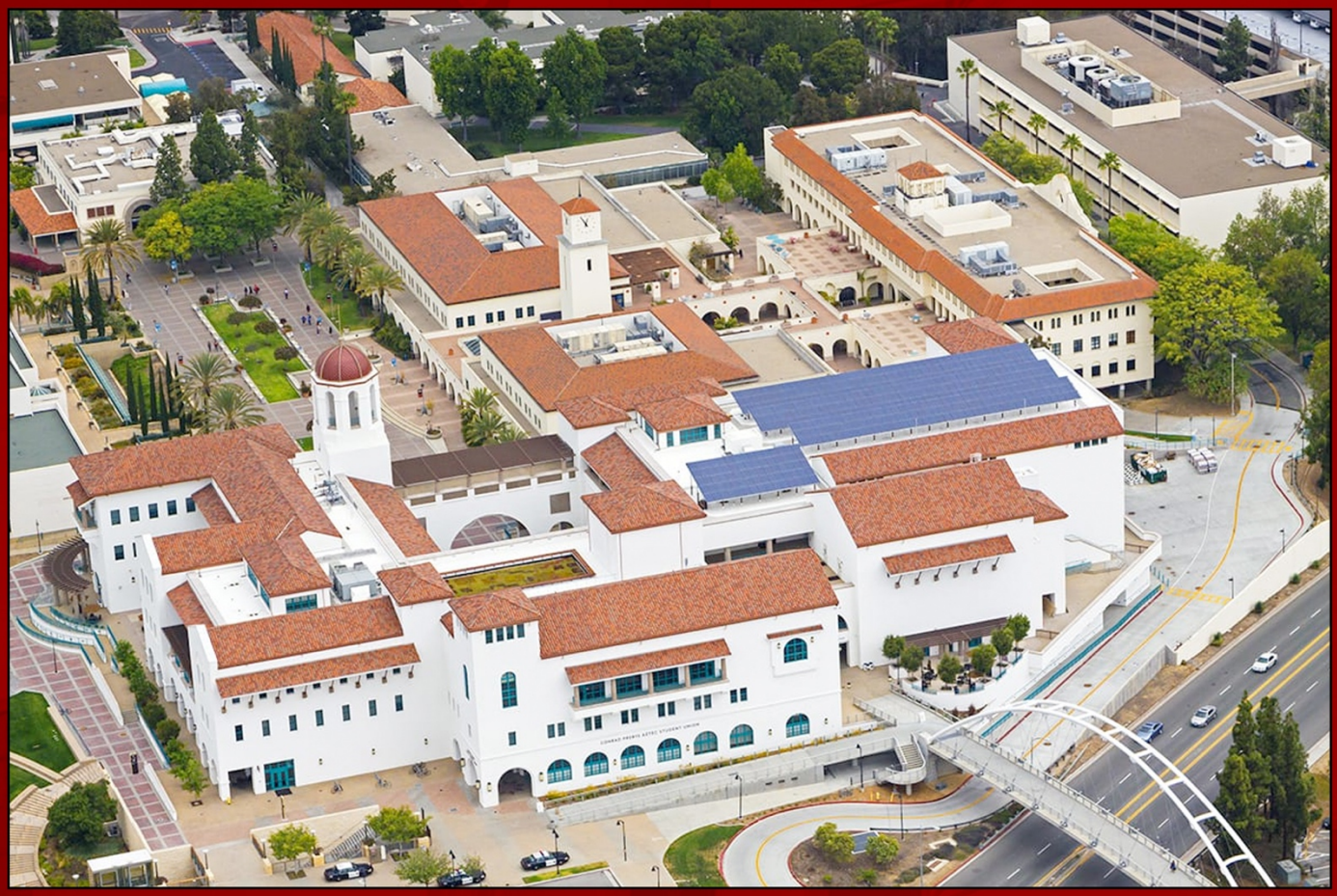
SAN DIEGO STATE UNIVERSITY

Sustainability Starts Here

Climate Action Plan for San Diego State University



Letter from the President

May 1, 2017

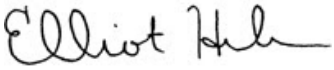
San Diego State University joined the nationwide movement of colleges and universities that are reducing greenhouse gas emissions in 2014, and this Climate Action Plan both renews our pledge to Second Nature's Carbon Commitment and charts a course for the university to reduce its carbon footprint while educating and inspiring tomorrow's leaders.

San Diego State's 35,000 students study and conduct research on a beautiful campus marked by Mission Revival architecture, and this Climate Action Plan positions SDSU to make our campus a national example of sustainability.

San Diego State University commits to achieving operational carbon neutrality by 2040 and carbon neutrality by 2050. This plan also addresses other sustainability issues, including water, waste and food. While our goals and actions are ambitious, they are necessary if we are to solve the immense and imminent issues facing our environment and our society.

Through implementing this Climate Action Plan, San Diego State will make an impact by reducing our environmental footprint, lowering lifecycle costs, improving quality of life for the campus community, and educating students and the greater community on sustainable changes for the better. SDSU will serve as a climate action model for our peers, the region, and, most importantly, the students who will build our future world.

I hope you will review this plan with an eye to how you can contribute through implementation at SDSU and through your personal actions. Climate change is a tremendous challenge, but working together we can shape a world that meets the needs of present and future generations.



Elliot Hirshman, President
San Diego State University

Background

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC is an international treaty created to address the threats of climate change and to encourage the reduction of greenhouse gas emissions. Although the UNFCCC contains no enforceable standards, it has provided the framework for negotiating future international treaties. The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for assessing the science related to global climate change. The IPCC was created in 1988 with the goal of providing policymakers with regular assessments of the scientific basis for climate change, its potential impacts and future risks and adaptation and mitigation strategies.

In November 2014, the IPCC finalized the Fifth Assessment Report, which provided an update on the scientific and socioeconomic knowledge from previous reports released in 2007. It increased the confidence level to "extremely likely" that human influence has been the major cause of warming since 1950. It also stated that costs and losses from climate change impacts will continue to increase, especially if government inaction continues. Finally, all models from this report predicted that global mean temperature rise from pre-industrial levels will exceed 1.5° C by 2100. IPCC research suggests that limiting global temperature rise to below 2°C would require a 10-40 percent reduction of greenhouse gas emissions below 1990 levels by 2020, and a 40-95 percent reduction of emissions below 1990 levels would be necessary by 2050. This coincides with the current global goal, which was agreed upon at the 2015 Paris Climate Change Conference. Its goal is to prevent a global temperature increase of more than 2°C but also to strive to limit temperatures from increasing above 1.5°C from pre-industrial levels. Any increase over this limit is predicted to result in irreversible effects on Earth's climate systems. Human-generated greenhouse gas emissions are already having widespread impacts with global implications, but they must be addressed on a community scale.

Since 2002, California has passed much legislation aimed at mitigating the effects of climate change. This has prompted many communities and campuses throughout the state to begin creating greenhouse emission inventories and to adopt climate action plans that meet statewide regulations.

On March 5, 2014, San Diego State University President Elliot Hirshman signed Second Nature's American College and University Presidents' Climate Commitment to ensure SDSU's commitment to sustainability.

The Climate Action Planning Council was formed to oversee the development and approval of the process. The Council includes representation from administrators, staff, faculty and students.

A greenhouse gas inventory was conducted to determine the sources of emissions on campus. Several working groups were formed – i.e. transportation – to calculate campus baseline emissions and propose sustainability strategies to achieve carbon neutrality.

The results indicate that campus emissions are primarily due to the on-site power plant and commuters. While the focus for carbon neutrality

must be energy and transportation, other areas of sustainability are covered as well.

The Climate Action Plan provides a set of interim goals and strategies in order to achieve carbon neutrality and to improve sustainability efforts on campus. These strategies address operational efforts, engagement and academics.

Each section provides an assessment, vision and set of actions. The actions are displayed as short, medium or long-term and include estimated dates of completion. These action tables will be used to track progress and assign implementation responsibilites to individuals and groups. After adoption of the Climate Action Plan, a campaign will be launched to educate and energize campus around the efforts.

San Diego State University has a goal of achieving campus carbon neutrality by 2050 and operational neutrality by 2040. Operational neutrality consists of emissions the university has direct control over: electricity and steam generation, energy purchases and fuel used for university-owned vehicles.

This report came out of a collaboration of dozens of faculty, staff, students and consultants who contributed their time to discuss, strategize, write and review. SDSU will now shift to the implementation of the plan.

Greenhouse Gas Inventory & Metrics

The majority of campus emissions are Scope 1 and 2 or operational emissions. Scope 1 emissions are directly generated on campus from combusting fuel for the power plant, boilers and fleet vehicles. The largest contributor (48.4 percent) is from the co-generation plant, which burns natural gas. Scope 2 emissions from purchased electricity make up a smaller portion of total campus emissions. The remaining emissions are Scope 3 emissions, primarily from commuting by students, faculty and staff (36.9 percent). Scope 3 also includes emissions from university travel, water, waste and electrical losses. Due to their overwhelming contributions to the carbon footprint, reducing energy and commuting emissions must be the university's focus.

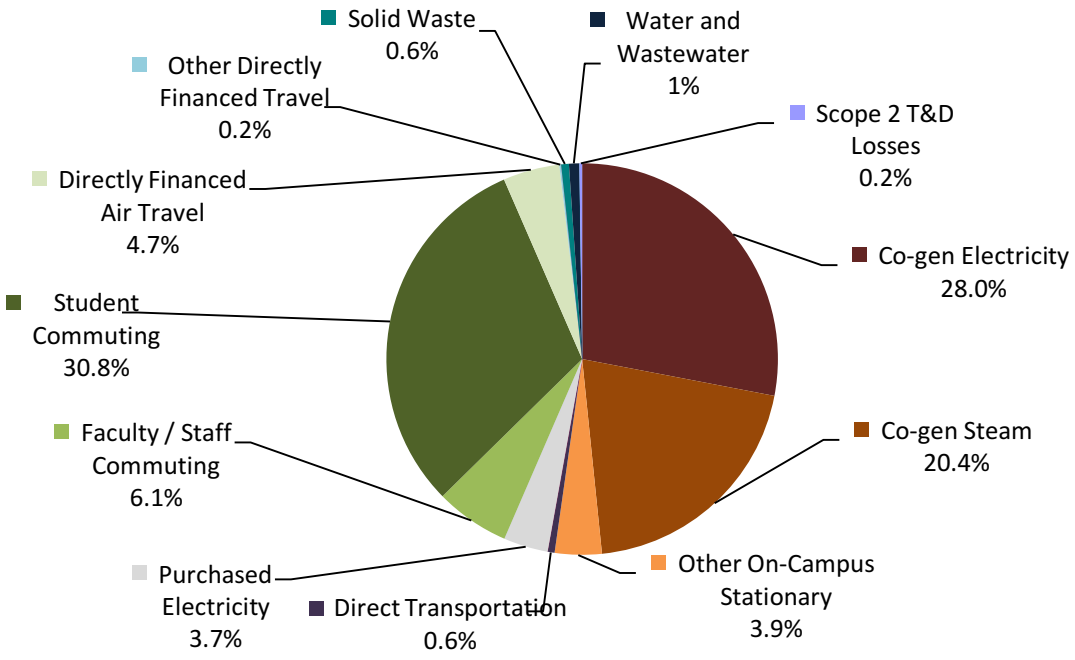
Greenhouse Gas Emissions Scopes & Definitions[1]

Scope 1: Direct emissions from owned or controlled sources.
Sources included: Natural gas for co-gen, other on-campus stationary sources (boilers), direct transportation (fleet vehicles).

Scope 2: Indirect emissions from the generation of purchased energy.
Sources included: Purchased electricity.

Scope 3: All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.
Sources included: Faculty/staff commuting; student commuting; directly financed air travel; other directly financed travel; solid waste, water and wastewater; Scope 2 transmission and distribution losses from purchased electricity.

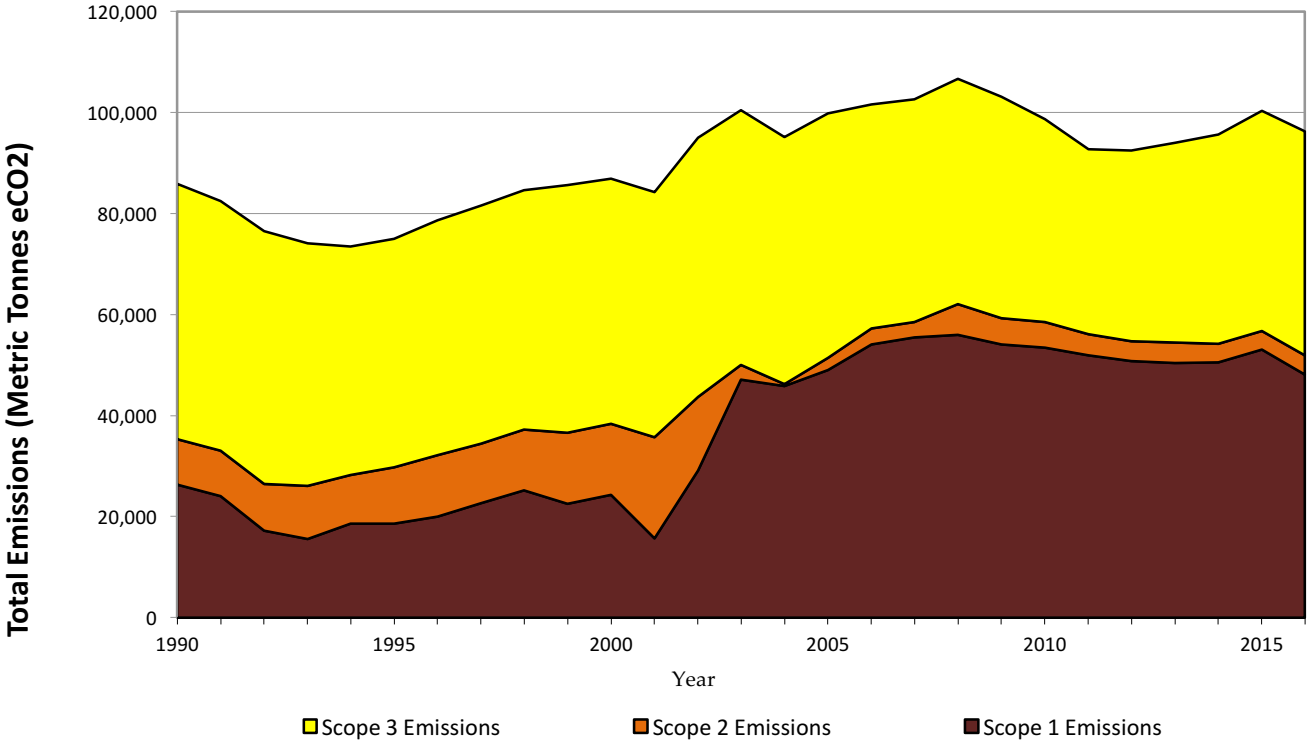
Baseline Emissions (FY14/15)



[1] http://www.ghgprotocol.org/calculation-tools/faq

The greenhouse gas inventory used the Clean Air Cool Planet spreadsheet model and pulled in data from a variety of sources. Energy and water usage were collected from the campus utility spreadsheets, which are based on utility bills. The carbon intensity of water came from the City of San Diego's Climate Action Plan[2]. Commuting emissions were estimated and based on a campus-wide survey, as discussed later. Emissions from university-owned vehicles came from the campus garage data system and stored in the utility spreadsheets. University-funded travel was provided by the Accounts Payable Department. Mileage was available when booked through the Rancho San Diego Travel Agency and for Air Planning charter flights. Other air travel data was only available in dollar amounts and was converted to miles through Airlines for America[3]. Total campus area and employees include all auxiliaries and satellite locations.

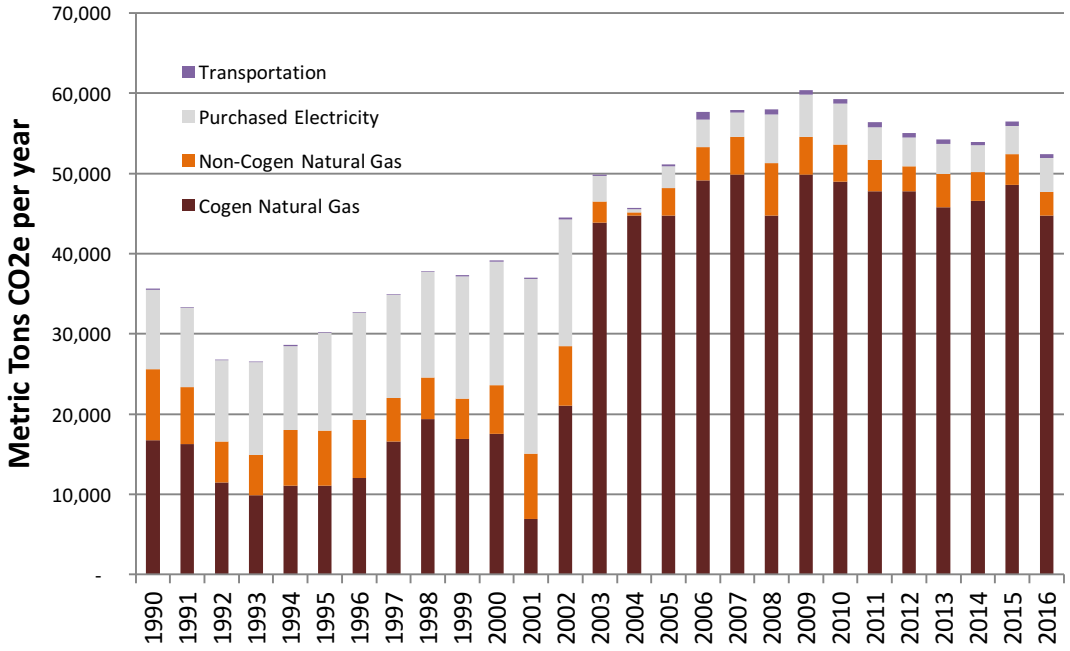
Operational emissions increased by nearly 60 percent from 1990 to 2015, primarily driven by campus growth. Normalized to gross square footage, campus carbon intensity dropped during this time period. SDSU experienced a major drop in emissions from 1990 to 1992. It is unknown whether the drop was actual or a data anomaly.



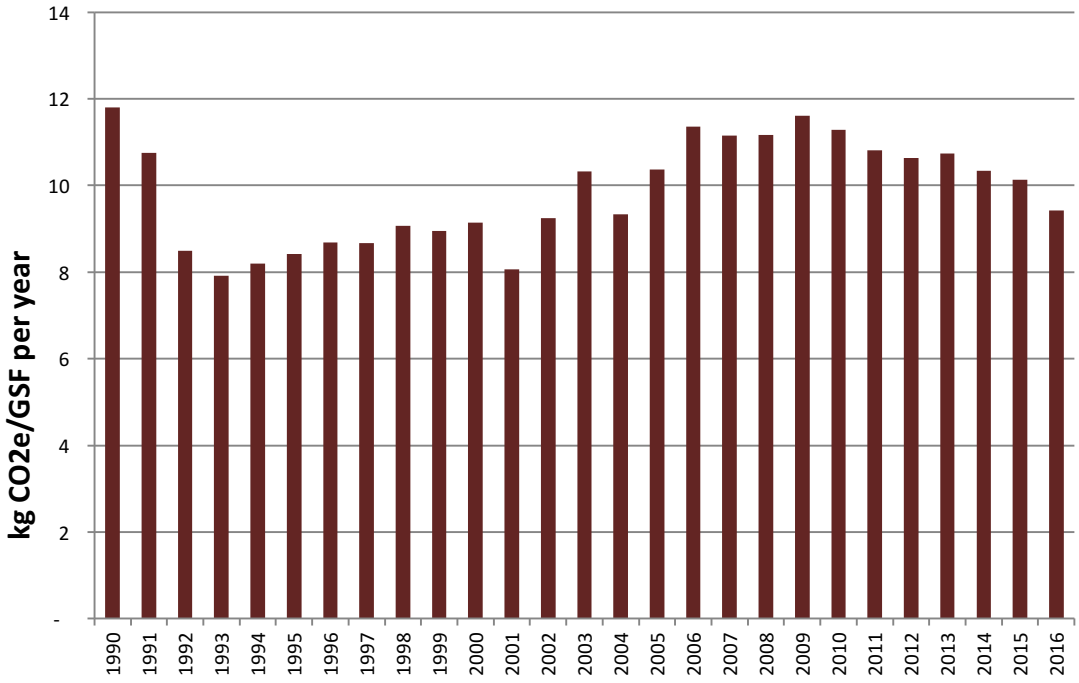
Historical Emissions by Scope

[2] https://www.sandiego.gov/sites/default/files/final_july_2016_cap.pdf

[3] http://airlines.org/dataset/a4a-monthly-yield/



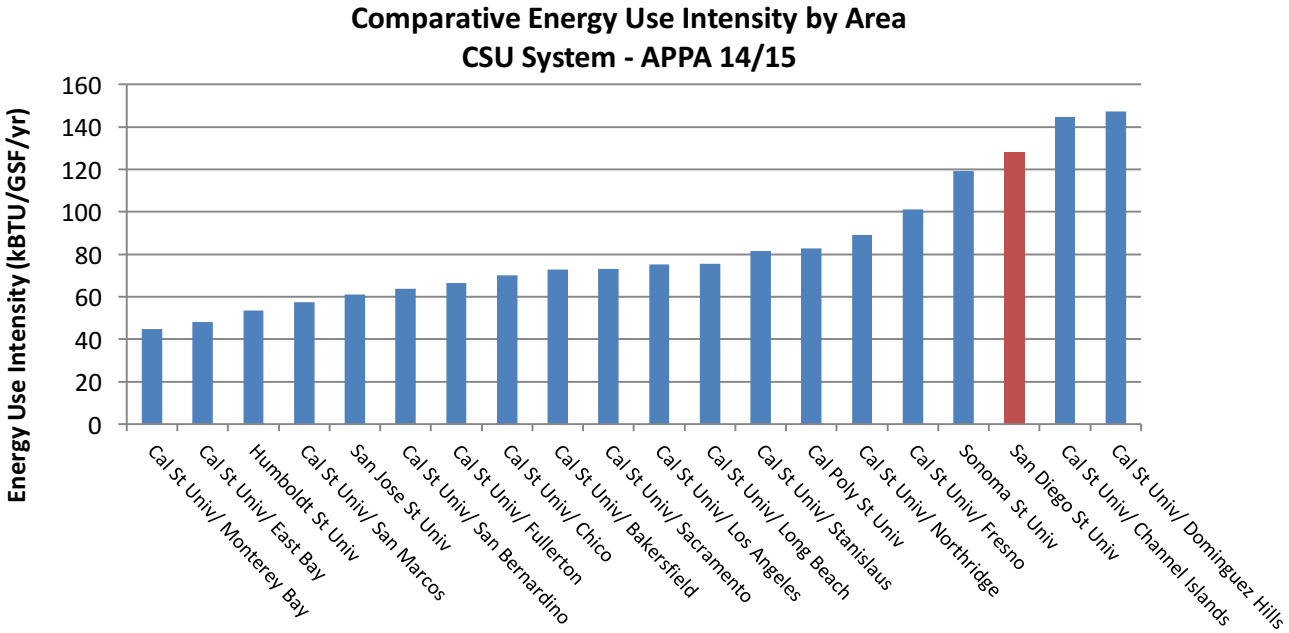
Operational Emissions (Scopes 1 and 2)

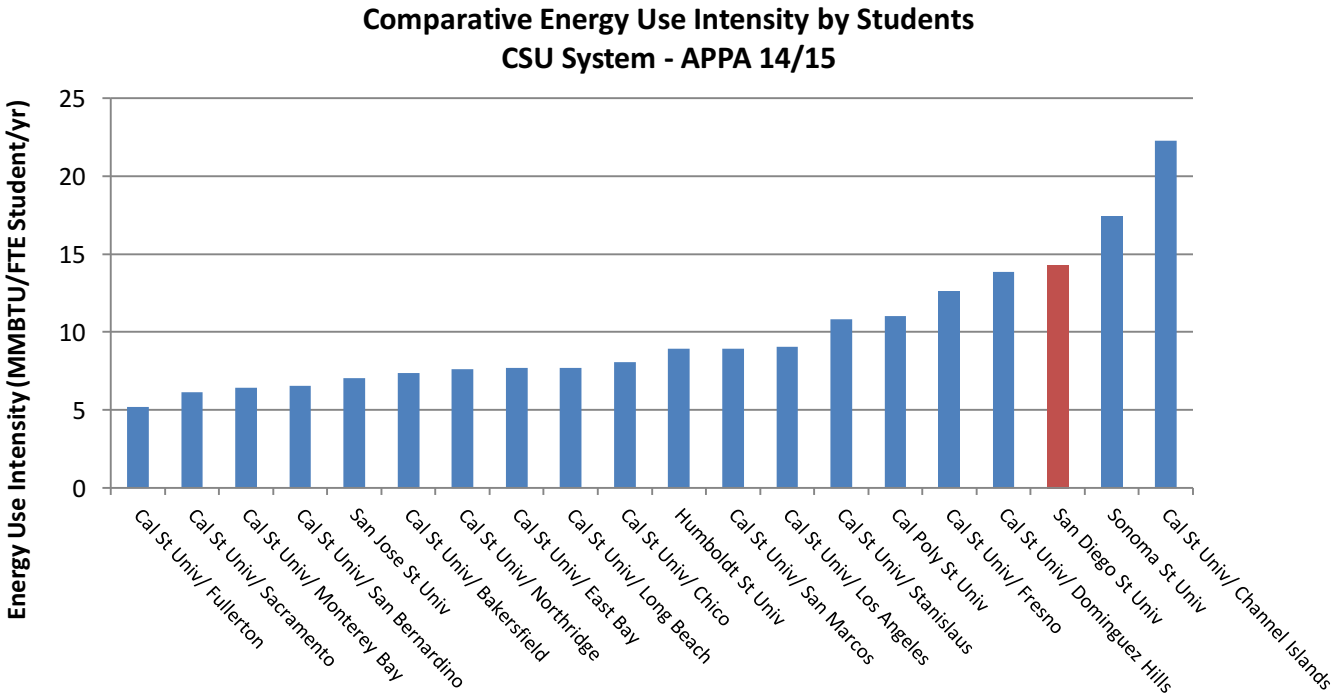


Operational Emissions (Scopes 1 and 2)
Normalized to Square Footage

Energy

Within the California State University system, San Diego State University has the third-highest energy use per square foot, consuming 55 percent more than the system average. SDSU has nearly three times the energy intensity of the most efficient campus, CSU Monterey Bay. Energy performance is similar on a per-student basis, with SDSU being the third-most energy intensive and 44 percent higher than system average. Reasons include inefficient building systems, research activities and older building stock: half of campus buildings were built before the energy code was implemented in 1978.



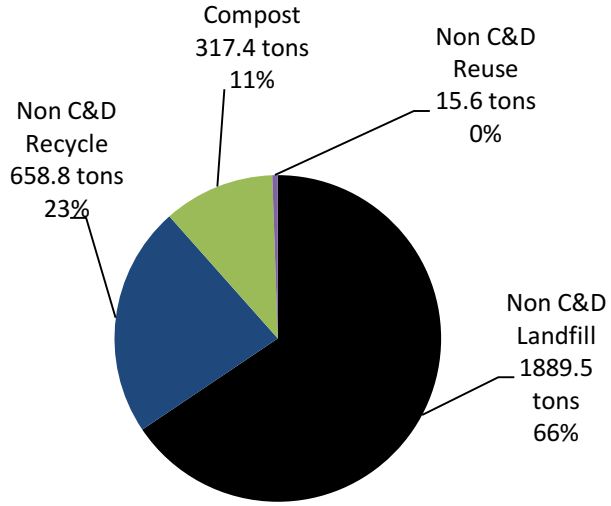


Waste

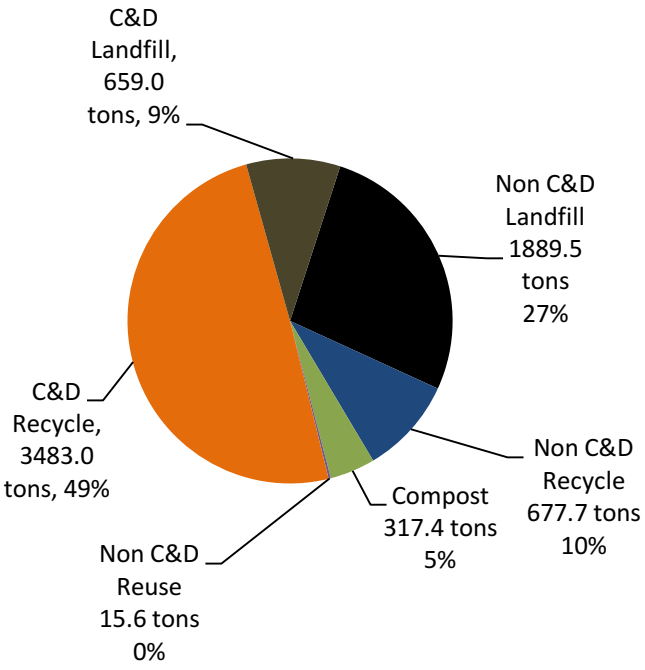
Starting in fiscal year 15/16, a new waste and recycling contract was put into place with several sustainability features, including improved tracking of waste and recycling amounts.

The non-construction and demolition (C&D) diversion rate was 34 percent for fiscal year 15/16, with a third of the diversion coming from composting yard waste and pre-consumer food waste. When C&D is included, the overall diversion rate increases to 64 percent. This is primarily due to diversion efforts from the Engineering Lab and Industrial Technology building demolition and the South Campus Plaza project.

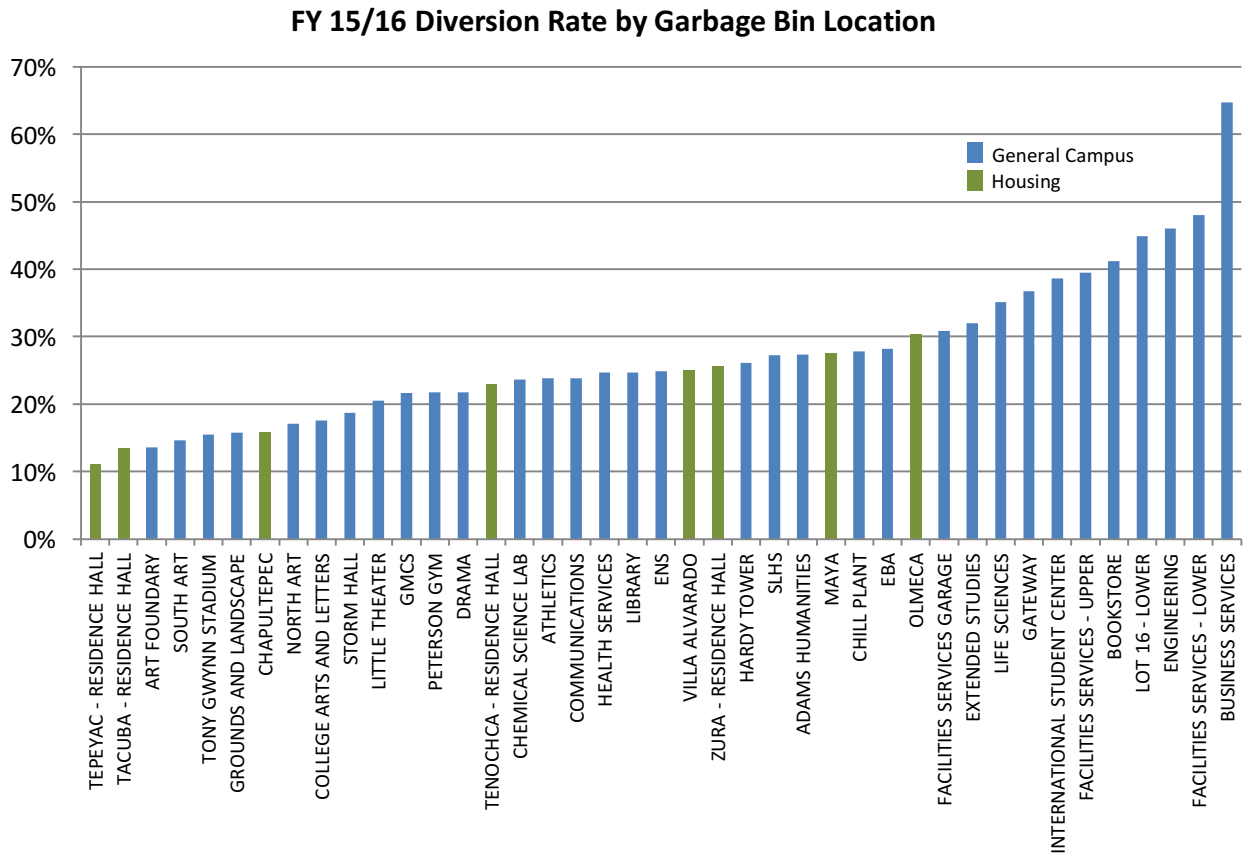
Each garbage bin on campus is weighed daily. This allows campus to right size service and track performance by building. Diversion rates for the general campus vary from 14 percent at the Art Foundry up to nearly 70 percent at Business Services – due to the printing operations paper output. Housing diversion rates vary from 10 percent up to 30 percent and are strongly correlated to the quality of recycling infrastructure. Recycling rates at housing are higher when students dispose waste at side-by-side landfill and recycling garbage bins or chutes. Diversion rates are lower when students have a single landfill chute and separate residential-sized bins.



Non C&D Diversion (7/15 to 6/16)



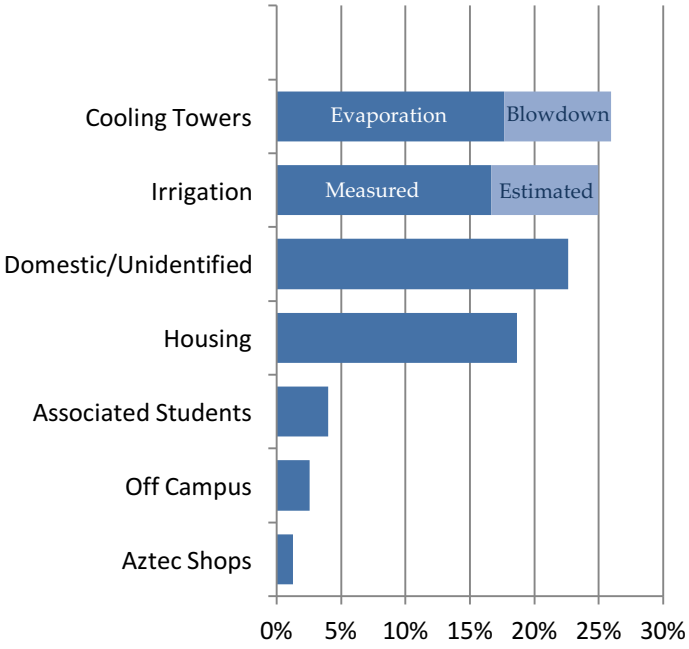
Total Diversion (7/15 to 6/16)


FY 15/16 Diversion Rate by Garbage Bin Location
70%
60%
50%
40%
30%
20%
10%
0%
General Campus
Housing
TEPEYAC - RESIDENCE HALL
TACUBA - RESIDENCE HALL
ART FOUNDARY
SOUTH ART
TONY GWYNN STADIUM
GROUNDS AND LANDSCAPE
CHAPULTEPEC
NORTH ART
COLLEGE ARTS AND LETTERS
STORM HALL
LITTLE THEATER
GMCS
PETERSON GYM
DRAMA
TENOCHCA - RESIDENCE HALL
CHEMICAL SCIENCE LAB
ATHLETICS
COMMUNICATIONS
HEALTH SERVICES
LIBRARY
ENS
VILLA ALVARADO
ZURA - RESIDENCE HALL
HARDY TOWER
SLHS
ADAMS HUMANITIES
MAYA
CHILL PLANT
EBA
OLMECA
FACILITIES SERVICES GARAGE
EXTENDED STUDIES
LIFE SCIENCES
GATEWAY
INTERNATIONAL STUDENT CENTER
FACILITIES SERVICES - UPPER
BOOKSTORE
LOT 16 - LOWER
ENGINEERING
FACILITIES SERVICES - LOWER
BUSINESS SERVICES

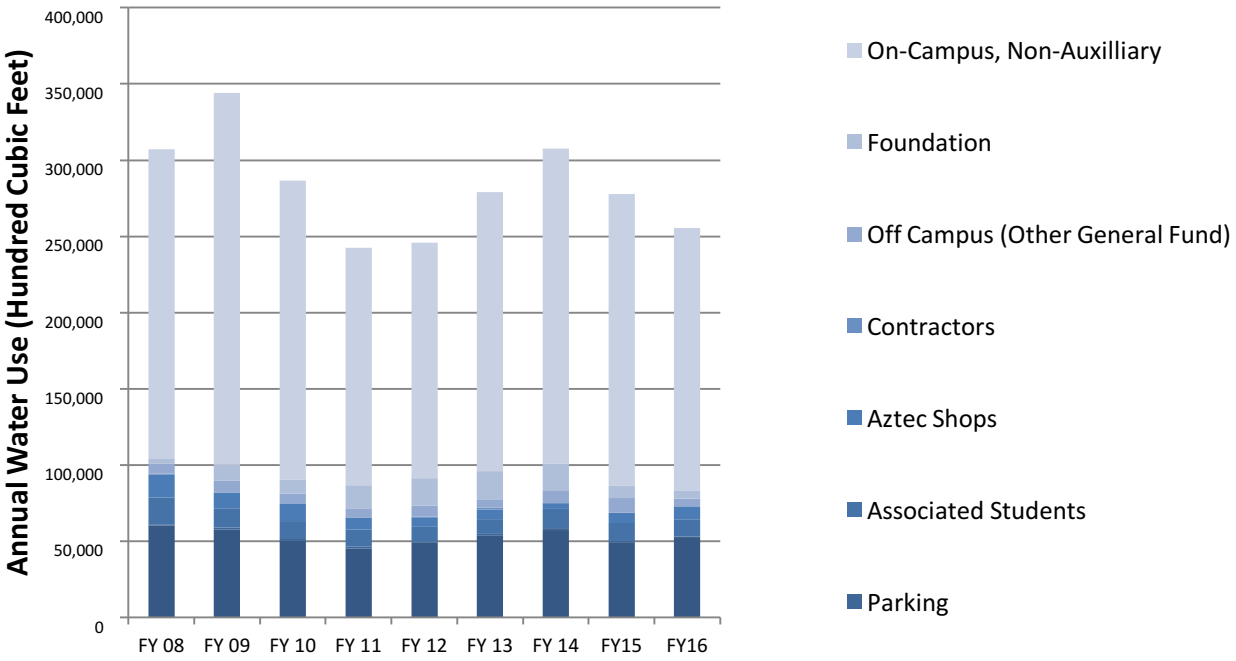

LANDFILL
MIXED RECYCLE
COMPOST

Water

Water consumption varies greatly from year to year and is highly sensitive to weather – both temperatures and precipitation. Due to campus drought-response efforts, water consumption decreased even with hotter conditions. The largest identified water consumers on campus are the cooling towers, which are a part of the campus chilled water system and co-generation plant. They are followed by housing and metered irrigation – which only captures a portion of total campus irrigation use. The largest overall consumer was unidentified due to the fact that many end uses are not metered. The most likely source would primarily be domestic consumption, such as toilets, urinals and sinks. Additionally, a substantial portion of this category is likely from irrigation not captured by the metered Calsense irrigation system.



Water Use Breakdown (FY 13/14)



Historical Water Use by Operational Area

Utility Costs

Total utility costs for campus are over $11.5 million per year, including all auxiliaries. This includes natural gas, electricity, water and sewer, and waste hauling.

The largest contributor to energy cost is electricity at $5.2 million, and it is broken down into three categories. Electricity consumption is the cost most people are familiar with and what residential users pay. This represents the energy delivered to campus, primarily the generation costs. SDSU is a direct-access campus, which means it can purchase from third parties instead of the local utility, San Diego Gas & Electric. This reduces costs when market conditions are favorable, which they have been recently. Not all accounts are on direct access; the Imperial Valley Campus purchases electricity through the Imperial Irrigation District and several San Diego accounts buy from SDG&E. A substantial amount of these charges is from the Research Foundation, which is not connected to the main SDSU grid.

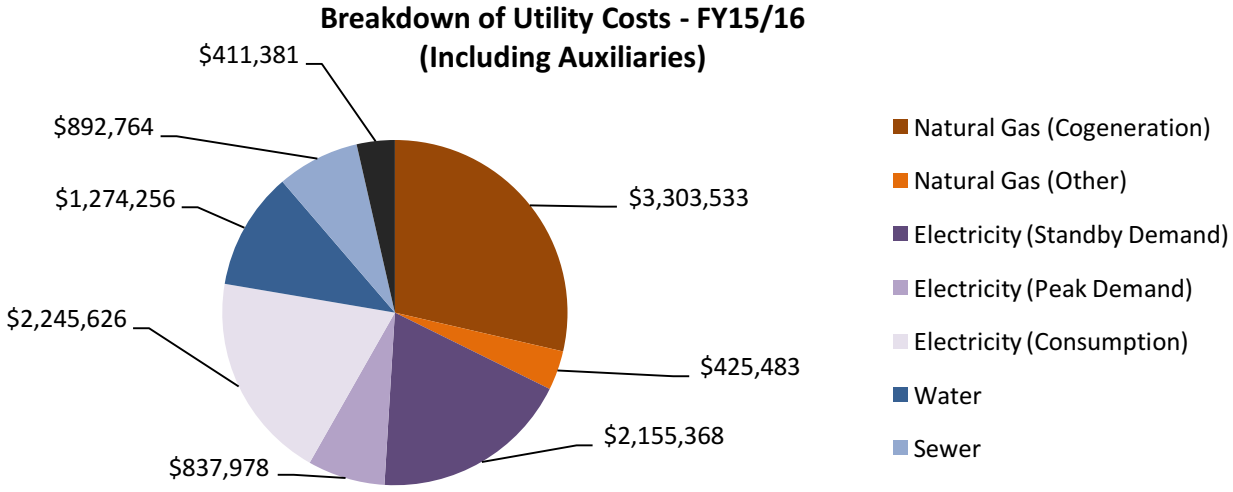
Standby demand is a charge levied by SDG&E. Since SDG&E must serve campus in the event the co-generation plant goes down, it must have capacity available to serve. These charges are based on the total electric demand required by the campus at any time, whether or not the power is coming from the co-generation plant or from the utility.

Peak demand is charged when campus pulls from the grid during peak periods as defined by SDG&E. This only relates to purchased power; demand served by the co-generation plant is not included. For the main SDSU grid, the co-generation plant is operated to avoid all peak demand charges. However, peak demand charges are levied when equipment is down for planned or unplanned maintenance.

The next largest category is from natural gas, primarily from the co-generation plant. Due to lower natural gas prices and reduced co-generation operation, this cost has been decreasing. A small amount of natural gas costs come from boilers, cooking equipment and other small users.

Water and sewer costs are over $2 million each year. City of San Diego water rates have increased in the last few years and are scheduled to continue to increase.

Waste hauling is the lowest utility cost, though this category only includes the main SDSU campus.



Goals

Carbon Commitment

By signing the the American College and University Presidents' Climate Commitment, now rebranded as the Carbon Commitment, San Diego State University has agreed to achieve carbon neutrality. The Carbon Commitment includes completing a greenhouse gas inventory, creating a climate action plan and regular reporting on progress. The Climate Action Plan will develop benchmarks and actions to reach carbon neutrality, as well as highlight opportunities to engage education and research around climate change.

The goal of carbon neutrality will require a significant effort to reduce campus energy consumption and increase use of clean energy. It also will require substantial efforts to reduce indirect emissions from commuting by students, faculty and staff.

California State University System

The California State University has a State University Administrative Manual that outlines requirements for the administration and operation of campuses. The manual includes policies related to energy conservation and utilities. The California State University system has a sustainability policy[4] with several goals, some of which are summarized below. This policy will be integrated into the State Administrative Manual in the near future.

- Reduce direct (Scope 1 and 2) greenhouse gas emissions to 1990 levels by 2020 and 80 percent below 1990 levels by 2040. This primarily consists of electricity and natural gas usage and fleet gas usage.
- Exceed the State of California's renewable portfolio standard of 33 percent of electricity from renewables by 2020.
- Reduce water consumption by 10 percent by 2016 and 20 percent by 2020.
- Meet waste diversion rate of 50 percent by 2016 and 80 percent by 2020 – toward a goal of zero waste.
- Procure 20 percent of food purchases from sustainable sources by 2020 – as defined by the Real Food Challenge or equivalent systems.
- Design and build all new buildings and major renovations to LEED Silver standards at a minimum, with Gold and Platinum standards encouraged.

[4] http://www.calstate.edu/cpdc/sustainability/policies-reports/documents/JointMeeting-CPBG-ED.pdf

State of California

The State of California has codified several ambitious statewide sustainability goals aimed at addressing climate change and protecting the environment. A few are highlighted below:

- AB 32[5] established a statewide goal of reducing greenhouse gas emissions to the 1990 level by 2020. This goal was recently enhanced when SB 32[6] was passed and signed by Gov. Edmund G. Brown Jr., setting a new statewide greenhouse gas reduction goal of 40 percent below the 1990 level by 2030.
- Former Gov. Arnold Schwarzenegger also signed Executive Order S-3-05 calling for greenhouse gas emissions to be reduced to 80 percent below the 1990 level by 2050.
- SB 1078[7] established California's Renewables Portfolio Standard, which has been amended several times and currently requires all electric load-serving entities to procure 33 percent of their total annual electric retail sales from eligible renewable sources by 2020, 40 percent by 2024, 45 percent by 2027 and 50 percent by 2030.
- SB 350[8] mandates the development of statewide targets that would lead to a doubling of energy efficiency savings in all retail electric and natural gas end-uses by 2030. In addition, SB 350 mandates that the state's electric investor-owned utilities engage in activities that encourage the widespread electrification of transportation within their territories.
- Finally, AB 341[9] set a goal of 75 percent recycling, composting or source-reducing waste by 2020.

City of San Diego

The City of San Diego also has a Climate Action Plan, adopted in December 2015, as well as other sustainability goals.

[5] Nunez, Chapter 488, Statutes of 2006
[6] Pavley, Chapter 249, Statutes of 2016
[7] Sher, Chapter 516, Statutes of 2002
[8] De Leon, Chapter 547, Statutes of 2015
[9] Chesbro, Chapter 476, Statutes of 2011

- The plan established carbon equivalent emissions reduction targets at 15 percent below the 2010 baseline by 2020 and 50 percent below the 2010 baseline by 2035.
- It calls for 100 percent of electricity used in the city to be from renewable sources by 2035.
- The city's plan includes strategies for reducing transportation-based emissions. Specific targets are broken out by strategies – for example, achieve 6 percent bicycle commuter mode share by 2020 and 18 percent mode share by 2035 in transit priority areas. Collaborating with the city on transportation will greatly benefit SDSU's efforts.
- The city is committed to reducing daily per-capita water consumption by 9 gallons by 2035.
- The city's Zero Waste Plan calls for diverting 90 percent of collected trash by 2035. By 2040, the goal will be to divert 100 percent of collected trash.

San Diego State University

SDSU GHG Emission-Reduction Goals

Each campus selects its own neutrality date, with 85 percent committing to 2050 or sooner and 40 percent committing to 2040 or sooner. SDSU will have a goal of campuswide carbon neutrality of no later than 2050. As an interim goal, SDSU will reach 1990 emissions levels by 2020 – a 10 percent drop in total emissions.

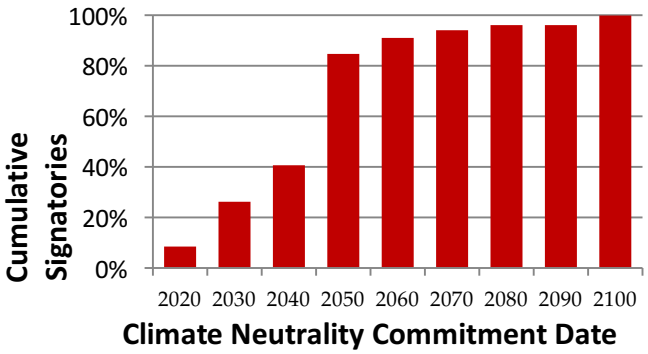
In order to meet the CSU goal for operational emissions reduction (Scopes 1 and 2), aggressive action would need to be taken. It would require a 32 percent reduction in operational emissions by 2020. A heavy investment in energy efficiency, solar photovoltaic installations and shifts in co-generation plant operation could reduce emissions by about 20 percent.

However, this change would be offset by new building emissions on the order of 5-10 percent (including the Engineering and Interdisciplinary Sciences Complex and South Campus Plaza).

San Diego State will target an operational emissions goal of 1990 emissions levels by 2025 and operational neutrality by 2040.

This exceeds the CSU goal to reduce emissions by 80 percent over 1990 levels by 2040. Moreover, it provides time for a potential campus central energy conversion, allowing for decreased dependency on co-generation and increased importation of electricity from a cleaner statewide electric grid.

Under this scenario, commuting would then contribute nearly all of campus emissions after 2040.



Goals:

Reach 1990 campuswide carbon emissions levels by 2020

Reach 1990 operational emissions levels by 2025

Operational carbon neutrality by 2040

Campuswide carbon neutrality by 2050

SDSU Water Goals

In fiscal year 15/16, SDSU met the CSU water conservation goal for 2020 – a 20 percent reduction over baseline year 2013. However, there are more opportunities to conserve. By 2020 and 2025, the campus will reduce water consumption by 25 percent and 30 percent, respectively. This will be accomplished primarily through cooling tower water reduction, with continued reductions in landscape and domestic water use. This also considers additional water use through expanded on-site student housing.

Goals:

25 percent below 2013 water usage by 2020

30 percent below 2013 water usage by 2025

SDSU Waste Goals

Campus waste generation and diversion is sensitive to the amount of construction going on during the time period. For instance, the diversion rate increased from 40 percent to 59 percent between fiscal years 14/15 and 15/16, due to the demolition of two buildings. SDSU met the CSU goal of 50 percent waste diversion in 2016 due to the extra construction recycling, but this may not be met in fiscal year 16/17.

SDSU will have a goal for non-C&D of 50 percent by 2020, up from 35 percent in fiscal year 15/16. This will be accomplished through increased recycling infrastructure and education and a post-consumer food composting program (once a facility is available). Total diversion will target 60 percent by 2020, but that will be heavily contingent on the level of construction activity.

Goals:

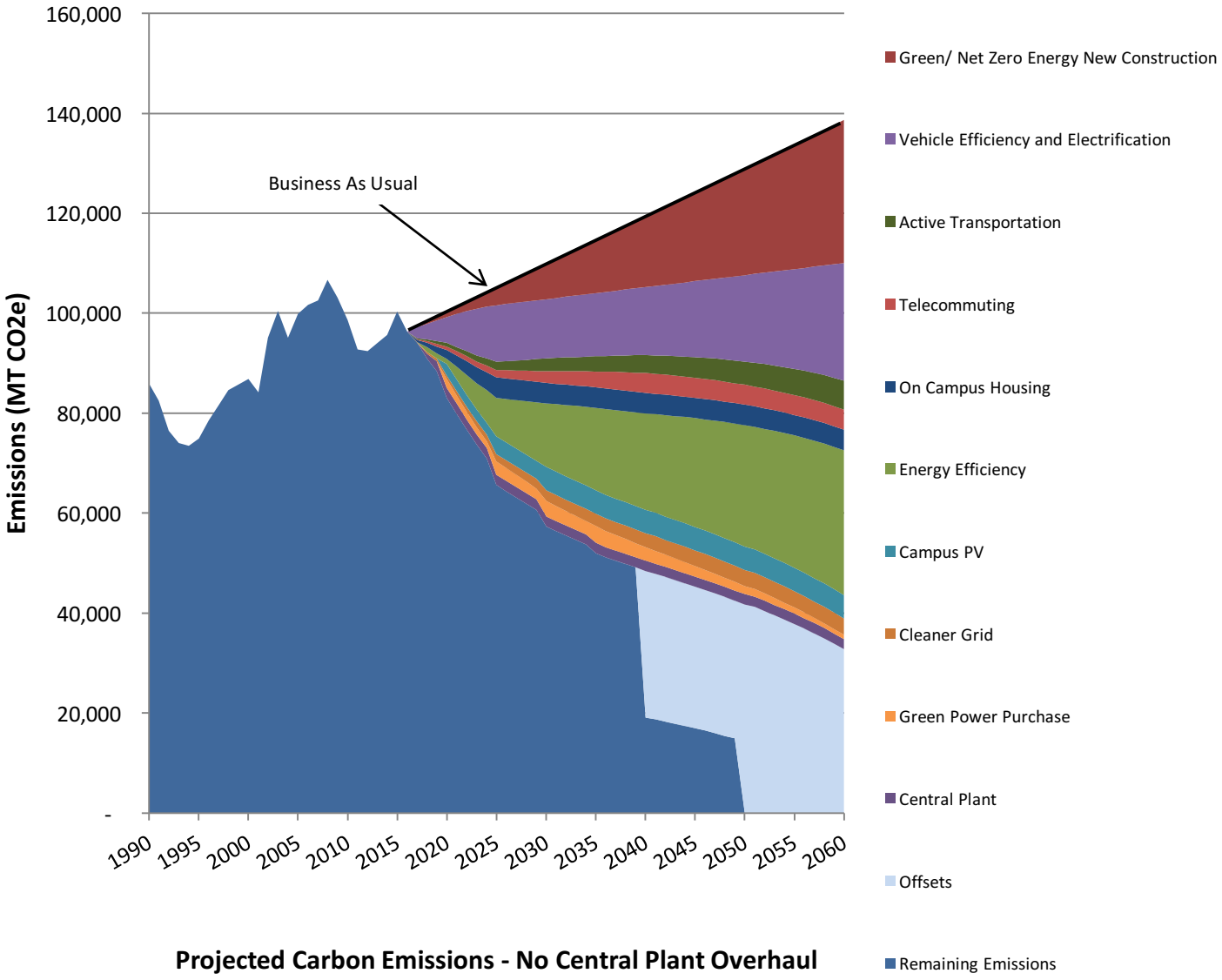
50 percent non-C&D diversion rate by 2020

60 percent total diversion rate by 2020

80 percent total diversion rate by 2025

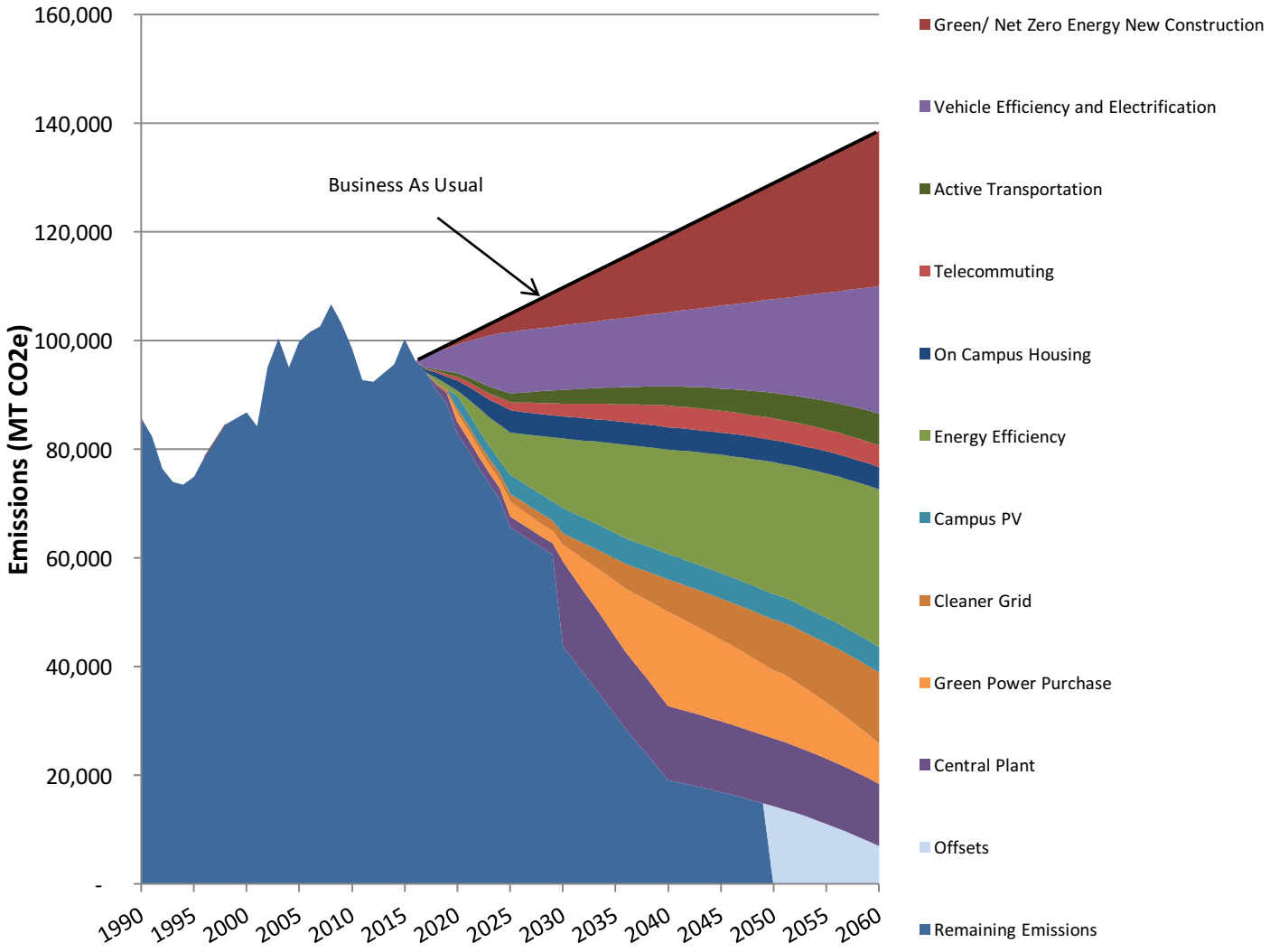
Projected Emissions

The graph below represents a set of strategies to achieve carbon neutrality while operating the existing central plant. The top line of the graph represents historical and projected business-as-usual emissions. Each wedge below represents the estimated impact of a strategy discussed in the report. It also reflects the need to increase green power purchases and carbon offsets to meet neutrality goals.



Projected Carbon Emissions - No Central Plant Overhaul

The following graph presents the same information if a central plant overhaul takes place. Since this issue is currently being studied, both options are shown.



Projected Carbon Emissions - With Central Plant Overhaul

Energy

Overview

Energy use is the largest source of carbon emissions at SDSU. Energy is used in a variety of ways on campus: lighting buildings and exteriors; heating and cooling spaces; and powering computers, displays, lab equipment, and other plug loads. Most of campus electricity and steam is provided by a central co-generation plant, which consumes natural gas. Campus cooling comes from several electric-driven chiller plants and is pumped throughout campus. There are many ways to reduce our energy use through more efficient equipment, optimizing existing systems and better controlling our heating and cooling. Emissions can also be reduced by using cleaner sources of energy.

Central Energy Systems

Assessment

The vast majority of electricity and steam provided to campus comes from the co-generation plant, which is composed of two 5.2-MW natural gas turbines, a 4.2-MW steam turbine, heat-recovery steam generators, duct burners and auxiliary natural gas boilers. Portions of campus can operate in island mode during local and regional grid outages. The majority of the campus has direct-access electric service. The transportation and distribution is provided by the local electric utility, SDG&E, while the electricity is provided by Shell Energy.

Historically, the plant has attempted to provide all of campus electricity with both natural gas turbines operating, avoiding importation from the electric utility. This causes the gas turbines to be operated at low load or with duct burners, which reduces overall plant efficiency. An efficiency level must be met in order to avoid certain charges on generated electricity – over $1 million per year. There have been several recent years where this efficiency came close to not meeting the requisite level under the previous strategy. The high portion of self-generation reduces opportunities for utility incentives from San Diego Gas & Electric and on bill financing.

An optimization study was completed in 2016, focusing on the co-generation plant. The primary recommendation was to shut off (cycle) one turbine during wholesale off-peak periods in order to boost plant efficiency and reduce overall operating costs. This recommendation estimated an operational emissions reduction of 9 percent. The report also suggests moving to real-time optimization for additional savings and a 14 percent reduction in operational emissions. Graphs summarizing the optimization study can be found on the following page. This does not include major investments required for the co-generation plant to operate at the optimal level.

The plant began the simple cycling on weekday nights and weekends in March 2016. Due to the increased starts and stops, some maintenance impacts have been identified. These impacts have resulted in monthly peak demand charges. Several issues have been corrected, and uptime has improved. This new operating scheme has resulted in a 6 percent reduction in operational emissions.

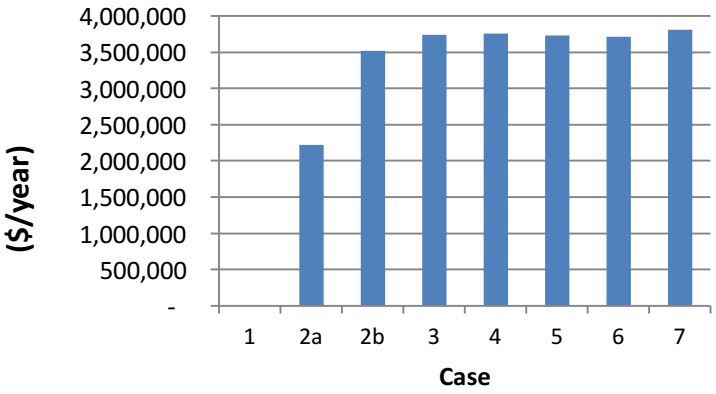
A significant portion of heat is lost through the steam distribution system. Recently, $20 million was spent to replace existing steam lines, due to safety concerns. Several campuses have converted from steam to hot water distribution, including Stanford University and the University of British Columbia. In order to achieve carbon neutrality, a natural gas-driven co-generation plant would

require carbon offsets or biogas, which is expensive and in short supply. Alternatives include electrifying the system with heat-recovery chillers or distributed heating, with reduced amounts of biogas or carbon credits. Electrification allows the central energy systems to be provided by clean energy sources, such as solar. SDSU is currently undergoing a central energy study that will analyze and recommend a path to move forward.

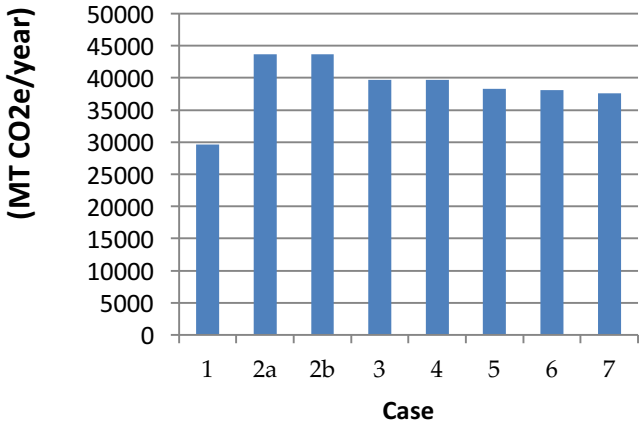
The main chiller plant was commissioned in 2015 with efficient electrically driven chillers and thermal energy storage. One of the two chillers at the satellite EBA plant is a fairly efficient modular chiller, while the other is aged and inefficient. The Athletics chiller plant has upcoming renovations that will include connection to the main chilled water loop. In the past decade, steam-driven absorption chillers have been replaced with electrically driven chillers. This has negatively impacted the overall efficiency of the plant, which must remain above certain levels to avoid financial penalties from SDG&E.

Vision

Electricity, chilled water and heat will be provided efficiently and reliably to campus. The campus will analyze several options for its central energy generation and distribution systems. Systems-level impacts will be considered, including requisite co-generation plant efficiency, lifecycle cost and carbon impacts. Options to be studied include, but are not limited to, steam-to-hot-water conversion, centralized versus distributed boilers, heat-recovery chillers, biogas and solar photovoltaics.



Co-gen - Potential Annual Cost Savings



Co-gen - Potential GHG Emissions

Case #	Case Name
1	Base case, no co-gen
2a	Previous - power track mode w/co-gen (PURPA efficiency unmet)
2b	Previous - power track mode with co-gen (PURPA efficiency met)
3	Current - turn off one turbine during wholesale off-peak hours
4	Add 500-ton absorption chiller to Case 3
5	Base load single-gas turbine at off-peak at only 3,500 kW
6	Base load single-gas turbine at off-peak at only 3,000 kW
7	Real-time optimized run

Actions

			Short			Medium		Long
			2017	2018	2019	2020	2021	2022+
Central Energy Systems	1.1.1	Implement recommendations from the optimization study. SDSU is already shutting off one turbine during wholesale off-peak periods. The next step is to upgrade meters and explore real-time optimized operation.						
	1.1.2	Complete central energy system study that will focus on developing a long-term strategy to reduce lifecycle costs and allow campus to achieve carbon neutrality cost effectively. The target completion of this study is May 2017.						
	1.1.3	Complete Fowler Athletic Center chiller plant upgrades, including connection to main chiller plant.						
	1.1.4	Replace insulation on thermal energy storage tanks.						
	1.1.5	Implement central plant overhaul as identified in central energy study.						

Energy Information System & Metering

Assessment

In 2011, an Automated Utility Metering and Billing Study was conducted by Cogent Energy, summarized by the following assessment:

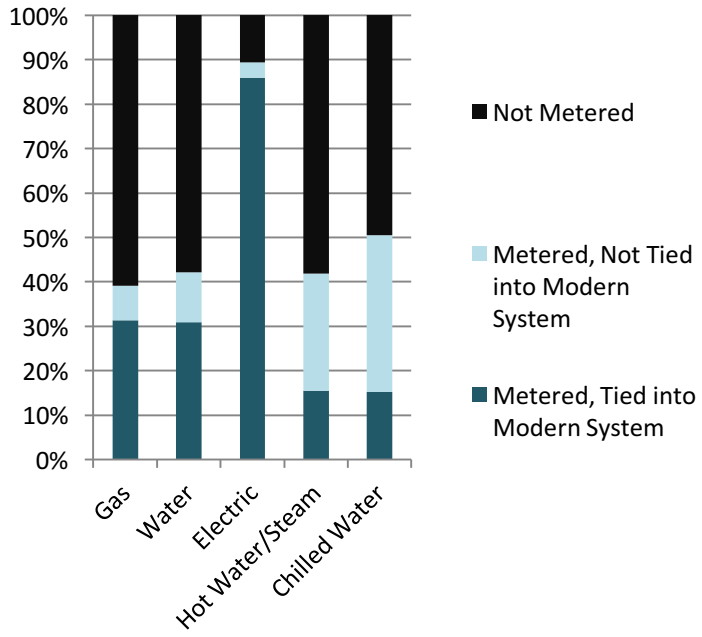
"The current process for metering and billing revenue-generating buildings, which involves collecting, uploading and processing monthly utility meter data and issuing monthly bills, is ineffective in terms of efficiency, transparency and accuracy."

While small improvements have been made, the overall assessment is still valid. External bills are entered by hand, students read meters and recharge billing is always late and often has errors. Data read from meters on a monthly basis is not easily actionable. All information is stored in a series of dozens of Excel spreadsheets, one for each month. All analysis is contingent on pulling data from multiple spreadsheets.

In addition to the monthly recharge billing of campus auxiliaries and contractors, there are several regulatory and systemwide reporting requirements that need to be met. This is currently done manually with a major time investment.

Most buildings have electric metering, but less than half have thermal or domestic water metering. Only a minority of steam and chilled-water meters connect directly to the modern management

system, Tridium/Niagara. The rest are tied into legacy systems with limited export functionality or are read manually. After the new chiller plant came online, nighttime (and overall) cooling demand jumped. Due to the lack of meters and centralized data collection system, the individual building contributors could not be identified. Several meters will be installed with Chancellor's Office funds. Metering allows campus staff to know which buildings are the greatest contributors and direct resources to large users. Additionally, real-time data allows for changes to be made more rapidly.



Campus Metering Breakdown
The Chancellor's Office has created a master enabling agreement for four groups that will provide these services to the campuses. SDSU has decided to move forward with EcoVox to implement a robust energy information system. Implementation is expected in Spring 2017.

Vision

All buildings will be fully metered, including electricity, steam/hot water, chilled water, domestic water and natural gas (when said utility is available). These meters will automatically feed into a centralized energy information system. Utility bills will be automatically uploaded, entered and checked for errors. The system also will collect from other data sources, such as recycling and irrigation.

Auxiliaries will be billed for their utility use consistently, accurately and on time. They also will be able to pull energy usage data throughout the month to help manage their resources.

A dashboard will be available at various levels in order to manage and visualize energy usage. Energy and sustainability staff will use the dashboard to actively manage energy consumption and complete reporting requirements. Budget staff and administrators can use the dashboard for budget tracking and forecasting throughout the year, especially for utility projections and year-end accruals.

Buildings with a low-performance indicator will easily appear in portfolio views. Controls specialists, energy analysts, as well as students and professors, can dig deeper into trend data and identify opportunities to improve.

Campus staff also will engage with the energy information system through public-facing dashboards. Anyone in the campus community will be able to pull up a website to view comparative energy use among buildings, overall energy costs and associated environmental impacts. Interactive screens located in buildings throughout campus will relay actual usage information to students, faculty and staff, along with tips for reducing energy. The system also will enable classes and faculty to easily access data to conduct energy research.

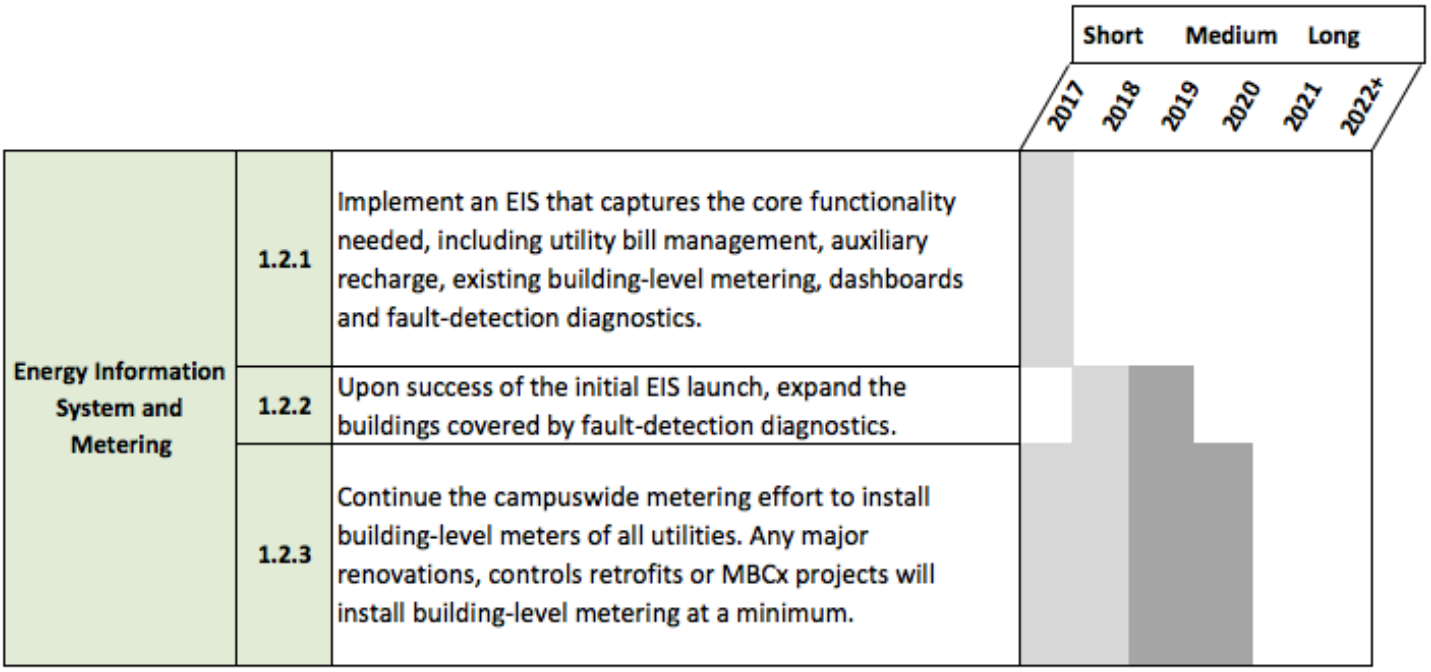
The energy information system will automatically populate reports for various entities, including the

Chancellor's Office, Air Resources Board, APPA, ENERGY STAR and LEED. More time will be spent analyzing and understanding these reports than developing them. Furthermore, relevant performance indicators will be tracked throughout the year instead of at the end, allowing Facilities Services to actively manage usage and costs.

Performance of energy efficiency and renewable energy projects will also be tracked within the system. This will assist in validating projects for the revolving loan effort. This tool also will be used to assist in large-scale monitoring-based commissioning and for continuous commissioning to ensure that savings are maintained after the engineering team walks away.

System-level optimization will be more easily achieved with all building and plant data available in one place. Advanced fault-detection diagnostics will identify energy and comfort problems before customers alert Facilities Services. This also will allow buildings to maintain performance after commissioning efforts. Work orders will be automatically sent to the AiM computerized maintenance management system. The operations of the co-generation and chiller plants will be optimized, based on rate structure and real-time pricing information. Signals for demand response will be generated to reduce campus standby and on-peak demands.

Actions



Energy Information System and Metering	1.2.1	Implement an EIS that captures the core functionality needed, including utility bill management, auxiliary recharge, existing building-level metering, dashboards and fault-detection diagnostics.
	1.2.2	Upon success of the initial EIS launch, expand the buildings covered by fault-detection diagnostics.
	1.2.3	Continue the campuswide metering effort to install building-level meters of all utilities. Any major renovations, controls retrofits or MBCx projects will install building-level metering at a minimum.

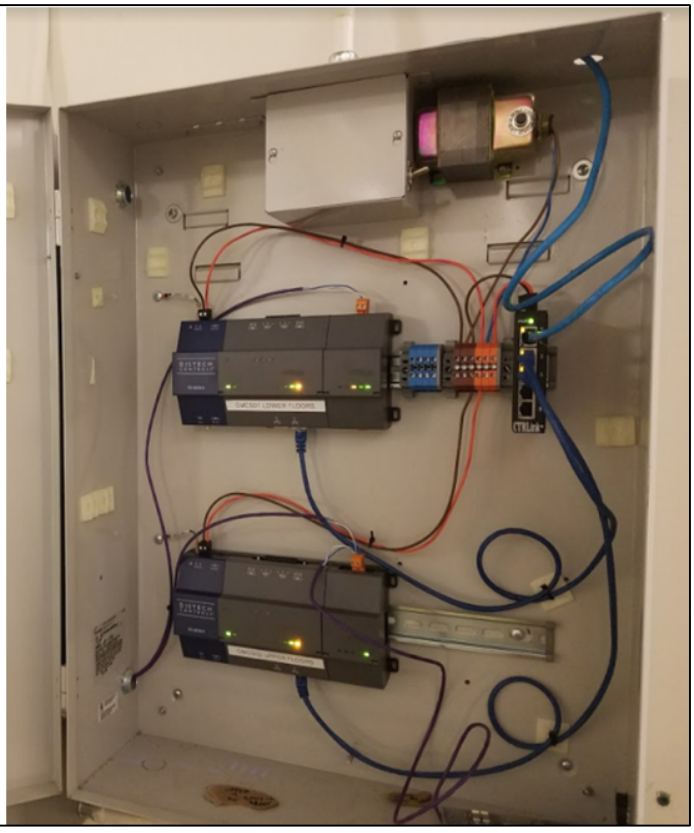
Building Automation

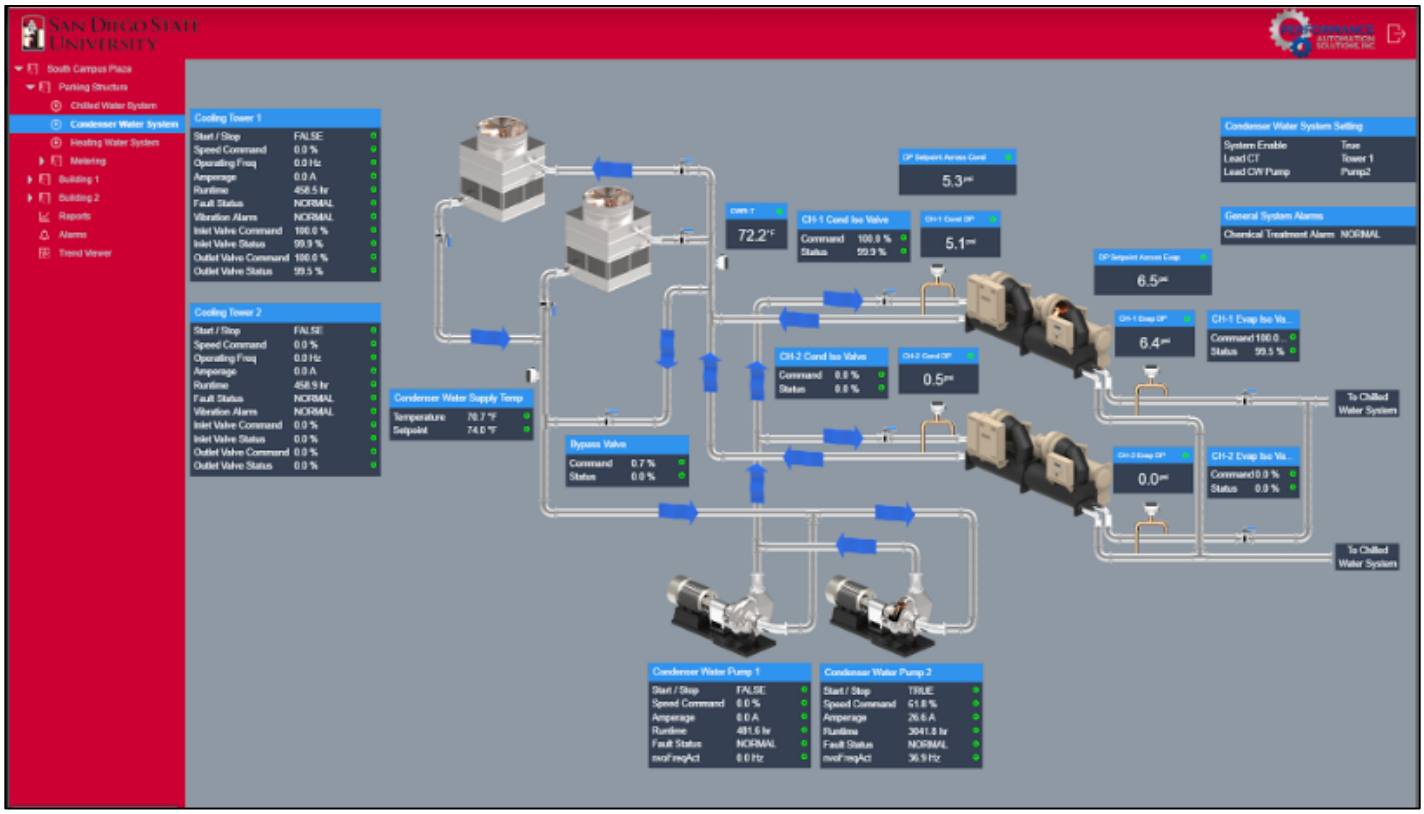
Assessment

Building automation systems are responsible for centrally controlling building systems, including heating, ventilation, air conditioning and lighting. Newer systems use direct digital controls, which allows for better control and reporting. Older systems use pressurized air to open and close dampers and other devices. There is a great opportunity to reduce energy consumption by optimizing and modernizing these systems.

The majority of campus buildings are currently served by an outdated and inefficient pneumatic control system. Pneumatic systems provide limited capability to centrally control zone temperatures and require a substantial amount of work to properly maintain. Only a portion of the pneumatic systems report to a central building automation system, which leaves limited capability for Facilities Services to proactively address building issues.

Several buildings are served by a legacy direct digital control system, RobertShaw DMS. This system has been well-maintained but has limited capability for trending and other advanced features. Newer buildings have a more advanced direct digital control system, Tridium/Niagara. Some older buildings have been converted to this system, but most of these have been partial renovations. Tridium/Niagara allows for more finite control and advanced sequence of operations to optimize energy efficiency. Due to an institutional lack of maintenance and qualified personnel, many buildings on Tridium/Niagara are no longer visible on a central front end, while some were never properly integrated.





SDSU is currently undergoing an HVAC controls upgrade project. This will re-establish visualization, modernize the Tridium/Niagara system and begin converting RobertShaw DMS systems to Tridium/Niagara. While this will bring Tridium/Niagara to current standards, there will still be many Robertshaw DMS and pneumatic systems. Upgrading these to modern standards will be a multi-million-dollar endeavor. However, it will yield energy savings, comfort improvements, and provide for resiliency as parts and qualified staff become scarce.

The current controls situation results in excessive energy use and poor comfort conditions across campus. In some situations, poorly operated equipment impacts proper ventilation levels and indoor air quality. Pneumatic zones only have one setpoint, resulting in most of campus being cooled and heated to around 72° F.

Facilities Services staff cannot view the building automation systems remotely at home or in the field. This causes unnecessary callbacks and inefficient troubleshooting. An effort to provide remote access is underway.

Class scheduling currently does not take energy consumption into consideration. If one out of 10 classrooms served by an air handler is scheduled to be used during the summer, it triggers the entire air handler to operate. Consolidating summer classes in a smaller group of buildings would allow SDSU to optimize air handler schedules and reduce energy consumption. There is currently no regular process to ensure that the equipment operation is aligned with usage schedules.

Lighting controls are inconsistently applied across campus. Several building systems utilize PowerLink, which is a timer-based system with limited functionality. For new projects, campus has begun moving towards a more advanced lighting control system, nLight.

Vision

San Diego State University will operate a state-of-the art building automation system that will reduce costs, optimize energy usage and improve indoor environmental quality. Spaces will be heated to 68-70° F and cooled to 74-76° F, and fresh air will be supplied to spaces as needed. All buildings will operate on an open direct digital control system with full visibility. Building graphics will be visible in real time to controls specialists, FS shops, FS management and relevant building users. Access to programming will be limited to controls specialists and other qualified personnel. FS staff will be able to pull graphics on a handheld device in the field in order to diagnose problems. Controls specialists and energy analysts will have access to trend data in order to continually look for improvements.

Appropriate personnel will be able to monitor systems from home.

Advanced-fault detection diagnostics will assist FS in predicting maintenance requirements, such as replacing filters, identifying failing equipment and detecting efficiency improvements. This system will integrate with the FS computerized maintenance management system.

Lighting controls will be fully compliant with and exceed the Title 24 energy requirements. Fixtures will be controlled based on occupancy and daylighting, eliminating the need for legacy time clocks. Information about the lighting system, including energy use and occupancy, will be delivered to a central system. This will integrate with the building automation system to reduce heating, cooling and ventilation when spaces are unoccupied. Occupancy information also will be used to optimally schedule classes and other space needs. Classes, especially those in the summer, will be scheduled in a way that allows air handlers to turn off for extended periods of time.

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
Building Automation	**1.3.1**	Complete project to develop new front end and replace Robertshaw DMS through Chancellor's Office-funded HVAC Controls Modernization Project. This project will also ensure existing DDC systems are visible and trending.						
	1.3.2	Complete effort to securely allow front end to be viewed by appropriate individuals from multiple locations (office, field, home).						
	1.3.3	Begin adjusting heating and cooling temperatures. Buildings with zone-level control should decrease heating and increase cooling temperatures until the targets of 68-70° F and 74-76° F are reached. This effort will start in buildings with capability to set different heating and cooling temperatures remotely.						
	1.3.4	Ensure that a preventative maintenance schedule is in place for controls systems. Carbon dioxide sensors and economizers should take high priority, as these are common failure points.						
	1.3.5	Investigate and address excessive nighttime cooling usage.						
	1.3.6	Develop process to regularly update equipment operational schedules to more closely meet campus needs, including optimum start and resets. Investigate opportunities to automate scheduling process.						
	1.3.7	Explore campuswide pumping efficiency effort, including the utilization of energy valves and conversion of three-way to two-way valves.						
	1.3.8	Complete conversion from pneumatics and Robertshaw DMS.						

HVAC Systems

Assessment

Heating, ventilation and air conditioning systems provide fresh air, comfort and safety for campus buildings. Air handlers use fans to distribute hot and cold air to spaces, while pumps circulate water to buildings and spaces. HVAC systems are controlled by building automation systems.

HVAC systems on campus tend to consist of aging air handlers and other components which have suffered from a lack of maintenance. There are several air handlers operating beyond their anticipated life, which results in higher energy consumption and impacts indoor air quality. There is no budget set aside for managed replacement of equipment; components are run to failure and then replaced or deferred. In many cases, facilities staff waiting for additional funding have extended the life of components far beyond expectations through temporary fixes. This simply defers the cost while not enjoying the benefits of a new system.

The majority of buildings have a variable-air volume reheat system, which is the primary system put into modern buildings. Approximately half a dozen buildings have inefficient constant-volume dual-duct or reheat systems. Other buildings include dual-duct VAV (3) and multizone (5), which are more efficient than constant-volume systems serving more than one zone but typically less efficient than VAV reheat, due to duct leakage and simultaneous heating and cooling. There are seven buildings with single-zone, constant-volume fan coil systems; these eliminate reheat but have no volume control.

Building controls and preventive maintenance are covered elsewhere in this plan and are also crucial elements to a well-functioning HVAC system. Lack of a rigorous preventive maintenance program reduces component lifetime and increases energy consumption. There are also impacts to indoor air quality, including mold and inadequate ventilation, which have been encountered on campus.

Most systems that would benefit from variable speed drives already do so, but there are still opportunities to install them.

Buildings suffer from a substantial amount of duct leakage. The Professional Studies and Fine Arts building had a measured duct leakage of 25 percent on average. CSU San Marcos conducted a duct leakage project in nearly every building, resulting in a two-year payback[10].

Vision

San Diego State University will operate efficient HVAC systems that deliver healthy fresh air and comfort to campus occupants. Equipment will benefit from a thorough preventive maintenance program. The campus will begin to budget for

[10] http://www.calstate.edu/cpdc/fpm_conference/2016/best-practice-awards/documents/BPA-Energy-Retrofit_002.pdf

scheduled replacement of aging equipment. Building control systems will be modernized and operated with state-of-the-art fault detection diagnostics. Monitoring-based commissioning efforts will regularly occur to optimize HVAC system operation.

When major renovations take place, HVAC system upgrades will happen concurrently to maximize resources.

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
HVAC Systems	1.4.1	Enact HVAC-related actions from Building Automation and Preventive Maintenance sections.						
	1.4.2	Develop budget for regularly scheduled replacement of mechanical equipment.						
	1.4.3	Pilot duct-sealing project on five buildings.						

Monitoring-Based & Continuous Commissioning

Assessment

Monitoring-based commissioning is a process to analyze existing energy use in a building, identify energy savings opportunities and implement those measures. The process involves several months of data collection before and after implementation to confirm savings. It is an effective and impactful process to significantly reduce energy consumption on a building-by-building basis. Typical implementation measures include updating the programming in building automation systems and retuning mechanical equipment. Continuous commissioning is employed after a project is completed to make sure the savings are retained.

Campus building systems have suffered from a long period with maintenance as a low priority with limited resources. Over time, deferred maintenance results in higher energy consumption, lower comfort, poor indoor air quality and a higher lifecycle cost. Specific issues include frozen economizers that control outside air, broken dampers, sensors that have never been calibrated, and control sequences that have been overridden – leaving buildings to run manually.

Various types of commissioning are available to help rectify these issues and bring buildings to their intended operations. In 2014, the Arts and Letters Building underwent a monitoring-based and continuous commissioning (MBCx) project, resulting in an energy reduction of 40 percent. The Chemical Sciences Laboratory is currently going through a similar project, thus cutting costs in the building with the highest energy use.

Campus energy performance will not meet expectations if only one building undergoes monitoring-based and continuous commissioning each year. Campus needs to increase the effort to five buildings per year in a 10-year cycle. Implementation of the fault detection diagnostics system will assist in identifying issues through traditional MBCx methods. It may also allow campus to envision a new paradigm of commissioning. With the support of the energy information system vendor and energy staff, SDSU can capture most of the MBCx savings at a more rapid rate and reduce costs.

However, SDSU needs to correct the deficiencies and implement the recommendations in the MBCx reports. One way to do this is with an in-house MBCx trades team. A small group of people would be dedicated to energy efficiency improvements – primarily MBCx – and to implementing recommendations identified by the fault detection diagnostics system. The team also would learn from the process and assist in identifying additional savings. Campus staff are knowledgeable about our systems, and this effort would be solidly aligned with Facilities Services' maintenance-focused mission. Alternative options include outsourcing the implementation, which may result in higher premiums and reduce the payback of projects. A similar program was instituted at the University of Illinois and resulted in saving $39 million over nine years, maintaining three-year paybacks and cutting campus energy use by 30 percent[11]. Caltech also has a similar program incorporated into its revolving loan fund[12]. Regardless of approach, the process needs to be streamlined.

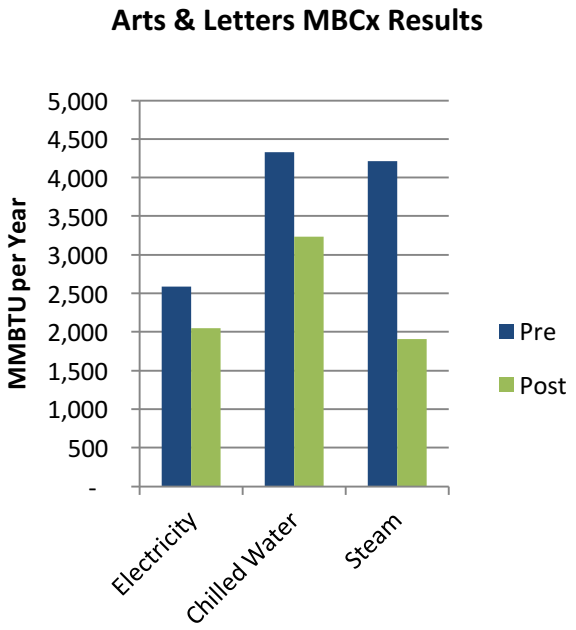
[11] http://fs.illinois.edu/services/utilities-energy/energy-conservation/retrocommissioning

[12] https://www.sustainability.caltech.edu/CECIP

Vision

Campus buildings will all be fully commissioned, with major buildings undergoing full MBCx and smaller buildings going through a modified commissioning process. When commissioning is complete, building energy use will continue to be monitored through continuous commissioning. This will ensure that the majority of energy savings will be retained. These efforts will be supported by an in-house MBCx team. Preventive maintenance practices will be improved to reduce lifecycle maintenance and energy costs for campus. The continuous commissioning system will identify opportunities or issues and interact directly with the work management system, automatically generating work orders as needed. Each building will have a goal of being actively commissioned at least once every 10 years.

In order to achieve these goals, buildings will need to have meters and building automation systems that are capable of trending data.



Actions

			Short			Medium		Long
			2017	2018	2019	2020	2021	2022+
Monitoring-Based and Continuous Commissioning	1.5.1	Begin conducting a minimum of three MBCx projects each year, increasing to five. Complete commissioning of all major buildings by 2025.						
	1.5.2	Determine feasibility of creating an in-house MBCx team to implement recommendations identified by MBCx and the fault-detection diagnostic system.						
	1.5.3	Develop a continuous commissioning program to ensure that savings continue to be achieved and that new problems are quickly identified. This will be based on the fault-detection diagnostics system provided by the new EIS.						
	1.5.4	Implement recommendations from Storm-Nasatir Measurement and Verification report.						

Lighting

Assessment

The majority of interior lighting systems are linear fluorescents with limited controls capability. Several buildings use time clocks, which require scheduled changes. New construction and renovated spaces use LED lighting with occupancy sensors. Smaller renovations are most likely not meeting Title 24 requirements. There is no centralized reporting of lighting, either interior or exterior.

The ideal solution is to replace all existing fixtures with new LED fixtures and advanced controls. Based on current cost, a campuswide retrofit may need to utilize some portion of LED tubes or other retrofits that would reduce controllability.

Exterior lighting systems are a mix of older lighting systems, resulting in a variety of colors and styles. The prevalent parking lot and roadway light fixtures are low-pressure sodium fixtures with an orange glow that is inadequate for campus security purposes. Exterior lighting controls vary from timers to photocells. Some lots and structures have been renovated with LED lighting, some of which utilize bilevel occupancy sensors.

Vision

Campus will be lit by high-efficiency, high-performance LED lighting. Lights will automatically turn off based on occupancy but must be turned on manually. Lighting will dim based on integrated daylight sensors. Where possible, an advanced lighting control system will be used to control lights in small groupings, reporting data back to the central system. This system will be used to task-tune new installations, track electricity consumption and identify failed lights. The centralized system also will speak to the building management system to reduce or shut off relevant HVAC equipment. Demand response will automatically dim lights across campus during peak events.

Exterior lighting will use LEDs with a similar control system. Instead of turning off when no motion is sensed, exterior lights will dim to a lower level. Campus security will be able to view active areas when areas are lit through a centralized reporting system.

Over the life of a fixture, light levels begin to dim. Task-tuning can be used to maintain previous light levels to extend the useful life of the fixture. When a light is predicted to fail, a notice will be sent to the Facilities Services Center.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Lighting	1.6.1	Complete first phase of exterior lighting retrofit project, prioritizing retrofitting exterior fixtures, starting with parking lots, roadways and parking structure roofs.						
	1.6.2	Explore opportunities for campuswide interior lighting retrofit. Both new fixture replacements and retrofits will be considered.						
	1.6.3	Include advanced lighting controls, like daylighting and task-tuning, in new construction and renovation. Controls will meet Title 24 Energy Code as a minimum.						

Plug Loads

Assessment

There is currently no system in place on campus to manage the energy consumption of plug loads, which include computers, monitors, printers, fans, chargers and other devices that plug directly into outlets. While some of these devices, such as computers, are provided by the university, much of the load can be attributed to external devices that include student laptops and cell phones.

In order to ensure timely and secure updates, campus staff and faculty are asked to leave computers on when they leave for the day. In 2015, an on-campus pilot study showed a 60 percent reduction in computer energy use by utilizing power-management devices.

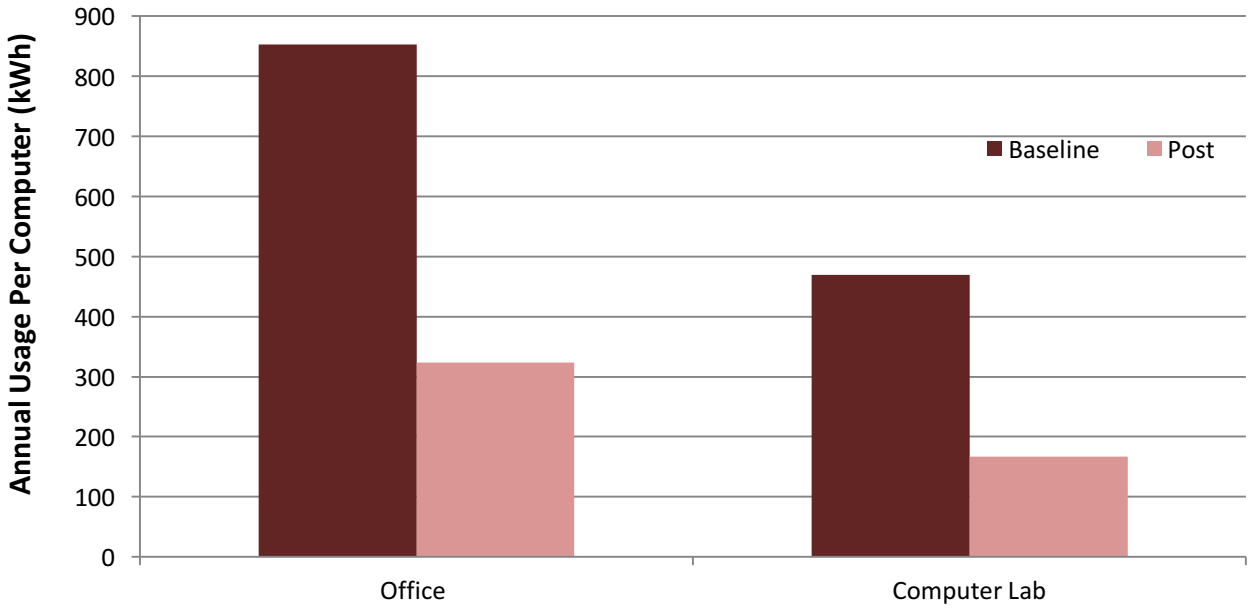
There is no policy in place to require or encourage efficient use of computers or other equipment.

SDSU has begun to move away from individualized printers towards centralized printers, which will reduce energy consumption.

Non-auxiliary departments do not directly pay for energy, providing limited incentive for purchasing efficient equipment. The revolving loan fund can be considered to provide delta funding to pay for the additional cost of the equipment.

Vision

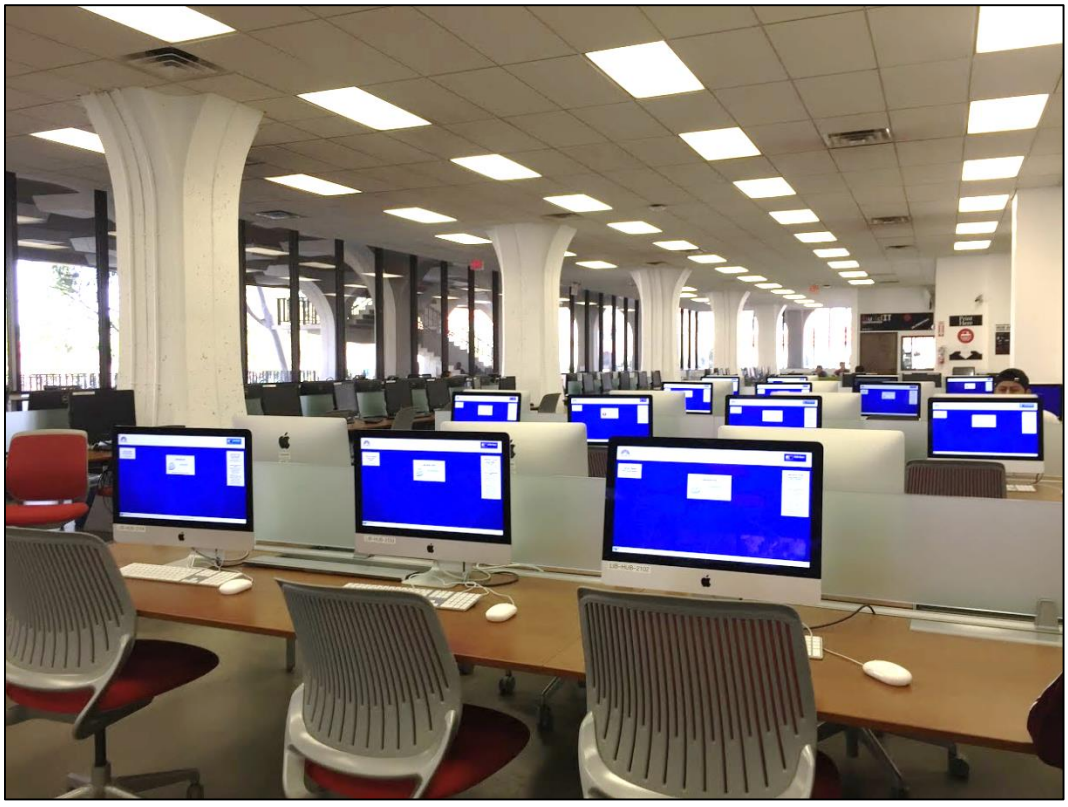
Procurement will limit energy-consuming equipment to those with ENERGY STAR ratings, with further recommendations to purchase devices with the higher efficiency. Printers will be centralized and power-management settings will be implemented. Plug load-management systems will put computers into sleep mode and automatically wake them up for updates.



Energy Savings from Embertec PC Trial

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
Plug Loads	1.7.1	Implement ENERGY STAR and energy-efficiency purchasing requirements. Computers, monitors and other devices that qualify for the Electronic Product Environment Assessment Tool will be certified at a Silver level.						
	1.7.2	Test and select a computer power-management solution.						
	1.7.3	Release campus energy policy that bans personal space heaters and large fans and discourages personal refrigerators and coffee makers.						
	1.7.4	For large, departmental process loads, provide delta funds through the revolving loan fund to pay for additional cost of more-efficient equipment. This will be piloted with ultra-low temperature freezers.						



Renewable Energy & Storage

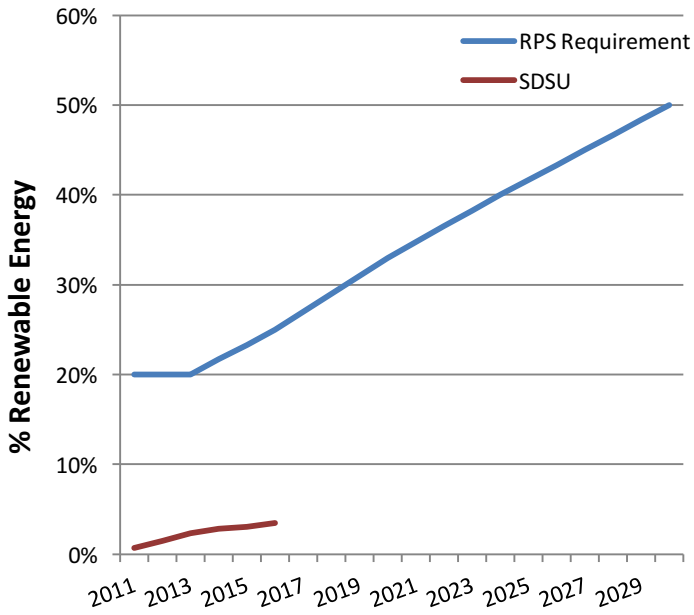
Assessment

San Diego State University has 1 Megawatt of solar photovoltaic production capacity. Nearly 85 percent was developed through Associated Students, which has a goal to reach net zero electricity by 2020. Total annual electricity provided by on-site renewables is at 3.5 percent. The state-mandated renewable portfolio standard for all load-serving entities in California is 33 percent by 2020 and 50 percent by 2030. At the end of 2015, 35.2 percent of SDG&E's resource mix was comprised of renewable portfolio standard-eligible renewable energy (RPS). Historically, most of campus received electricity from the natural gas-fired co-generation plant, which would result in limited impact from a cleaner grid. Since campus has shifted to more electrical imports, it will further benefit from a clean electrical grid.

The CSU Chancellor's Office has developed a systemwide procurement effort for a solar power purchase agreement. SDSU has identified 4.7 MW on site that could participate in the program and has provided initial information.

SDSU has 2 million gallons of chilled-water thermal energy storage, providing load-shifting benefits. Water is chilled at night, when it's more efficient and less-expensive. This chilled water is released throughout the day to avoid using chillers during peak periods. This becomes more important as campus shifts from co-generation to grid purchases.

There is no large-scale electrical storage available on campus. Batteries would provide additional load-shifting benefits and reduce peak charges. As additional renewable energy is added to campus, storage would assist in maintaining efficient operation at the co-generation plant. The Chancellor's Office is including battery storage as an option for the systemwide procurement effort.



Renewable Generation Percentages

Vision

Long term, San Diego State University should aim toward meeting and exceeding the state renewable portfolio standards. This would require an eventual shift from natural gas-based co-generation toward grid energy and on-site renewables. Opportunities to leverage available land in the Imperial Valley for photovoltaic should be explored.

SDSU will purchase a fuel mix with greater portions of renewables from its electrical supplier.

If feasible, SDSU will implement large-scale battery storage on campus. In addition to the reduction in energy cost and improved plant operation, this system will provide valuable insights to researchers on campus.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Renewable Energy and Storage	1.8.1	Support Associated Students in its efforts to install additional solar capacity to meet its goals.						
	1.8.2	Pursue solar Power Purchase Agreement bids with the Chancellor's Office.						
	1.8.3	Investigate battery storage as part of the Chancellor's Office systemwide effort.						
	1.8.4	Include solar in LEED projects to achieve net zero energy at the building or from panels installed elsewhere on campus.						
	1.8.5	Complete central energy study that will look at alternatives to the current co-generation system, including solar, to meet GHG emissions goals.						
	1.8.6	Increase green-power portion of purchased electricity.						

Transportation

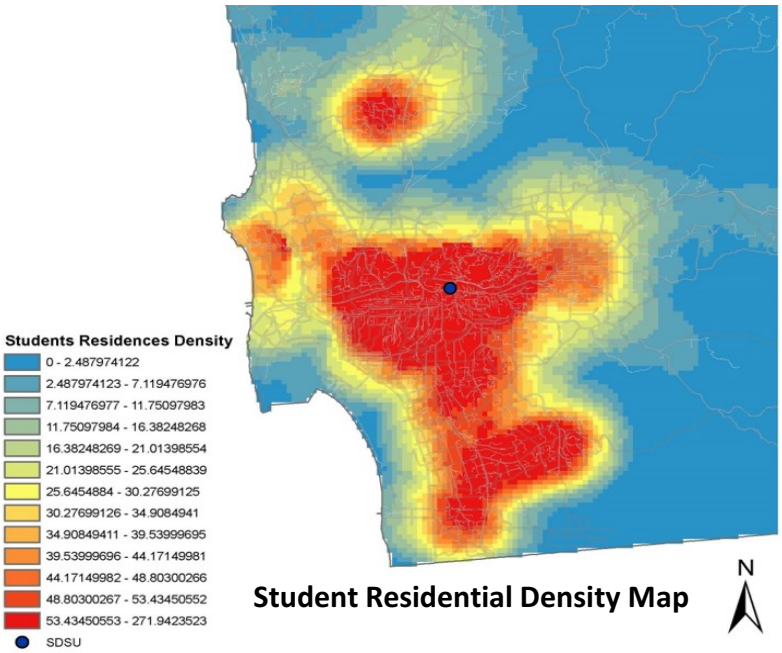
Greenhouse gas emissions from commuter-related transportation represents 42.4 percent of total emissions at San Diego State University. Campus commuting represents the second-largest source of emissions, behind emissions produced from the campus power plant. Campus commuters include students, staff and faculty traveling between their homes and campus. Student commuting is responsible for 30.8 percent of the campus carbon footprint, while faculty and staff commuting represents 6.1 percent. The remainder is 4.7 percent due to directly financed travel (primarily flights), other direct travel at 0.2 percent and 0.6 percent from campus fleet operations.

A comprehensive online travel survey was developed in the fall of 2015. The purpose was to establish frequency of travel and mode of commute to SDSU and to gather information regarding various aspects of current university transportation behavior. Frequency and mode of commute were used to establish baseline greenhouse gas emissions. The Campus Carbon Calculator was chosen for this study due to its popularity in academia. Over 90 percent of universities that have publicly reported their greenhouse gas emissions did so through its use.

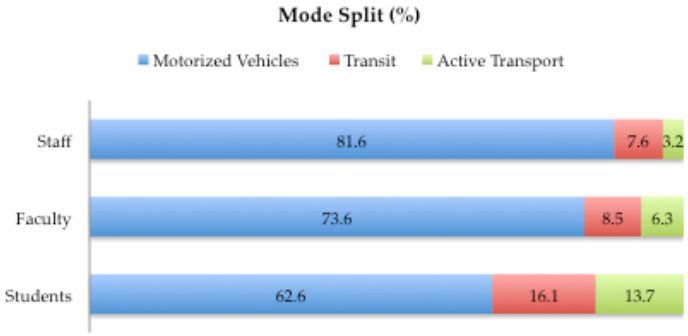
This survey was deployed via email to all faculty, staff and auxiliaries in the fall of 2015 and to all students in the spring of 2016. The survey contained about 30 questions.

The survey received 2,801 responses, which represents an overall 7.55 percent sampling rate – similar to rates found in other travel surveys distributed to entire university populations. There were 2,122 student responses, 202 faculty responses and 477 staff responses.

The geospatial analysis helped identify the overall contribution to the release of greenhouse gas emissions via location and travel mode and also informed and helped calibrate the testing of alternative scenarios to determine policy options that shift travel behavior and reduce greenhouse gas emissions.



Student Residential Density Map



How people travel to SDSU Campus

Survey Result

The study revealed that 81.6 percent of staff and 73.6% of faculty drive to campus compared to 62.6% of students. Compared to faculty and staff, students are twice as likely to use public transit. Active transport (such as walking or biking) is also much more prevalent in the student population, with 13.7 percent of students walking, biking or skating to campus, due to the number of students with residences on or near campus.

Mean Commute Distance by Mode (Tuesdays, Spring 2016)

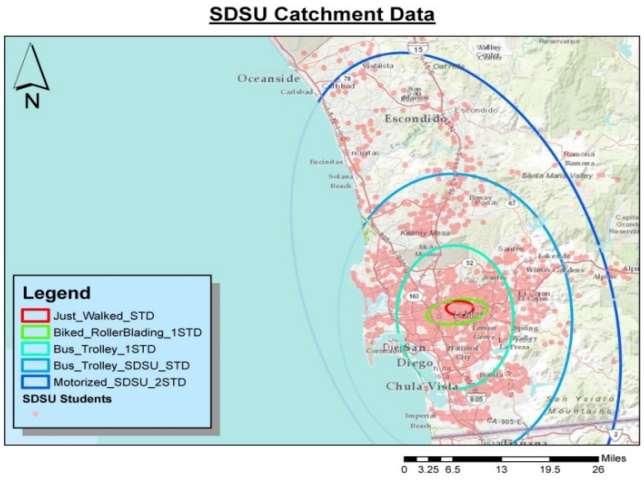
Mode	N	%	Mean Distance (miles)
Single Occupancy Vehicle	1447	54.4%	12.8
Carpooling	205	7.7%	12.4
Motorcycle	16	0.6%	15.3
Public Transit – Bus	122	4.6%	8.4
Public Transit – Trolley	225	8.5%	11.4
Car share	9	0.3%	7.4
Bike	80	3.0%	2.4
Skate	18	0.7%	1.2
Walk	219	8.2%	1.2
Did Not Visit Campus	202	7.6%	12.6
Live on Campus	104	3.9%	2.7
Other	15	0.6%	8.3
Total	2662	100%	10.7

On average, people commute about 10.7 miles one way to reach SDSU 4.72 times per week. The median commute distance is 8.5 miles and four campus visits per week. People driving to SDSU alone or carpooling typically commute a little over 12 miles one way to reach SDSU campus. For bus commuters, the mean distance is about 8.4 miles, while trolley commuters live a little further on average and commute 11.4 miles. The mean commute distance for skaters and walkers is 1.2 miles, while bikers commute 2.4 miles one way, on average, to reach the SDSU campus. The majority of walkers and skaters do not travel more than 2 miles, while 95 percent of bike commuters do not commute longer than 7 miles one way to reach the campus.

Campus Commute and Policy Zone

Mapping commuter location and transportation policy zone helped identify the overall distributions of emissions and provided a more nuanced approach to strategy identification. Using the standard deviation ellipse function of ArcGIS, five catchment areas were formed, with SDSU serving as the mean center. Of all the students geocoded from the registrar data, the largest portion (40.92 percent) were found to live in the biking zone, followed by the first trolley zone (32.19 percent), the motorized zone (13.85 percent), the second trolley zone (6.77 percent), and finally the walking zone (6.27 percent).

About 70 percent of people living in the bike buffer area and 50 percent of people living in walking buffer area commuted to campus via automobile.



Emission-Reduction Scenario

Six scenarios were developed to determine potential transportation emission-reduction opportunities.

Scenario A: Changes in Student Housing: This scenario is based on the possibility of SDSU imposing a sophomore live-on rule. If all sophomores were required to live in on-campus housing, regardless of current location, the change has the potential for a 10.81 percent reduction in transportation emissions.

Scenario B: Telecommuting: This scenario examines the impact of telecommuting and online-learning. It assumes that SDSU were to allow telecommuting for all university affiliates once per week. Therefore, each of the group's frequency of commute would therefore be reduced by one round trip to campus. The potential emission reduction is 21.1 percent.

Scenario C: Encourage Bicycling and Walking: This scenario assumes about 80 percent of individuals living inside both the walking and biking zones switches to a form of active transportation, thus making them emission-free. The potential emission reduction is 2.17 percent.

Scenario D: Encouraging Transit 1: This scenario aims to reduce emissions from the first inner transit zone. Given the proximity of this zone to campus and major transit routes, it assumes that 10 percent of those who indicated they used a motorized vehicle to travel to campus would switch to public transit (5 percent bus and 5 percent light rail). The potential emission reduction is 1.03 percent.

Scenario E: Encouraging Transit 2: This scenario attempts to reduce emissions from the second outer transit zone. It again assumes that 10 percent of commuters living inside this zone will switch to some form of public transportation (5 percent bus and 5 percent light rail). Potential emission reduction is 2.32 percent.

Scenario F: Carpooling: This scenario attempts to reduce emissions from the motorized zone. This scenario assumes that 10 percent of those who indicated they drove alone switch to carpooling. The potential emission reduction is 6.76 percent.

Scenario	Emission Reductions ($MTCO_2e$)	Emission Reductions (% total reduction)
Base Case (37,859 $MTCO_2e$)	0	0
Scenario A: Changes in Student Housing	4,092.71	10.81%
Scenario B: Telecommuting	7,989.10	21.10%
Scenario C: Encourage Bicycling and Walking	822.1	2.17%
Scenario D: Encouraging Transit 1	388.7	1.03%
Scenario E: Encouraging Transit 2	879.7	2.32%
Scenario F: Carpooling	2559.3	6.76%

Policy Opportunity

Currently, the campus has several transportation-related sustainability initiatives, including Zipcar, Zimride, electric vehicle charging stations and bike lanes. The on-campus trolley station makes a compelling case for students, faculty and staff to use mass transit to commute to campus. Recent additions of campus bike lanes have improved bikeability, but the area outside campus still suffers from a lack of sufficient bicycle infrastructure.

Although parking fees are increasing to maintain the fiscal health of the program, semester parking (Fall 2016) on campus is relatively inexpensive ($165) and underpriced, compared to other campuses and to a transit pass ($154). This ultimately incentivizes driving alone and increases demand for parking.

Survey analysis reveals the top motivator for students to not drive alone is a discounted transit pass. Providing subsidized public transit passes with unlimited access resulted in 10-30 percent reductions in automobile trips, in some cases, for eight U.S. campuses and led to 400 percent increases in student ridership during the first years of program operation[13].

Instead of semester parking passes, some universities have instituted performance-based parking prices that vary by time and location. Flexible pricing for parking that is fair, efficient and transparent can help reduce parking demand and air pollution. Better pricing mechanisms for parking can favor high-occupancy vehicles (people who carpool), bikers, walkers, and short-term parkers;

[13] Barata et al. 2011

accommodate occasional users; reduce the time to find parking for everyone; and maximize opportunities for individual choice. About 61 percent of survey respondents stated they were willing to pay more for parking (>$25), if they could find campus parking faster. New technology – such as EasyPark personal parking meter – provides high-impact and low-cost approaches to performance-based parking and is currently being used at UC Davis and other campuses.

Right pricing parking can also incentivize carpooling, and there is a need to better inform the campus community of existing carpooling options (including shared rides via Lyft and Uber). Survey results have shown that people are interested in sharing rides but had little information or knowledge.

There are many excellent transportation demand-management strategies in the California State University's Transportation Demand Management Manual (Nelson Nygaard, 2012), but there has been minimal implementation due to a lack of dedicated personnel to implement transportation programs.

Finally, while the campus vehicle fleet is a small portion of the transportation-related emissions, there are opportunities to increase efficiency and improve the optics of the operation.

Vision

San Diego State University will have a dynamic alternative transportation system that encourages and incentivizes students, faculty and staff to use green and active modes of transportation and zero-emission vehicles for campus commuting. A transportation coordinator will actively engage the campus community in transportation demand-management activities and connect people to transportation resources. The campus will incentivize transit through pretax benefits and subsidized passes. The overall health of the campus community will improve as people shift from single-occupancy vehicles to more active forms of transportation. Bicycling infrastructure will allow for safe travel to and within campus and include adequate bike paths, racks and repair stations. Campus-owned vehicles will migrate to all-electric or plug-in hybrids as options become available.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Transportation	2.1.1	Enroll the campus community in pretax benefits for transit.						
	2.1.2	Conduct parking pricing, bikeway and shared mobility network study.						
	2.1.3	Explore feasibility of a universal transit pass.						
	2.1.4	Continue to improve and increase on-campus housing and amenities.						
	2.1.5	Identify potential carpool and vanpool incentives to reduce single-vehicle occupancy trips.						
	2.1.6	Improve bicycle and pedestrian amenities -- install bike-repair stations, access to bike lockers and shower facilities, explore bike-share option and conduct extensive marketing.						
	2.1.7	Enhance student outreach and engagement. Provide a summary of transportation options to students before orientation and develop a transportation resources section on sustainability website.						
	2.1.8	Complete vehicle replacement plan for Facilities Services and begin purchasing electric carts.						
	2.1.9	Increase electric vehicle-ready infrastructure as identified.						
	2.1.10	Study feasibility of telecommuting options for regular commuting, meetings and conferences.						

Water

Landscape & Irrigation

Assessment

The landscape is the most visible and symbolic component of campus water consumption. While campus has several drought-tolerant areas, including the Mediterranean Garden and spaces around the Conrad Prebys Aztec Student Union, there are still several areas with turf grass used for aesthetic rather than functional purposes. Several of these areas are being reviewed for turf removal and renovation. The Centennial Mall project removed turf grass and replaced it with shade trees, seating, and drought-tolerant plants. This project provided an attractive spot for recreation, while also reducing water consumption

The irrigation system is a centrally operated CalSense system that is remotely controlled based

on evapotranspiration rates and precipitation. It tracks water use based on location. The system connectivity needs to be updated, as it runs on a phone line and is slow to use. SDSU has a history of using efficient rotators to deliver irrigation and is experimenting with more efficient drip irrigation.

The irrigation team has begun to perform proactive irrigation checks on a zone level-basis. This effort has identified leaks and other issues that can be addressed early.

The campus has made strides in recent years to improve soil conditions, leading to healthier plants and lower water use. SDSU has increased use of mulch, microbials and aeration. Fertilizers are primarily organic and are moving more in that direction.

Efforts have also been made to maintain and grow the urban tree canopy. A trimming program has been established that addresses individual species' needs. The campus has been adding more trees than are removed due to damage or renovations.

Vision

The SDSU campus will be host to a thriving, inspiring and responsible landscape. Landscape will be primarily drought-resistant, with an effort to use native species when possible. Turf grass will be limited to functional areas, including athletics, recreation and events. Irrigation systems will deliver water as efficiently as possible, with a priority for drip irrigation. The irrigation control system networking will be modernized and integrated with the energy information system. Irrigation will be based on actual weather conditions and plant need and compared to an accurate water budget. Mandatory drought restrictions will be met. However, the campus landscape will be resilient and not substantially impacted. The campus environment will encourage habitats for pollinators and other wildlife. The urban canopy will be maintained and provide environmental services to the campus.

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
Landscape and Irrigation	3.1.1	Complete turf conversion project through Campus as a Living Lab.						
	3.1.2	Enact landscape policy limiting turfgrass to functional areas, specifying irrigation system requirements and setting plant-palette guidelines.						
	3.1.3	Convert identified nonprogrammable lawns to drought-tolerant landscaping with high-efficient irrigation. SDSU has retained a landscape architect to survey existing turf areas in an effort to reduce environmental impact and improve aesthetics.						
	3.1.4	Convert irrigation to rotators or drip as appropriate.						
	3.1.5	Enact a tree planting-to-removal ratio of 2:1.						
	3.1.6	Overhaul water budget to reflect soil type, canopy coverage, irrigation efficiency, microclimates and plant type.						
	3.1.7	Pilot biological testing to direct-amendment application.						
	3.1.8	Complete a test on water-retention amendments, such as biochar, polymers, or crystals, on Campanile Mall.						

Industrial

Assessment

Over 25 percent of campus water usage is consumed in cooling towers, an integral part to providing cooling to campus. The majority of this amount is due to evaporation and directly related to the cooling load on campus. The other major use is blowdown, which flushes cooling tower water to ensure proper chemical levels are maintained. The blowdown usage is related to the water source; the drought has increased the hardness in the water supply, increasing blowdown usage.

At least one instance of once-through cooling has been identified, in which potable water is only used once by the equipment before being sent to the sewer. Wind tunnels in the Engineering Building use once-through potable water for cooling rather than using the chilled water system. A survey has begun to gather other locations for possible conversion. The equipment will need to be isolated

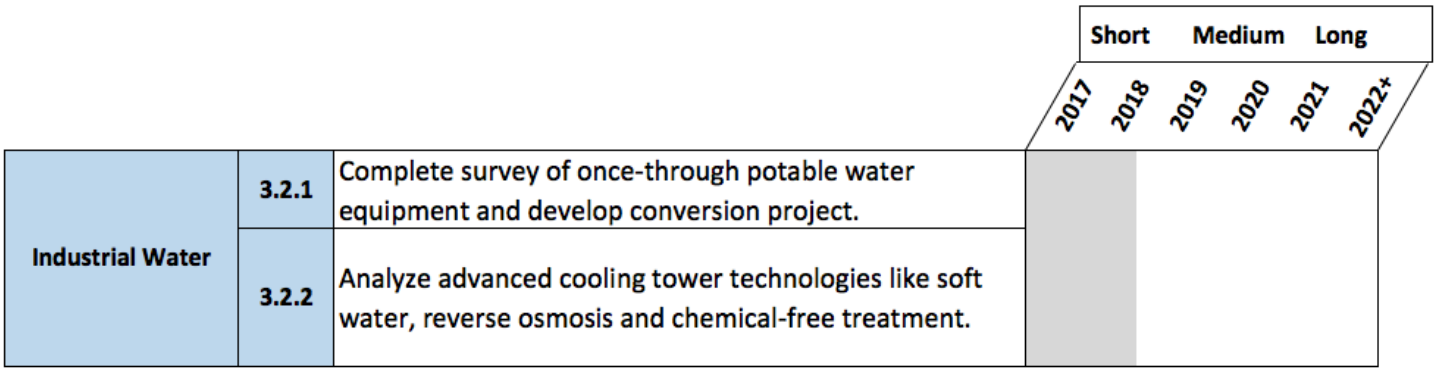
via heat exchanger to prevent impacts to the main chilled water system.

SDSU is currently collecting condensate water from cooling coils and from once-through vacuum pumps at the co-generation plant for use in the cooling towers, reducing the amount of potable water used.

Vision

Campus energy-efficiency efforts will decrease the amount of cooling required by campus, thereby reducing the amount of evaporative water use. Cycles of concentration will be maintained at the highest-level adequate from a maintenance perspective.

Actions



Domestic Water

Assessment

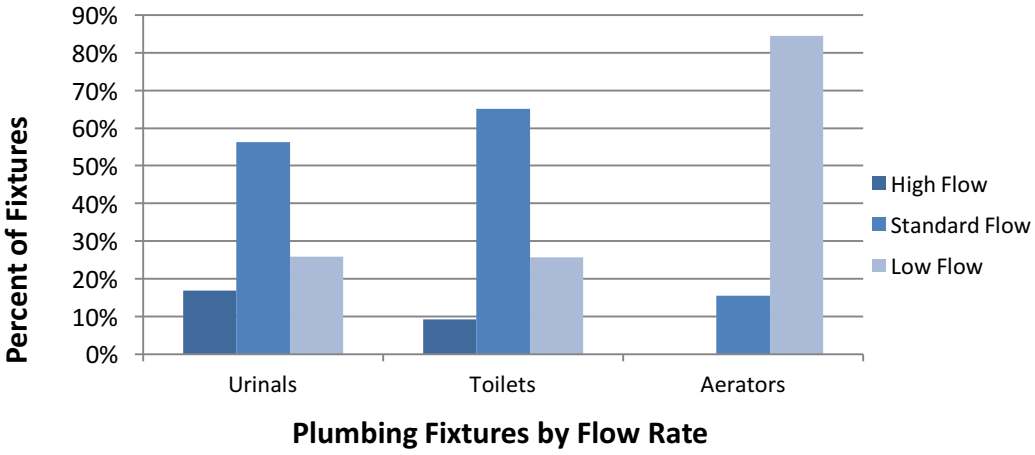
SDSU has completed several projects to reduce domestic fixture water consumption; however, there are still many fixtures that can be upgraded. A small portion of these are old, high-flow devices while the majority are standard flow (1- and 1.6-gallon per flush urinals and toilets, respectively). Housing has begun to experiment with lower-flow showerheads.

SDSU has completed the first phase of a leak-detection effort on the domestic water distribution system, identifying possible leaks. These will be investigated further and addressed. If successful, the rest of campus will be tested for leaks.

Vision

All plumbing fixtures on campus will be ultra-low flow and high-performance. Preventive maintenance on fixtures will reduce water waste from phantom flushing and leaks. An educational campaign will encourage people to assist by reporting leaks and reducing their overall water consumption.

Actions



			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Domestic Water	3.3.1	Complete leak-detection survey and address discovered issues.						
	3.3.2	Receive cost estimate to convert high- and standard-flow fixtures to low-flow fixtures.						
	3.3.3	Develop system to identify and address excessive flushing.						
	3.3.4	Complete showerhead pilot effort.						
	3.3.5	Continually test new, more-efficient fixtures.						

Water Reclamation

Assessment

San Diego State University has a handful of reclamation projects, including rainwater collection at the Conrad Prebys Aztec Student Union and vacuum pump and condensate recovery at the co-generation plant. A preliminary feasibility study from Sustainable Water for a campuswide water treatment plant was favorable. This system would treat nearly all sewage to levels adequate for irrigation and cooling towers. The system would be installed at no upfront cost with water purchased from the system at rates lower than from the City of San Diego.

Vision

A centralized wastewater treatment plant will greatly reduce the use of potable water at San Diego State University. The plant will use ecological methods to treat wastewater that will be used in cooling towers and fields. SDSU will be more resilient to drought conditions. Classes and research projects will use the treatment plant as an educational tool.

Water Hub at Emory University

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Water Reclamation	**3.4.1**	Complete feasibility study for wastewater treatment plant.						

Zero Waste

Infrastructure

Assessment

San Diego State University has recycling programs in place for mixed-use recycling, yard waste composting, pre-consumer composting, e-waste, and construction and demolition. There is also a robust surplus program. For fiscal year 15/16, campus recycling rates were estimated to be 64 percent, including construction and demolition. Excluding construction and demolition brings the diversion rate down to 35 percent. The large difference is due to the removal of Engineering Lab and Industrial Technology as part of the Engineering and Interdisciplinary Sciences Complex construction.

CSU sustainability policy calls for a 50 percent diversion by 2016 and an 80 percent diversion by 2020, with an end goal of zero waste. Statewide mandates through AB 1826 are now requiring composting programs be put in place.

SDSU has a wide assortment of waste receptacles across campus. Many bins still indicate paper-only or containers-only, while campus has moved to mixed recycling. A consistent, color-coded, well-labeled infrastructure is crucial to a successful

diversion effort. There is also a lack of recycling bins in classrooms and other critical areas. As part of the current waste hauling contract, a large number of new bins will be provided.

The campus has recently moved to consistent bag coloring (landfill is black and recycling is clear) to assist in the diversion efforts and provide the campus with a chain of custody from the bin to the dumpster. Dumpsters are now color-coded and well-labeled.

The new hauler contract also has several enhancements to the recycling infrastructure, including new bins, dedicated trucks and daily dumpster weighs that allow campus to pinpoint areas for improvement. Collaboration with the hauler has improved move-in and move-out efforts, which is further discussed in Housing and Residential Education.

SDSU has a good process for handling surplus. An undesired piece furniture or equipment gets sent to Business Services. Faculty and staff can visit to pick out goods for university use at no cost. If no one on campus wants an item, it gets sent to a public auction. In some cases, items may be donated – an entire semi-trailer truck full of furniture was donated to a low-income school in Mexico. Developing a system to internally publicize what equipment is available would provide more opportunities for on-site reuse.

There is currently no outlet for post-consumer compost. A facility is expected to be available by SDSU's current vendor in the next few years. There is a small composting facility in the Community Garden that accepts waste from the Children's Center and zero-waste events at the Conrad Prebys Aztec Student Union. When post-consumer composting begins on campus, additional infrastructure will be needed to support the effort. SDSU has also begun to reduce food waste through efforts to combat food insecurity.

SDSU has installed many hydration stations to reduce bottled water consumption. This has been achieved through a partnership between Associated Students and Facilities Services.

Vision

All recycling receptacles will be blue, all landfill receptacles will be black and all compost receptacles will be green. For exterior concrete bins, the labeling and lids will match these colors. All areas on campus will have at least one recycling receptacle for each matching landfill receptacle.

SDSU will participate in post-consumer food and soiled paper composting when the hauler begins accepting it.

Campus diversion rates will be displayed through the energy information system.

SDSU will move forward with a zero-waste mindset and goal.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Zero Waste - Infrastructure	4.1.1	Continue with assessment and ordering of new bins through the waste hauler. Focus on classrooms and public areas.						
	4.1.2	Codify bin standards on projects going forward.						
	4.1.3	Develop system to better advertise available surplus.						
	4.1.4	Continue installing hydration stations. Show locations on campus map.						
	4.1.5	Prepare for and participate in post-consumer food composting when locally available.						

Behavioral

Assessment

There has not been previously a robust educational effort around recycling, but a new outreach campaign has begun with the hiring of a dedicated student recycling intern. There has been engagement with student groups and custodial staff, including tours to the local recycling transfer station. Decals and posters on recycling guidelines have been developed and distributed. Students have attended classes to discuss recycling and have engaged staff and faculty by going door to door. The campus has coalesced these efforts around the RecycleMania competition.

SDSU has increased the use of paperless systems, such as Adobe Sign. This reduces paper waste while increasing operational efficiency. There is a major opportunity to implement other waste reduction measures, such as double-sided printing.

Vision

The campus community will be engaged with recycling and zero-waste efforts on campus. The campus sustainability website will describe how to divert different kinds of materials on campus. Information about diversion will be transparent, visually compelling and updated regularly. The campus community will be aware of recycling guidelines through targeted outreach. A green office certification program will engage the community on waste reduction and other sustainability areas. Custodial staff will be aware of building diversion performance and contribute to zero-waste efforts. The entire campus will engage in the Recyclemania competition, with the assistance of the hauler.

What to RECYCLE
almost everything!

Paper
(non-waxed/slightly-soiled ok)
cardboard/pizza boxes
newspaper/magazines
100% paper cups**
paper plates
office paper
paper bags

Styrofoam Containers & Packaging
(clean/no peanuts)

Metal
(no liquids)
aluminum/tin cans
aluminum trays/bowls
aluminum foil
scrap metal

Cartons
(no liquids)
soup/broth cartons
juice cartons
milk cartons

Plastic*
(no liquids)
plastic bottles & jars
plastic yogurt/dairy tubs
plastic food containers
plastic caps

Glass
(all colors & no liquids)
glass bottles & jars

* all containers, cups, and lids marked 1 - 7 are recyclable

** including: Starbucks, Big City Bagels, and Juice It Up cups

LANDFILL
soiled: plates, bags, & plastic wrap
paper towels/napkins/tissues
chip bags/food wrappers
glass shards or mirrors
plastic straws & utensils
plastic rubber bands & twist ties
plastic bread clips

SPECIAL DISPOSAL

Batteries & Light Bulbs
call EH&S at (619) 594-6778 for proper disposal

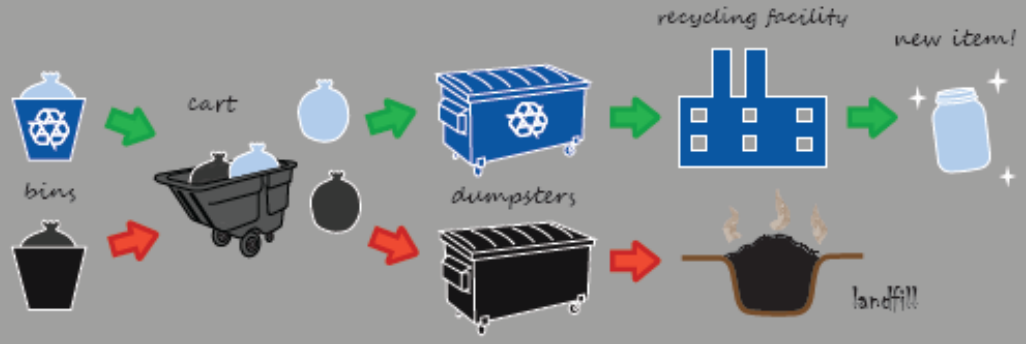
Plastic: Bags/Wrap/Gloves
(clean) reuse, return to store, or drop-off on campus

Surplus
(Toners, Electronics, Books, & Furniture)
call Business Services at (619) 594-0741 for proper disposal

HOW IT WORKS:

CLEAR bag + BLUE bin = RECYCLABLE

BLACK bag + BLACK bin (or GREY) = LANDFILL



Sustainability Starts Here sustainable.sdsu.edu

For more rules on SDSU recycling, visit: edcodisposal.com

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Zero Waste - Behavioral	4.2.1	Complete website and publish recycling information online. Integrate with the Energy Information System.						
	4.2.2	Create a highly visible zero-waste campaign to promote recycling guidelines, zero-waste campus events and green office certifications.						
	4.2.3	Continue to engage custodial staff. Develop standard operating procedures for recycling.						
	4.2.4	Engage in comprehensive recycling outreach program within housing and during orientation.						
	4.2.5	Increase efforts to implement waste-reduction measures, such as surplus and double-sided printing.						
	4.2.6	Expand special disposal programs for students, faculty and staff -- both continuously and during drop-off events.						
	4.2.7	Complete paperless reporting effort in Accounts Payable.						

Preventive Maintenance

Assessment

A preventive maintenance program proactively maintains equipment to reduce lifecycle costs and maintain efficient operation. Program activities include filter changes and lubrication of moving parts.

San Diego State University has lacked a robust preventive maintenance program, evident by the growing deferred maintenance lists, equipment degradation, frequent breakdowns and high energy use. Air handlers, in particular, suffer from lack of attention, resulting in indoor air-quality issues and energy inefficiencies. Due to limited resources, some preventive maintenance tasks have been removed from the computerized maintenance management system, making it difficult to track resource needs. Other areas have a limited history of preventive maintenance, including controls. The large amount of unplanned maintenance and emergencies highlight the limited focus on preventive maintenance.

Facilities Services has recently made strides focusing on air handlers and preventive maintenance in general. A comprehensive study of all equipment and recommended preventive maintenance has been completed and will be entered into the computerized maintenance management system. There is not enough staff to adequately cover all preventive maintenance. However, several additional facilities workers will be added in 2017 to bolster the ability to complete preventive maintenance activities.

Vision

San Diego State University will have a “best practice” preventive maintenance organization. Facilities Services will comprehensively track preventive maintenance tasks as recommended by the manufacturer and industry best practices. Preventive maintenance tasks will be prioritized to extend the life of equipment and reduce energy usage. Persistent commissioning practices will identify issues and opportunities before occupants are affected or aware.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Preventive Maintenance	5.1.1	Complete priority of PM tasks based on resource availability. If an ideal PM schedule cannot be met for a piece of equipment, it should still be maintained on some level of frequency. Contracted services, such as cooling tower cleaning, should also be included. Predictive maintenance can be used for specific items, such as filter changes, to optimally manage resources.						
	5.1.2	Specific areas of focus for mechanical services include filter changes, heating and cooling coil cleaning, economizer operation, cooling and heating valve operation, sensor calibration, and carbon dioxide sensors.						
	5.1.3	Continue regular irrigation system checks.						
	5.1.4	Implement a system to check for leaks and phantom flushing in plumbing fixtures.						
	5.1.5	Develop process to bring equipment from new construction and renovations into the CMMS.						
	5.1.6	Gauge program resource needs after implementation of new PM program and staff hires.						

Green Certification

New Construction & Renovations

Assessment

The Leadership in Energy and Environmental Design certification, managed by the U.S. Green Building Council, is the primary green building rating system in the United States. LEED has pre-requisites and credits in a variety of sustainability areas, such as location and transportation, energy and atmosphere, and materials and resources. LEED has four certification levels: Certified, Silver, Gold and Platinum. The release of the new v4 system has greatly increased the requirements to achieve each certification level.

The San Diego State University campus had its first new construction LEED-certified building in 2015, the LEED-Platinum Conrad Prebys Aztec Student Union. Since then, several other buildings have achieved LEED certification for new construction, major renovations or existing buildings. South Campus Plaza and the Engineering and Interdisciplinary Sciences Complex are both targeting LEED certification. There is no current SDSU requirement for LEED certification, but all new buildings are required to be built to LEED Silver standards or equivalent, per CSU policy. However, without tracking all of the requisite information, it is difficult to prove whether a building would have been LEED-certified.

Building standards for San Diego State University are out of date, which results in a variety of electrical, mechanical, plumbing and controls systems across buildings and prevents greater efficiencies in operations. There is an effort to update these standards, but they will need to be continually monitored and updated to ensure the most modern and efficient technology and practices are being used. Use of performance criteria and general guidelines are being considered.

Vision

At a minimum, all new construction and major renovation projects will be LEED-certified to a Silver level. Projects will provide analysis on the feasibility of achieving Gold or Platinum certification. Architects and engineers will be provided with a set of standards, performance criteria and guidelines, which will include a sustainability component. SDSU will take requests when projects deviate from requirements to take feedback and improve implementation with each project. Total cost-of-ownership modeling will be used through project energy and water modeling to inform first-cost design decisions with operational costs and savings.

Buildings will exceed expected performance due to a strong commissioning and measurement and verification program. Buildings will continue to perform through continuous commissioning efforts, as described in the monitoring-based and continuous commission section of the plan.

Buildings will strive to achieve net-zero energy when feasible. Buildings without on-site energy resources will install energy production at other campus facilities to achieve net zero. Design and construction teams will create energy-use intensity targets appropriate to the project and not to exceed campus maximum.

Sample Energy Use Intensity Targets from UCSD

	Annual Electricity kWh/gsf/yr Includes pro-rated part of plant use and site lighting	**Maximum Power** W/gsf Includes pro-rated part of small peak (pumping) load at plant	**Max. Chilled Water** tons/kgsf Load on plant	**Annual Thermal** therms/gsf/yr Includes pro-rated part of plant use	**Max Thermal** therms/yr/kgsf Includes pro-rated part of plant use	**Total Energy** kBTU/gsf/yr
Academic/Administrative Non-Complex Space	6.1	1.11	0.83	0.08	0.1	29
Housing Non-Complex	4.3	0.77	0.58	0.11	0.14	26
Lab/Complex Space	18.4	2.7	2	0.9	0.34	153

Adopted from University of California's targets for UC San Diego.

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
New Construction and Renovations	6.1.1	Adopt LEED Silver certification as the campus standard for new construction and major renovation. All projects over $10 million will trigger certification requirements. Projects will be analyzed for feasibility to achieve a Gold or Platinum rating.						
	6.1.2	Identify a set of sustainability guidelines, informed by LEED, that all projects -- regardless of size -- must comply with.						
	6.1.3	Revise set of campus building standards that will apply to new construction, major renovations and smaller projects -- whether in-house or contracted out. Review for sustainability elements.						
	6.1.4	Require the use of total-cost-of-ownership model, with inputs from capital costs, energy models and anticipated maintenance and replacement costs.						
	6.1.5	Create and adopt maximum energy-use intensity targets.						

Existing Buildings

Assessment

LEED for Existing Buildings: Operations and Maintenance is designed to rate the sustainability practices of buildings after they have been completed. While the LEED for new construction and major renovations is focused on the design and construction of the building, LEED EBOM looks at ongoing performance and policy. LEED EBOM offers a framework for individual buildings to implement strategies that will further the energy, water, waste and engagement goals of SDSU.

Associated Students currently has a goal to achieve LEED EBOM certification in all of their facilities by 2020. The Mission Bay Aquatic Center, Children's Center and Aztec Recreation Center have all received LEED EBOM certification, and the Conrad Prebys Aztec Student Union received LEED Platinum for both LEED EBOM and New Construction. General campus does not currently have any LEED EBOM-certified buildings. While LEED EBOM buildings are not required to have LEED new construction certification, it does make it easier to achieve certification.

In 2012, SDSU received a Silver rating from the Association for the Advancement of Sustainability in Higher Education's Sustainability Tracking Assessment & Rating System (STARS). This program focuses on campuswide sustainability efforts rather than individual buildings and is broader than LEED EBOM, extending to academics, engagement and administration. This system is also used for other sustainability ranking programs. The previous STARS rating has expired as a new version of the program has been rolled out.

Vision

SDSU will have a robust set of green building policies that position itself for LEED EBOM certification. Buildings with new construction LEED certifications will pursue LEED EBOM certification. Buildings that undergo successful MBCx efforts will also be reviewed for possible certification.

SDSU will be recognized for its sustainable operations and will secure a Gold STARS rating.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Existing Buildings	6.2.1	Complete a campuswide assessment for the potential of LEED EBOM certification. The focus will be on compliance with high-level programmatic and performance elements, as well as opportunities to improve.						
	6.2.2	Achieve LEED EBOM certifications in two general fund campus buildings by end of 2018.						
	6.2.3	Complete Ongoing Purchasing and Waste Policy and the Facilities Maintenance and Renovations Policies to meet LEED EBOM prerequisites.						
	6.2.4	Compile and submit reporting for the latest version of STARS.						

Food

Assessment

Aztec Shops manages Dining Services and oversees all food vendors on campus. Both Aztec Shops and Associated Students are involved in sustainability initiatives related to food.

In 2015, SDSU became the first campus to require all of its tenants to meet the Green Restaurant Association's Certified Green Restaurant standards. Nearly two dozen entities on campus are Level 2-Certified. SDSU Dining is embarking on the journey in 2017 of raising all entities to Level 3-Certified.

The CSU sustainability policy has a goal to increase "sustainable food purchases to 20 percent of total food budget by 2020," as defined by the Real Food Challenge or an equivalent. The campus does not currently track food with the Real Food Challenge guidelines, but the Certified Green Restaurant standards do track sustainable attributes of food purchases.

SDSU Dining is a partner in the College Area Community Garden, adjacent to campus and by the Children's Center. The garden allows local residents to rent a plot and grow their own organic produce. SDSU Dining currently has 20 plots in the garden to grow organic produce used on campus.

Compostable waste from the Children's Center and zero-waste events, such as the Green Lunch Bag series, is composted and used at the garden. SDSU Dining has two small gardens adjacent to the Faculty-Staff Club to grow produce for club use.

SDSU successfully remodeled the all-you-care-to-eat residential dining restaurant from a high protein-focused concept to a plant-forward concept, increasing plant-based offerings by 200 percent while reducing animal-based proteins by 60 percent.

SDSU has a strong pre-consumer composting program. In the next few years, a post-consumer composting facility should be available. Campus has invested in bins and is passively training to prepare for compost collection by educating the campus community with signs on the bins. At this time, all refuse put in the post-consumer compost bins is added to the landfill, but the campus is set with infrastructure once we get the post-consumer facility.

Food insecurity is a major issue within and outside the campus community. Several initiatives are in place to begin provide support and food to the food-insecure. Aztec Rocks Hunger is an annual event that collects and donates hundreds of thousands of pounds of food each year. The Associated Students mobile food pantry is available for needy students to come and collect food once a week. The Associated Students No Waste campaign alerts students when extra catered food is available in the Conrad Prebys Aztec Student Union after an event.

Vision

San Diego State University will offer food that is healthy and sustainable. Students will become more aware and make choices to reduce the environmental impacts of their food. Food vendors will embrace sustainability and actively work to improve their operations.

Actions

			Short			Medium		Long
			2017	2018	2019	2020	2021	2022+
Food	7.1.1	Analyze total sustainable food purchases with both the Real Food Challenge and Certified Green Restaurant standards. Increase sustainable food purchases to meet the CSU sustainability policy goal of 20% by 2020.						
	7.1.2	Ensure all food vendors to be certified as Level 2 under the Certified Green Restaurant standards.						
	7.1.3	Increase self-operated facilities from Level 2- to Level 3-certified.						
	7.1.4	Provide additional vegan and vegetarian options and outreach to reduce meat intake and related carbon emissions.						
	7.1.5	Prepare and participate in post-consumer composting when available.						
	7.1.6	Expand No Waste program to recover more edible food.						
	7.1.7	Grow more food on campus, including through hydroponic towers.						

Engagement

Assessment

There are currently pockets of students, faculty and staff interested in energy and greater sustainability efforts. A recent study at the co-generation plant was completed by Dr. Asfaw Beyene and his students. Based on the results, new, efficient filters were installed and are estimated to save the campus $100,000 a year. Student groups, including Green Love, GreenFest and the Enviro-Business Society, have an interest in more active engagement.

There is limited communication from the administration regarding energy and sustainability efforts, with some ad hoc Facilities Services staff collaborations. There is no online home for energy and sustainability, although a campus sustainability website is nearly complete. Marketing and Communications has a separate “sustainability” tag that gathers articles about events, initiatives and research related to sustainability.

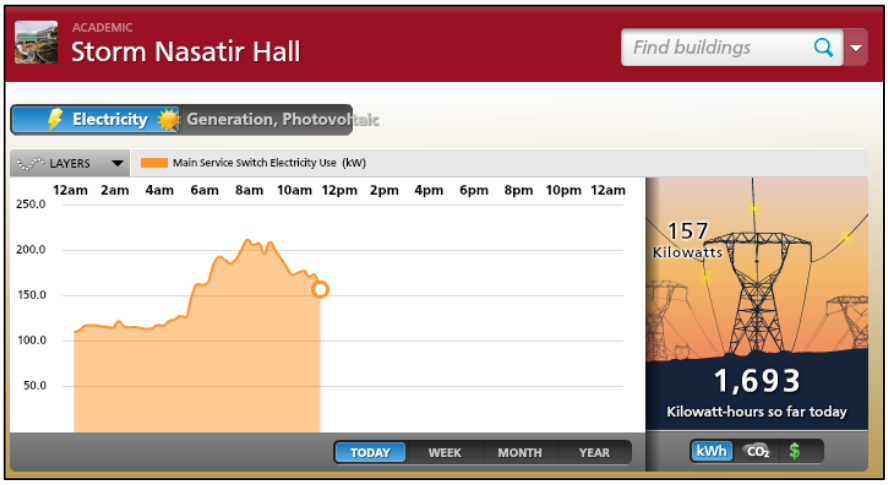
Vision

The campus community will be actively engaged in energy and sustainability efforts. Dashboards will display energy data in a visually compelling way through the sustainability website and in kiosks. Energy analysis will be available to building occupants, classes and research groups – allowing for a greater number and more diverse group of people to identify improvement opportunities. An active website and social media presence will keep the campus community informed and engaged. SDSU will participate in energy, recycling and other

sustainability competitions, beginning with Housing.

SDSU will create a green office certification program to engage on the departmental level. Energy and sustainability liaisons within departments will engage building occupants, updating them on energy use and encouraging conservation. Students will assist in the education and certification of green offices.

SDSU will flourish as a living lab, with researchers accessing and analyzing energy data to help Facilities Services better understand usage patterns and energy-saving opportunities. Grants will be secured to test cutting-edge technologies, such as large-scale battery storage.



Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Engagement	8.1.1	Complete sustainability website, with a section highlighting energy projects and performance. Engage in larger social media efforts.						
	8.1.2	Strengthen partnership with Marketing and Communications to produce SDSU NewsCenter content and inclusion in other communications like the provost's and University Research and Development's newsletters.						
	8.1.3	Increase collaboration with students. Expand team of student sustainability interns and increase engagement with student groups.						
	8.1.4	Roll out public-facing dashboards with the energy information system.						
	8.1.5	Participate in Recyclemania and other sustainability competitions.						
	8.1.6	Develop a green office certification program supported by a network of sustainability liaisons within departments.						
	8.1.7	Create partnerships with academics to analyze data.						
	8.1.8	Include sustainability training in new employee onboarding.						

Housing & Residential Education

Assessment

Housing has a sustainability committee with representation from Housing Administration, Residential Education and Housing Facilities Services as well as student representation that has been identifying and implementing projects related to sustainability. There are engaged campus staff and student leaders interested in expanding these efforts. Outreach activities have been centered on pilot water savings campaigns, e-newsletter education and competitions, particularly RecycleMania. All renovations and new construction have obtained or have a goal of LEED Silver certification as a minimum. In recent years, the majority of halls have integrated building automation systems designed to efficiently control lighting and HVAC systems and dashboards that show building energy consumption.

There is some information provided to students at orientation regarding how to recycle and on other sustainability components.

A 2016 study on residence hall recycling percentages showed differences in diversion rates based on different recycling infrastructure. Several recommendations were identified.

As of summer 2016, all residence halls have a filtered water bottle-filling station on each floor. Residents have filled up the equivalent of 750,000 water bottles.

During move-in of 2016, 98.6 percent of all materials generated were recycled. This was due to an event fully staffed by hauler staff and plastic bag and film collection.

During several years, the Give It Up program has been implemented during move-out as a partnership with the San Diego Food Bank and the Disabled American Veterans organization. Residents were encouraged to donate any unwanted items that would otherwise go to the landfill. The 2016 move-out yielded a diversion rate of 70 percent, including 26,000 pounds of durable goods and 4,000 pounds of food.

The laundry rooms in the residence halls and apartment charge residents for each washer and dryer use. These charges: 1) encourage students to maximize their loads and reduce water and electricity or gas consumption, and 2) produce proceeds that will contribute to a need-based housing subsidy once fully endowed.

In fall 2016, Housing Administration adopted an electricity cap in the apartments, and all charges above the monthly cap are charged to the residents, incentivizing students to reduce their consumption.

The newly announced sophomore success program will require non-local sophomore students to live on campus starting in the fall of 2019. This initiative will reduce transportation emissions, create a sense of community and improve academic performance. In a recent analysis, 32 percent of students living on campus purchase parking permits compared to 46 percent of off-campus students. Information from Dr. Bruce Appleyard, assistant professor of City Planning and Urban Design at SDSU, suggests that the sophomore initiative will have an estimated 5-8 percent reduction in the campus carbon footprint.

Vision

Housing will infuse a culture of sustainability within the halls and apartments. Given that the majority of all freshmen and sophomores live on campus, this has the potential of real cultural shift for the campus. Residents will actively participate in recycling, energy and water conservation, and sustainable transportation. Engagement will include meaningful building dashboard displays and sustainability competitions based on actual meter data. Residents will be made aware of sustainability and recycling guidelines during orientation and will have the opportunity to participate in the advocate program. Throughout the year, sustainability advocates within Housing will educate and engage their peers. Community assistants and residential advisers will be partners in educating students about recycling and sustainability through engaging programs. All residence halls shall meter natural gas, water, electricity, heating and cooling energy, and report to the campus energy management system.

Actions

			Short		Medium		Long	
			2017	2018	2019	2020	2021	2022+
Housing and Residential Life	**8.2.1**	Provide and improve sustainability guidance at orientation and as residents move into the halls.						
	8.2.2	Include sustainability and recycling information in the student handbook provided to new students during orientation.						
	8.2.3	Create sustainability advocates' program.						
	8.2.4	Provide consistent and expanded recycling signage.						
	8.2.5	Improve waste collection system based on bin study.						
	8.2.6	Educate residence hall and apartment staff on sustainability during summer training.						
	8.2.7	Develop green certification program for on-campus rooms/units.						
	8.2.8	Advertise move-in as a zero-waste event.						
	8.2.9	Replace failed exterior bulbs with LED or high-efficiency compact fluorescent bulbs.						
	8.2.10	Connect Maya and Olmeca halls to the existing residence hall Building Automation System to achieve 100% BAS control.						
	8.2.11	Install metering in Maya and Olmeca Halls for natural gas, water, electricity, heating and cooling meters.						

Academics & Research

Assessment

San Diego State University has witnessed a strong growth in academics related to sustainability. The sustainability major and minor programs have been successfully developed, and several other academic majors incorporate aspects of sustainability: geography; civil, construction and environmental engineering; mechanical engineering; electrical engineering; public health; city planning; and marketing.

Regarding research, efforts across campus include such programs as Blue Gold and the Industrial Assessment Center. Electrical engineering professors are researching renewable energy, energy efficiency and energy storage. City planning professors are researching sustainable development and active travel options, including collaboration and leadership on the transportation analysis and recommendations for this report. However, research activities are often decentralized, and faculty doing sustainability research or coursework may not be aware of others' efforts. For instance, researchers from geography, public health and environmental engineering independently focus on water quality and watersheds, though some collaborations do occur.

The Sage Project engages hundreds of students from multiple classes each year to work on real projects in a regional community, with an emphasis on sustainability. The Sage Project has an annual symposium, and coordinates projects amongst majors and faculty.

The University Senate has a sustainability committee that works on enhancing sustainability in academics and elsewhere. The Senate sustainability committee has been working with faculty to self-identify classes and research related to sustainability. This information will be available on the sustainability website. However, there are no formal methods to identify which classes have sustainability components. Furthermore, there is no general education requirement or option for sustainability.

Finally, SDSU puts a major emphasis on study abroad, with several majors requiring it for graduation. These experiences provide insight into other cultures and how they address sustainability issues. Students can filter study abroad opportunities based on sustainability.

Vision

All students graduating from SDSU will have a base understanding of sustainability and climate change, which will be verified through a literacy assessment. The sustainability major and minor program will flourish for dedicated students, while others will have the opportunity to take identified sustainability courses within their own programs.

Faculty and students will become more aware of sustainability-related academic activity on campus through various events and programs. Students will learn through high-impact practice experiences, such as the Sage Project and Campus as a Living Lab. The campus sustainability website will identify sustainability-related courses, faculty, and research efforts, as well as provide resources for faculty to integrate sustainability into their curriculum.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Academics & Research	9.1.1	Identify courses, faculty and research related to sustainability. Make available on campus sustainability website. Utilize this information to achieve STARS certification. Explore opportunities to formalize this distinction.						
	9.1.2	Provide opportunities for researchers working on sustainability issues to collaborate. This could include symposia, luncheons and rapid presentations like PechaKucha.						
	9.1.3	Develop and share resources (readings, presentation slides) on relevant topics, including climate change.						
	9.1.4	Investigate options for sustainable literacy assessments.						

Administrative

Purchasing

Assessment

There is no set of purchasing guidelines related to sustainability. The available information indicates mixed performance. The CSU system requires compliance with the Buy Recycled campaign, requiring 50 percent of items in certain categories to meet minimum requirements. On the whole, more than 50 percent of campus purchases meet these requirements. This is primarily due to metal used in construction projects. In certain areas, campus exceeds the minimum requirements but falls short in several other categories.

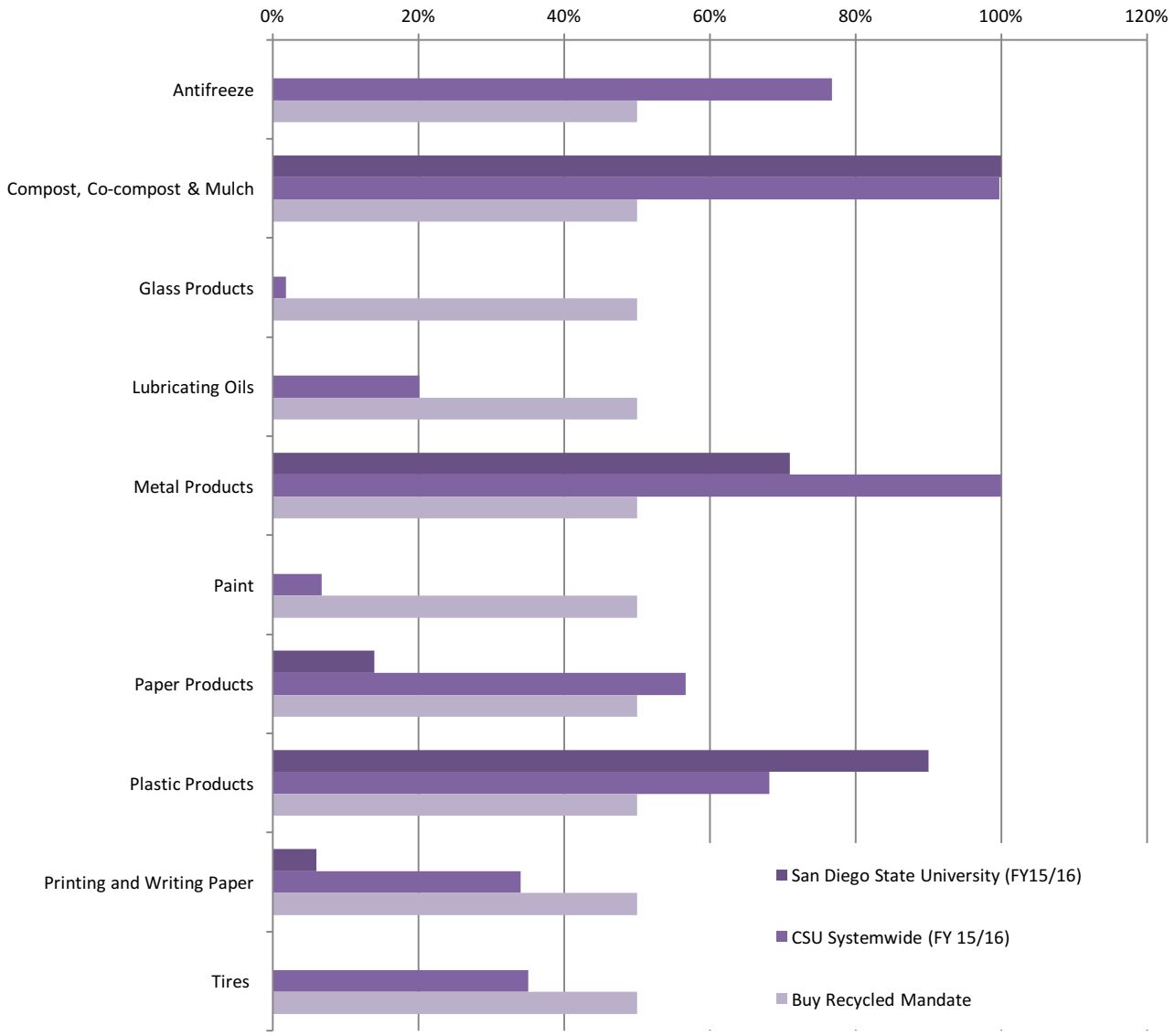
In FY 15/16, 80 percent of cleaning supplies were considered sustainable by the vendor. This definition of sustainability is based on compliance with LEED EBOM. The lowest-performing category was chemical purchases.

SDSU does not have any requirements related to energy efficiency, like ENERGY STAR or EPEAT. There is approval to proceed with ENERGY STAR requirements, but it has not been implemented.

While it is important to develop sustainable procurement policies, there needs to be a system for tracking and enforcement.

Vision

SDSU will have a purchasing policy reflecting sustainability goals. The campus community will be aware of sustainability-related purchasing requirements, which will be supported by higher administration. SDSU will meet Buy Recycled requirements and ensure purchases help enable certifications like LEED EBOM and STARS.



Buy Recycled Performance

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Purchasing	**10.1.1**	Implement sustainability policy, including purchasing.						
	10.1.2	Improve system to track and enforce compliance of purchasing policies.						

Funding

Assessment

Current and previous energy-efficiency projects have typically been funded by the Chancellor's Office, with some funding matched from campus. Utility incentives are often unavailable due to the low amount of imported electricity. However, that will change as campus shifts to importing more from the grid. SDSU has created a revolving loan fund, in which high-return energy projects would be funded and the cost-savings returned to replenish the fund.

There are several other funding sources, such as grants and alternative financing, that need to be explored.

Vision

Identified energy-efficiency projects will be funded from various sources according to payback and project type. Rapid-payback projects will be funded through the revolving loan fund. This will be used to fund efficiency retrofit and as a delta fund for new construction and equipment. Longer-payback projects will be vetted for funding, especially those with attractive internal rates of investment. The performance of these efforts will be tracked with transparent results.

The excitement around campus sustainability will extend to alumni and others who will donate to a fund specifically for these efforts. SDSU will secure grants that improve infrastructure, reduce environmental impact and provide research opportunities.

Based on optimized co-generation operation, electricity purchases will increase and result in increased availability of utility incentives. This will increase the viability of energy projects by reducing payback periods.

SDSU is required to participate in California's Cap and Trade program. Most of the required carbon allowances are provided to the university by the state as allocations. The number of allocations will decrease each year. The value of these allocations must be spent on projects that reduce greenhouse gas emissions. The first few years of this requirement was achieved by the establishment of the revolving loan fund. Going forward, an annual amount of approximately $600,000 must be spent on emissions reductions projects.

Actions

			Short		Medium		Long
			2017	2018	2019	2020	2021	2022+
Funding	10.2.1	Complete first revolving loan fund project, the MBCx of the Chemical Sciences Laboratory.						
	10.2.2	Pilot tracking projects in Green Revolving Investment Tracking System (GRITS).						
	10.2.3	Vet alternative financing options through Budget & Finance.						
	10.2.4	Discuss development of sustainability fund with The Campanile Foundation.						
	10.2.5	Re-establish utility incentives based on modified co-generation operation.						

Personnel

Assessment

There are currently a handful of people associated with sustainability at SDSU. The Facilities Services' assistant director for campus sustainability is responsible for stewardship of energy and water resources, recycling and the operation of the SDSU co-generation plant, as well as chairing the Climate Action Planning Council. He is assisted by the energy analyst, who is primarily responsible for data management, analysis, billing and metering. Student interns provide value, but turnover makes it difficult to sustain an effective program. Several other campuses have a recycling coordinator, transportation demand management coordinator and/or sustainability coordinator to engage in outreach. However, additional staffing is unlikely. For the near future, existing staff and student interns and volunteers will need to be effectively utilized to implement this plan.

Associated Students has a director of facilities and sustainability who is responsible for the stewardship of Associated Students' facilities and engagement with student green groups.

Housing has a project specialist and an administrative coordinator who are involved in sustainability efforts.

On the academic side, the sustainability major has two co-directors/advisers.

The parking and transportation director is responsible for sustainable transportation programs but has no staff even though transportation accounts for more than 40 percent of campus carbon emissions.

When opportunities from monitoring-based and continuous commissioning projects are identified, there is limited staff available to implement the measures. The preventive maintenance program is understaffed, resulting in equipment with limited maintenance that shortens its life and increases energy use. Additional facilities workers will improve the effectiveness of this program.

Vision

San Diego State University will have a sustainability team that sets vision, implements projects, engages with students, and tracks metrics and efforts. Staff will be efficiently employed to maximize progress with limited resources and will collaborate with students and campus partners. Students will assist in outreach, especially around recycling and social media, campus STARS certification, and developing a green office certification and sustainability liaison program.

A dedicated team for monitoring-based and continuous commissioning will implement recommendations from studies and address issues identified by the energy information system. Additional staff will be added to the preventive maintenance team.

Short-Term Actions

- Expand the team of students to assist in specific sustainability efforts, either through employment, internships or volunteers.
- Bring on newly approved employees to the preventive maintenance program.

Policy

Assessment

There is no established energy policy for San Diego State University, though there is a sustainability policy, including energy, at the systemwide level.

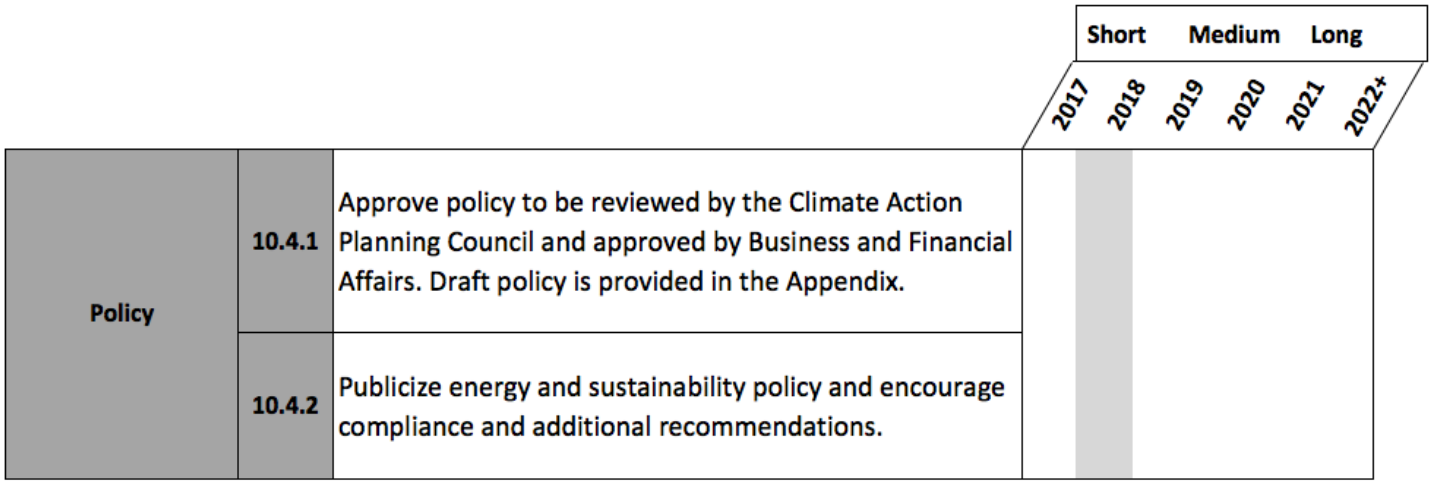
Vision

San Diego State University will have a robust energy and sustainability policy that encourages occupants and decision-makers to reduce their contribution to SDSU's energy consumption and environmental footprint.

Implementation & Tracking

Implementation will require support from across the campus community from dedicated sustainability and energy staff, faculty, management, staff and students. The Climate Action Planning Council will continue to oversee implementation. Initially, the council will develop an implementation matrix to determine prioritization, based on criteria such as cost/benefit analyses, ease of implementation, visibility and available champions. Goals and actions will be monitored and publicized on a regular basis. Actions will be assigned to individuals and departments with regular follow-up. Annual greenhouse gas inventories and progress reports will be submitted to Second Nature and available publically. The Climate Action Plan will be reviewed and revised every five years at a minimum.

Actions



Appendix

Draft Energy & Sustainability Policy

San Diego State University will be a judicious steward of its energy, water, waste and other environmental resources. A conscious effort will be made to reduce our impact, from individuals to purchasers to project managers to administrators.

The campus will comply with California State University and State of California executive orders regarding energy, water and sustainability.

Energy

Buildings will be heated to 68-70° F and cooled to 74-76° F. Other measures to increase thermal comfort, such as desktop fans, proper solar shading and supply air reset, will be preferred. Domestic hot water temperatures will not be set above 115° F. Exceptions will be made to increase energy efficiency, such as outdoor air economizing, or where other temperature settings are required by law or by specialized needs of equipment or scientific experimentation.

Mechanical equipment will be shut off during unoccupied periods, including weekends, holidays and varying periods each night, except where it would adversely affect instruction, data integrity or other scientifically critical or 24-hour operations. The use of buildings will be scheduled with energy consumption in mind. Night and summer classes will attempt to consolidate in a subset of buildings to allow other buildings' systems to shut off.

Outside air ventilation will be provided at code-minimum levels. Outside air economizers will be routinely maintained to ensure optimal performance.

Windows and doors will be closed when mechanical cooling or heating is being provided.

Fume hood sashes will be closed when not in use.

All lighting, except what is required for security purposes, will be turned off when buildings and facilities are unoccupied. Custodial personnel will turn lights back on only for the time actually required for custodial work. The campus will move toward automated occupancy and daylighting controls.

No incandescent lights shall be used on campus, including personal lamps. Upon replacement, CFLs will be replaced with LEDs. New installations will use LED lighting. Mercury in lamps will be limited to 70 picograms per lumen.

No personal space heaters or large fans are permitted. Exceptions can be made for medical reasons and for temporary use while repairs are being made to HVAC systems. Small desktop fans less than 20 W max are permitted but only operated when occupant is present. Refrigerators and coffee makers should be located in kitchenettes or other central locations.

The use of refrigerators for individual employees is prohibited. Departmental refrigerators should maximize the number of employees served.

The use of individual printers for individual employees is prohibited. Printing resources shall be centralized to serve the maximum number of employees, with proper settings for security when required. Printers will be set with double-sided printing as a default.

Water

Drought restrictions, both local and statewide, will be met.

Identified leaks will be repaired within 24 hours.

Landscape plants will be selected to be drought-resistant and installed with crop coefficients lower than 0.5.

For new projects, turf grass will only be used for programmable space.

Waste

All trash, recycling and compost receptacles will use campus standards with clear, consistent labeling.

Faculty, staff and students shall follow guidelines to properly recycle or dispose of materials.

Green Building

All new construction and renovations will comply with prescriptive requirements of the energy and CALGreen sections of Title 24. Equipment purchases will meet prescriptive requirements of the energy code.

All new construction and major renovations over $5 million will achieve LEED Gold certification at a minimum.

Variations from campus energy policy must result in a lower lifecycle cost.

Purchasing

Departments must purchase a minimum of 30 percent post-consumer recycled paper. Departments are encouraged to purchase 100 percent post-consumer paper; defaulting users to double-sided paper will help balance any cost increase.

If a product category has ENERGY STAR ratings, only ENERGY STAR-rated products can be purchased. Purchasers should consider energy consumption and refer to list of suggested products.

Motors shall be NEMA premium and either operated by variable frequency drives or be electronically commutated motors (ECMs).

Vehicle purchases will meet California State government fleet requirements. Purchasers shall prioritize electric, plug-in hybrids and hybrids. If a vehicle does not meet these vehicle classes, documentation will be submitted stating that no suitable alternative is available or the purchase will result in a lower life cycle cost.

Electronic equipment will meet EPEAT Silver rating, when the relevant category is available.

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