

Alternative Energy Supplies—Distributed

Further reductions in the demand for power placed on the central generating plant can be achieved by investing in de-centralized power that has little or no GHG emission. For our campus, grid-tied solar photovoltaic power is one promising technology that fits the bill. With some external support, WMU has already invested in two PV projects with 62 kW rated capacity.



Figure 5. 50 kW Photovoltaic array located on main campus, Miller Auditorium in the background.

Grid-tied solar photovoltaic panels are a pretty good match to the electric demand curve, since there is considerably less demand at night. Such panels could be mounted on buildings or at

ground level, in each case near where the power would be used. Our main campus has enough roof area to easily satisfy a third of our average electric power consumption with the efficiency of panels that are already widely available. However, due to the relatively high cost today and the problem of intermittency, it may not be feasible to go that far in the near future.

Nevertheless, we are recommending that WMU increase the amount of renewable energy collected on campus, de-centralized and separate from the power plant, to generate electric power near the locations where that power is used. We recommend a relatively slow increase in on-site PV production over the timeframe of this plan, but that at least 9% of electricity demand is filled by PV in 2065. We have modeled the financial investment needed to accomplish this based on current photovoltaic technology and likely cost trends, although some other technology could be substituted for all or part of this capacity in the future. By crediting the costs avoided by generating electricity this way, a steady rate of capital investment would accelerate the increase in the amount of power generated each year with zero GHG impact.

Commuting

Commuting by faculty, staff and students to and from campus is the next largest source of greenhouse gases attributed to the operation of WMU. It is helpful to separate the contributions made by student commuting from those of faculty and staff. Conceptually, it is also useful to consider the number of miles traveled separately from the efficiencies of the particular modes of travel that are used.

We have some survey data that helps us to estimate both the distances traveled, on average, by various groups and in what proportion various modes of travel are used. Factored into our projections is our belief that private automobiles used for commuting will gradually get more fuel efficient over the next 50 years, and that this will reduce the GHG emissions per mile independent of any action taken by WMU. We base this on fleet average fuel economy standards (CAFÉ), which are already in place and apply to all cars and trucks sold in the U.S.

To further reduce the climate impact of commuting, we recommend the following:

1. Increase the amount of desirable on-campus housing for students significantly. The target is a net increase of 3,500 beds by 2035 (per the 2008 Housing Master Plan) with more thereafter as demand allows.
2. Continue to support and improve mass transit options for students and others.
3. Facilitate car-pooling for employees who work regular hours, perhaps by developing some online tools or financial incentives.
4. Improve infrastructure for non-motorized commuting options (mainly walking and cycling). This would involve working with the city of Kalamazoo to ensure that bike lanes or off-street trails exist to connect all nearby student residences with the campus,

that the connections to campus in all directions are safe and smooth, and that ample, safe bicycle storage is conveniently located on campus, etc.

5. Improve maintenance of non-motorized routes, in particular snow-removal to extend the number of days/school year that walking or cycling is practical.
6. Explore ways to motivate people to make choices other than single-occupancy automobiles, perhaps by re-vamping the way they pay for parking or providing incentives for staff to live closer to campus. The current parking pass system provides no incentive to drive less, once a pass is purchased (this applies to both students and staff, whose permits are purchased for them by WMU).
7. Support electric vehicle adoption by continuing to provide free electricity at EV charging stations on campus. This will increase demand for electricity, of course, but it still has the net effect of reducing GHG emissions in the near term. In the longer term, we assume that very low-carbon electricity will be produced on campus, so there should be a considerable net benefit associated with continuing this effort.

Even if all of these recommendations are reasonably successful, we do not envision that the GHG emissions due to commuting can be brought to zero. We believe that a combination of fewer miles traveled, more efficient use of internal combustion, and increased use of zero-carbon means of travel can achieve an 82% reduction in GHG emissions from commuting by 2065.

Campus Vehicles

We recommend that all campus-owned vehicles be converted or replaced such that they are zero net carbon fueled or battery-electric powered by 2040 at the latest. Current battery-electric technology is already a good fit for most of the fleet used for maintenance and parking enforcement, but for heavier vehicles, riding mowers, or vehicles needing long range a biofuel option may be preferable. In our calculations, we have projected no change in usage for campus vehicles, but that half will be electric and half will be fueled by other means. We have added the electric load for charging these vehicles to the total demand, but we assume that as a rule, they will not be charged during periods of peak demand, and therefore will not impede progress toward the desired elimination of purchased utility power. WMU is already using seven fully electric vehicles and a hybrid lift truck in its maintenance fleet along with several hybrid vehicles in the university fleet.

Air Travel, Including Study Abroad

We recommend that the university eliminate unnecessary air travel by faculty and staff, possibly by making teleconference facilities on campus easier to access. Air travel is quick and often convenient, but it is one of the most carbon-intensive modes of travel scaled by distance (although it is still better than single passenger automobiles). WMU should explore ways to incentivize alternatives to air travel where possible.

A market for the purchase of air travel offsets is already in existence, and it appears that it will soon be well-established and easily accessible. For a modest surcharge on each ticket purchased, the buyer may be able to contribute to projects that reliably and verifiably reduce GHG emissions elsewhere, in an amount that equals the emissions due to the travel. Assuming such options remain available from reputable vendors, we recommend that WMU establish a policy requiring that all university-funded air travel be 100% offset by 2020.

Solid Waste and Wastewater

Wastewater and solid waste contribute to GHG emissions in the way they are treated after leaving campus. WMU has had a recycling program for over 20 years, but further progress can be made in both the diversion and recycling rates along with reducing total waste in all campus operations.

As of 2012, a local pig farmer is picking-up pre-consumer food waste for use as feed. Post-consumer food waste, which has been scraped off trays and into disposals, has already been reduced from most of our student cafeterias by eliminating trays. We recommend that these efforts be continued and expanded, as this has a major effect on the amount and quality of the wastewater generated.

Further reductions in waste of both types would be possible with a post-consumer composting program. Preliminary studies indicate that treating all of our compostable waste material on campus should be economically viable, given the charges we currently incur for disposing of this waste and the fact that our own campus landscape can make use of the resulting material. A student directed vermicomposting research program is underway to help us better assess the costs and benefits of this biomimetic strategy.

We believe that a 90% reduction in GHG emissions due to wastewater and solid waste combined is a reasonable goal to achieve by 2065.

Negative Contributions to GHG Emissions

Besides the surcharge for air travel mentioned above, we do not recommend entering any larger market that might develop for purchasing CO₂ offsets. We believe two strategies should be employed to offset any GHG emissions that remain by the 2060s.

Western Michigan University currently owns and maintains significant undeveloped green spaces off campus, as well as smaller green areas on campus. Significant off-campus areas are the Kleinstuck Preserve and the Asylum Lake Preserve, both of which contain forested areas and wetlands. These natural areas already absorb about 1000 metric tons of CO₂ annually. We recommend that WMU continue to maintain current total area of green space, both off campus

and on. We further recommend that in the future, more green space be added to WMU property as opportunities arise, either through land acquisition or restoration of areas that are no longer needed as parking lots or other facilities.

The absorption of CO₂ by natural areas will likely remain a relatively small effect. In order to offset remaining emissions after all other strategies have been implemented, we recommend that WMU develop a program to identify ways to reduce GHG emissions elsewhere in Kalamazoo County, then give financial support to fund such efforts where needed. We would then take credit for verifiable reductions in GHG emissions in accounting for our total. Such a program will also have cascading positive benefits in the area of Community Outreach, by facilitating improvement in quality of life (see below). Planning for this effort can and should begin soon, within the next five years. The financial investment can ramp up slowly; we estimate it will need to account for about 5000 metric tons eCO₂ of reduction by the year 2060.

The following figure summarizes the cumulative effect of all of the reduction strategies described above:

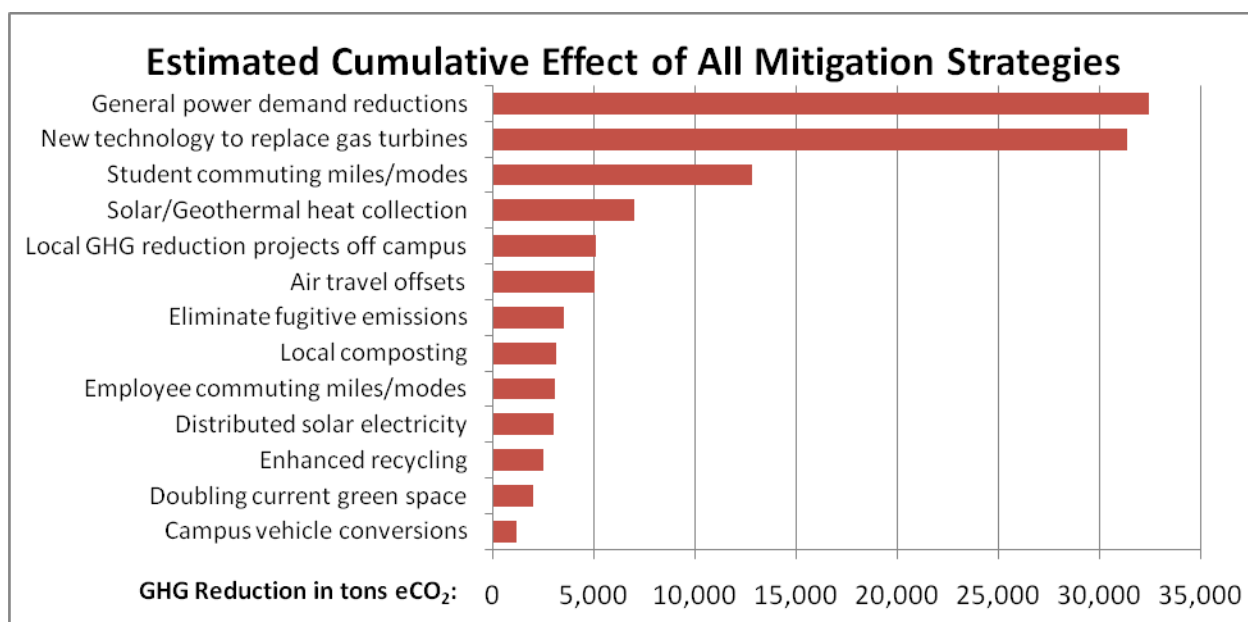


Figure 6. Cumulative reductions by broad categories of strategies, totaled over the period from 2011 to the 2065 target date. The sum total of all of these reduction estimates is less than current GHG emissions because we have assumed that factors outside of our control will also reduce emissions, such as mandated renewable portfolio standards for Michigan utility companies, improvements in vehicle fuel efficiencies, etc.

Trajectory for GHG Reductions

The following figure illustrates the anticipated year-to-year reductions in GHG emissions in all categories within the operational bounds, based on the assumptions and strategies described above. Actual emissions are shown as positive on the vertical scale, and stacked. Offsetting

factors are stacked vertically in the negative direction. By 2065, it is predicted that the total of the offsetting factors will equal or exceed the remaining annual emissions, resulting in net climate neutrality.

The two discontinuities in the rate of decrease (2041-43 and 2055-59) are due to our proposal to replace natural gas as the source of centralized power in two phases, spaced 12-15 years apart to ease the financial impact. If this major change can be completed in a single phase, or if either phase can be done sooner, the result could be climate neutrality at a much earlier date.

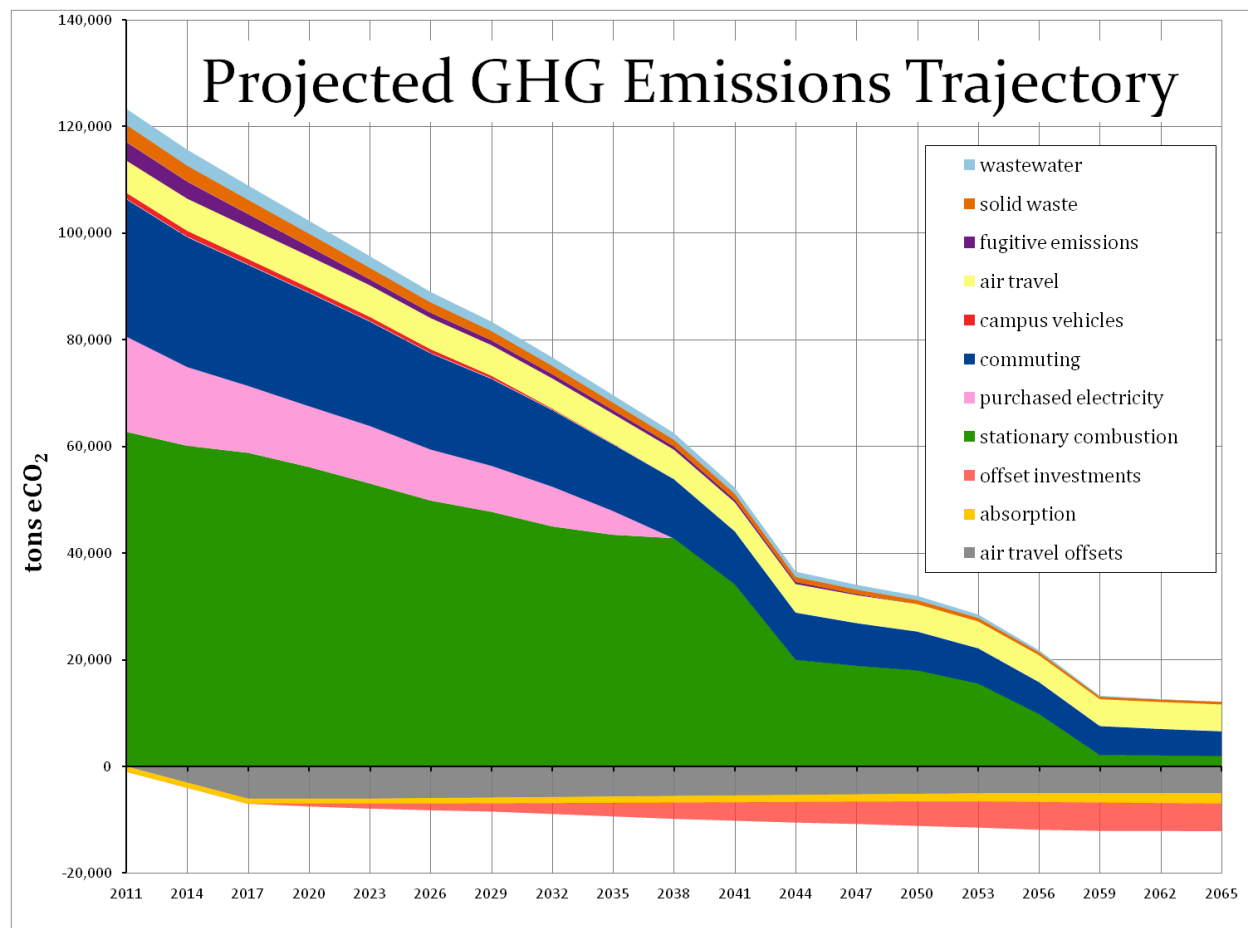


Figure 7. Proposed trajectory for GHG Emissions from present to target date. Categories are the same as Fig. 2. Strategies which subtract emissions are shown as negative on the vertical scale

Educational Efforts

Western Michigan University has a long history of making climate neutrality and sustainability a part of the formal curriculum. The Campus Sustainability Assessment Project, the first national-scale effort to review and evaluate best practice in campus sustainability assessment, grew out of Andrew Nixon's Lee Honors College thesis research in 2000. WMU's first GHG inventory grew out of a class project in 2002. The full GHG inventory for academic year 2000-2001, completed

in 2003 by Jennifer Mansfield, Gloria Benson, and Hannah Gryska, also resulted in a Lee Honors College thesis. Another group of students, Chris Caprara, Kaitlyn Shields, Matt Van Ness, and Kelly Krug completed the first comprehensive campus GHG inventory using the Clean Air-Cool Planet protocol in 2009. Chris Caprara and Kate Shields continued their research with a best practice evaluation of the first 100 ACUPCC signatories' GHG inventories and climate action plans. This research has been instrumental in helping to develop WMU's current climate action plan. While these projects were under the direction of Harold Glasser, faculty from all across the university continue to support a wide variety of sustainability and climate change student research projects.

WMU's active commitment to build a campus culture of sustainability took off in full force in January 2008 when then recently appointed president John Dunn signed the Talloires Declaration and created the President's Universitywide Sustainability Committee. The PUSC, as it's known on campus, has faculty members from all colleges as well as Facilities Management and other staff, administrators, and both undergraduate and graduate students. After a yearlong baseline assessment and brainstorming process, the PUSC created a Strategic Sustainability Initiatives Report in 2009, which outlined a series of prioritized initiatives in five categories (Governance and Administrative, Operations and In-reach, Community Service and Outreach, Curriculum, and Research).⁵ One of the PUSC's key recommendations was to create an Office for Sustainability to coordinate the implementation of these initiatives, which were intended to be realized in the five year period following the report. On the curriculum side, four recommendations ranged from integrating sustainability into all curricula, throughout all colleges to creating new opportunities for student sustainability research and internships and creating summer faculty development workshops to assist faculty with integrating and infusing sustainability into the curriculum to creating new sustainability-oriented degree combinations and graduate study opportunities. In May 2010, a faculty sustainability luncheon was held to explore these opportunities and challenges.

In the spring of 2010, WMU's student body voted to create the first student sustainability fee in Michigan, which was approved shortly after by the Board of Trustees.⁶ This strong statement of support for sustainability from the student body greatly enhanced the potential of the planned Office for Sustainability, which was scheduled to open in the fall of 2010. The Office's mission "is to guide and assist the Western Michigan University community in fulfilling and growing its sustainability commitments. Through building a diverse and flourishing learning community around sustainability, we will continually explore and develop new opportunities to create a culture of sustainability and improve quality of life for all."⁷ The Office for Sustainability has

⁵<http://www.wmich.edu/sustainability/pdf/initiatives-report.pdf>

⁶ This fee is \$8 fall and spring and \$4 summer I and summer II.

⁷<http://www.wmich.edu/sustainability/about/index.html>

created a variety of programs and co-curricular activities that supplement the existing formal curriculum. These include:

1. Wesustain Internships

Wesustain Internships are yearlong opportunities open to all students (undergraduate and graduate) who pay the sustainability fee. Interns participate in leadership and discovery-driven learning opportunities and are paid to research and work on campus sustainability projects and policies. To date, fifty students have participated in the program.

2. Student Sustainability Grant (SSG) Program

The Student Sustainability Grant (SSG) is also available to all students who pay the sustainability fee. Any proposal that promotes a campus culture of sustainability and potentially benefits all students is eligible. Proposals must be safe, legal, adequately budgeted, and possible within existing University infrastructure to qualify. Selection is through a blind-review process and an allocation committee composed solely of undergraduate and graduate students. Seventy-five thousand dollars was allocated for academic year 2011-2012.

3. The Gibbs House Fellowship Program

The Gibbs House Fellowship Program is a special, residential form of the Wesustain Internships. In addition to the normal Wesustain Intern responsibilities, fellows live in the historic Gibbs House across from Asylum Lake (at reduced rent), and participate in projects to make the home and property more sustainable. The Gibbs House property houses the Student Farm, which grows organic produce for Campus Catering and has an ongoing integrated pest management research program. The Gibbs House also serves as a community sustainability resource center.

4. Office for Sustainability Initiatives

The Office for Sustainability also hosts a variety of initiatives developed and led by students (undergraduate and graduate), faculty, and staff. A sampling of projects include: an annual Student Sustainability Survey, an initiative to create a student-led sustainable foods café, bike and pedestrian friendly campus research, student gardens, Oil to Mowers, and the EcoMug™, a program that distributes an insulated, stainless steel beverage container to all incoming students. The Office for Sustainability also supports or leads a variety of initiatives with other departments and offices, which include: coordinating the campus' Climate Action Plan (including preparing GHG inventory updates and GHG reduction research); coordinating participation in the RecycleMania Tournament; collaborating with First-Year Experience to integrate sustainability into Fall Welcome and pilot a program for infusing sustainability into First-Year Seminar⁸; collaborating with Admissions to build sustainability into promotional materials and the Campus

⁸See for instance the "Sustainability at Western Michigan University" video, on the Office for Sustainability's YouTube Channel along with the winning video from the First-Year Seminar Campus Sustainability Video Competition, at: <http://www.youtube.com/user/WMUSustainability>

Tour as well as an effort to enhance the sustainability of the Admissions Office's operations; partnering with Residence Life and Facilities Management to run Eco-Thon⁹, an annual residence hall competition that integrates waste reduction and recycling, electricity consumption, Residence Assistant programming, Hall Government involvement; and the Sustainability Across Research and Teaching Initiative. The Office for Sustainability also houses Waste Reduction and Recycling Services, which operates primarily with student labor.

In addition to these internal programs, the Office for Sustainability encourages interns to submit Campus Ecology case studies, abstracts to attend national campus sustainability conferences, such as Ball State's Greening the Campus and the Association for the Advancement of Sustainability in Higher Education's (AASHE's) annual meeting, to write up projects for academic journals, and to serve as informal campus sustainability ambassadors that motivate other students to participate in climate-related educational initiatives such as Focus the Nation.¹⁰ The Office also helps to facilitate the participation of students on university committees related to sustainability and climate neutrality, such as the recently created committee to implement the Billion Dollar Green Challenge.

In an effort to build on the Kellogg Commission's Future of State and Land-Grant Universities conclusion that in our rapidly changing world with tenacious problems and growing challenges, public universities "exist to advance the common good"¹¹, the Office for Sustainability conducted a survey of faculty in January 2012 to help further integrate sustainability into the formal curriculum. This survey had two main purposes. First, it was intended to help identify and prioritize the types of initiatives and policy changes faculty believe are important for facilitating the infusion and integration of sustainability into research and teaching across campus. Second, it was intended to stimulate and support the creation of an engaged group of scholars and students that is not only dedicated to making their work about sustainability but is also dedicated to advance sustainability on regional, national, and global scales.

This new universitywide learning community will work—in both its teaching and research—to better understand and create the conditions to improve quality of life for all, both on campus and off, generation after generation. It will take to heart WMU's new *Mission and Vision* that describes us as a "community of learners committed to human dignity, sustainability, social responsibility, and justice"—one that "transforms wisdom into action".¹²

⁹For more details, see: <http://www.wmich.edu/sustainability/student/eco-thon/index.html>

¹⁰<http://www.focusthenation.org/about>

¹¹Kellogg Commission on the Future of State and Land-Grant Universities. (2000: 9). *Renewing the covenant: Learning, discovery, and engagement in a new age and different world*. Washington, DC: National Association of State Universities and Land-Grant Colleges, <http://www.aplu.org/NetCommunity/Document.Doc?id=186>

¹²<http://www.wmich.edu/about/mission>

As a follow on to this survey, to help build sustainability into the fabric of what we do and how we do it, the Office for Sustainability created a new initiative, Sustainability Across Research and Teaching (StART), with support from the provost. StART is a ground-up, faculty-driven effort that takes as its foundation the Kellogg Commission's (2000: 20) conclusion that:

The obstinate problems of today and tomorrow in our nation and the world—poverty, family and community breakdown, restricted access to health care, hunger, overpopulation, global warming and other assaults on the natural environment—must be addressed by our universities if society is to have any chance at all of solving them.

In its initial incarnation, the StART Initiative consists of three luncheons during the spring Semester 2012 (two on curriculum and one on research). The luncheons will mine the survey data as well as further explore what it means and what it will take to build a vital and flourishing learning community around sustainability that addresses content, pedagogy, and context (how WMU models sustainability in all of its functions and activities—the *shadow curriculum*). The first result will be a report to the president and provost, scheduled for the fall of 2012, which will outline a series of recommendations for further advancing the StART Initiative. It's our hope that the Initiative will take on a life of its own and lead to a host of cross-college activities—from brown bags to faculty development workshops and speakers series to research collaborations and specialized sustainability courses, certificates, a minor, and a cross-college graduate research lab.

In addition to the StART Initiative, faculty have also independently created efforts to raise awareness about sustainability and climate change and pilot innovative courses. In the fall semesters of 2009 and 2010 professors Charles Ide and Dave Karowe and Toni Woolfork-Barnes, Director of First-Year Experience Programs, led a National Science Foundation sponsored Course, Curriculum, and Laboratory Improvement (CCLI) grant to integrate climate change into two First-Year Seminar Courses. In early 2012, professors Ron Kramer (Sociology), Paul Clements (Political Science), and Dave Karowe (Biological Sciences) received support from the new Center for the Humanities to create an Interdisciplinary Study Group on Climate Change. This group of highly engaged and enthusiastic faculty and emeriti has met throughout the spring semester. As with the StART Initiative, they hope to identify collaborative teaching and research projects and initiatives. As a further example of faculty leadership, Dave Karowe has created a climate change course that he will be piloting in the fall of 2012 in the Lee Honors College. On the sustainability side, professor Andrew Targowski of the Haworth College of Business created The Center for Sustainable Business Practices in 2009 to “to create and disseminate information, concepts, knowledge and wisdom about global sustainable business practices as the planet faces the challenges of lack of resources, declining business ethics, and immediate questions related to globalization and its impact on the State of Michigan, the U.S. and the World in the 21st century”. Professor Targowski's efforts resulted in a college-wide commitment to require each service, major, minor, and concentration to select a leading

course(s), which will include 1-3 sessions on how to develop and manage sustainable business practices.¹³

Future plans under consideration to advance sustainability, climate change, and climate neutrality learning opportunities include:

1. Systematically assessing the scale and character of sustainability and climate change course content currently available across the entire WMU curriculum;
2. Working with WMU's Office for Faculty Development to create faculty development opportunities to facilitate the infusion and integration of sustainability and climate neutrality education across the curriculum;
3. Redeveloping the Campus Sustainability website to share more information on WMU's efforts to implement the ACUPCC with both alumni and community members;
4. Creating an html Office for Sustainability newsletter to help spread the word about programs, policies, and incentives to different constituencies;
5. Creating a public lecture series to share innovative GHG reduction efforts (such as zero net buildings and the Living Building Challenge) and to foreground pioneering efforts to advance community sustainability;
6. Working with the PUSC and the StART group to consider recommendation of a graduation requirement in sustainability (per recommendation of the ACUPCC);
7. Building an asset map of who is doing what on campus—climate change and sustainability related—to facilitate communication, cooperation, and collaboration; and
8. Identifying new opportunities and incentives to facilitate the success and expansion of the StART Initiative.

Efforts to review and assess progress as well as to identify new projects and initiatives will be built into the annual Office for Sustainability work-plan development process each May.

Research Efforts

Western Michigan University is a doctoral-granting university with “high research activity”, according to the Carnegie Foundation for the Advancement of Teaching. WMU is student-centered, discovery driven, and globally engaged. Cutting-edge research is a significant part of our continuing mission and the enhancement of research efforts has a prominent place in the institutional strategic plan.

With regard to climate change, we plan to focus on six areas of research during the next few decades. These are areas where we already have faculty who are engaged or have expertise, or

¹³<http://www.wmich.edu/business/about/centers/sustainability/documents/Policy.pdf>

which promise applications that are particularly appropriate to our local situation. These areas are:

1. New techniques for energy management and conservation in buildings and manufacturing processes;
2. Practical applications of biomass as an energy source, both for stationary power generation and as fuels for transportation (“Bronco Biodiesel” and our “Oil to Mowers” initiative, which super-filters spent oil from campus cafeterias for use in a campus diesel lawnmower as a research pilot for a potential, larger scale waste oil transportation initiative);
3. Studying the efficacy of various means and strategies to facilitate energy conserving and sustainability-oriented behaviors among both individuals and groups (such as the different constituencies that make up university campuses);
4. New technologies for storing energy locally, economically and practically, at a scale that is useful for campus, neighborhoods, or small utilities. Energy storage in a form easily utilized for electrical power or space heating;
5. Carbon capture and sequestration, with particular emphasis on sequestration in suitable geologic formations that exist in Michigan. Research in this area is already underway by members of our Geosciences Department; and
6. Analysis of actual costs and returns on investments in a wide variety of greenhouse gas mitigation efforts. The objective would be to provide published data which are general enough to aid others in predicting costs of such efforts and in choosing the most cost-effective strategies in the long run.

We recommend that the Office of the Vice President for Research both seek out potential sources of external grant funds in these areas and dedicate some fraction of internal research support funds to “seeding” researchers with new projects to develop. The Office for Sustainability will also play a role by providing internships, by serving as a clearinghouse for matching students with faculty who share interests in these areas, by its own research initiatives, and through facilitation of the StART Initiative.

Community Outreach

The City of Kalamazoo signed on to the U.S. Conference of Mayor’s Climate Protection Agreement in 2007. Resource limitations have hampered the City’s ability to coordinate a large-scale effort to assess and reduce GHG emissions. In May of 2009, Mayor Bobby Hopewell, WMU President John Dunn, and Lynn Spurr, President of the Southwest Michigan Sustainable Business Forum, along with thirteen other regional and community leaders signed the

“Southwest Michigan Regional Sustainability Covenant”¹⁴ in an effort to facilitate collaboration and cooperation and situate climate change response in the larger context of community sustainability.

Prior to signing this covenant, WMU President John Dunn and then Vice President for Business and Finance, Lowell Rinker, created the Sustainable Communities Initiative to provide campus leadership and university support to this fledgling effort. In February of 2009, WMU hosted a luncheon that brought public and private leaders from across Southwest Michigan to share best practices and “facilitate meaningful cooperation and collaboration on sustainability planning, research, and projects throughout the region.” Subsequent to this luncheon, a survey was created to identify the major areas of interest among Covenant signatories. Two topics, “regional planning for sustainability” and “community sustainability indicators” rose to the top of this list.

In response, WMU’s President’s Universitywide Sustainability Committee hosted Maureen Hart, author of the *Guide to Community Sustainability Indicators* and the founder of Sustainable Measures, a company that “develops indicators that measure progress toward a sustainable economy, society and environment”. From November 11-13, 2009, Hart led a series of community sustainability indicator events, which included a public lecture, a public workshop, and four targeted meet and greet opportunities with community leaders. Workshop participants ranked the following six topics (in rank order) as most significant: community awareness/sustainability education, regional coordination, rebuilding neighborhoods, right metrics/best practices, sustainability indicators design, and land use/sprawl.

Based on workshop and survey data, two long-term projects were identified that could leverage the drive and creativity of community members and their commitment to improve of quality of life for all. These included a grassroots, community-wide visioning effort and regional asset mapping. The visioning effort was suggested to help broaden and deepen participation before attempting to initiate a sophisticated community sustainability indicator project. Regional asset mapping was suggested as a way to provide cohesion by helping to identify individuals and organizations that are already working on community sustainability and what they are doing.

On April 14, 2010, signatories of the Southwest Michigan Sustainability Covenant held their first general assembly at the Douglass Community Center in Kalamazoo. Organized by Mayor Bobby Hopewell, Director of Public Services Bruce Merchant, Environmental Services Superintendent Mike Wetzal, and WMU Professor Harold Glasser, the meeting was intended to bring together covenant signatories to discuss their vision and goals for the Covenant, next steps, and commitments for the future.

¹⁴http://www.kalamazoocity.org/docs/sustain_covenant.pdf

In advance of the meeting, WMU Sustainability Researcher Matt Hollander and Dr. Glasser prepared and administered a web-based survey to participants. The survey focused on seven main questions:

1. How do Covenant signatories characterize “sustainability?”
2. What planning and/or action are signatories currently engaged in to address sustainability?
3. What knowledge and/or experience do signatories need to support this planning and/or action?
4. What are three aspects of our region signatories want preserved for the next fifty years?
5. What are three aspects of our region signatories want changed over the next fifty years?
6. What does your organization need to be doing NOW to help us all realize your vision of sustainability?
7. Recognizing that some sustainability initiatives can only be accomplished through collaboration with others, what SINGLE, high-leverage activity, action, or project is most critical to get launched—from the perspective of your organization?

The intention of the survey was to gauge the overall priorities of the group and begin to develop a common language and vision for the future. The majority of participants resonated with Sustainable Seattle’s characterization of sustainability as “long-term cultural, economic, and environmental health and vitality”.¹⁵ They characterized air and water quality, green space, and economic vitality as key aspects of our region to preserve and quality of life, land-use planning, air and water quality, economic development, energy efficiency and renewables, and green transportation as aspects to enhance. There was general agreement among attendees that this conversation should be continued and expanded to incorporate the perspectives of the wider community. Subsequently, the group moved into a discussion of current grant opportunities for sustainability efforts in the region. Although no concrete plans were made, everyone agreed to meet again on a future date. Despite these aspirations, no follow up meetings with the full Covenant group have occurred as of March 2012.

Sustainability, as improving quality of life for all, is a prodigious goal that is as much about process as product. It can only be “reached” through meticulous visioning, broad collaboration, and outstanding leadership. The Southwest Michigan Regional Sustainability Covenant and WMU’s Sustainable Communities Initiative provided initial leadership, but to move the

¹⁵Sustainable Seattle, *Indicators of Sustainable Community: A Report to Citizens on Long-Term Trends in Our Community*, Seattle, WA, 1993, p. 2.

Covenant forward, we recognize that we must expand the conversation while identifying financial, intellectual, and social capital resources to hire and support a dedicated community sustainability coordinator.

Individual faculty and staff members have also taken exemplary leadership roles to facilitate community sustainability and educate about climate change and GHG reduction opportunities. A few representative examples follow. David Karowe, in Biological Sciences, has offered a Lifelong Learning Academy course on climate change. John Patten and David Meade, from the Green Manufacturing Initiative in the College of Engineering and Applied Sciences, facilitate cooperative research programs to support industry's sustainability and GHG reduction goals. John Patten has converted a Prius into a plug-in hybrid and Paul Pancella, the former chair of physics, converted a Honda Civic into a fully electric vehicle. Both lecture widely and publicly on electric vehicles. John Miller and Steve Bertman in Chemistry and Sarah Hill in Anthropology have ongoing research in algae-based biofuels that they regularly share with the community. Andrew Targowski from the Haworth College of Business created The Center for Sustainable Business Practices to “to create and disseminate information, concepts, knowledge and wisdom about global sustainable business practices as the planet faces the challenges of lack of resources, declining business ethics, and immediate questions related to globalization and its impact on the State of Michigan, the U.S. and the World in the 21st century”.

Cari Delong, a WMU alumna and the university's Natural Areas Coordinator, frequently collaborates with faculty and local schools to run programming to address “nature deficit disorder”. WMU Facilities Management energy conservation staff share best practice regularly with local business and government leaders as well as their parallels from other campuses. Judy Gipper, Director of Dining Services, in collaboration with the Office for Sustainability, initiated innovative efforts to send pre-consumer food waste to a local pig farmer, super filter waste vegetable oil (from soybeans grown and processed locally) for use in a campus diesel lawn mower, and purchase food from local, organic farmers. These are just a few examples of the many university—community collaborations to advance sustainability and reduce GHG emissions.

WMU's Office for Sustainability, founded in the fall of 2010, is dedicated to collaborate with Facilities Management, the Environmental Studies Program, Lee Honors College, student organizations such as the Western Student Association and Students for a Sustainable Earth, the Interdisciplinary Study Group on Climate Change (recently established in WMU's Center for the Humanities), and other offices and departments on campus as well as individual faculty and staff members to identify and support partnerships to reduce GHG emissions and promote sustainability in our community, and beyond. In 2011, the Office for Sustainability received a grant from the Clean Energy Coalition to install fifteen electric vehicle charging stations and a 50 kW photovoltaic array. Along with five electric vehicle charging stations obtained through ChargePoint America, WMU now has twenty electric vehicle charging stations that are available to the public, for free, during normal business hours. In addition, Office staff collaborate with

local, regional, and international groups, such as PeaceJam, and lecture widely on sustainability and climate neutrality.

Future plans under consideration include:

1. Creating a public lecture series to share innovative GHG reduction efforts (such as zero net buildings and the Living Building Challenge) and to foreground pioneering efforts to advance community sustainability;
2. Offering faculty development opportunities to local schools to learn about sustainability and climate neutrality;
3. Collaborating with local schools to offer a summer fellowship to high school students that will be mentored by our Office for Sustainability interns;
4. Developing local carbon offset projects;
5. Continuing to expand Lifelong Learning Academy courses on climate change, sustainability, and climate neutrality;
6. Organizing experts on campus to make consultation services available to the public (using land grant universities' cooperative extension service as a model);
7. Utilizing social networking and collaborating with University Relations to issue periodic press releases to increase the effectiveness of information sharing;
8. Redeveloping the Campus Sustainability website to share more information on WMU's efforts to implement the ACUPCC with both alumni and community members; and
9. Continuing to work with Kalamazoo's mayor and community sustainability leaders to advance the goals of the Mayor's Climate Protection Agreement and the SW Michigan Regional Sustainability Covenant.

Efforts to review and assess progress as well as to identify new projects and initiatives will be built into the annual Office for Sustainability work-plan development process each May.

Financing the Recommendations

For several years, Western Michigan University has used an innovative "Quasi-Revolving Fund" to support a wide variety of energy conservation measures. This Quasi-Revolving Fund recaptures money from cost-savings, similar to a typical green revolving fund, but it also sources capital from the broader utilities, maintenance, and other budgets as necessary in a fluid manner. Therefore, its ability to finance projects is often far more substantial than the fixed pool of capital that comprises most revolving funds. As a result, it does not have a formal and consistent fund size; project finance opportunities are constantly tracked and reviewed as modifications to the overall utilities and maintenance budgets are made. This process allows for the institution to continuously invest in energy and other conservation initiatives that promise a high rate of return

without being limited by a lack of capital in the fund itself. We estimate that this combined strategy for funding sustainability improvements through a Quasi-Revolving Fund has achieved a 47 percent return on investment since its establishment in 1980.

Until now, the unofficial cutoff for maximum payback period of initiatives considered has been about five years. We recommend increasing this maximum payback time so that more projects can be funded from this source going forward. We should also consider making the maximum payback time proportional to anticipated annual savings.

In October of 2011, WMU joined 32 other leading institutions of higher education to launch the Billion Dollar Green Challenge. The goal of this initiative is to invest a cumulative total of \$1 billion in self-managed green revolving funds that finance energy efficiency upgrades on campus. Here at WMU, we will supplement the current Quasi-Revolving Fund with another \$1 million endowment, to be built up over the next four years. This will allow more of the recommendations contained in this plan to be implemented in a timely fashion.

WMU has also been very successful in obtaining external support from foundations and research agencies for several projects that have an impact on reducing GHG emissions. We recommend that these efforts be continued, and that the Development Office and the Office of the Vice President for Research become more involved in supporting and facilitating these efforts.

Tracking Progress

A basic GHG emissions inventory will be performed annually. The Office for Sustainability, with cooperation from Facilities Management and Institutional Research, will have primary responsibility for conducting the GHG inventory. Every three years, we recommend that a more detailed study of GHG emissions be performed to update various assumptions and extrapolations that affect the data. In particular, the annual GHG inventory will likely assume no changes in transportation modes or average distances for commuting; these data will have to be obtained with carefully designed survey instruments on a three-year cycle.

We recommend that a small implementation committee composed of students, faculty, staff, and administrators be formed to compare actual GHG emissions in all categories with the interim targets and to make recommendations as appropriate. This committee, which could be a sub-committee of the President's Universitywide Sustainability Committee, should meet at least annually and present its findings to the PUSC annually. While the primary target is net zero GHG emissions in eCO₂ units, the committee should analyze (and report on) progress in all major categories of the three scopes as well as report on actions to "expand research or other efforts necessary to achieve climate neutrality" and actions to "make climate neutrality and sustainability a part of the curriculum and educational experience for all students".

In addition to evaluating and reporting on data and trends, this implementation committee should work closely with Facilities Management, researchers on campus, and national campus sustainability leaders to identify promising new technologies and opportunities for accelerating GHG reduction on campus and in the community.

Every three years, when the data from the more detailed GHG inventory becomes available, this implementation committee should thoroughly compare actual GHG emissions in all categories with the interim targets (see Table 1, below) and review trends. Interim targets should be broken down by these categories as well and the success or failure of specific initiatives should be thoroughly analyzed wherever possible.

Based on trends and actual emissions compared to targets, this implementation committee should recommend to the PUSC actions necessary to maintain the desired trajectory in reductions. The implementation committee should also be empowered to recommend changes to the Climate Action Plan, adjusting targets in individual categories in a manner that would still allow the climate neutrality target to be met, within the uncertainties described below (see figure 8).

Table 1. Target ranges for total emissions, 6-year increments

	Target Range, net tons eCO ₂	
Year	Low	High
2011	122,500	125,000
2017	99,300	111,800
2023	82,900	98,900
2029	68,000	85,000
2035	52,400	69,400
2041	34,200	52,700
2047	17,400	36,400
2053	8,100	27,000
2059	1,000	12,500
2065	0	5,000

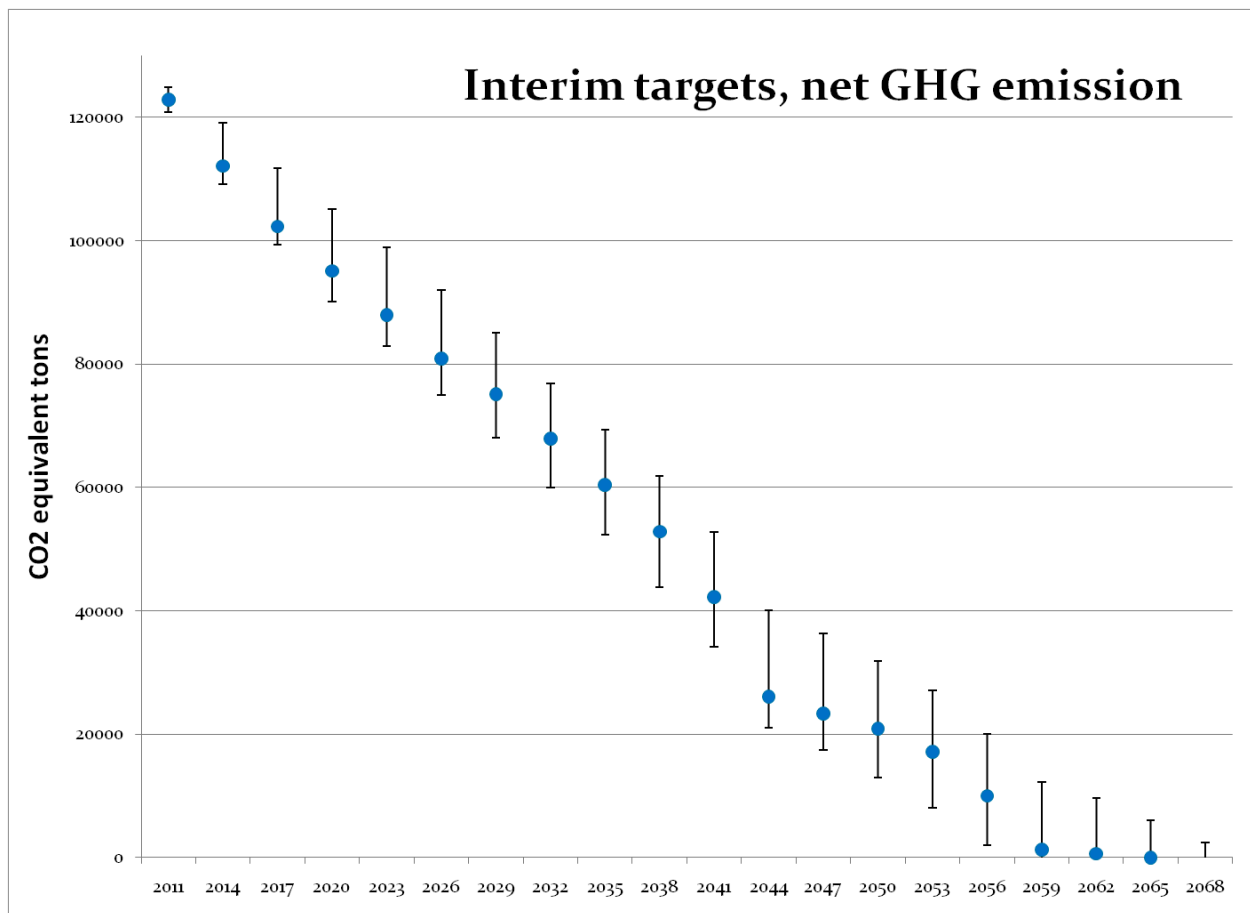


Figure 8. Graphical representation of the range of interim targets. Solid dots are the predicted emissions minus the offset factors, as shown in Fig. 7, with a data point every three years.

At least every six years, this implementation committee should publish a report that thoroughly details progress toward the goal of climate neutrality. This report should be submitted to the ACUPCC reporting site, and be made available to the local community as well.