UNIVERSITY OF MICHIGAN
ENVIRONMENTAL TASK FORCE ADVISORY REPORT TO PRESIDENT MARY SUE COLEMAN

APRIL 20, 2004

Making a Greener Maize and Blue

ENVIRONMENTAL TASK FORCE

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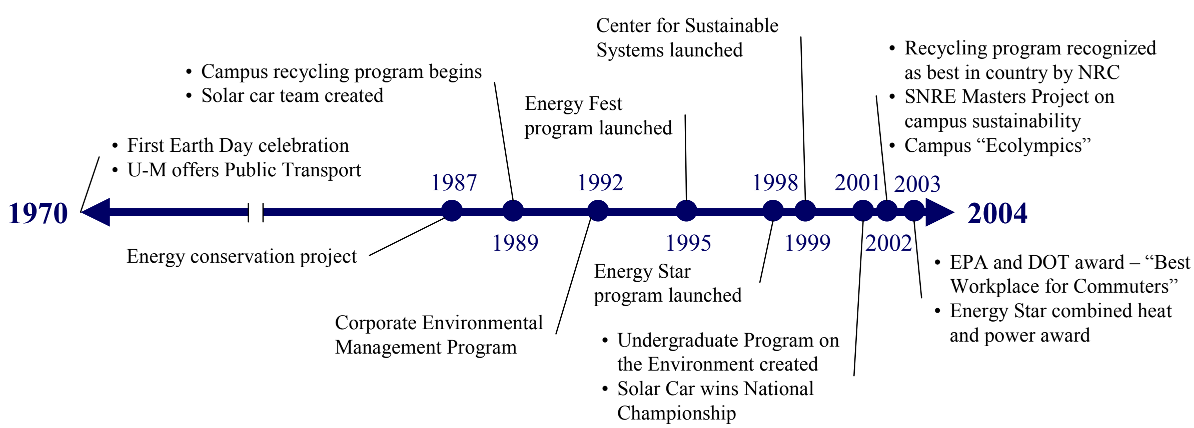
INTRODUCTION

In 2003, President Mary Sue Coleman established an Environmental Task Force to "develop a plan for the University of Michigan to create a more sustainable future." This Task Force is charged with identifying indicators which best measure the progress of the University with respect to its environmental performance, as well as investigating how these indicators might best be measured and reported on a regular basis. This report presents recommendations of the Task Force in response to President Coleman's charge.

Environmental Stewardship at the University of Michigan

The University of Michigan (U-M) has a long history of leadership and innovation on environmental issues (see timeline below).[1] There are close to 200 environmental stewardship projects currently underway at the University.[2] These include programs in recycling, energy conservation, building design, pollution prevention, emissions reduction, alternative-fuel vehicles, storm water management and de-icing and anti-icing impact reduction. A complete list of programs and initiatives is included in the Appendix. Noteworthy initiatives include Energy Star, alternative-fuel vehicles and recycling. Through the implementation of U.S. Environmental Protection Agency's Energy Star program, which began in 1997, U-M saves 25 million kilowatt-hours of electricity annually, enough to power 1,600 average-size homes.[1] This program also saves $9.7 million per year.[2] In recognition of these efforts, the Central Power Plant received the EPA Energy Star Combined Heat & Power Award in September 2003. U-M also operates the largest alternative-fueled fleet in the state with 110 diesel-powered vehicles that burn bio-diesel fuel and more than 400 passenger cars that burn ethanol fuel.[2] Lastly, recycling efforts at U-M capture roughly 30 percent of the solid waste stream. In recognition of its recycling efforts, U-M received the National Recycling Coalition's 2001 Outstanding School Program.[2]

Chronology of Select Environmental Initiatives at the University of Michigan



[1] Rodriguez et al (2002) *Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus*

[2] Brown, Diane (March 3, 2003) U-M continues environmental stewardship work. *The University Record.*

Environmental Efforts at other Colleges and Universities

In a survey administered as part of a report by the National Wildlife Federation's Campus Ecology Program, over 60 percent of U.S. institutions of higher learning were found to exhibit good environmental practices. When asked why campuses were implementing environmental programs, the number one response from college presidents (from 64% of those surveyed) was that such programs fit with the culture and values on America's college and university campuses. Presidents also cited public relations (47%) and cost-effectiveness (41%) as important factors.[3]

Over 270 colleges and universities worldwide have produced campus sustainability assessments. Approximately half of these were comprehensive sustainability assessments, while the other half were focused on one specific issue within the broader sustainability arena.[4] U.S. institutions producing reports include Michigan State University,[5] University of Florida,[6] Pennsylvania State University,[7] University of Vermont,[8] University of North Carolina[9] and Yale University.

Examples of Environmental Initiatives at other Institutions

- Rutgers University gives solid and liquid food waste to farmers for animal feed.
- By recycling tree prunings, Colorado State produces roughly 2,000 cubic yards of mulch each year.
- Harvard's Green Campus Initiative has created a $3 million loan fund to help finance green projects.
- In October 2003, Lewis & Clark College became the first campus in the nation to comply with the Kyoto Protocol.
- In May 2001, Indiana University became the first university to prohibit the purchase of products derived from old growth forests.
- Connecticut College has committed to offset over 40% of its electricity consumption over the next two years with wind energy

Environmental Assessment and Reporting at U-M

Following an initial research effort to explore the feasibility of developing a sustainability report for the University, a team of School of Natural Resources & Environment (SNRE) graduate students formed in January 2001 to assess the environmental, social and economic performance of the University's Ann Arbor campus (UM-AA). Their research was conducted in collaboration with U-M's Center for Sustainable Systems and U-M's Occupational Safety and Environmental Health Department (OSEH) and involved over 30 other U-M departments. Project objectives included:

- To propose a definition of sustainability and a framework for assessment tailored to UM-AA

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[3] McIntosh et al (2001) *State of the Campus Environment: A National Report Card on Environmental Performance and Sustainability in Higher Education*. A National Wildlife Federation Report.
[4] Glasser, Harold, Andrew Nixon, and Jason Tallant (2002) *Campus Sustainability Assessment Review Project*. Paper for presentation at Economicology 4.5 conference.
[5] Michigan State University Campus Sustainability Report (2003) (http://www.ecofoot.msu.edu/files/pdfs/sustainability.pdf)
[6] University of Florida Sustainability Indicators (2001) (http://www.sustainable.ufl.edu/indicators.pdf)
[7] Penn State Indicators Report (2000) (http://www.bio.psu.edu/greendestiny/publications/gdc-indicators_2000.pdf)
[8] Tracking UVM: An Environmental Report Card for the University of Vermont for the years 1990 to 2000 (2002) (http://www.uvm.edu/greening/trackinguvm.pdf)
[9] UNC Chapel Hill Campus Sustainability Report (2003) (http://sustainability.unc.edu/Documents/AnnualReportWeb2003.pdf)

- To use the framework to evaluate a set of sustainability indicators
- To highlight findings in a Prototype Sustainability Report
- To provide recommendations for an institutionalized reporting process

Indicators were proposed using the Global Reporting Initiative (GRI)[10] as a template, and were based on an extensive review of reports from corporations and other colleges and universities. Twenty-five environmental performance indicators were defined and these served as the basis for selecting the eight Environmental Performance Indicators recommended in this report. The findings of the students' efforts were presented to Interim President B. Joseph White in June of 2002, and to President Mary Sue Coleman in December of 2002.

THE PRESIDENT'S CHARGE TO THE ENVIRONMENTAL TASK FORCE

President Coleman established the U-M Environmental Task Force with the following charge:

> *Environmental stewardship is a key responsibility of the University, the city of Ann Arbor, and, indeed, the nation. The importance of stewardship is reflected not only in its relevance to our students, faculty, staff, and alumni; but, also in response to growing environmental challenges such as global warming, urban sprawl, limited natural resources and the loss of biodiversity.*
>
> *In its role as a world-class educational institution, the University of Michigan has historically led by example. With respect to environmental stewardship, the University should pursue leadership in its approach to environmental policies, practice, and education by setting a standard for other universities, for the state, and the local community.*
>
> *To this effect, I am establishing a task force that will develop a plan for the University of Michigan to create a more sustainable future. It is the charge of this group to identify ten to twelve indicators that best measure the university's progress with respect to environmental stewardship and to investigate how these indicators might best be measured and included in a periodic university report. I ask the task force to supply me with an advisory report, to be submitted early in the Winter 2004 semester, which will be shared with the Provost and Executive Vice President for Academic Affairs, the Executive Vice President and Chief Financial Officer, and the Executive Vice President for Medical Affairs as well as the University community.*

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[10] The Global Reporting Initiative is a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines. See www.globalreporting.org.

OBJECTIVE AND SCOPE OF TASK FORCE REPORT

The objective of this Environmental Task Force Advisory Report is to respond to the President's charge to identify indicators of environmental progress and to devise a plan for the periodic reporting of these indicators to the University community. The assessment and reporting of environmental performance is expected to provide multiple benefits to the University and the broader community, including the following:[1]

Benefits of Assessment	Benefits of Reporting
▪ Identification of cost-savings ▪ Reduction of environmental risks ▪ Measurement of performance improvement initiatives ▪ Better evaluation of costs and benefits of different forms of capital, including environmental ▪ Better identification and management of intangible assets such as reputation ▪ Identification of new opportunities for development	▪ Tool for tracking progress ▪ Improved stakeholder engagement and feedback ▪ Enhanced ability to educate U-M community about environmental issues ▪ Creation of new networks of communication within U-M ▪ Build and/or bolster reputation for transparency and credibility

Institutionalizing the indicators and a reporting process will enable the University to measure its progress with respect to environmental stewardship on the Ann Arbor campus. In the future, it is expected that the proposed indicators can be used to track environmental performance for the Dearborn and Flint campuses, using the UM-AA reporting process as a model. It is also envisioned that social and economic indicators will be developed and included in future reports.

As a consequence of meeting with the President, the Task Force limited its selection to a manageable set of eight Environmental Performance Indicators that best measure the University's impact and progress with respect to environmental stewardship. In proposing these eight indicators, the Task Force recognizes the complexity of the environmental issues that will be assessed and reported. These issues can be global or local in scale, highly interconnected, can cause both acute and chronic health effects and can pose long term threats with irreversible consequences. The Task Force also recognizes the complexity of the U-M itself in terms of aspects such as size and diversity of activities (e.g. education, research, medical care, and recreation). Certain indicators were normalized to better represent changes over time in facilities, the population of the University community and the core activities of the University.

The Task Force acknowledges that, in assessing the impacts of the Ann Arbor campus, most upstream and downstream environmental impacts are not inventoried due to modeling complexity and lack of data. Environmental impacts result from upstream activities including the production of goods and services imported by U-M and from downstream activities such as waste disposal and wastewater treatment. The Ann Arbor campus system boundary is defined as all university-owned and operated land and infrastructure within the city limits of Ann Arbor that is utilized mainly by University faculty, staff, or students, as well as Matthaei Botanical Gardens and Radrick Farms Golf Course. However, it is important to recognize the relationship between the University campus and the local community in achieving broader environmental sustainability objectives. For example, the location of University employee residences is a key factor in determining the environmental impacts associated with commuting.

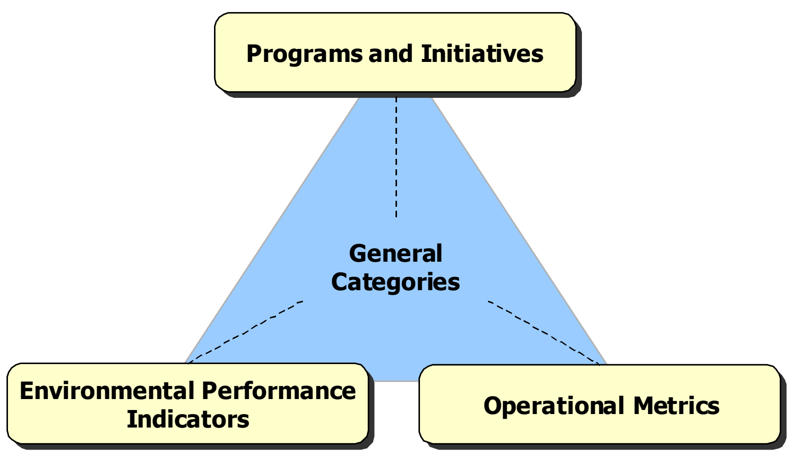
Since data are available for these indicators dating to 1990, the University will be able to make historical comparisons. The 1990 data can be considered the baseline data, with more recent and future data allowing for trend analysis.

PROPOSED ENVIRONMENTAL PERFORMANCE INDICATORS

Overview of Framework

With the objective of identifying a set of environmental performance indicators, the Task Force developed a framework to capture the impact and progress of the U-M with respect to environmental issues. The framework, which is depicted below, is comprised of: six General Categories for assessing environmental performance; a set of eight Environmental Performance Indicators for evaluating campus wide performance; and Operational Metrics to provide a more detailed assessment of specific operations and activities of the University. In addition, existing Programs and Initiatives are identified that guide environmental improvement in each General Category. Assessment, monitoring, and developing the programs and initiatives proposed for the eight environmental performance indicators have the potential to not only enhance the performance and quality of the campus, but also to engage students and faculty through courses, research projects and outreach.

Environmental Assessment and Reporting Framework



General Categories

The first step in selecting a set of measurable and reportable environmental performance indicators was the selection of a set of General Categories that best captured the environmental footprint of the UM-AA campus. These six General Categories were chosen for their significance of impact, campus-wide applicability and availability of data. These categories are:

1. **Energy: Buildings and Transportation**
2. **Water Use**
3. **Land Use: Built and Natural Spaces**
4. **Emissions: Air Pollutant Emissions and Water Discharges**
5. **Material Use and Solid Waste**
6. **Cross-Cutting and Emerging Issues**

The category "Cross-Cutting and Emerging Issues" was included to classify indicators, metrics and programs that are cross cutting and to provide a means for capturing ideas that might be implemented in the future. For example, the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council is a rating system for buildings that assesses energy and environmental performance. LEED addresses Categories 1 through 5. This category can also be used to report on health and safety indicators. The Global Reporting Initiative framework and the prototype U-M sustainability report classify health indicators under social sustainability rather than environmental sustainability. Health and safety indicators can be included here provisionally until a social sustainability reporting process is implemented. In the future, this category might also include indicators relating to environmental education and research at U-M.

Environmental Performance Indicators

The Task Force used the following criteria for identifying and selecting campus wide Environmental Performance Indicators:

- Identify indicators that best represent the University's "environmental footprint"
- Ensure that data is readily available for evaluating each indicator
- Identify at least one indicator for each General Category
- Limit the set to a manageable number of campus wide environmental indicators

The eight indicators were derived from the General Categories presented above, and utilize the same numbering scheme. For example the first Environmental Performance Indicator, *Primary Energy Consumption,* is numbered 1.1 and belongs to the General Category *Energy: Buildings and Transportation* (number 1 above). These eight Environmental Performance Indicators are shown in the table below. Following the table, these indicators are defined, and the basis for selection and units of measurement for each are presented.

General Category	Environmental Performance Indicators
1. Energy: Buildings and Transportation	1.1 Primary Energy Consumption 1.2 Renewable Energy Contribution
2. Water Use	2.1 Water Use
3. Land Use: Built and Natural Spaces	3.1 Impervious Surface Area
4. Emissions: Air Pollutant Emissions and Water Discharges	4.1 Greenhouse Gas Emissions
5. Material Use and Solid Waste	5.1 Solid Waste 5.2 Percent of Solid Waste Recycled
6. Cross-Cutting and Emerging Issues	6.1 Building Utilization

1.1 Primary Energy Consumption

Basis for Selection

At the 1992 Earth Summit in Rio de Janeiro, and in a publication, which followed (Agenda 21), the United Nations Conference on Environment and Development recognized that the largest impact of human development comes from energy production, distribution, and use. Agenda 21 points out that much of the world's energy is produced and used in ways that may not be sustainable if total demand continues to increase and technology remains unchanged.[1] Environmental impacts associated with the production and consumption of energy include global climate change, acid rain, hazardous air pollution, smog, radioactive waste and habitat destruction. Similarly, energy consumption is arguably at the root of the University's most significant environmental impacts.

Definition, Units and Normalization

This indicator measures the total primary energy consumption by the University and includes the energy used in powering the campus, including U-M facilities and transportation systems. Primary energy is defined as the total energy consumed by end users, including the energy consumed by electricity generation facilities (e.g. electric utilities). In keeping with U.S. Department of Energy (DOE) convention, the units of measurement for primary energy consumption will be British Thermal Units, or BTU.[11] This indicator will be reported on a total and per capita basis, the latter of which will account for fluctuations in the campus population.[12] Along with BTU per person, this indicator may also be reported on the basis of Barrels of Oil Equivalents (BOE) per person.

Primary Energy Consumption	
Units:	BTU
Normalization:	BTU/person Barrels of oil equivalent/person

1.2 Renewable Energy Contribution

Basis for Selection

Renewable energy sources address major challenges of our conventional energy system including resource scarcity and security, greenhouse gas emissions and air pollution impacts. Currently, the most promising forms of renewables include wind, biofuels (fuel derived from plant material) and solar thermal and photovoltaic technologies. The University has taken several steps to increase its use of renewable energy, particularly in the transportation sector.

Definition, Units and Normalization

Renewable energy contribution is defined as the percentage of total campus energy consumption from renewable sources. The DOE defines renewable energy as "energy resources that are naturally replenishing but flow-limited. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action."[13] This indicator will be reported as percentage of total UM-AA campus energy consumption.

Renewable Energy Contribution	
Units:	% of campus energy provided by renewable sources

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[11] One British Thermal Unit is the amount of energy required to raise the temperature of one pound of water by one degree Fahrenheit.

[12] The SNRE Master's Project team defined "campus population" as the sum of students, faculty and staff.

[13] U.S. DOE Energy Information Administration. Energy Glossary (http://www.eia.doe.gov/glossary/glossary_main_page.htm)

2.1 Water Use

Basis for Selection

The U-M AA's educational, research, residential, and recreational activities require the use of freshwater, a use that can impact the ecosystems from which the City of Ann Arbor obtains its water. About 80 percent of the City of Ann Arbor's water supply is withdrawn from the Huron River at Barton Pond, while the remaining 20 percent comes from the Steere Farm wells located on the west side of town.[1] A portion of the water used by the University is returned to the Huron River following tertiary treatment by the City's wastewater treatment plant. It is projected that the Great Lakes Region's reliance on groundwater will increase with further population shifts, development and demands of a water dependent economy.[14] For this reason, it is important to monitor and report the University's water usage and manage it in a way that is sustainable in the long run.

Definition, Units and Normalization

Total water use is defined as the total volume of water used in buildings, power plant operations and landscape maintenance on the Ann Arbor campus. This indicator will be measured in gallons, and will be normalized on a per capita basis to account for growth in University population.

Water Use	
Units:	Gallons
Normalization:	Gallons/person

3.1 Impervious Surface Area

Basis for Selection

In addition to this use of water supplied by the City of Ann Arbor, the Ann Arbor campus also contributes storm water and snow melt runoff into the Huron River. Storm water runs off impervious surfaces and flows via storm drains either untreated or with minimal treatment into the Huron River. This storm water may contain a variety of pollutants, including animal waste, litter, oil or pesticides, all of which can have harmful impacts on water quality and aquatic ecosystems. Green space, on the other hand, can absorb and filter the precipitation that falls upon it. Green space serves other ecosystem functions as well, for example habitat for plant and animal species as well as recreation. For these reasons, an increase over time in the ratio of impervious surface area to total surface area on campus would have negative environmental implications.[1]

Definition, Units and Normalization

In the SNRE Master's Project report, the authors included the following categories in total impervious surface area: sidewalks and plazas, gravel surfaces, parking lots, ramps and stairs and game courts. Data were not available for roads and buildings, though the team did make an estimate for surface area covered by buildings. In the future, it is hoped that these two categories are included in data collection. This indicator will be measured in acres and normalized as a percentage of total campus area.

Impervious Surface Area	
Units:	Acres
Normalization:	% of campus area

[14] Institute of Water Research (1999) Michigan State University. Michigan's Drinking Water: What is Groundwater? from Rodriguez et al (2002)

4.1 Greenhouse Gas Emissions

Basis for Selection

Atmospheric concentration of carbon dioxide (CO_2) continues to increase in part due to human activities including the combustion of fossil fuels, agricultural activity and land use changes. The global CO_2 concentration of 373 parts per million (ppm)[15] in 2002 was 33 percent higher than that of the preindustrial era (280 ppm), and is projected to be significantly higher by the end of the century (estimated range of 550 to 970 ppm).[16] While the effects of increased levels of atmospheric greenhouse gases are difficult to predict, the Intergovernmental Panel on Climate Change (IPCC) has found that:[16]

- The global average surface temperature has increased over the 20th Century by roughly 0.6°C
- Globally, it is very likely that the 1990s was the warmest decade, and 1998 the warmest year on record
- Snow and ice cover have decreased in the 20th century
- Average sea level worldwide rose by 0.1 to 0.2 meters during the 20th century

The IPCC predicts that global average temperatures will increase from 1.4 to 5.8°C by 2100, with an average predicted increase of around 2.5°C.[16] The expected consequences of these warmer temperatures include flooding of coastal areas, more severe weather events such as hurricanes and changes in local temperature and precipitation that will shift agricultural production zones and adversely impact plant and animal species.[17] With respect to the University and the region in which it is located, evidence suggests that winters are getting shorter, average annual temperatures are increasing, the duration of lake ice cover is decreasing and heavy rainstorms are becoming more common.[18]

Definition, Units and Normalization

This indicator will inventory the greenhouse gas emissions resulting from campus activities. The six greenhouse gases identified for inclusion in the United Nations Framework Convention on Climate Change are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Each gas differs in its ability to absorb heat in the atmosphere –

Greenhouse Gas Emissions	
Units:	Metric tons CO_2 equivalent Metric tons carbon equivalent (MTCE)
Normalization:	MT CO_2 eqv./person MTCE/person

[15] Keeling, C.D. and T.P. Whorf (2003) Atmospheric CO2 records from sites in the SIO air sampling network. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. (http://cdiac.esd.ornl.gov/trends/co2/sio-mlo.htm)

[16] IPCC (2001) Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. (http://www.grida.no/climate/ipcc_tar/wg1/005.htm)

[17] U.S. EPA. Global Warming – Impacts. (http://yosemite.epa.gov/oar/globalwarming.nsf/content/Impacts.html)

[18] Kling, G.W., K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Shuter, M.M. Wander, D.J. Wuebbles, D.R. Zak, R.L. Lindroth, S.C. Moser, and M.L. Wilson (2003). *Confronting Climate Change in the Great Lakes Region: Impacts on our Communities and Ecosystems*. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

the so-called Global Warming Potential (GWP).[19] For example, methane traps over 23 times more heat per molecule than CO_2, and SF_6 is 22,200 times more potent than CO_2.[20] Estimates of greenhouse gas emissions are often presented in units of metric tons of carbon equivalents (MTCE), which weights each gas by its GWP. Using this convention, CO_2 accounts for over 83 percent of GHG emissions, while methane and nitrous oxide contribute roughly 9 and 6 percent respectively.[20]

The University will report greenhouse gas emissions in both million tons of CO_2 equivalent and millions tons of carbon equivalent (MTCE). As was the case with the SNRE Master's Project, the University will measure and report emissions of three of the six gases identified above: CO_2, methane and nitrous oxide. This indicator will be reported on an aggregate basis to assess the University's total GHG footprint, as well as on a per capita basis to normalize for fluctuations in campus population.

5.1 Solid Waste

Basis for Selection

Waste generation by Americans has increased at a significant rate. In 1960, Americans produced an average of 2.7 pounds of municipal solid waste (MSW) per capita per day. By 2001, that figure reached 4.4 pounds per capita per day.[21] The generation and disposal of solid waste poses several environmental problems, including land use for landfills and groundwater contamination through leaching. Closer to home, the Michigan Department of Environmental Quality estimates that the state of Michigan has 15-17 years of landfill disposal capacity remaining at current rates of solid waste disposal. Compounding this problem is an increasing volume of imported waste from New York and Toronto.[22]

Definition, Units and Normalization

Solid waste generated at the University consists of a mixture of everyday items such as paper, packaging, yard clippings, bottles and food scraps. The inventory of solid waste will report the quantity of non-hazardous waste from the University including the medical facilities. This solid waste will be measured in tons, and normalized on a per capita basis.

Solid Waste	
Units:	Tons
Normalization:	Tons/person

5.2 Percent of Solid Waste Recycled

Basis for Selection

Reducing the amount of solid waste disposed of not only reduces the impacts associated with landfills (e.g. land usage, leaching), but it also means that less virgin material and energy are consumed in producing new products. The recycling rate indicates the extent to which waste is diverted from landfills and instead recovered for reuse.

[19] As defined by the U.S. EPA, "the global warming potential of a greenhouse gas is the ratio of global warming, or radiative forcing, from the emission of one unit mass of a greenhouse gas to that of one unit mass of carbon dioxide over a specified time horizon."
[20] U.S. EPA (2003) Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2001.
[21] U.S. EPA (2003) Municipal Solid Waste Basic Facts (http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm)
[22] Michigan Department of Environmental Quality (2000) Report of the Solid Waste Importation Task Force to Governor John Engler and Department of Environmental Quality Director Russell J. Harding. Cited in Rodriguez et al (2002).

Definition, Units and Normalization

The percent of solid waste recycled is defined as the total solid waste recycled in a given year divided by the total solid waste generated in that year. It will be expressed as percentage of solid waste recycled per year.

Percent of Solid Waste Recycled	
Units:	Percent of solid waste recycled

6.1 Building Utilization

Basis for Selection

Campus buildings are major source of environmental impacts ranging from raw material and energy consumption to air emissions. In the United States, buildings account for 30 percent of raw material use, 36 percent of total energy use and 30 percent of greenhouse gas emissions.[23] More efficient utilization of buildings can reduce resource requirements and other environmental impacts related to building construction, operation, and maintenance. This can also translate into capital and operating cost savings.

Definition, Units and Normalization

This indicator measures the total area of conditioned buildings per person. A less area intensive building footprint per capita would generally reflect a greater efficiency in the use of resources for construction, operation and maintenance of campus facilities. One approach to improving this indicator is to focus on better utilization of existing space rather than construct new facilities.

Building Utilization	
Units:	Total area of conditioned buildings (ft^2)
Normalization:	ft^2/person

Operational Metrics

Complementing the Environmental Performance Indicators is a set of Operational Metrics that provide greater detail on campus environmental performance. Certain Operational Metrics are directly linked to the eight Environmental Performance Indicators, while others address additional environmental issues. For the indicator Primary Energy Consumption, Building Energy Consumption is an example of the former, while Campus Bus Ridership is an example of the latter (see the table "General Category: Energy – Buildings and Transportation" below for an example of how Operational Metrics are linked with Environmental Performance Indicators).

Programs and Initiatives

Also associated with each General Category is a series of Programs and Initiatives underway at the U-M that address a particular environmental impact. For example, Programs and Initiatives associated with Primary Energy Consumption include Energy Star, the Greening of Dana, and the University's bio-diesel and ethanol fuel programs. A complete list of programs and initiatives is included in the Appendix.

[23] U.S. Green Building Council. Why Build Green? (http://www.usgbc.org/AboutUs/whybuildgreen.asp)

Example of General Category Energy – Building and Transportation

To demonstrate how General Categories, Environmental Performance Indicators, Operational Metrics and Programs and Initiatives fit together, below is an example of the General Category Energy – Buildings and Transportation.[24]

General Category: Energy – Buildings and Transportation

	Units	**Normalization**
Environmental Performance Indicators (2)		
Total Energy Consumption	BTU	BTU/person Barrels of oil equivalent/person
Renewable Energy Contribution	Percent renewable	
Operational Metrics (15)		
Building Energy Consumption	BTU	BTU/ft^2 BTU/person $BTU/ft^2/person$
Total Electricity Consumption	MWh	
Electricity from Renewable Sources	Percent	
Transportation Energy Consumption	BTU	BTU/person
Bus Energy Consumption	BTU	BTU/passenger mile
Fleet Vehicles Energy Consumption	BTU	
Fleet Fuel Economy	MPG by vehicle class	
Renewable Percentage for Transportation Energy		
Campus Bus Ridership	Total passengers Passenger miles	
Car/Van Pooling (U-M pool vehicles only)	Vehicle miles traveled *Passenger miles traveled	
AATA Bus Passes	Number of passes	
AATA Bus Ridership	Total number of rides	
*Bicycle Ridership	Number of bike racks	
*Vehicular Commuting	Vehicle miles traveled Passenger miles traveled BTU	
*Air Travel	Passenger miles traveled BTU	
Programs and Initiatives (examples)		
Energy Conservation	Energy Star, Green Lights, Poster Campaign	
Renewable Electricity Purchases		
Combined Heat and Power		
Biodiesel and Ethanol Fuel		
Plant Extension Office Design Guidelines	80 strategies for all new construction and retrofits	
Greening of Dana	Radiant cooling system, insulation of building envelope	

*Data is not yet collected for this indicator.

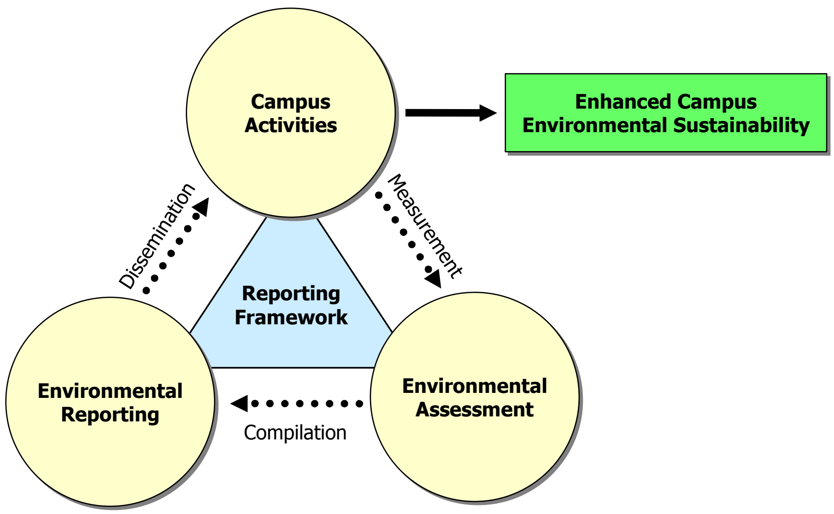
[24] Matrices for the other General Categories are included in the Appendix of this report

Implementation Plan for Environmental Assessment and Reporting

Overview of Assessment and Reporting

The reporting framework shown earlier supports the assessment and reporting process as shown in the figure below. The programs and initiatives from the framework support improvement of ongoing campus activities that are measured and evaluated as part of the assessment process. The environmental indicators described earlier are compiled from this assessment for reporting and dissemination back to the campus community.

Overview of Assessment and Reporting Process



Responsibilities for Data Collection and Reporting

With eight Environmental Performance Indicators identified, the next step is to ensure that an effective and efficient system is in place to manage the data throughout the reporting life cycle (i.e. collection, compilation, analysis, storage, reporting). It is imperative that clear responsibility is assigned for each of these phases. It should be noted that Units within the University already track about 75 percent of the raw data that underlie the eight Environmental Performance Indicators. For example, the U-M Utilities Department gathers basic data on energy sources for electricity, heating and cooling and hot water.[1] It is likely that additional resources need only be dedicated to the collection of the remaining 25 percent of the raw data, as well as central data compilation, data analysis, conversion to appropriate measurement units, normalization and actual production of the periodic report.

Report Content and Reporting Frequency

Given that data are currently being collected for the eight indicators, the Task Force recommends that the University report on these indicators on an annual basis. Such frequency will enable the University to chart its progress towards environmental sustainability, to assess whether or not its Programs and Initiatives are having the desired impact and to set meaningful objectives. Such frequency could also better position the U-M to engage stakeholders on these issues.

For manageability and efficiency, it is recommended that the bulk of the periodic campus environmental report be dedicated to the eight Environmental Performance Indicators. Therefore, each year, concerned parties can assess and chart the University's environmental performance along the same eight criteria. The Task Force suggests that in each report, the authors select a particular topic to highlight, presenting University efforts and accomplishments. For example, the report might focus on Transportation to highlight the University's alternative fuel programs. By going in depth on a particular theme, the authors can then present certain Operational Metrics and Programs and Initiatives that demonstrate the University's commitment to environmental stewardship. Models for such a layout can be found in corporate environmental reports, of which there are many.

Dissemination Plan

In producing and disseminating this report, it is important to first consider who will be using the report and how will they be using it. The report could be printed in a small number for those stakeholders who prefer this medium. The report could also be converted to an electronic file and either emailed to the University community or placed on the University's existing Environmental Stewardship website at http://www.umich.edu/~urel/stewardship.

RECOMMENDATIONS FOR FUTURE DEVELOPMENT

It is expected that campus environmental assessment and reporting will be an iterative process that is refined over time as the University follows new developments in environmental science, technology, policy and practice and receives feedback from internal and external stakeholders. With this in mind, the following issues should be considered as the University proceeds with periodic reporting:

Near Term Recommendations

Use this report to establish goals to guide improved campus environmental performance

Reporting itself is not the ultimate goal of this proposed effort, rather reporting is a means to improve campus environmental performance. Through this report, the University can track its progress on environmental stewardship and establish meaningful goals.

Revise and refine indicators based on new and improved understanding of important environmental issues

Reporting on environmental performance is a dynamic process, and indicators may need to adjust accordingly. For example, it is possible that new environmental challenges may arise in the future – challenges that impact the University and are worthy of reporting. It is also possible that the science underlying these indicators may change over time. For example, the Global Warming Potential of particular greenhouse gases has changed over time as model accuracy has improved. In these instances and others, the report should present the current indicators in a way that allows for comparison to indicators of prior reports. The advisory committee mentioned below might help in setting the University's agenda on these issues.

Solicit feedback on report content and presentation

The authors of the report should ask themselves how and why relevant stakeholders are using the report. The Task Force may consider exploring ways to accept feedback on the report, for example surveying users on report content, relevance and transparency.

Longer Term Recommendations

Establish an assessment and reporting advisory committee

In preparing the Sustainability Report, the SNRE Master's Project team drew upon the expertise of a steering committee comprised of representatives from industry, academia, government and non-profits. This committee held expertise in environmental reporting as well as in certain subject matters covered by the team. A similar, multidisciplinary review board might be considered for the U-M's reporting process. Many acknowledged experts and committed stakeholders can be found on the Ann Arbor campus.

Incorporate social and economic indicators

In the corporate world, the "triple bottom line" approach to measuring the value creation and depletion is fast becoming commonplace. This approach consists of three equally weighted categories of impact: social, environmental, and economic. Like definitions of environmental sustainability, the triple bottom line framework is grounded in the recognition that the long term health and prosperity of companies hinge upon positive stocks of economic, environmental, and social resources.[1] Similarly with the University, environmental efforts are not conducted in a vacuum. The University has both social and economic impacts, and faces certain social and economic realities that can shape the University's progress towards environmental goals. The SNRE Master's Project team included a set of social and economic indicators in its Prototype Report – indicators which might be used to stimulate discussion as to which are the most relevant to include in a campus report. One particular topic, Health and Safety, is often considered under social indicators as it is under the Global Reporting Initiative framework. Future U-M reports might consider this topic under social indicators, or under the General Category Other, as many Health and Safety issues have environmental attributes.

Incorporate cultural and aesthetic indicators

Another dimension of environmental performance and stewardship is cultural, aesthetic and even spiritual. Although more difficult to quantify, these qualitative factors are too important to be overlooked. For instance, the physical beauty of landscape, buildings, public art, interior space, and everyday artifacts often determines people's level of attachment, which determines the level of stewardship, which in turn determines how long and how well it is sustained. Well-designed and well-crafted buildings in beautiful settings are the hallmark of great university and college campuses, which are among the most cherished, integrated and sustained environments on the planet. In an increasingly technological and secular world, aesthetics play a critical and needed role in cultural and spiritual well-being. Accordingly, tracking the quality of landscape, architecture and design at the University through metrics such as design awards and honors, would be a sympathetic effort in addition to quantitative indicators.

Relationship to teaching and research

The goals outlined above all have the potential to be integrated with courses, research projects, and informal campus activism involving both undergraduate and graduate students. These opportunities present a chance to capture some of the idealism and energy of students and to expand the boundaries of educational experience. Based on experience at this and other college campuses, students take pride in contributing to the improvement of their school and its reputation.

Demonstrate and highlight the "business case" for environmental stewardship
If the University were endowed with unlimited financial resources, it would likely undertake most environmental initiatives that were presented. However, this is not the case, especially with the current funding reductions at the state level. It therefore may become more important for the University to demonstrate the business case for undertaking environmental programs. Certain University initiatives create tangible financial value, for example the Energy Star upgrades generate annual savings of close to $10 million.[2] Others may generate more qualitative benefits that may make the project worthwhile. For example, the University has received quite a bit of positive press on the Greening of Dana project. To be able to make the business case in the future, it will be necessary to measure and report the financial aspects of environmental stewardship at the U-M.

Track and utilize the Global Reporting Initiative framework
The Global Reporting Initiative (GRI) is "a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines." GRI is fast becoming the standard in corporate sustainability reporting, and it is believed that there will be GRI guidelines developed specifically for colleges and universities. Given the wide use and acceptance of GRI, the U-M should monitor developments in the GRI guidelines.

APPENDIX: GENERAL CATEGORY MATRICES

General Category: Water Use

	Units	Normalization
Environmental Performance Indicators (1)		
Total Water Use	Gallons	Gallons/person
Operational Metrics (4)		
Total Purchased Water	Gallons	Gallons/person
*Total Discharged to Sewers	Gallons	Gallons/person
**Building Specific Water Use	Gallons	Gallons/person
**Total Irrigation Water	Gallons	Gallons/area maintained green space
Programs and Initiatives (examples)		
Eco Program (focus on water conservation)	Education and outreach to influence behavior	
Greening of Dana	Waterless urinals Composting toilets	
Cooling Tower Optimization		
Sanitary and Storm Water Pollution Prevention Program	Retention basins	

*Data is not yet collected for this indicator.
** Limited data is collected for this indicator.

General Category: Land Use – Built and Natural Spaces

	Units	Normalization
Environmental Performance Indicators (1)		
Total Impervious Surface Area	Acres	Percent of campus area
Operational Metrics (9)		
Total Green Space	Acres	Percent of campus area
Maintained Green Space	Acres	Percent of campus area
Unmaintained (Natural) Green Space	Acres	Percent of campus area
Impervious Surface	Acres	Percent of campus area
Tree Population	Number of Trees	
Protected Natural Spaces		Percent of campus area
Total Building Area	Total building square footage	Square footage/person
LEED Certification	Number of LEED certified buildings on campus	Percent of total buildings
Deck Parking	Percentage of all parking spaces that are in parking decks	
Programs and Initiatives (examples)		
Conversion of Surface Lots to Porous Pavement		
Wetland Projects		
Invasive Species Control		

General Category: Emissions – Air and Water Pollutants

	Units	Normalization
Environmental Performance Indicators (1)		
Total Greenhouse Gas Emissions	Metric tons of CO_2 eqv. Metric tons of carbon eqv.	MT CO_2 eqv./person MTCE/person
Operational Metrics (6)		
Criteria Air Pollutants from Stationary Sources (O_3[25], PM, CO, NO_X, SO_2, Pb)	Pounds emitted for each pollutant	Pounds/person
* Air Pollutants from Mobile Sources	Pounds emitted for each pollutant	Pounds/person
Fertilizer Use (e.g., potassium, phosphorous, nitrogen)	Pounds	Pounds/person
Salt Use	Pounds	Pounds/person
Sand Use	Pounds	Pounds/person
Pesticide Use, Solid and Liquid (includes herbicides, insecticides and fungicides)	Pounds (solids) or gallons (liquids)	Pounds or gallons per person
Programs and Initiatives (examples)		
Continuous Emissions Monitoring	Power plant emissions monitored using a chemical analyzer	

*Data is not yet collected for this indicator.

General Category: Material Use and Solid Waste

	Units	Normalization
Environmental Performance Indicators (2)		
Total Solid Waste	Tons	Tons/person
Percent Recycled	Percent	
Operational Metrics (12)		
Hospital Waste	Tons	Tons/person**
Waste from Campus Buildings	Tons	Tons/person
Waste from Auxiliary Buildings	Tons	Tons/person
Paper Recycled	Tons	Percent of total paper generated
Glass Containers Recycled	Tons	Percent of total glass generated
Plastics Recycled	Tons	Percent of total plastics generated
Metal Containers Recycled	Tons	Percent of total metal generated
Construction In-house Waste Recycled	Tons	Percent of total construction in-house waste generated
Composting	Tons	Tons/person
Reuse (PD or Ann Arbor Recycling)	Tons	Tons/person
Materials Reuse (Housing Moveout)	Tons	Tons/person**
*Paper Purchases and Recycled Paper Purchases Including Chlorine-Free Paper	Tons	Tons/person
Programs and Initiatives (examples)		
Recycling Initiative		
Composting Program		
Greening of Dana	Composting toilets	
Recycling Award Program		

[25] Ozone is not emitted directly into the air, but rather is created at ground level by a chemical reaction between NOx and volatile organic compounds (VOC) in the presence of heat and sunlight.

Property Disposition	
Ann Arbor Reuse	

*Data is not yet collected for this indicator.
**Need to define "person" in this context.

General Category: Cross Cutting and Emerging Issues

	Units	Normalization
Environmental Performance Indicators (example, additional indicators to developed over time)		
Building Utilization	Total conditioned building square footage	Square footage/person
Operational Metrics (examples)		
Educational Programs and Initiatives	Assessment procedures to be developed	
LEED Certification	Number of buildings (Include LEED award level)	Percent of total buildings
Aesthetics	Number of planning, architecture and environmental design awards received.	
Programs and Initiatives (to be determined over time)		

APPENDIX: SUSTAINABILITY PROJECT LIST 2004

ENERGY CONSERVATION
Utilities
Energy Star - Five Stages
Green Computing
Direct Digital Control Systems
Central Power Plant – Co-Generation
Lighting Retrofits
Variable Air Volume (VAV) Controls - existing buildings and new construction
Renewable Power Purchases
Energy Reduction - Behavioral Modification Campaign
New Energy Conservation Initiatives
Transportation
Heavy Duty Transit Coaches – Particulate filters
Electric Vehicles – 6
Ethanol Fueled Vehicles – 400
Vehicle Oil Recycled
Oil Filters Recycled
Alternative Degreaser Use
Hybrid Electric Vehicle Loaner – pending
Hybrid Electric Bus Review
Free Vanpooling Program
AATA Bus Passes
Ultra-low sulfur fuel use
Use of bio-diesel B-20 fuel
TRAVEL
Green Travel Web Assistance
RECYCLING
Grounds and Waste Management
Paper and Cardboard
Mixed Containers (glass, plastic, aluminum, steel food and beverage containers)
Scrap Metals
Food Waste Composting
Animal Bedding Waste
Brush & Tree Trimmings
Football Stadium recycling program
Student Move-In
Student Move-Out
Other Stuff (Ink jet cartridges, transparencies, polystyrene foam, packing peanuts, text books, office supplies, TGT's -To Good to Trash)

PLANT MAINTENANCE
Paint Recycling
Environmentally Friendly Product Usage
CFC Collection/re-use
A/C Systems Oil Recovery
Metal Recycling -fittings/faucets/valves,etc
Sanitary waste improvement
Wire Recycling
Useable overages/outdated commodities
GROUNDS AND WASTE MANAGEMENT
Invasive Species Program
Salt Use Reduction Program
Sand Use Reduction Program
Tree Planting Program
Low Maintenance Plantings
Reduce Irrigation Usage
Native Plantings
Natural Landscape Design
Pesticide/Herbicide Reduction program
Phosphorous Fertilizer phase out
CONSTRUCTION
Supplemental General Conditions
Instructions to Contractor
Design Guidelines- General Requirements
Sustainability parameters
Design Guidelines - Site work
Jobsite Salvage
Demolition - Jobsite Recycling
Carpet Recycling
Earthwork
Fill Materials
Engineered Granular Fill
Lawn Repair
Slag
Xeriscaping
Leaf Composting
Recycled Plastic in Outdoor Construction
Buffalo Grass
Recycled Gypsum

Design Guidelines - Concrete
Cast In Place Concrete
Blast Furnace Slag
Fly Ash Mixes
Design Guidelines - Masonry
Concrete
Brick
Petroleum Brick
Insulated Concrete
Design Guidelines - Metals
Structural Steel
Metal Fabrications
Design Guidelines - Wood and Plastics
Rough Carpentry
Treated Wood
Adhesives
Plywood
Architectural Woodwork
Division 7 - Thermal and Moisture Protection
Roofing Insulation
Rigid Insulation
Recycled Insulation
Cellulose Insulation
Design Guidelines - Windows and Doors
Flush Wood Doors
Aluminum Storefront
Glazing
Mirror
Design Guidelines - Finishes
Gypsum Board Assemblies
Ceramic Tile
Dimension Stone Tile
Acoustic Ceilings
Resilient Flooring
Cork Flooring
Linoleum Flooring
Bamboo Flooring
Resinous Flooring
Painting
Electrostatically Applied Coatings
Wood Floor Finish

Multicolored Interior Coatings
Adhesives
Design Guidelines - Specialties
Toilet Compartments
Signs
Lockers
Design Guidelines - Equipment
Energy Star Rated
Design Guidelines - Furnishings
Casework - Adhesives
Casework - Woods
Design Guidelines - Conveying Systems
Motors
Design Guidelines - Mechanical
Variable speed drive (VSD) applications for reduced BHP and energy consumption
VSD / Chilled Water
CFC Contractor Use
Reduce use of HCFC refrigerants
Old Chiller Use
Minimize or eliminate use of ethylene glycol in chilled water and hot water heating systems
Air Cooled Chillers
Maximize use of "free cooling" and heat recovery systems to reduce HVAC energy consumption
Design Guidelines- Electrical
Electronic Ballasts
Fluorescent Lights
Compact Fluorescent Lights
Switching
Occupancy Sensors
Dimmer Switches
Metal Halide
Transformers
Emergency Generators
Natural Gas Generators
Additional Construction Topics
LEED Design Criteria
Recycle Construction Materials
Soil Erosion Reduction
Greening of Dana
Stormwater P2 Structural Controls

BUSINESS SCHOOL
Executive Residence - "Green Hotel"
MICHIGAN UNION, LEAGUE, PIERPONT COMMONS
Recycling
Recycle food waste
Recycling cardboard, plastics, aluminum
Utilities and Energy
Utilities- Reduce water consumption
Utilities- Reduce water consumption
Further Utilization of Insight DDC system
Reduce lighting energy consumption
Mechanical
Convert to environmentally friendly refrigerants
POLLUTION PREVENTION
Recycling
Fluorescent Light Bulbs
Ballasts
Chemical Redistribution Program
Solvent Recycling - Distillation
Battery Recycling
Oil Filter Recycling
Paint Thinner Re-Use
Waste Minimization
Micro-Teaching Techniques in Laboratories
Mixed Waste Minimization Program
Chemical Tracking Program
Silver Recovery Program
Alcohol Reuse
Product Substitution
PBT Reduction
Mercury Thermometer Elimination Program
Bulk Mercury Elimination Program
BUILDING SERVICES
Integrated Pest Management
Environmentally Friendly Cleaning Products
Energy Reduction Cleaning Techniques
Stormwater Best Management Practices

PURCHASING
Green Purchasing - Prime Vendors - Web
Micro-quantity in Prime Vendor Contracts
Incorporate sustainability into customer reporting
Green Product Catalog
Icon
Green Product Identification
SUSTAINABILITY COMMUNICATION CAMPAIGN
Develop sustainability communication plan
STORMWATER POLLUTION PREVENTION
Wastewater Pollution Reduction
Best Management Practices
AIR POLLUTION REDUCTION
Title V Permitting Process
Health System Incinerator Removal
HOUSING
Governing Ideas
Task Group
Communication
Networking
Recycling
Best Practices Research and Initiatives
Training and Education