University of San Diego Climate Action Plan Technical Documentation

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ENERGY POLICY INITIATIVES CENTER
UNIVERSITY OF SAN DIEGO SCHOOL OF LAW

About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

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1 Overview

The University of San Diego (USD) Climate Action Plan (CAP) Technical Documentation describes the method used to calculate 2010-2015 USD campus-wide greenhouse gas (GHG) emissions by scopes and categories, business-as-usual (BAU) GHG emissions forecast throughout 2035, and GHG emissions reductions based on California statewide policies and strategies included in the CAP. Since USD operates on a fiscal year basis, all inventory and forecast years are based on fiscal years.

The baseline emission year, a reference year to start the BAU forecast and calculate target emission reductions, is set at 2010 to conform to the City of San Diego CAP.[1]

1.1 About this Document

Section 2 provides background sources, assumptions, and methods to estimate USD campus-wide GHG emissions inventory from 2010-2015. Section 3 provides the methods used to project BAU emissions and reduction targets. The methods used to estimate GHG reductions from statewide policies and strategies in the USD CAP are presented in Section 4.

2 Greenhouse Gas Inventory

In general, the *Greenhouse Gas Protocol for the U.S. Public Sector* (referred to as U.S Public Sector Protocol), which is consistent with framework of the Corporate Standard and Local Government Operations Protocol, is used as guidance to identify and define the boundary and scopes of the GHG inventory.[2] In general, the GHG emissions calculation methodology from Local Government Operations Protocol is used to quantify the GHG emissions.[3] For some Scope 3 indirect emissions categories that are not covered in the Local Government Operation Protocol, methods from *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* (referred to as Scope 3 Calculation Guidance) are used.[4]

2.1 Inventory Overview and Background

2.1.1 Greenhouse Gases

The primary greenhouse gases (GHGs) included in this inventory are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG has a different capability of trapping heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed in carbon dioxide equivalent (CO_2e). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate greenhouse gas emissions. The GWPs used in this inventory are from IPCC Forth Assessment Report (AR4) and provided in Table 1.[5]

[1] The City of San Diego Climate Action Plan was adopted in December 2015. The document is available at https://www.sandiego.gov/planning/genplan/cap

[2] The Greenhouse Gas Protocol for the U.S. Public Sector (2010). http://www.ghgprotocol.org/standards/public-sector-protocol

[3] Local Government Operations Protocol (2010) http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm

[4] Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance

[5] IPCC Fourth Assessment Report: Climate Change 2007. Direct Global Warming Potentials. (2013) https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Table 1 Global Warming Potentials (GWPs) Used in the University of San Diego GHG Inventory

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

2.1.2 Boundary and Scopes

The inventory follows the recommended boundary and scopes of the U.S Public Sector Protocol.[6] As recommended by the U.S. Public Sector Protocol, the operation control approach is used. The inventory includes all direct GHG emissions from sources within USD operational control (Scope 1), GHG emissions from the generation of purchased electricity consumed on campus (Scope 2), and other indirect GHG emissions result in the activities associated with USD but from sources not owned or controlled by USD (Scope 3). The categories included in each scope are given in Table 2. USD chose to include emissions from all scopes in its inventory and mitigation assessment to account for emissions that result from and are caused by activities within the mission of the University.

Table 2 University of San Diego GHG Emissions Inventory Categorized by Scope

Direct GHG Emissions	Indirect GHG Emissions	
Scope 1	**Scope 2**	**Scope 3**
• Stationary Combustion • Campus Fleet Fuel Combustion	• Purchased Electricity	• Water Consumption • Solid Waste Generation • Wastewater Generation • Student and Employee Air Travel • Student and Employee Commuting • Generation of Electricity Consumed in Transmission & Distribution System (T&D System losses)

2.1.3 Rounding of Values in Tables and Figures

Within the tables and figures throughout the document rounding is often required. Values are rounded to the nearest integer of a higher order of magnitude. Values are not rounded in the intermediary steps in the actual calculation. As a result of rounding, some totals may not equal the values summed.

2.2 Summary of GHG Emissions

In 2010, the total GHG emissions from USD, including all scopes, were estimated at 30,301 metric tons CO_2e (MT CO_2e), distributed into nine categories as shown in Figure 1.

[6] The Greenhouse Gas Protocol for the U.S. Public Sector (2010). http://www.ghgprotocol.org/standards/public-sector-protocol

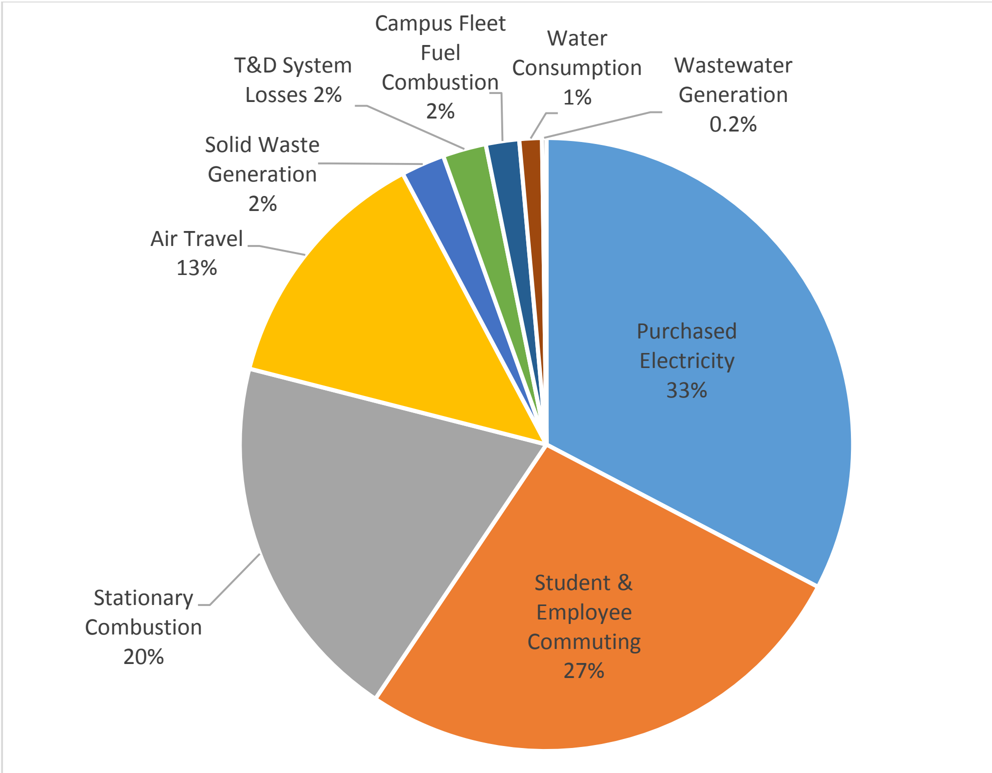

Figure 1 University of San Diego Fiscal Year 2010 GHG Emissions Breakdown

Direct emissions (scope 1) accounted for 21% of the total emissions with the rest of from indirect emissions (33% from scope 2 and 46% from scope 3). The emissions distribution from FY 2011 to FY 2015 is similar, the emissions in each category and scope from FY 2010 to FY 2015 are presented in Table 3.

Table 3 University of San Diego Fiscal Year 2010-2015 GHG Emissions by Category and Scope

Category	**GHG Emissions (MT CO_2e)**					
Fiscal Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Scope 1 Total Emissions	**6,459**	**5,559**	**5,469**	**5,056**	**4,598**	**4,049**
Stationary Combustion	5,926	5,027	4,922	4,504	4,013	3,468
Campus Fleet Fuel Combustion	532	532	547	552	585	582
Scope 2 Total Emissions	**9,906**	**7,884**	**8,122**	**8,649**	**8,407**	**8,342**
Purchased Electricity	9,906	7,884	8,122	8,649	8,407	8,342
Scope 3 Total Emissions	**13,937**	**14,607**	**14,612**	**14,795**	**14,566**	**13,916**
Solid Waste Generation	696	684	684	684	684	618
Water Consumption	360	295	290	349	327	269
Wastewater Generation	70	27	22	27	29	27
Student & Employee Air Travel	4,018	4,838	5,027	5,491	4,944	4,339
Student & Employee Commuting	8,100	8,211	8,021	7,638	7,995	8,080
T&D System Losses	693	552	569	605	588	584
Total Emissions (Scope 1-3)	**30,301**	**28,049**	**28,203**	**28,500**	**27,571**	**26,308**

The changes in each category throughout the years are given in Figure 2. Total emissions in 2015 is 26,308 MT CO_2e, reduced 13% (3,994 308 MT CO_2e) from 2010. Emissions from wastewater generation decreased 62% since 2010 even though it is the smallest category in the GHG emissions inventory. Emissions from stationary combustion also decreased significantly, by 41%, which contribute to more than half of the total reduction since 2010.

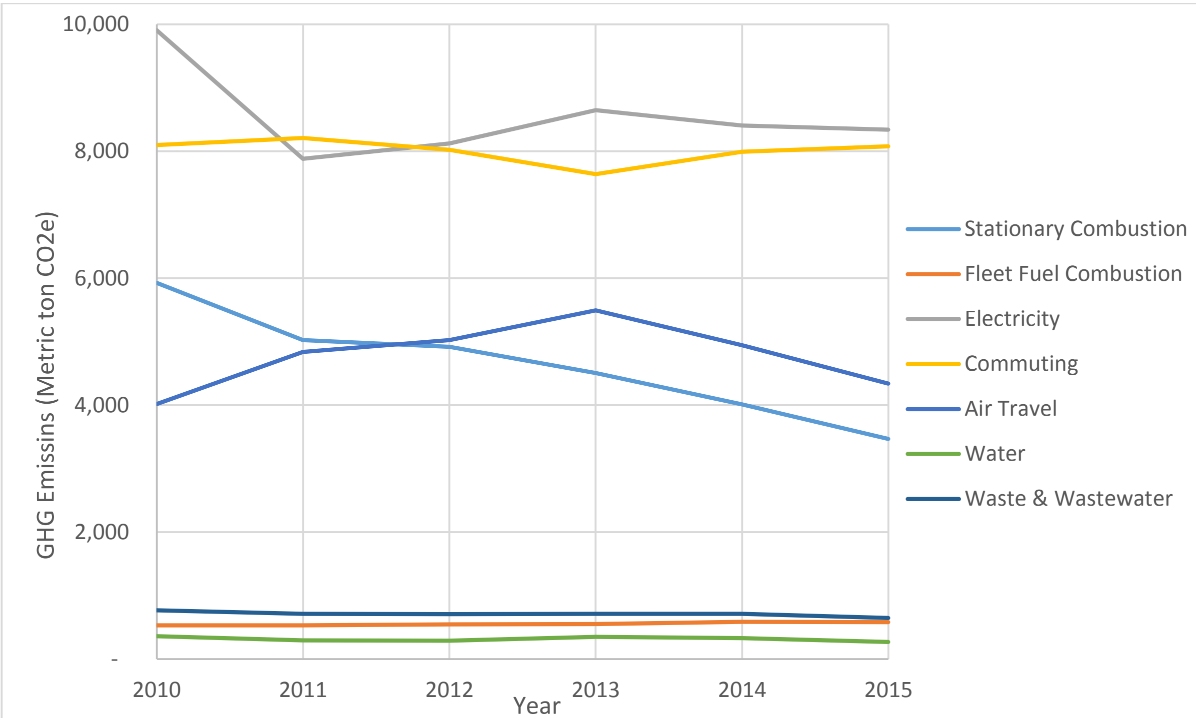

Figure 2 University of San Diego Fiscal Year 2010-2015 GHG Emissions by Category

2.3 Methods to Calculate GHG Emission Inventory

In general, the calculation-based methodologies in the Local Government Protocol are used to quantify GHG emissions in each scope and category. For some scope 3 categories that are not covered in the Local Government Protocol, the methods from *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* (referred to as Scope 3 Calculation Guidance) are used.[7] Emissions estimates are calculated using data for the level of "activity" (e.g., kilowatt-hours of electricity consumed, tons of solid waste generated, etc.) from USD operation activities and corresponding "emission factors." When emission factors specific to USD or the San Diego region are not available, default emission factors recommended in the Protocol and Standards are used.

2.3.1 Scope 1 Direct GHG Emissions

Scope 1 emissions represent emissions emitted as a direct result of USD operational activities, including stationary combustion and campus fleet fuel combustion.

[7] Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance

2.3.1.1 Stationary Combustion

The stationary combustion category includes combustion of fuel in stationary equipment for the purpose of generation heat, steam and cooling. GHG emissions from stationary combustion, in this case the natural gas use on USD campus, are estimated using the recommended approach in the Local Government Protocol.[8]

For each calendar year, the natural gas emission factor is calculated based on the heat content of natural gas, fuel CO_2, CH_4, and N_2O emissions from the latest California's Greenhouse Gas Inventory[9] and GWP for CH_4, and N_2O from Table 1. The quarterly natural gas consumption was multiplied by the corresponding natural gas emission factor. The total natural gas consumption, emission factor and GHG emissions in fiscal year 2010-2015 from USD operations are given Table 4.[10]

Table 4 GHG Emissions from Stationary Combustion (University of San Diego, FY 2010-2015)

Fiscal Year	Natural Gas Consumption (therms)	Natural Gas Emission Factor (MT CO_2e/therm)	GHG Emissions from Stationary Combustion (MT CO_2e)
2010	1,101,836	0.0054	5,926
2011	933,605	0.0054	5,027
2012	921,442	0.0053	4,922
2013	843,211	0.0053	4,504
2014	752,738	0.0053	4,013
2015	653,735	0.0053	3,468

2.3.1.2 Campus Fleet Fuel Combustion

The campus fleet fuel combustion category includes combustion of fuel used for USD-owned and -controlled vehicles. GHG emissions from fleet fuel combustion, including gasoline, diesel, and natural gas use for USD fleet, are estimated using the recommended approach in the Local Government Protocol.[11]

For each fuel, the emission factor is calculated based on the heat content of the fuel, fuel CO_2, CH_4, and N_2O emissions from the latest California's Greenhouse Gas Inventory[12] and GWP for CH_4, and N_2O from Table 1. The emission factor for each fuel is given in Table 5 and used as constant for fiscal year 2010-2015.

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[8] Local Government Operations Protocol (2010). Section 6.1 Stationary Combustion. http://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf

[9] California Air Resources Board (2016). Documentation of California's Greenhouse Gas Inventory (9th edition – last updated on 03/30/2016). Fuel Combustion – Natural Gas. http://www.arb.ca.gov/cc/inventory/doc/doc_index.php

[10] The total GHG emissions are calculated based on quarterly natural gas consumption (provided by USD Facilities Management to EPIC, March 2016) and the emission factor of the quarter. Emission factor for each fiscal year in the table is the direct calculation from total emissions and consumption, for illustration purpose.

[11] Local Government Operations Protocol (2010). Section 7.1 Mobile Combustion. http://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf

[12] California Air Resources Board (2016). Documentation of California's Greenhouse Gas Inventory (9th edition – last updated on 03/30/2016). http://www.arb.ca.gov/cc/inventory/doc/doc_index.php

Table 5 Fuel Emission Factor for On-road Vehicle

Fuel Type	Fuel Emission Factor
Gasoline (g CO_2e/gallon)	8,913
Diesel (g CO_2e /gallon)	10,212
Natural Gas (g CO_2e /btu)	0.053

The annual fuel use is multiplied by the corresponding emission factor. The total fuel consumption and GHG emissions in fiscal year 2010-2015 from USD fleet are given Table 6.[13]

Table 6 GHG Emissions from Fleet Fuel Combustion (University of San Diego, FY 2010-2015)

Fiscal Year	Gasoline		Diesel		Natural Gas		GHG Emissions from Fleet Fuel Combustion (MT CO_2e)
	Consumption	Emission	Consumption	Emission	Consumption	Emission	
	gallons	MT CO_2e	gallons	MT CO_2e	MMBtu	MT CO_2e	
2010	56,190	503	314	3	500	27	532
2011	56,564	506	30	0.3	486	26	532
2012	58,258	521	364	4	417	22	547
2013	58,174	520	820	8	444	24	552
2014	60,772	544	1,082	11	566	30	585
2015	58,632	524	1,291	13	833	44	582

2.3.2 Scope 2 Electricity Indirect GHG Emissions

Scope 2 emissions electricity purchased to serve campus consumption no served by onsite generation.

2.3.2.1 Purchased Electricity

The purchased electricity category includes the emissions associated with the electricity purchased from a source off campus and consumed on campus. GHG emissions for this category are estimated using the GHG Protocol Scope 2 Guidance[14] and the recommended approach in the Local Government Protocol.[15]

Using the recommended market-based method in the Scope 2 Guidance, the electricity purchased from the Electric Service Provider (Noble Americas) and the electricity purchased through a power purchase agreement from on-campus solar generation, are counted separately.

For the on-campus solar generation, USD owns the renewable energy credits (RECs) of the electricity generated from the 1.2 MW solar system, therefore, the electricity is 100% renewable with no associated greenhouse gas emissions. The annual generation from on-campus solar from fiscal year

[13] Gasoline and Diesel in gallons, and compressed natural gas (CNG) in GGE (gasoline gallon equivalents) for each fiscal year are provided by USD Facilities Management to EPIC, April 2016. EPIC converted natural gas in GGE to therm with a conversion factor (10 CNG therm = 8.32 GGEs). Conversion factor from California Energy Commission. http://www.energyalmanac.ca.gov/transportation/gge.html

[14] GHG Protocol Scope 2 Guidance (2015). http://www.ghgprotocol.org/scope_2_guidance

[15] Local Government Operations Protocol (2010). Section 5.1 Electricity Use http://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf

2010-2015 is given Table 7.[16] The system was online in early 2011, so no generation was available in fiscal year 2010 and the generation in fiscal year 2011 was a reduced number.

Table 7 On-campus Solar Generation (University of San Diego, FY 2010-2015)

Fiscal Year	On-campus Solar Generation (MWh)
2010	-
2011	705
2012	1,935
2013	1,928
2014	1,914
2015	1,905

For the electricity purchased from the Noble Americas, the annual electricity consumption was multiplied by the supplier specific emission factor. For a given calendar year, the electricity emission factor for Nobel Americas is developed based on its power mix[17] and the emission factor of each power source.[18] The electricity consumption, emission factor and total GHG emissions in fiscal year 2010-2015 are given in Table 8.[19] The difference in emissions reflect change in Noble Americas power mix and other available electricity sources, such that more on-campus solar generation will offset purchased electricity from Noble Americas.

[16] The monthly kWh from solar system was provided by USD Facilities Management to EPIC, March 2016.
[17] Nobel America's power mix are obtained from its reported power source disclosure form to the California Energy Commission (CEC). The power mix consists eligible renewable source and unspecified source. Reports provided by CEC to EPIC on January and August 2016.
[18] For the eligible renewable source, there is no GHG emissions associated with the source. For the unspecified sources, the default emission factor, 0.428 MT CO2e/MWh (943 lbs CO2e/MWh), from California Air Resource Board's Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR) was used. Unofficial Electronic version of MRR. (2015) http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr-2014-unofficial-02042015.pdf
[19] The total GHG emissions are calculated based on monthly electricity consumption (provided by USD Facilities Management to EPIC, March 2016) and the emission factor for the month (year). Power mix information for Noble Americas is not available for calendar year 2009, information for calendar year 2010 is used as proxy. Emission factor for each fiscal year is the direct calculation of total emissions and electricity consumption, for illustration purpose.

Table 8 GHG Emissions from Purchased Electricity (University of San Diego, FY 2010-2015)

Fiscal Year	Purchased Electricity (MWh)	Noble Americas Electricity Emission Factor (lbs CO_2e /MWh)	GHG Emissions from Purchased Electricity Category (MT CO_2e)
2010	32,571	670	9,906
2011	25,448	683	7,884
2012	24,239	739	8,122
2013	24,963	764	8,649
2014	24,618	753	8,407
2015	25,054	734	8,342

2.3.3 Scope 3 Other Indirect Emissions

Scope 3 emissions represent all other indirect emissions other than purchased electricity, including those from water consumption, solid waste generation, wastewater generation, student and employee air travel, student and employee commuting, and generation of electricity consumed in transmission & distribution system (T&D system losses).

2.3.3.1 Water Consumption

The water supplied to USD for domestic and irrigation use by City of San Diego contributes GHG emissions through energy use for transporting and distribution the water. Emissions depend on the sources of water, distance of water conveyance, and the treatment processes before the end-use phase. To be consistent with the City of San Diego CAP, the same method was used to account for each segment of the water cycle (upstream supply and conveyance, water treatment, and local water distribution) individually, using estimated energy intensities per unit of water for each segment of the water cycle. The energy intensity of each segment is provided in Table 9.

Table 9 Energy Intensity for Each Segment of Water System

Segment of Water System	Energy Intensity (kWh/Million Gallons)
Upstream Supply and Conveyance[20]	9,727
Conventional Water Treatment[21]	684
Local Water Distribution[22]	292

City of San Diego does not provide recycled water to USD, so it is assumed all campus water consumption include water use for irrigation is potable water and goes through conventional water treatment process. The emissions from water are calculated by multiplying the water consumption

[20] California Energy Commission (CEC). Navigant, *Refining Estimates of Water-Related Energy Use in California.* 2006

[21] Conventional water treatment processes include coagulation/flocculation, sedimentation, filtration and disinfection. Energy intensity of standard treatment was calculated based on data from City of San Diego's three Water Treatment Plants, provided to EPIC in 2014. (Value for 2010)

[22] City of San Diego provided to EPIC in 2014. (Value for 2010)

(domestic and irrigation water use), energy intensity for each segment, and electricity emission factor in the San Diego region. Total water consumption and emission are given in Table 10.[23]

Table 10 GHG Emissions from Water Consumption (University of San Diego, FY 2010-2015)

Fiscal Year	Water Consumption (Domestic + Irrigation) (Gallons)	Total GHG Emissions from Water Consumption (MT CO_2e)
2010	107,329,043	360
2011	90,495,899	295
2012	84,485,887	290
2013	95,279,492	349
2014	95,341,950	327
2015	83,301,020	269

2.3.3.2 Solid Waste Disposal

The emissions from the decomposition of organic material in the waste disposed by USD are estimated by the waste-type-specific method from the Scope 3 Calculation Guidance and the recommended approach in the Local Government Protocol, based on the emission factors for specific waste types and waste treatment method.[24] This includes all future emissions that result from the waste generated in the reporting years.

The total waste disposed, recycled, and composted green waste collected by Waste Management from USD, in fiscal year 2010 and calendar year 2015, are used directly. For other inventory years, waste amount is based the average of 2010 and 2015. The waste diversion rate (recycled + composted) increased from 23% in 2010 to 33% in 2015 (Figure 3).[25]

[23] Water consumption data, separated by domestic and irrigation use, were provided by Facilities Management to EPIC, April 2016.

[24] Category 5 Waste Generated in Operations. Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance Section 9.3.2 Landfill with Comprehensive LFG Collection Systems. Local Government Operations Protocol (2010) http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm

[25] Waste amounts are provided by Facilities Management for EPIC, April 2016.

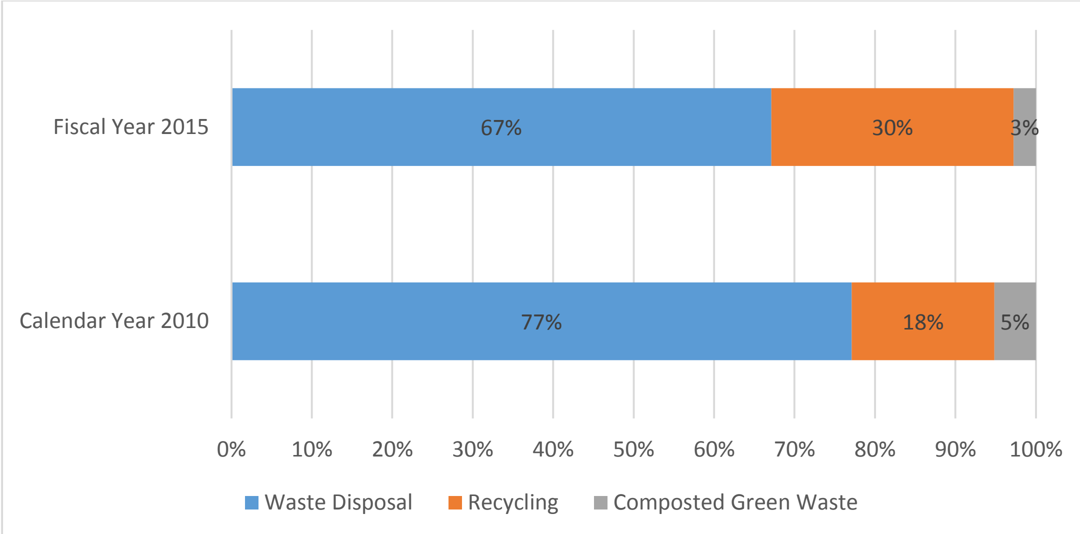

Figure 3 Breakdown of Waste Disposal, Recycling and Composting (University of San Diego, FY 2010 & CY 2015)

In 2011, a waste characteristics study was conducted on campus as part of a sustainability solutions opportunity assessment report to identify opportunities to increase diversion of recyclable materials. The emission factor for the campus disposed waste, 0.069 MT CH4/short ton, was calculated based on the waste characteristics study and the emission factor of each type of waste (MT CH4/short ton waste).[26] The landfill gas capture rate was assumed to be 75% and 10% oxidization rate based on the Local Government protocol and the same as the City of San Diego CAP. The total solid waste disposal and GHG emissions are given in Table 11.[27]

Table 11 GHG Emissions from Solid Waste Disposal (University of San Diego, FY 2010-2015)

Fiscal Year	Solid Waste Disposal (short ton)	Total GHG Emissions from Solid Waste (MT CO_2e)
2010	1,803	696
2011	1,772	684
2012	1,772	684
2013	1,772	684
2014	1,772	684
2015	1,601	618

2.3.3.3 Wastewater Generation

The emissions associated with wastewater generation from USD operations are estimated using the same method in the City of San Diego Climate Action Plan and the recommended approach in the Local

[26] EPA Documentation for Greenhouse Gas Emissions and Energy Factors Used in the Waste Reduction Model (WARM). 2006. Table SW.5 CH4 Yield for Solid Waste Component. Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). http://icleiusa.org/tools/ghg-protocols/

[27] Solid waste disposal from Fiscal year 2011-2014 are not available. They are estimated based on the average of disposal in 2010 and 2015, therefore, the total amounts and emissions are the same from 2011-2014.

Government Protocol and represent the stationary CH_4 emissions due to the combustion of digester gas.[28]

The wastewater generated on campus are collected by City of San Diego, treated, and disposed at the city's Point Loma Wastewater Treatment Plant (WWTP). The emission factor for wastewater treatment was calculated based on the total flow treated and total GHG emissions at Point Loma WWTP. The total emissions are calculated by multiplying the wastewater generation on campus and the emission factor. The total wastewater generation and GHG emissions are given in Table 12.[29]

Table 12 GHG Emissions from Wastewater Generation (University of San Diego, FY 2010-2015)

Fiscal Year	Wastewater Generation (Gallons)	Wastewater Emission Factor (MT CO2e/ million gallons)	Total GHG Emissions from Wastewater Generation (MT CO_2e)
2010	82,681,562	0.84	70
2011	67,937,744	0.39	27
2012	56,714,646	0.40	22
2013	65,132,690	0.42	27
2014	64,144,366	0.45	29
2015	59,338,092	0.45	27

2.3.3.4 Student and Employee Air Travel

Every year, USD students and employees fly nationally and internationally to participate in research programs, conferences, and events. In addition, USD is ranked #2 among national doctoral university for undergraduate study abroad participation with 77.8% of undergraduate student study abroad during their time at USD.[30] Emissions from direct financed air travel and study abroad travel are included in this category.

The emissions from student and employee air travel are estimated using a combination of distance-based method and spend-based method (when information on travel distance is unavailable) from the Scope 3 Calculation Guidance.[31]

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[28] Local Government Operations Protocol (2010) Chapter 10 Wastewater Treatment Facilities. http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm

[29] For wastewater generation, it is assumed only domestic water use goes through sewer system. For wastewater emission factor, the difference between 2010 and the rest of years are due to the change of GHG emissions report method, not change of wastewater treatment process.

[30] University of San Diego. Office of International Students and Scholars. http://www.sandiego.edu/international/study-abroad/

[31] Category 6 Business Travel. Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance

For directly financed travel, which represents the amount of air travel paid for by the University, the total travel distance is estimated by travel airfare[32] and an average fare paid per round-trip journey ($0.16 /passenger miles).[33] For study abroad travel, which is funded directly by students, the air miles are estimated based the flight distance between San Diego International Airport and the major airports of the destinations in the study abroad programs offered by USD International Center and Ahlers Center for International Business.[34]

The total emissions are calculated by multiplying the air miles and energy intensity of air travel for domestic operation and international operations (btu/passenger-miles)[35] and the fuel carbon content of jet fuel (g CO2e/btu).[36] The total air travel miles and GHG emissions are given in Table 13.

Table 13 GHG Emissions from Student & Employee Air Travel (University of San Diego, FY 2010-2015)

Fiscal Year	Direct Financed Air Travel				Student Study Abroad		Total GHG Emissions from Air Travel ($MT\ CO_2e$)
	Student		Employee				
	Miles	GHG Emissions ($MT\ CO_2e$)	Miles	GHG Emissions ($MT\ CO_2e$)	Miles	GHG Emissions ($MT\ CO_2e$)	
2010	1,025,721	228	6,375,214	1,415	10,618,878	2,375	4,018
2011	1,367,077	302	7,201,309	1,591	13,393,460	2,945	4,838
2012	718,141	157	8,799,406	1,926	13,268,577	2,944	5,027
2013	1,671,625	355	8,506,127	1,808	15,486,453	3,328	5,491
2014	1,598,711	330	6,766,576	1,398	15,369,479	3,215	4,944
2015	1,195,003	243	6,176,468	1,257	13,942,064	2,838	4,339

2.3.3.5 Student and Employee Commuting

To collect information on how students and employees commute between their residents and USD, a commuter survey was conducted through a campus-wide email. The survey was opened to all USD

[32] Airfare expenditure provided by Procurement Services to EPIC, March and April 2016. Student travel includes Air Travel Student category. Employee travel includes the categories: Prof Dev Airfare, Faculty Dev Airfare, Travel Admin Airfare, Travel Faculty Airfare and Travel Team Air fares.
[33] Airlines for America. Annual Round-trip fares and fees: Domestic. 2014 average fare paid by domestic passengers per mile flown. (Yield D) http://airlines.org/data/annual-round-trip-fares-and-fees-domestic/ Accessed March 2016.
[34] Program information and destinations are provided by Facilities Management to EPIC, March and April 2016. International Center's programs include all summer 2009 to spring 2016, Ahlers Center's programs include all summer 2009 to summer 2012.
[35] US Department of Transportation, Bureau of Transportation Statistics. Energy Intensity of Passenger Modes. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_20.html Accessed: March 2016.
[36] California Air Resources Board. Technical Support Document for the 2000-2012 California's Greenhouse Gas Emissions Inventory. http://www.arb.ca.gov/cc/inventory/doc/methods_00-12/annex_1d_transport.pdf Accessed: March 2016.

students and employees and collected 1,503 total responses, which is a representative sample size for commuter pattern information.[37] The breakdown of survey participants are given in Figure 4.

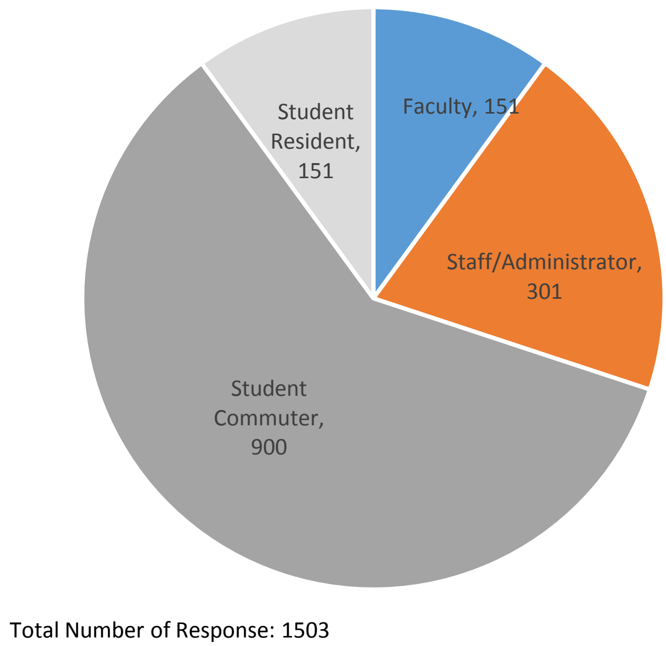

Figure 4 Breakdown of Commuter Survey Participants (University of San Diego, 2016)

It is assumed the student residents (total 151 survey participants) live on-campus and walk, bike or take the campus shuttle (tram) within campus, so their commute information is not included in this category. For the student commuters (900 survey participants) and employee (452 survey participants), their primary choice of commute modes are given in Figure 5.

[37] The survey was conducted anonymously by Office of Sustainability and Institutional Research and Planning (opened April 7-18, 2016), and the survey questions were developed by EPIC.

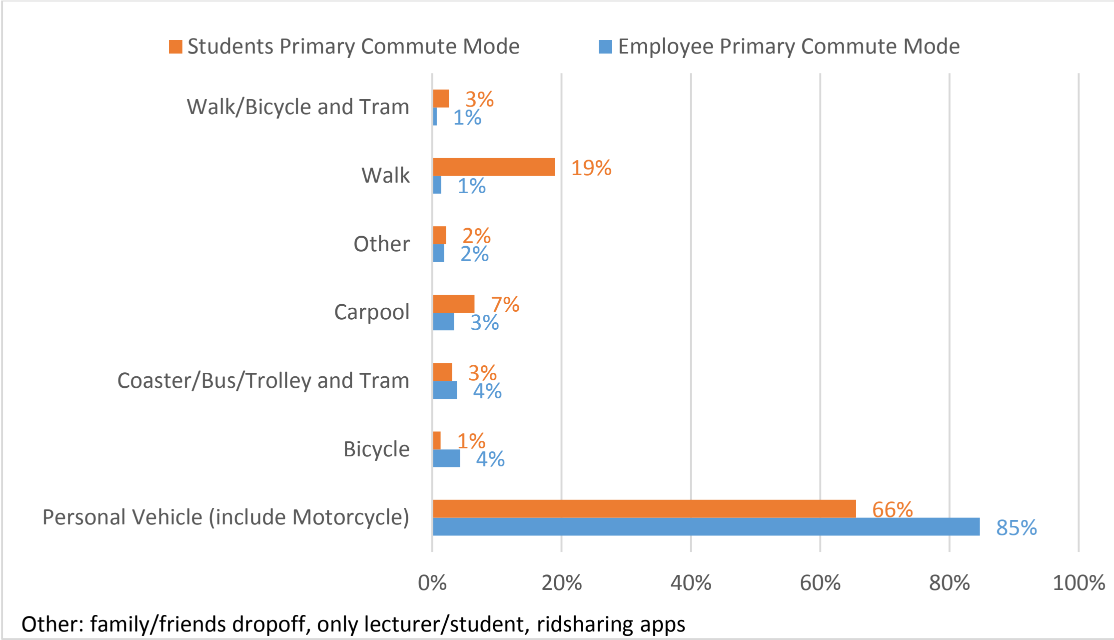

Figure 5 Breakdown of Student and Employee Commuter Mode from Survey (University of San Diego, 2016)

Based on Figure 5, a majority of students and employees chose personal vehicle as their primary commute choice. This category only focuses on the personal vehicle travel, as the GHG emissions related to campus tram is included in the campus fleet fuel combustion category (Scope 1 – direct emissions) and other modes (walk and biking) have no GHG emissions contribution.

The emissions from vehicle travel are estimated using the distance-based method from the Scope 3 Calculation Guidance.[38] The number of commuters, commute distance, frequency, and commuter vehicle emission rate are collected separately through different sources.

Number of Commuters

All students and employees, including part-time and full-time, are required to purchase parking permits to park on campus. The number of commuters can be estimated from the parking permit database based on each unique permit and ID number.[39] In addition, based on the commuter survey, 5% of the employees indicate they drive to USD but park off-campus so they do not own a USD parking permit, therefore the number of commuters was adjusted accordingly. The total number of commuters are given in Table 14.[40]

[38] Category 7 Employee Commuting. Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance

[39] Parking permit data set for FY2010 to FY 2016 was provided by Parking Services to EPIC, March 2016. In addition, IRP combined parking permit, student/employee address zip code and time-status for baseline year 2010 and provided to EPIC, April 2016. Similar information was not available for other years. Number of commuter for FY 2010 was based IRP dataset and the rest of years are based on Parking Services data set.

[40] The number of commuters are identified by each unique ID, multiple vehicles under the same ID are counted as one commuter. Full-time and part-time status are separated by type of permit.

Table 14 Number of Student and Employee Commuters (University of San Diego, FY 2010-2015)

Fiscal Year	Full-time Employee	Part-time Employee	Full-time Student	Part-time Student
2010	1,236	423	3393	1170
2011	1,375	482	3240	1058
2012	1,356	475	3208	945
2013	1,286	440	3088	901
2014	1,479	479	3042	864
2015	1,431	641	3009	919

Commute Distance

For employees, the average one-way commute distances in fiscal year 2010, 13.2 miles for full-time and 13.1 miles for part-time, are calculated based on employee local addresses and used as proxy for the other years.[41] For students, the average one-way commute distances, 11.6 miles, was calculated based on student local or mailing address from FY 2010 and used as proxy for the other years.[42]

Commute Frequency

Based on the commuter survey, on average employees commute 10 one-way trip per week (full-time) and 8 one-way trip per week (part-time), and students commute 8 one-way trip per week (full-time) and 6 one-way trip per week (part-time). Considering the academic calendar, winter and summer breaks, it is assumed employees commute 40 weeks per year and students commute 30 weeks per year.

Vehicle Emission Rate

When purchasing the parking permit, students and employees have the option to enter vehicle information into the database including vehicle make, model and model year. For the vehicles in the parking permit database that have vehicle make and model information, the vehicle class can be identified. For example, a RAM 1500 is identified as a medium pickup and a Volkswagen Tiguan is identified as Small SUV. A breakdown of student and employee commuter vehicle types for fiscal year 2015 is given in Figure 6.

[41] Anonymous Employee addresses with unique identifier was provided by Facilities Management to EPIC, March 2016.

[42] Student Address was provided by Facilities Management to EPIC, March 2016.

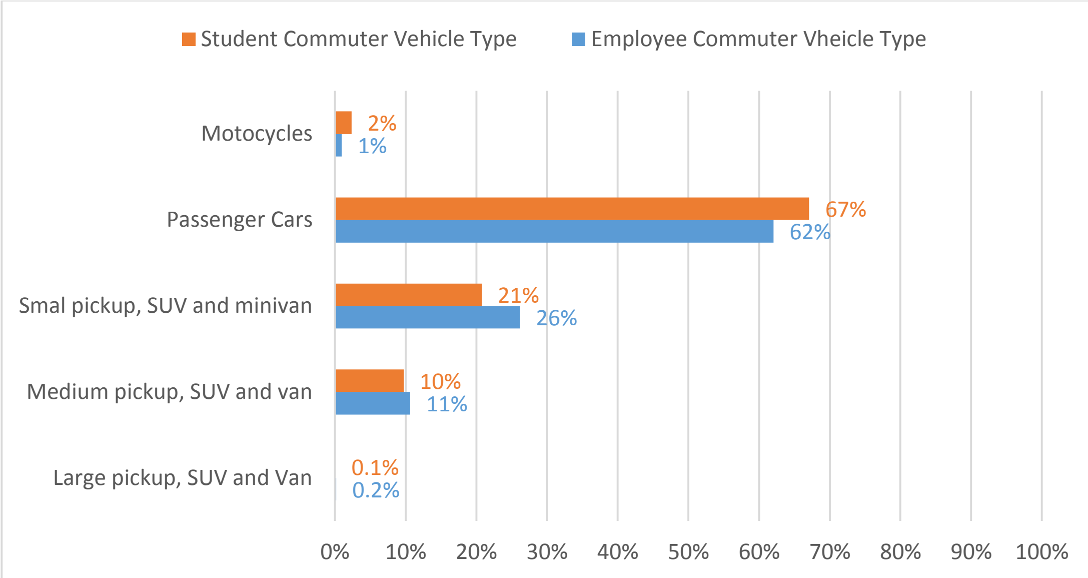

Figure 6 Breakdown of Student and Employee Commuter Vehicle Type (University of San Diego, Fiscal Year 2015)

Combining the vehicle class and vehicle model year, the emission rate for each vehicle (g CO_2e /mile) is matched with the emission rate assigned in the statewide mobile source emission inventory, EMFAC2014, for the same vehicle class and model year specifically in San Diego region.[43] From FY 2010-2015, approximately 50-60% of the vehicles in the parking permit database have complete vehicle information (make, model and model year), the average emission rate from vehicles with complete information are used as proxy.

Total GHG emissions from Commuting

The total GHG emissions is estimated by multiplying average emission rate and total miles, given in Table 15.[44]

Table 15 GHG Emissions from Student & Employee Commuting (University of San Diego, FY 2010-2015)

Fiscal Year	Student Commuting			Employee Commuting			Total GHG Emissions from Commuting (MT CO_2e)
	Miles	Emission Rate (g CO_2e/mile)	GHG Emissions (MT CO_2e)	Miles	Emission Rate (g CO_2e/mile)	GHG Emissions (MT CO_2e)	
2010	11,864,623	401	4,753	8,275,924	404	3,347	8,100
2011	11,206,172	398	4,463	9,256,874	405	3,749	8,211
2012	10,881,808	397	4,317	9,126,053	406	3,704	8,021
2013	10,456,732	397	4,149	8,611,152	405	3,490	7,638
2014	10,251,835	396	4,059	9,791,151	402	3,936	7,995
2015	10,274,755	392	4,031	10,212,901	396	4,049	8,080

[43] California Air Resources Board. EMFAC2014. Emission rate for each vehicle class and model year in San Diego County. https://www.arb.ca.gov/emfac/2014/

[44] The total GHG emissions are calculated based on monthly commute miles and the emission factor of each month. Emission factor for each fiscal year in the table is the direct calculation from total emissions and miles, for illustration purpose.

2.3.3.6 Generation of Electricity Consumed in Transmission & Distribution System (T&D System losses)

The emissions from transmission and distribution of the electricity used on campus are estimated using supplier-specific method from the Scope 3 Calculation Guidance.[45] Total emissions are calculated by multiplying the purchased electricity (not including on-campus solar generation), the T&D loss factor and electricity emission factor. The T&D loss factor, 1.067, is for the T&D system in local utility SDG&E's service territory, based on the ratio of the net energy for load (total electricity sales + net losses) and total sales each year.[46] Even though USD purchases electricity from Noble Americas, an Electric Service Provider, the electricity is transmitted and distributed by SDG&E. The total GHG emissions from T&D System Losses is given in Table 16.

Table 16 GHG Emissions from T&D System Losses (University of San Diego, FY 2010-2015)

Fiscal Year	Total GHG Emissions from T&D System Losses (MT CO_2e)
2010	693
2011	552
2012	569
2013	605
2014	588
2015	584

3 Emission Projection and Reduction Targets

3.1 Business-as-usual Emission Projection to 2035

In the USD CAP, the baseline year is set at 2010, the same as City of San Diego CAP. Business-as-usual (BAU) emission projections are developed for all years through 2035 using the 2010 emissions level as a starting point, to be consistent with the City of San Diego CAP.

The method used to project BAU emissions is based on the fixed GHG emissions per full-time equivalent student (student FTE) in baseline year 2010 and the student FTE growth. In the latest version of USD Mater Plan draft, the enrollment is projected to be 10,000 on-campus student FTE by 2035. The on-campus student FTE does not include student on study abroad program, online courses, and off campus programs.[47] The baseline emissions per student FTE, 4.4 MT CO_2e/Student FTE, is calculated by dividing the total GHG emissions (30,301 MT CO_2e) and student FTE (6,897) in 2010.[48] The student FTE from 2010 to 2035 is interpolated linearly. This value is used to project forward the emissions per student value.

[45] Category 3 Calculating emissions from transmission and distribution losses. Technical Guidance for Calculating Scope 3 Emissions. (2013) http://www.ghgprotocol.org/feature/scope-3-calculation-guidance
[46] California Energy Commission. Electricity Demand Forecast. SDG&E Form 1.2 Mid. http://www.energy.ca.gov/2014_energypolicy/documents/demand_forecast_cmf/Mid_Case/ Download Date: June 2015.
[47] University of San Diego Master Plan. Draft. May 17, 2016. Section 5. Enrollment & Space Analysis. http://catcher.sandiego.edu/items/usd/1408_USD%20MasterPlan-DRAFT-2016-05-18.pdf Accessed Date: 09/07/2016
[48] Student FTE in 2010 is the Fall 2009 student FTE number. Student FTE from Fall 2009 to Fall 2014 are provided by Facilities Management to EPIC, May 2016.

Figure 7 shows the BAU emissions projection in comparison to actual emissions from 2010 through 2015.

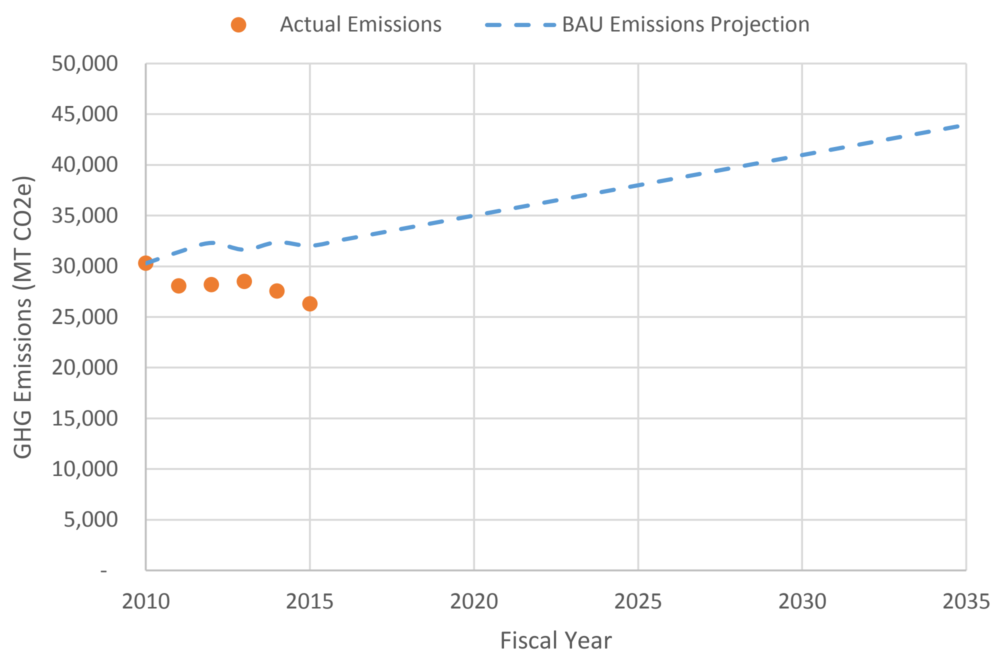

Figure 7 Business-as-usual GHG Emissions Projection (University of San Diego)

3.2 Emission Reduction Targets

The target emission level for 2020, 2030 and 2035 in the USD CAP are also the same as the targets in City of San Diego CAP:

- 15% below baseline 2010 emission levels by 2020
- 40% below baseline 2010 emission levels by 2030
- 50% below baseline 2010 emission levels by 2035

Table 17 shows the BAU emissions, target levels, and the emission reductions needed for each target year.

Table 17 BAU Emissions and Target Levels in USD CAP

Year	BAU Emission (MT CO_2e)	Target Emission Level (% below baseline)	Target Emission Level (MT CO_2e)	Emission Reductions Needed to Meet Target (MT CO_2e)
2010 (baseline)	30,301	-	-	-
2020	35,008	15%	25,756	9,252
2030	40,958	40%	18,181	22,778
2035	43,934	50%	15,151	28,783

4 Methods for Estimating Greenhouse Gas Reductions

To achieve the above targets USD will implement GHG reduction measures included in the CAP. The methods used to estimate the impacts of these measures are described below.

4.1 Summary of Emission Reductions

A summary of emission reductions from statewide policy and USD CAP mitigation strategies is provided in Table 18. The USD CAP includes the following 6 mitigation strategies:

- Strategy 1: Increase campus energy efficiency and clean & renewable energy sources
- Strategy 2: Increase cleaner and alternative modes of transportation in commuter fleet
- Strategy 3: Reduce air travel and offset associated emissions
- Strategy 4: Achieve zero waste in USD operations
- Strategy 5: Increase cleaner and alternative modes of transportation in USD fleet
- Strategy 6: Increase water efficiency in USD operations

Each strategy has specific goals and actions associated with it. The details on specific goals for USD CAP mitigation strategies and in statewide policies are given in Section 4.4.

Table 18 Summary of GHG Emission Reductions by Strategy in USD CAP

Policy and Strategy	**Emission Reductions from Strategies (MT CO2e)**		
	2020	**2030**	**2035**
Statewide Policies	3,479	9,744	11,301
Strategy 1: Increase energy efficiency and clean & renewable sources	5,226	7,588	10,817
Strategy 2: Increase cleaner and alternative modes of transportation in commuter fleet	154	673	815
Strategy 3: Reduce air travel and offset associated emissions	4,238	4,958	5,318
Strategy 4: Achieve zero waste in USD operations	387	575	682
Strategy 5: Increase cleaner and alternative modes of transportation in USD fleet	60	174	262
Strategy 6: Increase water efficiency in USD operations	87	99	127
Total Reductions	13,632	23,811	29,322
Remaining Emission After Reductions	**21,376**	**17,147**	**14,612**
Target Meet	**Yes**	**Yes**	**Yes**

Figure 8 provides a visualization of the target emission levels for 2020, 2030 and 2035 and the GHG emission reductions by strategy over time in Table 18. The targets are shown as black dots in the figure, and the colored wedges represent each strategy or goal within a strategy.

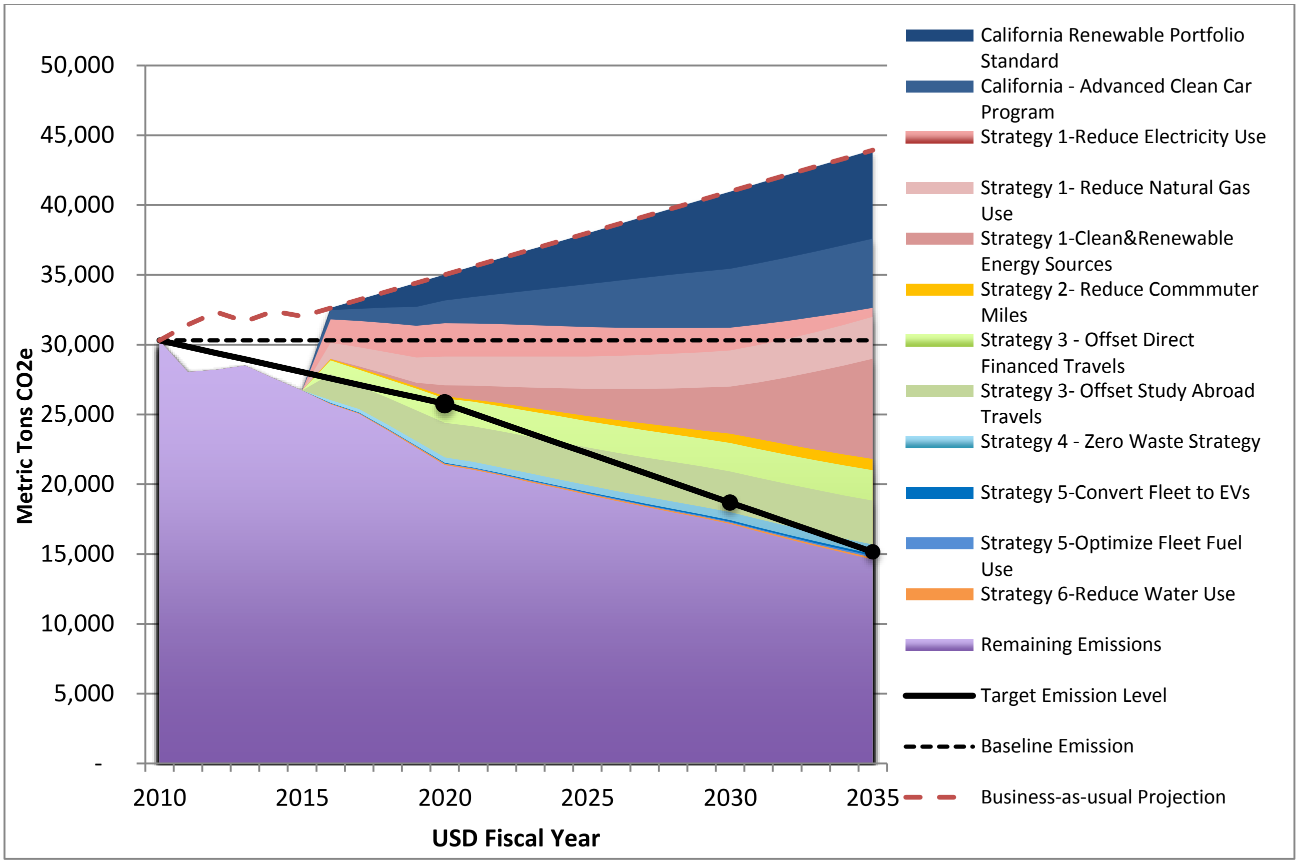

Figure 8 Target Emission Levels and GHG Emission Reduction Strategies in USD CAP

The projected BAU emissions are represented by the red dash line along the top of the graph. From 2011 to 2015, the actual emissions calculated in the inventory section is different from the projected emissions from the projected BAU emissions from 2011 to 2015. The purple wedge at the bottom represents the emissions remaining after all the mitigation strategies that is used to compare with the target emission level. Table 19 gives a detailed summary of targets and projected GHG emission reductions from statewide policies and each USD CAP strategy and goal.

Table 19 Summary of Target and GHG Emission Reductions by Strategy and Goal in USD CAP

Strategy and Policy	Targets			Emission Reduction (MT CO2e)		
	2020	2030	2035	2020	2030	2035
Strategy 1: Increase energy efficiency and clean & renewable energy sources				**5,226**	**7,588**	**10,817**
Reduce projected electricity use by %	25%	30%	35%	2,395	1,632	643
Reduce projected natural gas use by %	30%	33%	35%	2,048	2,596	2,999
Increase on-campus renewable and clean energy production	6.5%	10%	15%	363	1,148	2,095
Purchase additional electricity from renewable sources beyond California RPS	7.5%	20%	40%	419	2,212	5,080
Strategy 2: Increase cleaner and alternative modes of transportation in commuter fleet				**154**	**673**	**815**
Reduce miles driven for commuting by %	2%	10%	12%	154	673	815
Strategy 3: Reduce air travel and offset associated emissions				**4,238**	**4,958**	**5,318**
Offset study abroad travel by %	100%	100%	100%	2,497	2,922	3,134
Offset directly financed air travel by %	100%	100%	100%	1,741	2,036	2,184
Strategy 4: Achieve zero waste in USD operations				**387**	**575**	**682**
Increase solid waste diversion to %	60%	70%	75%	387	575	682
Strategy 5: Increase cleaner and alternative modes of transportation in USD fleet				**60**	**174**	**262**
Reduce projected fossil fuel consumption of USD fleet through optimized use	5%	10%	15%	31	72	116
Reduce projected fossil fuel consumption of USD fleet by increasing clean-fuel vehicle use	5%	15%	20%	29	102	146
Strategy 6: Increase water efficiency in USD operations				**87**	**99**	**127**
Reduce projected water use by %	20%	25%	30%	87	99	127
Reduction from Statewide Policies				**3,479**	**9,744**	**11,301**
Renewable Portfolio Standards (RPS)				1,845	5,529	6,350
California Advanced Clean Cars program				1,634	4,215	4,951
Total Projected GHG Emission Reductions				**13,632**	**23,811**	**29,322**

4.2 Background and Common Assumptions

4.2.1 Common Background Data

Table 20 presents a summary common data used to estimate GHG reductions. All data are BAU projections based on 2010 per student FTE and student FTE population in the target years.

Table 20 Common Business-as-usual projection data for USD CAP

Data Category	2020	2030	2035
Student FTE Population	7,968	9,323	10,000
Electricity Consumption (MWh)	37,630	44,027	47,225
Gross Generation (MWh)	40,202	47,184	50,584
Natural Gas Consumption therms)	1,272,974	1,489,364	1,597,558
Water Consumption (gallons)	123,999,514	145,077,836	155,616,997
USD Fleet Fuel Uuse (gallon gasoline)	64,917	75,953	81,470
Student Commuting (miles)	13,707,450	16,037,540	17,202,585
Employee Commuting (miles)	9,561,351	11,186,657	11,999,311
Study Abroad Travel (miles)	12,268,214	14,353,653	15,396,372
Direct Financed Air Travel (miles)	8,550,457	10,003,925	10,730,659
Solid Waste Generation (tons)	2,702	3,162	3,391

4.2.2 Electricity Emission Factor

Electricity accounts for a significant portion of USD emissions. Determining and emission factor for electricity is an important step in estimating overall GHG emissions.

4.2.2.1 On-Campus Renewable Generation

In the CAP, solar and other on-campus renewable generation are considered as part of overall electricity supply to the campus, rather than a demand reduction. USD owns the renewable energy credits (RECs) of the electricity from solar system, therefore, the electricity is 100% renewable with no associated greenhouse gas emissions. Increase on-campus campus renewable generation will decrease purchased electricity needs from outside suppliers. From 2012-2015, the average electricity generation from the on-campus solar PV system is 1.9 GWh per year. It is assumed that 1.9 GWh will be the projected annual generation over the PV system's useful life. Currently, the existing PV system supplies 6% of USD electricity consumption. To reach the target of increase on-campus renewable energy generation to 10% of consumption by 2020 and 15% by 2035, additional renewable sources other than existing on-campus solar PV systems (including the RECs associated with the renewable sources) are needed.

4.2.2.2 Purchased Electricity from Electric Service Providers (ESPs)

Currently, USD purchases electricity from Noble Americas. The Renewable Portfolio Standards (RPS) requires all California's EPSs, including Nobel Americas, to procure 33% of electricity sales from renewable sources by 2020 and 50% by 2030.[49] In 2014, 19% of Noble America's electricity sales was from renewable sources, the remaining portion was categorized as unspecified. Combining the effects of both supply categories, the weighted emission factor for this electricity supply is 764 lbs CO_2e/MWh. Combining RPS and the CAP target of increasing percentage of renewable content in purchased electricity (Strategy 2), the emission factor for purchased electricity will decrease over time. Table 21 shows how the emission factor for electricity will change as the percentage of renewables increases from the RPS and additional purchases.

[49] California Renewables Portfolio Standard http://www.cpuc.ca.gov/rps_homepage/

Table 21 Renewable Content and Emission Factor for Purchased Electricity

Year	% Renewable required by RPS	% Additional Renewable from CAP target	% total Renewable	Emission Factor for Purchased Electricity (lbs CO_2e/MWh)
2020	33%	7.5%	41%	561
2030	50%	20%	70%	283
2035	50%	40%	90%	94

4.2.2.3 Weighted Average Emission Factor for Electricity

To develop the annual weighted average emission factors for the CAP horizon, both electricity supply categories, on-campus renewable generation and purchased electricity, are weighted based on the percentage of gross generation supplied by each category and the renewable content. Gross generation is the total electricity that is required to be generated to meet the electricity needs from USD, including on-campus electricity consumption, losses in electricity transmission and distribution, and additional electricity needs for on-campus electric vehicle (EV) charging. Each component of gross generation is given in Table 22.

Table 22 Component of Gross Generation for University of San Diego

Year	Electricity Consumption (MWh)	Losses (MWh)	Additional Electricity for EV Charging (MWh)	Gross Generation (MWh)
2020	37,630	2,463	109	40,202
2030	44,027	2,774	384	47,184
2035	47,225	2,810	549	50,584

The percentage of gross generation supplied by each category, the renewable content and the weighted average emission factor are given in Table 23.

Table 23 Weighted Average Emission Factor and Contribution from each Category

Year	Gross Generation supplied by Purchased Electricity	Renewable Content in Purchased Electricity	Gross Generation supplied by On-campus Renewable Generation	Renewable Content in On-campus Renewable Generation	Renewable Content in Gross Generation	Weighted Average Emission Factor (lbs CO_2e /MWh)
2020	94%	41%	6%	100%	44%	525
2030	90%	70%	9%	100%	72%	254
2035	85%	90%	14%	100%	90%	80

4.3 Reduction from Statewide Policies

Two state policies will reduce emissions related to USD operations: California's Renewable Portfolio Standard and the Advanced Clean Cars program. A summary of the methods used to estimate the impact of these on USD GHG emissions is provided below.

4.3.1 California Renewables Portfolio Standard (RPS)

The Renewable Portfolio Standards (RPS) requires all California's ESPs to procure 33% of electricity sales from renewable sources by 2020 and 50% by 2030.[50] It is assumed the 33% RPS requirements being achieved by 2020, 50% RPS being achieved by 2030 and holds constant at 50% through 2035 for all electricity purchased by USD. To calculate the GHG emission reductions from the RPS, the total emission reductions from all policies and strategies that contribute to increase the renewable content of the electricity are estimated first (Table 24). This is done by comparing the baseline emission factor to the new emission factor after assuming renewable measures are implemented. The result yields the total reduction, which then must be allocated to the actions that contributed to this overall reduction.

Table 24 Total Emission Reductions from Increasing Renewable Content in Electricity

Year	Gross Generation (MWh)	2010 Baseline Emission Factor (lbs CO_2e/MWh)	Weighted Average Emission Factor (lbs CO_2e/MWh)	Total Emission Reductions from Increasing Renewable Content (MT CO_2e)
2020	40,202	670	525	2,628
2030	47,184	670	254	8,889
2035	50,584	670	80	13,525

The method to allocate total emission reductions to each policy and strategy that contribute to increase renewable content is based on the percent of renewables in gross generation (Table 3) from each policy or strategy. The higher the percentage, the more emission reductions are allocated. For example, in 2020, 44% of the gross generation is from renewables, of that renewables 70% from RPS requirement, 16% from CAP measure and 14% from on-campus renewable generation. Therefore 70% of the emission reduction from increasing renewable content is allocated to RPS, 1,845 MT CO2e. Table 25 shows the emission reduction from RPS in other target years.

Table 25 Emission Reduction from RPS requirement

Year	Renewable Content in Gross Generation	RPS Requirement for Purchased Electricity	% of Renewable in Gross Generation from RPS requirement	Emission Reductions from RPS requirement (MT CO_2e)
2020	44%	33%	70%	1,845
2030	72%	50%	62%	5,529
2035	90%	50%	47%	6,350

4.3.2 California Advanced Clean Cars (ACC) Program

In 2012, the California Air Resources Board (ARB) approved the Advanced Clean Cars (ACC) program. These new regulations on the new model year 2017-2025 cars seek to reduce the GHG and smog

[50] California Renewables Portfolio Standard http://www.cpuc.ca.gov/rps_homepage/

emissions from California's cars and light-duty trucks.[51] The ACC program includes two elements: 1) the Low Emission Vehicle (LEV) program to regulate fleet average emission rates, and 2) the Zero Emission Vehicle (ZEV) program to promote the use of electric, fuel cell, and plug-in hybrid electric cars.[52]

The latest mobile source emissions model developed by ARB to assess on-road vehicles, EMFAC2014, accounted for the adopted ARB regulations and federal emissions standards, including the above ACC program and 2013 Heavy-Duty GHG Phase 1.[53] The emission rate in gram CO2 per mile for San Diego region in each calendar year to 2035 can be derived from EMFAC2014 and converted to grams of CO2e per mile (g CO2e/mile) using the same method as described above in the Student and Employee Commuting Section 2.3.3.5. Assuming the fleet turnover rate of USD commuter vehicle fleet is the same as that of the San Diego region, the rate of decrease for fleet emission due to ACC program are the same. Similar to cleaner energy measures, to estimate the emissions reductions from cleaner vehicles, it is necessary to compare the projected emission rate and 2010 baseline emission rate, for all the projected student and employee commuter mile. The total emission reduction from ACC program are provided in Table 26.

Table 26 Projected USD Commuter Fleet Emission Rate and Emission Reduction from ACC Program

Year	USD Student Commuter			USD Employee Commuter			Total Emission Reductions from ACC Program (MT CO_2e)
	Projected Commuter Miles	2010 Baseline Emission Rate (g CO_2e/mile)	Projected Emission Rate (g CO_2e/mile)	Projected Commuter Miles	2010 Baseline Emission Rate (g CO_2e/mile)	Projected Emission Rate (g CO_2e/mile)	
2020	13,707,450	401	330	9,561,351	404	335	1,634
2030	16,037,540	401	246	11,186,657	404	249	4,215
2035	17,202,585	401	231	11,999,311	404	235	4,951

4.4 Strategies to Reduce GHG Emissions

4.4.1 Strategy 1: Increase Campus Energy Efficiency and Clean & Renewable Energy Sources

Strategy 1 includes four goals: reduce electricity use, reduce natural gas use, increase on-campus renewable and clean energy production, and purchase electricity with higher than state mandate renewable content. The summary of goals and emission reductions needed to reach those goals are given in Table 27. The reduction target of each goal is the target below the projected amount in the given year. For example, the target is to reduce the projected electricity use in 2020 by 25%. Reaching that target would reduce GHG emissions by MT CO_2e.

[51] The model years 2009-2016 vehicles are covered by "Pavley" regulation. Air Resources Board. Clean Car Standards – Pavley, Assembly Bill 1493. Access Date: 06/21/2016 http://www.arb.ca.gov/cc/ccms/ccms.htm

[52] Air Resources Board. Advanced Clean Cars Summary. Access Date: 06/21/2016 http://www.arb.ca.gov/msprog/clean_cars/acc%20summary-final.pdf

[53] Air Resources Board. EMFAC2015 Volume III – Technical Documentation. V1.0.7 (May 2015) Access Date: 0http://www.arb.ca.gov/msei/downloads/emfac2014/emfac2014-vol3-technical-documentation-052015.pdf

Table 27 Goals and Emission Reductions from Strategy 1: Increase Campus Energy Efficiency and Clean & Renewable Energy Sources

Strategy 1 Goals	Reduction Targets			Emission Reduction (MT CO_2e)		
	2020	2030	2035	2020	2030	2035
Reduce Projected Electricity Use by %	25%	30%	35%	2,395	1,632	643
Reduce Projected Natural Gas Use by %	30%	33%	35%	2,048	2,596	2,999
Increase on-campus renewable and clean energy production	6.5%	10%	15%	363	1,148	2,095
Purchase additional electricity from renewable sources beyond California RPS	7.5%	20%	40%	419	2,212	5,080
Strategy 1 Total	-	-	-	**5,226**	**7,588**	**10,817**

4.4.1.1 Goal 1.1: Reduce Projected Electricity Use

Reducing electricity use can be achieved by campus-wide energy management program, energy audits and performance assessment, and efficiency programs. To calculate emission reductions from this goal, the projected electricity (gross generation) reduction (MWh) is multiplied the weighted average emission factor. The projected electricity use and weighted average emission factor in 2020, 2030 and 2035 are given in Table 22 and Table 23. The emission reductions are given in Table 28.

Table 28 Emission Reductions from Reducing Projected Electricity Use (Goal 1.1)

Year	Electricity Reduction (GWh)	Weighted Average Emission Factor (lbs CO2e/MWh)	Emission Reduction from Goal 1.1 (MT CO_2e)
2020	10	525	2,395
2030	14	254	1,632
2035	18	80	643

4.4.1.2 Goal 1.2: Reduce Projected Natural Gas Use

Similar to reducing projected electricity use, to calculate emission reductions from reducing projected natural gas use, the projected natural gas (million therms) is multiplied the 2013 natural gas emission factor described in the inventory, the latest year with data available. The natural gas use is projected by using the per student FTE natural gas consumption in 2010 (160 therms/student FTE) and the student FTE growth. The projected natural gas use and reduction and emission reductions for 2020, 2030, and 2035 are given in Table 29.

Table 29 Emission Reductions from Reducing Projected Natural Gas Use (Goal 1.2)

Year	Projected Natural Gas Use (MM Therms)	Reduction Target	Natural Gas Reduction from Goal 1.2 (MMTherms)	Natural Gas Emission Factor (MT CO_2e/mmbtu)	Emission Reduction from Goal 1.2 (MT CO_2e)
2020	1.3	30%	0.4	0.054	2,048
2030	1.5	33%	0.5	0.054	2,596
2035	1.6	35%	0.6	0.054	2,999

4.4.1.3 Goal 1.3: Increase On-Campus Renewable and Clean Energy Production

Increasing on-campus renewable and clean energy production can be achieved by installing a fuel cell system using biogas, solar thermal water heating systems, investigating energy storage and other related technologies. The method to calculate emission reductions from an increase in renewable electricity use is described in the state policy section. First a total reduction from the overall change in percentage renewable electricity is estimated and then a proportion is allocated to each related policy based on the percent of renewables of gross generation (Table 23) affected by each policy or strategy. Table 30 shows the emission reduction from increasing on-campus renewable and clean energy production in the target years.

Table 30 Emission Reduction from Increase on-campus renewable and clean energy production

Year	Renewable Content in Gross Generation	Renewable Content from Goal 1.3	% of Renewable in Gross Generation from Goal 1.3	Emission Reductions from Goal 1.3 (MT CO_2e)
2020	44%	100%	14%	363
2030	72%	100%	13%	1,148
2035	90%	100%	15%	2,095

4.4.1.4 Goal 1.4: Purchase Additional Electricity from Renewable Sources beyond California's RPS

Increasing the amount of renewable electricity by USD can be achieved by adopting a policy and procedure for renewable energy procurement and purchasing renewable energy credits. The method to calculate emission reductions is the same as Goal 1.3 (above). Table 31 shows the emission reduction from purchase additional electricity from renewable sources in the target years.

Table 31 Emission Reduction from Purchase Additional Electricity from Renewable Sources

Year	Renewable Content in Gross Generation	% Additional Renewable from Goal 1.4	% of Renewable in Gross Generation from Goal 1.4	Emission Reductions from Goal 1.4 (MT CO_2e)
2020	44%	7.5%	16%	419
2030	72%	20%	25%	2,212
2035	90%	40%	38%	5,080

4.4.2 Strategy 2: Increase Cleaner and Alternative Modes of Transportation (Commuting)

Strategy 2 includes the goal to reduce projected miles driven for commuting by students, faculty, and staff by 2% in 2020 and 12% by 2035. The CAP proposes to achieve these reductions by developing a transportation demand management plan, optimizing permit registration process and parking regulations, and developing programs and initiatives to encourage alternative transportation. The projected commuter miles and emission reduction for students, faculty, and staff commuters are given in Table 32.

Table 32 Projected Commuter Miles and Emission Reduction from Strategy 2

Year	Faculty/Staff		Student		Total Emission Reductions from Strategy 2 ($MT\ CO_2e$)
	Projected Reduction in Miles Driven	Projected Fleet Emission Rate ($g\ CO_2e$/mile)	Projected Reduction in Miles Driven	Projected Fleet Emission Rate ($g\ CO_2e$/mile)	
2020	191,227	335	274,149	330	154
2030	1,118,666	249	1,603,754	246	673
2035	1,439,917	235	2,064,310	231	815

4.4.3 Strategy 3: Reduce Air Travel and Offset Associated Emissions

Strategy 5 includes the goal to offset 100% of USD-related business and educational travel by 2020 and to continue to offset air travel through 2035. The projected emissions for study abroad travel and direct-financed travel are based on the per student FTE miles in baseline year 2010 (1,540 study abroad miles/student FTE and 1,073 direct financed miles/student FTE). The target and amount of offset emissions are presented in Table 33.

Table 33 Strategy 3 and Offset Travel Emissions

Strategy 3 Goals	Offset Targets			Emission Reduction ($MT\ CO_2e$)		
	2020	2030	2035	2020	2030	2035
Offset Study Abroad Travel	100%	100%	100%	2,497	2,922	3,134
Offset Directly Financed Air Travel	100%	100%	100%	1,741	2,036	2,184
Strategy 5 Total	-	-	-	4,238	4,958	5,318

4.4.4 Strategy 4: Achieve Zero Waste in USD Operations

Strategy 4 includes the goal to increase projected solid waste diversion to 60% in 2020, 70% in 2030 and 75% in 2035. USD will conduct waste characteristic audits, implement waste collection procedures on campus, and provide educational programs to achieve the goal. Assuming the waste characteristics are the same as the most recent students, the total waste diverted and emission reductions are given in Table 34.

Table 34 Total Waste diverted and Emission reductions from Strategy 4

Year	Total Waste Diverted (tons)	Total Emission Reductions from Strategy 4 ($MT\ CO_2e$)
2020	619	387
2030	724	575
2035	777	682

4.4.5 Strategy 5: Increase Cleaner and Alternative Modes of Transportation in USD Fleet

Strategy 5 includes two goals: reducing the projected fossil fuel consumption of USD fleet through optimized use and by increasing clean-fuel vehicle use. The summary of goals and emission reductions are given in Table 35.

Table 35 Goals and Emission Reductions from Strategy 5: Increase Use of Cleaner and Alternative Modes of Transportation (USD Fleet)

Strategy 5 Goals	Reduction Targets			Emission Reduction (MT CO_2e)		
	2020	2030	2035	2020	2030	2035
Reduce projected fossil fuel consumption of USD fleet through optimized use	5%	10%	15%	31	72	116
Reduce projected fossil fuel consumption of USD fleet by increase clean-fuel vehicle use	5%	15%	20%	29	102	146
Strategy 3 Total	-	-	-	60	174	262

4.4.5.1 Goal 5.1: Reduce Projected Fossil Fuel Consumption of USD Fleet through Optimized Use

Reducing projected fossil fuel consumption of the USD fleet, including gasoline, diesel and natural gas consumption, can be achieved by developing a vehicle replacement schedule, fuel efficiency guideline for new vehicles, and valuing on-campus travel alternatives. The method to calculate emission reductions from this goal is to multiply the projected saving for each fuel and its emission factor. Table 36 shows the projected fuel savings and emission reduction from optimizing fleet fuel consumption in the target years.

Table 36 Emission Reduction from Projected Fossil Fuel Saving of USD Fleet through Optimized Use

Year	Projected Fossil Fuel Reduction			Total Emission Reductions from Goal 5.1 (MT CO_2e)
	Gasoline (gallons)	Diesel (gallons)	Natural Gas (mmbtu)	
2020	3,246	18	29	31
2030	7,595	42	68	72
2035	12,221	68	109	116

4.4.5.2 Goal 5.2: Reduce Projected Fossil Fuel Consumption of USD Fleet by Increasing Clean-fuel Vehicle Use

Replacing gasoline-fuel vehicles, such as carts and trams, with clean-fuel vehicles, such as electric vehicles, can reduce USD fossil fuel consumption. The method to calculate emission reductions from projected fossil fuel saving is the same as Goal 5.1. Assuming all electric vehicles are charged on campus, the additional electricity load has been added to the campus gross generation (Table 22). Table 37 shows the projected fuel savings and emission reduction from converting to clean fuel vehicles in the target years.

Table 37 Emission Reduction from Projected Fossil Fuel Saving through Increasing Clean-fuel Vehicle Use

Year	Projected Gasoline Reductions (gallons)	Additional Electricity for EV Charging (GWh)	Total Emission Reductions from Goal 5.2 (MT CO_2e)
2020	3,246	0.1	29
2030	11,393	0.4	102
2035	16,294	0.5	146

4.4.6 Strategy 6: Increase Water Efficiency in USD Operations

Reducing water use can be achieved by campus-wide water audits and assessment, water efficiency projects, and investigating water capture opportunities and technologies. To calculate emission reductions from this goal, the lifecycle impact of the water reduction is considered. Reducing domestic water use reduces wastewater generation (downstream emissions). Similar, reducing on-campus water use also reduces the energy used upstream to deliver and treat the water (upstream emissions). Future water use is projected by using the per student FTE water use in 2010 (15,562 gallons/student FTE) and the student FTE growth. The projected water use and reductions and emission reductions for 2020, 2030 and 2035 are given in Table 38.

Table 38 Emission Reductions from Strategy 6: Reducing Projected Water Use

Year	Projected Water Use (million gallons)	Reduction Target	Water Use Reduction from Reduced Water Use (million gallons)	Emission Reduction from Reduced Projected Water Use (MT CO_2e)
2020	124	20%	25	87
2030	145	25%	36	99
2035	156	30%	47	127