The Ohio State University

Sustainability Plan

Volume III - Technical Detail

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YUDELSON ASSOCIATES

THE OHIO STATE UNIVERSITY

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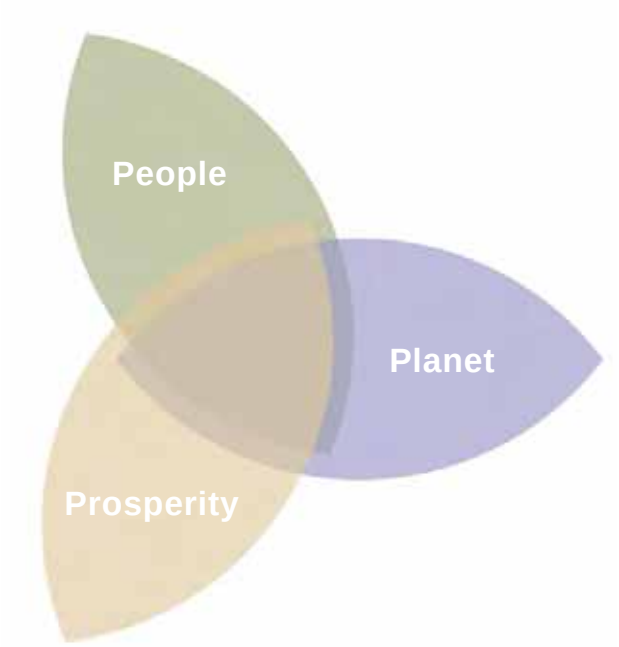


1 Introduction

1.1 Overview

This volume of *The Ohio State University Sustainability Plan* provides the technical detail to support Volume I - Executive Summary. The study purpose, process, scope, and concurrent planning efforts are also described in more detail.

1.2 Sustainability at Ohio State

Sustainability efforts at The Ohio State University are well-established and have been in place for a number of years. These efforts have been initiated at the grass roots level, from the President's Office, across divisions and by faculty, staff and students. One of the most difficult challenges is understanding the scope of the many efforts happening throughout the university and coordinating practices and policies that push the university forward toward deliberate overall goals. With limited resources, a university-wide, coordinated effort is critical and requires a hierarchy of actions that is based on:

- A solid understanding of the baseline
- Clear goals and metrics that, in the end, support the university mission
- Policies, strategies, actions and practices that support the goals
- Effective tracking systems
- Organizational structure to oversee and support implementation

Image: Google

1.3 Sustainability Plan Purpose

As part of the "One University" plan, this plan is intended to help the university establish comprehensive university-wide sustainability goals. This requires focus on a range of topic areas that relate to the physical campus environment, campus operations and the core university activities. This *Sustainability Plan* sets a specific course toward climate neutrality supporting the American College and University Presidents' Climate Commitment (ACUPCC - signed by President Gee in 2008), helping to position The Ohio State University as a leader among its peers, and increasing Ohio State's contribution to national and international efforts that address climate change.

The focus of this plan is to create a holistic set of university-wide goals for all the topic areas. This is established through a comprehensive understanding of current conditions, and supported by a hierarchy of actions and policies that tie to the overall goals. This plan builds upon established policies for sustainability and concurrent planning studies.

1.4 Sustainability Efforts and Policies

Over the course of the last several years, the university has developed multiple policies that relate to campus land use, buildings, infrastructure, purchasing and waste. A range of initiatives have been put in place through the below list of plans and policies, developed to support the university's future growth and operations:

- Energy Services and Sustainability Program Plan 2007/08 (10/06)
- Design Values for Campus Development (12/06)
- 2009 - 2014 Capital Plan (Sept. 07)
- Principles & Practices for a Sustainable Ohio State University (2/08)
- Purchasing Policy #2.21 (10/08)
- Interim Green Build and Energy Policy #3.10 (12/08)
- FOD Five-Year Business Plan (4/09)
- PCS - Short and Long Term Goals (4/09)
- OSU Blueprint for Waste Reduction (8/09)

In addition a range of successes have helped to build a solid foundation for sustainability at Ohio State. The Presidents' Council for Sustainability developed a list of the following successes in the spring of 2009:

Successes to Celebrate

- Recruited and retained world-class faculty in the fields of energy, agriculture, climate, and environment. Established leading research centers on sustainability, including (but not limited to) the Institute of Energy

and Environment; Center for Energy, Sustainability, and Environment; Center for Resilience; and Center for Auto Research.

- Eliminated trays in dining halls, reducing 70% of food waste while saving water and energy. Currently developing and implementing reusable bags and biodegradable bags, trays, plates, and utensils at various Dining Services' locations.
- Installed additional recycling containers and increased the percentage of waste recycled on campus from 16.8% in 2004 to 21.2% in 2008. During football season, 47% of the waste at Ohio Stadium is recycled.
- Purchased 3.3 million kWh of green electricity in 2008, enough to power Hagerty Hall.
- Achieved high energy efficiency (LEED certification) for new buildings, including the state-of-the-art Nationwide 4-H building. Formulated Green Build and Energy Policy.
- Partnered to sell Dining Services' used cooking oil as bio-diesel fuel.
- Established sustainability coordinators for residence halls.
- Switched all campus buses to bio-diesel.
- Installed low-flow showerheads in RPAC, saving 20% in water and heating costs ($40,635/yr).
- Encouraged use of public transportation with CABS, van pooling, and reduced-rate COTA service.
- Implemented a campus-wide policy to use a minimum of 30% recycled computer and copy paper.
- Received numerous awards, grants, and journal and book publications on sustainability research while continuing to develop new sustainability courses.
- Made sustainability a part of future strategic planning and building.
- Put in place an environmentally responsible purchasing policy.
- Took steps to ensure that Ohio State's print shop will be Forest Stewardship Council (FSC) certified by the end of 2009.
- Leveraged our purchasing power to encourage sustainability by vendors.

Image: OSU website

1.5 Concurrent Planning Studies

This plan builds upon the "One Ohio State" visioning process, the *One Ohio State Framework Plan*, the *Energy and Infrastructure Plan* and the *Stormwater Master Plan*.

The *One Ohio State Framework Plan* was initiated in the summer of 2008 to articulate the overall, long-term vision of the Columbus campus. Focused on President Gee's concept of "One University" and led by Sasaki Associates, Inc., the plan is comprised of multiple components including specific plans for Academic Facilities, Housing, the Medical Center, an Arts District, Athletics, the Olentangy River, and Transportation. The process has included significant campus-wide input and resulted in a fully integrated plan. The *Sustainability Plan* is partnered with the *Framework Plan* in the spirit of "One University." The *Framework Plan* concepts are supported through this plan and in turn the *Sustainability Plan* identifies more specific sustainability strategies and initiatives for components related to the physical environment such as Energy, Water and Ecosystem Function.

The *Energy and Infrastructure Plan*, led by Affiliated Engineers, Inc., focuses on campus-wide emissions related to on-site combustion of fossil fuels and purchased utilities. The effort identified and then concentrated on 12 selected buildings, using the information to extrapolate campus-wide conditions and help set priorities. Campus central plants also received special focus. The plan identifies strategies for achieving climate neutrality of on-site combustion. These strategies are summarized here and incorporated with more detail into the *Climate Action Plan*.

Image: Sasaki | AEI

The *Stormwater Master Plan*, led by CDM, examines current stormwater overflows, predicts future conditions related to the *Framework Plan* and proposes specific strategies to address current and future issues. Work from the *Stormwater Master Plan* directly informed the stormwater element of the *Sustainability Plan* and in turn, the *Sustainability Plan* identifies low impact strategies related to storm water management.

Impervious Surfaces

% Impervious Surface by Catchment
Existing

Typical Year Totals for All of Campus:

Scenario	Infiltration	Runoff	Rainfall
East - Existing	136	327	463
West - Existing	513	757	1,270
Total	649	1,084	1.733

* All units in million gallons; Source: CDM

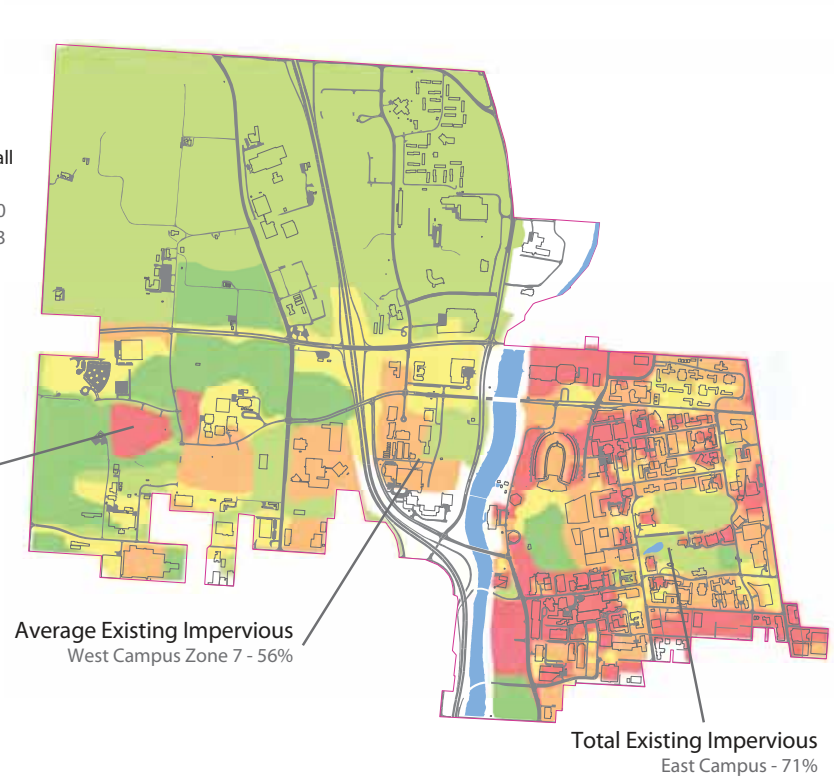


Image: Mithun, Data OSU & CDM

1.6 Sustainability by Topic Areas

With this foundation, the plan focuses on being as comprehensive as possible with synergistic solutions that create a more sustainable university consistent with its mission. This involves a full range of topic areas. The following areas are covered:

- Research, Curriculum and Outreach
- Water
- Ecological Function
- Food
- Purchasing
- Waste
- Energy/Carbon/Transportation

Of these components, focus areas for the sustainable planning team were: Water, Ecological Function, Food, Purchasing and Waste. Other components are incorporated through the integration of concurrent efforts. In chapter 9 Energy/Carbon/Transportation, the energy & carbon components build upon work developed through the *Energy and Infrastructure Plan* and is presented in detail in the Volume II - *Climate Action Plan* (CAP) document. The CAP identifies strategies and a timeline for achieving carbon neutrality as required of the American College and University Presidents' Climate Commitment (ACUPCC) signatories. A transportation survey conducted by Ohio State Transportation and Parking provided an understanding of the current mode-split and total annual vehicle miles traveled by commuters. The study of Water builds upon the *Storm Water Master Plan* and provides specific recommendations for how the *Framework Plan* relates to the Olentangy River. Strategies and initiatives for Research, Curriculum and Outreach are based on a white paper, *Sustainability Planning at OSU: Beyond the Physical Campus* developed by faculty representatives of the Sustainability Advisory Group to the President's Council on Sustainability.

Image: OSU

Developing an understanding of the university's current efforts is critical in setting a track-able path toward future goals and strategies.

2 Sustainability Plan Process

2.1 Introduction

Many activities taking place on a university campus have the potential to impact the university's climate footprint. With this plan's global scope covering all sectors of the university including the physical environment, operational activities and research and curriculum, developing a systematic strategy was necessary.

2.2 Assessing the Baseline

The plan sought first to identify typical metrics and best practices based on the many rating systems that have been developed in recent years and sustainability activities at other institutions, against which Ohio State could be compared (see *Volume V - Benchmarking*).

Developing an understanding of the Ohio State

University's existing physical environment as well as current efforts and policies supporting sustainability and baseline conditions is critical in setting a track-able path toward future goals and strategies. This is central to any sustainability plan. The baseline can be described in terms of quantities such as carbon emissions and energy use and less quantifiable activities such as the existence and content of a purchasing policy that guides university procurement.

The baseline/ existing conditions for each topic area at Ohio State vary widely. In each case, a series of interviews and review of the university policies, plans and/or physical conditions was necessary. Over 30 interviews took place with representatives of all divisions (Athletics, Student Life, Medical Center, Academics, and Administration) and across all constituents (faculty, staff, and students) to discuss the five focused topic areas, along with focus group sessions that included approximately 50 people. Additional interviews and work sessions took place to coordinate with the concurrent planning efforts.

Image: OSU

2.3 Setting Goals

Once the baseline was established, a series of discussions took place with Ohio State representatives (representing the full cross-section of the university) to identify the best and most appropriate future goals, objectives, strategies, and initiatives.

For each topic area a “Goal Tree” was developed that includes a Goal statement, a series of Objectives and Strategies, and Potential Initiatives relating to specific actions. The Potential Initiatives are tailored to OSU and build upon current activities and knowledge of existing conditions. Each initiative ties directly to a Strategy, Objective and the overall Goal. With this framework, the Initiatives are certain to support the overarching goal of the topic area and the University in a hierarchy of actions. This hierarchy is consistent with the OSU strategic plan and coordinated with the President’s Council on Sustainability Advisory Committee members.

The following sections describe the baseline/ existing conditions of each topic area along with the resulting strategies and potential initiatives.

Image: OSU

"Sustainability issues present The Ohio State University with one of its most compelling and interdisciplinary teachable opportunities."

3 Education, Research & Outreach

Text from the following section is also provided in Volume II - Climate Action Plan (CAP). The text is also provided here, along with the topic's related goal tree, in order to provide a complete volume that is usable on its own.

3.1 Integration with University Mission

Sustainability efforts, delineated in the Climate Action Plan, should be embedded into the full range of University activities and must tie directly to its founding mission. Integrating sustainability work and themes into the activities of faculty, staff, and students is a natural complement to Ohio State's land-grant mission, its exceptionally broad range of teaching and research endeavors, and its historic action-orientation. This includes identifying opportunities for teaching and learning, conducting research, and enhancing the institution's service to its communities.

This Section of the Climate Action Plan is informed by the insightful white paper "Sustainability Planning at OSU: Beyond the Physical Campus" (March 22, 22010) authored by Professors Joseph Fiksel, Rick Livingston, Jay Martin and Steve Rissing on behalf of the Sustainability Advisory Group to the President's Council on Sustainability.

3.2 Education

The Ohio State University is committed to providing an educational experience that inspires a new generation of global citizens. Accordingly, sustainability education is thoughtfully and intentionally integrated into the student experience.

Sustainability initiatives driven by Ohio State's interested faculty and passionate students include: concentrations in majors and minors; customized interdisciplinary degrees; graduate specializations and seminars and other opportunities for student involvement.

In moving forward, the university wants to heighten environmental and social awareness campus wide by spotlighting the many dimensions of sustainability. Opportunities for doing so could include:

- Developing an inventory of sustainability-related educational programs, graduate and undergraduate, that are offered or planned by Ohio State's colleges and departments;
- Developing a systemic overview of the goals, content, and potential linkages among these programs and identifying potential synergies with ongoing research and outreach activities;
- Developing learning objectives and performing a baseline survey of sustainability literacy and education needs for incoming students;
- Expanding the sustainability-related content in the general education curriculum;
- Developing a coordinated framework of graduate education options that include "sustainability" content;
- Investigating co-curricular options for strengthening educational programs;

"The university wants to heighten environmental and social awareness campus-wide."

Image: OSU

Image: OSU

- Investigating co-curricular options to reinforce sustainability awareness; and
- Investigating the expansion of service-learning options, including opportunities for students to become involved in campus or community sustainability programs operated by Ohio State or partner organizations.
- The university is transitioning from a quarter system to a semester-based calendar for the 2012-13 academic year. This change requires adjustments to courses and curriculum which presents a unique opportunity to integrate sustainability. One of the first steps the university is undertaking is to gather baseline information through exit surveys. The dialogue will be continued with questions such as: What would be the learning outcome for students? What do students need? How best can the different ways students receive information be incorporated into the curriculum so they understand the ramifications of sustainability? Current thinking includes "theme-mesters", incorporating summer-reading books, offering interdisciplinary minors such as citizenship and requiring first year students to attend related events. Throughout the physical environment, it will be important to engage students with the campus, leveraging it as a living laboratory whenever possible.

3.3 Research

As one of the country's leading research universities, Ohio State has made important contributions to sustainability science, technology, and human behavior. The university strives to integrate the recognized works of its faculty researchers and apply this expertise to problems on local, regional, national, and international scales. Two categories of research are considered in this document – research directly related to sustainability planning for Ohio State campuses and research related to broader sustainability issues of concern to university stakeholders, regionally, nationally, and internationally.

Broader sustainability research

Many Ohio State faculty members are already deeply involved in research related to different facets of sustainability, from technological innovation to social responsibility. The university has established the Institute for Energy and Environment (IEE) as a mechanism for coordinating some of these research efforts and is also served by the Center for Automotive Research (CAR) and the Center for Resilience. The following is a partial list of areas of sustainability research excellence at Ohio State.

- College of Arts and Sciences – assessment of climate change and associate changes in the aquasphere, geosphere and biosphere;
- Fisher College of Business – sustainability in supply chain management, product development entrepreneurship, enterprise strategy , social responsibility;
- College of Engineering – sustainable technologies for energy, mobility, manufacturing and waste recovery; life cycle assessment of ecological impacts;
- College of Food Agricultural and Environmental Sciences – carbon cycling, ecosystem adaptation, natural resource economics, bio-based products, renewable energy;
- College of Medicine – connections between healthy outcomes and behavioral change; and
- College of Public Health – impacts of changes in climate, lifestyle, technology and environmental conditions on human health and well being.

To help the university establish a clear identity as a sustainability leader among collaborating universities and research sponsors, and to support efforts to attract major funding for sustainability research facilities and programs, Ohio State will strive for a unified "One University" approach to sustainability. Actions to promote this approach could include:

"Ohio State will strive for a unified "One University" approach to sustainability."

Image: OSU

- Developing a comprehensive inventory of Ohio State's sustainability research initiatives, programs, and resources;
- Developing an overarching document setting forth Ohio State's sustainability vision, research strengths, and aspirations; this document could be used for building internal awareness, enhancing student and faculty recruiting, and developing communications;
- Making available specialist resources to assist faculty who include a sustainability component in their grant proposals for research funding;
- Encouraging faculty researchers to connect their sustainability research programs with communities of practice in Ohio and beyond;
- Communicating with the university community at regular intervals highlighting Ohio State's sustainability research accomplishments and funding opportunities; and

Participating in professional conferences to expand international awareness of Ohio State's sustainability research accomplishments.

Sustainability planning for Ohio State campuses

The sustainability planning effort commissioned by Ohio State is yielding data about a broad range of campus activities and their impacts. Implementation of the university's sustainability plan will generate additional information about physical and behavioral changes associated with sustainability initiatives. For example, incorporating sustainable design principles into campus construction standards and practices should result in measurable energy savings. It is likely that researchers across campus will be keenly interested in participating in such efforts and could use the resulting data streams to develop and refine important hypotheses about systemic sustainability.

Several grass-roots initiatives have emerged to connect Ohio State's sustainability research to ongoing campus enhancements, including the following:

- Research on improved management of food waste, including life cycle assessment, sponsored by the Energy Services and Sustainability Group;
- Efforts to develop sustainable infrastructure including completion of three rain gardens and the planned construction of another, as well as planned construction of a green roof;
- Studies by student groups of energy use and efficiency of buildings on campus that have resulted in grants and physical improvements to reduce energy use;
- Environmental restoration and renewable energy production initiatives at Waterman Farm;
- Investigation of geothermal and photovoltaic

Image: OSU

energy systems and other alternative energy technologies; and
- Plans to develop the Olentangy River as a learning laboratory with embedded research opportunities for multiple colleges.

To accelerate its steps forward, Ohio State will make efforts to coordinate campus sustainability initiatives with ongoing and emerging research programs, and multiply opportunities for developing new knowledge, refining methodologies and experimenting with technological innovations. Examples of potential research opportunities include:

- Broadening the collaboration between the Energy Services and Sustainability Group and faculty research initiatives, with dedicated funding for campus research internships;
- Engaging faculty in applying integrative sustainability metrics to track the overall progress of Ohio State's sustainability improvement initiatives over time;
- Integrating faculty knowledge and expertise into campus sustainability improvement initiatives;
- Incorporating campus testbeds into applications for research grants;
- Collaborating across universities to track, compare, and disseminate sustainability initiatives and results under different campus conditions;
- Introducing a sustainability category in the Denman Undergraduate Research Forum and the Edward F. Hayes Graduate Research Forum;
- Collaborating with student organizations to communicate sustainability research activities and encourage involvement of students in campus-related sustainability projects; and
- Encouraging interdisciplinary research on effective strategies for teaching sustainability and disseminating the results in mainstream publications.

3.4 Outreach

Ohio State plays a major role in shaping the intellectual, economic, and social environment in Central Ohio. On a broader scale, OSU Extension services reach every county in the state, while the university's researchers and alumni are active throughout the world. This rich array of resources and points of leverage are crucial to advancing an awareness of Ohio State's sustainability efforts and maximizing their effects.

Three types of continuing outreach are important to consider: partnerships, capacity-building, and social learning. Instances of all three exist at the university, but it is their systemic relationship that is emphasized here.

Partnerships

Partnerships involve institutional collaboration with entities engaged in planning for sustainability. These entities include government agencies at various levels (city, county, State, Federal); quasi-governmental authorities such as SWACO, Central Ohio Transit Authority, Soil and Water Conservation Districts, and Mid Ohio Regional Planning Commission (MORPC); and large-scale private-sector organizations and

Image: OSU

"Ohio State plays a major role in shaping the intellectual, economic, and social environment in Central Ohio."

corporations (Nationwide, Coca Cola, American Electric Power, the Columbus Partnership, Edison Welding Institute (EWI), Battelle Memorial Institute). These partnerships variously provide for educational programs, sponsored research and consulting, and collaboration on regional development initiatives.

One example of Ohio State's participation in such partnerships is the Ohio By-Product Synergy network (www.OhioBPS.org), which is organized by the university's Center for Resilience, in collaboration with the U.S. Business Council for Sustainable Development, MORPC, and the Ohio Department of Natural Resources. This network helps businesses convert waste materials into valuable by-products, thereby protecting the environment while stimulating the local economy. Ohio State has incubated similar networks in other areas.

Formal partnerships can also create learning opportunities for students as a bridge between academics and civic or business engagement. Student enthusiasm about sustainability runs high, and visible channels for students to contribute to the university's sustainability efforts – the Environment and Natural Resources Scholars program, the Mount Leadership Society, the Net Impact Society, and Engineers for a Sustainable World, to name but a few – provide valuable lessons in civic participation.

Capacity-building

Capacity-building involves engagement with grass-roots efforts that address emerging areas of concern, such as recycling, local food systems, and alternative transportation. At a community level, it means enhancing opportunities for civic understanding, deliberation, and decision-making; for the university, it means developing students' skills in citizenship and leadership.

Exemplary work in capacity-building is demonstrated by a class in which students have collaborated with neighborhood groups to draft sustainability plans illuminating possible future goals for a range of urban communities. OSU Extension conducts such environmental programs as Sustainable Agriculture, Woodland Stewardship, and Watershed Management. Many faculty members provide technical advice to government agencies, environmental groups or cultural organizations.

The arts and humanities also play a critical role in promoting a regional culture of sustainability. For example, the Wexner Center's film "From Field to Screen" focused on local food systems and sustainable agriculture, while a grant from OSU CARES supported a "Ways of Knowing Water" exhibit that highlighted the efforts of local watershed-protection groups.

Social Learning

Social learning refers to the tacit or informal curriculum of campus life and the habits and expectations of the Ohio State community. While difficult to measure directly, social learning is a function of how the university is seen to approach sustainability and how prominently the issue figures in Ohio State's public profile. Social learning also complements Ohio State's ongoing efforts to cultivate culture change.

In support of the Climate Action Plan, The Ohio State University is committed to developing a unified approach to sustainability outreach that is interwoven with its education and research activities. Opportunities include:

- Developing and strengthening sustainability partnerships with government agencies, global corporations, and universities in Ohio and beyond; this includes opportunities for research and service-learning in developing and achieving sustainability goals;
- Improving regional capacity-building through enhanced cooperation with public, private, and non-profit sector organizations; engaging and empowering Ohio State faculty, students, and staff to participate in local and regional activities; developing, publicizing, and disseminating innovative tools and data for local and regional planning purposes; and working with local and regional school systems to develop pragmatic initiatives for sustainability education;
- Promoting social learning by actively associating the Ohio State name with sustainability initiatives at public and university sponsored events and in multi-channel communications;
- Engaging undergraduate students in sustainability activities through deliberate outreach efforts;
- Empowering advisors and directors to develop a culture of sustainability in residence halls;
- Promoting communication and transparency about sustainability both internally and externally; and
- Making the funding of sustainability initiatives a university development goal, focusing on signature sustainability projects that demonstrate innovative practices.

3.5 Goal Tree

Following is the goal tree for the Education, Research and Outreach topic area.

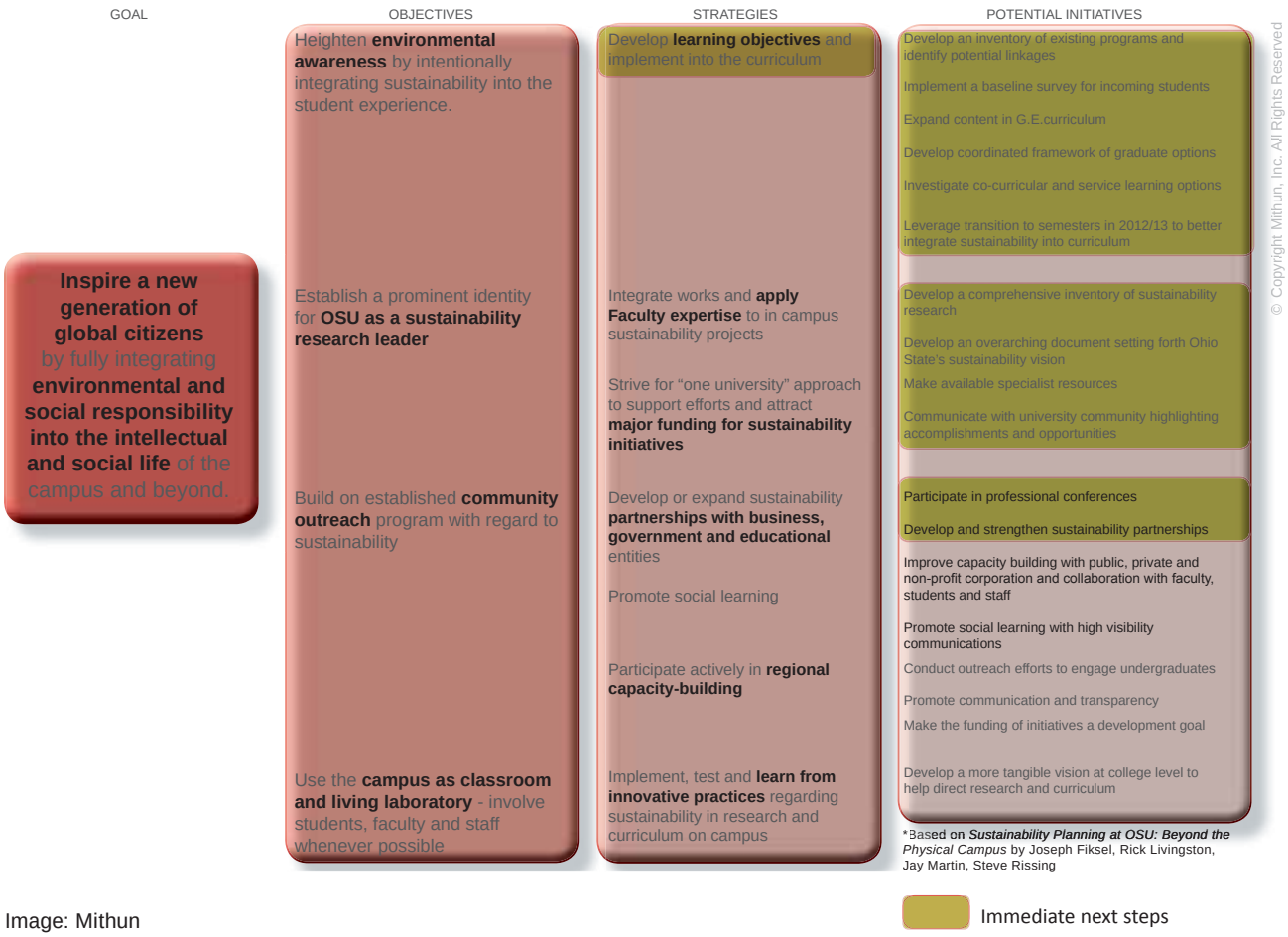


Image: Mithun

Energy, Carbon and Transportation are central to Sustainability at The Ohio State University.

4 OSU Energy, Carbon & Transportation

4.1 Introduction

Energy, Carbon and Transportation are central to sustainability at Ohio State and the drivers of the *Climate Action Plan (CAP)*. Higher education institutions throughout the US make significant contributions to the nation's carbon footprint through operations and commuting. The *CAP*, as a requirement of the *American College and University Presidents' Climate Commitment (ACUPCC)*, signed by President Gee in 2008, provides a detailed description of the university's greenhouse gas emissions inventory and strategies with a timeline for achieving climate neutrality. The *CAP* describes steps Ohio State has taken already to reduce GHG emissions, and its plan to eliminate net emissions in a timeframe that is aggressive yet feasible. Along with all volumes of the Sustainability Plan, the *CAP* lays the groundwork for a campus-wide conversation about the importance of climate action and definitive steps that need to be taken on the path toward a carbon-neutral future. This section summarizes material from the related sections in *Volume II, Climate Action Plan* and also includes a discussion on metrics, best practices, current Ohio State policies and this topic's Goal Tree. Material on emissions from stationary combustion has been provided by *Affiliated Engineers, Inc. (AEI)*.

4.2 Metrics

The most indicative method of measuring progress on energy and carbon include:

- Amount of overall energy use and carbon emissions campus-wide including:
  - stationary combustion
  - fleet fuel use
  - utility emissions, and
  - commuting

Several methods of measuring progress on sustainable transportation include:

- Percentage of campus staff, faculty and students using public transportation, walking or bicycling; reduction in single-occupant auto travel (using conventionally powered vehicles, the LEED standard)
- Percentage of campus fleet vehicles that use alternative fuels (hybrids, electric, biodiesel, etc.)
- Reduction in trips to/from campus using single-occupant auto/vehicles
- Average greenhouse gas (GHG) emission rate of campus fleet vehicles, as measured in pounds or kilograms of carbon dioxide equivalent (CO_2e) per passenger mile traveled
- Bicycle friendly community designation from the League of American Cyclists

Best Practices

Many rating systems focus on energy and carbon as one of their main drivers, including AASHE STARS, LEED. These systems have helped push for the use of best practices. Best practices can be categorized as those that reduce the demand for energy and those that improve upon the energy supply.

Demand reduction strategies include:

- Behavior change through education and dashboards
- Using space more efficiently
- Improving building efficiencies
- Instituting a green build policy for new buildings
- Metering buildings and monitoring the resource use and emissions.

Improved energy supply options include:

- District heat
- Combined heat and power system
- Smart grids
- Renewable fuels such as biomass, waste-to-energy, geothermal, solar, wind
- Green power purchases

Campuses tend to use the following methods to implement sustainable transportation practices:

- Intra-campus shuttles
- Incentives and preferential parking for carpools and vanpools
- Emergency Ride Home programs for carpool and vanpool users (using car-sharing, taxi vouchers and similar means)
- Relatively high parking rates for single-occupant vehicles

- Cash incentives for using public-transportation; shuttles from public transportation to campus destinations
- Car-share programs like Zipcar® for short-term transportation needs
- Designated bike and pedestrian lanes and road crossings, to make non-auto travel safer and thus more desirable
- Bike racks or secure bicycle storage, bicycle lockers, and shower facilities (these might often just be the campus student/staff athletic facilities)
- Bike rental and repair programs

4.3 Current Policies and Regulatory Framework

Actions are underway at many levels of government to plan for a substantial reduction of greenhouse gas emissions. This *Sustainability Plan* exists amidst an evolving regulatory framework at the State level with changes expected at the Federal level in the near future. The outcomes of these external climate policies will play an important role in the development of climate policy and action within the university alongside the recommendations and commitments of this *Sustainability Plan*. This plan, particularly components related to Energy and Greenhouse Gas Emissions, should be periodically reviewed to assure concurrency with changing regulations.

State of Ohio Energy Policies

The State of Ohio has enacted two important pieces of energy legislation in recent years. Because of the climate impacts associated with predominantly coal-fired electricity throughout Ohio, any policy that aims to reduce energy consumption or promote certain alternative or renewable fuels has the potential to reduce greenhouse gas emissions as well.

In 2007, the Ohio Legislature passed HB 251, requiring state-funded institutions to create a 15-year plan to perform energy audits on all buildings and phase-in energy efficiency and conservation projects. The ultimate goal is to reduce building energy expenditures by at least 20% (measured against a standard 2004 baseline) by 2014. HB251 has had a significant influence on planning for OSU and the Interim Green Build

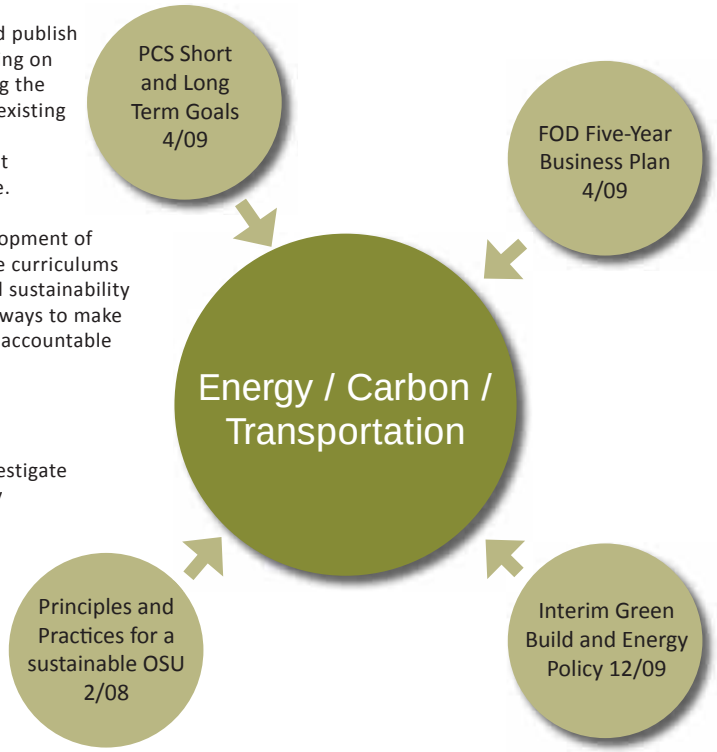
and Energy Policy was specifically developed in response to HB251. Ohio has postponed the adoption of ASHRAE 90.1-2007 until at least July of 2011.

In 2008, the Ohio Legislature passed SB 221, making state-wide changes to energy pricing and sources. One provision established an alternative energy portfolio standard that requires 25% of all electricity produced for retail sale in the State of Ohio to be generated from alternative fuel sources. Half of the standard (12.5%) must be met with renewable sources – including wind, solar, hydro, geothermal, and biomass. The other half (12.5%) can be met via implementation of Energy Conservation Measures. The bill also creates a renewable energy credit (REC) tracking system and requires electric utilities to achieve energy efficiency gains of 22.5% by 2025.

A number of existing policies help to provide direction for energy, carbon and transportation practices at Ohio State, in addition to sustainability in general. They include *Principles and Practices for a Sustainable OSU* which focuses on resource conservation of the university's buildings and infrastructure, the *Interim Green Build and Energy Policy* focusing on building performance, *OSU's Five Year Business Plan for Facilities Operations and Development (FOD)* and the *Goals of the President's Council on Sustainability*.

Image: OSU

- Develop a plan, including action items and interim goals, for climate neutrality
- Implement a “turn-off the lights” drive to change behaviors and culture. Reduce building energy consumption by changing temperature settings for both heating and cooling, and by powering down in off-peak time
- Encourage green computing practices
- Pursue policy for the purchase of Energy Star-certified products where appropriate
- Complete comprehensive inventory of all greenhouse gas emissions and report results annually
- Conduct energy and environmental audits, and develop campus operating guidelines
- Pursue travel tax/carbon offsets as part of a travel policy
- Support the University Energy Conservation Initiatives proposal
- Adopt a plan to meet House Bill 251 requirements, which includes targeted reductions in energy use by 2014 and a 15 year plan for energy efficiency.
- Expand the university’s renewable enrgy portfolio by purchasing more green energy and increasing its generation on campus
- Add HEV and PHEV cars and buses to fleet, improve public transportation, reduce campus traffic, encourage carpooling, create a more pedestrian and bike friendly campus, and reduce the number of state vehicles on campus.
- Expand energy metering and publish energy usage for each building on the web. Invest in improving the energy performance of our existing buildings.
- Install automatic sensor light switches, where appropriate.
- Support and encourage the improvement and development of undergraduate and graduate curriculums in energy, environment, and sustainability
- Design and implement new ways to make units more responsible and accountable for their energy use.



- Install meters on an ongoing basis

- Identify, implement and investigate options for renewable enrgy
- Reduce dependence on non-renewable energy
- Develop and test new technologies
- Strive to conserve energy
- Facilitate alternative modes of transportation
- Incorporate energy efficiency and other sustainable principles into planning and operations of facilities
- Consider life cycle costs in project planning
- Incorporate flexibility in buildings for long funcitonal life

- Life cycle energy systems and cost analyses shlal be rpimary considerations
- Exceed new and current ASHRAE standards
- Design to LEED silver or higher in projects > $4m
- Provide annual reports on success of energy and sustainabilty programs

4.4 Green House Gas (GHG) Emissions Inventory

The vast majority (99%) of Ohio State's GHG emissions are related to energy use through the use of grid electricity, natural and distillate oils and transportation. Energy related to support of buildings and infrastructure on campus makes up 85% of the university's GHG emissions. This includes electricity, natural gas, and liquid fuels such as gasoline and diesel. Only 1% relates to agriculture, solid waste and other 'de minimis' sources. Emissions are categorized by 'scope'.

Scope 1 relates to direct emissions from sources owned or controlled by the university such as on-site combustion of fossil fuels to support OSU facilities and the university fleet. The primary sources of the university's Scope 1 emissions are stationary combustion of natural gas and fuel oil and fuel for the university fleet. Natural gas accounts for 21% of the university's annual GHG emissions. Ohio State fleet contributes 1% of the university's annual emissions. In total, Scope 1 makes up 23% of the university's emissions.

Scope 2 emissions are from energy produced elsewhere and delivered to campus by a utility provider. The only Scope 2 emissions for the

Energy Inputs and Greenhouse Gas Emissions

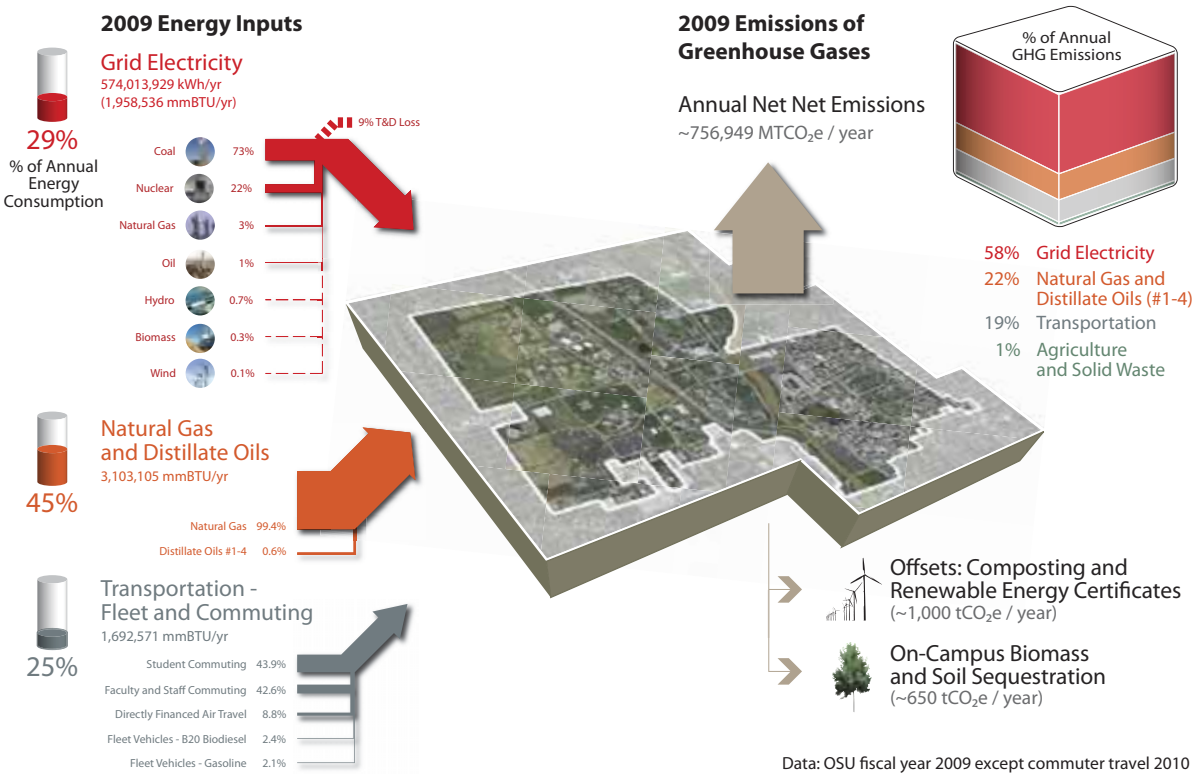


Image: Mithun
Data: OSU / CACP

university are from electricity delivered to campus by the local utility, American Electric Power (AEP). The majority of the electricity provided by AEP is produced by burning coal and is the single largest source of the university's greenhouse gases representing almost 58% of the total. Scope 2 emissions are expected to decrease eventually based on technological advancements but when is largely out of the university's control. The most effective way to reduce Scope 2 emissions for the university is to reduce its reliance on utility-provided electrical power.

Scope 3 emissions are not emitted by the university but directly related to university activity. They include faculty/staff/student commuting, directly financed air travel, electricity T & D losses and solid waste. Commuting and air travel represent 18% of the university's annual emissions.

The following diagram shows Ohio State's historic emissions from 2005 to present and projected into the future based on projected square footage or population, depending on the source. Continuing business-as-usual, emissions will increaase by 20% by 2050.

Historic and Projected GHG Emissions
metric tons CO2-equivalent (CO2e)

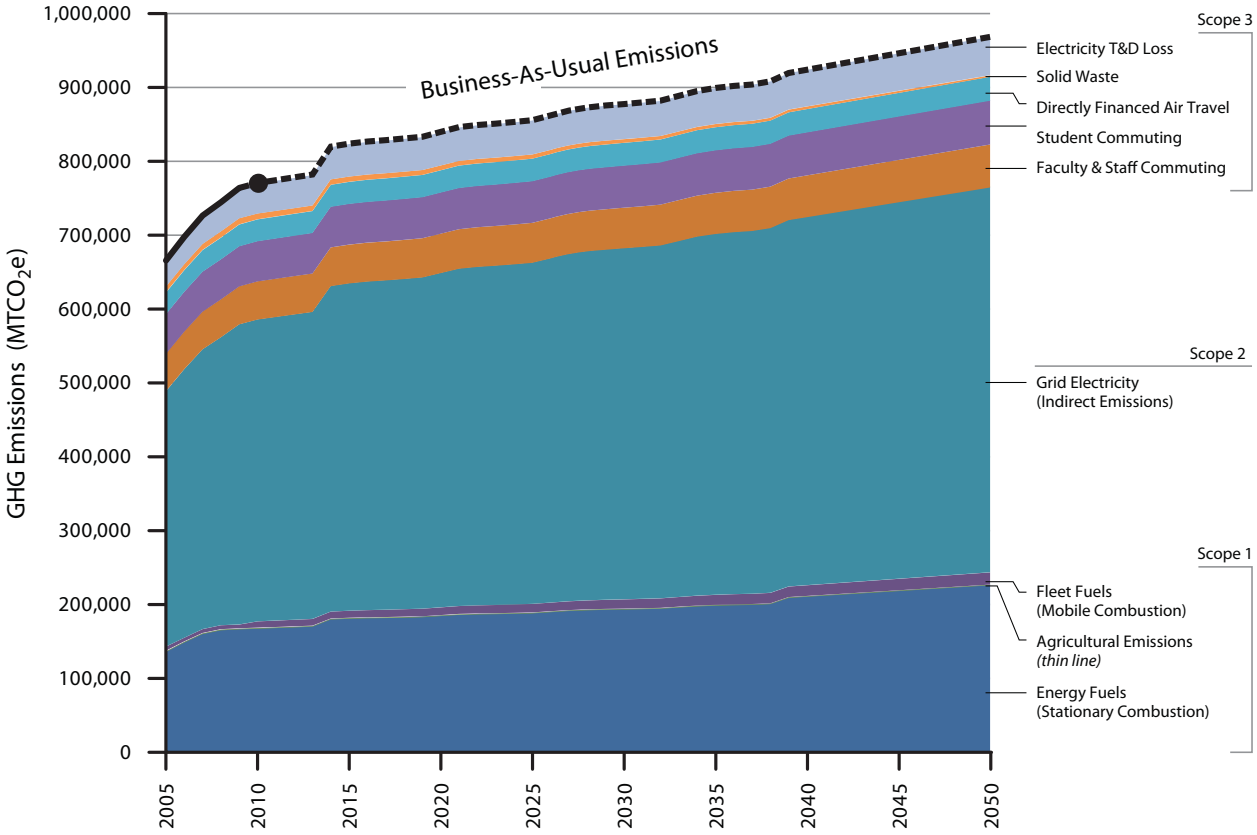


Image: AEI, Mithun | Data: AEI, OSU

4.5 Achieving Climate Neutrality

Many strategies will need to be implemented for the university to become climate neutral by 2050. One thing is clear - there is no single solution. A range of strategies as the most effective, most feasible and having the greatest benefit in the long run for the university have been identified. Implementing every one may not be feasible given the uncertainties of future funding.

They include:

- Green building standards;
- Space planning and management;
- Energy conservation measures;
- Heat recovery chillers;
- Regional chiller plants;
- Back-pressure steam turbines;
- Geothermal heating and cooling;
- Combined heat and power plant;
- Single-occupant-vehicle (SOV) trip reduction strategies.

Energy Strategies Long-Term - Reduction from Business-As-Usual*

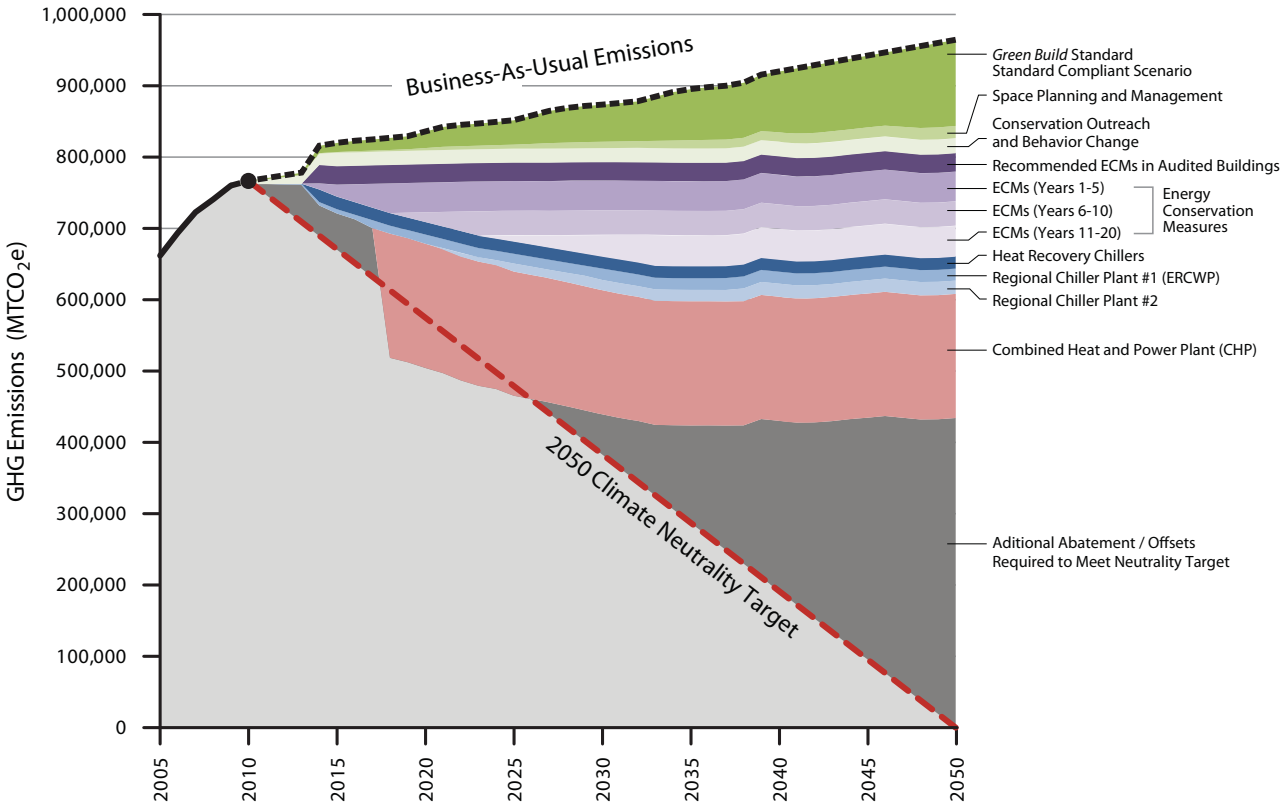


Image: AEI, Mithun | Data: AEI, OSU

* See Vol.II-CAP for specifics on strategies planned to 2015.

SOV reduction strategies might include:

- Targeted increase in vanpool use
- Expanded walking and biking option;
- Support for transit use;
- Parking rates to support SOV reduction programs;
- Providing incentives for faculty/staff home ownership near the campus;
- Working with COTA to expand transit access
- Setting a realistic yet aggressive goal for SOV reduction;
- Reducing intra-campus travel with remote parking lots and a shuttle service as called out in the Framework Plan.

To reach climate neutrality, offsets are a viable alternative. Whenever possible however, the university will implement the mitigation strategies outlined, along with new innovations, before purchasing offsets. Offsets will be considered the final strategy.

4.6 Financial Considerations and Tracking Progress

This CAP exists amid constantly evolving economic and financial, technological, political, and social contexts. The financial implications of reaching climate neutrality are very serious. Substantial investments into the tens of millions of dollars may be necessary. Not all potential strategies will be economically feasible. Of those that are feasible, the initial capital costs, payback periods, and impacts on CO_2 emissions will have significant variations. Additionally, even strategies that may appear to have a net positive payback over time may not be feasible if initial capital costs are prohibitively high. These issues need to be considered as strategies for achieving carbon neutrality are weighed as part of the university's future capital planning discussions.

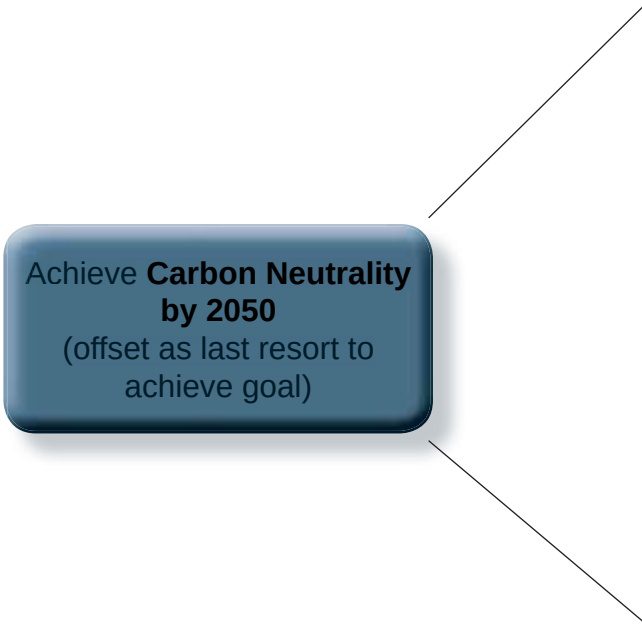
Content experts will continue to assess and make recommendations to update the CAP periodically as appropriate. The university will learn from its initial steps and adjust forward-looking plans as appropriate. With the availability of funding expected to decrease significantly in the coming years, identifying specific timing for strategies is difficult and will be reassessed as part of the university's and the state's normal required processes and procedures of capital planning and the regular review and update of this CAP. Assessment of the fiscal environment and the outcomes of external climate policies also will play an important role in the ongoing development of climate policy and action within the university. The university is deeply committed to continually improve its emissions footprint with a goal of carbon neutrality by 2050.

Successful implementation of the CAP requires campus-wide involvement to address climate neutrality in core activities of the university—research, curriculum, outreach, operations, and building development. Regular reports outlining progress will be submitted to the President's and Provost's Council on Sustainability, university leaders, and other key stakeholders.

4.7 OSU Energy, Carbon & Transportation Goals & Strategies

The overall goal for energy, carbon & transportation is to achieve carbon neutrality by 2050. As mentioned, many strategies will need to be implemented to meet the overall goal and implementing every one may not be feasible given the uncertainties of future funding. Offsets remain the final strategy, as needed, to achieve carbon neutrality by 2050.

Objectives are stated by Scope. The Scope 1 objective is to reduce on-campus stationary combustion and fleet combustion as a first priority. The objective for Scope 2 is to reduce the purchase of coal-fired electricity – the most effective way to do this will be to develop combined heat and power on campus. The Scope 3 objective is to reduce commuting, air travel and solid waste. Specific targets and dates are not yet identified for each scope due to the uncertainties of future funding. This will need to be assessed each fiscal year.



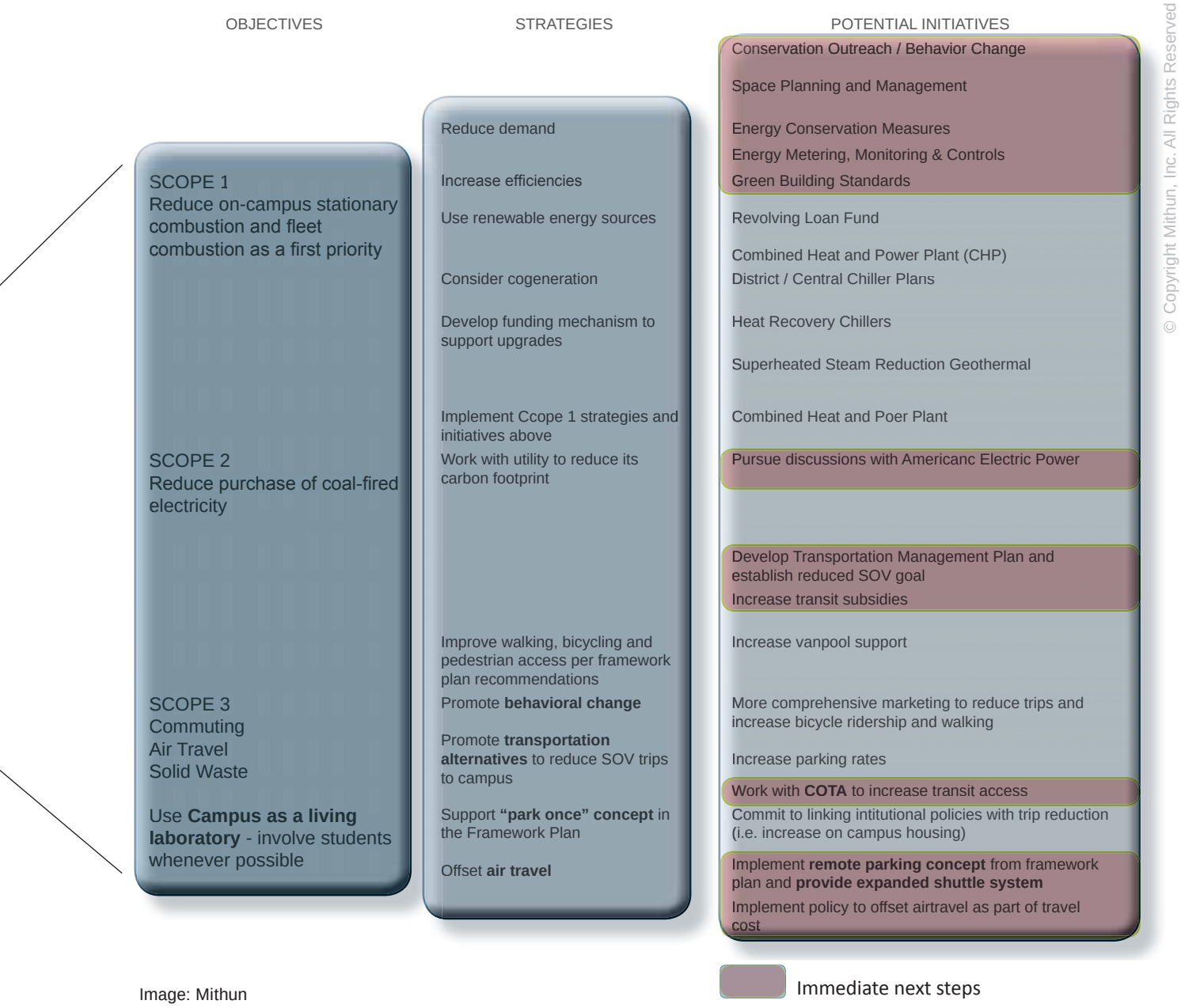


Image: Mithun

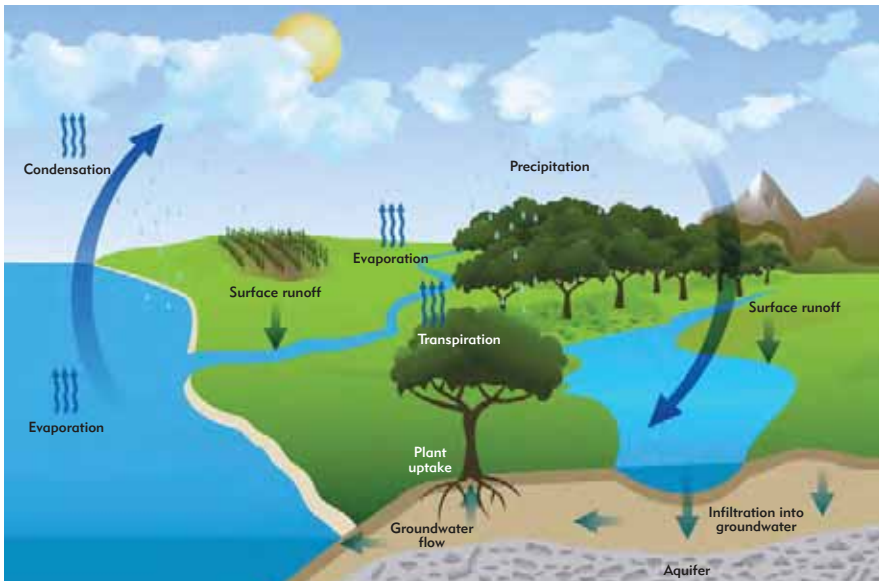


Image: The Natural Hydrologic Cycle, The Sustainable Sites Initiative

5 Water

5.1 Introduction

Through countless interactions within the Earth's system, the global hydrologic cycle integrates physical, chemical, and biological processes that sustain the earth. This water cycle has been operating for billions of years and all life depends on it.

States in the Great Lakes region, including the State of Ohio, are fortunate to have abundant, clean water. Unlike many regions of the Western U.S., it is not immediately apparent that water conservation is necessary. But water requires energy for treatment and distribution and must be clean for environmental and human health. As a finite resource we must think about our potable water supply, waste water treatment and the impacts of our storm water runoff. From a global perspective, if water isn't well managed, it ceases to be usable by humans and the environment. Water conservation is the most important step to take in managing our global water system.

5.2 Metrics and Best Practices

Metrics

The most common and basic means of gauging success in water conservation is the percentage of water use reduction from a baseline year. It is important to incorporate total campus size (square footage of buildings) when determining reduction goals. Campuses that address water, typically establish baseline water use in a given year and then determine a water reduction goal. The next step is to commit to reducing water use by, for example, 30%, within 10 years. (If a campus is growing or shrinking, water use goals would be adjusted accordingly.)

Best Practices

Best Practices can be grouped into four categories of water use:

- Water Use Management
- Demand Reduction
- Water Reuse
- Stormwater Reduction and Cleansing

Metering, assessing baseline water use and setting reduction goals, recording information about fixture retrofits and cooling tower water management are good first steps for the *management of water use*.

Low-flow fixtures, efficient irrigation controls, use of native or adapted landscaping and rain gardens that use stormwater runoff are all common water reduction strategies. Providing water use information is also important for *demand reduction* as people tend to conserve more when aware of their use level.

Water reuse is an effective strategy for reducing waste and stormwater runoff. Campuses are beginning to employ rainwater/ gray water collection and reuse as well as blackwater treatment and reuse methods as cutting-edge practices.

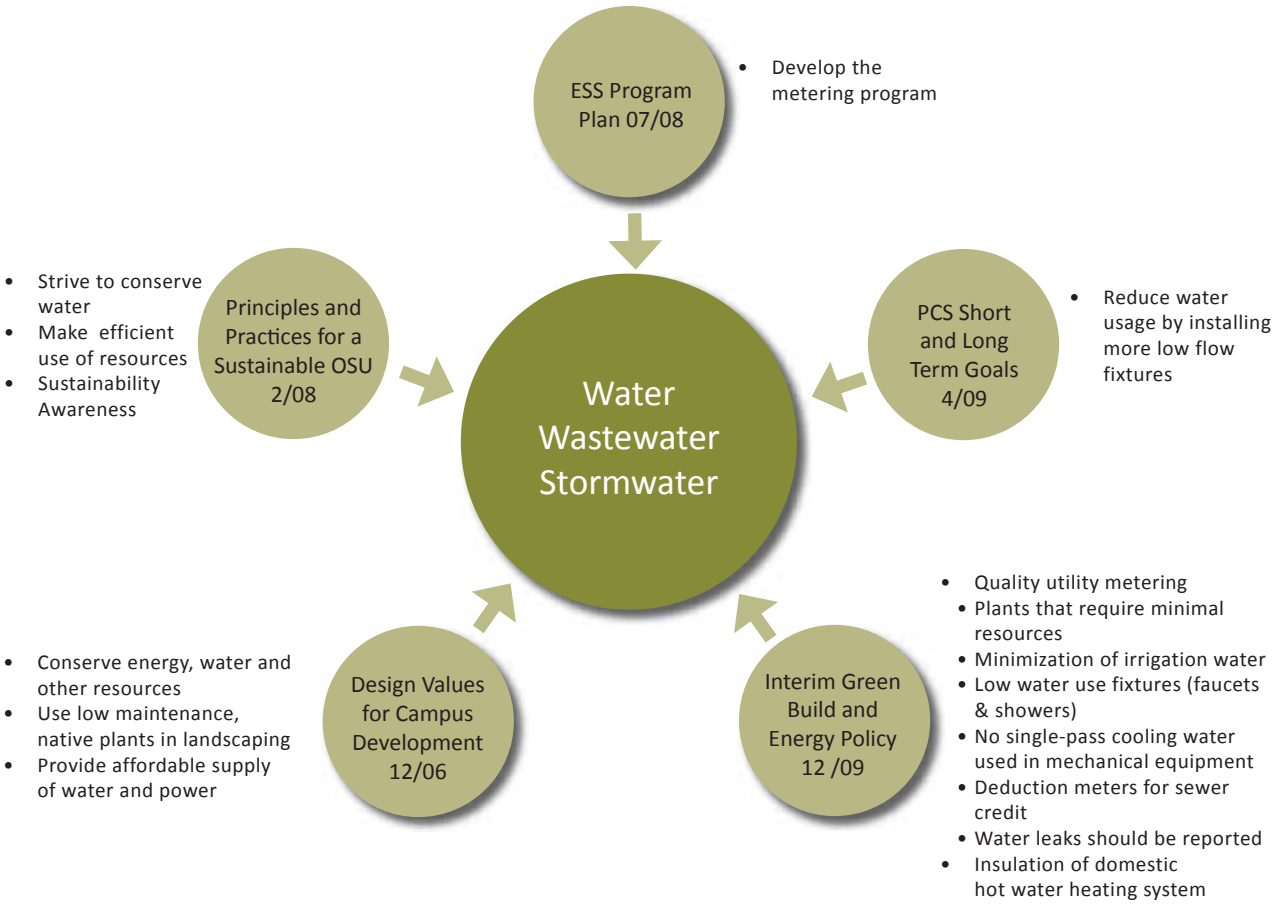
Reducing imperviousness through landscaping and green roofs as well as implementing raingardens and bioswales are effective *stormwater reduction and cleansing* strategies.

Image: Mithun

5.3 Ohio State Current Efforts and Conditions

Ohio State policies

Many existing policies at the university address the use and conservation of potable water with an emphasis on awareness and facility upgrades. The *Design Values for Campus Development* speak to conservation of water and other resources, using low maintenance landscaping and providing affordable supply of water and power. The *Principles and Practices for a Sustainable OSU* also encourage water conservation and sustainability awareness. In 2008, the *Energy Services and Sustainability (ESS) Program Plan* identified the need for a water metering program. The *President's Council on Sustainability (PCS) 2009 Long and Short Term Goals* address water by calling for reduction of water usage through more low flow fixtures. The most recent policy, the *Interim Green Build and Energy Policy* from December of 2009 stresses the importance of quality utility metering, low water use fixtures (faucets & showers), no single-pass cooling water used in mechanical equipment, deduction meters for sewer credit, reporting of water leaks, insulation of domestic hot water heating system, use of plants that require minimal resources, and minimization of irrigation water.



Potable Water

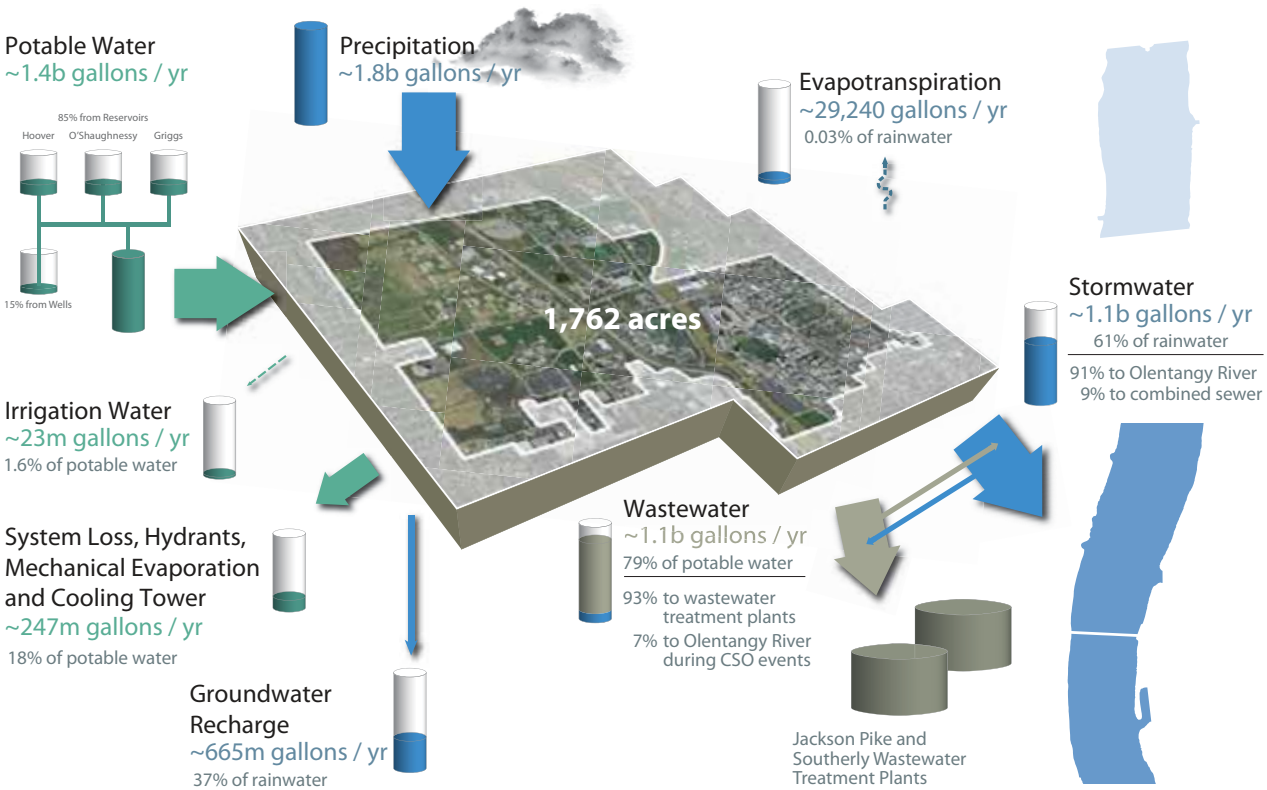
The diagram below shows the hydrologic cycle on the OSU campus. The university uses approximately 1.4 billion gallons of potable water per year, 85% of which comes from reservoirs. Roughly 1.8 billion gallons of water fall on the campus in the form of snow or rain annually.

The pie diagram shows potable water needs at a comparable university institution. The majority of water coming into campus (64%) is used for flushing (toilets and urinals). Only about 25% really needs to be potable (for sinks, showers and drinking water). Similar data for OSU is not available. Of course regulatory hurdles and funding for the needed infrastructure ("purple pipe") can be challenging. In the long run the university should embrace its unique position of water abundance, work toward innovation in this area and become an example for other institutions in a similar position.

Metering

As mentioned, measuring success in percentage of water use reduction is one of the most common first steps for a campus striving to be sustainable. Metering is critical for this. Ohio State has a master metering system in place for water, with 300 sub-meters. Sub-meter deducts apply to cooling tower water use, irrigation and hydrants. Individual buildings fed directly by the City have their own meters and are included in an annual report. Most buildings however lack meters.

Water Resource Flow Diagram



Data: Calendar Year 2008

The Divisions of Athletics, Student Life, Academics and Medical Center are each billed with an internal process based on square footage. (They are also each billed directly by the City for some buildings.) There are no meters specific to Waterman Farm, only deducts.

All new buildings now include dedicated meters and a budget of $250K/yr has been established to add meters to existing buildings. Dedicated, building-specific meters are the best way to track water use, establish a baseline and identify inefficiencies.

Buildings that house uses such as labs, residences, dining and recreation would be the best initial targets for installing meters.

Efficiency

With the policies currently in place, some low flow fixtures have been installed throughout campus including all residence halls. Waterless urinals are in a pilot phase (with some issues) for Student Life. Steam condensate return to the boiler plant is a known area of inefficiency and needs to be addressed campus-wide.

Irrigation

Because of the abundant rainfall in Ohio, minimal irrigation is needed at the Columbus campus as well as the OARDC and ATI campuses. Potable water is used for irrigating approximately 20 acres of planting and lawn area in the main campus: Fisher Hall, Drinko Hall, Scott Lab, Business School, KSA, Oval, and the Hospital. Well water is used to irrigate the Intramural Fields, (approximately 80 acres). In addition, 8 athletic fields are irrigated. The OSU farms are not irrigated. The golf course is irrigated with water from the storm pond. Drought-tolerant turf species are being used around campus, and the plan is to slowly replace the Bluegrass Rye, with a more drought tolerant and pest resistant Tall Turf Fescue. The Campus aims to use native plants when practical (sometimes they are not durable enough) and drought tolerant plants as a priority.

Typical Potable Water Needs

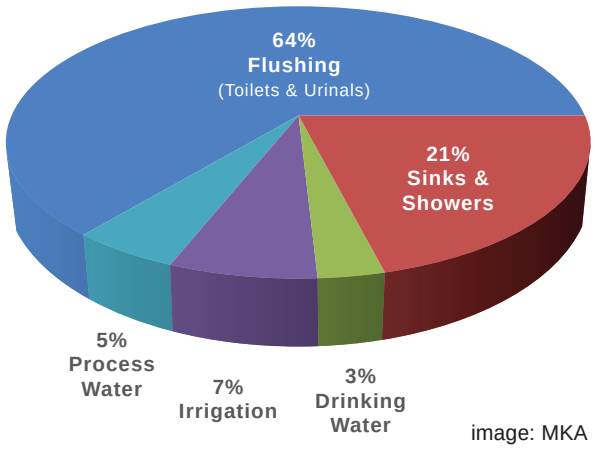


image: MKA

Image: Mithun

Annual precipitation is not only adequate to meet annual demand at the Columbus campus, but also water demand every month of the year. This is an opportunity that campuses in many other regions lack. If strategies were available for water capture and re-use minimal storage treatment and conveyance would be needed.

Precipitation on Campus & Campus Use

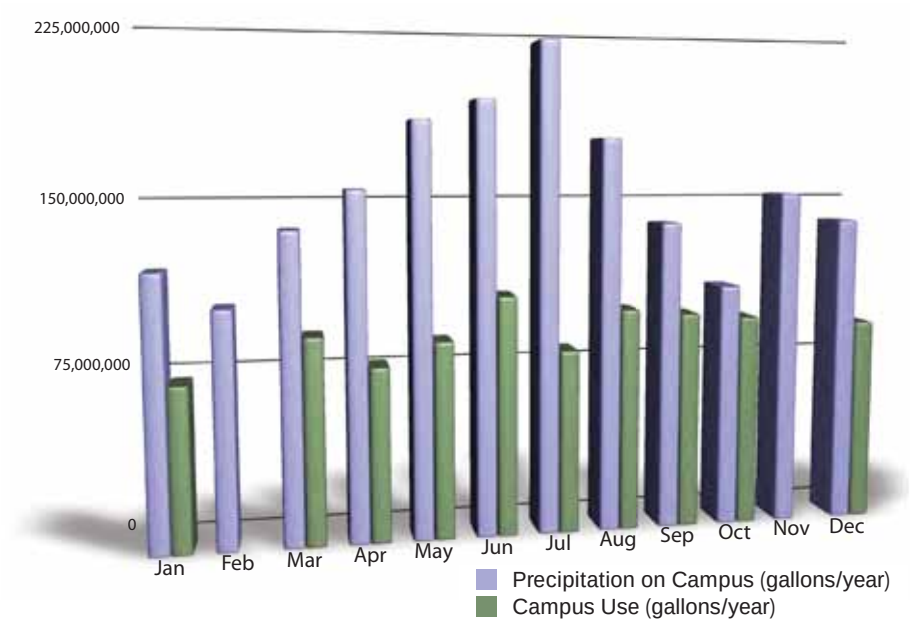


Image: Mithun

Potential Strategies

A range of strategies were studied for their potential to reduce the university's potable water use overall. They all are considered reasonably feasible and together could reduce overall water use by 14-22%.

This would be an achievable reduction goal for 2025/30 (using 2008 as the baseline), requiring approximately $1M per year (not including the McCracken Plant condensate improvements). This list of strategies is not exhaustive but rather provides preliminary guidance for further investigation. (Behavioral changes for example, could yield much more savings if other factors were included.) Potential kitchen equipment upgrades were also not included.

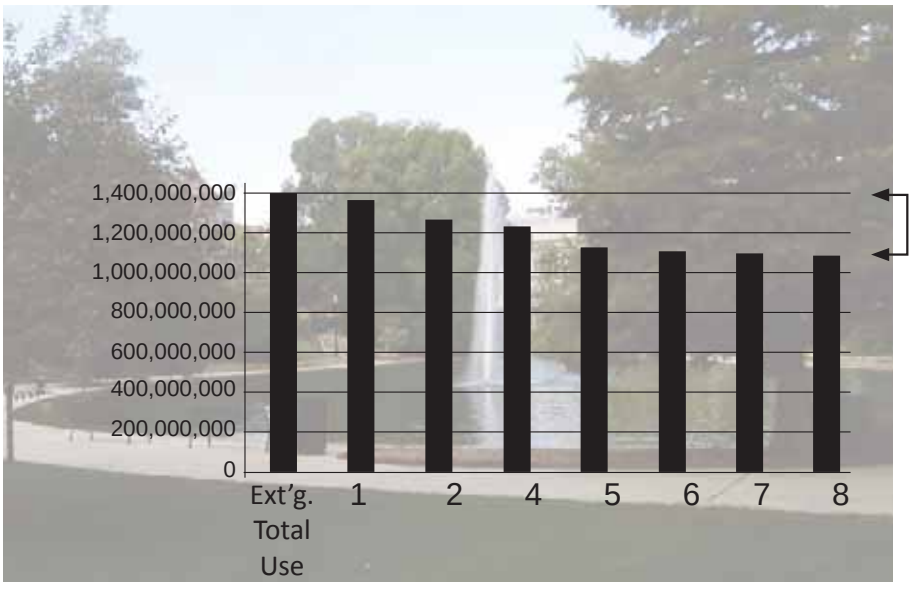
1. Addressing Boiler Plant cooling tower inefficiencies = 35,000,000 gal. (2.5% total)

- This has already been reduced by half, therefore further reductions unlikely at this location.

2. Addressing Boiler Plant steam condensate return inefficiencies = 98,000,000 gal. (7% total)

- Implementation costs could be very high and further investigation is recommended.

3. Use of cooling coil condensate as make-up water to cooling towers for building chiller systems = TBD gal. (% TBD total)



* Based on the average Ohio household:
2.3 people per household (Ohio) x 63.75 gallons per day per person x 365 days / year = 53,520 gallons / year / household

Image: Mithun

4. Installing more low flush fixtures
   = 35,000,000 gal. (2.5% total)

- $1,200 - $1,500 / fixture (x12,000 fixtures = $14M - $18M).
- Should be implemented as fixtures need to be replaced.
- Based on replacing 3.0 gal/flush fixtures.
- If there are many 3-5 gal/flush fixtures left, savings could be doubled.

5. Installing more low flow fixtures
   = 105,000,000 gal. (7.5% total)

- Student Life has implemented already in dorms.
- Much less expensive than low flush.

6. Convert Mirror Lake Pond water supply to spring or greywater (not potable water)
   = 12,000,000 gal. (0.9% total).

7. Behavioral changes
   = 7,200,000 gal. (0.5% total)

- Assumptions
  - 8 min. shower vs 10 minutes .
  - 2.5 GPM showerhead saves 5 gallons ea.
  - 6,000 students & 240 days.

8. Laundry (& Kitchen) equipment
   = 14,000,000 gal. (1% total - Laundry only)

- Assumptions
  - Front loading washers (15 v 45 gal).
  - 6,000 students washing 2 loads/ wk each.

Existing Total Ohio State use: 1.4 billion gallons water
Potential reductions

	1- Boiler Plant Cooling Tower	2.5%
	2- Boiler Plant Steam Condensate Return	7%
TBD	3- Coil condensate make-up to Cooling Towers	TBD
	4- Low Flush Fixtures	2.5%
	5- Low Flow Fixtures	7.5%
	6- Mirror Lake	0.9%
	7- Behavioral changes (showers only)	0.5%
	8- Laundry equipment	1%
5,720 Hhds	TOTAL	21.9%

 = 100 Households*

* Based on the average Ohio household:
2.3 people per household (Ohio) x 63.75 gallons per day per person x 365 days / year = 53,520 gallons / year / household

Stormwater

Of the 1.8 billion gallons of precipitation that fall on the campus in a year, approximately 61% exits as stormwater and flows directly into the Olentangy River (91%) or to the combined sewer (9%) threatening river water quality. Over a third, (37%) of the precipitation currently is recharged into the ground.

Small areas with low impact strategies have been implemented, such as bioswales at Jennings Hall, raingardens and permeable pavement at the Audubon Center.

The diagram below shows native soil types throughout campus ranging from A as the most permeable to soil type to D, which is almost impervious.

Soil Type	Description
A	Well-drained sand and gravel; high permeability.
B	Moderate to well-drained; moderately fine to moderately coarse texture; moderate permeability.
C	Poor to moderately well-drained; moderately fine to fine texture; slow permeability.
D	Poorly drained, clay soils with high swelling potential, permanent high water table, claypan, or shallow soils over nearly impervious layer(s).

Landscape Analysis

Soil Types

Area Within Campus Boundary
~1,762 acres

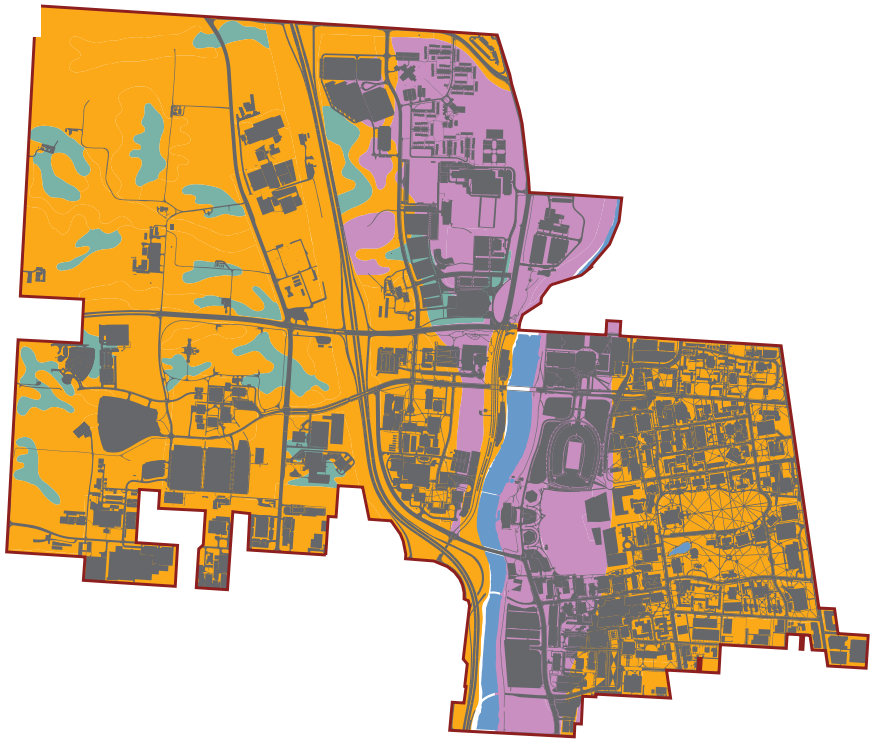


Image: Mithun | Data: OSU & CDM

Name	Hydrologic Soil Group	Percentage of Area
East	B	34%
	C	**64%**
	D	2%
West	B	27%
	C	**65%**
	D	5%
Farm	**C**	**88%**
	D	12%

Soil type C dominates campus.

Knowing native soil types is useful in identifying areas where pervious surfaces might be preserved and/or increased. However since much of the campus soil has been disturbed, further analysis of specific areas will be necessary. Areas along the river are most pervious (and probably least disturbed) so should be preserved as much as possible to retain permeability. Areas of soil types C&D provide the least opportunity for water infiltration so targeting pervious surfaces in these areas may have the least effect.

As part of the Stormwater Master Plan, a 1-year model simulation for the entire campus estimated the total annual runoff volume. The outcome is shown in the diagram below for existing conditions. Of the 463 million gallons that fall on the east campus, approximately 71% leaves the area as runoff and about 29% infiltrates into the ground. Of the 1,270 million

Percent Impervious Surface by Catchment

Existing

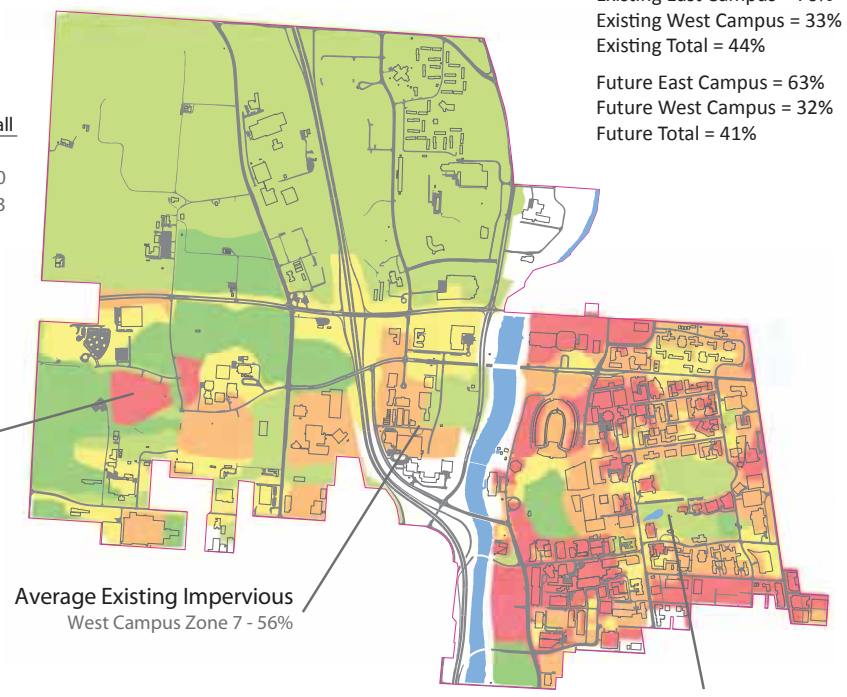
Typical Year Totals for All of Campus:

Scenario	Infiltration	Runoff	Rainfall
East - Existing	136	327	463
West - Existing	513	757	1,270
Total	649	1,084	1.733

* All units in million gallons; Source: CDM

Impervious surfaces
Existing East Campus = 70%
Existing West Campus = 33%
Existing Total = 44%

Future East Campus = 63%
Future West Campus = 32%
Future Total = 41%



Legend
< 20%
20-40%
40-60%
60-80%
> 80%

Source: OSU GIS Data

Image: Mithun | Data: OSU & CDM

gallons that fall on the west side of campus, approximately 60% leaves as runoff and 40% infiltrates. The average for the entire campus shows that 63% of the rainfall leaves campus as runoff versus 37% that infiltrates. The *Framework Plan* will reduce the percentage of impervious surfaces from 44% currently to 41% campus-wide, helping to improve stormwater infiltration.

Because of the high water table on campus, ground water recharge is not the primary goal. Water cleansing and stormwater runoff reduction should be the focus through raingardens, bioswales, and other plant-related reduction strategies. Strategies for capture and reuse should also be a priority.

5.4 The Olentangy River

Many studies have been conducted regarding the Olentangy River. Periodic flooding along the river impacts recreation fields, streets and parking. Plans exist to bring the Olentangy River back to a wildlife habitat area with the 5th Avenue Dam removal and the Framework Plan proposing related solutions.

This *Sustainability Plan* builds on the proposed river corridor enhancements spelled out in the *Framework Plan* with ecological strategies for enhanced River system function.

Image: Sasaki Associates

The proposed strategies described below all serve the Olentangy River restoration. Some of the most effective and most compelling strategies for the river section on campus are highlighted and shown in more detail on the following pages.

Plant cuttings / live stakes
Initial restoration strategy to control erosion, introduce native plant assemblages and provide habitat

Herbaceous plants
Native plantings both on the streambank and in appropriate areas of the river channel can help control erosion and provide critical habitat.

Emergent vegetation in mudflats and wetland areas
Creates habitat, enhances infiltration and water treatment, and protects against erosion.

Raingardens
Planted areas designed specifically to capture and slow stormwater and increase infiltration. Helps prevent stormwater from directly entering river the channel.

Vegetated / dry swales
similar to raingardens, vegetated or dry swales help slow stormwater and increase infiltration.

Terraced or pocket wetlands
Wetlands designed to help infiltrate and treat storm or flood waters and provide critical habitat. Should provide appropriate native plant assemblages to support enhanced habitat and functioning.

Successional tree plantings
Planting plan that addresses the natural succession of the landscape. A critical component of ecosystem self design

Removal of invasive species
Controlling invasive species is one of the most challenging but important components of restoration. Providing a plan for initial removal and ongoing maintenance is a critical part of a successful strategy.

Remove man-made debris
Removal of human trash and other man-made debris that leaches toxic materials into the water and inhibits natural stream function.

Permeable pavement
Paved surfaces that allow water to penetrate, thereby reducing stormwater flow and increasing infiltration. Does not provide any habitat value.

Rock riprap/underwater stone berms
Riprap or stone berms used, where appropriate, to help control erosion around critical infrastructure or areas of erosion potential.

Erosion control blanket / fiber rolls
Blankets or rolls designed to be used as part of a restoration strategy to reduce erosion. Usually used as a temporary measure while allowing native vegetation to become established.

Live fascines / live cribwalls
Long bundles of live woody vegetation buried in streambanks parallel to flow of the stream, and wooden structures built into streambanks, filled with rock, soil and willow cuttings.

Tree kickers / deflectors
Logs anchored to the streambank on the outside curve to 'kick' the water flow away from the banks, reducing erosion, and spurs of rocks and logs extruding into stream.

Log / wood frames
Wood structures anchored to streambanks and within stream channel that provide a scaffold for ecosystem self design.

Stream boulder placement
Rocks and or man-made structures placed in the stream channel to provide aeration and, where appropriate, protect against bank erosion.

Modify setback requirements
Set stricter rules to limit disturbance within river corridor, protecting river habitat from erosion, pollution, development and access.

Daylight + restore tributary streams
The overall health of the Olentangy River is directly tied to the health of the tributaries feeding it. Restoring natural river function to these piped and channelized tributaries is a critical component of a successful restoration strategy.

Construct islands in the river channel
Creates areas for habitat to thrive, supports varying water speeds, encourages ecosystem self design, and restore a more natural river corridor form.

Recreate shallow river slopes
Reduces erosion, creates shallow pockets for habitat and emergent vegetation.

Diversity of river form - meander river
Natural river systems are dynamic and stream channels move through time. This creates areas of faster or slower moving water depending on how the river bends and the substrate over which it flows. Such complexity is essential for providing a healthy, habitat rich stream system. Whenever possible, the restoration plan should allow for dynamic change in overall river form and complexity (ecosystem self-design).

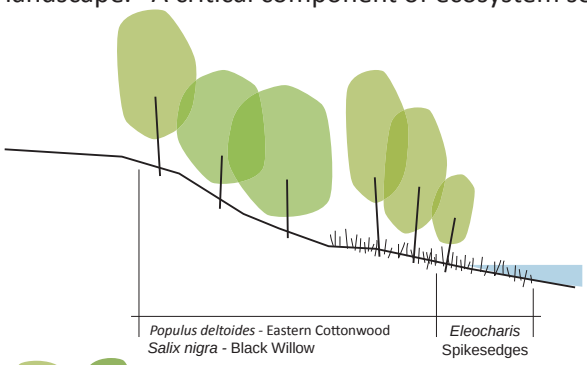
Provide fish ladders/bypass channels
Where barriers to fish movement are unavoidable, fish ladders or bypass channels allow for fish migration and recreate a more natural river hydrology.

Aerate pools to increase dissolved O2
Low oxygen or hypoxic zones created by nutrient loading and stratification are biologically deprived and result in aquatic dead zones. Aerating pools reduces algae growth helps increase dissolved oxygen resulting in better habitat for fish and other aquatic life.

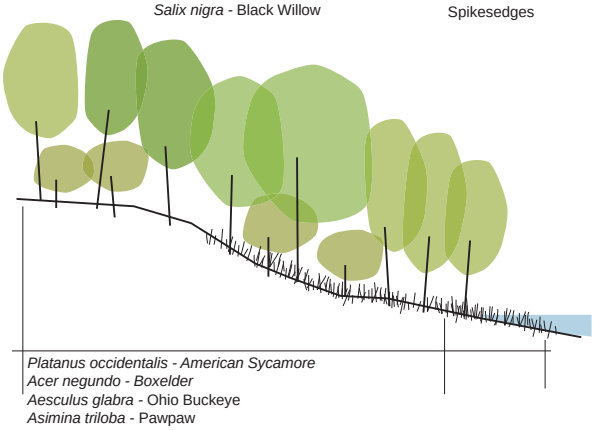
Resources:
FLOW - Friends of the Olentangy Watershed: http://www.olentangywatershed.org/
Olentangy River Wetland Research Park: http://swamp.osu.edu
Ohio Watershed Network: http://ohiowatersheds.osu.edu/team/
USDA Forest Service: http://www.na.fs.fed.us/
5th Avenue Dam Project: http://fifthavenuedam.net/clean.html
Project Clean Rivers: http://utilities.columbus.gov/dosd/CleanRivers.htm

Successional tree plantings / Riparian forest zone

Planting plan that addresses the natural succession of the landscape. A critical component of ecosystem self design.



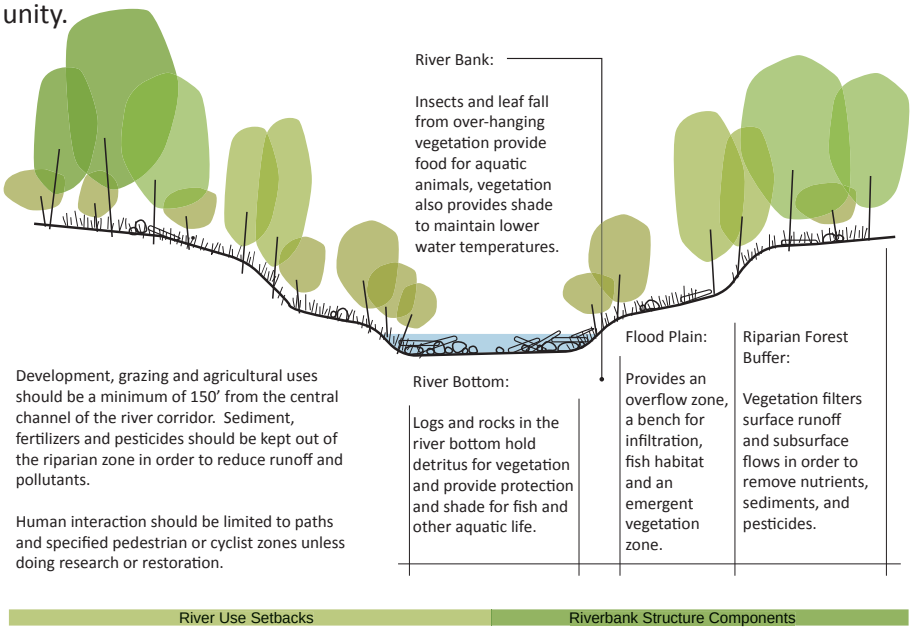
Potential initial colonization
Develop a riparian edge planted with early succession riparian forest plants:
Black Willow, and Eastern Cottonwood, and Eleocharis in the exposed river bank mudflats



Potential secondary colonization
American Sycamore, Boxelder, Ohio Buckeye, Pawpaw
Other early succession trees: Silver Maple, Swamp White Oak

Modify setback requirements

Set stricter rules to limit disturbance within river corridor, protecting river habitat from erosion, pollution, development and access. Identify area as a living laboratory for students and an educational resource for the wider community.



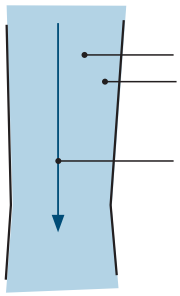
Resources:
Olentangy River Wetland Research Park, Lower Olentangy River Ecosystem Restoration Project, Vegetation establishment in the mitigation billabong at the Olentangy River Wetland Research Park, 2000-2002

Olentangy River Wetland Research Park, USDA Forest Service, Riparian Forest Buffer

Images: Mithun

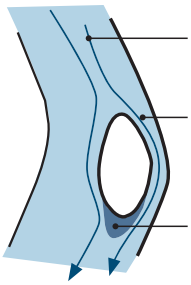
Construct islands in the river channel

Creates areas for habitat to thrive, supports varying water speeds, encourages ecosystem self design, and restores a more natural river corridor form.



Channelized River Corridor

Existing river is dammed and straightened negatively impacting river health.

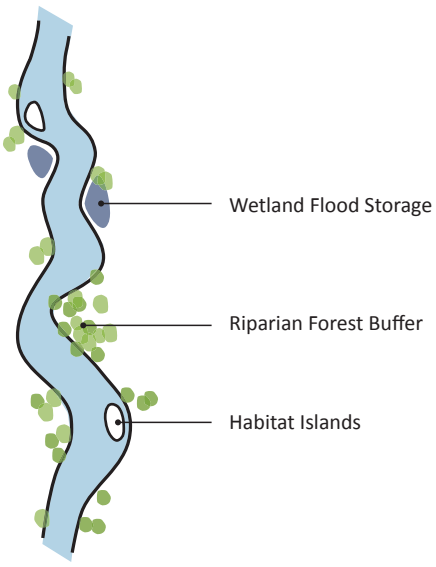


Diversifying form of the River Corridor

Creation of small habitat islands in order to increase biodiversity and river function.

Diversity of river form - meander river

Natural river systems are dynamic and stream channels move through time. This creates areas of faster or slower moving water depending on how the river bends and the substrate over which it flows. Such complexity is essential for providing a healthy, habitat rich stream system and where possible should be allowed to self design.



Meandering River Corridor

A more natural river form supports a diversity of substrate elements and water flows resulting in a healthier stream system.

Promotes a more flexible framework for ecosystem self design

Resources:
Olentangy River Wetland Research Park,
FLOW - Friends of the Olentangy Watershed

Images: Mithun

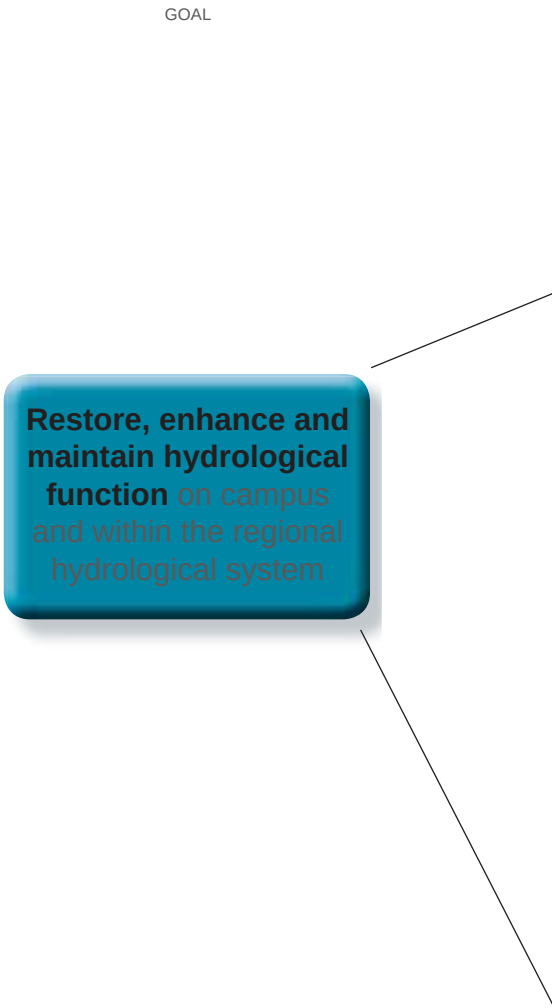
5.5 OSU Water Goals and Strategies

The overarching goal for water at OSU is to "restore, enhance and maintain hydrological function on campus and within the regional hydrological system". Objectives, Strategies and Potential Initiatives are grouped by Potable Water, Stormwater, the River System and the Use of the campus as a Living Laboratory.

Potential immediate next steps include metering high intensity water use buildings in order to meet a reduction goal of 20% by 2030. Other immediate initiatives include installation of low flow and low flush fixtures where currently not in place and promoting behavioral changes toward conservation of water.

Potential immediate next steps for stormwater include putting a system in place to track stormwater runoff and the installation of more bioswales, green roofs and raingardens to slow runoff and improve water quality.

The most important next step for the river is to continue building on existing knowledge by working with faculty, staff, students and local community groups who have invested significant time into this issue to identify the best strategies for enhanced river health.



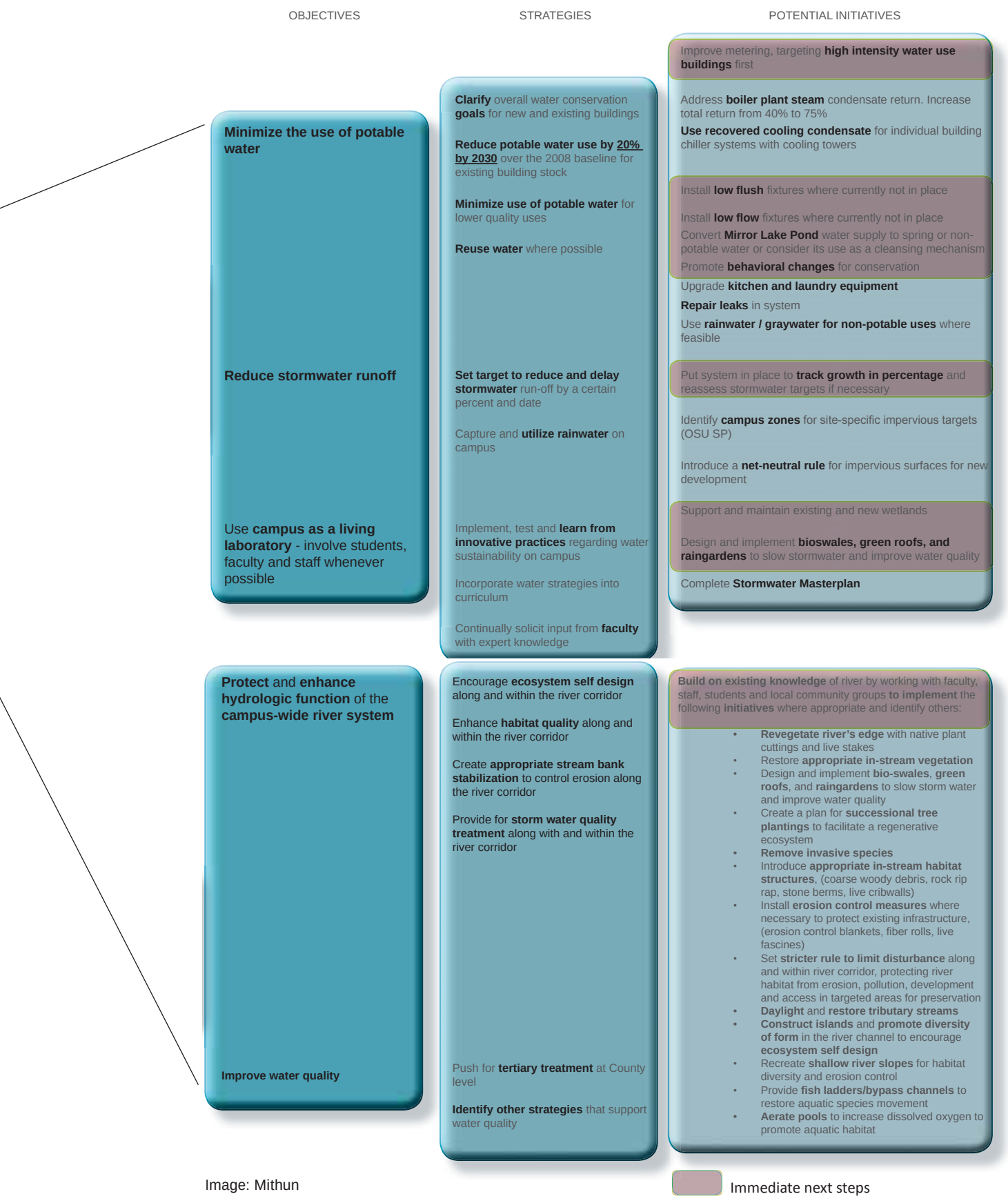


Image: Mithun

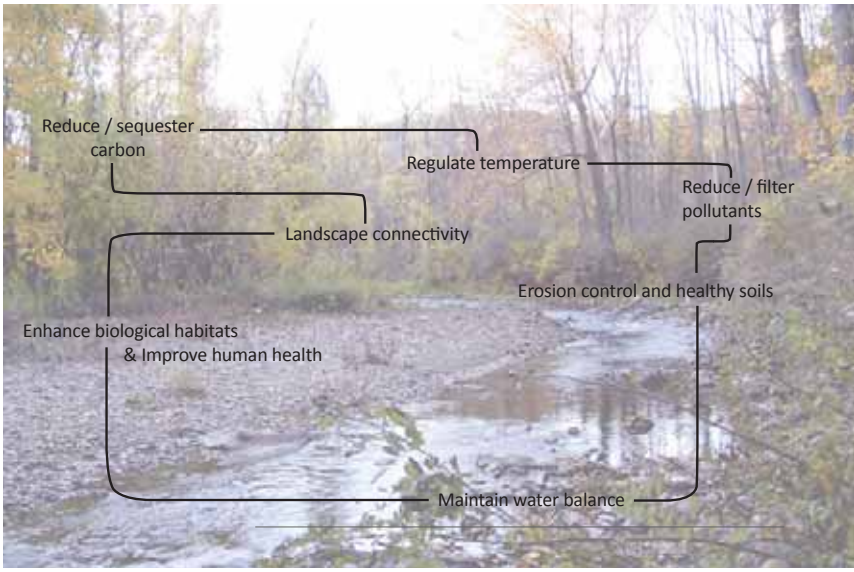


Image: Mithun

6 Ecological Function

6.1 Introduction

Ecological Function refers to the performance health of an ecosystem. Healthy ecosystems provide services that benefit humans and other organisms. Unlike water, energy and carbon, ecological function is not easily measured. Yet the elements of a functional ecosystem are so interconnected that non-sustainable approaches to land development and management practices can have immense effects rippling throughout the system. While native ecosystems are highly functioning habitats, we know that reverting all of our contemporary environments to their native state is impossible. We need to establish urban environments that provide the functions of a healthy ecosystem, such as:

- Supporting habitat and biodiversity
- Improving human health
- Sequestering carbon
- Filtering Pollutants
- Maintaining water balance
- Regulating temperature
- Providing for erosion control
- Supporting our natural resources

6.2 Metrics and Best Practices

Metrics

There are no consistent metrics developed for measuring progress in terms of Ecological Function, but there are several rating systems that have been developed to address the topic. The *Sustainable Sites Initiative* of the American Society of Landscape Architects recently released a report entitled "Guidelines and Performance Benchmarks 2009". The Initiative promotes sustainable land development and management practices. The National Wildlife Federation Campus Ecology Guide on Sustainable Landscaping is scheduled to be released in 2010.

Several methods for determining Ecological Function on a campus include:

- Percentage of native plants
- Percentage of tree canopy covering campus acreage
- Percentage of greenscape vs. hardscape covering campus acreage
- Number of green roofs and/or total area of green roofs
- Baseline use of pesticides and reduction goals
- Percent of total campus area in "Natural" state

This plan describes a method developed by Mithun that measures ecosystem function in a way that can be tracked over time.

Best Practices

There are a number of practices that sustainability-focused institutions employ, such as:

- Developing a university-wide landscape management plan that includes:
  - Erosion and Sedimentation Control Plan
  - Integrated Pest Management (IPM)
  - Protecting land from development; e.g. conservation easements for permanent protection of open space
  - Increasing the amount of green/open space on campus
  - Restoring habitat, such as wetlands or forests
  - Using native plants for landscaping

- Certifying the campus through multiple programs:
  - Tree Campus USA (requires a tree count or inventory)
  - Audubon International Cooperative Sanctuary
  - National Wildlife Federation's Certified Wildlife Habitats

6.3 Brief History of Ohio's Ecosystems

Before focusing in on strategies to target and establishing measurable indicators, it is helpful to understand the history of Ohio's native systems and the benefits they provide.

Forest Analysis: Cover Timeline

Prior to the settlement of Ohio the state was predominately forests (up to 95%). At the start of settlement the lands that nurtured tree growth were almost completely cleared for agricultural production (down to 10%).

In 1885 a forestry agency was created in Ohio. Subsequently, policy and laws were introduced that encouraged forest development, resulting in the growing and planting of more trees, as well as the protection of forests from fire, such that by the 1940's the forest cover had grown to 15%.

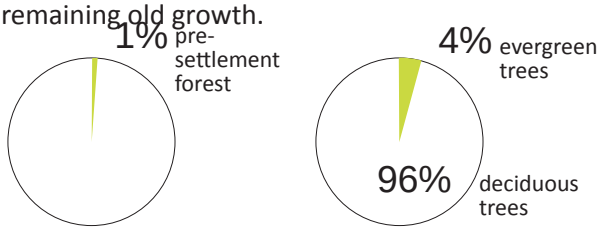
After the Division of Forestry and Ohio Department of Natural Resources were created, many programs and organizations followed to increase forestlands across the state including the following:

- Civilian Conservation Corps
- Land Utilization Program
- 20-Year plan: the creation of new forests and forest-parks
- Appalachian Regional Reforestation Initiative.
- Division of Forestry and Reclamation's reforestation and mine reclamation program
- Tree City USA

Today, 31% of the State of Ohio is forested.

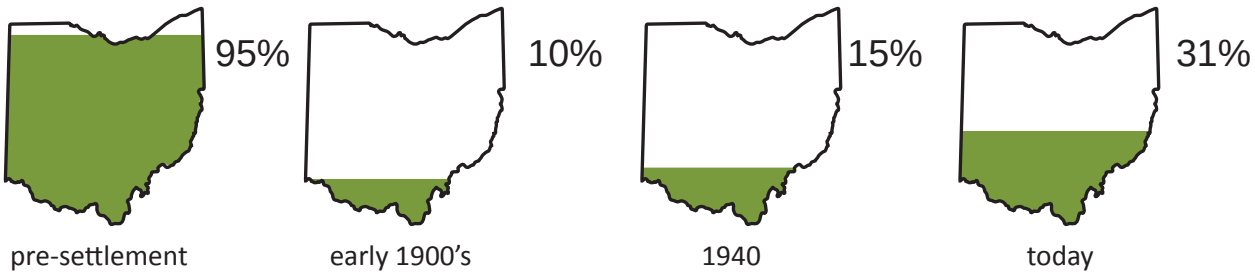
Forest Analysis: Habitat Condition & Current Composition

Rapid settlement of the Ohio region resulted in a steady decline of forest cover, and although today 31% of Ohio is forested, less than 1% of the pre-settlement (original) forest remains. Although forest cover has increased dramatically in Ohio over the last century, most existing forest land is early- to mid-successional with little remaining old growth.



The current forest composition is 96% deciduous, and 4% evergreen. Although the original vegetation had a greater percentage of deciduous tree species, evergreen trees can also provide a great amount of support to habitat biodiversity.

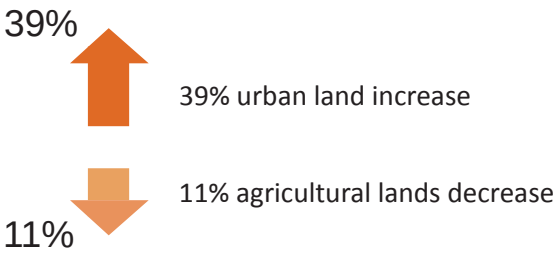
Forest Cover Timeline



Images: Mithun

Land Use Change

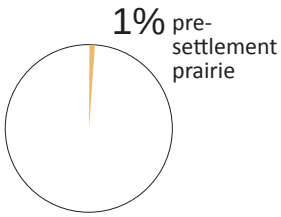
In just two decades the amount of urban land in the State of Ohio increased 39% resulting in the loss of a variety of different crucial habitats including grasslands.



Agricultural lands have decreased by over 11% in the last two decades.

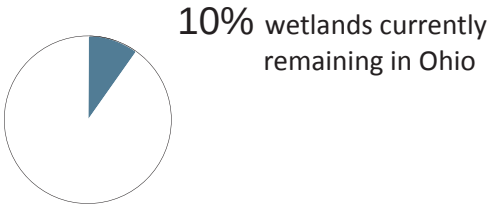
Grasslands / Prairie Habitat Condition

Prior to European settlement in the early 1800's Ohio contained about 1000 square miles of prairies which comprised about 2.5% of the vegetation of the State. The vast majority of these prairies were converted to agriculture and today less than 1% of Ohio's original prairie remains.



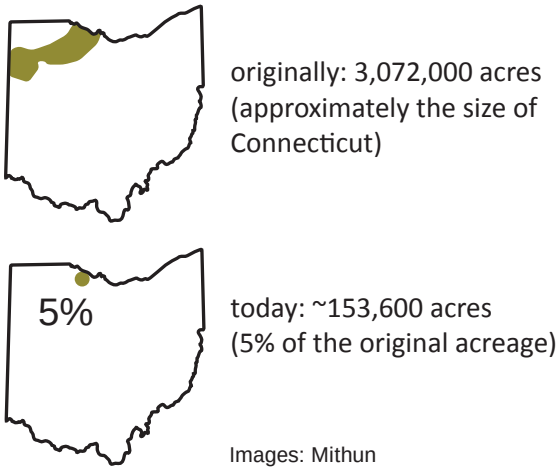
Wetland Analysis: Wetland Habitat Condition

Most of Ohio's wetlands were drained and filled to make way for farms, roadways, houses and other development. Mining, fluctuating water levels and logging also impacted Ohio's wetlands. In fact, nearly 90 percent of Ohio's original wetlands have disappeared. From the 1780's to the 1980's, Ohio wetland areas declined from about 5,000,000 acres to approximately 483,000 acres.



Wetland Analysis: Great Black Swamp Wetlands

Only 5 percent of Ohio's original Great Black Swamp, which was once 120 miles in length and an average of 40 miles in width (about the size of Connecticut), remains.



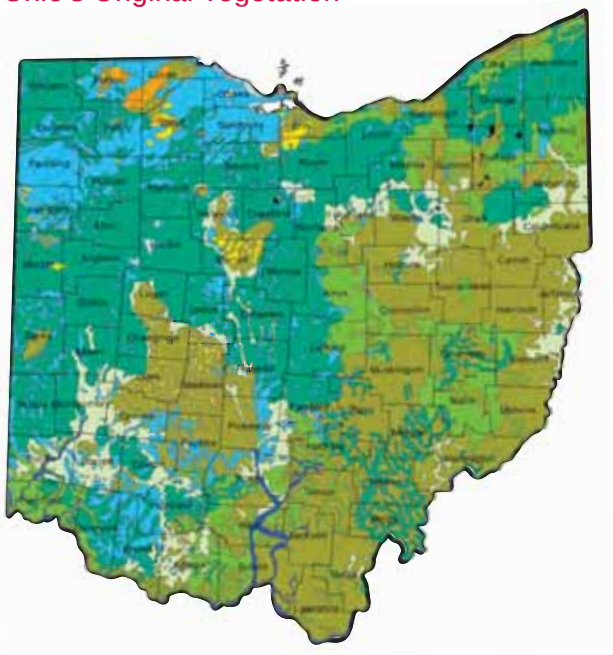
For detail on Ohio's physiographic regions, refer to the Appendix.

Historical Vegetation Areas

The following ecosystem types are native to Central Ohio and should be targeted for preservation and implementation, where appropriate, in future university development. Of course, site specific conditions and programmatic needs will also need to be taken into account.

Four primary ecosystem types comprise the above list are generally what should be targeted. They include Prairie/Grasslands, Shrub-Scrub, Forests and wetlands. For more detail, please refer to the appendix attached to this volume.

Ohio's Original Vegetation



Ohio's original vegetation at the time of the first land surveys

- Beech forests
- Mixed oak forests
- Oak sugar maple forests
- Elm-ash swamp forests
- Mixed mesophytic forests
- Prairie grasslands
- Oak savannah
- Sphagnum peat bog
- Marshes and fens
- Bottomland hardwood forests

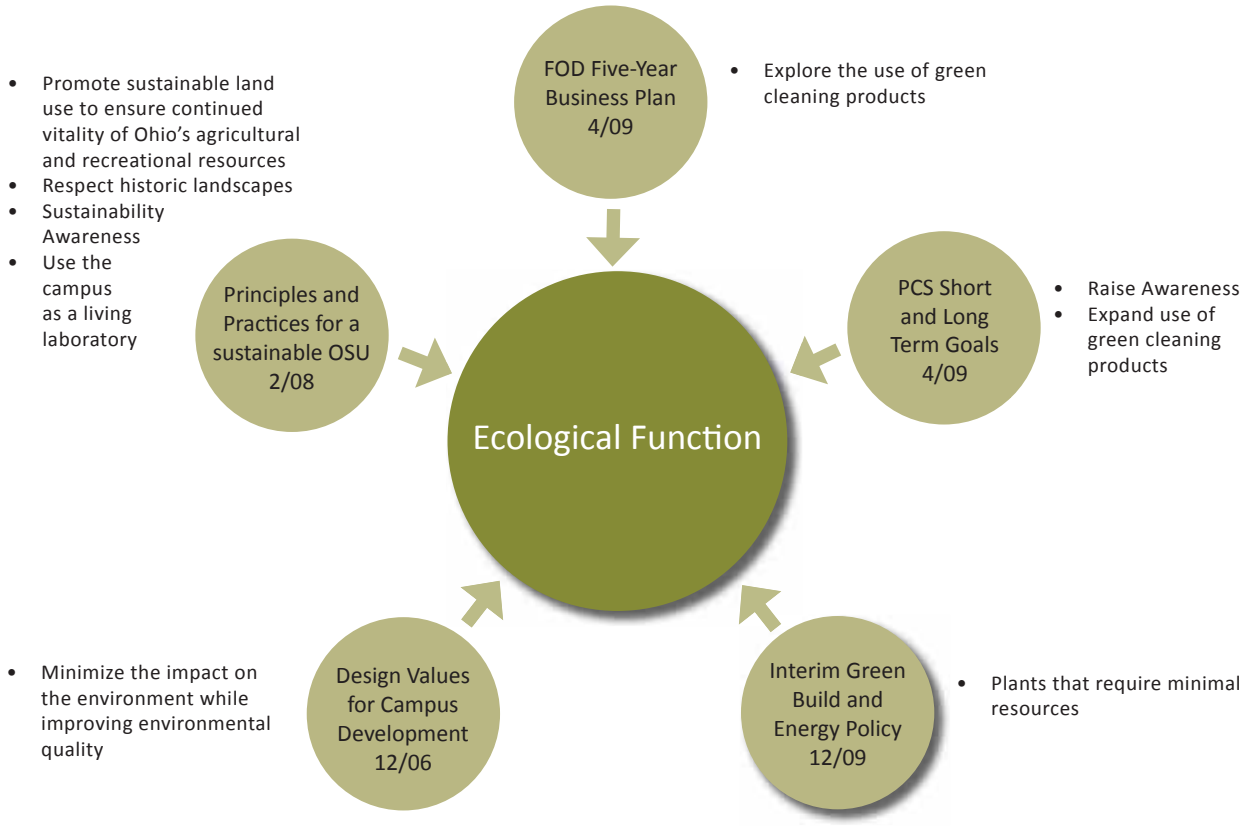
Image: Mithun

6.4 Ohio State Current Efforts

Ohio State policies

Many policies at the university speak to ecological function issues, but the topic has not been specifically addressed. The *Design Values for Campus Development* from 12/06 mention minimizing impact on the environment while improving environmental quality. The *Principles and Practices* for a sustainable OSU dated 2/08 stress the promotion of sustainable land use to ensure continued vitality of Ohio's agricultural and recreational resources, call for respect of historic landscapes, promote sustainability awareness and the use of the campus as a living laboratory. The *FOD Five Year Business Plan* dated 4/09 touches on ecosystem function only in the sense that the use of green cleaning products should be explored. The *PCS Short and Long Term Goals* from 4/09 speak to raising awareness and expanding the use of green cleaning products. The *Interim Green Build and Energy Policy* dated 12/09 calls for the use of plants that require minimal resources.

This sustainability plan seeks to develop ecosystem function as its own discrete topic.



Ohio State existing efforts

The campus can be described as Collegiate in character, and, as mentioned, is primarily lawn and shade trees. Apart from lawn and trees, there are a number of specialty gardens, including: Chadwick Arboretum, Jennings Hall Raingarden, Mirror Lake Hollow, Buckeye Grove. Historically, the landscape has been viewed as an aesthetic asset to the campus, but now is seen more and more as integrated with the function of campus ecology.

The 2003 update to the 1993 *Landscape Master Plan* aimed to simplify grounds maintenance regarding landscape management (lawn & shade trees), materials (simplify furnishings) and lighting (high pressure sodium, some LEDs). The plan addresses water and ecological function issues and includes all of the university's land holdings in Columbus. The *Plant Materials Inventory* relates to the Landscape Architecture curriculum and engages that program.

Ohio State currently has a *tree inventory*. Identification of Heritage Trees, or a Tree Protection Plan do not exist. There is currently no plan for tree succession.

The *soil quality* of the main campus is most likely poor from continuing disturbances for development and utilities work. Some areas seem to be 'dead zones' where nothing will grow. Organic matter/biomass generated on campus is taken off-site for processing and bought back by the university for use as mulch on campus. A soils management plan is not in place.

Regarding *integrated pest management*, the university minimizes the use of toxics as much as possible and selects plants that do not require pesticides for health. Some pest management issues exist with Gypsy moth, Emerald Ash Borer and Bagworms. The 4-H campus is Chemical-Free (LEED certified). There is no pest management plan in place.

Erosion and Sedimentation control plans are required by the State on new campus construction.

For *plant selection*, the general goal is to choose plants that will thrive without special care (i.e. low maintenance natives or other plants adapted to their locations). There are no specific policies in place with regard to use of native plants.

Sustainable practices currently in place include:

- Drought tolerant plantings;
- Plant list to support biodiversity;
- Tree inventory;
- Use of mulch in planting beds to conserve water;
- Selection of plant material for hardiness and adaptability, (establishment period is the first year);
- Trimming & pruning maintenance;
- The Jennings Raingarden was the first raingarden implemented and is used both for its functional as well as educational qualities;
- Bioswales at Kinnear Road ;
- Mirror Lake Hollow - rehabilitation of ravine & stream;

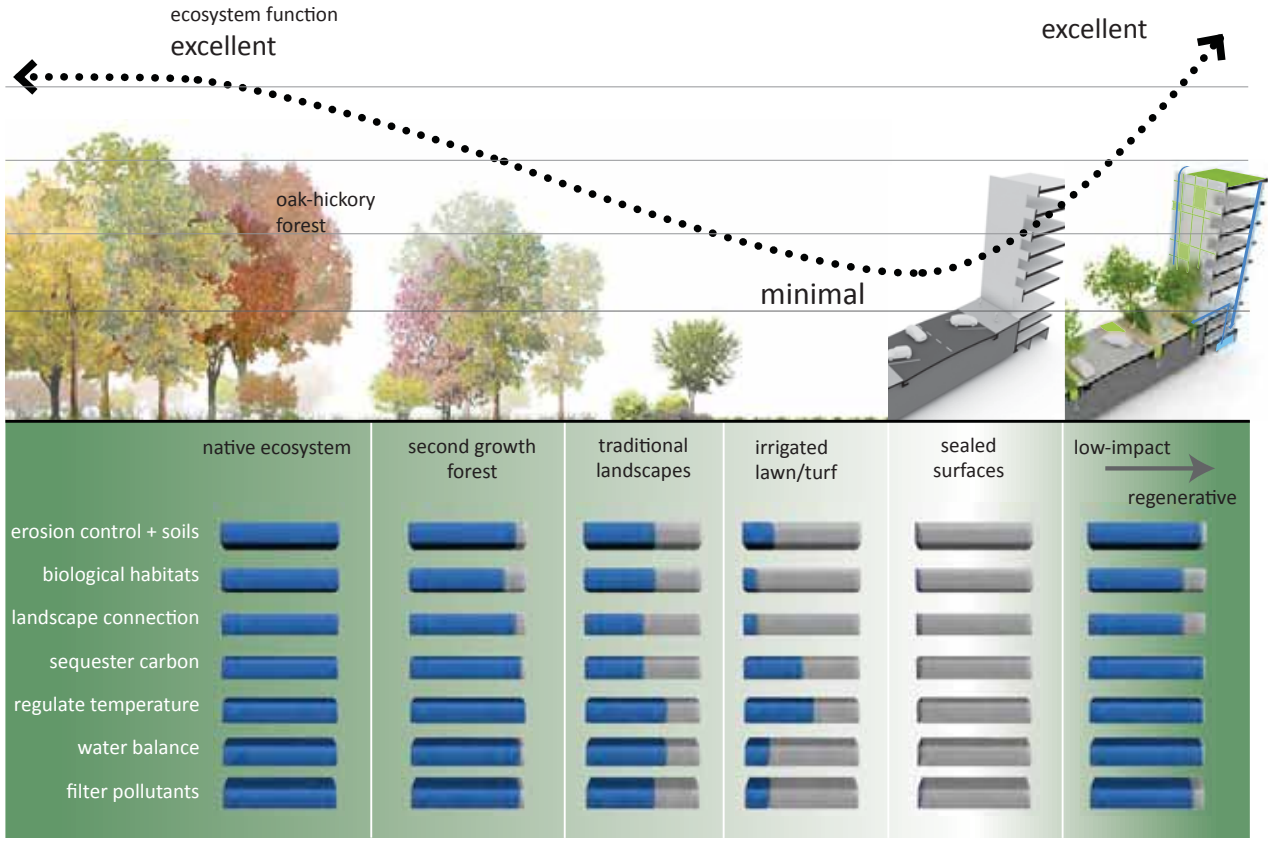
- Areas of porous paving along Neil Avenue, north of 17th Avenue. This area is being researched in order to explore using porous paving at other areas on campus, namely parking lots.

6.5 OSU Ecosystem Function

Quality of Campus Ecosystem Function

The ecosystem function of central Ohio environments can be considered on a continuum, with native environments (oak-hickory forest, for example) being the highest in function, and urban impervious surfaces being the lowest. The goal for human environments should be to simulate healthy ecosystems as closely as possible while simultaneously supporting human activities.

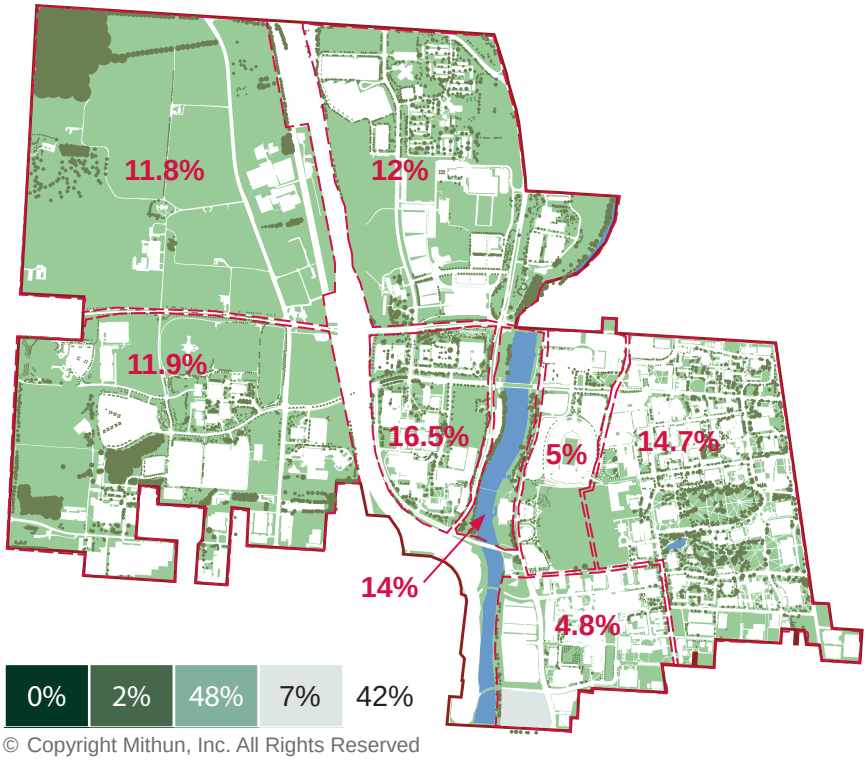
This continuum concept can be used to evaluate the functional quality of an existing environment in order to establish a baseline and set measurable goals that can be tracked over time.



Currently, 42% of the Columbus campus is sealed surfaces. Approximately 7% is lawn and field turf. Tree canopy covers 12%. Traditional and unirrigated landscapes, including agricultural land and the golf course irrigated with stormwater, make up approximately 48%. A stand of trees that approximates second growth canopy covers 2% at the north-west corner of campus on Waterman farm. Increasing pervious surfaces and planting more native or drought tolerant shrubs and trees to reach a higher percentage coverage, would begin to increase the ecological function of the campus. Using this measurable technique, progress can be tracked over time.

The land cover distribution diagram below is also helpful for understanding ecosystem function. Currently 56% of the campus area is open space, 24% is used by streets and parking lots, 12% is building footprints, 6% is hardscapes and 2% is water features. These percentages can also be tracked over time to ensure positive progress toward supporting ecosystem function.

Ecosystem Function Zones



Area within campus boundary
~1,762 acres

Area of Tree Canopy
~196 acres
11.8% of campus

Second Growth Canopy
~43 acres
2.4% of campus

x% - percentage tree canopy coverage by zone

6.6 Ecological Function Goals & Strategies

The overarching goal for Ecological Function at OSU is to *"maintain, restore and enhance ecosystem services in and around the OSU campus."* This goal statement aims to be as aspirational as possible, highlighting OSU as one of the first large higher education institutions to focus on the area of ecosystem function, and the varying levels of health that exist throughout the 1,762 acre campus.

Objectives focus on native biodiversity, watershed function, nutrient cycling, soil health, and using the campus as a living laboratory. Strategies and potential initiatives tie directly to these overall categories. Some potential immediate next steps include assessing the current percentage of native and adapted species, mapping the current tree canopy, developing a soil management plan and introducing a net neutral rule for impervious surfaces.

GOAL

Maintain, restore and enhance ecosystem services in and around the OSU campus

Effectiveness of Strategies

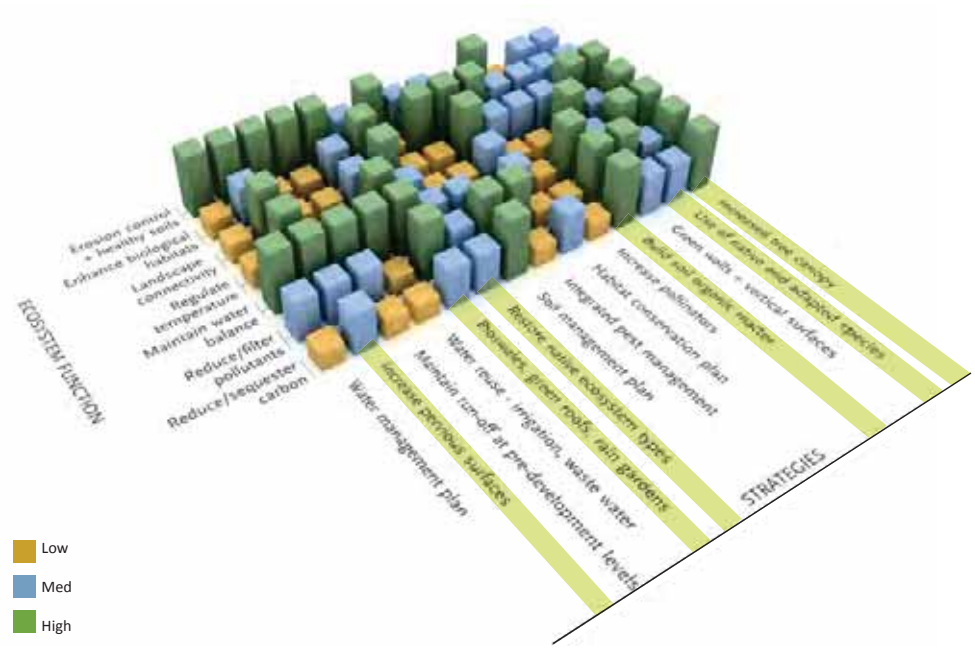
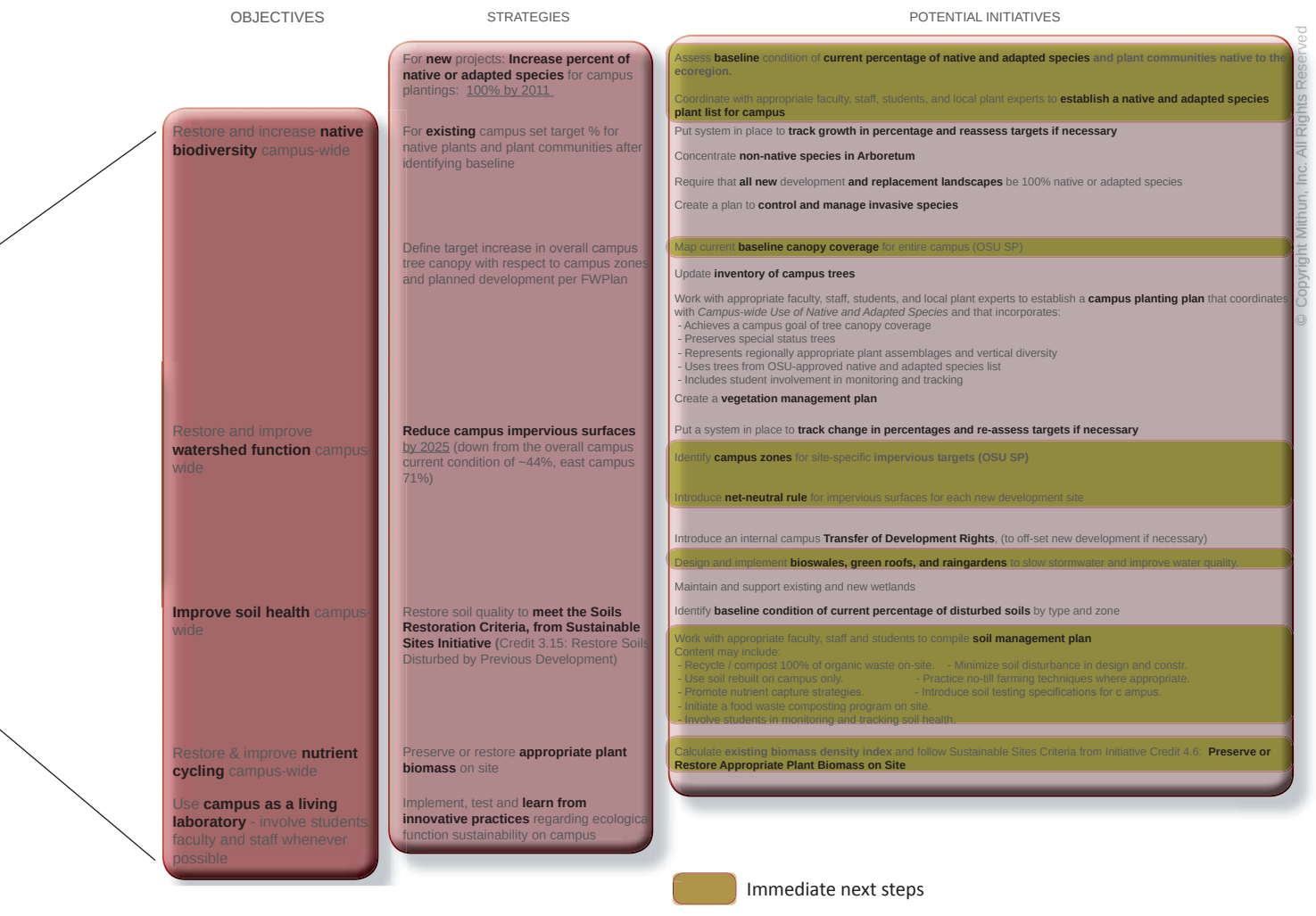


Image: Mithun



The food system represents an important part of community and regional economies.

7 OSU Food

7.1 Introduction

The food system represents an important part of community and regional economies. It must be sustained, yet current standard practice requires a significant amount of land and considerable quantities of fossil fuel for production, processing, transport and disposal. Pollution of ground and surface water from overuse of chemical fertilizers and pesticides also adversely affects drinking water supplies.

In addition, many diseases, such as heart disease, certain cancers and diabetes are related to diet. The importance of a sustainable, healthy food supply is not only critical for environmental protection but also for the sustainability of human health.

Image: Mithun

7.2 Metrics and Best Practices

Metrics

There are few established metrics for food. The College Sustainability Report Card (Green Report Card) Dining Survey looks at the percentage of sustainably sourced food. Several questions are used to determine approximate dollar amounts:

- Total Annual Food Budget
- How much do you spend annually on purchasing food that was grown or raised locally?
- How much do you spend annually on purchasing food that was processed locally?
- How much do you spend annually on organically grown or produced food?

By summing the answers for these questions one can obtain an approximate figure for total spent annually on food from sustainable sources. Dividing by the total annual food budget then determines the percentage of food sourced sustainably.

The Green Report Card uses a 150-mile radius to define “local”. Other rating systems, use other radii, such as a 250-mile radius with AASHE.

Image: OSU website

Best Practices

Many institutions have practices and/ or policies in place regarding food purchasing and sourcing food sustainably with varying degrees of constraints. Developing a food management plan and a system that identifies and tracks progress is among established practices. Some institutions have campus gardens which are used for food served on campus and/or integration into the curriculum. Farm-to-Fork programs support the health and wellbeing of the local community by buying locally.

Other efforts commonly found in institutions (including Ohio State) are the use of trayless dining and re-usable to-go containers (which reduces the amount of food waste), dedicating space to specialty cafes that provide vegan and vegetarian options as well as encouragement to eat lower on the food chain.

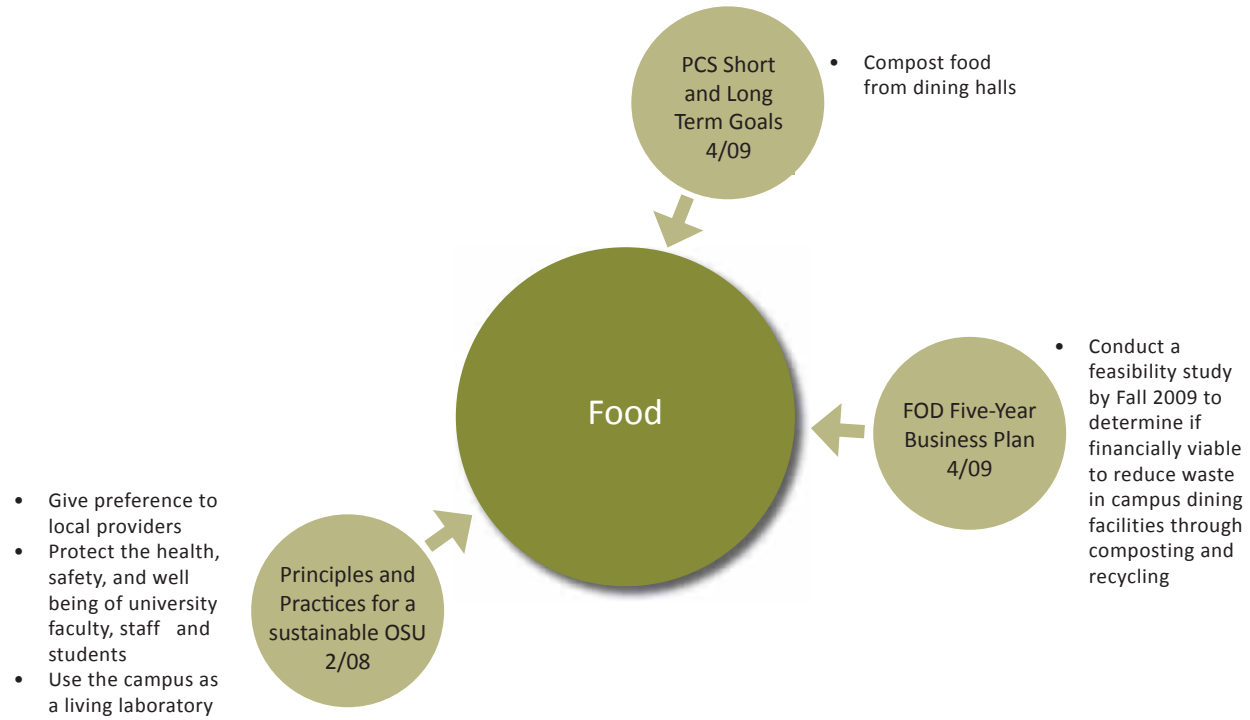
In addition, many dining services compost and recycle packaging and shipping materials to reduce waste.

With the high energy and water use of kitchens, efficient appliances and resource-conserving practices are also part of best practices.

7.3 Ohio State's Current Efforts and Conditions

Ohio State policies

The university's policies address food in the following way: *The Principles and Practices for a Sustainable OSU* dated 2/08 mentions preference for local providers, protection of health, safety, and well being of university faculty, staff and students and using the campus as a living laboratory. The *PCS Short and Long Term Goals* from 4/09 list a short-term goal of composting food from the dining halls. The *FOD Five-Year Business Plan* from April '09 calls for a feasibility study in Fall 2009 to determine the financial viability of reducing waste in campus dining facilities. The study contributed to current practices that include recycling and composting.

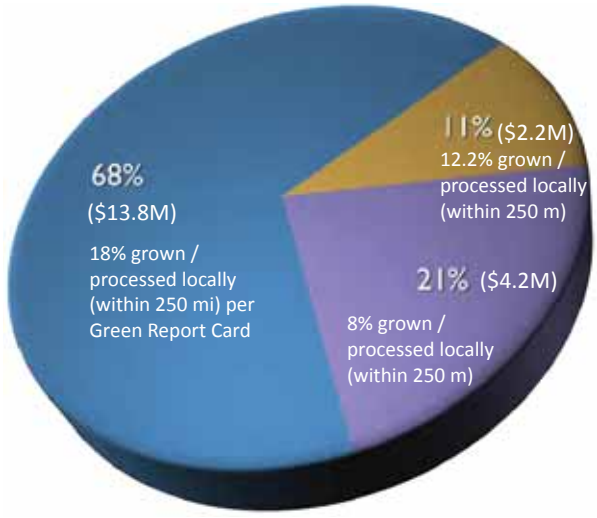


Ohio State Current Facts - Student Life

Af all the food consumed on campus, 68% is purchased by Student Life, 21% by the Medical Center and 11% by Athletics with varying percentages of food grown or processed locally.

Student Life

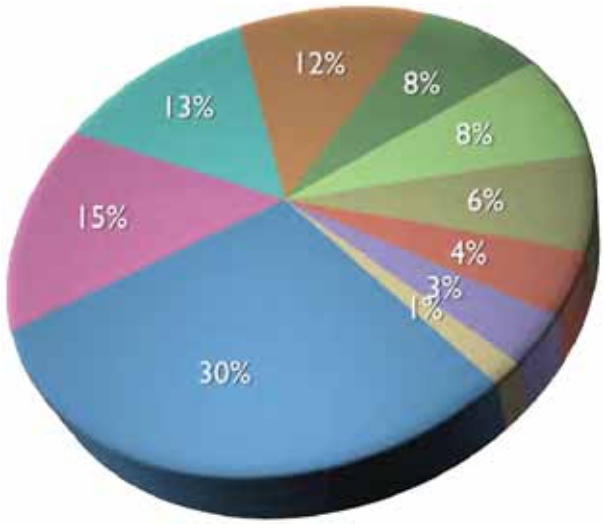
Student Life runs 20 food locations, including the new Student Union (opened in the spring of 2010 and the largest provider on campus). As shown in the diagram, perishable items make up the largest percentage of Student Life food expenditures. Perishable items along with baked goods are often purchased locally. Opportunity likely remains to increase local purchase of perishable items. Student Life initiatives have improved the impact of food waste including the elimination of trays in dining halls (reducing waste by 70%) and the use of anaerobic pulpers in the new Student Union.



OSU Columbus Food Purchasing Breakdown

Total OSU
Expense: $20.2 M

- Student Life - 68%
- Athletics - 11%
- Med Center - 21%



Student Life Food Purchasing Breakdown

Total Student Life Expense: $13.8 M

- 18% of purchases grown / processed locally (within 250 mi)
- no organic
- no fair trade
- Milk and Cheese = 12% of total (approx. $1.6 M)

- Meats, Eggs, Cheese
- Fruits & Vegetables
- Prepared Foods
- Non-Food
- Baked Goods
- Grocery & Staples
- Dairy
- Beverages
- Cereal, Nuts, Grains
- Other

Images: Mithun, Data: OSU

Following is a list of some of the current Student Life sustainability efforts:

Food Purchasing

- Approx. 18% of food within Student Life is bought from Ohio (Buy Ohio - w/in 250 miles)
- Prime vendor is in Cincinnati (90% of purchases)
- Purchase from local farms or growers directly and through distributors

Guidelines regarding sustainable food practices

- The use of Styrofoam has been eliminated and plasticware will be soon;
- Trayless dining reduced consumption by 40% resulting in significant dollar savings;
- Kitchens use 'no-run' water policy;
- Some vegetarian and vegan dining on campus;
- Concerted efforts to buy trans-fat-free oil and other items, but some snacks still remain
- Mug discount and bag program;
- Napkins are 100% recycled, but white
- There currently is no third party verification.

Frying Oil

- Outside operator picks up and recycles for biodiesel.

Waste

- Pre- and post- consumer composting goes through a pulper system and then to a local, off-site composter (Kurtz Brothers);
- All-In-One recycling;
- Cardboard is bailed, then transported/ collected.

University Food Locations

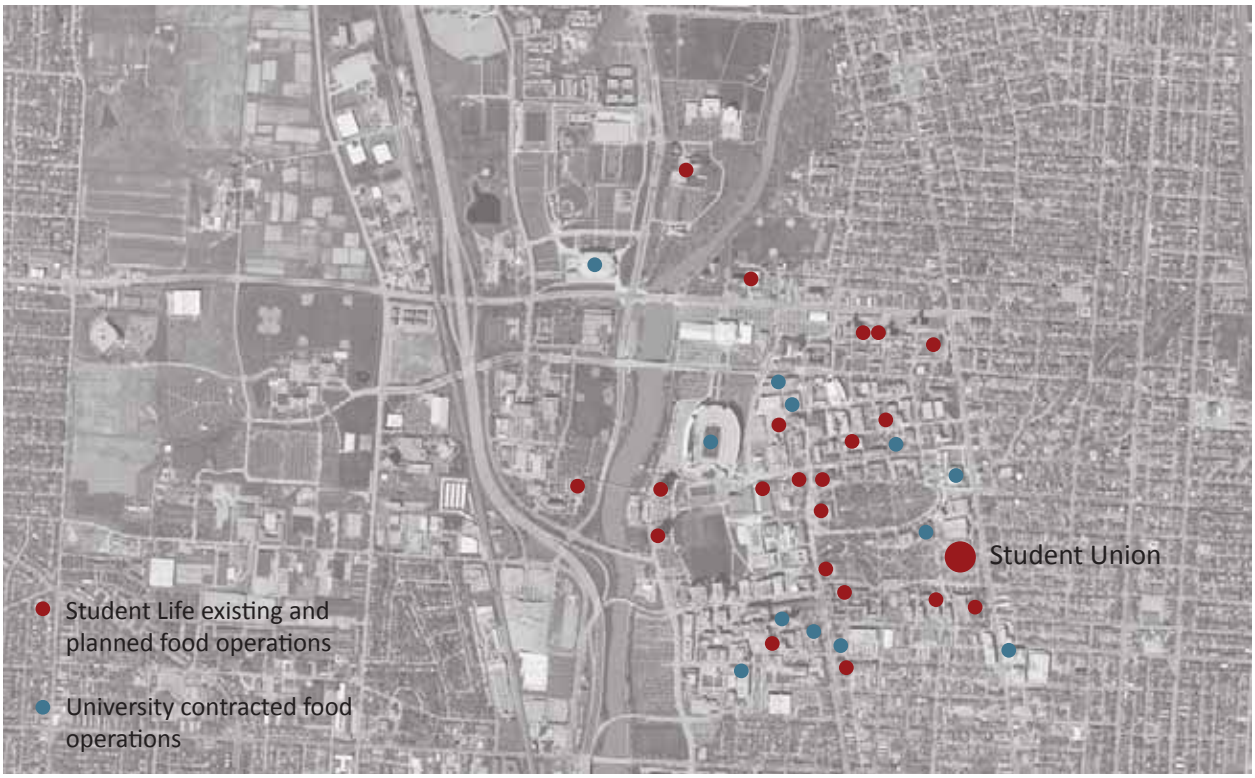


Image: OSU & Mithun

Hobart

- OSU buys the products specified by Hobart (dishwashers, etc.), which are both Energy-Star and Buy-Ohio.

Franchises

- Currently no guidelines for franchises.

Energy & Water strategies

- Valves shut machines off (dishwashers);
- Signs to "Please turn off the lights";
- Herb garden in new union with rain barrels ;
- Pulper system conserves water;
- Purchasing crew keeps track of energy and water use.

Student Support

- Students are very involved in sustainability;
- Typically want to buy local, but less so for organic because of higher cost - not always willing to pay more for new strategies.

OSU Medical Center

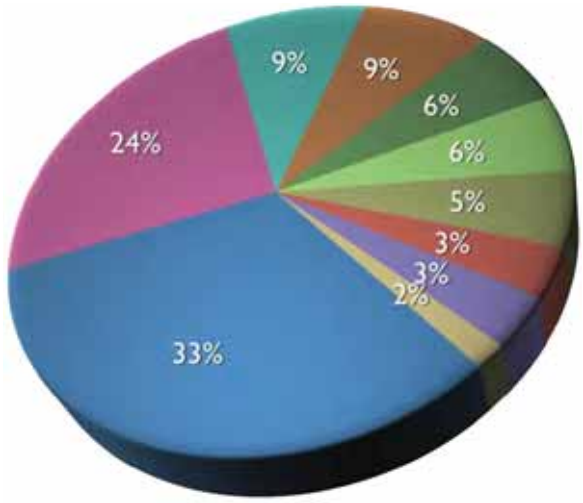
Food and Nutritional Services is a self-operating entity for patient dining, and serves 3 million meals per year. Several retail food services are also located on the Medical Center campus such as Wendy's, a cookie shop, coffee shops, five Season's Café locations, and the garage Food Court managed by Transportation and Planning.

For patient dining, food is part of the room rate, which includes variable medical costs. This cost structure is very different from other food services on campus in that when medical costs increase, a smaller proportion remains to cover food. Because of this constraint, the current goal is to purchase safe and wholesome foods, not necessarily sustainable. Food and Nutritional Services buys local when possible, but there is no policy in place.

Current Efforts

- Food and Nutritional Services purchased through a consortium of multiple university medical centers for competitive pricing;
- `Milk from Cincinnati (w/in 250 miles);
- Bread, fresh pastry items purchased locally;
- Farmers' markets have been hosted on campus, in the summer and fall with mainly locally grown food and seasonal vegetables. (The farmers' markets are very popular, self-generated events, organized through the Medical Center's food distributor.) ;
- Meat and produce used to come from within 250 miles, but this is no longer the case;
- Third party verification is not common, and only occurs if convenient, since The Medical Center is not comparable to the college or university level where consumer demand might dictate more sustainable practices;

- Cafes and patient areas serve both vegetarian and vegan dining;
- Trans-fats have been 99% eliminated, but some items remain;
- A company recycles frying oil to double its life, then removes it to sell for bio-diesel (although not many fryers are used in Medical Center);
- Other efforts include
  - the use of recycled napkins and biodegradable plates and bowls based on corn starch and fully compostable;
  - Plasticware is partially recycled with post-consumer waste (needs to hold up for hot foods);
  - New coffee cups are 25% recycled.



Medical Center Food Purchasing Breakdown

Total Medical Center Expense: $4.2 M

- 8% of purchases grown/ processed locally (within 250 mi)
- no organic
- no fair trade

Image: MIthun, Data OSUw

Franchises

- Currently no guidelines for franchises;
- Sales and competitiveness are most important;
- Information on food is available and a wide variety of choices is offered.

OSUMC Food Waste, Recycling, Composting & Donations

- Having been in place for about 1.5 years, the recycling program is fairly new;
- Cardboard from food deliveries is being recycled: about one ton per week goes to bailer;
- No pre or post consumer composting in place because of the lack of space for pickup or holding and refrigeration requirement. With upcoming facility renovations, opportunities are being explored;
- Not much food waste is produced because of food donations.
- The Medical Center has participated with the Second Serving, Ohio food bank since the late 1980's for food donations. Pick-up occurs five days per week;
- A pulper system has been used for over 15 years. The wet slurry from the pulper goes to the trash and does not get composted, but the trash volume was reduced by 75%. Paper and milk cartons go into the pulper as well.

Energy and water reduction strategies

- The Ohio State Medical Center kitchens were completed in the 70's. Equipment is old and not water or energy efficient. With upcoming renovations, in addition to Project ONE, food operations will be made much more energy efficient.

Ohio State Athletics

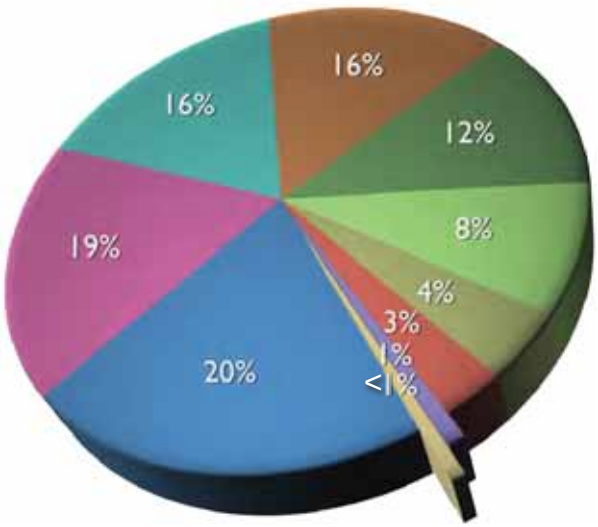
Athletics' food service is provided by Sodexo. Approximately 95% is across-counter sales. Concession vending is based on quick prep and to-go items, which limits options. If prices were more competitive, more sustainable items would be purchased. The diagram below shows the distribution of food purchases with 20% in the meat, egg, cheese category. Many of these perishable items are locally purchased.

Current efforts

- Items such as hot dogs, bratwurst and chips are bought locally (within 250 miles);
- Veggie burgers are offered and bulk pumps for mustard and ketchup are used;
- Some napkins are 100% recycled. Athletics makes food donations to a local food bank;
- Certain measures can't be taken because of food safety (for example, relish can't be used in bulk pumps).

Pilot Projects

- A number of practices are being tested, such as paper nacho trays and paper wraps for bratwursts;
- Some composting is currently tested at the Basketball arena.



Athletics Food Purchasing Breakdown

Total Athletics Expense: $2.2 M

- 12.2% of purchases grown/processed locally (within 250 mi)
- no organic
- no fair trade

Meats, Eggs & Cheese	20%
Beverages	19%
General Food	16%
Grocery	16%
Retail (Packaged Items)	12%
Beer	8%
Produce	4%
Baked Goods	3%
Dairy	1%
Frozen Food	<1%

Image: Mithun, Data: OSU

Integrated University-wide Food Policy

Sustainable food strategies must be economical, responsible and reasonable, taking into account the unique challenges of each division. For example, students are not always willing to pay more for sustainable dining options, patient dining budgets get pinched as medical costs rise, and concession food for Athletics requiring to-go items requires extra packaging or disposable containers. Even so, a university-wise policy would help guide each of the diverse divisions in terms of food practices.

The table below shows components that could be part of a university-wide food policy and where the university already has efforts in place.

	Student Life	Medical Center	Athletics
Grown & Processed within 250 miles of Institution	x	x	x
Seasonal	x	x	
Third - party certified			
USDA Certified Organic			
Marine Stewardship Council Blue Ecolabel			
Food Alliance			
Fair Trade			
Other			
Trayless Dining	x		
Vegetarian & Vegan Dining	x		
Exclude Trans-Fats	x		
Food Donations		x	x
Recycled Content Napkin	x		
Reusable Mug Discount	x		
Reusable To-Go Containers			
Pre-consumer Food Waste Composting			
Post-consumer Food Waste Composting	x		
Guidelines for franchises/dining service contractor			
Kitchen equipment upgrades (Energy Star etc.)	x	x	

x = OSU has efforts in place

7.4 Food Production Potential

With OSU's land grant mission, extensive agricultural programs and large landholdings, the potential for food production to support the Columbus campus was examined. The Wooster campus used to supply all dairy, eggs and some beef. Now, some is provided. The Waterman Farm and the Wooster campus are the most feasible locations for food productions. There currently is a dairy at the Waterman Farm on the Columbus campus. Milk, cheese and ice-cream potentially could be provided for the Columbus campus. Land for additional production is available, but would take capital to set up a processing facility.

Food production would need to retain an emphasis on teaching and research. Supplying all campus needs would not be possible, but increasing efforts with the goal of education and awareness is encouraged. ATI in particular, could include food production as part of its curriculum.

Further discussions need to take place between CFAES and Student Life to better understand seasonal demand and the ability to meet some of that demand.

7.5 OSU Food Goals & Strategies

The overarching goal for Food is to *"Pursue a leadership role in managing the food life cycle (sustainable food purchasing, food waste and on-campus production practices)"*. The objectives are grouped into sustainable purchasing, food waste, on-campus production, community outreach and using the campus as a living laboratory. Potential immediate next steps include the development of a university-wide Food Management Plan that is coordinated yet addresses the unique needs of each food service entity. Part of the plan should include development of a system that identifies and tracks progress.

Image: Mithun

OSU's purchasing power is hugely significant and has the potential to influence more sustainable models.

Image: Mithun

8 Purchasing

8.1 Introduction

Purchasing touches every aspect of university life. Purchasing policies and behaviors impact the use of natural resources and influence our environmental health, affect social equity, human health, the regional economy and to the university's overall carbon footprint. When carefully managed, purchasing can act as a gatekeeper to a full range of sustainable activities and as a tool to track progress.

Sustainable purchasing aims to procure products and services with minimal environmental impact. The university's commitment to buying goods, materials, services, and capital improvements in a manner that reflects the university's values is demonstrated through purchasing policies and actions.

Applicable Items

Sample products

- Building construction and maintenance
- Electricity
- Furniture
- Landscaping
- Pest management
- Vehicle fleet
- Cafeteria supplies
- Office supplies

Sample contracted services

- Automotive waste disposal
- Campus mailing list purchases
- Food service supplies
- Soft drink vending
- Construction & remodeling
- Concessions

A life cycle (or "cradle-to-grave") assessment considers the environmental impacts of a product or service over its life time, including how a material is extracted, processed, used, disposed of and transported. The goal is to close the loop and make informed decisions based on a better understanding of the human health and environmental impacts of products, processes and activities. Cradle-to-grave thinking can be considered in many purchasing decisions.

7.2 Metrics and Best Practices

Metrics

Due to the lack of consistent rules for labels and declarations on products with environmental attributes, it is very difficult to rank green purchasing policies. There are an array of third-party product certifications and self-evaluation methods for manufacturers, but there is no consistent method of evaluating which attributes are least harmful in the developing green product market. Life Cycle Analysis (LCA) and ISO 14025 (a list of principles and procedures for labels and declarations on environmental products) are two of the more rigorous systems for evaluating environmental attributes, but they have not been widely adopted.

Best Practices

Most green purchasing policies state the following **goals**

- Source Reduction (packaging take-back, cradle-to-cradle products, etc)
- Pollution Prevention
- Support of human health
- Social equity

Green purchasing policies typically urge purchasing agents to buy products with the following **attributes:**

- Reusable & Durable
- Post consumer content
- Recyclability
- Rapidly Renewable Materials
- Local or regional source
- Environmental Product Certifications
- Energy efficiency / low embodied energy
- Water efficiency

Most green purchasing policies also include preferences for socially and/or environmentally responsible vendors. Green purchasing cooperatives are an innovative approach; they can reduce product costs and increase the use of environmentally preferable products and services.

Identifying green vendors and products through electronic purchasing systems or purchasing websites is an approach that can be used to increase use of these vendors and items.

8.2 Ohio State's Current Efforts and Conditions

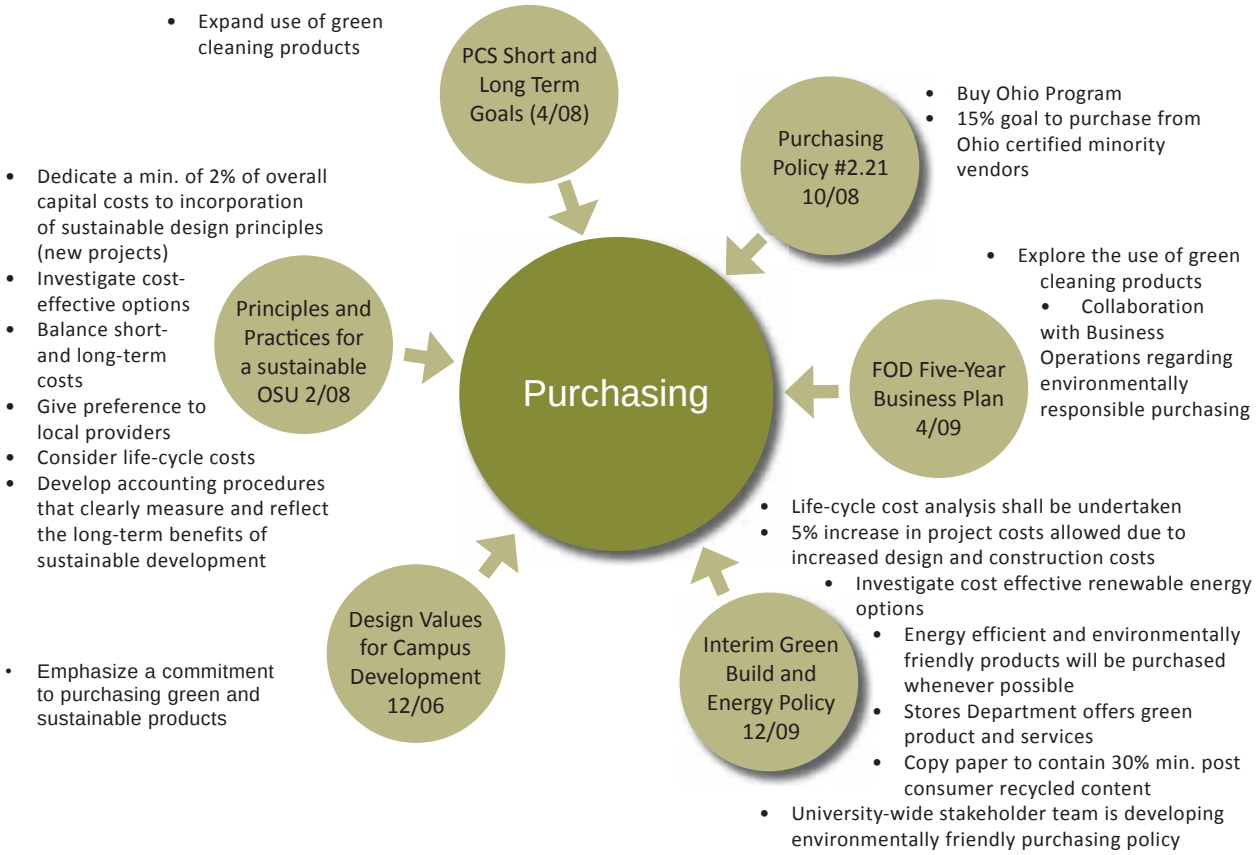
Ohio State Policies

Ohio State has many policies in place that address the topic of Purchasing. The *Design Values for Campus Development* dated December 2006 emphasize a commitment to purchasing green and sustainable products.

The *Principles and Practices for a Sustainable OSU* from February 2008 includes a policy to dedicate a minimum of 2% of overall capital costs to the incorporation of sustainable design principles for new projects. It also calls for investigating cost-effective options, balancing short- and long-term costs and giving preference to local providers and mandates developing accounting procedures that clearly measure and reflect the long-term benefits of sustainable development.

The *President's Council on Sustainability's 2009 Short and Long Term Goals* expand on the use of green cleaning products.

The *Purchasing Policy #2.21* dated October 2008 states the Buy Ohio Program, which the university is required to participate in. In addition, the policy mentions the goal of purchasing 15% from Ohio certified minority vendors.



The *FOD Five-Year Business Plan* from April 2009 mandates exploring the use of green cleaning products in partnership with Operations as well as a collaboration with Business Operations regarding environmentally responsible purchasing.

The *Interim Green Build and Energy Policy* from December 2009 declares that life-cycle cost analyses shall be undertaken for each qualifying building construction project in accordance with the standards established in the Ohio House Bill 251. These shall include an energy systems analysis and the results of these considerations shall be a primary consideration in developing the project design. The policy also allows a 5% increase in project costs due to increased design and construction costs per this policy. Other mandates include investigating cost effective renewable energy options, purchasing energy efficient and environmentally friendly products whenever possible as well as purchasing paper with a minimum of 30% post consumer recycled content. The policy further mentions that Ohio State's Stores offers green products and services and that a university-wide stakeholder team is developing an environmentally friendly purchasing policy.

Ohio State Purchasing Distribution

The pie chart below shows the distribution of purchasing by campus. Clearly, the Columbus Campus is the largest purchasing entity (and the focus of this study).

Reviewing the distribution of dollars spent by category, the largest percentage of expenses is in utilities on the Columbus campus (24%). The next largest category is consulting, followed by consumables. Together these three categories make up slightly more than half of the university's purchases. In many cases, the purchase of durable goods can reduce the need for consumables or utilities (i.e. the purchase of fuel efficient cars or energy efficient appliances). Sustainable purchasing is not tracked either campus-wide or by division although some sustainable purchasing does take place.

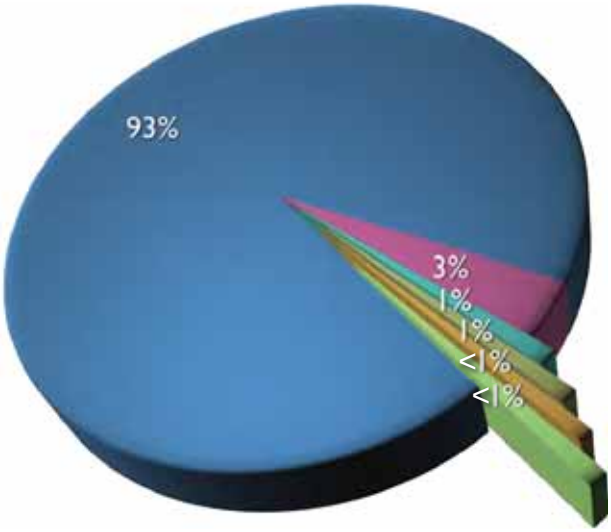


Image: Mithun, Data: OSU

Campus Purchasing Distribution 2009

- Columbus
- OARDC
- Mansfield
- Marion
- Lima
- Newark

In the e-Procurement Store, 5,000 green items can be tracked and a list of green products and suppliers is available. But e-Procurement represents only approximately 12% of the total purchases.

A task force for environmentally responsible purchasing was in place and established the university's 30% recycled content policy for paper, but disbanded afterward. Green teams are in place in all business units but current university-wide purchasing policies do not address sustainability beyond the recycled paper content policy.

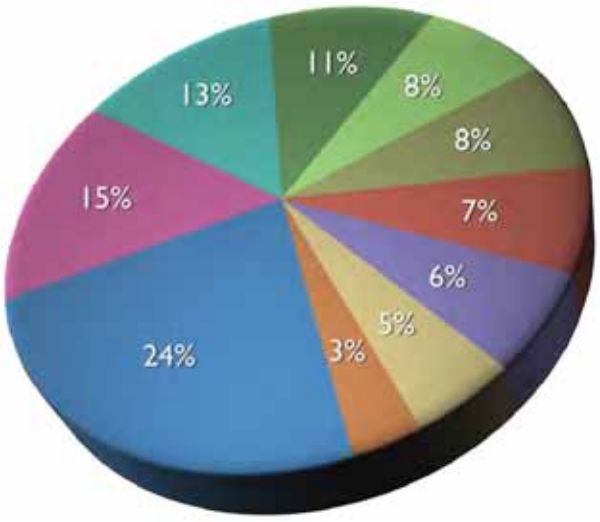


Image: Mithun, Data: OSU

Columbus Purchasing Spent by Category 2009

- Utilities
- Consulting
- Consumables
- Lab Consumables
- Durable Goods
- Other
- Electronics/Tech
- Operations
- Software
- Cleaning

8.3 OSU Current Efforts and Conditions

Materials-In

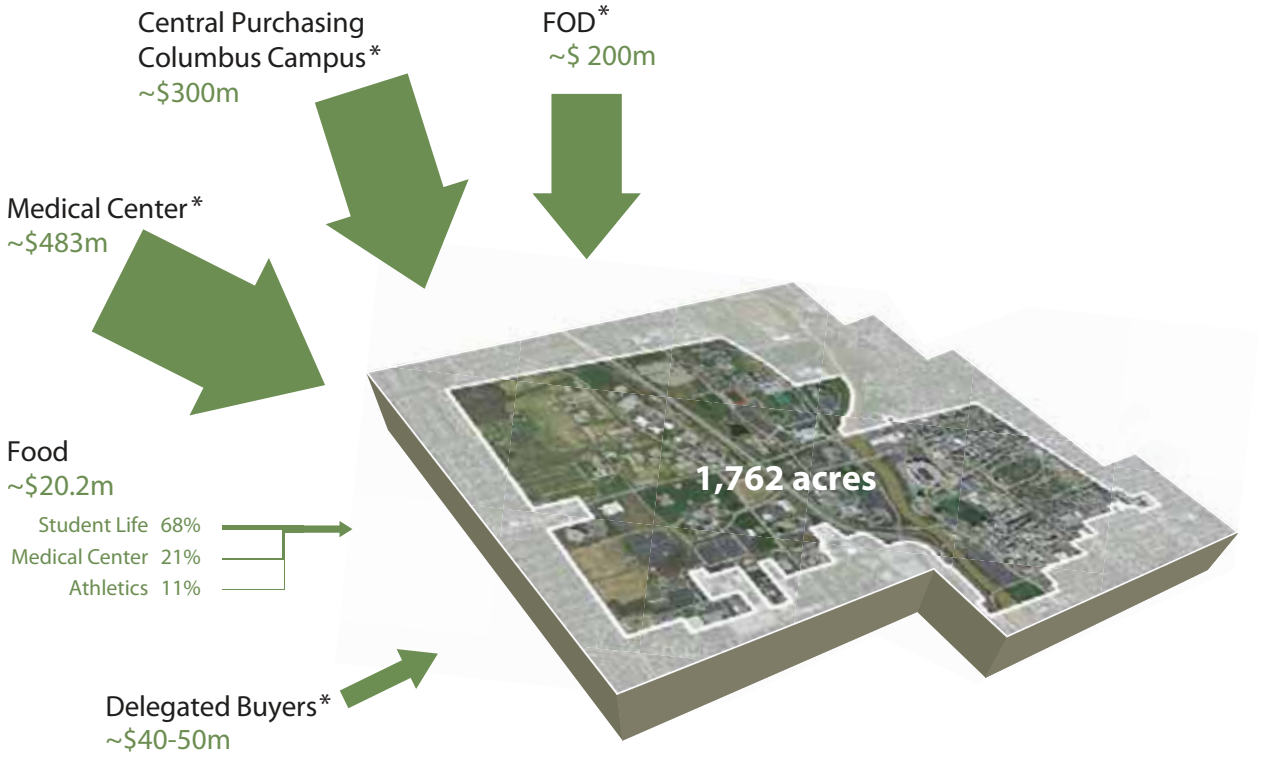
The Materials In Diagram below shows the flow into campus in millions of dollars.

Central Purchasing is set up with eight to nine central buyers. Anything purchased over $5,000 goes through central buyers at the Central Purchasing Office. Approximately 300 delegated buyers have the authority to purchase in the amount of $5,000 or less independently. This system is effective for addressing immediate needs, but since half of the delegated buyers routinely use the system tracking is difficult.

Facilities Operations Development's (FOD) purchases and all food are procured independently and also typically not tracked. (Food purchasing for Student Life is procured, however, see the Food section for details).

University-wide Practices Include:

- Approximately 50% of products are purchased through the Buy-Ohio program. This program has generally been applied in bid situations only. Limits are $25,000 for goods and $50,000 for services. If the lowest bidder is in Ohio or a bordering state, he/she can be awarded the project with a 5% differential from the low bidder;



* indicates sustainable purchasing within this category not tracked

Data: Calendar Year 2009 (except as noted)

- Purchase orders are in electronic format to avoid the use of paper;
- A list of green products developed by vendors has been developed (but not analyzed against green protocols);
- Fisher Scientific's and Officemax's online catalogues (via Ketera, the university's e-procurement platform) have self-identified "green" products highlighted for customers to identify;
- Trademark & Licensing is monitoring working conditions and labor practices for licensed products;
- A program entitled the "Buckeye Bin" is in place in conjunction with the office supply provider, Officemax. This program involves the use of reusable plastic bins, in lieu of traditional cardboard boxes, to pack and deliver the office supply orders to campus customers.
- Paper
    - Office Paper: 30% post consumer content per policy, 50% or 100% is available for purchase
    - Paper is purchased in bulk
    - Central Purchasing prints with Forest Stewardship Council (FSC) certified paper
- Energy Star purchasing for computers
- Recycled cartridges and toners
- Chemical purchasing guidance
- The Medical Center re-furbishes furniture when economically feasible and encourages contractors to buy back
- Transportation & Parking provides consultation on vehicle purchases
        - Purchasing is based on ratings and low emissions
        - Increasing bio-diesel and electric fleet
- Discussions are underway regarding
    - A policy for sustainable cleaning products & equipment
    - Inclusion of sustainability language in RFP's and RFQ's
- Vendor code of conduct
    - Minority Business Program: Ohio State is consistent with the State's goals and mandate of procuring approximately 15% of its goods and services from state-certified minority vendors
    - Encouraging Diversity, Growth & Equity (EDGE): 5% goal for certain small and disadvantaged businesses that don't fit into the Minority Business Program

Student Life Policies & Procedures

- Entrance matting systems
    - Environmentally friendly
    - Effective
- Vacuums & carpet care
    - CRI Green Label Testing
    - Restorative / preventive maintenance
- Floor care - Green Seal Standard
- Green Seal hand soap
- Cleaning chemicals & dilution control
- Low VOC / Non-chemical deodorizers, dust cloths, urinal blocks
- Paper products
    - Green Seal
    - Airhand dryers
- Plastic Trash Bags
    - EPA GS-42 Guidelines
    - Low-impact / re-use
- Dump and Run program at end of year
- Employee training/ building occupant education

8.4 OSU Purchasing Goals and Strategies

Purchasing goals and strategies rely on a university-wide commitment to sustainable purchasing through a university purchasing policy.

The ultimate goal for OSU will be to bring together policies, communication tools, process improvements, standards, and reporting mechanisms to help align purchasing practices with University values and incorporate these into a Sustainable Purchasing Program.

This policy must be enforced through consequences. Guidance and training are vital parts of enforcement. An improved tracking system of purchases will help establish the baseline and monitor how purchases are becoming more sustainable over time.

The OSU goal is to "develop a sustainable purchasing policy that balances cost, community and ecological footprint." Objectives range from developing the policy to establishing quantifiable goals with timeframes university-wide.

Specific strategies and potential initiatives follow the objectives. One potential immediate next step is to develop a tracking system.

GOAL

Introduction setting culture	
Encouragement to use products designed for reuse & recycling	
Computer EPEAT purchasing	
Cleaning Equipment	
Paper - 100% recycled (OSU's policy currently calls for 30% recycled)	x
Reduced mercury lamps	
Manufacturers that employ sustainable practices	
Use of salvaged and recycled materials	
Certified wood	
Adhesives, sealants & paints	
Minority owned & local businesses	x

x = OSU has efforts in place

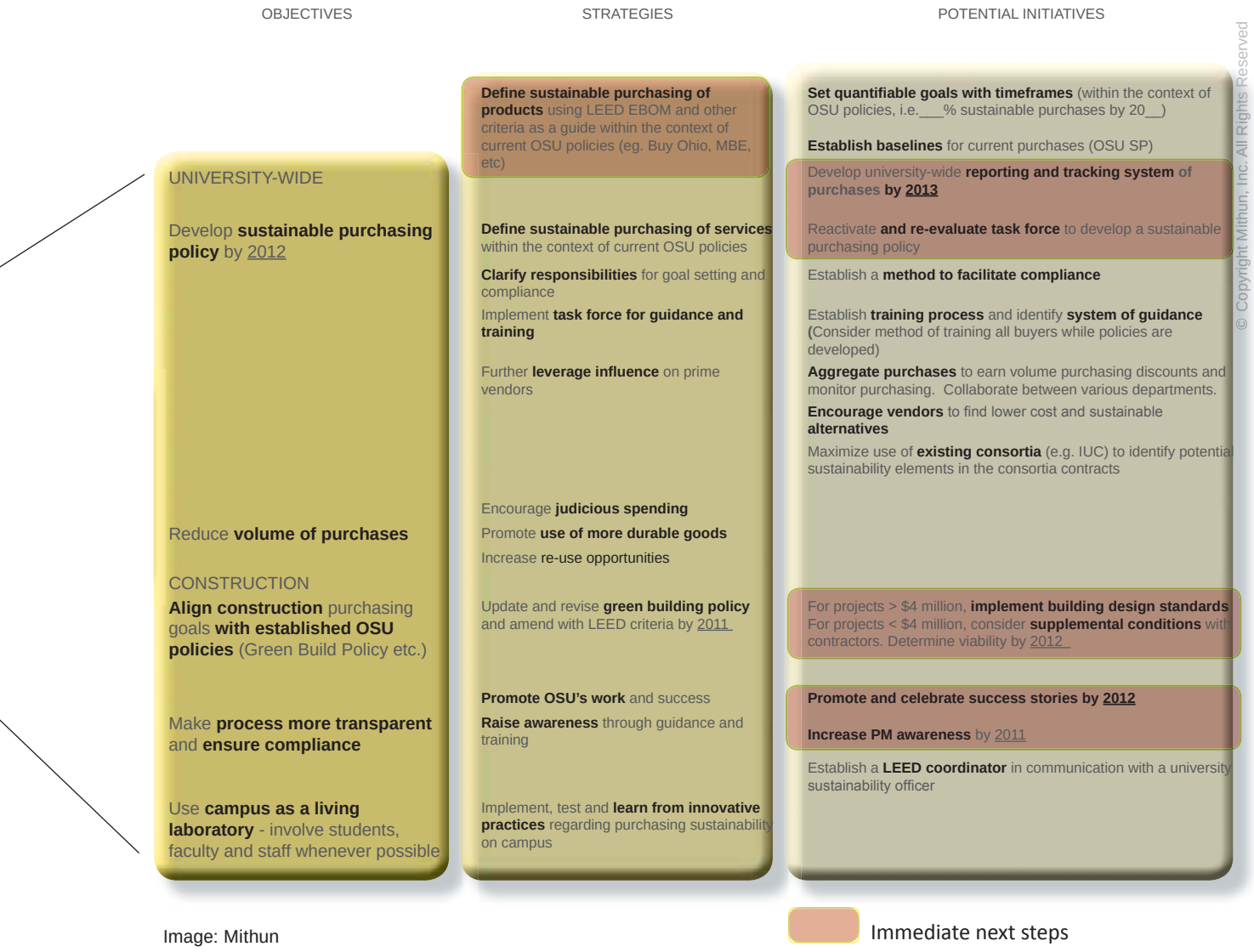


Image: Mithun

There is no waste in nature. The production of waste is a human construct.

9 OSU Waste

9.1 Introduction

"There is no waste in nature. Take ants as just one example of nature's brilliance. Ants safely handle their own waste and those of other species. They grow and harvest their own food while nurturing the ecosystems of which they are a part. They construct houses, farms, dumps, cemeteries, living quarters, and food-storage facilities from materials that can be truly recycled. They create disinfectants and medicines that are healthy, safe and biodegradable. And while they are busy doing all that they maintain soil health for the entire planet.
Nature doesn't have a design problem.
We do."
(Dave Hieatt, Howies.co.uk)

The production of waste is a human made problem. While recycling is on the rise nationally (33% of all waste in 2008*), waste disposal continues to make significant contributions to greenhouse gases through transport, landfill emissions and replacement purchases. Human and environmental health are also directly impacted by the growth of landfills with impacts such as water and soil contamination. Diversion of waste away from landfills is the ultimate goal.

*Source: EPA

9.2 Metrics and Best Practices

The Environmental Protection Agency's (EPA) waste reduction diagram below encourages the prevention of waste first by using less material, then minimization of waste, reuse, recycling, energy recovery and as a last resort, disposal in the landfill.

Zero waste is the concept of recycling all materials back into nature or the marketplace in a way that protects human health and the environment. This should be the ultimate goal.

Composting food and plant material is another way to reduce waste (helping to amend our soils at the same time). Hazardous materials require proper disposal for preservation of our drinking water, our health and other natural resources.

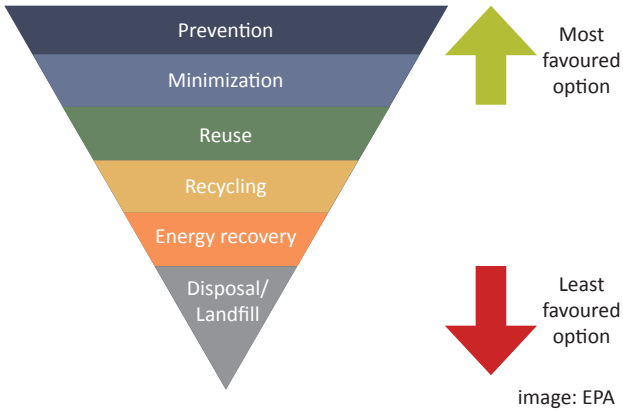


image: EPA

Metrics

The most basic metric for gauging success in waste reduction is the percentage of total waste diverted from landfills, typically measured in percentage by weight.

RecycleMania, a nation-wide campus recycling competition, uses seven different metrics to rank schools. Waste diversion data, submitted in weight (either pounds or kilograms), is collected over an eight-week period that typically begins in January. The word "cumulative" refers to the sum of recyclables collected at the end of the eight-week period. As a metric, this has been seen as controversial due to its limited time period (8 weeks). Another common metric is recycle rate. This is a percentage of overall waste.

Best Practices

Best practices in waste reduction include conducting a comprehensive waste audit, reducing material flows, reuse, recycling and composting.

Reducing material flows is often achieved through purchasing more durable goods with a longer life cycle.

One method of increasing material reuse is a dorm move-out program. These programs typically involve an orchestrated means of collecting and donating items students no longer need at the end of the academic year.

Recycling and composting are fairly common

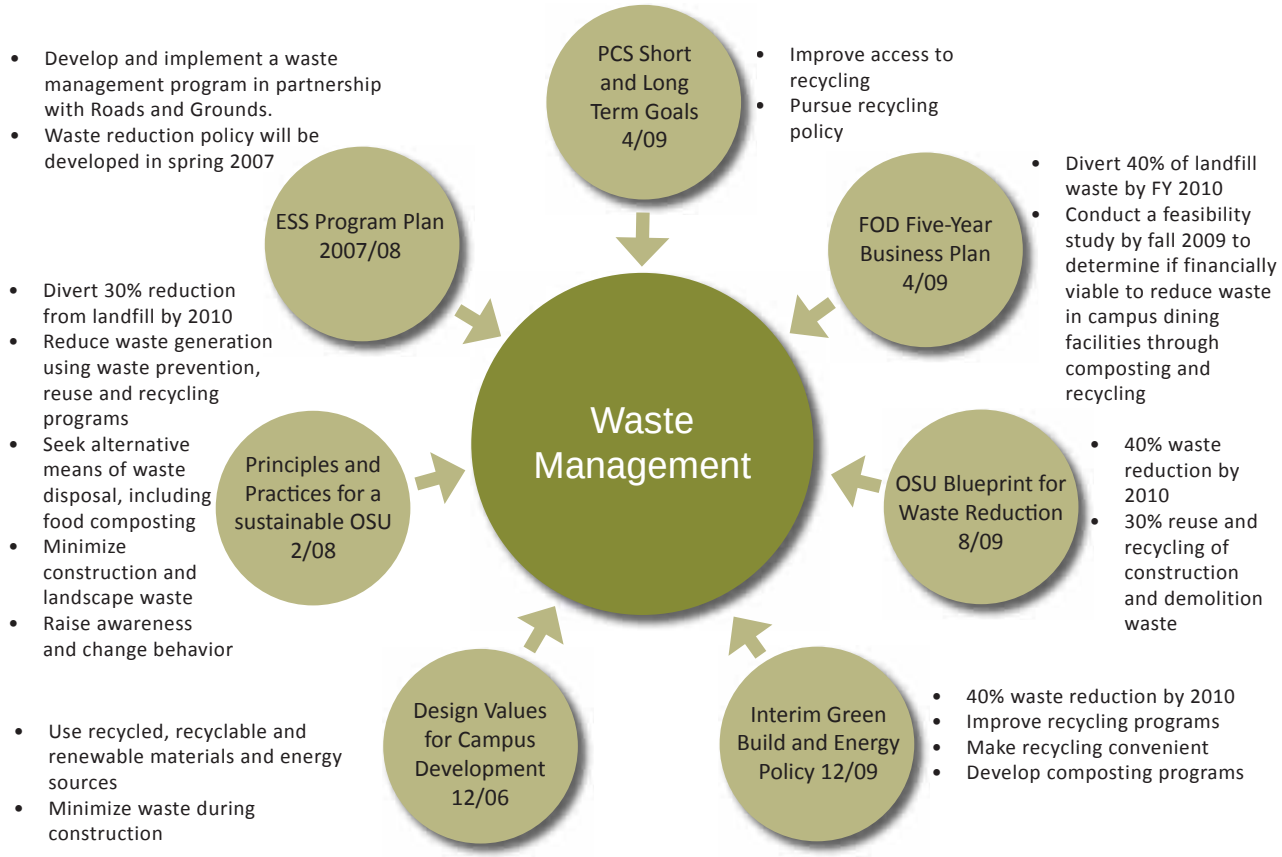
across campus sustainability programs. One way to increase recycling and composting rates is to make those collection bins more convenient than trash bins.

Establishing a zero-waste goal and implementation plan (i.e. a target date for zero-waste as well as annual reduction goals along the way), as all of these campuses have done, is cutting-edge practice in campus waste management. Setting ambitious targets provokes innovation.

9.3 Ohio State Existing Efforts and Conditions

Ohio State policies

OSU's policies show a significant focus on Waste. Starting with the *Design Values for Campus Development* in December of 2006, the policy addresses recycled, recyclable and renewable materials and energy sources, as well as the minimization of waste during construction. The *Principles and Practices for a Sustainable OSU,* from February 2008 include a goal of diverting 30% of OSU's waste from the landfill by 2010 and reducing waste generation using waste prevention, reuse and recycling programs. The



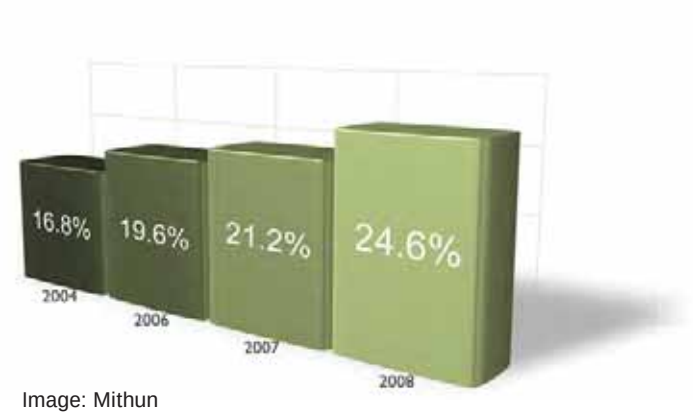
policy also mentions aspirations such as seeking alternative means of waste disposal, including food composting, minimizing construction and landscape waste as well as raising awareness and changing behaviors.

The *ESS Program Plan* developed in 2007/08 calls for the development and implementation of a management program in partnership with Roads and Grounds as well as the development of a waste reduction policy to be developed by the spring of 2007. The *PCS Short and Long Term Goals,* from April 2009 address the topic by dedicating one of the short term goals to improving access to recycling and to education on best recycling practices as well as to pursuing a policy making recycling mandatory at campus events. The *FOD Five-Year Business Plan* from April 2009 sets the goal of 40% diversion from landfill waste by FY of 2010. The *OSU Blueprint for Waste Reduction* dated August 2009 calls for a 40% waste reduction by 2010 and for 30% reuse and recycling of construction and demolition waste. Finally, the *Interim Green Build and Energy Policy* of December 2009 also mentions the 40% waste reduction by 2010, improving recycling programs, making recycling convenient and developing composting programs.

Image: Mithun

University-Wide

Ohio State's recycling program is well-established. As described above, the percentage of waste diverted from landfills annually is 26% All buildings are equipped with desk-side recycling and new all-in-one containers are distributed throughout campus. The goal of 40% waste diversion for faculty/staff waste (now at 25%) is consistent with the peers's goals. The University has seen a 24% increase since the simplified co-mingling system and is continually increasing the quantity of diverted materials, see diagram below. Printing has been limited and construction waste is required to be at least 30% reused or recycled. Ohio State recycles and redistributes chemical recycling, E-waste and has an extensive university surplus system.



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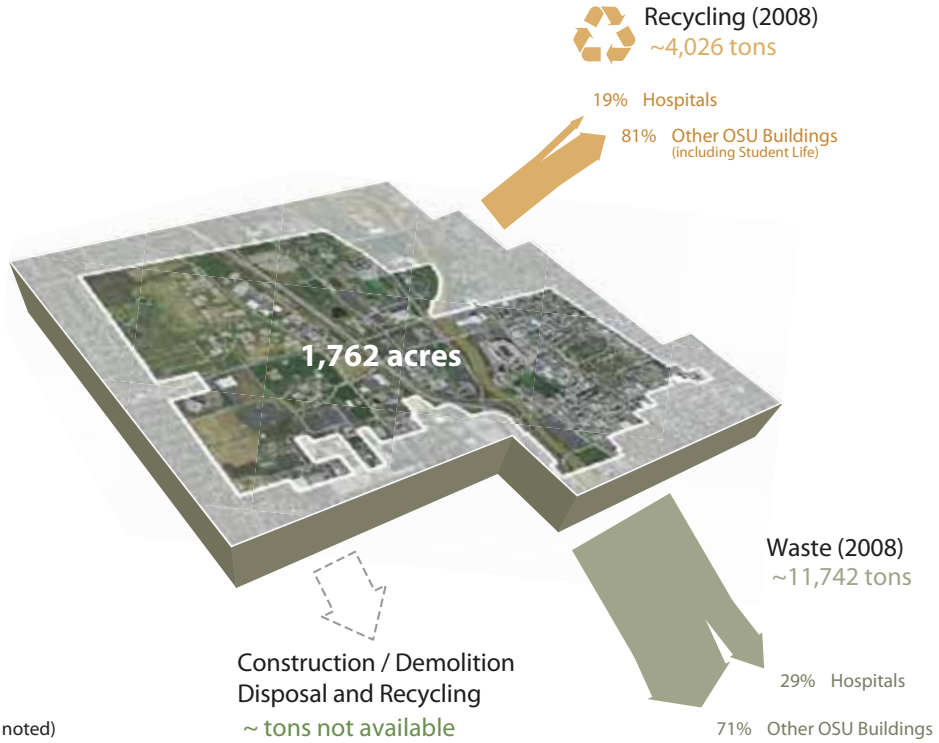

Data: Calendar Year 2009 (except as noted)

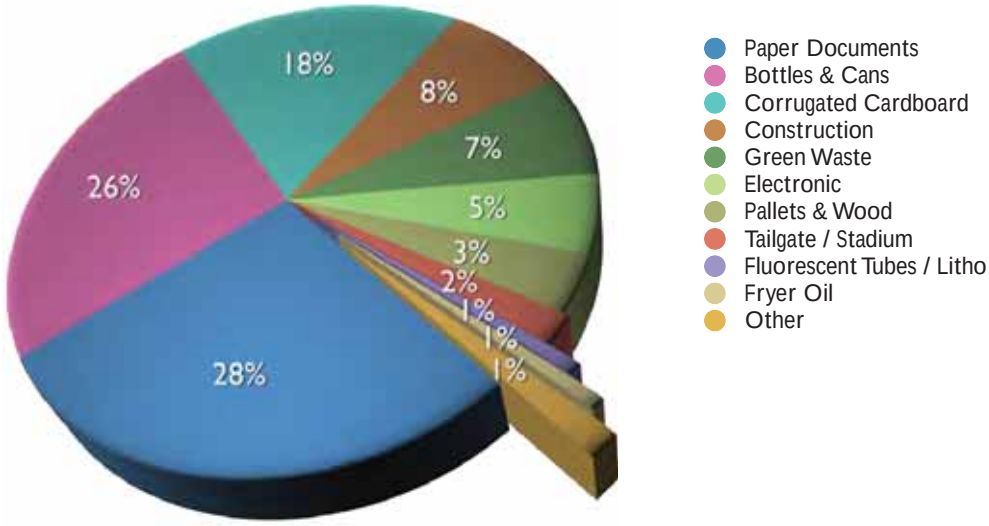

Image: Mithun, Data OSU

Data indicates fluctuating trends for individual entities, which means that annualized and more consistent tracking would improve baseline measurements, strengthen benchmark comparisons and improve existing audits. On a building-by-building basis replacing scales will lead to better information.

Barriers to increasing the recycling rate include awareness, infrastructure that limits tracking progress and a tracking system for construction waste that needs to be refined.

The College of Food, Agricultural and Environmental Sciences (CFAES)

The College of Food, Agricultural and Environmental Sciences currently does research on composting, dairy and poultry waste composting and yard waste, which could potentially work with the university grounds staff. Waste-to-energy efforts include liquids to fields, solids and methane to generate energy as well as experimenting with solid oxide fuel cells.

Student Life

The bulk of recycling occurs in the residence halls. Student Life together with Energy Services and Sustainability (ESS) has established recycling in all residence halls (and 5,000 rooms). Students are on board and oversee sustainability initiatives through the Sustainability Chair program. As much as 13% was recycled in 2008 with the all-in-one container. This is a 43% increase from the previous year (sorting of waste is provided by the waste and recycling contractor).

The “Dump + Run” program collects students’ furniture and any other donated belongings at the end of the school year. Items are then sorted over the summer. A garage sale is held during Welcome Week to sell or re-use the items. Any remaining items are donated. The latest collection yielded 15 tons.

Medical Center

The OSU Medical Center recycles bottles, cans, cardboard, paper. Construction waste is recycled for large projects.

The Medical Center encourages using materials on-line and limiting printing. There currently is no program in place to segregate electronic waste, but there is a plan to recycle needle boxes, which make up 70% of the biohazard material.

Athletics - Football games

Athletics now recycles 81 tons (68%) of waste from the stadium during football games and at tons (36%) from the tailgate lots. Athletics' goal is to achieve 100% recycling.

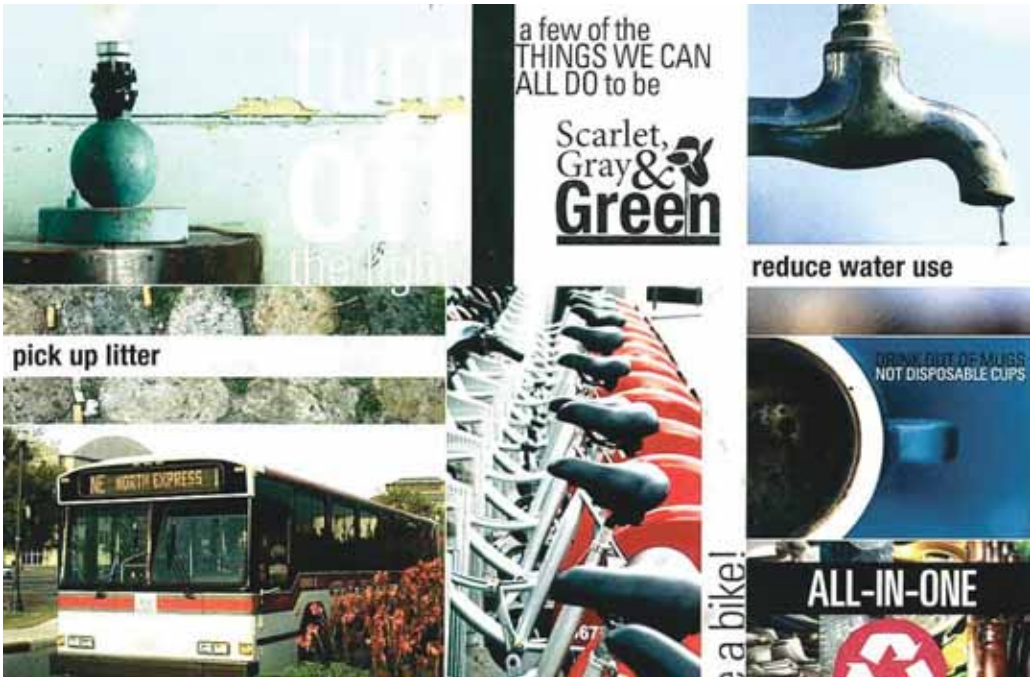

Image: OSU

9.4 OSU Waste Goals and Strategies

The waste goal is to *"reduce, reuse, minimize and eventually eliminate waste."* A major objective is to continue to increase awareness. Increasing recycling rates by specific dates and setting a target for zero waste are other objectives. For construction and demolition waste, an objective is to increase diversion to 80% by 2012.

Potential immediate next steps include building upon the "Scarlet, Gray and Green" campaign to improve awareness, recruit a sustainability ambassador for each campus building, and provide adequate collection infrastructure. Refining the mechanism for tracking demolition and construction waste and developing a reporting system to ESS by 2011 are other immediate next steps for construction waste.

Image: Mithun

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Ecosystem Types: Prairie / Grasslands

Short, mixed, and tallgrass prairies

Prior to European settlement in the early 1800's Ohio contained about 1000 square miles of prairies which comprised about 2.5% of the vegetation of the state. These prairies were mostly scattered around the western half of the state and varied in size from a few to several thousand acres.

The map below shows the location of prairies prior to settlement based on original survey notes. The vast majority of these prairies were converted to agriculture. However, a few remnant prairies still can be seen.

Some of the best prairies are located in frontier cemeteries, or along railroad right-of-ways. Four major concentrations of prairies occurred in Ohio prior to European settlement. One of the largest concentrations of prairies occurred in the Darby Plains west of Columbus.

Today, less than 1 percent of Ohio's original prairie remains. In fact, there are currently fewer acres of native prairie than native wetland; it is the most endangered natural landscape in Ohio.

Ecosystem Types: Shrub-scrub

Sagebrush and chaparral,
dominated by shrubs and short trees.

Ohio's original vegetation survey does not show shrubland habitat as a category present at settlement. This is because Shrublands are an edge habitat, often straddling two different zones such as grasslands and forest. They are often a natural evolution of grasslands to woodlands. Shrublands or Scrub-Scrub is an important component of a healthy ecosystem matrix. Its presence is a very important component of a healthy ecosystem that provides critical habitat for birds and overall biodiversity. The Shrubland habitat is a successional habitat. Such habitats commonly result when mature woodlands are disturbed by wind, fire, flooding or commercial activities such as timber harvesting and farming.

Scrub-shrub habitats are characterized by low, multistemmed woody vegetation in young or stunted stages of growth. The species composition is variable, depending on the location and length of time since disturbance, abandonment, or management. Scrub-shrub communities can be dense and impenetrable

Ecosystem Types: Forests

Closed-canopy forest (pine and oak savannas)

or can consist of a mosaic of low woody cover interspersed in herbaceous cover. Trees may be present but are widely spaced.

Consequently, species of birds reliant on scrub-shrub habitat for nesting, cover, and other resources are rapidly declining. Scrub-shrub species include a wide assortment of species from song birds to hawks and owls to waterfowl and other game birds.

In northeastern Ohio the white pine, hemlock, yellow birch, beech, and sugar maple grow native. These trees are typical of northern forest areas. In southeastern Ohio the shortleaf, pitch, and scrub pines are more typical of the southern forest regions. Hardwoods of the southern forest region include the blackjack oak, Spanish oak, sourwood, and bigleaf magnolia that have advanced into the state from the lower Allegheny and Appalachian areas. In southeastern Ohio many trees are limited in their distribution and are entirely confined to southern Ohio. Forest preservation and implementation may be a sustainable strategy some of OSU's centers and regional campuses could target.

Ecosystem Types: Wetlands

Freshwater, brackish, saltwater marshes, rivers, ponds, lakes, open ocean, and beaches.

Wetlands are shallow to intermittently flooded ecosystems that are more commonly known by such terms as swamps, bogs, marshes, and sedge meadows. They are revered as important parts of the natural landscape because of their functions in cleaning and retaining water naturally, preventing floods, and providing a habitat and food source for a wide variety of plant and animal species. It is estimated that more than half of the original wetlands in the world have been lost to drainage projects and human development projects.

When we lose wetlands, we lose their ability to provide clean water, prevent floods, sequester carbon and enhance biological diversity. Many organizations are calling for the creation and restoration of wetlands and stream and river restoration to clean up and repair our streams, rivers, and lakes.

Ohio's original wetlands were very large. Examples include:

- The Great Black Swamp, which was once 120 miles in length and an average of 40 miles in width.

- The Scioto and Hog Creek marshes of Hardin County, which once covered 25,000 acres or 39 square miles.

The map shows large and widely distributed areas comprised of elm-ash swamp forests, prairie, freshwater marshes and fens, sphagnum peat bogs and bottomland hardwood forest wetlands in Ohio.

Today, existing large wetlands are very small in comparison to the original wetlands. With the notable exceptions of a few large tracts of marsh and swamp in Ottawa, Sandusky, Lucas, Ashtabula, Geauga and Trumbell Counties, most of Ohio's remaining wetlands are scattered wooded tracts. These wooded tracts, along with restorable wetlands, are privately owned, while the largest blocks of remaining wetlands are publicly owned.

OSU has an extensive carbon sequestration research program and a long-term, large-scale wetland research facility. The Wilma H. Schiermeier Olentangy River Wetland Research Park is located on a 21 hectare (52 acres) site owned by OSU, just north of the Columbus campus.

Wetland habitats

- Elm-ash swamp forests
- Sphagnum peat bogs
- Marshes and fens
- Bottomland hardwood forests

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Sustainability Planning at OSU: Beyond the Physical Campus

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on behalf of the Sustainability Advisory Group
to the President's Council on Sustainability

Revised, March 22, 2010

Executive Summary

Like other universities, The Ohio State University (OSU) has committed to integrating sustainability considerations, including energy conservation and environmental stewardship, into the design and management of its physical campus operations. However, OSU's historic land-grant mission calls for more than operational improvements. To exercise genuine leadership in this arena, we should weave sustainability awareness into the fabric of One University by integrating it into OSU's core activities—education, research, and outreach. Our overarching objective should be to increase dramatically the capacity of the communities we serve—local, regional, and global—to understand and address the challenges and opportunities of sustainability. Reducing energy consumption is a valid goal, but OSU's greatest impact on sustainability will be to inspire a new generation of global citizens.

OSU has many distinguished researchers whose contributions to sustainability science and technology are recognized worldwide. However, to achieve eminence in sustainability at an institutional level will require integration across these islands of excellence and broader engagement of the entire university community. Accordingly, we recommend that President Gee immediately appoint a task force charged with developing a plan for coordination of OSU efforts in sustainability education, research, outreach, and university operations. We further recommend that President Gee appoint a Chief Sustainability Officer, equipped with the resources to implement this plan, and charged with engaging all relevant stakeholder groups, including students, faculty, staff, alumni, and the surrounding community. The plan should enable the OSU campus to serve as a living laboratory for sustainability research and to demonstrate the university's global involvement with sustainability issues. Bold action within the next 3 to 5 years can establish Ohio State's distinctive approach to sustainability and reinforce the university's transition from excellence to eminence.

The following is a summary of the specific recommendations presented in this document.

Education: Create a sustainability education committee to develop a systemic overview of relevant OSU programs and explore options to promote cross-disciplinary sustainability learning in both undergraduate and graduate curricula and degree programs. In particular, introduce sustainability modules into the GEC curriculum as part of the semester transition, and reinforce instructional efforts through student life activities and service-learning initiatives.

Research: Encourage faculty involvement in campus sustainability projects, thus enhancing the progress of OSU's physical operations while creating distinctive research testbeds and opportunities for student involvement. At a broader level, establish a prominent identity for OSU as a sustainability research leader and attract major funding by stimulating innovative research collaborations and communicating OSU's accomplishments.

Outreach: Develop or expand sustainability partnerships with business and government organizations, and participate actively in regional capacity building and communication. Engage undergraduate students through early awareness-building, foster a sustainability culture in residence halls, and establish ongoing sustainability communication mechanisms. Make the funding of sustainability initiatives a university development goal, focusing on "signature" sustainability projects that demonstrate innovative practices.

Sustainability Planning at OSU: Beyond the Physical Campus

Drafted by Joseph Fiksel, Rick Livingston, Jay Martin, and Steve Rissing
on behalf of the Sustainability Advisory Group to the President's Council on Sustainability

Sustainability is not a problem, not something to be solved, but rather a vision of the future that provides us with a road map.[1]

Introduction

Ohio State's "One University" Framework Plan includes sustainability as a key component. Like many U.S. universities, OSU has pledged to work toward climate neutrality and to build awareness of sustainability considerations into the university's plans for campus growth. In particular, OSU will introduce measurable goals, design standards, and action plans to assure sustainable management of energy, materials, buildings, transportation, and infrastructure, consistent with current best practices. However, even our best efforts in managing the physical campus operations will yield only incremental contributions to global sustainability. This paper argues that true leadership in sustainability requires more than operational improvements. We recommend that OSU take on the challenge of sustainability in the spirit of the university's historic educational mission, fully integrating environmental and social responsibility into the intellectual and social life of the campus. Beyond the physical operations, sustainability should be a vital thread interwoven into the fabric of One University, binding the institution to the multiple communities—local, regional, and global—that it serves.

The global challenges of sustainability include climate change, biodiversity loss, degradation and depletion of water supplies, population growth, lack of sanitation, and widespread poverty. These inter-related threats place intensifying pressure on natural and social resources; moreover the complexity of these systems means that every solution has hidden consequences. It has become apparent that "business as usual" will not lead to global sustainability.[2] Even as Congress debates the merits of carbon regulations, leading scientists believe that we have already exceeded the "safe operating space" for humanity in three critical indicators—greenhouse gas emissions, nitrogen flows, and biodiversity losses. And the rate of change is accelerating—new products and materials are emerging faster than scientists can study their impacts. Incremental efforts by corporations and governments to reduce emissions and waste are inadequate, unable to offset the costs of economic growth in the developing world, let alone deliver a sustainable future.[3] Radical breakthroughs are necessary: not only accelerated technological innovation, but also expanded research in the field of sustainability science, improved data management and analysis tools, broad-scale educational initiatives, intensive public outreach and communication, and strong collaboration among governmental agencies at all levels, businesses, and civil society.

Ohio State University is in an excellent position to help catalyze such breakthroughs. Cutting-edge research programs, a global reputation, extensive contacts throughout the world, a diversified undergraduate and graduate student population, ready access to instructional resources, a campus with economic and ecological footprints palpable at local and regional scales, and commensurate cultural and intellectual influence: by all measures, OSU has the capacity to exercise significant leadership. *A strong and deliberate effort is needed to translate this potential into visible and effective action. Reducing energy consumption is a valid goal, but OSU's greatest impact on sustainability will be to inspire a new generation of global citizens.* Sustainability planning at OSU should aim not just to reduce the university's operational footprint, but also to increase human capacity for understanding and responding to the above challenges, so that we can act as stewards of our collective destiny.

Figure 1 offers a systems view of the possible pathways for OSU to exert a positive influence upon sustainability progress, both on its campus and beyond. The aforementioned efforts at energy and operations management will create immediate benefits for the regional environment. In addition, linking these efforts to sustainability education and research will result in many important synergies. For example, students that enroll in sustainability courses and participate in sustainability projects will develop new skills that enable them to make vital contributions in their chosen professions. OSU's breakthrough innovations in the design of sustainable technologies and policy assessment tools will influence leading-edge business and government practices throughout the nation and the world. Moreover, OSU's collaboration with external organizations in sustainability research and innovation will create broader benefits for the State of Ohio as well as the fast-growing economies where OSU is establishing an international presence. The resulting influences on global sustainability progress will far outweigh the incremental gains that can be achieved through improvements in campus operations. These opportunities are discussed below under the headings of Education, Research, and Outreach.

To capitalize on these opportunities, we recommend that President Gee immediately appoint a **task force** to develop a **strategic plan** for sustainability. We further recommend that a **Chief Sustainability Officer** be appointed, accountable to the President, and charged with implementing this strategic plan and coordinating sustainability activities across research, teaching, and university operations. Detailed recommendations are presented in the following sections.

Figure 1. Systems View of "One Ohio State" Sustainability Framework.
Increased sustainability of OSU facility operations not only will benefit the regional environment, but also will strengthen OSU's missions of education, research and outreach, exerting a broad influence on regional, national and international sustainability practices in business, government and academia.

Education

OSU can achieve enormous returns on its campus sustainability efforts by integrating them with its teaching mission. Students enter OSU with a basic sense of "personal virtue" about sustainability. For example they may remember[4] to recycle aluminum cans once they are told. Higher education builds on these and related concrete[5] views to develop the analytical and formal reasoning skills expected of college graduates, required of responsible citizens, and essential for sustainability initiatives. The sense of personal responsibility will expand to a broader scope of organizational and social responsibility, accompanied by the skills and resources to take meaningful action.

Sustainability issues present OSU with one of its most compelling and interdisciplinary teachable opportunities. For example, OSU course lectures and laboratory demonstration projects can be linked to ongoing sustainability initiatives, such as carbon footprint reduction. Indeed, sustainability education should reach every student if the university is to contribute to an informed and effective citizenry. As such, sustainability can provide a unifying theme for the university's general education curriculum, and OSU's planned semester conversion presents a rare opportunity to realize such a concept. Introducing a sustainability curriculum for all OSU students could demonstrate how broad, interdisciplinary education can be fostered through the One University framework, as opposed to the traditional "silo" model.

Benchmarking efforts with other universities have revealed many creative avenues for integrating sustainability education into the student experience. A diverse set of initiatives, driven by interested faculty and passionate students, have already emerged at OSU. The following is only a partial list.

- Concentrations in existing majors (e.g., "Environment and Society" in the Department of Geography; course offered by the Environmental History group)
- Establishment of minors (e.g., existing minors include "Environmental Citizenship", "Environmental Engineering" and "Environmental Economics")
- The Institute for Energy and Environment is exploring potential degree programs that may include new majors (e.g., Energy and Environmental Studies).
- The College of Engineering's Center for Energy, Sustainability and Environment has proposed several graduate specialization options (e.g., Sustainable Systems Engineering).
- The Department of Agricultural, Environmental, and Development Economics offers a Ph.D. program in environmental economics and supports an Environmental Policy Initiative.
- The Center for Automotive Research sponsors seminars and student projects addressing sustainable mobility themes, and has close ties with the automotive industry.
- The Fisher College of Business has established sustainability electives and a certificate option for both undergraduates and MBA students.
- The Environmental Graduate Studies Program, led by Richard Moore, offers Ph.D. students from many departments an opportunity to customize an interdisciplinary degree in sustainability.
- The Health Science Colleges have a robust array of curriculum initiatives rooted in impacting behavior (e.g., Center for Personalized Health, Institute for Behavioral Medicine Research).

Recommendations

Without necessarily prescribing a core curriculum, the university should initiate a concerted effort to weave a thread of environmental and social awareness throughout OSU campus life, making visible the systemic connections between the many dimensions of sustainability. We recommend that the task force create a **sustainability education committee**, in coordination with the Office of Academic Affairs, to (a) develop clear sustainability learning objectives and measurable assessments, and (b) work with OSU administrators to explore the full spectrum of educational initiatives, as follows.

- Commission a comprehensive **inventory** of sustainability-related educational programs, graduate and undergraduate, that are offered or planned by OSU colleges and departments.
- Develop a systemic overview of the goals, content, and potential linkages among these programs, and identify potential synergies with ongoing research and outreach activities, as discussed in the following sections.
- Based on the above efforts, develop learning objectives (examples are shown in Figure 2), and perform a baseline survey of sustainability literacy and educational needs for incoming students (see also Welcome Week recommendation under **Outreach** below).
- Expand the sustainability-related content in the **GEC curriculum** by convening a working group of faculty members offering or developing GEC courses and representatives of professional colleges (e.g., business, public health, engineering, food, agriculture & environmental sciences, education and human ecology). This group should be coordinated by UCAT and provided with sufficient administrative resources. Their charge would be to:
    - Develop GEC-level sustainability learning objectives and assessments, and pilot test these in one or more GEC classes no later than Spring quarter 2011.
    - Improve student recognition of the interdisciplinary nature of sustainability issues through various mechanisms such as:
        - Learning modules (e.g. benefit/cost analysis of campus energy investments)
        - Engagement in campus facilities management (e.g., "adopt a building" and analyze its resource consumption patterns such as energy use)
        - Linked enrollment options for Global Awareness and science GEC classes.
    - Determine trade-offs between new GEC requirement/course (March 2009 proposal) vs. update/modify of current GEC statement/courses.
    - Introduce a sustainability pedagogy workshop series sponsored by UCAT
- As a service to graduate students, develop a coordinating framework for the multiplicity of **graduate education** options in different colleges that include different types of "sustainability" content. Use this as a basis for proposing an integrative scheme for graduate education, such as an interdisciplinary graduate specialization, and evaluate its potential for an NSF IGERT proposal.
- Investigate **co-curricular** options for strengthening educational programs. Examples include:
    - Course projects highlighting efforts to improve sustainability of physical operations.
    - Inclusion of an environment/sustainability theme as part of the First Year experience.
    - Proposed campus sustainability themes for senior capstone projects, individual or team.
- Investigate **student life** options to reinforce sustainability awareness. Examples include:
    - Improved coordination of student organizations (e.g., Net Impact, Save the Planet).
    - Creation of an "eco-village" in the form of a sustainable micro-society on campus.
    - Planned events such as Earth Day activities and Sustainability Week.

  Additional opportunities are discussed further in the **Outreach** section below.
- Investigate expansion of **service-learning** options, including opportunities for students to become involved in campus or community sustainability programs run by OSU or other partner organizations (e.g., Mid-Ohio Regional Planning Commission, Ohio EPA, City of Columbus.)
    - Make building energy metering data available to students for analysis projects.
    - Assign student teams to work on sustainability projects with OSU partner organizations.
    - Establish international exchange programs to foster global sustainability awareness.

1. Be capable of performing a benefit cost analysis to determine if they should purchase an incandescent or a compact fluorescent light replacement bulb.
2. Understand how carbon exhausted from a car engine came to occur in fuel and how this process resembles/differs carbon exhaled from living organisms.
3. Understand evolutionary time and processes (natural selection, genetic drift).
4. Understand the unique status of the human trait of intelligence and insight with respect to population growth and impact and long-term sustainability.
5. Understand why energy flows whereas materials cycle, why limitations in the availability of both exist, and human impacts on these processes.
6. Understand that DNA determines protein structure, which determines all heritable traits of all living things (physical and behavioral).
7. Understand we can alter genetic composition of living organisms including ourselves intentionally (genetically modified foods) or unintentionally (environmental endocrine disruptors) and the implications of this potential.
8. Understand the natural process of population growth in different species including humans and the concept of demographic transition as seen in human populations today.
9. Understand strengths and limitations of science as a way of knowing the human world and the development of science during the rise of civilization.
10. Develop, state and re-evaluate opinions on the above points based on multiple sources and modalities of information and personal experience. Be excited and able to continue this process throughout their lives.

Figure 2. Examples of Undergraduate Sustainability Learning Objectives[6]

Research

As one of the leading research universities in the U.S., OSU has made important contributions to knowledge about sustainability science, technology, and human behavior. To achieve eminence, OSU should strive to integrate the recognized work of its faculty researchers and to apply this expertise to problems at a local, regional, national, and international scale. Faculty expertise should also be channeled into enhancement of campus operations, since a "sustainable" campus should actively and visibly investigate the conditions of its own sustainability.

There are two major categories of research to be considered—research directly related to sustainability planning for OSU campuses, and research related to broader sustainability issues of concern to OSU stakeholders at regional, national, and international scales.

OSU Campus Sustainability Research. The sustainability planning effort commissioned by OSU has already begun to collect data about a broad range of campus activities and impacts. Implementation of the plan will generate additional data about physical and behavioral changes associated with sustainability initiatives. In particular, incorporation of sustainable design principles into campus construction standards and practices should result in measurable energy savings. Researchers in many colleges at OSU will be keenly interested in participating in these efforts, and could use the resulting data streams to develop and refine important hypotheses about systemic sustainability. A variety of grass-roots initiatives have already appeared that connect OSU research programs to ongoing campus enhancements, including the following:

- Research on improved management of food waste, including life cycle assessment, sponsored by the Energy Services and Sustainability Group.

- Efforts to develop sustainable infrastructure including completion of three rain gardens and the planned construction of another, as well as planned construction of a green roof.
- Studies of the energy use and efficiency of buildings on campus by student groups that have resulted in grants and physical improvements to reduce energy use.
- Environmental restoration and renewable energy production initiatives at Waterman Farm.
- Investigation of alternative energy technologies, such as geothermal and photovoltaic.
- Plans to develop the Olentangy River as a learning laboratory with embedded research opportunities for multiple colleges.

Recommendations

In both planning and implementation, every effort should be made to coordinate campus sustainability initiatives with ongoing and emergent research programs at OSU, and to multiply opportunities for developing new knowledge, refining methodologies and experimenting with technological innovations. Examples of research opportunities include:

- Broadening of the collaboration between the Energy Services and Sustainability Group and faculty research initiatives, with dedicated funding for campus research internships.
- Faculty involvement in applying integrative sustainability metrics (e.g., life cycle footprint, emergy, exergy) to track the overall progress of OSU's sustainability initiatives over time, as opposed to merely tracking individual metrics (e.g., water, energy, waste).
- Integration of faculty knowledge and expertise into campus sustainability improvement initiatives (e.g., water reuse, treatment, and capture; green building technology; alternative energy systems; industrial ecology and by-product synergy; bioproducts innovation).
- Incorporation of campus testbeds into applications for research grants (e.g., NSF environmental sustainability programs, STEM education initiatives, engineering research centers).
- Collaboration across universities (e.g., Big 10) to track, compare, and disseminate sustainability initiatives and results under different campus conditions.
- Introduction of a sustainability category in the Denman Undergraduate Research Forum and the Edward F. Hayes Graduate Research Forum.
- Collaboration with student organizations to communicate sustainability research activities and encourage involvement of students in campus-related sustainability projects.
- Educational research on effective strategies for teaching sustainability to build appreciation of multi-disciplinary aspects; dissemination of results in mainstream publications.

Broader sustainability research. OSU faculty members in many colleges are already deeply involved in research related to different facets of sustainability, from technological innovation to social responsibility. The university has established the Institute for Energy and Environment (IEE) as a mechanism for coordinating across some of these research efforts. However, broadly speaking, OSU research activities related to sustainability remain fragmented in a diverse collection of departments and centers, mirroring the fragmentation of educational approaches to sustainability, and OSU's beneficial applications of sustainability research are not widely known. Further effort is needed to improve coordination of research across public health, humanities, business, and many other disciplines. The following is a partial list of OSU's areas of research excellence relevant to sustainability:

- College of Biological, Mathematical, and Physical Sciences—assessment of climate change and associated changes in the aquasphere, geosphere and biosphere.

For strategic purposes, we can distinguish between three types of outreach—partnerships, capacity-building, and social learning—based on their degree of formality. Instances of all three already exist at the university, but it is their systematic relationship that we emphasize here.

- **Partnerships** involve institutional collaboration with entities already engaged in deliberate planning for sustainability. These include government agencies at various levels (city, county, State, Federal), quasi-governmental authorities such as SWACO, COTA, Soil and Water Conservation Districts, or MORPC, and large-scale private-sector organizations and corporations (Nationwide, Coca Cola, American Electric Power, the Columbus Partnership). These partnerships can involve educational programs, sponsored research and consulting, or collaboration on regional development initiatives.

  An example of such collaboration is the Ohio By-Product Synergy network (www.OhioBPS.org) organized by OSU's Center for Resilience, in collaboration with the U.S. Business Council for Sustainable Development, MORPC, and the Ohio Department of Natural Resources. The network helps businesses to convert waste materials into valuable by-products, thereby protecting the environment while stimulating the local economy. OSU has incubated similar networks in other areas (e.g. the Ohio Watershed Network housed in Extension).

  Formal partnerships can also create learning opportunities for students as a bridge between academics and civic or business engagement. Existing OSU programs such as the Environment and Natural Resources Scholars, the Mount Leadership Society, the Net Impact Society, and the Engineers for a Sustainable World can be strengthened as part of OSU's sustainability planning, by placing a strategic focus on leadership through outreach. Student enthusiasm about sustainability runs high, and every effort should be made to nurture such interests. Visible channels for students to contribute to OSU's sustainability efforts can provide valuable lessons in civic participation.

- **Capacity-building** involves engagement with grass-roots efforts that are addressing emergent areas of concern, such as recycling, local food systems, and alternative transportation. At a community level, it means enhancing opportunities for civic understanding, deliberation and decision-making; for the university, it means developing civic skills in citizenship and leadership. Integrating isolated service-learning classes around a commitment to capacity-building for sustainability would deepen the dialogue between the campus and surrounding community, allowing for better-defined goals and more systematic reflection and evaluation among all participants. Conversion to semesters will likely enhance opportunities for in-depth service-learning due to the longer time frame available.

  Professor Maria Conroy has demonstrated exemplary work in capacity-building through her "Planning for Sustainable Development" class[7], in which students have collaborated with neighborhood groups to draft sustainability plans illuminating possible future goals for a range of urban communities. OSU Extension conducts many environmental programs, including Sustainable Agriculture, Woodland Stewardship and Watershed Management, which deserve to be more broadly appreciated. Other faculty members provide technical advice to government agencies (e.g., Andy Keeler to State of Ohio, Joseph Fiksel to City of Columbus), to environmental groups (e.g., Bill Mitsch via the Olentangy River Wetlands Research Park, Jay Martin via the Ecological Engineering Club) or to cultural organizations (e.g., Joe Heimlich to COSI).

  Additionally, the arts and humanities have a critical role to play in promoting a regional culture of sustainability. For example, the Wexner Center's "From Field to Screen" film focused on local food systems and sustainable agriculture, while a grant from OSU CARES supported a "Ways of Knowing Water" exhibit that highlighted the efforts of local watershed-protection groups.

- **Social learning** refers to the tacit or informal curriculum conveyed by campus life, the habits and expectations absorbed by belonging to the OSU community. While difficult to measure directly,

social learning is a function of how the university is seen to approach sustainability, and how prominently the issue figures in OSU's public profile. Is our commitment to sustainability visible or invisible? Is it taken for granted as a background condition or placed in the foreground as an ongoing challenge? To what extent does the institution promulgate environmental and social awareness throughout the community? How can faculty and staff become ambassadors for sustainability, exercising civic leadership? These questions should be addressed in the sustainability plan.

Recommendations

The university should develop a unified approach to sustainability outreach that is interwoven with the education and research activities suggested above. We recommend that the task force appoint an **outreach committee** to plan, initiate, and help coordinate the following activities.

- **Develop** and strengthen sustainability **partnerships** with governmental agencies, global corporations, and universities in Ohio and abroad. Include opportunities for research and service-learning while collaborating to develop and achieve sustainability goals.
- Improve regional **capacity building** through enhanced cooperation with public, private and non-profit sector organizations. Engage and empower OSU faculty, staff and students to participate in local and regional activities; develop, publicize and disseminate innovative tools and data for local and regional planning purposes; and work with local and regional school systems to develop pragmatic initiatives for sustainability education.
- Promote **social learning** by actively associating the OSU name with sustainability initiatives via participation in public events (e.g. Earth Day, Riverfest), visible presence at OSU-sponsored events, and multi-channel communications (website, signage, employee and student incentives).
- Engage undergraduate students through deliberate outreach efforts, including.
    - Freshman class survey for basic awareness of sustainability issues, with follow-up surveys to gauge changes in understanding and behavior over 4-5 years.
    - Welcome Week interventions (e.g., information packet; tour of campus sites; discussion with environmental groups; film screening) to engage core constituencies around different dimensions of sustainability (e.g., food, climate, design and engineering, biodiversity).
    - Periodic follow-up activities (e.g., regional tours, alternative spring break, service projects) to sustain student involvement.
    - Strengthen the program for "sustainability coordinators" in residence halls to include training, support and additional incentives (e.g., a freshman seminar or service-learning credit) to connect individual goals to larger campus initiatives.
- Empower advisors and directors to develop cultures of sustainability in residence halls by:
    - Providing regular updates on the university's strategic plans, goals, initiatives, and policies in various areas of sustainability (e.g., energy conservation, transportation, food, water usage).
    - Supporting efforts to promote "greening up" of residence halls, while maintaining an on-line archive of existing and proposed innovations (to minimize reinventing the wheel).
    - Utilize art and design to encourage ecological awareness and a deeper sense of place.
- Promote communication and transparency about sustainability both internally and externally:
    - Establish campus-wide communication networks and mechanisms for dialogue.
    - Publish a periodic sustainability report including measures of progress toward goals.
- Make the funding of sustainability initiatives a university development goal, focusing on “signature” sustainability projects that demonstrate innovative practices (e.g., the Eco-Village concept).

Conclusion: Sustainability and Social Responsibility

In recent years, the term "sustainability" has become something of a platitude, and its meaning has become ambiguous. Many organizations have used the term gratuitously as a marketing or branding tactic, without fundamentally changing the nature of their operations. The complexities of sustainability are so daunting that it is tempting to oversimplify, to focus on manageable targets and easily digestible "low hanging fruit" rather than on long-range planning and structural adjustments. Furthermore, the intergenerational time-frame of sustainability makes avoiding the challenge, postponing difficult and controversial decisions, a path of least resistance. Therefore, it is essential that universities provide the intellectual leadership to identify the true magnitude of sustainability challenges and to encourage relevant scholarly investigation and effective solutions.

Rather than protecting the status quo, sustainability involves a commitment to positive change and value creation. The potential for "sustainable growth" offers the promise of continued vitality for the Ohio economy as well as the public university system it supports. OSU can fulfill its commitments and help to realize this potential with educational initiatives, research programs, and outreach efforts associated with all aspects of sustainability. Graduate and professional concentrations and degree programs can integrate a well-designed and coordinated sustainability plan into the teaching and research missions of the university. This in turn will lead to a qualified and motivated workforce that is prepared to meet the sustainability challenges confronting business and government.

A commitment to authentic sustainability is arguably a necessary part of the social compact of OSU and implicit in its covenant with communities. Given the increasing likelihood of significant global climate change, the strains on natural resources such as water systems, the incalculable effects of diminishing biodiversity, not to mention the social and cultural pressures of an urbanized and interdependent world, sustainability is among today's most urgent issues for citizenship and advocacy—local, national and global. Therefore, it would be a disservice to students and stakeholders to treat sustainability as a tactical issue, or as the province of narrow disciplines and specialized expertise. Sustainability awareness, in its many forms and incarnations, should be woven into the academic and social life of the university, from physical operations to innovative research to public policy. In this way, sustainability leadership will become a distinguishing factor in OSU's regional and global presence.

The window of opportunity for OSU to exercise leadership in sustainability will close rapidly, as many universities are developing similar initiatives. Accordingly, we recommend the following actions.

- President Gee, with the help of the President's Council on Sustainability, should appoint a **task force** to develop a **strategic plan** for sustainability, expanding beyond the current focus on campus operations. (Target date: September 2010) This plan should build upon the recommendations provided in this document and propose a multi-phased approach for integrating sustainability into OSU's core missions—education, research, and outreach.
- President Gee should appoint a **Chief Sustainability Officer** (CSO), accountable to the President, charged with guidance and coordination of sustainability activities across research, teaching, outreach, and university operations. (Target date: January 2011) The CSO would be responsible for implementing the above strategic plan and engaging all relevant stakeholder groups, including students, faculty, staff, alumni, and the surrounding community. The CSO should be equipped with sufficient financial and intellectual resources to enable effective accomplishment of his/her mission as well as lateral coordination with various administrative offices. To expedite this process, the existing Energy Services and Sustainability Group could be transplanted from Facilities Operations and Development to report to the CSO, thus providing a starting nucleus of knowledgeable professional resources.

Endnotes

[1] Peggy Bartlett and Geoffrey Chase, *Sustainability on Campus* (2004)

[2] Fiksel, J., *Design for Environment: A Guide to Sustainable Product Development*, McGraw-Hill, New York, 2009.

[3] As Oberlin's David Orr writes, in a report by the WorldWatch Institute, "the addition of only four new medium-sized coal plants anywhere in the world would eliminate the gains even if all U.S. institutions of higher education were to eliminate their carbon dioxide emissions entirely." "What is Higher Education For?" in Erik Assadourian, ed. *State of the World 2010* (Norton 2010).

[4] As in Bloom's Taxonomy of Educational Objectives

[5] As used by Piaget

[6] Developed by Prof. Steve Rissing, The Ohio State University

[7] M. Conroy 2004, International Journal of Sustainability in Higher Education, v5 n2 p199-212 2004