Colorado State University

Climate Action Plan

Update January 2018

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Colorado State University was designated an official Tree Campus USA in 2012

1.0 Introduction

On March 20, 2008, Colorado State University (CSU) announced its intent to "seek environmental solutions that include making CSU carbon neutral in a rapid timeframe." Subsequently, CSU signed the American College & University Presidents Climate Commitment (ACUPCC), whereby CSU agreed to set climate neutrality as a long-term climate goal. The original 2010 Climate Action Plan (CAP) began the process of defining a path for CSU to achieve climate neutrality. This 2018 update provides an opportunity to demonstrate progress made toward the original goals and explain updates to the original plan.

The ACUPCC (now known as Second Nature's Carbon Commitment) is a high-visibility effort by a network of colleges and universities to address global climate change. Participating institutions have committed to eliminate net greenhouse gas emissions from specified campus operations and to promote research and educational efforts to equip society to re-stabilize the earth's climate. Its mission is to accelerate progress toward climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership by example for the rest of society.

The University is proud to put forth this update to the plan for achieving climate neutrality that recognizes CSU's unique land-grant heritage and strong research ties. As a land-grant university, CSU has unique opportunities to utilize renewable energy from wind and solar resources and to consider the potential for sequestering carbon in forest and grassland projects.

CSU has developed sustainability efforts that can be seen throughout campus and are being acknowledged across the nation. Recent recognition of sustainability accomplishments include:

- Association for the Advancement of Sustainability in Higher Education (AASHE) awarded Colorado State University the first ever Platinum rating in the Sustainability Tracking, Assessment and Rating System (STARS) in March 2015. In March 2017, CSU repeated this accomplishment by receiving a Platinum rating under STARS version 2.1. To date, only three institutions have earned this rating – Colorado State University, Stanford University, and the University of New Hampshire.
- CSU was the first major higher education institution to sign the Climate Reality Pledge in January 2017, committing the university to 100% renewable electricity by 2030.
- Princeton Review ranked CSU #8 on their 2017 list of Top 50 Green Colleges.
- Sierra Club Cool Schools 2017 ranked CSU #11.
- BestColleges.com lists CSU as #1 on their 2017 Greenest College rankings.
- Chronicle of Higher Education named CSU the #1 Top Performing Institution for Sustainability in 2016.
- CSU was one of only nine inaugural honorees for the U.S. Department of Education Postsecondary Sustainability Awards in 2015.
- The League of American Cyclist named CSU a Platinum Bicycle Friendly University in 2015.

- We continue to build on this strong reputation around sustainability and clean energy through many programs on campus including the School of Global Environmental Sustainability (SoGES) and the Powerhouse Energy Institute. These are just some of the assets that are increasing the potential to advance research that will better enable CSU to achieve climate neutrality and reduce greenhouse gas emissions, both on campus and in the broader global community.

1.1 ACUPCC Commitments

ACUPCC (which has subsequently been renamed Second Nature's Carbon Commitment) provides a framework and support for colleges and universities to implement comprehensive plans in pursuit of climate neutrality. It recognizes the unique responsibility that institutions of higher education have as role models for their communities and in educating the people who will develop the social, economic, and technological solutions and provide leadership to reverse climate change and help create a thriving, sustainable society.

By signing the 2008 ACUPCC, Colorado State University agreed to:

- Develop a greenhouse gas (GHG) emissions inventory.
  - *Inventories are publicly available for fiscal years FY06-FY17.*
- Within two years, set a target date and interim milestones for becoming climate neutral.
  - *The CAP sets a carbon neutral target date of FY50. The Climate Reality Pledge adds the interim step of achieving 100% renewable electricity by 2030.*
- Take immediate steps to reduce greenhouse gas emissions by choosing from a list of short-term actions, listed below.
  - *See notes below on the actions already underway.*
- Integrate sustainability into the curriculum and make it part of the educational experience.
  - *See Section 3.0 below for a discussion of CSU's sustainability-related curriculum.*
- Make the Climate Action Plan, GHG inventory, and progress reports publicly available.
  - *CSU's CAP documents and GHG inventories are available at https://www.fm.colostate.edu/sustain/cap.html*

2008 signatories were required to take two or more of the following tangible actions to reduce greenhouse gas emissions while the Climate Action Plan was being developed. Colorado State University was off to a fast start because three of the actions were already in place:

a. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's Leadership in Energy and Environmental (LEED) Silver standard or equivalent.
   - *Under the guidance of Senate Bill 07-051, CSU has a policy that all new significant campus construction will be built to the U.S. Green Building Council's LEED Gold standard or equivalent.*

b. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.

c. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by the institution.
d. Encourage use of and provide access to public transportation for all faculty, staff, students, and visitors.
    - *CSU encourages use of and provides access to public transportation for faculty, staff, students, and visitors. Students and staff can ride Transfort (the community bus system) free.*
e. Within one year of signing the ACUPCC, begin purchasing or producing at least 15 percent of the institution's electricity consumption from renewable sources.
f. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where the institution's endowment is invested.
g. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt three or more associated measures to reduce waste.
    - *The University has participated every year in both the Grand Champion and Waste Minimization component of the national RecycleMania competition – regularly finishing in the top tier*

On top of these efforts, in 2012 CSU adopted an "Environmentally and Socially Responsible Procurement Policy" (ESRP). The purpose of this policy is to support campus sustainability at CSU and to provide guidelines, information, and resources in procuring products that will minimize negative impacts on society and the environment to the greatest extent practicable. In 2015, a Fair Trade component was added to this policy. An ESRP Program takes into consideration both the long and short-term costs associated with the full life cycle of the product. This policy will guide CSU employees who wish to purchase goods and services for CSU to finding more environmentally sound products, and may require the use of environmentally preferable products in many instances.

1.2 Climate Action Plan Approach

Since CSU is a 2008 signatory to the ACUPCC, the original 2010 CAP, subsequent updates and associated analyses were prepared in accordance with the guidelines established by the ACUPCC as well as the ACUPUU *Implementation Guide*. This document includes a discussion of CSU's greenhouse gas emissions, its curriculum, research and outreach related to sustainability, and a set of greenhouse gas mitigation options to carry CSU toward long-term climate neutrality.

The term "climate neutrality" refers to achieving net zero greenhouse gas emissions by reducing or mitigating emissions through projects addressing energy efficiency, renewable energy, transportation, solid waste diversion, and other strategies along with a means to offset any remaining emissions with the purchase of carbon offsets, if needed.

The ACUPCC *Implementation Guide* provides its own specific definition of climate neutrality for colleges and universities:

> *To achieve climate neutrality under the terms of the Commitment, all Scope 1 and 2 emissions, as well as those Scope 3 emissions from air travel paid for by or through your institution and regular commuting to and from campus, must be eliminated and/or neutralized.*

The original CAP was developed through a collaborative process involving input from a campus task force, the campus community at large, and a consultant team. This 2018 update was prepared by Facilities Management staff and reviewed by the President's Sustainability Commission.

The President's Sustainability Commission (PSC) consists of representatives from a broad cross-section of campus units identified in the Appendix of this report. The mission of the PSC is to "promote and facilitate the effective integration of sustainability across all aspects of the University".

The goals of the President's Sustainability Commission include:

- Advocate for sustainability efforts on campus
- Advise on campus-wide sustainability initiatives including but not limited to STARS*, planning, budgets, community & public partnerships, and new buildings
- Help connect sustainability efforts across the university (including academics, research, operations, student engagement, administration & public outreach)
- Utilize STARS* as a framework to help set goals and assess progress

*STARS – Sustainability Tracking, Assessment, & Rating System administered by the Association for the Advancement of Sustainability in Higher Education (AASHE).

A 545 kW solar array located on the Student Recreation Center at CSU

2.0 Campus Greenhouse Gas Emissions Inventory

The University's greenhouse gas inventory is prepared annually using the Campus Carbon Calculator (CCC), created by Second Nature in partnership with UNH. The CCC tool was developed specifically to provide higher education institutions with a consistent approach to calculating campus greenhouse gas emissions and is recognized as an acceptable tool by the higher education community.

The inventory is based on utility data, other University records, discussions with staff, and an annual online campus commuting survey. The units of metric tons of carbon dioxide equivalent ($MTCO_2e$) are used in the inventory and throughout this plan to account for the collective global warming potential of all six greenhouse gases including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and various refrigerants. The University has completed inventories for fiscal years FY06 through FY17 as shown in Figure 1 below.

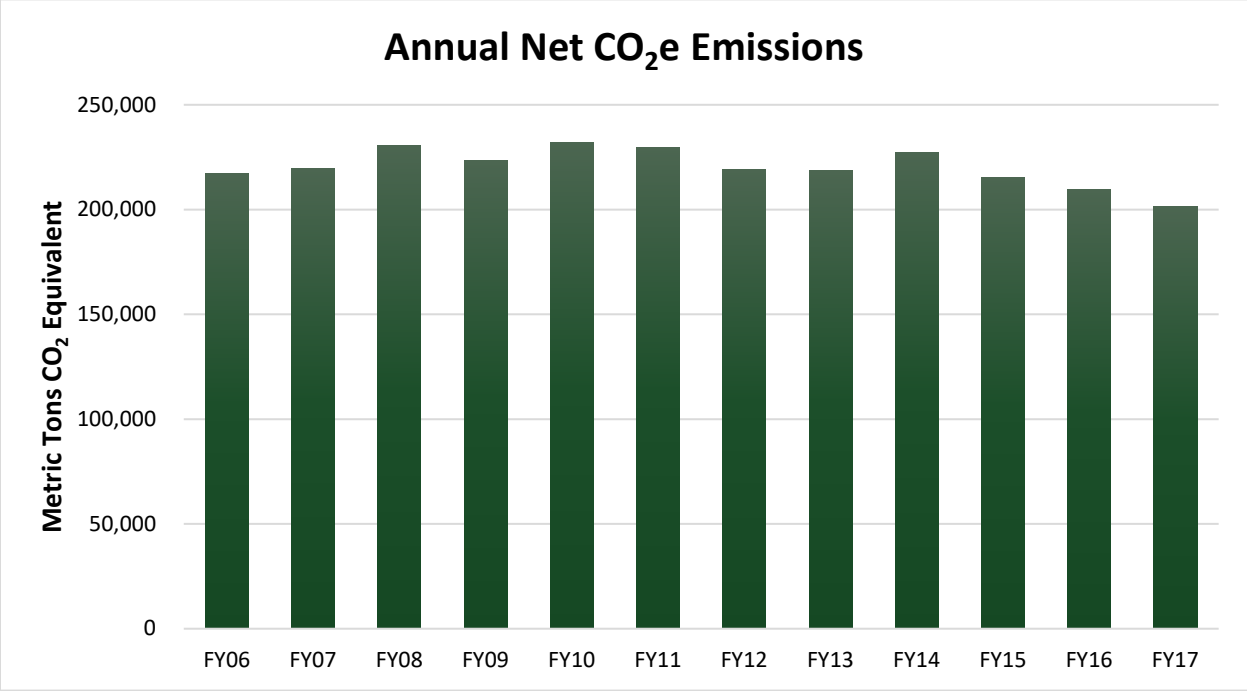


Figure 1. CSU Annual Greenhouse Gas Emissions

Following ACUPCC guidance, CSU's inventory includes all direct emissions, or "Scope 1" emissions such as those from on-campus stationary fuel combustion, fleet vehicles, agricultural activities, fertilizers, and refrigerants. Indirect energy emissions, or "Scope 2" emissions, from electricity purchases are also included. Other indirect emissions, or "Scope 3" emissions from directly financed air travel, student commuting, faculty/staff commuting, electrical transmission and distribution losses, and solid waste disposal are also included. The contribution of these emissions sources to CSU's inventory are depicted in Figure 2.

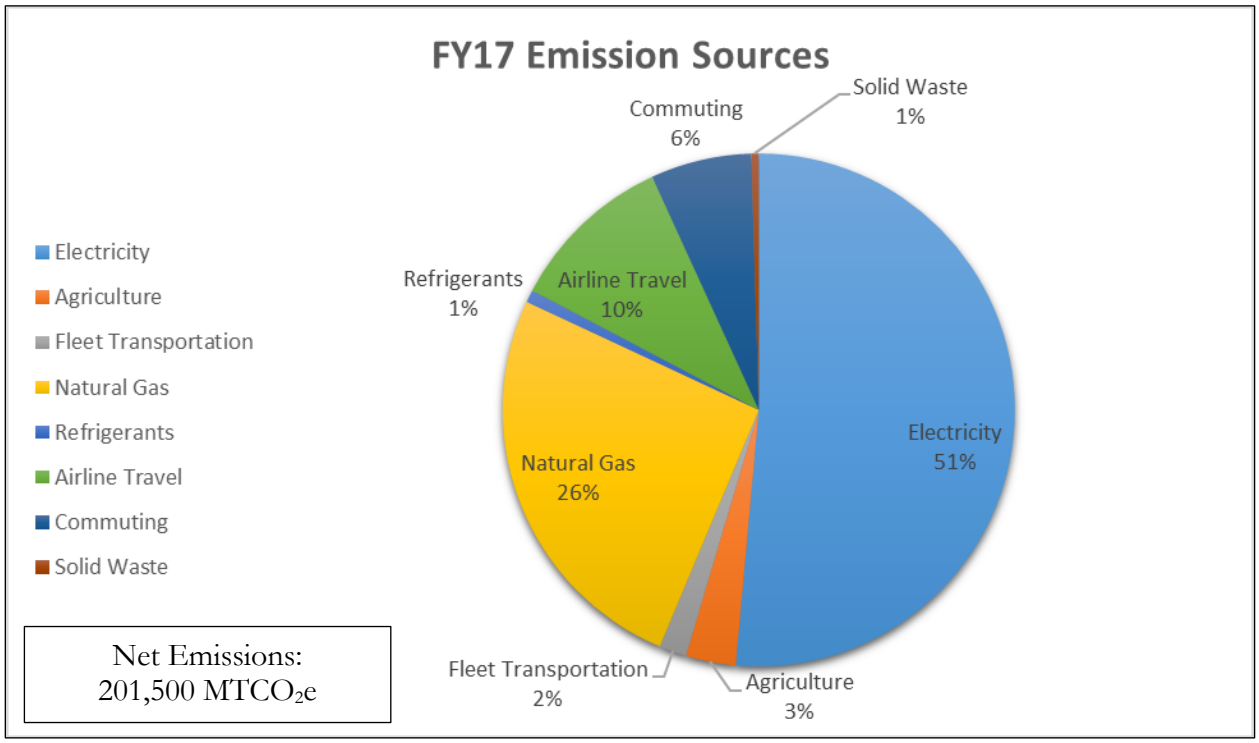


Figure 2. FY17 Greenhouse Gas Emissions Sources

This 2018 Climate Action Plan update considers CSU's projected emissions and identifies potential reduction and mitigation strategies between fiscal years FY10 and FY50. The business-as-usual forecast of emissions is primarily driven by increases in the intensity of electricity consumption in existing buildings (about 1 percent annually based on historical trends), and the construction of new buildings (growth averaged of 250,000 GSF/year through FY17, but a more conservative 150,000 new GSF is used for the model).

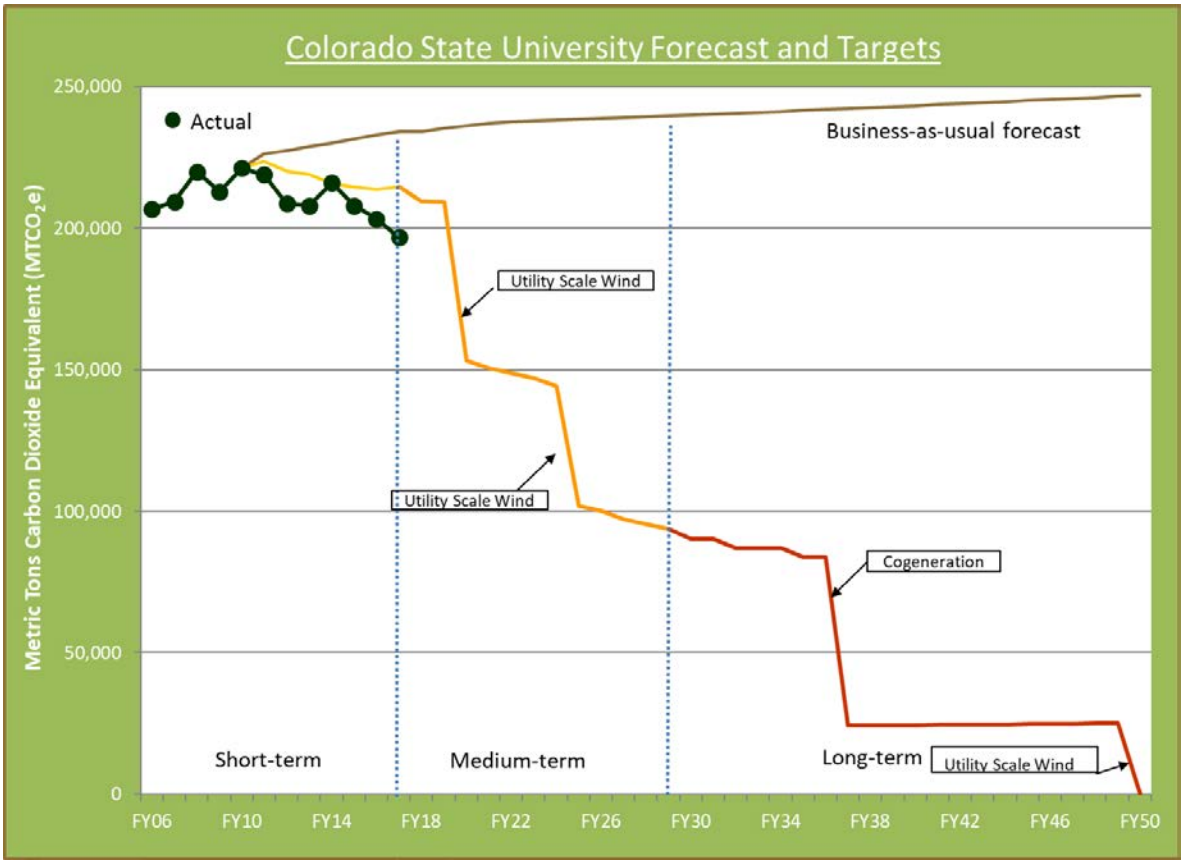


Figure 3. CSU Emissions Forecast and Targets

The CSU Climate Action Plan establishes a set of reduction and mitigation strategies that are divided between short-term (0-7 years), medium-term (7-20 years), and long-term (>20 years). Note that these timeframes were modified in the 2015 version of the CAP in order to align more closely with a CAP adopted by the City of Fort Collins. As depicted in Figure 3, these strategies are projected to reduce CSU's net emissions to climate neutrality by FY50. In addition, the Climate Reality Pledge created the interim goal of 100% renewable electricity by 2030.

3.0 Education, Research, and Community Outreach Efforts

One of the commitments CSU made as an ACUPCC signatory is to integrate sustainability into the curriculum and indispensable to the University educational experience. Academic areas at CSU that address environmental sustainability are offered in all eight of the University's colleges and span across programs in engineering, natural resources, forestry, public policy, environmental ethics, global and sustainable business, atmospheric science, soil and crop sciences, construction management, and many other programs. As the first university to achieve Platinum in the Sustainability Tracking, Assessment & Rating System (STARS), the University has been nationally recognized for its curriculum and research programs related to sustainability; a few of these primary programs and initiatives are discussed below.

It is also important to recognize the links between professional development, research and learning, and the opportunities moving forward as the CAP is implemented. Providing faculty with professional development opportunities in the realm of sustainability will help them integrate these topics into their research and teaching. Supporting faculty and staff efforts to publish their successful efforts will also help disseminate results widely. Furthermore, academic research drives new technologies and understanding, which in turn can be integrated to inform decisions and create beneficial outcomes for larger society. This generates a "feedback loop" that can help accelerate this plan's goal of reaching carbon neutrality at CSU while benefitting broader society.

3.1 School of Global Environmental Sustainability (SoGES)

The School of Global Environmental Sustainability (SoGES) connects all eight colleges at CSU to foster innovation in interdisciplinary sustainability research and education. A Special Academic Unit located under the Office of the Provost, SoGES builds on the University's legacy of leadership in environmental science by integrating sustainability studies with the other natural and social sciences, humanities, arts, and business. To strategically address CSU's strengths, the School's research and engagement is organized into six subject areas: climate change and energy; food security; environmental institutions and governance; sustainable communities; land and water resources; and biodiversity, conservation, and management.

The School encourages creative, interdisciplinary approaches to the grand challenges of sustainability through broad-based research, curriculum, and engagement initiatives. SoGES invests in research that crosses traditional disciplinary boundaries and addresses the inherent complexity of global sustainability science. It offers sustainability curricula and official recognition for courses campus-wide that incorporate sustainability education. Graduate certificates are also available through SoGES. In addition, the School is a conduit for information and engagement, working to communicate and make sustainability science available to diverse audiences at the University, our local communities, and globally.

Through SoGES, the Student Sustainability Center participates in the Nitrogen Footprint project, in which 20 other universities and colleges track their nitrogen emissions and collaborate to reduce their nitrogen use. CSU joined the first cohort with six other universities and colleges in 2014.

Using the N-Print calculator, CSU now has more accurate accounting of how CSU imports or produces nitrogen, how it is used, and how much nitrogen is lost to the environment. One form of nitrogen, nitrous oxide, is a powerful greenhouse gas, so tracking CSU's nitrogen is relevant to its greenhouse gas emissions. Nitrous oxide (N_2O) at CSU can be tied to the application of fertilizer for agricultural research, food consumption, and management of food waste. Another type of nitrogen, nitrogen oxides, are produced along with CO_2 from any kind of combustion process, so any actions that reduce fossil fuel use (power generated from coal, engines from motor vehicle and airplanes) produce co-benefits of reducing CO_2 and NO_x.

Currently the N-Print calculator and CSU's greenhouse gas tracking calculator differ in how they track C and N from university sources, but a combined campus carbon calculation and N-print tool was released in 2017. SIMAP (https://unhsimap.org) has reconciled emissions and tracking algorithms that allow simultaneous calculations of university sources and losses of both carbon and nitrogen. Since nitrogen pollution is among the top three major disruptions of the Earth, alongside climate change and land use, tracking and reducing CSU's nitrogen footprint is a valuable sustainability practice. Nitrogen released to the environment is a major cause of respiratory illness, pollutes surface and groundwaters, leads to harmful algal blooms, causes dead zones in estuaries, and reduces biodiversity, in addition to contributing greenhouse gases to the atmosphere.

A 2017 paper on CSU's nitrogen footprint found the university's agricultural experiment stations were the sources of 50% of CSU's N losses to the environment (Kimiecik et al. 2017). The remainder came from on-campus activities, primarily food consumption (10.7%) and utilities (9.8%). These two sectors provide opportunities for co-benefits of GHG reductions and nitrogen loss reductions through a coordinated effort.

See Appendix B for more information about CSU's nitrogen footprint.

3.2 The Energy Institute and Powerhouse Energy Campus

The Energy Institute serves as a nucleus of research, education, and outreach for the faculty, staff, and students of Colorado State University.

At CSU there are over 130 faculty members spanning all eight colleges who work each day to reinvent energy. There are labs, policy centers, Superclusters, and start-ups. What if that energy was all under one roof, bringing together world-class people in a world-class place? Then there would be something special – a powerhouse.

Continued access to clean, reliable and abundant energy is central to almost every major challenge the world faces today. CSU has long recognized the crucial role energy plays around the globe and pioneered research in this area – from developing better combustion engines that emit fewer

pollutants to testing new smart grid technologies. Today, faculty members across CSU are developing new technologies, exploring the economics, environmental, and sociological impacts of energy use, and proposing energy policy solutions.

CSU created the Energy Institute in 2013 to consolidate its vast energy research under one organization. Through its affiliated centers, the Institute aims to increase collaboration with industry and governmental partners to solve real-world energy problems and create new research and educational opportunities for CSU faculty and students. The Energy Institute is headquartered at CSU's Powerhouse Energy Campus on North College Avenue in Fort Collins.

The Powerhouse Energy Campus, a LEED Platinum energy research complex.

Member Organizations of the Powerhouse Energy Institute

3.3 Colorado State University Extension

As a land grant university, CSU plays a key role throughout Colorado in education, engagement, and outreach through Extension. The system of county offices puts Extension resources within easy reach of residents in all of Colorado's 64 counties. Extension has developed a number of important sustainability programs including:

- Rural Energy Center
- Your Energy Colorado
- Colorado Master Gardener
- Sustainable Agriculture
- Small Acreage Management
- Water Quality and Water Saving Education
- Native Plant Masters

COLORADO STATE UNIVERSITY
EXTENSION

Irrigation systems testing. Photo provided by Cary Weiner.

4.0 CSU's Climate Action Plan: Reduction and Mitigation Strategies

The following sections identify a number of proposed greenhouse gas reduction and mitigation strategies for fulfilling the Climate Action Plan's goal of making progress toward climate neutrality. These strategies are the reflection of work by the PSC to review priorities and strategies that can provide climate benefits while also providing the most significant economic, social, and environmental benefits to the University. Mitigation strategies roughly fall into three categories:

Energy Use in Buildings

- Building Energy Efficiency (4.1)
- Outreach, Advanced Metering, and Behavioral Engagement (4.3)
- Recommissioning and Retrocommissioning (4.4)
- Computer Power Management, Server Consolidation and Server Virtualization (4.8)
- High-Performance New Construction (4.14)

Renewable Energy

- Cogeneration / CCHP (4.2)
- Ground Source Heat Pump (GSHP) (4.9)
- Solar Electricity (4.5)
- Utility & State Policies (4.11)
- Wind Power (4.13)

Other

- Fleet Fuel Consumption (4.6)
- Waste Diversion (4.7)
- Commuting (4.10)
- Carbon Sequestration in Forests & Grasslands (4.12)
- Offset Airline Travel (4.15)
- Emerging Technologies (4.16)
- Reduce Nitrogen Emissions (4.17)

Each of these strategies identified as short term (0-7 years), medium term (7-20 years), and/or long term (>20 years) depending on their particular implementation characteristics. Each section below summarizes the context for each strategy and provides projections of annual greenhouse gas emission reductions and costs. Cost estimates include:

- One-time or first capital cost for implementing the strategy
- Annual operations and maintenance (O&M) cost
- Annual cost savings based on current utility rates
- A simple annual return on investment (net annual cost savings/one-time cost)

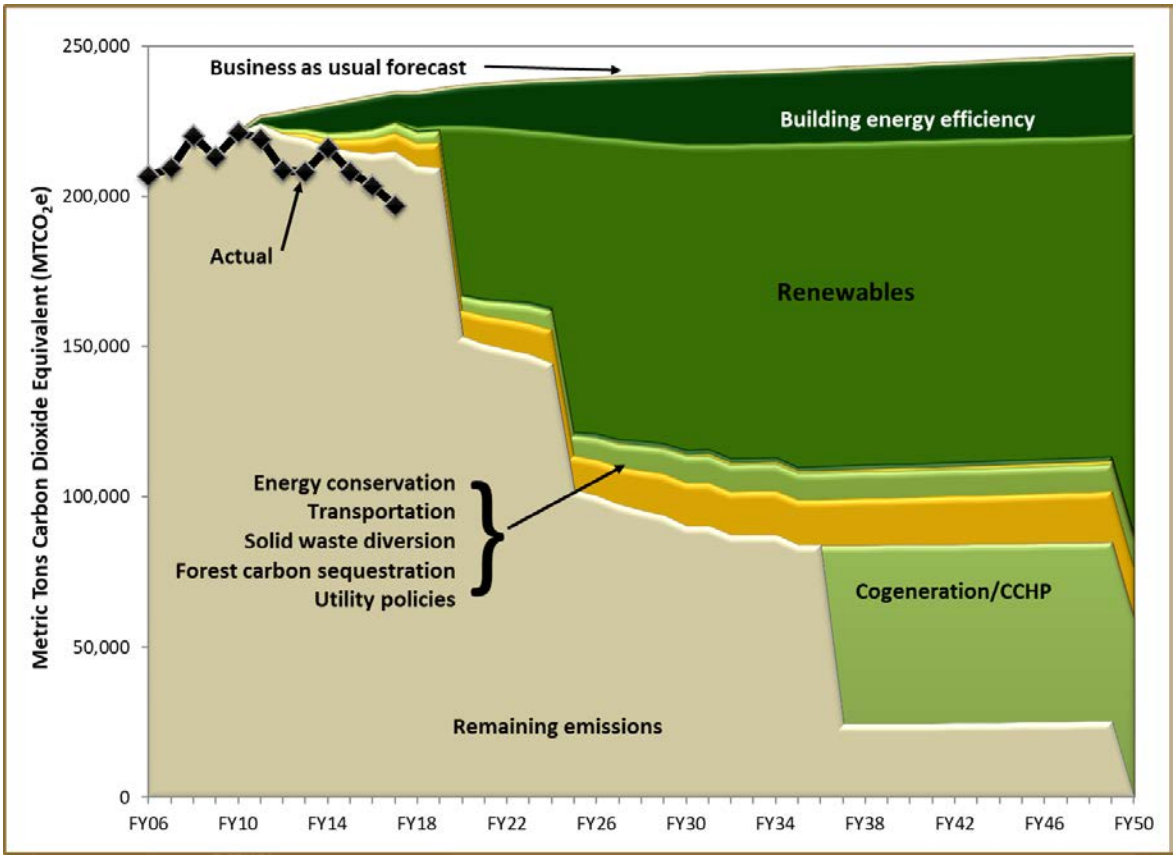


Figure 4. Greenhouse Gas Reduction Contributions by Strategy Type

4.1 Building Energy Efficiency

Term	Projected Annual $MTCO_2e$ Reductions	Percentage of Net FY09 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short Phase 1- Completed	(3,300)	2%	$1,000,000	$0	$370,000	37%
Short Phase 2 – Completed	(5,700)	3%	$1,576,000	$0	$680,000	43%
Medium Phase 3 - Completed	(7,700)	4%	$2,800,000	$0	$1,113,000	39%
Medium Phase 4	(1,400)	1%	$7,000,000	$0	$1,500,000	22%
Long Phase 5	(2,800)	1%	$7,000,000	$0	$1,100,000	15%
Long Phase 6	(1,400)	1%	$19,000,000	$0	$2,800,000	15%

The University has made significant strides in increasing building energy efficiency in a number of its facilities. This strategy focuses on a portfolio of energy efficiency opportunities, grouped into six phases, which can be implemented over the short, medium, and long term based on anticipated payback. Many projects have been completed, others have been funded and are underway, and more than 100 additional projects have been identified, including:

- Lighting upgrades
- Heat recovery
- Demand control ventilation
- Controls upgrades
- Variable-air-volume terminals
- Free cooling
- Fume hood upgrades
- Coil replacement

The Energy Reserve Fund

In FY12, the Vice President of University Operations developed the Energy Reserve Fund (ERF). The fund was seeded with one-time money of $500,000/year for the first 5 years. In addition, savings from projects implemented with these funds return to the ERF in subsequent years. As a result, once the seed money ran out at the end of FY16, the fund was self-sustaining with annual allocations of savings from previous projects. The Energy Team in Facilities Management develops a project list for the ERF each year. A subcommittee of the Presidents Sustainability Commission also reviews the list of projects each year.

Increasing energy efficiency in campus buildings saves both natural resources and money by decreasing electricity and natural gas use thus reducing environmental impacts and utility costs. Involving students and classes in this effort will generate ongoing ideas for improvement as well as increased awareness of sustainability. Colleges and universities control a large number of buildings including offices, housing, classrooms, labs, and athletic facilities and the University must pay for energy use in all of them. Straightforward retrofits to lighting, motors, heating & cooling systems, and other equipment can yield large energy cost savings. Such retrofits not only save money and reduce greenhouse gas emissions; generally, they lead to increased comfort and productivity for students, faculty, and staff who utilize the buildings.

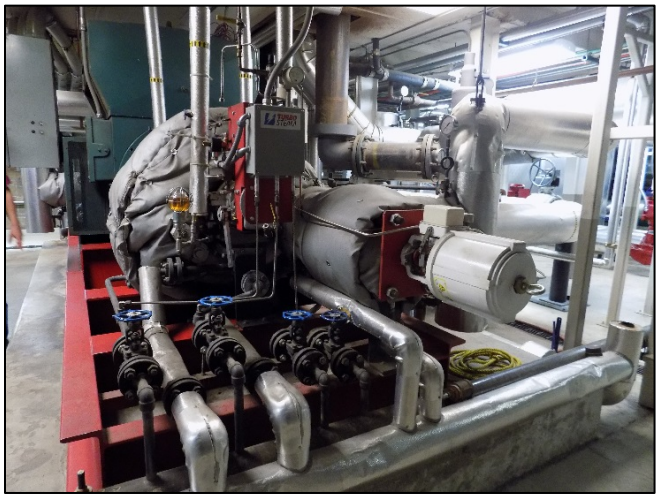
The revitalized Lory Student Center features numerous energy efficiency upgrades, including: smart glass, energy-efficient lighting and lighting control packages, low-emissive glass, overhauled mechanical heating and cooling systems, low-flow fixtures and water-efficient appliances, and high-performance insulation on all perimeter walls. Photo by Michael Quinn.

4.2 Cogeneration or Combined Cooling, Heating and Power (CCHP)

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Long	(59,700)	27%	$0	$0	$0	-

In 2016, CSU and the local utility companies collaborated to conduct a detailed study to understand the feasibility of this option in the medium term. The economics seemed promising until the gas utility quoted $4 million+ to bring a high-pressure gas line to the site. As a result, this project has been pushed to a long-term project and one additional phase of utility scale wind power has been shifted to a medium-term project to keep the goals in the plan on track.

Combined Cooling, Heat & Power (CCHP) with natural gas significantly reduces GHG emissions due to (1) the increased efficiency of producing both electricity and steam and (2) displacing coal fired electricity generation with natural gas fired electricity generation. CCHP is the generation of electrical power using a fuel source and recovering the waste heat for beneficial purposes such as the production of steam to be used for heating. The turbine uses natural gas that when ignited expands air to rotate turbine blades similar to a jet engine. Rotation of the turbine creates power through an electrical generator. The exhaust gases can produce steam without additional heating which is defined as the unfired state. A typical system would add a duct burner, which elevates the turbine exhaust gases to a higher temperature before they enter the waste heat boiler thereby increasing steam output. This is called duct firing. The most efficient CCHP plant utilizes all the "waste" heat from the turbine for beneficial use. For the CSU campus, production of campus steam would be the major benefactor of this waste heat. In addition, steam powered chillers could be incorporated as well in order to take advantage of the thermal energy year-round.



This 800 kW Steam Turbine Generator at the Main Campus Central Heating Plant recovers enough waste heat energy to meet 5% of the campus peak electrical load

4.3 Outreach, Advanced Metering, and Behavioral Engagement

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short - Completed	(300)	0.1%	$0	$20,000	$41,000	--
Medium	(1,300)	1%	$0	$80,000	$164,000	--

CSU has involved and engaged students in sustainability efforts for many years through curriculum, dozens of student organizations, and Residence Life. In addition, the Associated Students of Colorado State University (student government) has appointed a student Director of Environmental Affairs & Sustainability to increase outreach and involvement of the student community and, developed an Alternative Transportation Fee Advisory Board focusing on transit and transportation.

Housing & Dining Services has a Senior Sustainability Coordinator who administers the Eco Leaders program. There is one Eco Leader per residence hall. Eco Leaders help educate fellow students about sustainability issues, waste reduction, energy conservation, plan activities and implement campaigns. The Eco Leaders program started in 2011 and has grown each year since.

The Campus Energy Coordinator, a position in Facilities Management, is responsible for developing energy, water, and resource conservation engagement programs targeting faculty, staff, and students. The Campus Energy Coordinator initiatives include:

- "Faces of Conservation" – electricity reduction challenges in campus buildings, *see example below*
- Outreach and education specific to: campus Building Proctors, IT managers, Facilities Management staff, and various student organizations
- Development of a "Sustainable Labs" (Green Labs) program for CSU

Green Labs for a Green Campus

Laboratories have some of the most intense energy consumption of all spaces on campus. Facilities Management has therefore taken several steps to green our labs. One example involves a $2,000 rebate available since 2015 to any researcher on campus who wishes to purchase a new, efficient ultra-low temperature freezer. This initiative has so far allowed for an estimated annual energy savings of 100,000 kWh/year.

This strategy also includes "Advanced Metering" – involving improved utilization and expansion of the metering and building automation controls infrastructure on campus. This also includes improved scheduling, monitoring, and control of individual loads and temperature set-points to achieve energy and cost savings through demand control and reduced loads during periods of low occupancy.

Faces of Conservation

A commitment to energy and resource conservation

Facilities Services North – electricity usage:

Facilities Services North - electricity usage - month-by-month							
	FY14	FY15	FY16	3-year monthly average	FY17	Are we saving?	% change
July	39,645	36,724	38,009	38,126	39,941	Not yet	5%↑
August	38,011	36,627	38,724	37,787	37,208	YES!	2%↓
September	37,362	31,472	34,584	34,473	30,440	YES!	12%↓
October	34,462	31,553	30,844	32,286	30,715	YES!	5%↓
November	32,884	30,516	28,501	30,634	28,995	YES!	5%↓
December	28,400	28,825	28,161	28,462	26,961	YES!	5%↓
January	29,787	29,644	28,983	29,471	27,697	YES!	6%↓
February	31,702	28,725	29,469	29,965	28,239	YES!	6%↓
March	28,490	30,051	29,208	29,250	31,321	Not yet	7%↑
April	29,448	32,432	30,166	30,682	31,761	Not yet	4%↑
May	31,205	30,921	31,223	31,117	33,838	Not yet	9%↑
June	32,002	38,246	38,414	36,221	36,460	Not yet	1%↑
FY total kWh used	393,398	385,736	386,287	3 year trend is mixed	383,576	YES!	Ave. savings = 4%/mo

Just the facts:

- Facilities Services North had consumed an average of 388,500 kWh/year of electricity
  - That is equivalent to the use of 46 average homes in Fort Collins
  - That means we burn ~296,000 pounds of coal/year

Why we care:

- Over the past 3 years, our monthly electricity usage continues to trend (mostly) down
- And yet, our cost of electricity has increased over the same period – NOT great ☹
- To better control costs, we need conservation! ☺ We need YOU to be a Face of Conservation

GOAL: Continue to *use less* than our 3-year average

Example of a Faces of Conservation educational poster

4.4 Recommissioning and Retrocommissioning

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short - Completed	(1,000)	0.5%	$0	$35,000	$130,000	-
Medium	(5,000)	2%	$0	$80,000	$529,000	

Facilities Management has had a full time Recommissioning Engineer since FY13 who works with a Facilities Management Energy Team to troubleshoot and coordinate repairs of relatively small problems in building HVAC systems. In addition, he identifies larger capital needs in buildings that are using lots of energy and/or water or are challenged by big comfort or control problem. The results to date have been fantastic. The Energy Team has solved a multitude of operational and comfort problems and, provided dramatic utility savings doing so.

What are Commissioning, Recommissioning & Retrocommissioning?

Commissioning is a quality assurance process that takes place during construction of a new building, while recommissioning essentially consists of a "tune-up" of an existing building's mechanical and control systems to ensure operations are continuing efficiently and effectively. Retrocommissioning is just recommissioning of existing buildings that were not commissioned when they came on line. All of these strategies are intended to verify that building systems are performing efficiently and effectively, resulting in reduced energy and water use and increased occupant comfort.

4.5 Solar Electricity

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short On-buildings Completed	(280)	0.1%	$0	$0	$16,000	-
Medium Solar PPAs	(12,400)	6%	$530,000	$8,000	$390,000	-
Long Solar Purchases	(7,800)	4%	$0	$0	$120,000	-

This strategy includes net metering currently existing solar photovoltaic (PV) facilities on CSU's Main Campus, Foothills Campus, and Veterinary Teaching Hospital and several additional installations being studied for the future. Net metering is a policy that allows owners to take full credit for the cost of the electricity that their solar energy system produces and thereby reduces the amount of electricity that CSU has to purchase from the grid and the emissions associated with that electricity.

CSU Foothills Campus, Chrisman Field Solar Array – 5,300 kW

In FY15, CSU installed 1,200 kW of solar on campus buildings in response to a City of Fort Collins incentive. These installations bring the total installed capacity on campus to nearly 6,700 kW. There is a wide variety of ownership strategies on these existing systems but generally, they fall into three categories:

- Small systems installed with building funds. CSU owns both the electrical output and the environmental attributes. These are identified as the short-term projects.
- Chrisman Field (5,300 kW) where a third party will own and operate the plant until 2030 when CSU has the right to purchase the plant at fair market value. Currently CSU receives the electricity from this plant but Xcel Energy owns the environmental attributes. When the plant ownership changes in 2030, the ownership of the environmental attributes will revert to CSU. This is a medium term project since the environmental attributes are in the future.
- Rooftop Solar installed in FY15 (1,200 kW) is owned and operated by a third party for 20 years, and Fort Collins Utilities pays an incentive to the owner for both the electricity and the environmental attributes. In 2035, CSU has the option to buy out the systems and take ownership of both the electrical generation and the environmental attributes. This is a long-term project since the environmental attributes are further in the future.

Sunny Colorado

In addition to the large solar array at Chrisman Field, Colorado State University is currently home to 13 additional solar PV arrays on the:

- Engineering Building
- Lake Street Parking Garage
- Academic Village
- Behavioral Science Building
- Research Innovation Center
- The Cube at Morgan Library
- Powerhouse
- Braiden Hall
- Parmalee Hall
- Edwards Hall
- University Center for the Arts
- Veterinary Teaching Hospital
- Student Recreation Center

In the next several years, the cost of solar systems will likely reach "grid parity" with traditionally generated electricity. This has already happened in many areas of the country where electricity prices are higher. Once that point is reached, installing solar systems where the university retains the ownership of both the electricity and environmental attributes will become a net benefit for the university. Therefore, much of the long-term projects are expected to be this type.

4.6 Reduce Fleet Fuel Consumption by Ten Percent

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(300)	0.1%	$0	$0	$95,000	-

CSU can reduce the campus fleet's conventional fossil fuel consumption by ten percent over FY10 values through a number of measures. These include; purchasing more efficient vehicles when existing vehicles are due for replacement, right-sizing vehicles, optimizing fleet routes, combining trips, carpooling, more comprehensive maintenance practices, using electric vehicles, and/or using alternative fuels.

Electric Vehicle at a CSU charging station

EV Charging Stations

CSU is now the proud owner of 26 electric vehicle charging stations. While only ~5% of the CSU fleet are alternatively fueled vehicles, these cars are very popular among staff. Analysis is currently underway exploring options and strategies to convert more of CSU's fleet to hybrid and electric – to minimize vehicular emissions.

4.7 Increase Waste Diversion to 75 Percent

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(200)	0.1%	$0	$22,000	$32,000	-

Under this strategy, CSU would increase its solid waste diversion rate to 75 percent using a combination of reduction, recycling, and composting. Although solid waste makes up only a small fraction of the University's annual greenhouse gas emissions, waste minimization or net-zero waste is regarded as an important sustainability goal. Becoming a zero-waste campus is outlined in the CSU President's Sustainability Commission Strategic Plan as follows:

Goal #3. Zero waste campus…. Or darn near it!				
	Strategy	Who is Responsible?	When should this be accomplished?	What measure(s) will tell us if we are successful?
3.1	Endorse the City of Fort Collins Road to Zero Waste Plan and serve as an active partner in implementation	Carol Dollard & Sheela Backen	Fall 2016	PSC letter of support to City and successful steps taken towards implementation within the 2017 calendar year
3.2	Expand annual waste audit to include additional waste streams on campus.	Sheela Backen/Farrah Bustamante	Spring 2016	Documentation of expanded waste audit results.
3.3	Support University Facility Fee Advisory Board compost project.	Stacey Baumgarn	Spring 2016	PSC letter of support to UFFAB and successful approval of proposal – Approved!
3.4	Increase number of filling stations and employee bottles (i.e. Nalgene's to new staff).	Stacey Baumgarn	Ongoing	Track number of new filling stations installed and successful distribution of reusable bottles to new staff.
3.5	Start a lab waste recycling program (i.e. similar to CU's).	Sheela Backen & Stacey Baumgarn	2018	Successful implementation of lab waste recycling program.
3.6	Enhance opportunities to redistribute refurbished materials and/or create a library of shared equipment on campus.	Jake Drenth/ Farrah Bustamante	Long-term	Documentation of reduced redundancy.

In FY17, the University diverted 66 percent of its waste from the landfill (by weight). The diverted materials included bottles, cans, plastics, cardboard, paper and organics. CSU maintains the ongoing practice of recycling construction and demolition waste on a majority of construction projects when feasible based on site restrictions.

Waste Reduction Initiatives

- **Zero-Waste Team:** A team of volunteers who act as a recycling/compost/trash bin "goalie" at football games in CSU's new on-campus stadium. Volunteers educate and aid game attendees in proper waste sorting, with the ultimate goal of reducing CSU's football game waste to zero
- **Annual Waste Audit:** Each spring, during RecylceMania, the Live Green Team hosts a waste audit where trash from several residence halls is dumped on the plaza and sorted. This audit helps to inform planning for strategies to divert additional waste.
- **Plate Waste Audit:** Each semester, volunteers gather all food scraps at a select dining hall for a day to measure the total mass of food scraps and showcase it for students to raise awareness regarding food waste.
- **Move In:** Each semester as thousands of students move onto campus, volunteers from the Live Green Team and the EcoLeaders help staff stations to divert cardboard and other recycleables from the trash.
- **Leave it Behind:** Each semester as thousands of students move off of campus, reusable items are collected and then sorted and offered in a giant community yard sale. Proceeds of the sale go to the EcoLeaders program.

The CSU in-vessel composter (known as OSCAR) processes up to 2,000 pounds/day of pre-consumer food waste and animal bedding.

A windrow style compost bed at CSU. CSU's windrows have processed 8,000 lbs. of pre and post-consumer food waste and 9,000 lbs. of animal bedding per month since the operation began in March 2017.

Windrow Composting

CSU has recently set up its own windrow composting system, in addition to an in-vessel compost unit. Windrow is a compost practice utilized primarily in large-volume compost sites, wherein biodegradable materials are piled via tractor into long rows. Specialized windrow turners then pass over the rows to mix the pile with fresh air. The timing of mixing is dependent on the temperature of the compost.

CSU's windrows have been in development and testing and just coming online in fall 2017, with the end goal of providing a nourishing soil amendment to campus-grown food and to the Fort Collins community.

4.8 Computer Power Management, Server Consolidation and Server Virtualization

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short - Completed	(200)	0.1%	$17,000	$2,000	$20,000	102%
Medium	(7,400)	3%	$533,000	$73,000	$633,000	105%

The objective of this strategy is to explore options for improving efficiency by reducing the energy use of information technology (IT) equipment across campus.

CSU has nearly 26,000 hardwired devices and well over 30,000 wireless devices on its networks. These devices include switches, wireless access points, and printers, but many are computers. Computer power management is a great opportunity to reduce computer energy consumption by implementing lower power states. At CSU, the control of power management policies is currently decentralized and lies with each department that manages labs or faculty/staff desktop systems. As a result, the full potential effectiveness of power management is difficult to assess and achieve.

Furthermore, many IT services like email and file storage are provided at the departmental level; therefore, dozens of server rooms are distributed throughout campus. Server virtualization is an opportunity to reduce energy consumption of servers by combining the functions of multiple physical servers onto a single server and better utilizing that server's computational and memory resources. Some CSU departments have virtualized their servers for any number of reasons, including flexibility, scalability, reliability, energy savings, and cost savings.

In addition, efforts have been underway to help departments consolidate server rooms by moving them out of "closets" and into rooms designed to support IT equipment. These changes typically result in improved energy efficiency, back-up power and security of the equipment.

NESB Server Consolidation

Prior to 2014, the Natural and Environmental Sciences Building had a server room on-site. The size of NESB's chiller and the building layout made proper cooling of this room difficult and inefficient. Through collaboration between NESB faculty, Facilities Management, and university IT staff, the NESB servers were successfully relocated to a dedicated server room in an adjacent building, where they can be properly maintained, secured, backed-up and, use less energy.

A new partnership is forming between the campuses IT community and Facilities Management in order to meet mutual goals of having safe, secure, productive, and energy efficient IT systems on campus.

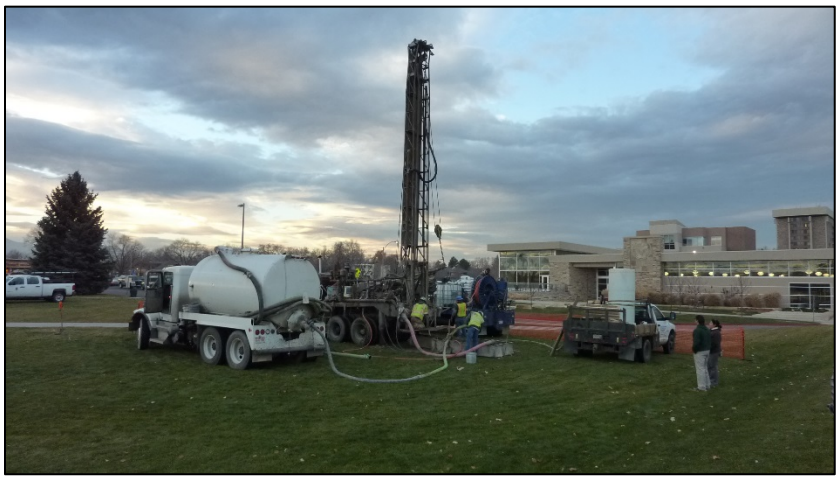
4.9 Ground Source Heat Pump (GSHP)

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(1,200)	0.5%	$800,000	$0	$120,000	15%

The Main Campus of CSU receives steam for heating, hot water and process loads from a central steam plant located near the Administration building on the Oval. As the campus grows and the ability to expand the steam plant in its current location is constrained, the University has decided to consolidate the steam system to the east side of campus – converting the buildings west of Meridian Avenue to alternative heating sources. Some of the residence halls have already converted to small district systems utilizing high efficiency boilers.

The Moby complex is nearly 300,000 square feet including an 8,000 seat basketball arena, a swimming pool, offices, and human-performance labs. A study was completed in 2013 to understand the feasibility of installing a GSHP rather than a traditional boiler/chiller system to serve this complex. The one-time cost listed above is the incremental cost of installing the GSHP rather than the traditional system.

GSHP systems are an energy efficient technology that use passive energy stored in the ground. With these systems, geothermal heat pumps are used to convert the energy in the ground to usable heating water and chilled water energy for the buildings. The most obvious benefit of a GSHP system is the free energy extracted and rejected through the seasons from the ground loop. Electrically powered chillers, condensing units and cooling towers along with natural gas powered boilers are not needed to condition the building.



Drilling a test well to determine conductivity in the soil

4.10 Reduce Single-Occupancy Vehicle Commuting

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Short - Completed	(7,300)	3.3%	$0	$40,000	$0	
Medium	(4,200)	1.9%	$0	$40,000	$0	

This strategy is focused on reducing single-occupancy vehicle commuting by the CSU community. Commuting by means other than single occupancy vehicles can reduce greenhouse gas emissions, contribute to good air quality, and encourage healthy walking and cycling habits. Enabling this strategy has been the development of the MAX, a transit corridor for Fort Collins that serves two of the CSU campuses. The corridor includes bus rapid transit, dedicated pedestrian paths and bikeways. The MAX became operational in 2014. Around the Horn is a bus service providing service around and from the Main to the South Campus. Students are involved in exploring alternative transportation through a newly appointed Alternative Transportation Coordinator in ASCSU (student Government) and through membership of the Alternative Transportation Fee Advisory Board (ATFAB).

Between FY10 and FY17 GHG emissions from commuting was reduced from 20,900 MTCO2e to 13,300 MTCO2e. This change was brought about by a combination of factors including increased bus, bike and pedestrian travel.

The university will also benefit from the improvements in federal standards for vehicle fuel economies as older vehicles are replaced with newer models. In addition, increased adoption of telecommuting options may produce even more significant reductions in the future. CSU also maintains a partnership with ZipCar, has on campus bike repair facilities, boasts over 17,000 bicycle parking spaces, and provides free bus passes to faculty, staff and students.

Faculty, staff and students have free access to the bus system in Fort Collins

4.11 Utility & State Policies

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(9,000)	4%	-	-	-	-

This strategy consists of two different components of state and local public policy. First, the Colorado Renewable Energy Standard (RES) is incorporated into the plan. CSU receives electric power from multiple utilities – Fort Collins Utilities, Xcel Energy, and several rural electric associations served by Tri-State Generation and Transmission – all of which are required to comply with the latest standard. The RES will significantly increase the percentage of renewable energy required in each provider's portfolio of energy sources and will thereby reduce the emissions associated with the electricity CSU purchases without any additional action on the part of CSU.

Colorado became the first state to create an RES by ballot initiative when voters approved Amendment 37 in November 2004. The original version of Colorado's RES required utilities serving 40,000 or more customers to generate or purchase enough renewable energy to supply 10 percent of their retail electric sales by 2015. Subsequent state legislation signed in 2007 and 2010 further increased the RES and made additional changes. Colorado's RES now requires investor-owned utilities to increase their renewable energy portfolios to 30 percent, with cooperative and municipal utilities required to increase their renewable energy portfolios to 10 percent by 2020.

The second component of this strategy is the updated City of Fort Collins CAP, adopted in 2015. In this plan the City accelerated goals to achieve 80 percent reduction in GHG emissions by 2030. Part of that strategy is to have 80 percent carbon-free electricity by 2030. Since the majority of CSU's campuses are served by the Fort Collins municipal utility, the university would also be a beneficiary of that strategy. However, the university will also be a participant in that strategy through renewable purchases. Much of that benefit is accounted for in the Wind Power section (4.13).

Solar Panels on the CSU Behavioral Sciences Building

4.12 Carbon Sequestration in Forests or Grasslands

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium/Long	(1,000)	0.5%	$1,250,000	$0	$0	0%

This strategy entails implementing projects to sequester carbon on university owned lands. This could include either forests or grasslands. Ongoing research at CSU show that grasslands could actually be more effective at sequestering carbon than forests.

As a land grant university, CSU could collaborate with the Colorado State Forest Service (CSFS) to plant trees under conditions where biomass sequestration can be increased. Scenarios might include planting in mountain areas of Colorado impacted by fire damage or pine bark beetles(an insect pest that has killed many trees in Colorado during a recent outbreak), and/or in lower-altitude areas as windbreaks and living snow fences for agricultural operations, highways, and other areas needing protection. In addition, research is underway at the university to help understand how "no-till" and other minimal impact farming techniques can improve carbon sequestration in grasslands.

Terrestrial carbon sequestration is the process through which CO_2 from the atmosphere is absorbed by trees, plants, and crops through photosynthesis and stored as carbon in biomass (tree trunks, branches, foliage, and roots) and soils. The term "sinks" is also used to refer to forests, croplands, and grazing lands and their ability to sequester carbon. Agriculture and forestry activities can also release CO_2 to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over a given time period. Carbon sequestration rates vary by plant species, soil type, regional climate, topography, and management practice.

Colorado State Forest Service Tree Nursery on the CSU Foothills Campus

4.13 Wind Power

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(95,200)	43%	$0	$6,850,000	$10,270,000	-
Long	(25,600)	12%	$0	$1,800,000	$2,800,000	-

When President Tony Frank signed the Climate Reality Pledge in January 2017, he committed the university to the goal of achieving 100% renewable electricity by 2030. As a result, the timeframe for the renewable strategies (particularly wind power) was adjusted slightly to align with the timeframe of this goal.

For this strategy, CSU would acquire significant wind power resources by collaborating with third parties; it may also involve collaborating with other institutions. Such projects would substantially reduce CSU's carbon footprint, create opportunity for University research, and eliminate the need to raise significant up front capital.

Wind energy is a clean energy source that results in virtually no CO_2, nitrogen oxide (NO_x), or sulfur dioxide (SO_2) emissions. Wind facilities could be an educational laboratory to provide students a hands-on learning experience in renewable energy development. Furthermore, the strategy would create a sustainable energy source to meet the electric needs of CSU and would provide clean, efficient, renewable energy to assist in meeting Colorado's RES requirements, CSU, Fort Collins, and the State of Colorado Climate Action Plans.

According to the National Renewable Energy Laboratory (NREL) in Golden, the state of Colorado alone has enough wind energy to supply 9 percent of the electricity consumption for the lower 48 states. That translates into 481 billion kWh per year of electricity.

Emissions – Gone With the Wind?

With the signing of the Climate Reality Pledge in January 2017, CSU has taken the first steps in working toward renewable electricity to meet the pledge's 2030 goal.

CSU received over ten responses in a preliminary wind power RFI, and in early 2018, is evaluating responses to an RFP for renewable electricity projects that would power the university. Transitioning the university to 100% renewable electricity is essential to meeting its ACUPCC Climate Action Plan Goals as well as the new Climate Reality Pledge.

4.14 High Performance New Construction

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
On-going	(1,600)	1%	$600,000	-	$109,000	18%

Buildings are the major users of energy on the CSU campus and nationwide. According to the U.S. Green Building Council, in the U.S. today buildings consume approximately 70 percent of electricity and account for nearly 40 percent of CO_2 emissions[1]. As a result, in addition to exploring energy efficiency in existing buildings (see Strategy 4.1), this plan also includes a focus on high-performance building in new construction. The Institute for the Built Environment (IBE) involves students in exploring efficient and sustainable building design and LEED project consulting.

FY 17 New Buildings, New Sustainability Metrics

CSU saw four large new buildings come to life in 2017 – Chemistry Research, Biology, the Health and Medical Center, and a new on-campus stadium. The new Biology and Chemistry Research buildings achieved LEED Gold, while the stadium and Health Center anticipate LEED Silver.

Energy efficiency, water conservation, and other elements of green design can be promoted and encouraged in new buildings and renovations. New development can be energy and resource efficient, use renewable and recycled building materials, provide for healthy working and living environments, reduce building operating costs, and help reduce greenhouse gas emissions. Almost all new major construction on CSU's campus is being designed and built to a standard of LEED Gold or higher, resulting in higher performing, more energy-efficient buildings. For the most current list of LEED certified buildings on the CSU campus visit:

http://www.green.colostate.edu/green-buildings.aspx

[1]U.S. Green Building Council. (2009) Green Buildings for Cool Cities: A Guide for Advancing Local Green Building Policies. http://www.usgbc.org/ShowFile.aspx?DocumentID=6445

The Pavilion at Laurel Village – first LEED Platinum building on the CSU main campus

4.15 Offset Airline Travel

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Medium	(2,600)	1%	$0	$47,000	$0	-
Long	(2,600)	1%	$0	$47,000	$0	-

Air Travel is responsible for a significant portion of the CSU's annual greenhouse gas emissions, yet specific tactics of this strategy have had little discussion until fall 2017. There is a multitude of ways to either reduce trips or offset necessary travel. Reduction efforts could include increased teleconferencing, train riding, and carpooling. Offset investments could take different forms as well. There are many commercial entities that can provide offsets for travel impacts; however, many universities use local projects to achieve some of these offsets. Exploration of these projects will lead to ideas for innovative implementation of this strategy at CSU. Because there is (often) no cost savings associated with this strategy, the implementation is noted as medium and long-term.

The President's Sustainability Commission formed a small subcommittee in November 2017 known as the Air Travel Team. The Air Travel Team has begun exploring and sorting through relevant data to determine potential reduction and offset strategies for CSU air travelers.

The Lagoon and Lory Student Center, photo by Michael Quinn

4.16 Emerging Technologies

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Long	TBD	TBD	TBD	TBD	TBD	TBD

As a living document, this plan will undergo regular reviews, and the opportunities to include new technologies will be many. A myriad of technologies on the horizon may become viable within the timeframe of this plan and alter the course of CSU's path to climate neutrality. Some of these technologies will come from the broader clean energy economy while others might emerge from research done at CSU. Some technologies that were considered for this plan but were not found to be viable at this time (either technically or economically) include battery storage, synfuels, solar thermal, micro hydroelectric, anaerobic digestion for food and animal waste, plasma waste-to-energy, algae biofuels, solar window tinting, and other sequestration options such as capturing carbon for use in building materials.

Thermal storage tanks & solar photovoltaic panels outside the Academic Village Residence Hall

4.17 Nitrogen Mitigation and Offsets

Term	Projected $MTCO_2e$ Reductions	Percentage of Net FY10 Emissions	One-time Cost	Annual Cost	Annual Cost Savings	Annual ROI
Long	TBD	TBD	TBD	TBD	TBD	TBD

CSU began tracking its nitrogen emissions in 2014, when Dr. James Galloway at the University of Virginia first created the "N-Print" project and calculator. Using this calculator, CSU now has more accurate calculations of its nitrogen emissions.

The N-Print Project has four objectives:

1. Communicate the importance and effects of nitrogen
2. Develop tools to calculate the nitrogen footprints of individuals and institutions
3. Promote the reduction of nitrogen footprints through the use of N-Print tools
4. Asses the contribution of an entity's nitrogen footprint to environmental impacts along with the development of regional nitrogen ceilings

Nitrous oxide (N_2O) is a powerful greenhouse gas. On a per-molecule basis, nitrous oxide has a 100-year warming potential 298 times higher than CO_2. This greenhouse gas becomes relevant in the university's agricultural research and food consumption. Currently, CSU does not include food processing and consumption in its greenhouse gas inventory. Food processing and consumption is, however, the most significant source of CSU's nitrogen use according to the N-Print calculator.

Nitrogen production, consumption, or application in excess has other environmental implications that are less directly tied to greenhouse gas emissions and climate change. Such effects include eutrophication of waterbodies (algal blooms), corresponding anoxic zones, and shifts in ecosystem dynamics.

CSU's N-Print team, which is part of the Student Sustainability Center, has developed a few strategies to reduce CSU's nitrogen footprint in the long run, including:

- Behavioral change – encourage less N-intense food consumption on campus
  - "Environmental Eats", an educational sustainable food night at certain on-campus dining centers, began in Fall 2017
  - Encourage options that could result in consuming less meat in on-campus dining halls
- Optimize fertilizer application to reduce runoff
- Work to minimize research-based nitrogen emissions

5.0 Financing

The costs and savings projected in the previous strategies are based on conservative assumptions such as no escalation in current utility rates. Financing mechanisms, such as bonding and third-party financing, can be used to reduce the capital requirements associated with climate neutrality and to level out the cost of this plan. Furthermore, many of the strategies proposed in this plan result in positive net cash flows and can be largely self-funding.

Due to current and anticipated future budget limitations, priorities for funding this plan may focus on low and no-cost strategies such as education programs, and those with very favorable paybacks that can help to finance the cost of later measures through their savings.

The University can explore several opportunities to help fund implementation of the plan's measures including:

- Utility rebates
- Third-party ownership with Power Purchase Agreement
- Federal incentives
- Grants
- Lease-purchases or other financing mechanisms
- Performance contracting
- Capital campaigns
- Revolving loan funds
- Public/Private Partnerships

The University will stay appraised of the latest funding opportunities. Note that several of these strategies have already been implemented to fund campus projects. This is a fast-changing landscape where legislation, incentives and rebates, and maturing technologies can rapidly improve the financial options of plan strategies.

Solar array installed on Braiden Hall as part of the City of Fort Collins SP3 Solar Power Purchase Program

6.0 Uncertainty

This Climate Action Plan update is the fourth version of a living document subject to further review and revision on a two-year cycle as strategies are implemented, new technologies and strategies develop and mature, progress is monitored, and intermediate goals are revisited.

The ACUPCC requires biennial updates of the greenhouse gas inventory and the Climate Action Plan in alternating years (e.g., inventory in 2011 and action plan in 2012). CSU has committed to update the greenhouse gas inventory annually to improve, and ensure continuity in, organizational practices around gathering information for the inventory. Updating the inventory annually also ensures more accurate tracking of progress toward emissions reduction goals.

Considering the many uncertainties in forecasting growth, greenhouse gas emissions, and the realities of implementing the strategies in this plan, it is apparent that the biennial updates to this living document will be pivotal to maintaining its relevancy and ensuring that CSU is establishing a trajectory toward climate neutrality. Rather than attempting an exhaustive forecast of potential scenarios, this plan recognizes some key uncertainties that could significantly alter the trajectory of CSU's greenhouse gas emissions or the financials associated with this plan:

- **Growth rates for CSU's emissions** – Much of the potential growth in CSU's emissions will be driven by new construction, enrollment, and research growth, which are difficult to forecast in a continually fluctuating budgetary environment. While improving construction practices, efficiency and conservation in existing buildings can minimize the impact of this growth, the plan is still very sensitive to these trends.

- **Utility rates** – The potential cost savings associated with most of the strategies in this plan are sensitive to utility rates. Accurately projecting utility rates through 2050 is an impossible task and subsequently dependent on the cost of fuels (e.g., coal, natural gas, and renewables) and the cost of carbon in a potentially monetized carbon future. Under these scenarios, it is generally safe to assume that the cost of utilities will increase and the savings associated with these strategies will improve from this conservative analysis using today's rates with no escalation.

- **Legislation** – In addition to federal legislation that may affect the price of carbon, there is the potential of increased stringency in the state's RES. The majority of CSU's electricity purchases are from utilities that are currently required to supply 10 percent renewable energy by 2020. It is conceivable that this requirement will be increased within the timeframe of this plan.

- **Financing mechanisms** – Legislation, tax credits, renewable energy standards, and community goals can drive the introduction of new financing mechanisms that could enable CSU to achieve some of these strategies with a minimum of up-front capital. For example, a third-party financing mechanism made the Chrisman Field Solar Plant financially feasible for CSU and still allows CSU to recognize the environmental benefits of the project within this plan's timeframe.

- **Changing technologies and associated costs** – The technological picture with respect to the built environment, renewable energy generation, and transportation is changing rapidly, particularly with the current focus on development in these areas. There are likely to be existing technologies that become increasingly viable and new technologies that will be introduced into future iterations of this plan.

The Indoor Practice Facility is a LEED Gold building that uses natural daylighting, creatively cleans stormwater with vegetation before leaving the site, and features water-conserving landscaping

7.0 Implementation and Measuring Success

The development of this Climate Action Plan and ongoing updates is a major step toward reducing the University's greenhouse gas emissions, pursuing climate neutrality, and furthering campus sustainability.

Collaboration among the members of the campus community, faculty, researchers, and community partners will benefit the implementation of the plan. A next step in implementing the strategies outlined in this plan is to identify a responsible party for implementing each and who can play a supporting role. The diverse nature of the strategies in this plan provides an opportunity for broad collaboration across the University. Within the President's Sustainability Commission framework, working groups are established around many of the plan's broad categories so that each can proceed independently and in parallel while still reporting results. In addition, efforts are underway to focus student classes and learning on exploring sustainable alternatives to current practices.

Partnerships are a particularly important component of implementation. CSU is fortunate to have many partners with an interest in sustainability in general as well as specific greenhouse gas reduction strategies in the Climate Action Plan. The CSU CAP aligns well with the plans put forth by both the City of Fort Collins & the State of Colorado. Such partnerships can be leveraged to share resources and expertise and can ensure that sustainability becomes part of the fabric of the campus and the community. In early 2015, the City adopted a very aggressive community Climate Action Plan. The timeline of CSU's CAP was modified at that time to better align with the City's plan because CSU is a significant contributor to the GHG emissions in the Fort Collins community. Therefore, it is imperative that our strategies support each other's and our shared goals.

While this plan sets a long-term goal of climate neutrality, achieving interim milestones will help demonstrate tangible progress toward this goal over time. As discussed earlier in this plan, an interim goal has already been established to track progress.

As noted in the discussions of the specific strategies, many short-term projects have already been implemented. Additional strategies can be implemented in a relatively short period while others will need to be phased over time. Establishing timeframes for implementing various strategies will ensure that there is enough time to complete them before the target goal year is reached.

CSU has a strong foundation of existing teaching, research and operational activities on which to begin the journey to climate neutrality. This plan establishes an initial path to climate neutrality that recognizes CSU's unique opportunities to reach this goal as a land-grant research University. The plan also recognizes the many uncertainties associated with a long-term planning effort and the need to revisit this plan and refocus efforts on a regular basis.

With the strong commitment of students, faculty, staff, and the broader Fort Collins community, CSU is proud of the preliminary progress made and is eager to continue implementing this plan and begin to realize the local and global benefits of setting a trajectory for climate neutrality.

Appendix A: President's Sustainability Commission Members

President's Sustainability Commission (PSC) Member List – January 2018

Chair – **Lynn Johnson**, Vice President for University Operations

Co-Chairs – **Carol Dollard**, Energy Engineer (Facilities Management) and **Tonie Miyamoto**, Director of Communications and Sustainability (Housing and Dining Services and Student Affairs)

Administrative Support – **Becca Mueller**, Program Manager (Facilities Management)

Campus Units/Divisions

Athletics – **Doug Max**, Senior Athletic Director for Facilities Management

College of Agricultural Sciences – **Jessica Davis**, Head, Department of Horticulture and Landscape Architecture

College of Business – **Nicole Johnson**, GSSE Program Facilitator

College of Engineering – **Mark Ritschard**, Assistant Dean

College of Health & Human Sciences – **Brian Dunbar**, Executive Director of the Institute for the Built Environment, and **Bill Timpson**, Professor of Education

College of Liberal Arts – **Ken Shockley**, Associate Professor of Philosophy

College of Natural Sciences – **Tony Rappe**, Professor of Chemistry, and **Andrew Warnock**, Director of Education and Outreach Center

College of Veterinary Medicine & Biomedical Sciences – **Colleen Duncan**, Assistant Professor of Pathology

Warner College of Natural Resources – **Terra Sampson**, Program Coordinator – Conservation Leadership through Learning M.S.

Vice President for External Relations

Public Relations – **Mary Guiden**, Communications Coordinator

Vice President for Information Technology/CSU Libraries

Morgan Library – **Don Albrecht**, Coordinator, and **John Fitch**, Affiliate Full Professor

Vice President for Research

Colorado Water Institute – **Julie Kallenberger**, Water Education and Outreach Specialist

Vice President for Student Affairs

Associated Students of Colorado State University – **Madelyn Royal**, Director of Environmental Affairs

Housing & Dining Services – **Tim Broderick**, Senior Sustainability Coordinator

Vice President for University Operations

Facilities Management – **Sheela Backen**, Integrated Solid Waste Manager, and **Van Wallace**, Sustainability Intern

Parking & Transportation Services – **Aaron Fodge**, Alternative Transportation Manager

Procurement Services – **Farrah Bustamante**, Strategic Sourcing Manager

Surplus Property – **Jake Drenth**, Surplus Property Manager

University Operations – **Jocelyn Hittle**, Director of Denver Operational Initiatives

The School of Global Environmental Sustainability (SoGES)

SoGES – **Aleta Weller**, Research and Outreach Coordinator

Student Sustainability Center – **Emily Taylor**, Director of Student Sustainability Center

Constituencies

Administrative Professional Council – **Ann Bohm-Small**, Financial Transaction Coordinator

Classified Personnel Council – **Stacey Baumgarn**, Campus Energy Coordinator

CSUF – **Geneve Huxley**, Federal Associate, and **Barb DiPasquale**, Federal Associate

Energy Institute – **Jeff Muhs**, Associate Director

Faculty Council – **Mary Stromberger**, Associate Professor of Soil and Crop Sciences

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Acknowledgement:

Many thanks to our dedicated Facilities Management Sustainability intern, Van Wallace, for his hard work in putting this 2018 document together.

Appendix B: CSU's Nitrogen Footprint

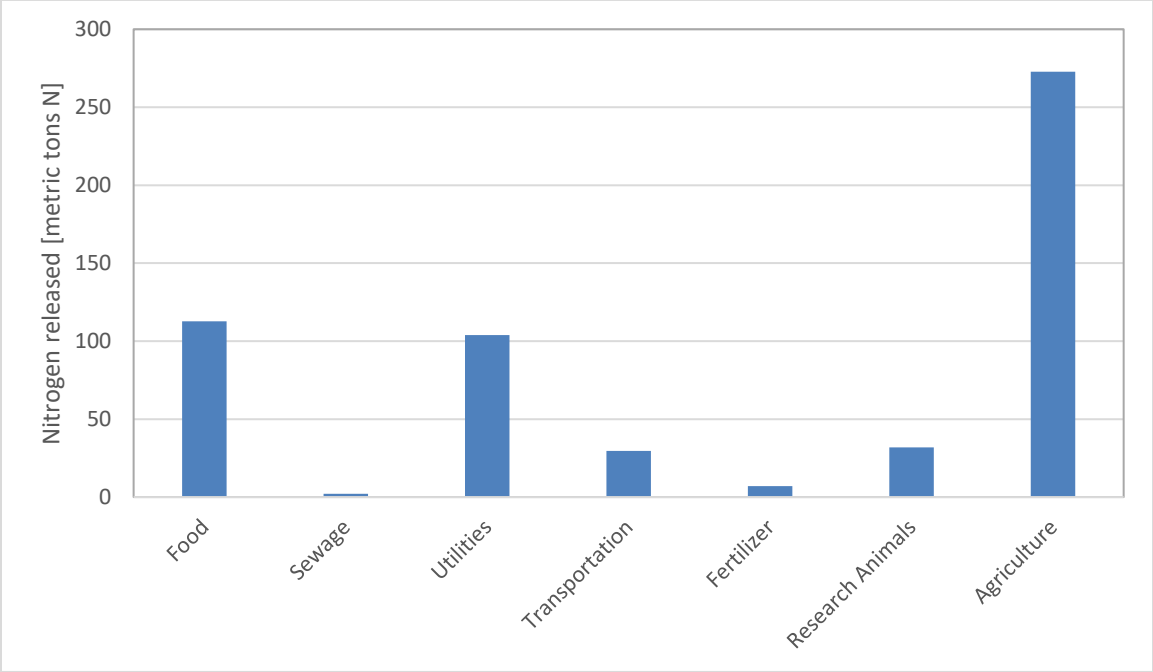

Table 2. The 2014-2015 N Footprint for Colorado State University

Sector	Type	Total N Released (metric tons N, rounded)	% of Total
Food	Meat	54.6	5.2%
	Dairy & eggs	22.6	2.1%
	Seafood	0.8	0.1%
	Vegetable products	34.7	3.3%
Food Consumption/ Human Waste	Sewage	2.2	0.2%
Utilities	Purchased	96.1	9.1%
	On-Site	7.7	0.7%
Transportation	Institutional	2.9	0.3%
	Commuting	16.9	1.6%
	Commercial Air	9.8	0.9%
Fertilizer	Fertilizer	7.0	0.7%
Research Animals	Research Animals	31.8	3.0%
Agriculture	Crops	128.5	23.0%
	Livestock	144.2	25.8%
Total (kg N)		559.7	100.0%