



2017

*Strategic Energy
and
Water Management
Plan*

Appalachian State University and the University of North Carolina Core Beliefs

"Appalachian State University is located in the Blue Ridge Mountains, a place of great beauty and cultural and recreational opportunity. The mountains inspire an appreciation for the traditions of the region as we connect to and learn from the world. We are a teaching institution with small classes in an innovative, interdisciplinary, and integrative curriculum supported by a faculty dedicated to research and invested in new strategies and technologies. Our faculty and staff inspire our students, who have a strong service ethic and involvement in the community. The green ethos at Appalachian infuses academic programs, environmental stewardship, research, and a community with an attitude of care for the planet."¹

Per the Climate Commitment signed by Chancellor Everts², "We believe carbon neutrality and resilience are extremely high priority areas of action for all institutions and we aim to lead the nation in these efforts."

"Toward Climate Neutrality³" signed by former Chancellor Peacock states "Appalachian State University leads in creating a world where environmental, societal, and economic qualities exist in balance to meet the needs of today and of future generations. Our community of students, faculty and staff continually advance our understanding, capabilities and practices in this vital journey. As an institution of higher learning, we lead by example, inspiring new generations prepared to share this knowledge, ingenuity and passion." Our Sustainability Vision includes implementing and continuously "improving efficiency and renewable strategies, demonstrating the University's commitment to climate change mitigation."

"The University of North Carolina Sustainability Policy⁴" states "The University shall develop a plan to become carbon neutral as soon as practicable and by 2050 at the latest, with an ultimate goal of climate neutrality" under the heading "Climate Change Mitigation and Renewable Energy" on page 1.

Overview: Achieving Appalachian State University's Climate Neutrality Goal:

To achieve the climate neutrality stated in the aforementioned University Policies, it is necessary to understand how energy and climate neutrality interact. Climate neutrality requires the elimination of carbon pollution from all University directly controlled sources (such as fuel emissions from the Steam Plant, Fleet Vehicles, etc.). Additionally, emissions from sources that are not directly controlled by the University, such as purchased electricity, commuter transportation, air travel, and operational waste must be completely offset by renewable energy purchases.

¹ From "The Vision" on Page 3, The Appalachian Experience: Envisioning a Just and Sustainable Future, The Strategic Plan of Appalachian State University July 2014 through June 2019, Appalachian State University

² From the "Second Nature Climate Leadership Statement," signed by Chancellor Sheri Everts on January 4, 2016

³ From Towards Climate Neutrality, developed by the University Sustainability Council and approved by Chancellor Kenneth Peacock dated September 16, 2010

⁴ From The UNC Policy Manual, 600.6.1, Adopted 10/09/09, Amended 06/14/13

The University's expected growth and occupant comfort expectations will perpetuate the need for additional facilities and infrastructure. To continue progress we must continue to look ahead to achieve our climate neutrality goals.

To achieve these goals, we need measureable guidelines. While eCO₂ is our primary measurement parameter, it takes time to get the results since it is dependent on the mix of energy sources; coal, gasoline, nuclear, solar, etc. create a different eCO₂ for the same unit of energy produced. Therefore, energy is a direct measurement that will be used to measure progress for each year, while comparing the previous year's eCO₂ emissions to our goal.

Existing and Historical Conditions

Energy and Water Consumption

Appalachian has made impressive progress towards these goals. As shown in the plots below, between 2002-2003 and 2016-2017 Appalachian has reduced its Energy Usage Intensity (EUI) by 45% and the Water Usage Intensity (WUI) by 53%.

Over this same period, overall campus energy use has dropped 17% (down by 7% in electricity and 26% in fossil fuel) while increasing square footage by 50%. It is important to note that Usage Intensity is the metric preferred by the NC State Energy Office Utility Savings Initiative for evaluating energy performance. The usage intensity normalizes energy or water to the campus square footage, providing reasonable year-to-year efficiency comparisons as institutions change size. *However, it does not represent the total energy consumption.*

Figure 1. Appalachian State University Energy Usage Intensity by Year

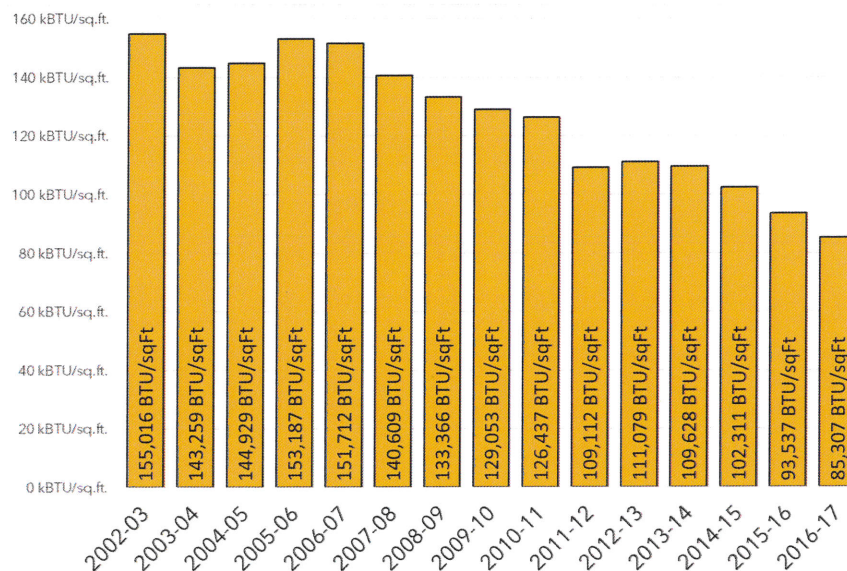
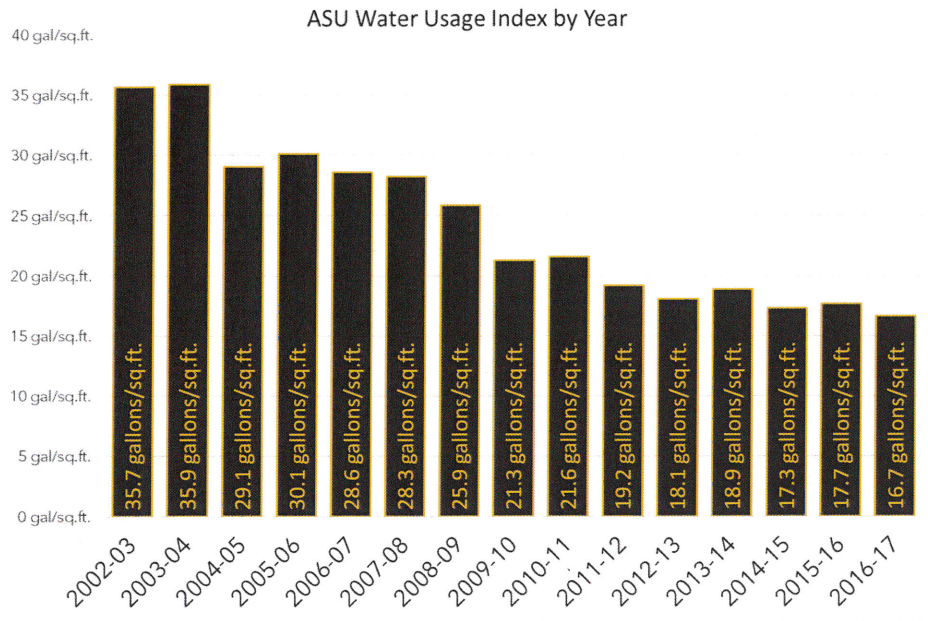


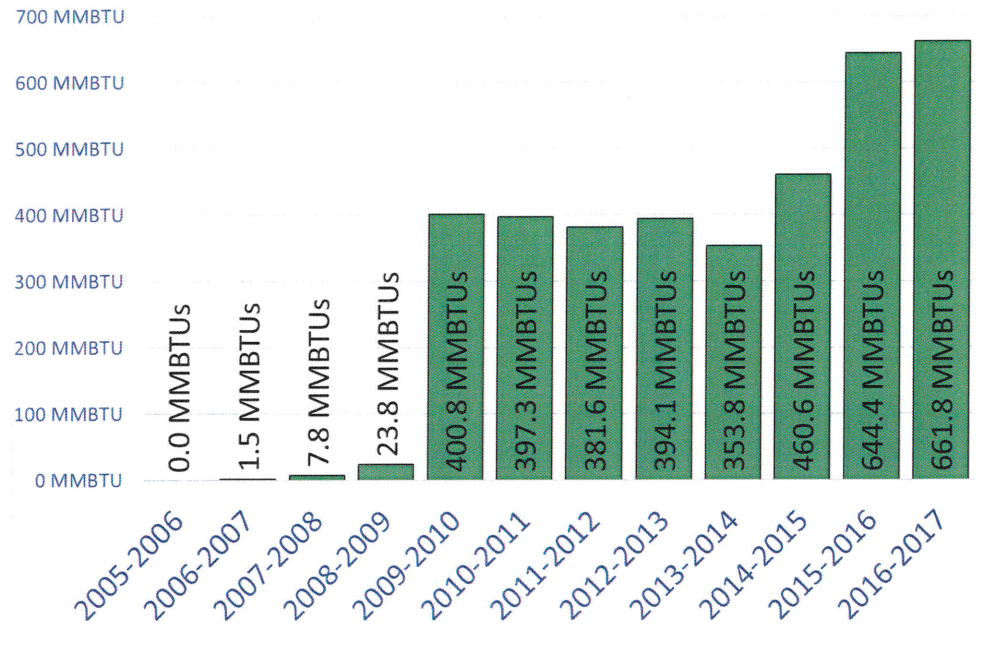
Figure 2. Appalachian State University Water Usage Intensity by Year



Renewable Energy

In 2016-2017, Appalachian produced 131,773 kWh of electrical energy and 212.1 MMBTU's of solar thermal energy for a total production of 661.8 MMBTUs. This represents 0.15% offset of Appalachian's total energy consumption.

Figure 3. Appalachian State University Renewable Energy Production



2018 - 2019 Goals and Current Status:

The Appalachian State University Strategic Plan⁵ has the following short-term Energy and Water specific goals; the met goals are highlighted in **green** and those in **red** are yet to be met.

Greenhouse Gas Emissions:

- 68,000 MT eCO₂ by '18-19
- **Met: Achieved 65,680 MT eCO₂ in 2016 – 2017.**

Energy Consumption:

- Energy Usage Intensity of 90,000 BTU/sq.ft. by '18-19
- **Met: Achieved 85,307 BTU/sq.ft. in 2016-2017**

Renewable Energy Utilization:

- 0.5% of total consumed energy from University owned renewable energy systems by '18-19
- **Not Met: Appalachian achieved 0.15% in 2016-2017 from University owned renewable energy systems.**

⁵ From Section 6 "Strategic Direction" on Page 12, *The Appalachian Experience: Envisioning a Just and Sustainable Future, The Strategic Plan of Appalachian State University July 2014 through June 2019*, Appalachian State University

Water Usage:

- Water Use Intensity of 17.15 gallons/sq.ft. by '18-19

Met: Achieved 16.67 gallons/sq.ft. In 2016-2017 Appalachian

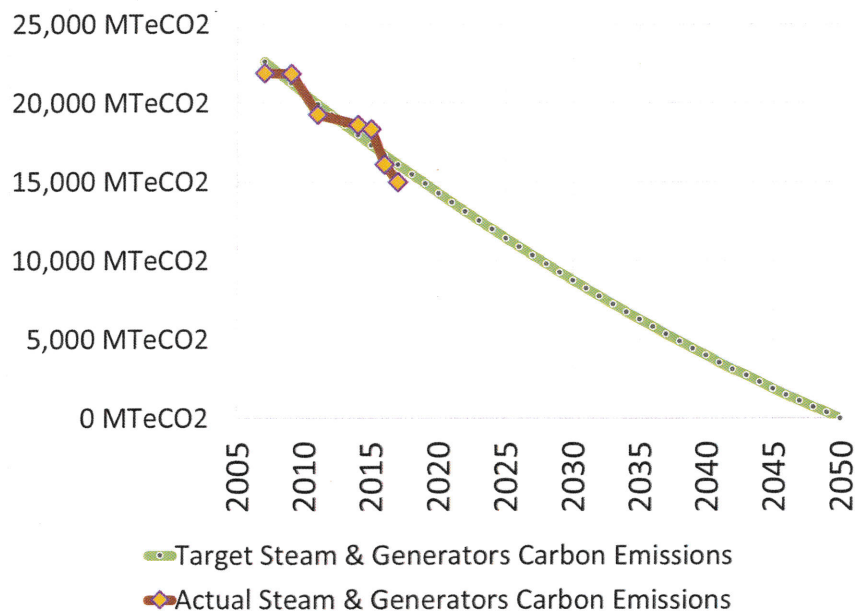
Long Term Goals:

Since climate neutrality is Appalachian's goal for 2050, we need to be able to measure how we are doing. The units we use to measure the level of progress towards Climate Neutrality are "Metric Tons of equivalent Carbon Dioxide," or MTeCO₂.

<MTeCO₂> totals are given in both the absolute weight of each of the gases, and in the internationally standard units of "Carbon Dioxide Equivalents, or eCO₂, according to their Global Warming Potential (GWP), a measure of each gas" contribution to climate change relative to that of carbon dioxide (colloquially referred to as "carbon"). For example, one molecule of methane (CH₄) is 23 times more potent than one molecule of CO₂ (whose GWP = 1) over the same time frame.⁶

The following three graphs represent the progress towards the Appalachian State University Climate Neutrality Goals

Figure 4. Target and Actual Non-Transportation Fossil Fuel Emissions



⁶ Campus Carbon Calculator™, Version 9.0 March 2017, UNH Sustainability Institute

Figure 5. Target and Actual Electricity Emissions

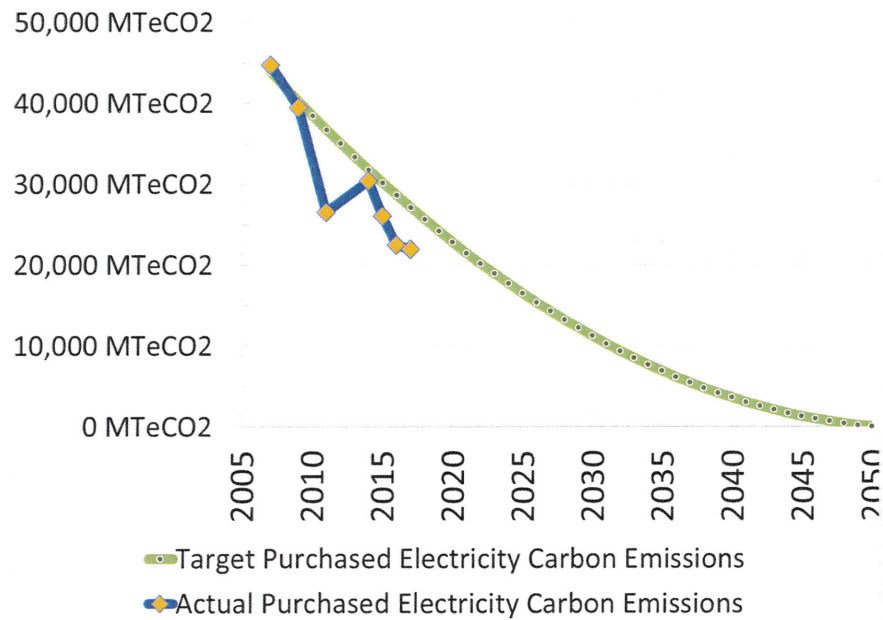
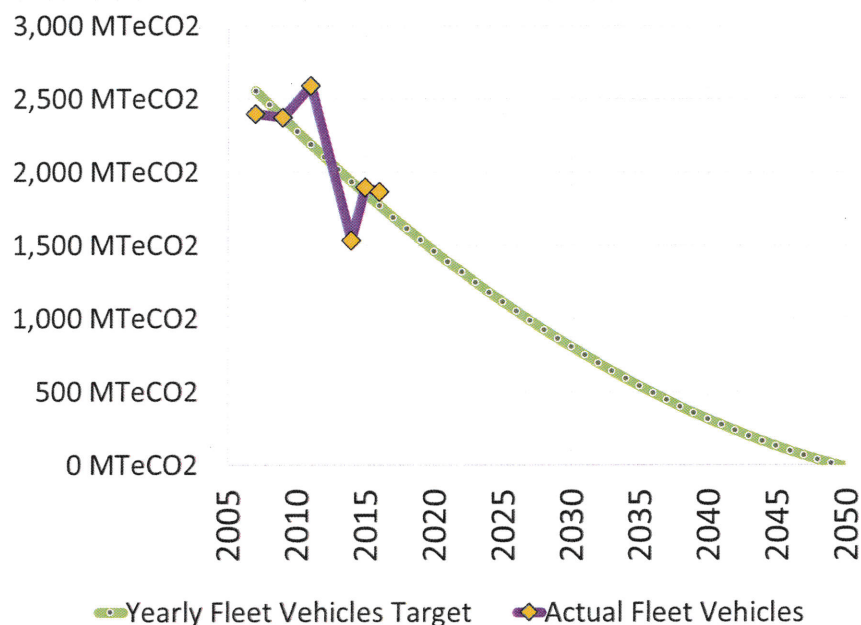


Figure 6. Target and Actual Fleet Vehicle Emissions



As can be seen in the above graphs, the aggressive energy management and commitment from the entire Appalachian Community puts Appalachian State University on track to meet the

guidelines set forth in the four documents referenced in the “Appalachian State University and the University of North Carolina Core Beliefs” section.

However, maintaining continuous improvement requires diligence. The reductions to date have been via intense University energy efficiency efforts utilizing internal staff and performance contracting. Implementing and updating the strategies outlined in this document will help keep the University progressing towards its stated goals.

Implementation Plan to Achieve Appalachian State University Energy Goals:

Leadership

Appalachian is a leader in Energy Management; the Physical Plant has achieved one of the highest energy reductions in the UNC system according to the NC USI (Utility Savings Initiative). Appalachian has also been recognized by numerous awards, including the STARS Gold rating since 2012 and the 2015 USGBC's Climate Leadership Award.

Current Active Leadership Projects:

Appalachian State sponsors the Appalachian Energy Summit (AES) each year. AES has brought sustainability and energy leaders together and has increased their overall effectiveness. The AES is now attracting participants from outside North Carolina.

Appalachian State University's Renewable Energy Initiative (ASUREI) is the gold standard for developing renewable energy through student responsibility and leadership. The ASUREI is a committee of students, with faculty and staff advisors that are responsible for allocating money towards the implementation of renewable energy on campus. The committee's annual operating budget comes from a self-imposed student fee of \$10 per student per semester. The ASUREI has shown active leadership on campus, leading the way in renewable energy projects on the campus. The ASUREI is expanding into a more active role in education and energy reduction.

Short and Long Term Leadership Recommendations:

Continue fostering and expanding our programs.

While we are always looking for new methods to reduce energy consumption or increase renewable energy, share what we have learned with the community outside of Appalachian State in particular leveraging our affiliations in AES and AASHE (Advancement of Sustainability in Higher Education).

Water Consumption

App State has done an excellent job with water consumption mitigation.

Active, Short Term, and Long Term Water Consumption Recommendations:

Improving water use in remodeled and new buildings will continue this trend. Replacement of older fixtures with more efficient ones should continue to be pursued aggressively.

Renewable Energy

Appalachian's target is to have a 0.5% ratio of total consumed energy from University owned renewable energy systems by '18-19. All current plans are for PV (photovoltaic) systems that provide electricity.

Currently Active Projects:

The student run REI has funded a 57 kW PV facility is scheduled for completion for 2018-2019 on the Beaver College of Health Sciences building would increase the ratio to 0.20%. The overall University Energy usage should drop 0.05%.

Short Term Recommendations:

The University's Strategic Plan of 0.5% of total consumed energy from University owned renewable energy systems by '18-19" can be achieved with the addition of 1,600 MMBTUs or 470,000 kWh of renewable energy or by a 71% reduction in the University's total energy consumption. The projects under consideration that combined would achieve 0.41% of the University's energy use include:

- Frank Hall 42 kW PV by the REI, replacing the present non-functional solar thermal system for 0.41% of App State's energy from renewable sources.
- Plemmons Student Union 175 kW PV via REI and donated funds could make renewable energy source 0.37% of ASU's energy.

Long Term Recommendations:

- Migration of purchased Appalachian State University Electricity sources to 100% renewable energy sources that do not use fossil or nuclear fuels⁷. This development is under review by App State's New River Light & Power and could reduce the University's carbon footprint by 33%
- Continued development of on-campus renewables to become part of a potential campus micro-grid to offset peak load and provide additional operational security.

Energy Reduction

App State has been a statewide leader in energy reduction. With all of the past projects, Appalachian is on track for meeting the Strategic Plans 2050 neutrality target.

⁷ While nuclear energy has low CO₂ emissions, it is not a renewable resource and is therefore not sustainable.

Currently Active Energy Reduction Projects:

- The physical plant will be investing in Johnson Controls (JCI) controller and software updates (\$250K/year, next 4 years) to maintain our existing energy profile and to keep building automation system (BAS) controls equipment up to date.
- The student run ASUREI plans to fund expansion of Events to HVAC (E2H) if approved. E2H is an automated system that looks at room schedules and turns down the air conditioning on unscheduled rooms. During E2H implementation tests at the Plemmons Student Union, E2H reduced air handler fan energy use by 40%.

Short Term Energy Reduction Recommendations:

The following strategies implemented over the next year would enable App State to maintain our progress towards a net zero energy use by 2050.

- Aggressively optimize existing buildings that have a BAS. Improvements between 5% and 60% per building along with reduced building downtime and comfort complaints.
- Stress and pursue equipment maintenance at all levels within the organization. Deferred maintenance increases energy consumption by as much as 50%⁸. Staff should bring forth maintenance issues to management as they are identified. Their management should present them with a priority level to the Physical Plant for a plan to address them appropriately.
- In the Information Technology (IT) department, change the standard “ASU Build” to have sleep mode enabled and supported by University IT for all computers on campus.

Long Term Energy Reduction Recommendations:

- Continuous scheduled reviews and upgrades that implement the latest sequences of operation and scheduling capabilities with appropriate commissioning every 3 to 5 years. Improvement in the overall University energy use should be in the 5 % range for *each* pass through the BAS equipped buildings.
- Researching and implementing new BAS programming leveraging ASHRAE RP-1455 and ASU’s staff to reduce energy consumption and increase comfort in existing automated buildings.
- Plan conversion of existing air-conditioned buildings with a life expectancy greater than 5 years to BAS using the latest programming techniques.
- Continued conversion of all University lights to LED technology.
- Convert Bookstore Chiller Plant to run on Plate and Frame economizer.

⁸ Garwood Hall increased 49% from the 2005-2008 average to the 2009-2013

- Continue stressing and pursuing equipment maintenance at all levels within the organization as described under the short-term energy reduction section.
- Continue to make use of 1292 funds as ASU has them available focusing on high ROI investments such as VFDs and controls to maintain 1292 funding increases.

Remodeling and New Construction

Currently Active Construction Projects:

The new 202,916 sq. ft. College of Health Sciences building should come on-line for the 2018-2019 school year. This building was designed to meet or exceed the 139,000 BTU/sq.ft. Energy Usage Intensity (EUI) of our existing Garwood Hall science building. At this energy intensity, the campus energy usage will increase by 28,000 MMBTU (6.3%) and increase the EUI by 2.3%. The design efforts should make this building significantly less than the target and with reprogramming of the HVAC system after construction, the building should easily achieve an EUI under 50,000 BTU/sq.ft. (36% of the target).

Short and Long Term Construction Recommendations:

As the University moves forward, replacement or remodeling of old and inefficient buildings is expected. How we design and construct these new buildings is critical to our 2050 climate neutrality goal.

There are two seemingly contradictory goals in the UNC policy manual.

The first is that Design and Construction's "Capital project planning and construction processes shall meet statutory energy and water efficiency requirements and deliver energy, water, and materials efficient buildings and grounds that minimize the impact on and/or enhance the site and provide good indoor environmental quality for occupants."⁹

However, it also requires "The University shall develop a plan to become carbon neutral as soon as practicable and by 2050 at the latest." Buildings being planned with a 30-year life span but using a 10-year life cycle cost analysis is problematic. Systems that would be cost effective before 30 years using today's technology (such as PV, ground source heat pump, etc.) may not be cost effective when using a ten-year interval.

While the University is diligently seeking renewable off-campus electricity sources, electricity is only 33% of our total carbon footprint. If we do not design highly efficient systems and utilize renewable energy in new buildings with the goal of climate neutrality by 2050, retrofitting these buildings will be considerably more expensive.

Appalachian State and the UNC system needs to either:

⁹ From The UNC Policy Manual, 600.6.1, Adopted 10/09/09, Amended 06/14/13

- Approve a policy funding energy efficient buildings based off a combination of the UNC Sustainability Policy and a true building lifetime cost analysis or
- Re-evaluate the University and UNC system energy goals to match provided funding for remodels and new construction.

Transportation

Transportation accounts for 15% of our greenhouse gas emissions. ASU was on track with the 2015 target but was 5.4% over the 2016 target.

Currently Active Transportation Projects:

The new vehicles purchased by the University are typically dual fuel (gasoline and ethanol).

Short Term Transportation Recommendations:

- New long distance fleet vehicle purchases should continue to be Flex Fuel capable (gasoline, E10, E15 or E85 capable).
- Consider purchasing Electric vehicles for local use.

Long Term Transportation Recommendations:

- Migrate towards electric, bio-diesel, and E-85 vehicles as appropriate.
- Provide charging stations on campus for University vehicles.
- Provide E-85 and bio-diesel at refueling stations.

We recognize that energy and water consumption management benefits Appalachian State University and its sustainability goals. Energy and water management is a responsibility of the students, faculty, and staff at each facility, guided and supported by the Physical Plant and the NC Utility Savings Initiative (USI) Liaison.

This University will implement this Strategic Energy and Water Plan. The attached plan outlines the actions required to reduce energy and water consumption to meet the University's overall Strategic Plan. The Physical Plant Director is responsible for the success of the program at Appalachian State University.

The Physical Plant energy analyst will review energy results monthly and share any problem or success indicators with the Physical Plant Director or his Designate for action as needed. These reports and graphs are available and posted internally. The Department Heads will review progress and results quarterly and will support staff attendance at training in energy and water management at least yearly.

Strategic Energy Management Plan Mandate Goals and Measures

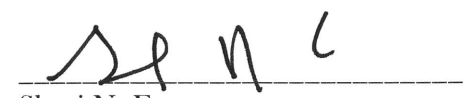
For 2017-2018, reduce energy use and eCO₂ emissions from the previous year as follows:

Fuel Source	Reduction Target	2017-2018 Energy Target	2016-2017 Emissions Target
Stationary Fossil Fuel	4 %	Less than 260,000 MMBTU _s	16,000 MTeCO ₂
Fleet Fossil Fuel	5 %	-	1,700 MTeCO ₂
Electricity	5 %	Less than 50,000 kWh	27,000 MTeCO ₂

I have read and support this Strategic Energy Plan for my Organization:


Mike J. O'Connor
Physical Plant Director


Paul D. Forte
Vice Chancellor of Business Affairs


Sheri N. Everts
Chancellor

Date: 9/30/17

Date: 10/16/17

Date: 10/17/17