Auburn University Climate Action Plan

Version 1.0

Auburn Climate Action Plan v 1.0
19 November 2010

Note: *Similar to other campuses, Auburn University has prepared this Climate Action Plan as a living document, and throughout the implementation and review of the campus commitment the document will be regularly revised. Changes from previous versions will be documented to transparently show the changes over time.*

Changes from previous draft version (15 May 2010):

- Executive Summary
  - overall neutrality goal
  - preliminary emissions reductions targets
  - strategies for each of the five main areas of focus

- Extensive revision and clarification of Energy-related plan and actions based on ongoing Facilities Energy Reduction Planning.

- Established an overall strategy statement for each category, revised goals to be measurable, and identified individual focal areas as initiatives.

- Re-numbered all action recommendations to be individually identified for discussion (e.g. E.1.2)

Executive Summary of Interim Targets, Neutrality Goal, and Strategies

Interim Reductions Targets

The plan outlined below includes many 1-3 year actions. The relative contribution of these actions to reducing electricity use, heating energy, travel, and commuting (the four largest emissions sources for Auburn) is undetermined at this point. Piloting potential action projects and quantifying the reductions achieved are the first priorities for Auburn.

We have established 5 year targets that are ambitious, but we believe achievable, and will allow the campus to determine how to best proceed with preliminary data in hand.

In 2015, after implementing and tracking the initial projects Auburn will be able to establish additional interim targets to create checkpoints leading to the neutrality goal in 2050 target.

Initial emissions reductions targets for Auburn University

By 2015 (compared to 2008 emissions baseline):

10% reduction in **purchased electricity** emissions

10% reduction in **on-campus stationary combustion** (heating) emissions

10% reduction in **commuting** emissions

10% reduction in **campus funded travel** emissions

10% reduction in **campus fleet** emissions, including small, gas-engine equipment

Climate Neutrality Target for Auburn University

<u>Neutrality Target Background Information:</u>

- Current scientific evidence suggests that in order to avoid the worst-case effects of climate change, the global average temperature can not rise more than 3.6 ºF

- Given the correlation between global temperature and atmospheric emissions concentrations, this thermal limit is expected to be achievable if atmospheric concentrations of CO_2 (and equivalents in other greenhouse gases) are maintained at or below a concentration of 450 ppm.

- In order to achieve this target concentration, it is currently suggested that global greenhouse gas emissions must be stabilized by 2050.

Given this currently accepted set of scientific conclusions, Auburn University will be part of the solution to be climate neutral by pledging to:

Reduce Auburn core campus greenhouse gas emissions 100% from 2008 levels by 2050

Summary of strategies to achieve the interim targets and neutrality goal
(pages for each complete section in parenthesis)

- The following strategies and detailed actions outlined in this plan will

Energy (p. 9-13)

- Increase efficiency of utility production and distribution systems.
- Improve the performance and efficiency of University building systems (including lighting, climate control, IT, and research equipment).
- Increase use of energy saving or energy efficient technologies and operational best practices.
- Increase energy awareness and energy conservation efforts by all AU faculty, students and staff.

Transportation (p. 14-17)

- Improve tracking of campus funded travel for mileage and associated emissions, and evaluation of reduction potential.
- Increase alternatives to single-occupancy private vehicles (SOV) transportation for students, faculty, staff, commuting to and from campus (mass transit, walking and biking, car/van pooling, car sharing).

- Increase use of transportation avoidance/elimination (videoconferencing, electronic delivery, telecommuting, distance learning).
- Improve the performance and reduce emissions associated with campus fleet.
- Increase awareness of emissions associated with transportation choices by all AU faculty, students and staff.

<u>Purchasing</u> (p. 18-20)

- Establish sustainable purchasing guidelines and/or best practices.
- Monitor and analyze campus purchasing trends to identify areas for emissions reductions.
- Increase awareness of emissions associated with purchasing choices by all AU faculty, students and staff.

<u>Grounds</u> (p. 21-23)

- Evaluate and manage for potential carbon sequestration through trees and plantings on core campus.
- Evaluate potential for reducing building cooling loads by reducing the heat-island effect associated with campus hardscapes.
- Reduce peripheral emissions associated with water infrastructure by aggressively targeting water reduction measures.
- Increase awareness of the value of tree protection by all AU faculty, students, staff, campus visitors (tailgating), and contractors.

<u>Community Engagement</u> (p. 24-27)

- Increase understanding and awareness of climate change, and the impact of campus operations and behavioral choices on campus emissions.
- Increase depth of information and availability of campus resource use to the Auburn community.
- Increase participation from the campus community in creating and implementing solutions to reduce campus emissions.
- Expansion of climate issues and emissions solutions into the campus curriculum.

Auburn University
Climate Action Plan 2010

Introduction and Background

Auburn University has committed to sustainability in a number of ways. It is woven throughout the 2008 Strategic Plan and is identified as one of three attributes that differentiates our university, increases our impact, and enhances our reputation: "we recognize the importance of sustainability as crucial for this century, and we are integrating this theme into our work." Sustainability is also a primary theme in the Campus Master Plan. In other words, sustainability has become a core value for Auburn University.

In keeping with the university's commitment, in September 2008 President Gogue signed the American College and University Presidents' Climate Commitment (ACUPCC). This report outlines our recommendations for Auburn's Climate Action Plan, which is one of the key tasks mandated by the ACUPCC. The recommendations that follow are the work of nine CAP Working Groups: Energy, Buildings, IT, Purchasing, Transportation, Grounds, Food and Dining, Community Engagement, and a Student group. Each group had ten to fifteen members who represented groups from across campus (Appendix 3).

As with any public institution, the following plan is contingent upon adequate funding, with an accurate accounting of the long-term costs and benefits of any mitigation action.

Where Are We Now? - Baseline GHG Inventory (Figures 1-3, Appendix 1)

Auburn will be using the FY 2008 Green Gas inventory as its baseline for recommendations and tracking. The total campus emissions for that year are 212,259 MT CO2e. 72% of these emissions are associated with buildings and energy, 22% are associated with transportation and travel, with the remaining 6% made up of smaller sources. There is a direct financial link to these emissions.

Auburn's utilities expenditures (i.e. electricity, natural gas, fuel oil, water) in 2008 were the largest line item in the complete campus budget ($21 million), and the combined travel expenditures for the same year reached a similar level ($17.9 Million). Efforts to reduce campus emissions will have a direct effect on campus finances.

At the national level, Auburn's emissions baseline is in the same range with similar universities (Carnegie Classification – Doctorate-granting University). While some schools have higher emissions from travel or on campus sources, Auburn will be part of a large community facing similar reduction goals and targets, and sharing solutions.

We will soon enter the second decade of the 21st century, which is considerably different from the 20th century. The recommendations included here address many of the 21st century issues for which new policies are needed.

Goals and Target Dates

The scientific community currently recommends a reduction of 80-100% in Greenhouse Gas Emissions by 2050 to avoid the worst consequences of climate change. Other predictions that concern us are rising energy costs (both electricity and gasoline), and growing scarcity of resources. Auburn will use this current recommendation from the scientific community as an ultimate goal, with 100% of emissions reduced from 2008 levels by 2050.

While it is difficult to recommend specific interim emissions reductions goals at this time due to incomplete information, we recommend considering the reduction goals of comparable campuses (Appendix 2).

Based on comparisons from other campuses, and evaluation of potential on Auburn's campus, we recommend the following interim targets and goals. These targets are established as aspirational goals designed to push the conversation and action beyond the level that

2015 – 10% reduction in the four major sources of campus emissions (purchased electricity, on-campus combustion for heating, campus funded travel, commuting, campus fleet)

2020, 2030, 2040 – in 2015 initial campus efforts will be evaluated and interim reduction targets for each decade will be established. These goals will be examined every 5 years for progress and minor revisions.

2050 – 100% reduction of Scope 1, 2, 3 emissions (from 2008 baseline)

Evaluation and Tracking

Because of the uncertainty surrounding technological potentials, the financial considerations, and the likelihood of new global targets based on scientific evidence, Auburn's Climate Action Plan should be regularly re-evaluated. The implementation and tracking structure for the Auburn CAP should be evaluated with full stakeholder input every 2 years.

In addition, the financial implications (both in terms of costs and savings) of the components within this plan must be regularly evaluated and accurately quantified. Traditional financial analyses, such as simple or discounted payback periods, often do not capture the long-term costs and savings, nor the costs and benefits seen in other sub-systems (e.g. the effects of lighting retrofits on heating and cooling systems). We recommend using Life-cycle cost analysis to evaluate the long term financial implications of energy use for projects considered as a result of the following recommendations, and for campus project evaluation in general.

ENERGY

Energy Background

Energy represents the largest portion of our carbon footprint and is the primary concern of the buildings and IT groups, therefore in this section utilities, buildings, and IT are addressed together.

Energy costs for the campus are projected to grow due to rate increases (Figure 4), and increased usage as additional facilities are constructed, or as existing buildings are renovated. In some cases, renovations may result in additional systems that use energy while remedying a previously unaddressed issue within the building (e.g. improved indoor air quality through expanded ventilation systems). In addressing the need to flatten the energy growth curve there are two general categories of recommendations: conservation through behavior change and new technology, and the introduction of renewable energy.

Auburn University has already made a good start by initiating a number of energy conservation projects (Appendix 4).

Overall Energy Strategy

Auburn University will work to reduce energy usage, utility consumption, energy costs, and the University's carbon footprint by utilizing the following strategies:

- Increased efficiency of utility production and distribution systems.
- Improved the performance and efficiency of University building systems (including lighting, climate control, IT, and research equipment).
- Increased use of energy saving or energy efficient technologies and operational best practices.
- Increase energy awareness and energy conservation efforts by all AU faculty, students and staff.

A consistent and steady investment of University funds will be made, in conjunction with other University requirements and needs, to implement this strategy

Energy Goals – Short Term (1-5 years)

1. By 2015, reduce emissions associated with purchased electricity 10% from 2008 baseline.

2. By 2015, reduce emissions associated with on-campus combustion (currently natural gas and #2 fuel oil) for hot water and steam 10% from 2008 baseline.

Energy Actions - Short Term (1-5 years)

Energy Initiative 1 – Improved monitoring, performance, and efficiency of existing building systems.

E.1.1: Develop and implement long-term retro-commissioning plan for all buildings.

E.1.2: Develop a priority list for efficiency upgrades by completing comprehensive building energy audits.

E.1.3: Create an existing buildings policy which includes minimum standards for renovations, for example replace single glazing with double glazing windows, add radiant barrier and insulation in appropriate roofs, use white high-reflective membranes on appropriate roofs, add insulation to walls whenever possible.

E.1.4: Install Automatic Meter Reading System and expand use of energy management systems (e.g. Metasys) for continuous building monitoring.

E.1.5: Develop models for each building to analyze their utility usage on a daily basis, and utilize to rapidly identify inefficiencies.

Energy Initiative 2 – Ensure that new buildings are built to achieve the highest feasible energy efficiencies.

E.2.1: Modify project design and review process to include full life-cycle energy cost analysis rather than simple payback period, discounted payback period, or simple cost-benefit analysis. This will ensure that operations costs and future volatility in energy markets are included in the financial evaluation of projects.

E.2.2: Create a new buildings policy which includes a high energy-efficiency standard (i.e. LEED Gold or Green Globes) for new campus construction and identify specific points related to energy efficiency as required points for construction on campus. The policy should ensure that efficiency measures are not "engineered out" during the construction process or if a building faces budget overruns.

E.2.3: Develop commissioning standards for new building and building renovations. This should include different levels of commissioning to reflect the type of building (e.g. Laboratory building, Classroom building)

Energy Initiative 3 – Improved efficiency of energy-intensive building sub-systems (lighting, HVAC, computing, appliances, research equipment).

E.3.1: Minimize energy consumption associated with lighting. a) Accelerate and complete current campus lighting retrofit to eliminate T12 fluorescent fixtures (being phased out nationally in 2011) b) continuously evaluate and deploy new, efficient lighting technologies (e.g. LED lighting).

E.3.2: Upgrade computer labs with efficiency as a key goal

E.3.3: Develop an education/training program for distributed IT managers to establish best practices for computer energy and e-waste reduction

E.3.4: Adopt EPEAT standards as a requirement for campus computer purchases, including peripherals

E.3.5: Investigate centralized computer power management system that allows IT managers to remotely shut the system down, but also bring it online for updates, repair, time-clocking, and to activate systems sequentially in the morning to prevent overload on the network

E.3.6: Investigate of the use of thin clients for base level computing needs (e.g. Penta thin clients use 5 Watts)

E.3.7: Move toward centralized networked printers to achieve overall electricity reduction, reduced printing, and reduced e-waste

E.3.8: Develop strategy reducing electricity consumption from computer peripherals (e.g. using "smart strips" to automatically turn off peripherals when the cpu is powered down or specifying peripherals with power saving modes)

E.3.9: Evaluate becoming a partner with the US DoE/EPA Labs21 Program to expand campus laboratory energy savings and best practices.

Energy Initiative 4 – Educate and empower building occupants to reduce energy consumption that they can directly affect.

E.4.1: For consumption awareness, utilize data from automated and continuous utility metering across campus and make real-time usage available on AU website and within each building (e.g. a “dashboard” system or other prominent visual).

E.4.2: Develop a campus-wide education program regarding energy conservation that addresses behaviors, appliance and research equipment selection, and building systems set-back policies. This needs to have top-level administrative support.

E.4.3: Create a committee on campus energy education and behavioral change composed of the energy manager, staff, faculty, and students to provide input on a campus energy plan and develop an implementation schedule.

Energy Initiative 5: Develop a renewable energy strategy.

The working group estimates that 15-20% of campus energy needs could be met through a combination of: solar thermal pre-heat, solar electric photovoltaic, and biomass gasification (for electricity production, hot water, or co-generation).

E.5.1: Install at least one pilot project on campus in the three renewables areas [solar thermal pre-heat, solar electric photovoltaic, biomass gasification (for electricity production, hot water, or co-generation)]

E.5.2: Solar thermal technologies are already well advanced, and for heating applications are highly efficient (50%-75%). We recommend a comprehensive review of all heating applications on campus for the potential of solar thermal substitution or pre-heating applications in conjunction with existing equipment.

E.5.3: Measure and evaluate geothermal heat exchange project at new soccer/track building and consider potential for additional use on campus

Energy Initiative 6 – Use administrative/policy solutions to expand efficiency and emissions reduction on campus, and evaluate campus operations for emissions offsets.

E.6.1: Revise university policies to ensure continued improvement regarding energy efficiency

E.6.2: Develop a campus energy strategic plan

E.6.3 Investigate and implement creative funding strategy for efficiency projects similar to Harvard's Green Campus Loan Fund (energy savings feed back into the fund). (Appendix 5).

E.6.4: Investigate possibilities for collaboration to reduce emissions associated with purchased energy (e.g. renewable Power Purchase Agreements (PPAs) with Alabama Power or other vendors)

E.6.5: Evaluate need for additional energy reduction staffing and develop prioritized staffing plan if evaluation indicates need.

E.6.6: Develop strategy to offset emissions by exploring potential for university lands or outreach projects to serve as carbon offsets.

Energy Actions - Intermediate (5-10 years)

We are not able to recommend specific intermediate target dates and reduction amounts due to lack of comprehensive data collection. Intermediate target dates and amounts will be set following an opportunity to evaluate the relative effects of the short-term projects listed above and with increased data collection and analytical capabilities (e.g. occupant controlled systems vs. automated systems; real-time or daily vs. monthly energy usage information). Intermediate targets will be evaluated and initially set by 2013.

Energy Actions - Long Range

Given the research and technological potential at Auburn, and the estimated need for renewable energy production in the Southeastern US, Auburn should position itself as a leader in solar and biomass research and in the use of these technologies to provide the energy needs for the campus.

TRANSPORTATION

Transportation Background

Based on the 2008 GHG inventory, transportation related activities are the second largest source of campus greenhouse gas emissions. At the same time, data for determining transportation related emissions on campus are the most uncertain (See Table 1). In order to address transportation emissions on campus in the long term, there will need to be additional data collection and analysis measure put into place.

There are three main components within transportation: Directly financed travel (air and ground travel supported with university funds), Commuting (faculty/staff/students), and Campus Fleet.

Overall Transportation Strategy

Auburn University will work to reduce emissions from transportation, fuel costs, and the University's carbon footprint by utilizing the following strategies:

- Improved tracking of campus funded travel for mileage and associated emissions, and evaluation of reduction potential.
- Increased alternatives to single-occupancy private vehicles (SOV) transportation for students, faculty, staff, commuting to and from campus (mass transit, walking and biking, car/van pooling, car sharing).
- Increased use of transportation avoidance/elimination (videoconferencing, electronic delivery, telecommuting, distance learning).
- Improve the performance and reduce emissions associated with campus fleet.
- Increase awareness of emissions associated with transportation choices by all AU faculty, students and staff.

A consistent and steady investment of University funds will be made, in conjunction with other University requirements and needs, to implement this strategy

Transportation Goals – Short Term (1-5 years)

1. By 2015, reduce emissions associated with campus funded travel 10% from 2008 baseline.

2. By 2015, reduce emissions associated with regular (daily, weekly) commuting for students, faculty, and staff 10% from 2008 baseline.

3. By 2015, reduce emissions associated with campus owned and operated fleet (including small, gas-engine equipment) 10% from 2008 baseline.

Transportation Actions – Short term (1-5 years)

We recommend that the following be initiated by 2012:

Transportation Initiative 1: Improved monitoring and utilization of existing campus resources related to transportation.

T.1.1: Annual evaluation of campus transportation resources and needs (including allocation of staff or resources) through:

- transportation mode surveys for faculty, staff, and students in order to track transportation trends and make further recommendations.

- annual parking occupancy surveys

- annual mileage logs per fleet vehicle (to identify high travel units in fleet)

T.1.2: Working with Payment and Procurement Services, establish a travel accounting system that allows determination of miles traveled (and separates out lodging and meals) for both ground and air trips using campus funds.

Transportation Initiative 2: Implement solutions that can reduce or eliminate the need for travel

T.2.1: In conjunction with HR, evaluate telecommuting, flex work hours, and other options for campus staff. If feasible, develop awareness campaign for supervisors and employees.

T.2.2: Evaluate the potential for expanded use of off-campus videoconferencing (see Appendix 10)

Transportation Initiative 3: Reduce the use of single-occupancy private vehicles for commuting to and from campus (Faculty/Staff)

T.3.1: With the assistance of the Community Engagement Group develop program for evaluating barriers to non-SOV transportation (surveys, focus groups) and establish education campaign for behavioral change on campus.

T.3.2: Develop incentives for not regularly bringing a car on campus (e.g. incentives permits for not registering a car but choosing alternatives- biking, walking, telecommuting)

T.3.3: Expand alternative transportation options available to campus staff and faculty.

- collaboration w/ city and county for shared mass transit options
- park and ride, carpooling, and car sharing programs
- carpooling program
- bike to work program (including route assistance and commuter info)

T.3.4: Evaluate the potential for increasing parking permit fees for vehicles to reflect the cost of parking facilities (~$5,000 per flat lot parking space, ~$15,000 per parking deck space). Any increases in parking fees should not penalize lower paid employees, but should be scaled as a proportion of salary (similar to health care benefit for campus staff).

Transportation Initiative 4: Reduce the use of single-occupancy private vehicles for commuting to and from campus (Students)

T.4.1: education program targeting students and parents before they arrive on campus (Camp War Eagle, acceptance mailings) to reduce number of cars brought initially

T.4.2: Provide viable alternatives to car-ownership for students by starting a car sharing program (e.g. Zipcar or WeCar) on campus, increasing transit opportunities that include key shopping needs, and expanding bike infrastructure.

Transportation Initiative 5: Reduce the need for on-campus travel.

T.5.1: Evaluation of all campus forms and paperwork for the potential of using electronic signature to eliminate on-campus document movement.

T.5.2: Establish bike messenger program for fast/sensitive deliveries on campus

T.5.3: Support and promote the use of on-campus videoconferencing for meetings.

Transportation Initiative 6: Continue to reduce the emissions from campus fleet

T.6.1: Movement toward small electric vehicles for on-campus service needs as vehicles are replaced. Establish vehicle replacement schedule targeting 1) high travel need units (give priority of efficiency to the units with greatest required travel) 2) most inefficient vehicles in campus fleet

T.6.2: Continue use of electric vehicles and consideration of low-emission equipment for Landscape Services.

T.6.3: incorporate biodiesel (preferably from on-campus biofuels research) into fleet diesel vehicles

Transportation Initiative 7 – Use administrative/policy solutions to reduce transportation miles and related emissions.

T.7.1: Develop a comprehensive campus transportation plan that addresses campus funded travel, fleet, and commuting.

T.7.2: For efficient management, increase communication between units associated with transportation or examine potential for consolidating transportation related administration on campus (parking, traffic, Tiger Transit, pedestrian, bicycling) into a single reporting line (currently transportation administration occurs through both Auxiliary Services and Facilities).

T.7.3: Coordinate with the City of Auburn to prioritize and develop facilities for alternative transportation in the city that connect to campus (e.g. bike lanes, sidewalks, mass transit).

PURCHASING

Purchasing Background:

Given the significant contribution of items purchased on campus to reduction goals (especially those that consume electricity), purchasing solutions can play an integral part in reducing building energy consumption, and transportation emissions.

Overall Purchasing Strategy

Auburn University will work to reduce emissions associated with items purchased with campus funds by utilizing the following strategies:

- Establish sustainable purchasing guidelines and/or best practices.
- Monitor and analyze campus purchasing trends to identify areas for emissions reductions.
- Increase awareness of emissions associated with purchasing choices by all AU faculty, students and staff.

Purchasing Goals – Short Term (1-5 years)

1. Establish Sustainable purchasing guidelines for campus.

2. Improve tracking and analysis of items purchased on campus as they relate to emissions contributions and reduction potential.

Purchasing Actions – Short Term (we recommend the following by 2012)

<u>Purchasing Initiative 1: Draft and adopt blanket sustainable purchasing policy for campus to centralize sustainable purchasing guidelines on campus</u>

P.1.1: Finalize and adopt the draft Auburn Sustainable Purchasing Policy (Appendix 9)

P.1.2: The initial sustainable purchasing policy is framed as guidelines and preferences. Once adopted, there should be regular (every 2-3 years) evaluation and consideration of the potential need for mandates in purchasing as details about specific product areas, and needs for campus energy considerations are fine tuned.

<u>Purchasing Initiative 2: Gather and analyze purchasing data as it relates to energy use and waste production to develop reduction goals and strategies.</u>

P.2.1: Centralized system with ability to track purchases on campus and analyze potential impact on energy use and waste production

P.2.2: Development of a prioritized list of items purchased on campus that potentially have the largest impact on campus emissions (energy consumption and transportation are the two primary sources of emissions, and should receive special consideration).

P.2.3: Working with the Division of Recycling and Solid Waste in Facilities, determine the contribution to the campus waste stream from packaging and shipping materials for consideration of waste minimization targets in contracts

P.2.4: Communication with all vendors holding existing contracts to express the campus interest in efficiency (utilities and transportation) and waste reduction options to see what they might voluntarily offer, or have in place

<u>Purchasing Initiative 3: Incorporate “best practices” for sustainable purchasing into the operations of centralized and decentralized purchasing decisions on campus</u>

P.3.1: To assist in evaluating the “best sustainability choices”, a multi-stakeholder group should (incorporating university staff and faculty with expertise in contracts, energy efficiency, materials choice, logistics, and waste minimization)

P.3.2: As existing contracts come up for revision and renewal, the specific details of the sustainability considerations for that product or product class should be evaluated by PPS, decentralized purchasers and the stakeholder group mentioned above to provide guidance on best practices.

P.3.3: Develop (in conjunction with the working group recommended by the Community Engagement Group) an education campaign targeting the decentralized purchasers on campus (e.g. facilities, athletics, departments) to encourage purchasing decisions with emissions reductions in mind.

- Integrate into HR training materials with additional sustainability goals/materials

- Integrate into the leadership courses required through HR (e.g. Dept. Chairs and staff)

- Incorporate into the purchasing card test? (or as a "click here for the green buying guidelines")

- TES training session

- develop clear guides and guidelines for sustainable purchasing (desk-side single sheet, web site, on purchasing card sleeve)

- develop continuously updated resource providing sources of information (using nationally recognized sources, and preferably third-party sources) that purchasers can use for credible information

GROUNDS

Grounds Background

Based on the standard for carbon accounting, there is not a large direct emission component related to grounds in the Auburn GHG baseline. The application of fertilizers and the fuel to operate landscaping equipment are the two direct contributions to the campus emissions, and the overall contribution of both is <2% (Figure 1).

However, campus grounds policies and decisions related to tree canopy shade, managed or unmanaged landscapes (restoration and conservation areas), pavement and sidewalks (amount, permeability, and material color) all have indirect effects through their contribution to the "heat island effect" on campus and the implications for building cooling loads. In addition, while stormwater and general water usage do not have a measurable effect on campus emissions, they do contribute to overall regional emissions levels (e.g. energy required to purify and/or pump water for delivery to campus).

Overall Grounds Strategy

Auburn University will work to reduce emissions associated with campus grounds and landscaping by utilizing the following strategies:

- Evaluate and manage for potential carbon sequestration through trees and plantings on core campus.
- Evaluate potential for reducing building cooling loads by reducing the heat-island effect associated with campus hardscapes.
- Reduce peripheral emissions associated with water infrastructure by aggressively targeting water reduction measures.
- Increase awareness of the need for tree protection by all AU faculty, students, staff, campus visitors (tailgating), and contractors.

Grounds Goals – Short Term (1-5 years)

1. Establish baseline inventory for campus trees and plantings, and calculate carbon sequestration potential.

Grounds Actions – Short Term (We recommend that the following be initiated by 2012)

Grounds Initiative 1: Continue to advance energy savings, potential carbon sequestration, and direct emissions reductions through campus landscaping solutions

G.1.1: Continued support for regularly updated Campus Tree Inventory. Including calculation of carbon sequestration through core campus plantings. Initial inventory completed 2010.

G.1.2: Develop existing campus GIS resources (in academic units) to provide support along with the Tree Inventory to be able to monitor and assess campus tree canopy cover and shade zones.

G.1.3: Increase the tree canopy in managed areas of campus by 5% per decade over the next 30 years and promote a healthy urban forest by continuing a robust tree planting program, enhancing tree maintenance, and implementing more stringent tree protection measures (see below).

G.1.4: Meet requirements of the Arbor Day Foundation for yearly recertification of Tree Campus USA designation (initially awarded Mar 2010).

G.1.5: Form a working group to examine potential for conservation and restoration of campus lands (presently managed or unmanaged).

G.1.6: (related to Energy Goal 2) Include campus fertilizer application in centralized data collection system for emissions monitoring, and examine potential for minimizing fertilizer application.

Grounds Initiative 2: Revise university policies to allow Landscape Services to optimize campus tree management, canopy cover, fertilizer application, and water

G.2.1: Revise Auburn University Tree Preservation Policy (Appendix 7; approved 1989) to:

- a) expand policy scope to include new construction projects, general Facilities operations, Telecom and outside vendors.
- b) impose penalties for tree damage that cover tree value, removal, and replacement, and that are punitive, similar to the policy of Clemson University
- c) establish a tree replacement fund: to be funded by penalties levied for the removal of trees due to new construction, and damage to trees during construction; also include a mechanism for accepting donations.

G.2.2: For consistency in policy, develop a landscape master plan that addresses all core campus landscaping (landscaping of President's Residence is currently outsourced).

Grounds Initiative 3: Include water-related considerations alongside emissions reduction concerns

G.3.1: Continue active management of landscape irrigation practices begun in 2008. (see Appendix 8 - Auburn Water Management Plan)

G.3.2: Develop a stormwater management plan for Auburn's campus

a) Form a working group from existing campus staff, faculty, administration and students. Specifically target: Landscape Services, Landscape Architecture, Building Sciences, Biosystems Engineering, Environmental Engineering, Agronomy and Soils, and Horticulture.

b) Examine potential for widespread campus use of: drains, bioswales, rain gardens, creek daylighting, constructed wetlands, cisterns and other best management practices.

G.3.3: Increase the use of porous paving alternatives wherever appropriate on campus when replacing old or installing new paved ground surfaces such as parking areas and walkways.

a) Porous paving alternatives include pervious concrete, open-jointed paving blocks, open-celled paving grids, plastic geocells, and other paving systems that positively impact the natural environment.
b) Benefits include: recharging groundwater, filtering contaminants, controlling erosion, and mitigating heat island effects.
c) Proper installation and maintenance of porous paving is critical to their long-term viability.
   i) Proper installation is ensured by using material suppliers and craftsmen experienced and qualified with the paving method being specified. Samples of recent work, demonstration of work proposed, and relevant certification of craftsman in proposed application are important quality control measures.
   ii) Once installed, regular maintenance is necessary to reduce pore clogging and maintain porosity of porous pavement.

COMMUNITY ENGAGEMENT

Community Engagement Background

While the specific percentages are unknown, there is a considerable link between individual behaviors and Auburn's Greenhouse gas emissions, as well as costs associated with utilities and transportation. Conservation through behavior change also goes hand in hand with recommendations for deploying the best efficiency technology and introduction of renewable energy production on campus.

Overall Community Engagement Strategy

Throughout the Climate Action Planning process, Auburn University will work to engage the campus and surrounding community to reduce the University's carbon footprint by utilizing the following strategies:

- Increase understanding and awareness of climate change, and the impact of campus operations and behavioral choices on campus emissions that contribute to climate change.
- Increase depth and transparency of communication of campus resource use to the community.
- Increased participation from the campus community in creating and implementing solutions to reduce campus emissions.
- Expansion of climate issues and emissions solutions into the campus curriculum.

Community Engagement Goals – Short Term (1-5 years)

1. Increase understanding of, and participation in, campus emissions reductions programs.

2. Increase the number of formal classes at Auburn integrating climate change science, policy discussions, and reductions technology solutions by 10% compared to 2010 baseline.

Community Engagement Actions – Short Term (we recommend the following by 2012)

<u>Community Engagement Initiative 1: Develop a campus-wide campaign to educate/raise awareness across all Auburn University members (students, faculty, staff) regarding the University's commitment to reducing our carbon footprint</u>

C.1.1: Provide the resources (human, social, economic capital) necessary for the Office of Sustainability (in cooperation with other key divisions on campus) to coordinate a campus wide campaign to raise awareness. Coordination should include developing at least these three working groups:

(a) An interdisciplinary team of student interns (working in the Office of Sustainability), led by a half-time graduate student (as a Graduate Research Assistantship) working in a field related to sustainability can support the effort. For example: students from Public Relations, Science, Engineering, Graphic Arts, and Architecture could collaborate to develop and implement a campaign.

(b) An interdisciplinary team of professors, representing most departments on campus, could meet once or twice a year to generate ideas for raising awareness within their classes in a less formal way than the Faculty Sustainability Training Workshop held each May – They could then return to their departments and share ideas with other faculty members to rally support and engagement.

(c) A team of both staff members and others who know the “low hanging fruit” referenced in the Energy and IT Working Group recommendations AND faculty experts in facilitating organizational change, human behavioral psychology, PR, marketing and education serve as a key source of information for the two groups recommended above. This group could be called together as needed to review materials and provide guidance.

C.1.2: Use the existing structure of the university to leverage education and visible support for the University's commitment to reducing our Carbon Footprint

(a) An awareness/education campaign within a university needs the visible support of the University President and Administration – The President and his Administration need to highlight the University's efforts and successes related to reducing our Carbon Footprint in their public addresses and in working with their reports. We hope the President and Administrators will strive to be present and participate in high profile campaign activities.

For example – President Gogue's signing of the final plan should be a PR event that incorporates broad participation and celebration

(b) A team of campus administrators/staff/faculty positions who oversee decisions or actions that directly relate to campus emissions reduction needs (e.g. campus fleet manager, individual building managers, preventative maintenance staff, departmental purchasing staff) should establish a prioritized list of actions and hold the campus community accountable for taking those actions

(c) Encourage the "Auburn Connects!" Common Book program committee to consider selecting a book that relates to the carbon reduction efforts of the University

C.1.3: Specifically integrate a fun educational/awareness program into the current Camp War Eagle and SOS (Successfully Orienting Student) programming.

Community Engagement Initiative 2: Gather and analyze energy data for each building and consider a centralized data collection system similar to other universities (We echo this from the Energy section)

C.2.1: Make relevant data visible and accessible to all members of the university

For example:

- In a prominent location, develop a large sign similar to the United Way Campaign thermometer to mark our progress in reducing our Carbon Footprint.
- Develop building specific modes of communicating energy usage – Research says that families who can see their real-time energy usage in their house, very quickly reduce their energy consumption.

C.2.2: Celebrate major milestones in a way that draws attention to the progress

C.2.3: Include emissions reductions progress and milestones in campus recruiting and publicity materials.

Community Engagement Initiative 3: Integrate education campaigns (and other emissions reduction efforts) into academic courses at Auburn

C.3.1: Create a working group that will evaluate the potential for academic units (departments and specific undergraduate majors) to contribute to the emissions reduction goals. Once evaluated, the group should target key units/departments/majors and identify a faculty/staff liaison.

C.3.2: Integrate campus emissions reduction goals into the ongoing curriculum development program (Sustainability Minor, Fall Line - Faculty Training Workshop, Honors symposium, Graduate level programs)

C.3.3: Incorporate emissions reductions and general sustainability into all new faculty/staff/student orientation and initial training.

C.3.4: Work with HR Annual Performance reviews to incorporate emissions reduction into the baseline performance criteria for staff at Auburn.

C.3.5: Work with HR to develop a sustainability or emissions reductions specific course to be offered through the HR Professional Development Courses

- Make this course part of the managers mandatory sequence of courses
- offer the course for any who are interested across campus

Miscellaneous Emissions Sources Recommendations

Organic waste and waste

The only portion of the campus emissions footprint that are directly attributed to “Waste” is through the decomposition of organic wastes into methane at landfill sites (Figure 1). However, there are indirect emissions associated with the processing and transport of wastes that can be reduced by eliminating the need to process them at all (focus on reducing “waste” that is delivered to campus).

<u>Waste Initiative 1: Reduce campus waste at the “source” side by including waste reduction mandates in purchasing, food and dining, and construction.</u>

W.1.1: (Related to Purchasing Goals 1 and 2) Include waste minimization in purchasing decisions and contracts (e.g. packaging reduction language in contract RFPs, requirement that packaging or products be recyclable in the regional recycling market specifically).

W.1.2: Include waste reduction mandates through reuse or recycling of materials in campus building and demolition projects.

W.1.3: Evaluate the potential to establish a “disposal” fund for items by including a small fee at the time of purchase.

<u>Waste Initiative 2: Reduce campus emissions associated with solid waste decomposition through composting (applies to Food and Dining, Landscape Services, Animal production).</u>

W.2.1: Working with the College of Agriculture, evaluate the potential for a campus-wide industrial composting facility. Such a facility should be sized and developed to handle as many streams from campus as possible (landscape waste, dining services waste, animal wastes, compostable plastics). This will likely require the consideration of a high-temperature composting facility.

W.2.2: Work with campus animal production facilities (poultry, swine, beef cattle) to compost animal waste through campus-wide composting facility.

Refrigerants

Refrigerant chemicals are among the most potent greenhouse gases. Accidental releases (i.e. fugitive emissions) at Auburn are low, but efforts should be made to eliminate releases completely.

Refrigerant Initiative 1: continue to minimize releases of highly potent refrigerants on campus.

R.1.1: Increased effort to eliminate leaks in refrigerant systems on campus, and consideration of controls systems that detect leaks and alert early.

Food

The only portion of the campus emissions footprint that Food and Dining directly contribute to are through solid waste. However, there are general indirect emissions associated with the transportation of food, and the methods associated with producing food that should also be addressed.

Food and Dining Initiative 1: Work with Chartwells (Tiger Dining) staff to help expand and support their existing efforts under the current Dining Services contract (through 2018?)

F.1.1: Consideration within a campus-wide composting program for an industrial (high temperature) composter that can accept all post-consumer food waste (vegetable, meat, corn-based plastics, paper service ware and to-go containers).

F.1.2: Work with Chartwells, College of Ag, and Adams Produce (AL produce distributor) to encourage and develop network of local (i.e. within 250 miles) producers and help to establish ties to distributors within the state.

F.1.3: Efforts to introduce “healthier” and potentially more sustainable options within the campus dining structure will only work if students actively choose those options over less sustainable and/or healthy options. Work with Tiger Dining on an education campaign to encourage students to support preferable food choices through what they choose to eat on campus.

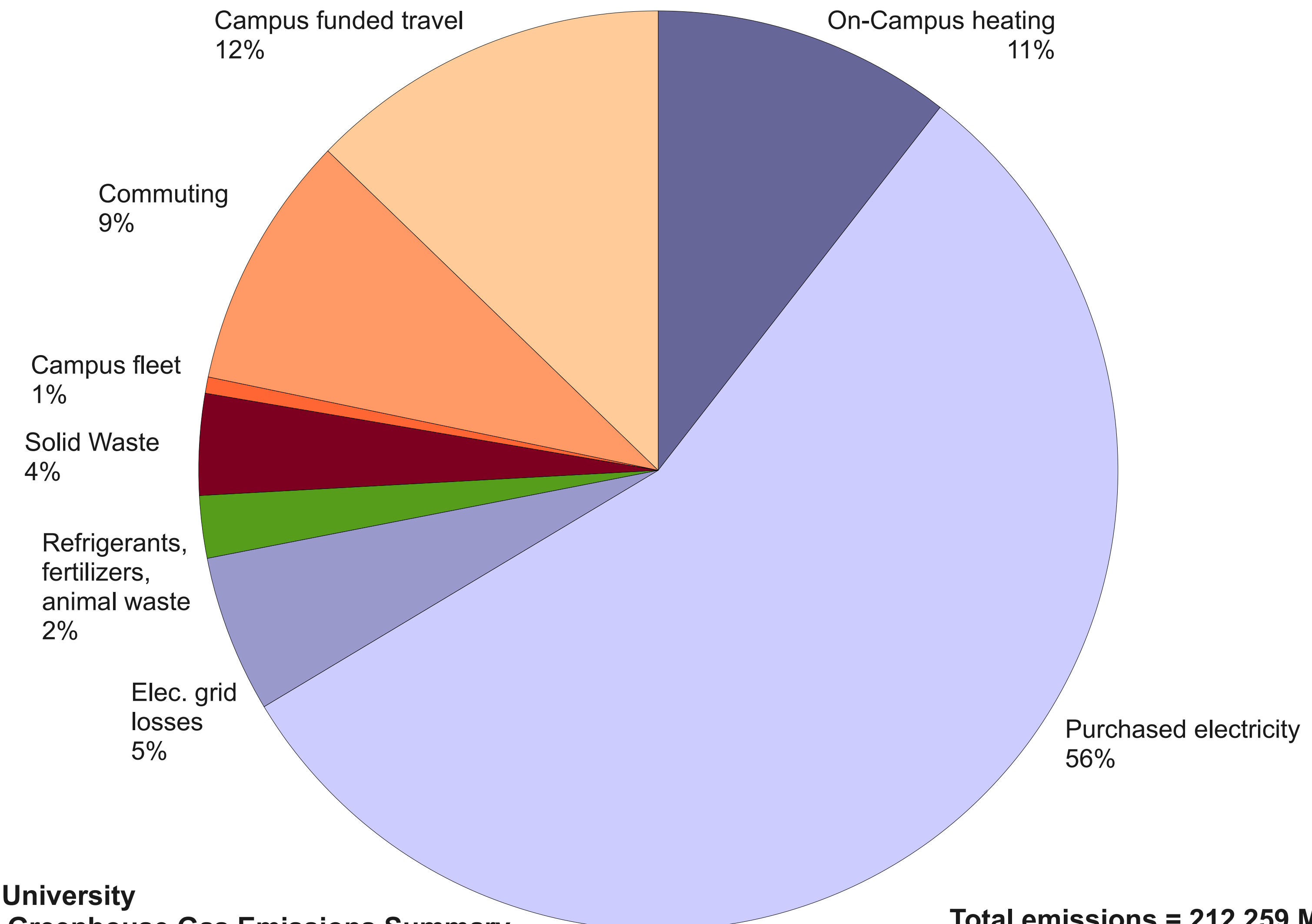
F.1.4: Establish program to reduce unpurchased (prepared but pre-consumer) food products from being wasted (e.g Campus Kitchens).

F.1.5: Support the use of the catering services to pilot and promote “green” dining options (e.g. local food menus, elimination of disposable serviceware)

Food and Dining Initiative 2: Incorporate emissions reductions as a core component in future dining services contracts

F.2.1: Establish a working group with broad campus representation (staff, administration, faculty, students) to determine best practices and options (e.g. local food options, transportation reduction, packaging reduction, food service energy use reduction) that should be included in the next dining services RFP.

Figure 1. Auburn's Greenhouse Gas emissions by source for the baseline year FY08. Emissions related to electricity are presented in shades of blue. Emissions related to transportation are presented in shades of orange.



Auburn University
FY 2008 Greenhouse Gas Emissions Summary

Total emissions = 212,259 $MTCO_2e$

Table 1. Summary of Auburn University Green House Gas Inventory FY 2008. FY08 has been selected as the baseline year that will be used to calculate and track emissions reductions targets. Raw data quality is variable depending on level of detail and consistency in collection over time.

Source	$MTCO_2e$	Percent of campus emissions	Quality of raw data available
Buildings related emissions			
Purchased Electricity	118,645	56%	High
On-Campus Heating	22,298	11%	High
Electric Grid Losses	11,734	5%	High
Buildings related total	***152,677***	***72%***	
Transportation related emissions			
Campus funded travel	27,104	12%	Low
Commuting (employees and students)	19,053	9%	Medium
Campus Fleet	1,207	1%	High
Transportation related total	***47,364***	***22%***	
Waste and direct emissions			
Solid waste	7,567	4%	High
Accidental Refrigerant losses	2,500	1%	Medium
Fertilizer Application and Animal Waste	2,151	1%	Medium
Waste and Direct emissions total	***12,218***	***6%***	
TOTAL (FY2008)	**212,259**	**100%**	

Figure 2. Total Auburn expenditures for purchased electricity and natural gas (for campus hot water) FY 2001-2009 in Million $. Data provided by Auburn Facilities accounting.

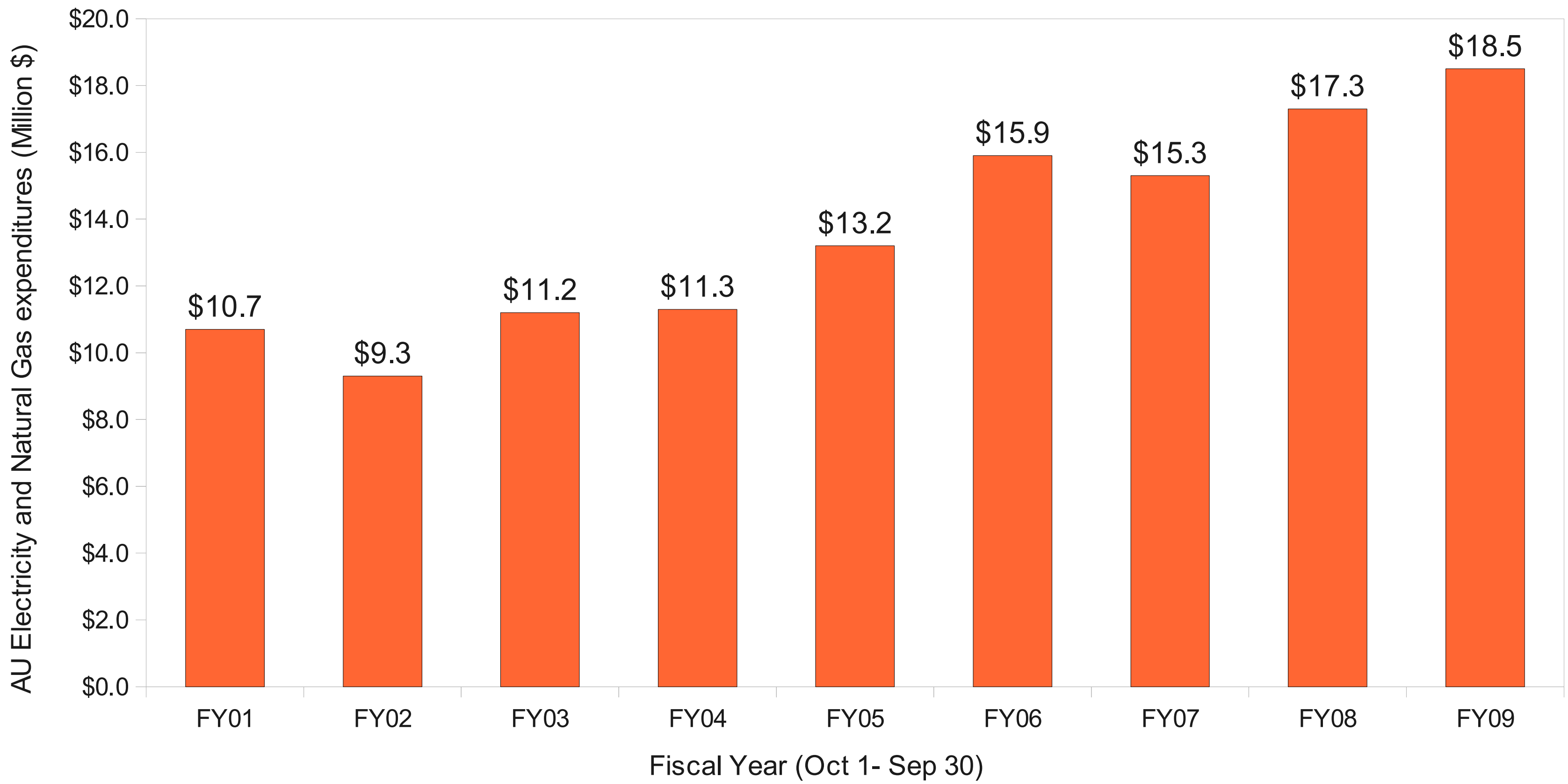
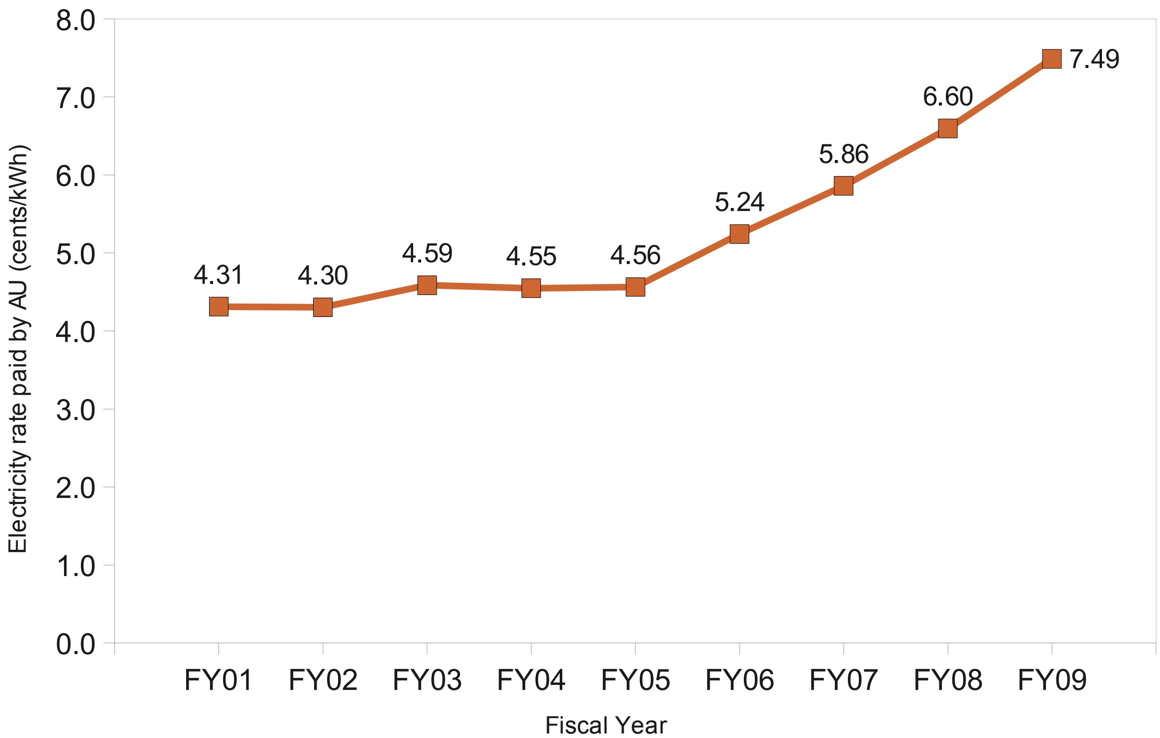


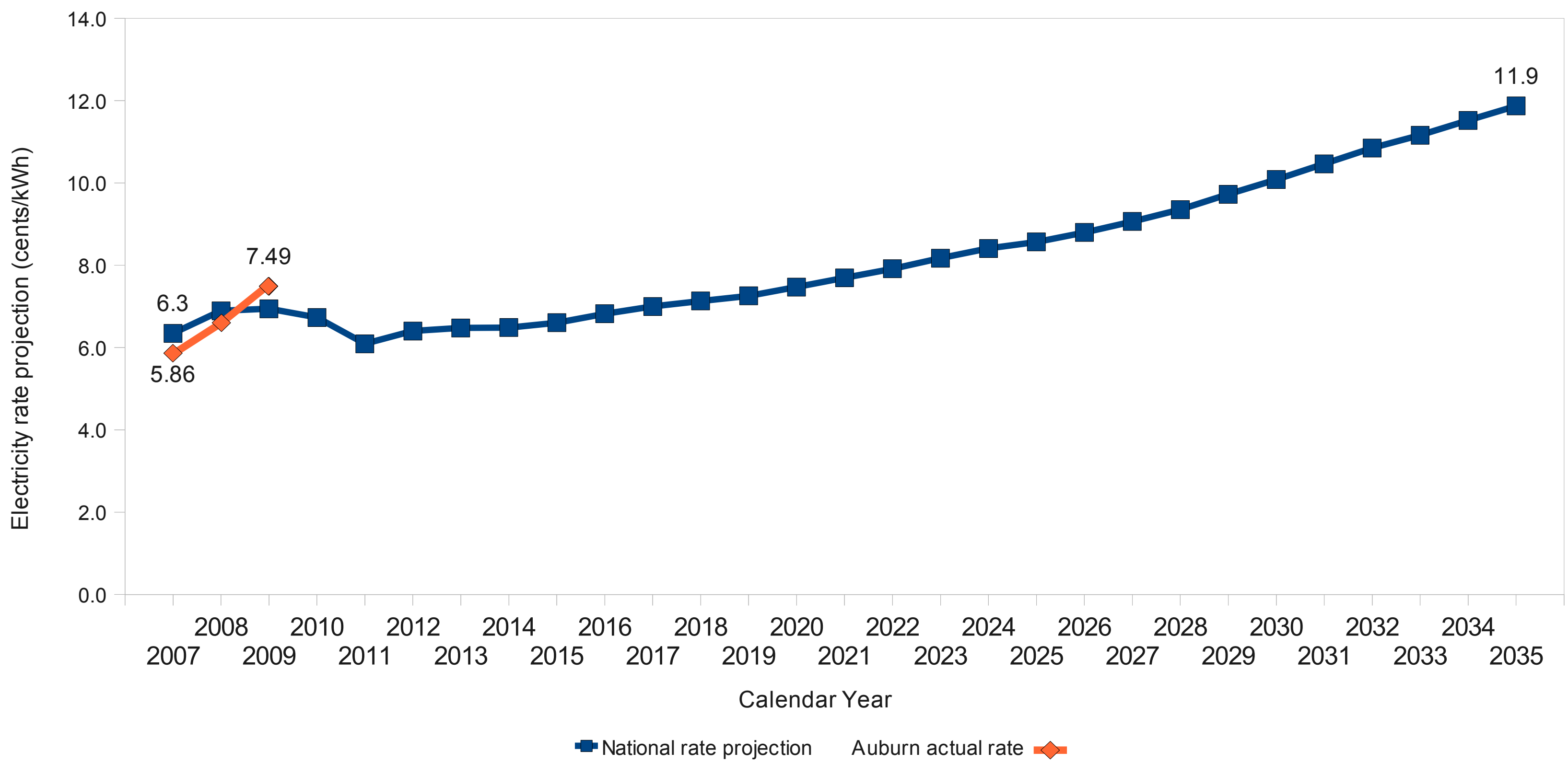
Figure 3. Electricity and natural gas rates paid by Auburn University, fiscal years 2001-2009. a) Electricity rates have almost doubled (1.74x increase) and b) Natural Gas rates have increased by 1.3x, and illustrate the volatility in that market, making future predictions difficult. Data provided by Auburn Energy Management Office.

a)



b)

Figure 4. National industrial electricity rates projected through 2035. The actual rate paid by Auburn for overlapping years is shown in orange and indicates a much faster increasing trend. Source for national projection US Department of Energy, Energy Information Administration, Annual Energy Outlook 2010.



Appendix 1
Summary of Auburn University Greenhouse Gas Inventory FY 2008

Because of data quality and consistency on campus, FY 2008 has been selected as the baseline year for Auburn's Greenhouse gas (GHG) emissions analyses and comparisons. Emissions have been calculated for FY 2006-2009.

Total emissions for Auburn University FY 2008*

- **212,259 $MTCO_2e$** (Metric tons of carbon dioxide equivalent)

What that level of emissions equals:

- The emissions generated by providing electricity for ~26,000 average American homes
- The emissions sequestered by 5.5 million coniferous tree seedlings growing for 10 years
- The emissions produced by 40,585 passenger vehicles in 1 year

(source US EPA GHG Equivalencies Calculator)

Of the FY 2008 emissions for Auburn University*:

- 72% are attributable to buildings (electricity and heating)
- 22% are attributable to transportation (fleet, commuting, travel)
- 6% are attributable to waste and direct emissions (solid waste, refrigerant leaks, fertilizers, animal waste)

* (see Figure 1 and Table 1 for details)

Boundary of Auburn GHG Inventory

<u>Campus holdings INCLUDED in Auburn GHG Inventory:</u>

- Main campus
- Vet School
- Animal Science research facilities on Shug Jordan Parkway and S. College

<u>Campus holdings NOT included in Auburn GHG Inventory:</u>

- AU Montgomery campus
- All off-campus agricultural and forest research lands (including those in Auburn but not directly linked to campus – e.g. Auburn Fisheries facilities on N College St.)

- Alabama Cooperative Extension facilities not on main campus
- Off-campus academic facilities (e.g. Harrison School of Pharmacy - Mobile campus)

Scope of Auburn GHG Inventory

- Scope 1, 2, 3 ALL included

Scope 1: all Direct GHG emissions (campus hot water and steam generation, campus owned vehicles, accidental refrigerant releases, fertilizer applied on campus, agricultural animals housed around main campus (not outlying units))

Scope 2: For Auburn this is only Indirect GHG emissions from consumption of purchased electricity.

Scope 3: "Other" Indirect emissions. This is the category that can be difficult to delineate.

Some activities result in clearcut, indirect emissions that are linked to a university function (emissions from managing campus waste, transportation paid for with campus funds - travel by campus employees for University business: research, meetings, recruitment...

Other activities are not so clearcut, but are also emissions that are specifically produced for the "normal operations of the university" (e.g. daily commuting of all employees and students, study abroad - even if paid for by the student because of the academic reason for the travel

Factors that need to be examined before comparing Auburn carbon emissions totals with other institutions:

- Physical boundary of inventory (the extent of campus holdings included in inventory – some campuses included outlying units, others do not)

- Total ft^2 included in inventory (to scale for emissions per ft^2)

- Emissions per Full Time Equivalent (FTE) (to scale for number of students served)

- Scope of emissions sources included (Most campuses include Scope 1-3, but some only Scope 1&2, the standard for private business)

- Quality of the data gathered (source on campus and consistency)

- Need to convert data (e.g. transportation emissions are based on miles traveled, but many campuses only record dollars spent on transportation. This requires conversion from dollars to miles, which can be problematic.)

- Emissions factors used (As scientific research continues to refine our general understanding of the effect of greenhouse gases, the emissions factors included in calculation tools changes. Inventories performed in different years can be based on different emissions factors)

Appendix 2: Summary of Carbon Reductions for US Colleges and Universities

Compiled by Auburn Office of Sustainability (Oct 2009)

School	Target reduction amount	Target reduction date	baseline year for reduction
Arizona State Univ	100%	2025	2007
Cornell Univ	20%	2010	2008
	100%	2050	
Florida International Univ	10%	2020	2008
	25%	2030	
Ithaca College	100%	2050	2007
LaGrange College	10%	2014	2008
SUNY Buffalo	100%	2030	2006
Syracuse Univ	8%	2015	2007
	15%	2020	
	25%	2025	
U Arkansas	10% of 2005 emissions	2014	2008
	30% of 1990 emissions	2021	
	100%	2040	
UC Berkeley	25%	2014	1990
	* will set next target by 2011	2020 or 2025	
Univ Florida	3%	2012	2005
	17%	2020	
	42%	2030	
	83%	2050	
Univ Illinois-Chicago	40%	2030	2004
	88%	2050	
Univ Maryland	15%	2012	2005
	25%	2015	
	50%	2020	
	60%	2025	
	100%	2050	
Univ New Hampshire	50%	2020	2001
	80%	2050	
UNC Chapel Hill	return to year 2000 levels	2020	2000
	100%	2050	
Univ Oklahoma	40%	2050	2008
Univ South Carolina	20%	2020	2004
Univ Washington	15%	2020	2005
	36%	2035	
	57.5% below 2005	2050	
Univ Wyoming	15%	2015	2007
	25%	2020	
	100%	2050	

Targets apply to all three emissions scopes
* For a discussion of Scopes, please see the FAQ for the AU Carbon Inventory
http://www.auburn.edu/projects/sustainability/website/cap/cap_AUfaq.html

Participants in Auburn Climate Action Planning Working Groups
Fall 2009 and Spring 2010

Executive Review Committee

April Staton – A&P Assembly Chair
Bliss Bailey – Exec. Director; OIT
Bob Ritenbaugh – Asst. VP Auxiliary Services
Clair Crutchley – Assoc. Professor, Finance, Chair-Elect University Senate
Daniel King – Asst. VP Facilities
Judy Woodrow – Staff Council Chair
Kathryn Flynn – Mosley Assoc. Professor, Forestry, Chair University Senate
Kim Trupp, Director – Housing and Residence Life
Shawn Asmuth – Exec. Director; Procurement and Payment Services
Thomas Tillman – Director; University Planning
W. Gaines Smith – Extension Director; Alabama Cooperative Extension System
Lindy Biggs – Director; Office of Sustainability
Matthew Williams – Program Manager; Office of Sustainability
All Working Group Chairs

Working Groups

Energy

Chair:
Ken Martin – Campus Energy Manager, Facilities Energy & Utility Management

Participants:
Sushil Bhavnani – Professor; Mechanical Engineering
Mike Brackin – Building Manager; COSAM
Jim Bannon – Director, Outlying Units; Agriculture & AAES
Cindy Selman – Director; Management Accounting
Steve Taylor – Professor, Head & Director; Biosystems Engineering
Bliss Bailey – Exec. Director; OIT
Steve Knowlton – Professor; Physics
Mark Barnett – Professor; Civil Engineering
Julie Rodiek – Research Engineer; Space Power Institute
Wes Wood – Professor; Agronomy & Soils
Chad Tyler – Student; Building Science
Steve Nelson – Assoc. Dir., Environment Health & Safety; Risk Management & Safety
Mark Tatum – Asst. Professor; Building Science

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Intern:
Alexander Pfeiffenberger – Student; Computer Engineering

IT
Chair:
Scott Santos – Asst. Professor; Biological Sciences

Participants:
Bliss Bailey – Exec. Director; OIT
Aaron Colley - Manager, IT; OIT
Jeff Stallworth – Manager; OIT
Darrell Crutchley – IT Specialist ; Liberal Arts
Mark Bransby – IT Specialist; Agriculture & AAES
Orlando Acevedo – Asst. Professor; Chemistry
Asim Ali – IT Specialist; College of Ed, Learning Resources Center
Glenn Adams – Manager, IT; Facilities

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Interns:
Kate Simpson – Student; Electrical Engineering
Alexander Pfeiffenberger – Student; Computer Engineering

Purchasing
Co-Chairs:
Melissa Morris – Asst. Director, Accounts Payable; Procurement & Payment Services
Missty Kennedy – Manager, Procurement; Procurement & Payment Services

Participants:
Leigh Jacobson – Recycling and Solid Waste Clerical Asst.; Facilities Division
Debby Miller – Manager, Accounting, Central; Procurement & Payment Services
Robin Jaffe – Assoc. Professor; Theater
Luke Fargason – Student; Business
Ursula Sandefur – IT Manager; OIT

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Intern:
Emily Vollers – Student; Intl. Business

Transportation
Chair:
Cathy Love – Campus Civil Engineer; Facilities

Participants:
Rod Turochy – Assoc. Professor; Civil Engineering
Becki Retzlaff – Asst. Professor Planning; Architecture

Raf Egues – Communication and Outreach Coordinator; Sustainability
Don Davino – Instructional Tech Specialist; Pharmacy
Ben Song-yul Choe – Assoc. Professor; Civil Engineering
Aaron Shapiro – Asst. Professor; History

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Interns:
Corey Farmer – Student; Mechanical Engineering
Kate Simpson – Student; Electrical Engineering

Buildings
Chair:
Richard Burt – Professor and Head; Building Science

Participants:
Norbert Lechner – Professor Emeritus; Building Science
Richard Brinker – Dean and Professor; Forestry & Wildlife Science
Marc Taylor – Assoc. Professor; Building Science
Christopher McNulty – Assoc. Professor; Art
Justin Miller – Asst. Professor; Architecture
Susie Fagg – Student; Architecture
John Mouton – John Edward Wilborn Chair; Building Science
Mark Aderholdt – Director Design Services, Facilities
Paula Peek – Assoc. Professor; Interior Design
John Thompson – Student; Architecture
Darren Olsen – Asst. Professor; Building Science
Melanie Duffey – Instructor; Interior Design

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Interns:
Sarah-Ashley McCall – Student; Building Science
Clinton Cook – Student; Building Science

Grounds
Chair:
Charlene LeBleu – Assoc. Professor; Landscape Architecture

Participants:
Gary Keever – Professor; Horticulture; AU Landscape Services
Nanette Chadwick – Assoc. Professor; Biological Sciences
Charlie Crawford – Superintendent; Landscape Services
Michael Hein – Professor; Building Science
Art Chappelka – Professor; Forestry and Wildlife Sciences

Dee Smith – Head Curator; Donald E. Davis Arboretum
Luke Marzen – Assoc. Professor; Geology and Geography
Will McCartney – Student; Civil Eng.

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Intern:
Linsey Grace – Student; Interior Design

Campus and Community Engagement
Chair:
Lisa Kensler – Asst. Professor; Educational Leadership

Participants:
Brigitta Brunner – Assoc. Professor; Journalism and Communications
Tim King – Advisor, Student Programs; VP Student Affairs
Gina Murray – Outreach Programs; Professional & Continuing Education
Beth Lawrence – Development Officer; Cooperative Extension & NRMDI
Shanna Brodbeck – Specialist, Disability Program; Students with Disabilities
Emma Mulvaney – Communication and Outreach Coordinator; Sustainability
Shannon Bryant-hankes – Communications and Marketing; Alumni Affairs
Nancy Robinson – Admin. Specialist ; COSAM
Megan Lupek – Graduate Student.; Forestry and Wildlife Sciences

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Intern:
Christi Talbert – Student; Nutrition

Food and Dining
No Chair

Participants:
Gina Murray – Outreach Programs; Professional & Continuing Education
Emil Topel – Executive Chef; Tiger Dining
Katie Jackson – Chief Editor; Agriculture & AAES
Jan Garrett – Research Fellow III; Plant Pathology
Hunter Morgan – Student; Public Administration
Jayme Oates – Research Associate; Water Watch
Olivia Martin – Student; English
Blair Stapp – Student; Graphic Design
Sabra Sweetland – Student; Education

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Supporting Sustainability Intern:
Christi Talbert – Student; Nutrition

Students
Co-Chairs:
Nathan Warner, Student; Biosystems Engineering
Michael Tiemeyer, Graduate Student; Mathematics

Participants:
Bethany Stillwell
Cate Babin
Claire Chapman
Stephanie Sizemore
Elizabeth Folmar
Camilla Thompson
Alison White
Ashley Smith
Elizabeth Robbins
Haley Porter
Cat Philips
Rebecca Campomanes
Kelsey Lott
Cailin Thomas
Nicole Arnett
Sarah Harrell
Rob Reid
Katie Lushington
Devin Jenkins
Mark Kleist
All students on specific Wgs as well
All AUOS interns

Supporting Sustainability Staff:
Matthew Williams – Program Manager; Office of Sustainability

Appendix 4 – AU Energy Projects (ongoing or under consideration) – Mar 2010

1. **HVAC Programming**
    1. Occupied/Unoccupied Modes
    2. Limit Thermostat Adjustment Range
    3. Static Pressure Reset
    4. Chilled Water Set Point Reset
    5. Hot Water (Domestic & Heating) Set Point Reset
    6. CO_2 Monitoring

2. **Lighting Control Systems**
    1. Occupancy Sensors
    2. Digital Timers (i.e. Mechanical, Electrical, Telecom Rooms)
    3. Programmable Lights

3. **Lighting Retrofits**
    1. Conversion of bulbs from T12's to T8's
    2. LED Lighting

4. **Continuous Commissioning / Recommissioning**
    1. Cimetrics
    2. Bes-Tech
    3. Energy Modeling
    4. Real Time Energy Data

5. **Air Filter Optimization**

6. **Vending Machines**
    1. Vending Misers
    2. Energy Star Machines
    3. Delamping

7. **Computer Savings**
    1. Sleep Mode
    2. LED vs. CRT Monitors

8. **Personal Practices**
    1. Managing Plug Loads
    2. Light Management
    3. Personal Appliances
    4. Dressing to the Environment
    5. Understanding Work Environment (Thermostat Locations, Opening Windows etc.)
    6. Incentive for use of utilities?

9. **Renewable Energy**
    1. Biomass Study
    2. Cogeneration (CHP)
    3. Solar

Auburn University Green Revolving Loan Fund Proposal
Buildings Working Group

Overview: The mission of the Auburn University Green Revolving Loan Fund (GRLF) is to encourage global sustainability on campus by funding innovative projects that demonstrate environmental leadership and economic benefit. As an independent fund at Auburn University administered by a range of representatives from the campus community, the GRLF will fund renewable energy, energy efficiency and other cost-saving projects that further the sustainability of campus operations.

Most large organizations, like Auburn University, separate the budgets of capital projects, utility spending, and maintenance costs. In most cases, a capital projects manager is not inclined to spend extra money that will not directly benefit his or her own budget. The problem with this approach is that incremental capital spending (on, for example, more efficient heating and cooling systems) can result in significant savings in utility and maintenance costs over the lifetime of the facility.

Our proposed solution is a green revolving loan fund, which provides interest-free capital for up-front investments, and is repaid by the savings – such as reductions in electricity bills or reduced maintenance costs — over the lifetime of the facility. These funds require that projects return slightly more money to the fund than the inflation-adjusted project cost.

Savings or returns from projects funded by the GRLF are divided between the project applicant and the fund. The recipient pays a pre-determined percentage of its savings back into the GRLF until the initial costs plus an additional percentage (allowing for growth) are repaid to the fund. After that point, the recipient receives the full cost savings of the project, which can amount to over 30% of the project's costs per year. As the GRLF grows over time, its funds are constantly "revolving" — being used, earned back, and reinvested — thus sustaining the fund over time and providing ever-greater funding resources for sustainable, energy-conserving projects across campus. By reducing the institution's energy consumption, the fund will also help to protect the Auburn from energy cost spikes in the future.

The Harvard example: Revolving loan funds are a funding mechanism that has been successfully used by many colleges and universities across the country to pay for sustainability upgrades. One of the best known such funds, the Harvard Green Campus Loan Fund provides capital for high-performance campus design, operations, maintenance, and occupant behavior projects. At $12 million in value, the Loan Fund has funded over 150 projects since its inception. The payback period for projects can be no greater than five years for existing buildings and ten years for new construction, though past loans have averaged just three years for payback. Applicant departments agree to repay the fund via savings achieved by project-related reductions in utility consumption, waste removal, or operating costs. This formula allows departments to upgrade the efficiency, comfort, and functionality of their facilities without incurring any capital costs. An annual 3% administrative fee is added to the loan and the payback period is adjusted accordingly.

Financially, the investments have been extremely profitable for Harvard. In 2005, capital projects generated a return on investment of 30% (compared to a 2005 ROI of 19.2% for the Harvard endowment). As of June 2007, Loan Fund projects were projected to save the university $3.8 million per year in energy and maintenance costs. Environmentally, the fund has reduced greenhouse gas emissions by 22,000 metric tons of CO_2 (equivalent to the emissions of 10,000 cars), dropped water usage by 86 million gallons, and reduced total waste by 200,000 pounds. The Green Campus Loan Fund has been such a success that many other universities (including the University of Maine, University of Pennsylvania, Iowa State University, University of California-Berkeley, among others) are following Harvard's lead and establishing loan funds of their own.

While the goal of most projects is to improve energy efficiency, the actual projects have focused on a variety of areas across Harvard's campus. Recent projects have included the changing lighting systems, improving heating and air conditioning systems, and investing in efficient kitchen equipment in dining halls. Other projects have tackled efficiency challenges in transportation, irrigation, and solar power.

The Proposal for Auburn University:

a. Goals

- Create a mechanism for reducing the University's GHG emissions in perpetuity by dedicating cost savings to provide funding for similar projects in the future.
- Enable investments in renewable energy, alternative fuels, and energy efficiency.
- Fund pilot projects that prove the functionality and cost-effectiveness of innovative methods of emissions reductions that could then be implemented on a wider scale.
- Encourage broader societal action by exemplifying best practices in greenhouse gas mitigation.
- Encourage students, faculty and staff to be proactive and engaged in the process of transitioning the world to a sustainable future.
- Serve as a role model on sustainability initiatives for other institutions of higher education, community groups, non-profit organizations, businesses, and governmental bodies.

b. Allocation of savings: Some revolving loan funds, like Harvard, include stipulations that funding can only be used to finance projects with a certain payback period (often 5 years of less). While such provisions can help achieve a strong overall return on investment, they tend to favor projects with shorter payback periods. Rather than requiring a specific payback period, we propose that 90% of the estimated savings from GRLF projects be paid back to the fund annually until 110% of the project cost, adjusted for inflation, has been repaid. Alternatively, for longer-term projects up to a maximum of ten years, 50% of the estimated project savings should be paid back annually until 125% of the inflation-adjusted cost has been repaid. We also advocate the "bundling" of projects with short-term and long-term paybacks into single applications that have an overall payback within the specified return on investment.

Under this proposal, two types of loan programs would be created:

- Full cost loans would cover the entire cost of conservation projects for existing buildings.
- Incremental loans would cover the cost difference between code-compliant new construction and a high-performing project.

Repayment of the loan will start one year after completion of the project. Loan payments will be due annually. If savings from the project do not cover the repayment amount as scheduled, the loan applicant must internally allocate funds to repay the loan as scheduled. For projects with several identifiable components, loan repayment funds may be aggregated.

c. Usage of funds: Eligible projects include those that:

- Reduce greenhouse gas emissions
- Reduce energy use
- Reduce water use
- Reduce sewage or storm water runoff
- Reduce pollutants
- Improve operations
- Educate occupants
- Install renewable energy

Any Auburn University department or unit can apply for a loan. Applicants may include general fund units, non-general fund units, auxiliaries, on-campus units, and off-campus units. The GRLF board will evaluate proposals according to their timeframe, estimated savings rate, estimated costs, and technical feasibility. The loan repayment schedule will be negotiated on a project-by-project basis. Approved projects will require a repayment schedule along with technically sound energy audits before funding to predict rates of return. Energy savings generated from projects financed by the GRLF should be tracked annually through metering and other data analysis. [The monitoring of such projects could provide real world experience for engineering, building science, and architecture students. With faculty supervision, these students could help generate project proposals by estimating energy usage and savings as well as tracking and analyzing data for implemented projects.]

The GRLF board should develop procedures and guidelines that enable applicants to not only prove that the financed energy retrofits would pay for themselves, but also to demonstrate that the actual energy savings will exceed the originally estimated savings by at least 10%. The program's quality controls should include: technical energy assessment report guidelines; development of protocols to have each GRLF project metered and monitored to track pre- and post-retrofit energy consumption; and, the creation of methods of analyzing energy savings from retrofits.

d. Composition of the board: It is important that relevant campus bodies have an opportunity to appoint board members and that no single campus entity has full control over the fund. However, we believe that is also important to keep the board small so that it can remain effective. We propose that the board consists of two students (one chosen by the Auburn Sustainability Action Program and the other by Student Government); the Director of the Sustainability Office; the university's Chief Financial Officer; the Energy Management Engineer for Facilities; a faculty member approved by the University Senate; and an alumnus chosen by the rest of the board.

The Director of the Sustainability Office, Energy Management Engineer, and Chief Financial Officer are permanent members of the board, and the term of the faculty member will be two years. All other members will serve annual terms. Terms can be modified based on scheduling. Any board member can be reappointed by the designated body for additional terms. New, qualified board members, however, should be appointed when possible. Should a board member resign, a replacement should be chosen through the established method at the earliest available opportunity. The board will select the chair of the board for a one-year term.

e. Decision-making process: Applications for the GRLF should address the following:

Project Description

- Project Scope: Provide a basic description of the project that identifies preliminary project scope, schedule requirements, and any essential project criteria.
- Project Goals: Provide a description of what you hope to achieve with the project.
- Environmental Impact: Identify the impact your project will have on the university's energy consumption and carbon footprint.
- Potential Utility Savings: Identify the annual energy savings of your project.

Project Financials

- Schedule: Include a project schedule for design and construction.
- Estimate: Provide an anticipated project budget. This budget must include construction costs as well as design costs, project/construction management costs (if applicable), demolition costs (if applicable), inspection fees, and a reasonable construction contingency (generally 5-10%).
- Anticipated Payback: Calculate the anticipated annual savings and the anticipated time for payback of the loan through project savings.

Applicants may apply as often as they wish. However, no applicant may have more than two projects in design and/or construction at any one time.

The GRLF board will meet at least twice a term—while classes are in session—to discuss proposals if any have been proposed. The GRLF approval process has four stages. (1) All proposals will be initially reviewed by the GRLF board. As few as four GRLF Committee members constitute a quorum for initial recommendation of a proposal. (2) All proposals that are initially approved by the Committee will be presented to the GRLF board. At least one of the project's initiators must be present during this presentation in order to field questions and make any additional comments. (3) The project will then be reviewed for a second time by the GRLF board, which then decides whether or not to approve the project. The board typically will not exhaust the Fund in a single year to the extent that the amount of funding available for projects in the subsequent year is less than half that available in the current year. That is, typically at least 50% of the Fund's value in a current year must be regenerated through project or investment revenue or payback by the beginning of the following year.

The loan recipient will be expected to provide a semiannual progress report until the loan is repaid. The first report for a project should be given the semester that the project is approved, and reports are necessary until the project is deemed completed by the GRLF board. The project report must identify the current and, if applicable, the future accountable—both biased and unbiased—parties for the project and must include an update on how the project is fulfilling its economic, educational and other goals. Once a year, the GRLF board will release a public document outlining the financial performance of each individual project and the fund as a whole, and to make public the progress the university is making to become a more sustainable university community. The Energy Management Engineer will be primarily responsible for the production of this report.

f. Legal status of revolving loan fund: The GRLF is envisioned as a "dedicated fund" that is part of the university and retains Auburn's non-profit status. However, the fund should be set up under the strictures of a "covenant" with the university that precludes the use of the fund for other than its intended purpose.

The GRLF is intended to be a fund-growing mechanism, not an original funding source. It could receive its seed funding from a variety of sources including:

- Direct administrative funding
- Student fees or voluntary contributions paid with registration fees
- Grants
- Alumni contributions
- Payroll deduction options for Auburn employees

[Some schools have also invested their endowments in revolving loan funds and received a high rate of return on investment.]

Appendix 6

Auburn University Greenhouse Gas Inventory and Climate Action Plan - FAQs

Why is Auburn doing a carbon inventory and a Climate Action Plan?

In October 2008 Dr. Gogue signed the American College and University Presidents Climate Commitment, committing Auburn to performing a greenhouse gas emissions inventory and a plan to ultimately reduce the university's carbon emissions. By signing, President Gogue joined the leaders of more than 650 universities (total signatories as of Sep 2009).

What tool was used to compile and calculate Auburn's carbon inventory?

We used the campus carbon inventory calculator developed by the non-profit Clean Air Cool Planet. This calculator is generally accepted to be the standard for higher education. The data collection, input, and analysis was completed by staff of the Office of Sustainability. The campus carbon inventory calculator User's Guide provides a great deal of detail about the general process. The specifics of how AU compiled the campus carbon inventory will be included in the final report released in Oct 2009.

What greenhouse gasses (GHGs) are part of Auburn's carbon footprint?

Determining who "owns" a greenhouse gas is actually a bit tricky. As a result, a global standard has been developed that is adopted for businesses, governments, and other large institutions. The Greenhouse Gas Protocol's web site can provide detailed answers to why certain decisions are made (e.g. emissions from a student's daily commute to and from campus is considered "Auburn's", but travel from their hometown to the Auburn area is considered "theirs").

What emissions are not considered to be part of Auburn's carbon footprint?

Much like the Scope 3 category above, it can be a little confusing delineating what emissions are "owned" by Auburn because of our activities, and what emissions are owned by the students, employees, and organizations/businesses that interact with the university. Some examples of emissions that are not counted in Auburn's total carbon footprint include: student travel to and from home over breaks, the emissions associated with delivering goods to campus (e.g. Tiger Dining to-go cups, campus purchasing a product that has a lower manufacturing emissions footprint than another - this is considered an "upstream emission", and is the responsibility of the company that produces the good).

Decisions about which emissions to include as part of Auburn's carbon footprint and what to exclude were made based on what other campuses around the country have done when calculating their own emissions.

Can I directly compare Auburn's carbon footprint to another university?

In general, no. Even though most U.S. campuses use the Clean Air-Cool Planet Campus Carbon Calculator, there are still differences in how rigorous the data collection was, how much effort was made error checking the raw data, what data was available to be included (e.g. air travel is very difficult for most campuses to incorporate, for Auburn it is as well), how much of the campus physical space was included (e.g. Auburn's carbon inventory is only for activities and facilities on the main campus. AU-Montgomery, Agricultural experiment stations, Alabama Extension system are NOT included), and regional differences in Emissions factors that are used to calculate the footprint.

TREE PRESERVATION

Auburn University recognizes that trees located on its campuses are valuable natural resources. Trees are important for the protection of the environment, for the maintenance of the quality of life and for added appearance of the campuses.

Because of Auburn's land grant traditions and expertise in the fields of forestry and agriculture it is essential that the University exert leadership by example in its efforts to preserve and renew these assets.

The Board of Trustees shall direct the development and adoption of a master landscaping plan for each campus which shall show the location, species and size of existing trees and of new trees to be planted. The Board further directs the establishment of a budget and the solicitation of gifts and memorials to fund this policy.

Since its trees are a living and growing resource that appreciate over a long growth process and which have an indeterminate life span, Auburn University does hereby establish these tenets for their protection, preservation and renewal:

I. Trees will be maintained, preserved and protected at all times; and

II. Trees will be considered for removal under certain circumstances hereinafter set out; and

III. Trees may be removed only after following the procedures hereinafter established; and

IV. Trees that are removed shall be replaced where feasible.

I. TREES WILL BE MAINTAINED, PRESERVED AND PROTECTED

1. Every effort shall be made to maintain, preserve and protect trees and to keep them pruned, stabilized, and free from damages from the elements and disease.

2. Every effort shall be made to limit the removal of trees on construction sites for new and expanded buildings, roads and utilities.

3. The University Architect shall work with project architects, engineers and landscape architects to limit tree removal through appropriate site development.

4. All construction plans and specifications shall require the identification of the trees to be protected, the construction of protective barriers around protected trees which shall be maintained during the construction, and substantial monetary penalties for the destruction and damage to such protected trees.

5. No trees shall be removed without adherence to the tree removal policy set out herein.

II. A TREE MAY BE CONSIDERED FOR REMOVAL UNDER THE FOLLOWING CIRCUMSTANCES:

1. When it is determined to be dead: or

2. When it is determined to be diseased beyond preservation, as evidenced by the lack of healthy, living foliage during the normal growing season: or

3. When its location, condition or deterioration constitutes a safety hazard: or

4. When its location affects the preservation and maintenance of adjacent buildings and unduly contributes to the deterioration of the building: or

5. When the tree is damaged from the elements or disease to the extent that its appearance *is* unduly affected; or

6. When its location is determined to be an obstruction and a hazard to utility lines: or

7. When its location interferes with the construction of facilities and their site development; or
8. For any other appropriate reason.

9. The identification of the tree meeting the above circumstances shall be the responsibility of the Superintendent of the Grounds Department at each campus.

III. TREE REMOVAL PROCEDURE

1. The Superintendent of the Grounds Department shall submit a written recommendation for the removal of a tree to the Assistant Vice President of Facilities at the Auburn University campus, or to the Director of Physical Plant at the Auburn University at Montgomery campus, who shall approve or disapprove the recommendation.

2. The recommendation shall identify the location, species and reason for removal.

3. The recommendation shall also indicate whether a replacement tree should be planted, giving the location and species, or the reason if the planting of a replacement tree is not recommended.

4. Approved recommendations for removal shall be submitted to a TREE PRESERVATION COMMITTEE for each campus, which shall consist of three persons appointed by the President of Auburn University for the Auburn campus and the Chancellor of Auburn University Montgomery for the Montgomery campus.

5. The Committee shall conduct timely review of the recommendation for tree removal and replacement, and in the interest of time may conduct a telephone conference call meeting.

6. Majority approval, in writing, of the Committee is required to permit removal.

7. The President of Auburn University may overrule the recommendation of the Committee.

8. It is recognized that there may be exceptions to this policy, as follows:

   a. Emergencies where safety and preservation of facilities require immediate removal.

   b. Replacement of newly planted trees which do not survive. Replacements will be made with similar species, size and shape.

   c. Reports of removals under these exceptions shall be made to the TREE PRESERVATION COMMITTEE of the appropriate campus.

IV. TREE REPLACEMENT

1. When it is necessary to remove a tree it shall be the policy to plant a replacement tree.

2. The location and species of the replacement tree shall be consistent with the master landscaping plan for each campus.

3. Particular care shall be taken to avoid the planting of trees that would interfere with the Master Campus Plan, future designated building sites, current and projected utility locations and projected street developments.

ADOPTED: <u>3/26/90</u>

REVISED:

Executive Summary

Auburn University faces numerous challenges in the twenty-first century, not the least of which is becoming more sustainable with our resources. This was particularly evident in 2007 as a 100-year historic drought plagued much of the Southeast, and mandated restrictions on water use were commonplace. To achieve significant reductions in water use, changes must be made in the University's operations, including campus landscape development and management.

Landscape recommendations for Auburn University's campus included in this report relate to design, installation, and management of outdoor spaces, and include landscape water conservation best management practices (BMPs). Many of these recommendations are guidelines rather than definitive actions and reflect a broad goal to simplify long-term maintenance, limit the use of irrigation, and develop a campus landscape that is environmentally responsible.

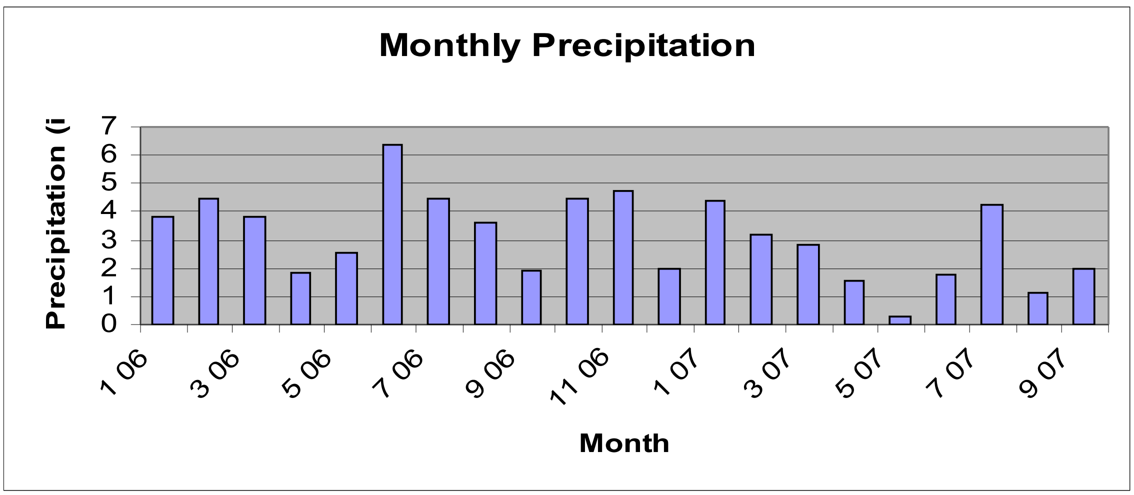
Auburn University's water conservation plan should target conserving water on a continuous basis, while a contingency plan addresses more stringent measures in times of severe water shortage. The plan should be science-based, take a systems approach, and utilize BMPs that integrate plant selection, plant adaptation, irrigation, cultural and management practices, and a change in the acceptable expectations of plant performance under sub-optimal water conditions.

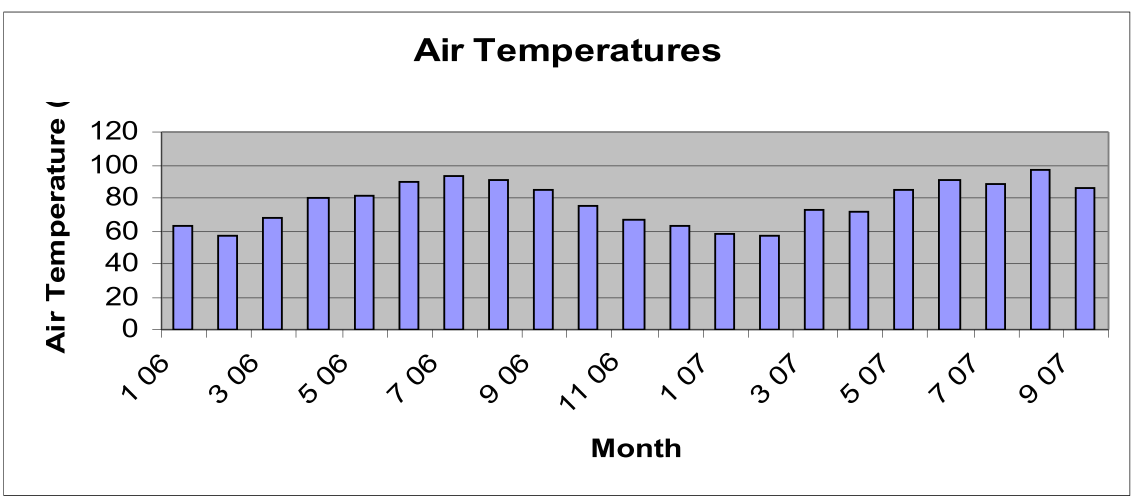
Changes in Auburn University's water conservation efforts should not end with campus landscapes, but extend to all University water use, whether it be for teaching, research, or service.

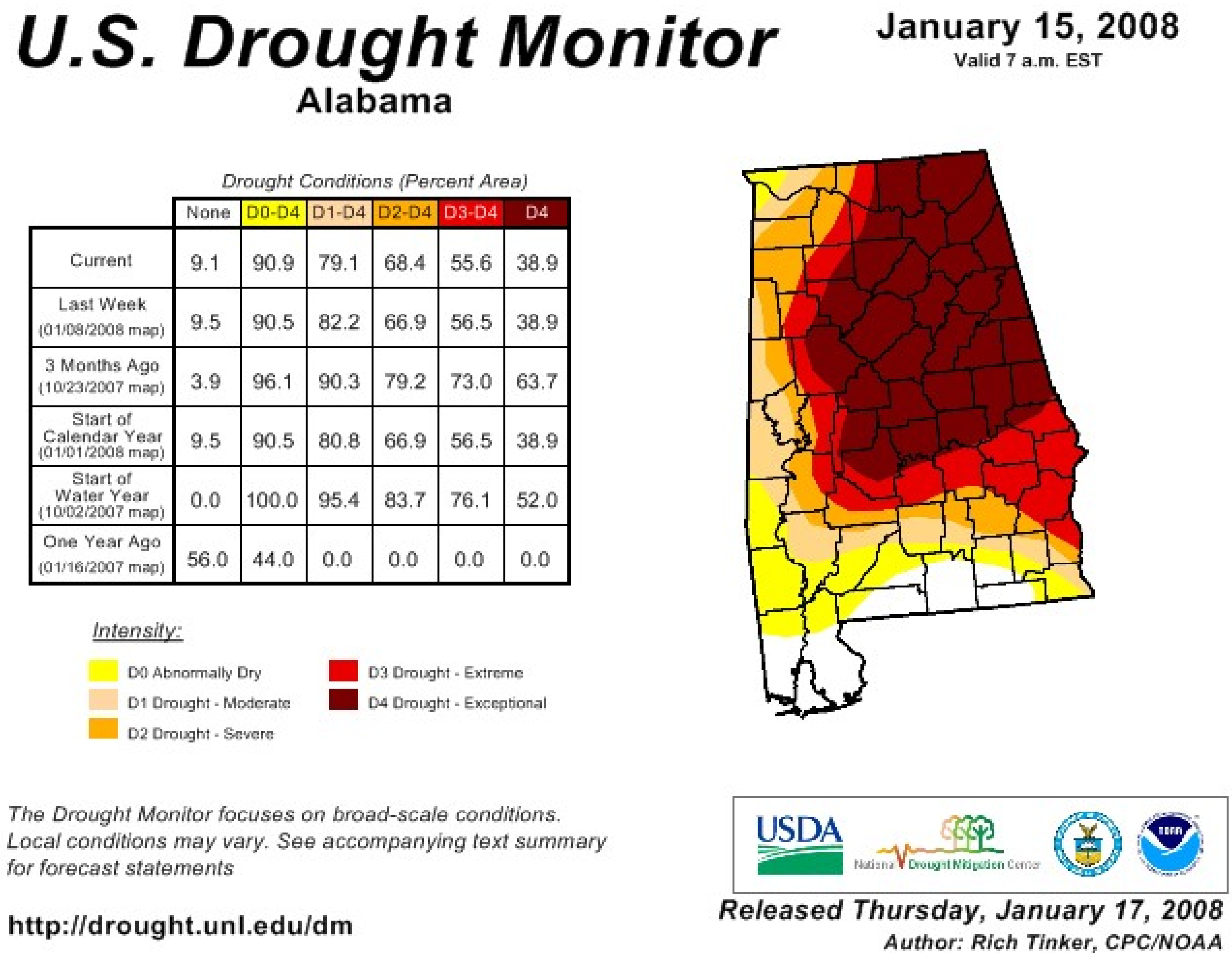
Landscape Water Management Plan for Auburn University

The southeastern United States has experienced below normal precipitation levels over much of the last five years culminating in unprecedented drought conditions and above normal temperatures in 2007 (Table 1). Drought severity in Alabama peaked the week of October 16, 2007, when over 73% of the land area was at the highest level of drought stress, D4- Exceptional. With the recent rain events the severity of the drought has lessened, but over 90% of the State remains under drought conditions (D0-D4). Forecasts call for continued below normal precipitation in 2008 which could have long-ranging environmental, economic, and social implications.

Table 1. Ambient air temperatures and monthly precipitation for Auburn, Alabama. Rainfall totals for January–September 2006 and 2007 were 32.73 and 21.33 inches, respectively; the normal for this period is 43.25 inches (Awis Weather Services).







Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
10/16/07	0.00	100.00	99.97	93.24	83.12	73.04
01/15/08	9.13	90.87	79.12	68.39	55.58	38.93

On a local level, the city of Auburn implemented voluntary outdoor water restrictions in August 2007 that continue in effect (Appendix A). Because of the number and complexities of campus landscape irrigation systems, Auburn University did not comply with the City’s voluntary restrictions. The remainder of this report will focus on recent landscape water usage, current landscape irrigation systems, and a plan for Auburn University to reduce its landscape water use.

Non-return water usage for Academics, Athletics, Contractor (President’s home grounds), Fraternities, Landscape Services, and USDA from April-September 2006 and 2007 was 57,901,600 gallons and 74,660,000 gallons, respectively, a year-to-year increase of 29% (Table 2, Appendix B). Landscape Services used 29% and 33% of these totals in 2006 and 2007 to irrigate campus landscapes and maintain plants in their nursery

Table 2. **Auburn University Non-Return Meter Water Usage***

Services Type	Total Usage by Type April-Sept. 2006	2007	% Change '06 to '07	% of Yearly Total 2006	2007
Academic	17,482,000	23,804,000	36.2	30.2	31.9
Athletic	11,367,000	11,726,000	3.2	19.6	15.7
President's Grounds	1,276,000	3,214,000	151.9	2.2	4.3
Fraternity	305,000	1,170,000	283.6	0.5	1.6
Landscape Services	16,930,000	24,514,000	44.8	29.2	32.8
USDA	10,541,000	10,177,000	-3.5	18.2	13.6
Totals	57,901,600	74,660,000			

*Totals don't include chilled water use.

and greenhouse areas. Landscape Services maintains 28 non-return water meters that supply irrigation to approximately 62 acres of campus landscape (map, Appendix C). Additional areas including those surrounding Gorrie Building Science (1 NR meter), Nichols Building (NR meter removed), and Parking Deck II (2 NR meters), and the Garden of Memory, are maintained without permanent irrigation systems. Beginning in April, zones with gear-driven heads are irrigated for about 30 minutes/cycle once per week, while spray zones are irrigated for about 10 minutes/cycle. Some variance in frequency and duration of cycles exists because of different soil conditions, plant needs, and system design. The frequency and duration of irrigation are adjusted, usually up, as the season progresses, based on plant needs. Generally, zones are irrigated twice/week when there is normal rainfall, but up to four times/week under extreme drought conditions such as occurred in 2007.

Recommendations

Landscape recommendations for Auburn University's campus relate to design, installation, and management of outdoor spaces, and include landscape water conservation best management practices (BMPs). BMPs are practices that integrate plant selection, plant adaptation, irrigation, cultural and management practices, and a change in the acceptable expectations of plant performance under sub-optimal water conditions. The primary objective of these BMPs is to reduce landscape water use, not just during periods of drought, but throughout the year. BMPs are designed to be economical, practical, and sustainable while maintaining a healthy, functional landscape. Many of the recommendations are guidelines rather than definitive actions and reflect a broad goal to simplify long-term maintenance, limit the use of irrigation, and develop a campus landscape that is environmentally responsible.

Specific Recommendations Related to Campus Landscapes

1. Define and prioritize landscape areas. A system of landscape areas with varying maintenance and water requirements should be established for the allocation of resources. This approach will facilitate practical planning for landscape

maintenance and operations budgets. The areas maintained by Landscape Services have been prioritized in appendix D based on visual and historical importance, and an irrigation priority ranking assigned to each. An exception to area priorities is newly installed plantings; these require more frequent irrigation during establishment. In general, newly planted shrubs require 2 or 3 weekly irrigations during the first growing season to survive. Turfgrasses sodded during the growing season should be watered 2 or 3 times a day for the first 7 to 10 days, then every other day for 7 days. After 30 days, irrigate as needed, generally when 30% of an area shows signs of wilt. Newly planted trees require at least 2 to 3 gallons of water per inch of trunk diameter applied to the root ball 2 or 3 times per week until establishment. Establishment takes 3 to 4 months per inch of trunk diameter. Various commercial bags are available for the slow application of water to trees.

2. Coordinate plant selection for all new landscapes and renovation of existing landscapes with the irrigation priority of the area and soil conditions. This will insure that water requirements of plants are met even when irrigation inputs are low. Recognize it may be necessary to relocate some plants and replace others in existing landscapes. A list of landscape plants adapted to Alabama and their water requirements are included in appendix E. This list, while including most species with landscape value and adapted to central Alabama, is not all-inclusive. Plants selection should not be made entirely on water requirements. Whenever possible, plants native to Alabama should be used. Plants should be non-invasive, generally have low maintenance requirements, free of diseases and pests, adaptable to specific soil and light conditions, and have aesthetic qualities that complement the area and campus as a whole. Plant diversity should recognize the Land Grant roots of Auburn University and the role campus landscapes serve in teaching, but not at the expense of visual unity and good design. An evaluation of the planting soil, including its structure, texture, water-holding capacity and drainage, should be routine. The physical and chemical characteristics of the existing soil should serve as a guide in determining what soil improvements are needed.

3. Use grasses with superior drought resistance/low water use as a primary means of reducing water needs on turfgrass sites. Turfgrass selection and management should focus on minimizing water use while maintaining acceptable quality and persistence. Currently, turfgrasses are established by sodding with either ‘Emerald’ zoysiagrass or 319 bermudagrass, two species that respond very differently to drought stress. Bermudagrasses have lower water requirements than zoysiagrasses (bermudagrasses: 1/2” or less per week to stay green, almost no water if dormant) vs. zoysiagrasses: 3/4” per week to stay green), are more traffic tolerant (high vs. fair tolerance), and recover from drought stress more quickly. Because of their deep root systems, bermudagrasses can remain green with 14-21 days between irrigations, dependent upon soil type, management level, and atmospheric conditions, while zoysiagrasses require weekly irrigation to remain green. Bermudagrasses also are more tolerant to soil salinity than zoysiagrasses, a potential condition if non-potable water sources are used for irrigation.

Bermudagrasses perform poorly under low light conditions, and should not be used in areas shaded by buildings, trees, or other structures.

4. Concentrate seasonal color (annuals and perennials) in high-impact areas where the extra required resources are warranted. In general, most annuals used in seasonal color displays are shallow-rooted and have high water requirements, while herbaceous perennials tend to have deeper root systems. However, herbaceous ornamentals vary widely in their tolerance to drought (see appendix E) but are rarely as drought tolerant as permanent plantings. The following guidelines should be followed:

    a. Prepare beds by running soil tests, adding organic matter, and avoiding luxury fertilizer applications
    b. Incorporate hydrogels, synthetic polyacrylamide or starch-based organic compounds capable of holding several hundred times their weight in water, into the soil. Also, use hydrogels in container plantings.
    c. Locate plants with similar water needs together in beds
    d. Select drought tolerant plants
    e. Control weeds which compete for moisture
    f. Minimize other stresses
    g. Use organic mulches
    h. Recognize some irrigation will be required, but when water restrictions apply these plants are less costly to replace than trees and shrubs.

5. Soil compaction from foot, equipment, and vehicular traffic, while a daily occurrence on Auburn's campus, should be managed on a continuous basis. Compaction reduces aeration, infiltration, drainage, and water-holding capacity and increases the physical resistance (impedance) that roots must overcome to extend through soil. The end result is reduced root growth and development and a greater sensitivity to drought stress. Trees, shrubs, herbaceous plants, and turf all suffer from soil compaction. Relief of soil compaction is accomplished by aerification, which in turf typically includes punching holes of varying diameter and depth into the soil. If cored, holes should be filled with sand. Heavily compacted soils should be aerified at least once per year (May-August), and more often (up to 4xs per year) if possible. Addressing soil compaction is vital to plant health, as well as to facilitating proper water management, especially of turfgrasses, to minimize water runoff during irrigation and rain events.

5. Avoid frequent turfgrass fertilization, especially nitrogen, which increases the amount and frequency of irrigation needed.

6. Manage thatch buildup in turfgrasses. Thatch slows water movement into the soil which increases water loss through run-off and evaporation, and thatch encourages a shallow root system. Excess thatch formation is promoted by over-fertilization, high mowing heights, frequent and short irrigations, and excess pesticide application. Dethatching with a vertical mower or other equipment should be done when the

thatch layer exceeds ½ inch. Core aeration at least twice a year reduces the rate of thatch development, increases water infiltration and reduces water run-off by relieving soil compaction.

7. Maximize tree use in campus landscape designs. Trees provide shade, reduce stormwater runoff, stabilize soil, reduce evaporative water loss, improve air quality and conserve energy. Trees also enhance the appearance of campus which has a positive influence on human behavior characteristics such as improved ability to concentrate and self-discipline. These attributes are thought to translate into improved academic achievement and fewer destructive tendencies. Indirect economic benefits of trees from lower energy consumption occur when power companies are able to use less water in their cooling towers, build fewer new facilities to meet peak demands, use reduced amounts of fossil fuel in their furnaces, and use fewer measures to control air pollution. Communities also save money if fewer facilities must be built to control storm water.

8. Develop non-potable water sources for landscape irrigation: runoff collected in ponds, reclaimed water, and wastewater. However, these water sources often contain significant contaminants, including high salt levels. Turfgrasses used on campus should not only be drought tolerant, but resistant to high salt levels often found in poorer quality water.

9. Incorporate efficient irrigation system design and management.

   a. Design for uniformity of application to minimize wet and dry areas: correct head spacing, proper head and nozzle selection.
   b. Minimize or eliminate irrigation of hardscapes.
   c. Zone similar areas together. A zone should be an area of similar soil, water requirements, slope, and climatic conditions. Don't mix sunny and partially shaded areas because of substantially reduced water usage in shade.
   d. Design a landscape plan before designing an irrigation system. Most current campus irrigation systems do not separate trees, shrubs, and ground covers into different zones from turfgrasses, a sound practice due to different watering needs; this should be done when feasible in future irrigation designs.
   e. Use drip or micro-spray irrigation in non-turf plantings when practical.
   f. Match application rate to soil infiltration rate.
   g. Apply enough water to soak the soil to a depth of 6 to 8 inches. This is usually equivalent to about one inch of water but will vary with different soils. Most sprinklers apply about one-fourth inch of water per hour. Test the depth of water penetration with a spade or soil probe two to four hours after irrigation. If water is being applied faster than the soil can absorb it, adjust the time clock to allow absorption, change to lower volume nozzles, and address soil compaction.

h. Apply overhead irrigation between 9 p.m. and 8 a.m., unless area use dictates otherwise. During this period, less wind and lower temperatures generally occur, reducing evaporative water loss. Drip irrigation systems can be operated any time of day because of minimal evaporative water loss and foliage remains dry.
i. Only water when necessary using plant appearance as a guide. Plants often wilt during the heat of the day but recover during the evening. However, if plants remain wilted the following morning, irrigation is needed. Include rain shut-off controls or turn off automatic sprinkler systems following or during significant rainfall.
j. Use low volume heads when appropriate.
k. Use multiple irrigation cycles (pulse) in areas of compacted soil to allow infiltration of water into the soil.
l. Monitor systems at least weekly for pipe leakage, head position, and other maintenance needs. Area supervisors and support staff can be trained to do this. As plants grow, trim or remove vegetation that interferes with applicator pattern or relocate heads to maintain the intended distribution of irrigation water.
m. Hand water selected plants that show signs of drought stress during dry periods when feasible.
n. Charge each supervisor with monitoring plant water needs in his/her areas and determining when to irrigate based on plant needs and an area's priority. Supervisors may require some guidance in making these decisions.
o. Monitor monthly water use in all areas with a goal of reducing yearly water use by 25% campus-wide compared to 2006 and 2007 usage.
p. Perform a thorough irrigation system inspection annually (Appendix F).

10. Use irrigation scheduling technology to reduce water runoff, leaching, and excess evaporation losses. Technological tools available are a) soil-based (to monitor soil water status), b) plant-based (to monitor plant water status, and c) atmospheric (to monitor atmospheric conditions that influence evapotranspiration rates). Of these tools, soil moisture sensors including porous blocks, thermal dissipation blocks, tensiometers, and dielectric constant probes may be the most cost effective (Appendix G). Sensors could monitor water flow, water pressure, rain shutoff, wind speed, soil moisture, plant canopy conditions, pipe leakage, proper functioning of valves/heads, weather data and ET information. Incorporate computer software programs that can integrate sensor information into useable formats for turf managers and allow electronic transfer of data off-site when educational/consulting support is required.

11. Irrigation systems: Test irrigation system output and uniformity by placing several open-top containers of the same size throughout a zone. After irrigating, quantify the container volumes to estimate water distribution and application rate. System modifications (nozzles type, head location, zoning) are necessary if differences in irrigation volumes exceed 25%.

12. Provide continuing education to landscape managers and grounds crews to assist managers in developing comprehensive best management practices (BMPs) in water conservation for specific areas they are responsible for. Landscape Services currently contracts employee training; one or more sessions should focus on understanding plant water needs and sound water management.

13. Turfgrass and landscape plant management under drought conditions:
   a. During moisture stress periods, raise the mowing height and mow frequently enough to not remove more than 1/3 of the leaf-tissue. Raising the mowing height helps the turfgrass maintain a deeper root system.
   b. Irrigate turfgrasses only when showing visible signs of moisture stress, usually when the turfgrass appears dull and bluish green, leaf blades fold or roll, and footprints remain after walking over an area. Bermudagrasses will go dormant under drought stress, but recover relatively quickly following irrigation or rainfall, while zoysiagrasses are much slower to recover.
   c. Irrigate between sundown and sunrise when the wind and temperatures are lower.
   d. Apply water absorbing polymers (hydrogels) to soils. Hydrogels absorb several 100 times their weight in water and slowly release it to plant roots. This may be especially valuable in beds of summer annuals and containers.
   e. Apply water through drippers to the soil under the canopy of valuable trees every two weeks. This is especially important for large trees with damaged root systems.
   f. Avoid planting shrubs and trees and sodding turfgrasses during dry conditions and high temperatures when possible.

14. Monitor water conservation by one or more of the following:
   a. Documentation of water use relative to plant performance. Compare monthly water use for each non-return landscape meter to use for the same period in the previous two years. Determine possible causes of water use above targeted goals, such as new plantings, and attempt to address shortcomings. Identify drought-related effects on plant health and solutions to the problems, while conserving water. Plants may have to be replaced, growing environment modified, or both.
   b. Periodic site audits to identify leaks, irrigation head malfunction, design limitations, irrigation scheduling problems, or other factors that may waste water. Systems should be audited at least monthly.
   c. Use of detailed soil moisture data by depth from soil sensors to justify irrigating during drought periods.

Broad Recommendations for Campus Planning

1. Strive to make campus landscape development and management sustainable. The Preliminary Report on the Standards and Guidelines for Sustainable Sites (November 1, 2007), the first report of the Sustainable Sites Initiative, is an excellent starting point, and includes such recommendations as a) eliminate potable water use in the landscape and b) manage water on-site.

2. Auburn University's water conservation plan should target conserving water on a continuous basis, while a contingency plan addresses more stringent measures in times of severe water shortage. The plan should be science-based, take a systems approach, and utilize Best Management Practices that integrate plant selection, plant adaptation, irrigation, cultural and management practices, and a change in the acceptable expectations of plant performance under sub-optimal water conditions.

Literature Cited

Augustin, B. J. and G. H. Snyder. 1984. Moisture sensor-controlled irrigation for maintaining bermudagrass turf. Agron. J. 76:848-850.

Bosmans, R. 2001. Xeriscaping and conserving water in the landscape. https://extension.umd.edu/sites/default/files/_images/programs/hgic/Publications/HG25_Xeriscaping_and_Conserving_Water_in_Landscape.pdf

Brown, R. W., and D. M. Oosterhuis. 1992. Measuring plant and soil water potentials with thermocouple psychrometers: some concerns. Agron. J. 84:78-86.

Carrow, R. N. and R. R. Duncan. 2000. Strategies for water conservation in turfgrass situations.

Carrow, R. N., R. R. Duncan, and C. Waltz. Overview of water conservation strategies on turfgrasses. http://commodities.caes.uga.edu/turfgrass/waterconservation/

Evans, E. 2000. Drought tolerant annuals. N.C. State Coop. Ext. Svc. http://www.ces.ncsu.edu/depts/hort/consumer/quickref/flowers/annuals-drought.html

Freeland, R. S., L. M. Callahan, and R. C. von Bernuth. 1990. Instrumentation for sensing rhizosphere temperature and moisture levels. Applied Engineering in Agriculture. 6:219-223.

Irrigation Association. 2004. Turf and landscape irrigation best management practices. https://www.irrigation.org/landscapebmps/. 50 pp.

Knox, G. W., S. M. Scheiber, L. Trenholm, A. Shober, K. A. Moore, M. del Pilar Paz and E. F. Gilman. Coping with drought in the landscape.

Landry, G., and K. Harrison. 2000. Water-use restrictions could help lawns. Georgia Faces, June 20. (http://georgiafaces.caes.uga.edu/storypage.cfm?storyid=953).

Landry, G. 2000. Help your lawn use rain, irrigation better. Georgia Faces, April 18. (http://georgiafaces.caes.uga.edu/getstory.cfm?storyid=903).

Landry, G. Proper water management key to turfgrass drought stress. Drought in Georgia Fact Sheet.

Landry, G. 2000. Turfgrass water management. Georgia Cooperative Extension Leaflet 399.

Morgan, W. C., J. Letey, S. J. Richards, and N. Valoras. 1966. Physical soil amendments, soil compaction, irrigation, and wetting agents in turfgrass management I. effects on compactability, water infiltration rates, evapotranspiration, and number of irrigations. Agron. J. 58:525-528.

Morgan, W. C., and A. W. Marsh. 1965. Turfgrass irrigation by tensiometer-controlled system. Calif. Agric. 19(11):4-6.

Sasaki Associates. June 2003. St. Edward's University Landscape Master Plan.

Smith, S. W. 1997. Landscape Irrigation Design and Management. John Wiley & Sons, Inc.

Snyder, G. H., B. J. Augustin, and J. M. Davidson. 1984. Moisture sensor-controlled irrigation for reducing N leaching in bermudagrass turf. Agron. J. 76:964-969.

Song, Y., J. M. Ham, M. B. Kirkham, and G. J. Kluitenberg. 1998. Measuring soil water content under turfgrass using the dual-probe heat-pulse technique. J. Amer. Soc. Hort. Sci. 123:937-941.

Univ. Georgia Coop. Ext. Svc. 2007. Best management practices for landscape water conservation. The University of Georgia College of Agricultural and Environmental Sciences and the USDA.

Wade, G.L., J. T. Midcap, K.D. Coder, G. Landry, A. W. Tyson, and N. Weatherly Jr. 1992. Xeriscape: a guide to developing a water-wise landscape. University of Georgia Cooperative Extension Bulletin 1073.

Appendix A

Press Release
For Immediate Release
August 14, 2007
Auburn Water Works Board to Implement Voluntary Outdoor Water Restrictions
Auburn, Ala. – During the last several weeks, Auburn has experienced rainfall deficits and record temperatures. These conditions have created a spike in water demands throughout the City. The Water Works Board of the City of Auburn has sufficient water supplies to meet the regular needs of its customers; however, if the current demand on water for landscape and irrigation practices continues, it will put a strain on the water supply. Effective immediately, the Water Works Board is asking customers to participate in voluntary outdoor water restrictions based on the odd/even street number system. Customers with an even number street address are asked to water on Mondays, Wednesdays, and Fridays between the hours of 10:00 p.m. and 6:00 a.m. Customers with an odd number street address are asked to water on Tuesdays, Thursdays, and Saturdays between the hours of 10:00 p.m. and 6:00 a.m. There should be no outdoor watering on Sundays. The Water Works Board has an ample supply of water to meet the day-to-day needs of its customers for public health and emergency purposes; however, the Board is asking customers to be responsible stewards of our natural resources and participate in the voluntary restrictions in an effort to control excessive water use and eliminate the need for mandatory restrictions. After a two week trial period of the voluntary restrictions, the Water Works Board will reevaluate the situation to determine if mandatory restrictions will be necessary. Customers are reminded of the following steps to make the most efficient use of watering year-round, especially during voluntary restrictions:

- Do not water your street, driveway, or sidewalk. Position your sprinklers so that your water lands on the lawn and shrubs and not the paved areas.
- Do not leave sprinklers or hoses unattended. Your garden hose can pour out 600 gallons or more in only a few hours. Use a kitchen timer to remind yourself to turn off the water.
- Water during off-peak demand hours, between 10:00 p.m. and 6:00 a.m.
- Check sprinklers and outside water connections for leaks.

The American Water Works Association defines water conservation as doing more with less, not doing without. By working together, we can help preserve Auburn's water supply year round and possibly prevent the need for mandatory water restrictions.
For more information, please contact the Water Works Board of the City of Auburn at 501-3060.

Appendix B

Table 2. Prioritization if campus landscapes based on irrigation allocations.

Key	Area	Division	Priority*
1	Agricultural Eng. Bldg, Corley Bldg	LandServices	Moderate
2	Animal Science Bldg	LandServices	Moderate
3	AU Medical Clinic	LandServices	Moderate
4	Biol. Res. (Satellite Steam Plant)	LandServices	Moderate
5	Building Science	LandServices	Moderate
6	Business Bldg./Shelby Bldg.	LandServices	Moderate
7	Cary Hall	LandServices	Moderate
8	Cater Hall	LandServices	Moderate
9	Chemistry Bldg	LandServices	Moderate
10	Comer Hall	LandServices	Moderate
11	District Energy Plant Irrigation	LandServices	Low
12	Draughon Library	LandServices	Moderate
13	Facilities Div. Irrigation	LandServices	Moderate
14	Forestry Building	LandServices	Moderate
15	Funchess Hall	LandServices	Moderate
16	Glanton House	LandServices	Low
17	Harbert Engineering Bldg	LandServices	Moderate
18	Intramural Fieldhouse Biggio Dr.	LandServices	Low
19	Jule Collins Smith Museum of Art	LandServices	Moderate
20	Langdon Hall Irrigation	LandServices	Moderate
21	Life Science Bldg	LandServices	Moderate
22	Miller Hall	LandServices	Moderate
23	Nichols and ROTC Services Bldg	LandServices	Low
24	Overton-Rudd	LandServices	Moderate
25	Parking Deck (2 meters)	LandServices	Low
26	Pebble Hill	LandServices	Moderate
27	Poultry Science	LandServices	Moderate
28	Ross Hall	LandServices	Moderate
29	Samford Park Irrigation	LandServices	High
30	Science Center Auditorium	LandServices	Moderate
31	State Diagnostic Lab	LandServices	Moderate

Priority*	Frequency	
Low	not irrigated except under extreme conditions:	Irrigate to keep plants alive
Moderate	irrigated occasionally (managed):	Some wilting acceptable
High	irrigated regularly (managed):	Irrigate to minimize wilting

Under drought conditions reduce irrigation frequency and duration of moderate and high areas.

Appendix C

Irrigation Requirements for Landscape Plants on Auburn University's Campus

Irrigation Regime
1= regular irrigation (managed)
2= occasional irrigation(managed)
3= low/no irrigation (natural rainfall)

Plant Category Scientific Name	Common Name	Irrigation Regime* 1	2	3
Deciduous Canopy Trees				
Acer floridanum	Florida Maple	*	*	*
Acer rubrum	Red maple	*	*	
Acer ×freemanii	Freeman Maple	*	*	
Acer leucoderme	Chalk Maple	*	*	
Betula nigra	River Birch	*	*	
Carpinus betulus/caroliniana	European/American Hormbeam	*	*	*
Cladrastis kentukea	Yellowwood	*	*	
Fagus grandifolia	American Beech	*	*	
Fraxinus americana	White Ash	*	*	*
Fraxinus pennsylvanica	Green Ash	*	*	*
Ginkgo biloba	Ginkgo	*	*	
Koelreuteria paniculata	Golden Raintree	*	*	*
Liquidambar styraciflua	Sweetgum	*	*	*
Liriodendron tulipifera	Tulip Poplar	*	*	*
Metasequoia glyptostroboides	Dawn Redwood	*	*	
Nyssa sylvatica	Black Gum	*	*	*
Ostrya virginiana	Eastern Hophornbeam	*	*	
Oxydendrum arboreum	Sourwood	*	*	*
Pistacia chinensis	Chinese Pistache	*	*	*
Quercus acutissima	Sawtooth Oak	*	*	*
Quercus alba	White Oak	*	*	*
Quercus coccinea	Scarlet Oak	*	*	*
Quercus falcata	Southern Red Oak	*	*	*
Quercus lyrata	Overcup Oak	*	*	*
Quercus macrocarpa	Bur Oak	*	*	*
Quercus nuttallii	Nuttall Oak	*	*	*
Quercus nigra	Water Oak	*	*	*
Quercus palustris	Pin Oak	*	*	
Quercus phellos	Willow Oak	*	*	*
Quercus prinus	Chestnut Oak	*	*	*
Quercus shumardii	Shumard Oak	*	*	*
Quercus stellata	Post Oak	*	*	*
Quercus virginiana	Live Oak	*	*	*
Salix babylonica	Weeping Willow	*		
Taxodium ascendens	Pondcypress	*	*	
Taxodium distichum	Bald Cypress	*	*	*
Ulmus americana	American Elim	*	*	*
Ulmus parvifolia	Chinese Elm	*	*	*
Zelkova serrata	Japanese Zelkova	*	*	*
Evergreen Canopy Trees				
Cedrus atlanica	Atlas Cedar	*	*	*
Cedrus deodora	Deodar Cedar	*	*	*
Chamaecyparis thyoides cvs.	Atlantic White Cedar	*	*	
Crytomeria japonica	Japanese Cryptomeria	*	*	*
Cunninghamia lanceolata	Common Chinafir	*	*	*
X Cupressocyparis leylandii	Leyland Cypress	*	*	*

Appendix D

Annual Irrigation Inspection Checklist

- Maintain maps of irrigation ones for reference and recording repairs and maintenance
- Review the system components to be sure they meet the original design criteria
- Verify that the backflow prevention device is working correctly
- Verify that the water supply pressure is within 10% of the design specifications
- Verify that pressure regulators are adjusted for desired operating pressure
- Examine filters and cleaning filtration elements
- Verify proper operation of the controller, including confirmation of the correct date/time input and functional back-up battery
- Verify that sensors used in the irrigation system are working properly and are within their calibration specifications
- Adjust valves for proper flow and operation
- Adjust valve flow regulators for desired closing speed
- Verify that sprinkler and spray heads are properly adjusted by checking the nozzle size, arc, radius, and height with respect to slope
- Verify that the applicators and risers are perpendicular to the actual slope
- Verify that other kinds of application devices such as drip emitters or drip tape are not clogged and have the expected flow rates
- Repair or replace broken hardware and pipe, restoring the system to its design specifications, preferably before the next irrigation application
- Ensure that replacement hardware used for system repairs matches the existing hardware and is in accordance with the design and installation plan
- Test repairs and record any substantial changes made to the original design in the design plan records and drawings

Appendix E

Probes for Water Conservation

Tensiometers.

- When compared to a set irrigation schedule, irrigation guided by tensiometers installed at two depths (5 cm and 12.5 cm) in a clay loam soil reduced water use by 83% (Morgan and Marsh, 1965).
- Bermudagrass used 42 to 95% less water was with tensiometer-guided irrigations compared to plots that received daily irrigation (Augustin and Snyder, 1984).
- Soils were less compacted under tensiometer-guided irrigation than under set irrigation schedules (Morgan et al., 1966).
- Nitrogen leaching was reduced in a sandy soil under tensiometer-guided irrigation (Snyder, 1984).

Dielectric Probes. A new technology used to determine soil moisture is the measurement of the soil dielectric constant (DC). The DC of dry soil ranges from 2 to 5, while the accepted DC value of water is 78. Soil moisture can be determined by evaluating the difference in DC between dry soil and water. Two basic types of probes measure DC:

- Time domain reflectometry (TDR) is a technique that provides reliable, instantaneous readings. TDR operates by emitting an electromagnetic pulse from a source through a wire into two parallel probes in the soil. An instrument measures the return speed of the pulse to the source, which is a function of the DC of the soil surrounding the probes.
- Capacitance probes (CP) can be buried in the soil, are small, and are easily integrated into automated data collection systems. As a result, CP can provide real-time moisture information so managers can quickly and accurately assess moisture in individual landscapes.

Other probes.

- Parallel bare wire ends to measure soil resistivity, which was converted to soil moisture content. While inexpensive, rapid, and useful in measuring relative moisture content, sensors are sensitive to fluctuating soil temperatures and compaction, and soil salinity (Freeland et al., 1990).
- Dual probe heat-pulse technique to measure soil moisture: nondestructive, easily automated, and not sensitive to bulk density, but accuracy is subject to soil temperatures and low water content (Song et al., 1998).
- Thermocouple psychrometers (TP) determine soil moisture by measuring the relative humidity of a sample and relating it to water potential. However, due to temperature differentials when buried in the upper 12 inches of soil, reliability of TP was reduced (Brown and Oosterhuis, 1992) and the technique requires a calibration curve.

Appendix 9 – Draft Blanket Purchasing Policy Feb 2010

DRAFT Auburn University Sustainable Purchasing

Purpose:

Auburn University is committed to environmental stewardship by maintaining purchasing practices that promote and encourage the use and purchase of environmentally and socially responsible products. The University's buying staff leverage current supplier relationships to raise awareness of the purchasing considerations necessary to reduce our environmental impact and to maximize resource efficiency. We appreciate your support in this effort and are always looking to promote new or improved environmentally friendly products. We encourage and welcome your feedback; contact the University's Climate Action Plan Team (e-mail address) if you become aware of new environmentally friendly products or have questions about our program.

In support of the American College & University Presidents Climate Commitment signed by the Auburn University President, Dr. Jay Gouge, PPS encourages the purchase of environmentally friendly products that are made with post-consumer recycled content, recyclable, energy efficient, and/or bio-based products. In order to further the University's commitment to sustainability, individual departments are encouraged to purchase recycled and environmentally preferable products, when quality, performance and price are comparable to alternatives.

In our commitment to support the purchase and use of such products, sustainability requirements shall be included in all University-wide contract solicitations. Depending on the commodity, requirements may include criteria for:

- Recycled paper and paper products
- Remanufactured laser printer toner cartridges
- Energy Star Rated computers and appliances
- Rechargeable batteries
- Re-refined lubrication, hydraulic oils, and antifreeze
- Recycled plastic outdoor-wood substitutes including plastic lumber, benches, fencing, signs and posts
- Recycled content construction, building and maintenance products, including plastic lumber, carpet, tiles and insulation
- Re-crushed cement concrete aggregate and asphalt
- Cement and asphalt concrete containing glass cullet, recycled fiber, plastic, tire rubber, or fly ash

- Compost, mulch, and other organics including recycled biosolid products
- Re-manufactured and/or low or VOC-free paint
- Cleaning products with lowered toxicity
- Energy saving products
- Waste-reducing products
- Water-saving products
- Regionally Recyclable Packaging Material

Best Practices and Procurement Strategies

1. Reduce waste at the point of purchase.

Faculty, staff and students can help achieve the University's waste reduction goals by practicing the three R's: reducing, reusing, and recycling. Priority should be given to reducing waste upstream by purchasing products made from recycled material that can be reused or recycled.

- Letterhead stationery, envelopes, and business cards made from recycled paper
- Office supplies
- Recycled toner cartridges

To reduce disposal costs and waste, choose items that can be remanufactured, recycled, or composted. Many products made from recycled materials are available and are being included in the Auburn University contracts.

2. Purchase durable and reusable goods.

Using life-cycle cost analysis, rather than automatically choosing goods with the lowest purchase price, can help departments identify the best long-term value. Factor in a product's estimated life span as well as its energy, maintenance, consumable supplies and disposal costs.

- Consider durability and reparability of products prior to purchase.
- Invest in goods with extended warranties. Conduct routine maintenance on products/equipment.
- Save money and minimize waste by eliminating single-use items, such as non rechargeable batteries, in favor of rechargeable batteries. Use rechargeable cartridges.

3. Buy goods in bulk or concentrated form.

This practice can significantly reduce the packaging associated with lower product quantities and save costs. Carefully estimate demand when purchasing in bulk; purchasing more than is needed can create excess that becomes waste.

[elaboration specifically about packaging of items (either minimizing, or specifying recyclability)]

4. Manage surplus effectively.

Auburn University can reduce waste by eliminating excess purchases. Reviewing past needs can minimize the procurement of unneeded items. On a periodic basis, clean out your office supply cabinet prior to placing orders for additional products. Utilize Surplus Property services for disposing of unwanted, out-dated property. Surplus Property will effectively redistribute, recycle, or dispose of surplus items. For more information see Surplus Property web site: http://www.auburn.edu/administration/auxiliary_services/property/.

5. Procure commodities that are certified to meet sustainability standards.

Paper and Forest Products:

- Forest Stewardship Council www.fsc.org
- Chlorine Free Products Association www.chlorinefreeproducts.org

Electronics and Appliances:

- Energy Star www.energystar.gov/purchasing
- Electronic Product Environmental Assessment Tool (EPEAT) - www.epeat.net

Cross-sector:

- Environmental Choice www.environmentalchoice.com
- Green Guard www.greenguard.org
- Green Seal www.greenseal.org
- Scientific Certification Systems www.scscertified.com

Renewable Energy:

- Green-e www.green-e.org

Building Practices and Indoor Air Quality:

- Green Building Council (LEED) www.usgbc.org/leed

Vehicles

- Federal Fuel Economy Summary www.fueleconomy.gov

6. Procure remanufactured goods and use refurbishing services.

It is generally much less expensive to buy remanufactured goods such as remanufactured toner cartridges, or to use refurbishing services for computer upgrades, carpet repair, and furniture reupholster, than to buy new items. "Recharged" toner cartridges typically save departments 30 to 50 percent per sheet of paper. Remanufactured items should require no sacrifice in performance. Check with PPS for current contracts in place for remanufactured products.

7. Purchase goods containing fewer toxic constituents.

By procuring goods with fewer or no toxic chemicals, departments can reduce their hazardous waste disposal, future liability concerns, and the risk of occupational exposure and spills. Low-toxicity products such as mercury-free medical supplies, printing ink low in volatile organic compounds (VOCs), and chrome and chlorine free cleaning supplies are increasingly available and cost-competitive.

8. Reduce paper use.

- Set all printers, copiers, and fax machines to the default duplex mode if the function is available.
- Purchase office equipment that has duplex capability.
- Utilize technology to send and store information electronically.

  A. Utilize internet fax when available.

  B. E-mail document files instead of faxing hardcopies.

  C. Instead of having forms preprinted and stored, fill out forms online and print as needed when available and feasible.

  D. Store documents electronically instead of storing hard copies.

Exemptions

Nothing in this directive should be construed as requiring the purchase of products that do not perform adequately or are not available at a reasonable price.

Potential mandates that have been included on other campuses

- inclusion of information regarding energy use, waste, and life-cycle cost in sole-source justifications

- EPEAT for computers and peripherals

- Energy Star for electronics, appliances

- recycled content minimums for paper

- efficiency and waste reduction settings as default from manufacturer (e.g. double sided printing, computer power savings programs

Appendix 10

Videoconferencing recommendations for travel reduction

Once relationships are established, video conferencing is a viable replacement for travel. But also note sometimes relationships are established because of video conferencing. Depending on the VC equipment, video conferencing can be individual to individual, individual to group, or group to group and include multiple sites. Content can be shown in addition to the camera video for presentations and collaboration. Calls can also be encrypted for security issues.

AU can see a rapid return on investment by reducing travel costs, saving lost work hours/time and see a reduction of Carbon Emissions. Polycom, a VC manufacturer, has a return on investment calculator that demonstrates these savings. Go to http://www.polycom.com/products/resources/roi/en_roi_green.html#

Example: One person; by car; making 12 trips per year; length of two days; hotel/living at $200/day; participant's annual salary $80,000; produces a saving's result of $3,903 in cost, 108 hours in labor and 273 KG of CO_2.

The division one universities who have implemented an aggressive VC Program departmentally or centralized, are seeing a %15-%50 return on investment. When comparing that ROI to AU's current administrative travel costs of $10 Million, (not including athletics), one can realize the savings potential after the adoption of VC. Conservatively speaking, you could expect Auburn to cut its administrative travel expenses by 30% ($3 Million) within the first year if they were to adopt and implement a video conferencing strategy and manage its usage across the university.
Higher returns are achieved by providing incentives and policies to assure adoption and providing usage reports back to the administration for tracking purposes.

Costs in implementing video conferencing depends on the type on VC endpoints, network providers, application of any centralized bridging, maintenance and AU personnel. The following pricing can be used for budgetary costs (Note pricing usually includes training and installation).

High Definition VC Endpoints:
Desktop VC unit for an individual. Includes monitor. $8,000
VC setup for groups. Adding VC endpoint to an existing conference room includes a VC unit, 52” Monitor and room microphone. $16,000

High Definition Centralized Bridging:
Centralized multipoint allows any VC endpoint to participate
Provides centralized call quality and other call aspects
Centralized scheduling
usage reports for tracking purposes
A slim client can be installed on a computer for individual video conferencing.
MSRP pricing is between $46,000 - $260,000 depending AU’s needs

Network:
Implementation of a T1 line from an Internet Service Provider is needed if a VC endpoint is not on Internet 1 or 2. Documentation is important in various network equipment setups such as firewalls so settings are set appropriately when equipment is updated or replaced.

Maintenance:
A maintenance agreement is usually cost effective to keep a VC Endpoint and centralized bridging from down time and protects the investment. This includes help desk support and replacement within 24 hours.

AU Personnel:
Personnel responsibilities would depend on number of VC units and maintenance agreements.
An on campus individual would provide a quick response to asses any issues and assist, train users.

To maximize usage and placement of video conferencing (VC) endpoints a questionnaire would be used to determine:

- whether people would be willing to video conference and to what frequency - daily, weekly, monthly and quarterly.
- destinations of common travel - Example: Auburn Campus to AUM Campus.
- a prioritized list of destinations, or high travel
- what relationships would you foster/expand if you did have videoconferencing
- separate questionnaire for administrative/faculty and course/student VC activity.

Beyond the cost savings, video conferencing allows individuals and departments to expand their roles at AU. This can be seen at the Harrison School of Pharmacy (HSOP). Video conferencing has allowed HSOP to have a synchronized satellite program in Mobile. VC also allows faculty throughout the state to teach, interact with students and handle administrative activities with minimal loss of time…time they apply to their clinical practice. OR be more generic Foster synchronized academic programs. Outreach to communities as in ACES, Vet school, engineering, Building Construction, etc.

Appendix 11. Recommended changes for campus parking pass policies to encourage alternative transportation

Allow faculty and staff to purchase a parking permit monthly, which will allow them more flexibility in choosing how they commute to campus throughout the year.

Give faculty and staff who choose not to purchase a monthly parking permit two or three free days of parking on campus per month, so that they can still have the flexibility of driving if needed without having to purchase a parking permit, and as an incentive to not purchase a parking permit.

Give free electricity outlets with preferential parking for electric vehicles until they become more popular on campus.

Create a guaranteed ride home program, in which faculty and staff who do not purchase a parking permit can take a taxi home in case of an emergency once or twice a year, with the campus reimbursing the cost of the taxi ride.

Give faculty and staff who do not purchase a parking permit for at least 10 months per year $300 to be used for equipment such as walking shoes, bicycles, or exercise clothing.