University of South Florida St. Petersburg

Greenhouse Gas Baseline - 2014

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Acronyms & Abreviations

ACUPCC- American College and University Presidents' Climate Commitment

AASHE- Association for the Advancement of Sustainability in Higher Education

BAU - business as usual

Btu - British thermal unit

C - carbon

CAFE - corporate average fuel economy

CAP - Climate Action Plan

CERCC- Clean Energy Research Conservation Commission

CH_4 - methane

CO_2 - carbon dioxide

CO_2e - carbon dioxide equivalent

CUP - Central Utility Plant

DEF- Duke Energy Florida

EE - energy efficiency

GHG - greenhouse gas

GSF - gross square foot

HFC - hydrofluorocarbons

kWh - kilowatt-hour

lb - pound

LED - light-emitting diode

LEED - Leadership in Energy and Environmental Design

MWh - megawatt-hour

MPG - miles per gallon

MSW - municipal solid waste

NSF - net square foot

N_2O - nitrous oxide

PV - photovoltaic

RE - renewable energy

SGEF- Student Green Energy Fund

t - metric ton

T&D - transmissions and distribution

TCR - The Climate Registry

TJ - terajoule

USC - University Student Center

USGBC- United States Green Building Council

USFSP- University of South Florida St. Petersburg

VMT - vehicle miles traveled

WTE - waste to energy

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Executive Summary & Overview

Background

On Earth Day, April 22nd 2013, University of South Florida St. Petersburg's Chancellor, Bill Hogarth signed the American College & University Presidents' Climate Commitment (ACUPCC). A part of the commitment is to conduct a Greenhouse Gas (GHG) Inventory and forecast (referred to in the rest of this report as the GHG "baseline"). The GHG baseline provides a campus' carbon footprint in terms of metric tons of carbon dioxide equivalent per year (tCO_2e/yr). The GHG inventory includes emissions from sources owned or controlled by an institution known as Scope 1 emissions, indirect emissions from purchased electricity, steam, heating, and cooling known as Scope 2 emissions, and all other indirect emissions upstream and downstream such as commuting by students, faculty and staff to and from campus known as Scope 3 emissions.


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View of USFSP from Bayboro Harbor

Text of the American College & University Presidents' Climate Commitment

"We, the undersigned presidents and chancellors of colleges and universities, are deeply concerned about the unprecedented scale and speed of global warming and its potential for large-scale, adverse health, social, economic and ecological effects. We recognize the scientific consensus that global warming is real and is largely being caused by humans. We further recognize the need to reduce the global emission of greenhouse gases by 80% by mid-century at the latest, in order to avert the worst impacts of global warming and to reestablish the more stable climatic conditions that have made human progress over the last 10,000 years possible.

While we understand that there might be short-term challenges associated with this effort, we believe that there will be great short-, medium-, and long-term economic, health, social and environmental benefits, including achieving energy independence for the U.S. as quickly as possible.

We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society. These colleges and universities will be providing students with the knowledge and skills needed to address the critical, systemic challenges faced by the world in this new century and enable them to benefit from the economic opportunities that will arise as a result of solutions they develop.

We further believe that colleges and universities that exert leadership in addressing climate change will stabilize and reduce their long-term energy costs, attract excellent students and faculty, attract new sources of funding, and increase the support of alumni and local communities. Accordingly, we commit our institutions to taking the following steps in pursuit of climate neutrality.

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
    - I. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.
    - II. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.
    - III. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:
        - i. A target date for achieving climate neutrality as soon as possible.
        - ii. Interim targets for goals and actions that will lead to climate neutrality.
        - iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
        - iv. Actions to expand research or other efforts necessary to achieve climate neutrality.
        - v. Mechanisms for tracking progress on goals and actions.
2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.

   I. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
   II. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.
   III. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by our institution.
   IV. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.
   V. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.
   VI. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where our institution's endowment is invested.
   VII. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.
3. Make the action plan, inventory, and periodic progress reports publicly available by submitting them to the ACUPCC Reporting System for posting and dissemination.

In recognition of the need to build support for this effort among college and university administrations across America, we will encourage other presidents to join this effort and become signatories to this commitment.

Signed,

The Signatories of the American College & University Presidents' Climate Commitment"

CERCC, the Clean Energy Research Conservation Commission, at the University of South Florida St. Petersburg (USFSP) has taken a lead on the inaugural GHG inventory at USFSP along with the Office of Sustainability. The members of CERCC for the spring 2015 semester are as follows:

- Alyssa Winston, Student and CERCC chair
- Carly Chaput, Student
- David Vasquez, Student and Office of Sustainability Intern for Spring 2015
- Dr. Dona Stewart, Environmental Science Professor
- James Scott, Student
- Jennifer Winter, Sustainability Coordinator
- Joe Trubacz, Regional Vice Chancellor for Administrative and Financial Affairs
- John Dickson, Director of Facilities Services
- Todd Waldorf, Student

Since this was the first time that CERCC embarked on such as large task, they decided to hire an expert company to educate them on how to do this project. CERCC hired a consultant company, the Center for Climate Strategies to assist with conducting the inventory and training CERCC on the process for future inventories; Stephen Roe led the Climate for Climate Strategies team. CERCC filed an extension for the inventory, as this first baseline took longer than expected. The extension allowed the Office of Sustainability until May 15, 2015 to finish the greenhouse gas inventory.

The Office of Sustainability was the main team lead for USFSP, with Sustainability Coordinator Jennifer Winter gathering the energy emissions data and David Vasquez leading the campus vehicle data gathering. Student Todd Waldorf along with student Carly Chaput led the waste management data collection; Professor Dr. Stewart led the transportation commuter survey. Michael Leggett, a USFSP student, provided a carbon sequestration study for the trees on the campus.

USFSP History

USF St. Petersburg has a history rich with academic excellence, entrepreneurial spirit and ingenuity. Its founders opened the doors to students on Sept. 5, 1965, and throughout its history this academic cove on Bayboro Harbor has embraced enormous change as Florida's need for higher education intensified. In the late 1990s, lawmakers began the process that would lead to USF St. Petersburg becoming a separately accredited institution within the USF System. That led to a rapid expansion under interim VP/CEO Ralph Wilcox. The Florida Legislature made it official in 2002 with a law creating the University of South Florida St. Petersburg. Since this time, USFSP has not only grown in student population but also in physical size with the addition of property and buildings.

Its first residence hall, RHO (Residence Hall One) broke ground in 2005. In 2006, USFSP was awarded separate accreditation by the Southern Association of College and Schools. In 2009, USFSP built the Science and Technology building (STG) which was the first LEED Certified Gold building in the USF System. In 2012, the second LEED Gold Certified building was added to USFSP; this University Student Center, was to be a multipurpose building with residence halls, a dining area, and public meeting spaces. In the spring of 2015, the construction for the new Kate Tiedemann College of Business started at the site behind the Piano Man building. This building will be completed by the Fall of 2016, and is planned to also be a LEED Gold Certified Building.

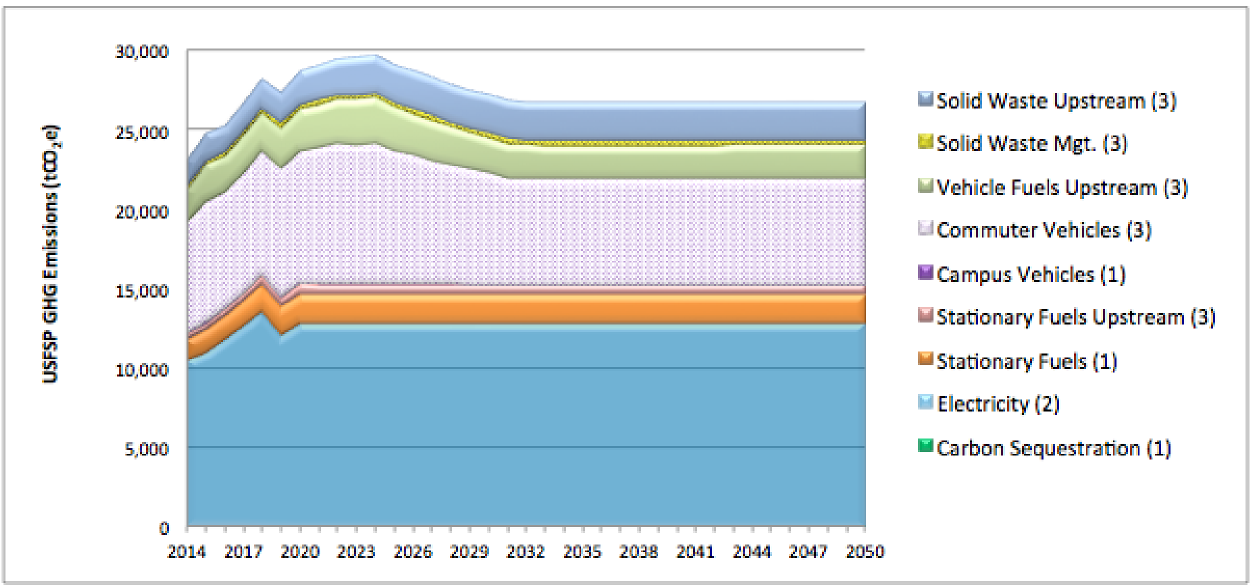
The University of South Florida St. Petersburg also hopes to continue to install electric vehicle charging stations on campus to encourage the purchase and usage of electric vehicles for the entire USFSP community. In the spring of 2015, two additional electric vehicle charging stations were installed with the help of grant dollars from Nissan and Duke Energy Florida, which brings up the total amount of charging stations to four. One of these newly installed stations, is a level three fast charger that will charge an electric vehicle from 0% (empty) to 80%(full) in roughly 30 minutes. All four charging stations are free and open to the public for use of charging electric vehicles.

Historic GHG Inventory & Business as Usual Forecast (GHG Baseline)

The GHG baseline for USFSP was designed to be as inclusive as possible to capture the full GHG emissions implications of the activities employed by the university to carry out its mission. This includes not only the direct operations of buildings and other systems on-site, but also the extension to the ways in which students and staff get to and from school, the sourcing of energy, and the sourcing/management of materials.

Figure ES-1 below provides the complete GHG baseline for USFSP through 2050. Total campus-wide emissions in the 2014 base year were estimated to be 23,070 metric tons of carbon dioxide equivalent emissions (tCO_2e). By 2050, emissions are expected to reach 26,795 tCO_2e. Each source is followed by the applicable reporting Scope. For example, the largest contributor is electricity consumption, which is a Scope 2 source. This means that it is an indirect source of emissions tied to the campus' electricity demand.

Figure ES-1. USFSP GHG Emissions Baseline



Close behind electricity consumption in terms of contribution to the overall footprint is commuter vehicles, which is a Scope 3 source. This is another type of indirect source where the energy demand is not directly tied to the campus, however, USFSP is driving the demand for transportation activity. One could also attach to this value, the associated source, "vehicle fuels upstream", which are the emissions associated with supplying the fuel used by the vehicles commuting to campus.

The solid waste sector is the next largest contributor to the baseline. There are two components and both of these are considered Scope 3, since the waste is not managed by USFSP:

- *solid waste management:* these are the emissions associated with waste transport to each waste management site, waste combustion, and landscape debris management;
- *solid waste upstream:* these are the emissions that are embedded in all the wastes generated at USFSP. Note the much higher contributions here than for the downstream management of waste. This indicates that some focus on waste reduction, re-use and recycling should be included in the campus Climate Action Plan.

Emissions are shown to flatten out in the post-2030 time-frame. This is brought about by two main influences. First and foremost is the assumption that the student body (and supporting faculty/staff) will not grow after 2024 when the Campus Strategic Plan indicates the “10 in 10” goal will be met (10,000 students within 10 years, or by 2024). This limits growth in energy consumption and all other emission driving activities after 2024 (including commuting activity and waste generation). Secondly, the impacts of the Federal vehicle fuel economy standards are expected to work their way through the vehicle fleet by about 2032, so no additional reductions are expected in subsequent years.

Figure ES-2 provides a summary of emissions by reporting scope for the 2014 base year. Only 5% are emissions from Scope 1 sources, which include on-site consumption of fuels for stationary (mainly natural gas) and mobile sources (gasoline and diesel in campus vehicles). Scope 2 sources are all from electricity consumption. The large contribution here points to the need to place significant emphasis on energy efficiency measures and the sourcing of renewable energy in the Climate Action Plan.

Figure ES-2. USFSP 2014 GHG Emissions by Reporting Scope

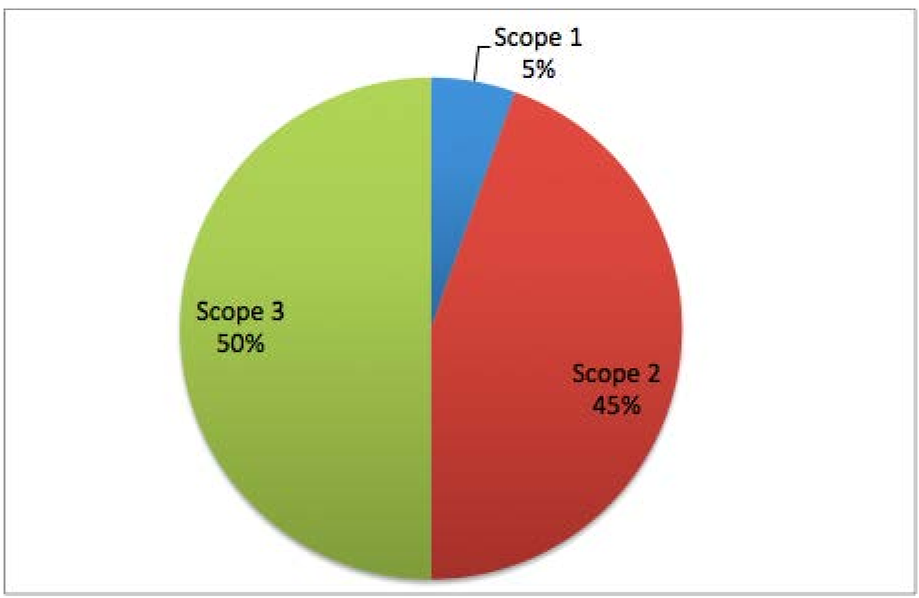
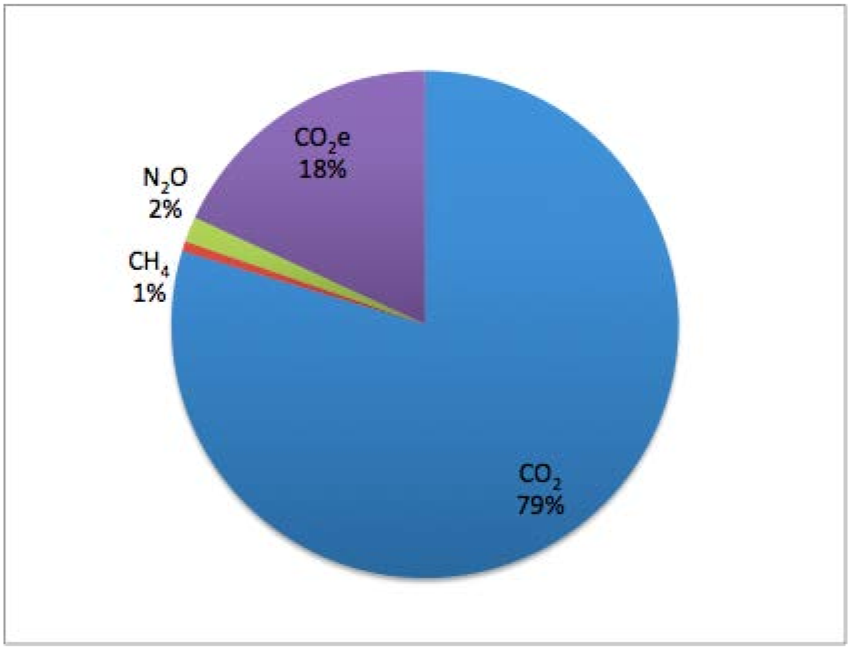


Figure ES-3 provides a summary of 2014 emissions contributions by gas. As is common in most organization reporting, most of the emissions contributions come from carbon dioxide (CO_2) emissions. The wedge labeled “CO_2e” refers to emissions estimates where the total amount could not be broken down by gas; however, most of this wedge will also be made up of CO_2 emissions (CO_2e stands for carbon dioxide equivalent).

Figure ES-3. USFSP 2014 GHG Emissions by GHG



Chapter 1. Energy Supply & Use

Sector Description

This sector addresses GHG emissions associated with both energy supply and consumption at USFSP. For the most part, this sector addresses Scope 2 emissions that are associated with the consumption of electricity purchased from Duke Energy Florida (DEF). However, there is also a small amount of natural gas and diesel consumption that occurs in stationary sources on campus (e.g. laboratories, emergency generators). Also, USFSP will begin operation of a photovoltaic (PV) solar array on top of the roof level at the campus garage in April of 2015. So, tracking of the power generated and consumed from this generation resource is also captured within the electricity consumption GHG emission estimates. The campus operates a number of smaller PV systems that are used for charging portable electronic equipment; however, the amount of power generated is not considered significant enough to quantify and capture within the GHG baseline.

Electricity Consumption

Table 1-1 provides an inventory of USFSP buildings. These include building space occupied by Barnes & Noble and USF Tampa; however, USFSP has included all of this space within its operational control boundaries. The Barnes & Noble space is a small portion of the Fifth Avenue Parking Facility (FPF) which is owned and operated by USFSP. The USF Tampa buildings are metered for electricity via USFSP's primary meter; and these buildings also receive chilled water for HVAC from the USFSP Central Utility Plant (CUP).

Table 1-1 also provides the gross square footage (GSF) and net square footage (NSF) for each building. DEF provided annual electricity consumption data for 2010 - 2014 and also provided monthly data for 2014. From those 2014 consumption and NSF data, an average annual energy intensity was calculated for all buildings except FPF (since consumption in that building is much lower than occupied building space). This value is 30.7 kWh/NSF. A separate value was calculated for FPF (0.07 kWh/NSF), as shown in the table.

From the 2011 USFSP and City of St. Petersburg Campus Development Agreement,[1] the following build-out of additional buildings was anticipated between 2012 and 2020:

- Academic/Research Buildings: 222,050 GSF; 145,464 NSF;
- Support Facilities: 310,267 GSF; 203,255 NSF; and
- Phase II Parking Structure: 110,000 GSF.

[1] *2011 Campus Development Agreement Between the University of South Florida Board of Trustees and the City of St. Petersburg,* signed September 20, 2013.

Figure 1-1. USFSP Campus Map

Table 1-2 provides a summary of the assumed build-out of this space through 2020. For support facilities, the footprint of the University Student Center (USC) was subtracted from the total anticipated additions, since that building was occupied beginning in 2012. All new building area was assumed to be added in equal increments from 2015 through 2020, except for the Phase II Parking Structure, which is assumed to be added in 2020.

All new building additions are presumed to address the additional growth needs of the campus in associated with the “10 in 10” goal. No long term growth goals or plans for the campus were identified. Given the location of the campus and the associated limitations for expansion, no additional structures are included in the forecast after 2020. The NSF value for the Phase II parking structure was estimated from the GSF value provided in the Campus Development Agreement and the ratio of NSF:GSF of the existing parking facility (FPF). All new buildings are assumed to have annual energy intensities equal to the average of existing buildings, as shown in Table 1-2.

Table 1-1. USFSP Buildings Inventory

Building	Prefix	Address	GSF	NSF	2014 Annual Energy Intensity (kWh/NSF)	Occupied
Barnes & Noble	B&N	(Fifth Avenue Parking Facility)	-	-		2006
Bayboro Hall	BAY	200 7th Street South	35,669	18,043		1980
Campus Welcome Center	CWC	501A 2nd Street South	354	275		2004
Center for Ocean Technology	COT	850 East Peninsula Drive	-	4,773		2002
Central Utility Plant	CUP	695 2nd Street South	3,392	67		1980
Children's Research Institute	CRI	400 6th Avenue South	48,352	26,564		1999
Coquina Hall	COQ	785 1st Street South	35,190	20,838		1984
Davis Hall	DAV	140 7th Avenue South	69,738	38,300		1980
Fifth Avenue Parking Facility	FPF	250 5th Avenue South	359,595	353,845	0.07	2006
Grounds	GROUNDS					
Haney Sailing Center	HNY	825 1st Street South	2,372	1,012		1997
Harbor Hall	HBR	1000 3rd Street South	30,472	28,998		2011
Knight Oceanic Reseach Center	KRC	840 East Peninsula Drive	68,821	38,009		1994
Marine Science Lab	MSL	860 East Peninsula Drive	93,588	65,977		1938
Marine Science Warehouse	MSW	865 West Peninsula Drive	13,492	8,367		1983
Nelson Poynter Memorial Library	POY	780 3rd Street South	115,040	48,078		1996
One 5th Avenue South	ONE	100/102/104 5th Avenue South	3,913	2,381		1948
Peter Rudy Wallace Center For Teachers	PRW	599 2nd Street South	23,823	12,474		2000
Piano Man Building	PNM	701 3rd Street South	5,729	3,578		2000
Plant Operations & Receiving	POR	830 1st Street South	8,916	3,578		1984
Residence Hall One	RHO	500 2nd Street South	125,000	80,419		2006
Science & Technology	STG	199 7th Avenue South	34,027	22,564		2009
Snell Historic House	SNL	501 2nd Street South	3,610	2,038		2000
Special Services Building	SVB	547 1st Street South	2,973	1,874		2000
Student Life Center	SLC	131 6th Avenue South	-	35,901		1989
Terrace	TER	100 7th Avenue South	6,440	5,211		2001
University Research Labs	URL	705 3rd Street South	2,882	2,192		2004
University Student Center	USC	200 6th Avenue South	92,770	70,500		2012
Williams Historic House	WMS	511 2nd Street South	4,902	2,679		1990
All Campus Buildings, except Parking Facility			**831,465**	**544,690**	**30.7**	

Table 1-2. USFSP New Buildings Forecast

Building Additions	GSF	NSF	Energy Intensity (kWh/NSF/yr)	Occupied
2015 Additions: Academic/Research	37,008	24,244	30.7	2015
2015 Additions: Support Facilities	36,250	22,126	30.7	2015
2016 Additions: Academic/Research	37,008	24,244	30.7	2016
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2020 Additions: Academic/Research	37,008	24,244	30.7	2020
2020 Additions: Support Facilities	36,250	22,126	30.7	2020
2020 Additions: Phase II Parking Structure	110,000	108,241	0.07	2020
Totals	**549,547**	**386,460**		

Renewable Energy Production

USFSP completed work on a 100 kilowatt (kW) photovoltaic (PV) system on top of FPF early in 2015. The system is located on top of the Fifth Avenue Parking Facility (FPF) and is shown in the top two photos in Figure 1-2 below. The photos at the bottom of the figure show two light-emitting diode (LED) fixtures also at FPF (interior lighting and exterior street/parking lights). The PV system is expected to be generating power at the end of April 2015. Annual production is expected to be 146 megawatt-hours (MWh). The production from the PV system was incorporated into the forecasted campus electricity demand beginning in 2015 (prorated to operating two-thirds of the year). The panels are warranted for 25 years. Degradation in production was assumed to begin in 2016 at a rate of 0.5%/yr.[2]

Carbon Intensity of DEF Power

DEF provided information on their 2014 generation resource mix, as well as expected near-term changes.[3] This information can be summarized as follows:

- Coal: 25% of net generation at a heat rate of 10,100 Btu/kWh;
- Natural Gas: 72% of net generation at a heat rate of 7,000 Btu/kWh;
- Renewables: 3% of net generation (mostly biomass, with small amounts of combined heat & power and PV); for this study, we assume 100% biomass.

By mid-2018, the Crystal River Station will shut down which will shift the resource mix to:

- Coal: 14% of net generation at a heat rate of 10,000 Btu/kWh;
- Natural Gas: 81% of net generation at a heat rate of 6,500 Btu/kWh;
- Renewables: 5% of net generation; again, we assume 100% biomass, since the small contributions from other renewables were not specified.

DEF also provided transmission and distribution (T&D) losses. Losses of 1.5% were reported for transmission, 2.5% for primary voltage delivery, and 6.4% for secondary voltage delivery. Total T&D losses were estimated as the sum of transmission and secondary voltage delivery losses (7.9%). This value could be refined in the future with information on the amount of primary versus secondary voltage power consumed by USFSP.

The carbon intensity of delivered power was calculated from the fraction of net generation for each resource in each year, the heat rate, and the applicable GHG emission factors for CO_2, CH_4, and N_2O. These emission factors by fuel type were taken from The Climate Registry (TCR).[4] For 2010 - 2018, the carbon intensity of power consumed on campus was estimated to be 0.613 tCO_2e/MWh. From 2019 onward, the intensity drops to 0.513 tCO_2e/MWh due to the close down of the Crystal River Station. Note that it is likely that the carbon intensity of grid electricity will change in the future, beyond 2020. For example, the national Clean Power Plan could end up driving more structural change in the DEF energy

[2] Based on a 2012 study by the US Department of Energy's National Renewable Energy Lab: http://www.nrel.gov/docs/fy12osti/51664.pdf.

[3] L. Whitted, Duke Energy Florida, email communication to S. Roe, CCS, 3/11/2015.

[4] The Climate Registry, *General Reporting Protocol*, Default Emission Factors: http://www.theclimateregistry.org/tools-resources/reporting-protocols/general-reporting-protocol/.

mix, which in theory, could lower future carbon intensity. These influences have not been factored into the USFSP forecast.

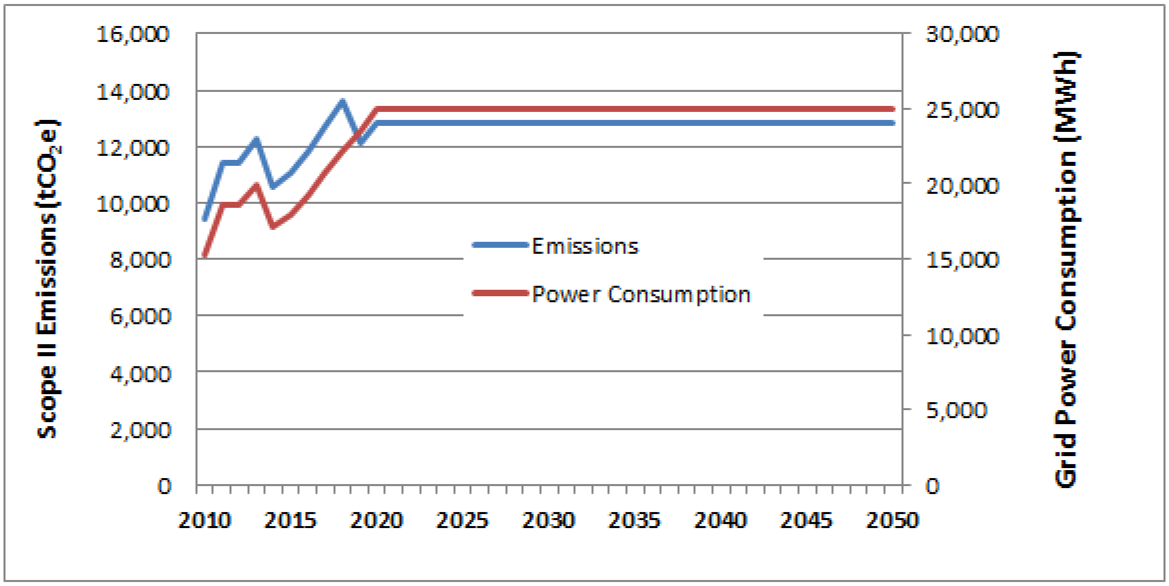
Figure 1-2. USFSP Parking Garage PV System and LED Fixtures

Power Consumption and Scope 2 GHG Emissions

Figure 1-3 provides the historical and forecast grid power consumption estimated for the campus. Consumption and emissions flatten out by 2020 when all new buildings are presumed to be constructed and there are no further changes to building energy intensity. So, it is important to note that, in these initial estimates, the carbon intensity of grid supply and energy intensity of demand remain fixed after 2020. This means, for example, that there are no building energy efficiency measures factored into the BAU forecast.

The emissions shown in Figure 1-3 are considered Scope 2 emissions. They include CO_2, CH_4, and N_2O emissions associated with total campus-wide consumption of electricity from the grid (based on the DEF generation mix). In constructing these estimates, total campus-wide electricity consumption from the grid was derived by subtracting the expected PV system generation from the forecasted buildings demand.

Figure 1-3. USFSP BAU Power Consumption and Scope 2 GHG Emissions



Not included in these totals are any additional upstream GHG emissions associated with the fuel supply of these generation sources (e.g. emissions associated with the extraction, processing, transmission and distribution of natural gas). The emissions of all three GHGs are aggregated into total carbon dioxide equivalents (CO_2e) by applying the global warming potentials (GWPs) from the IPCC's Fifth Assessment Report (AR5)[5] to the mass emissions of each and then summing the results.

Stationary Fuel Consumption and Scope 1 GHG Emissions

Figure 1-4 provides a summary of the historic and BAU forecast stationary fuel consumption for the campus, as well as the associated BAU emissions. Energy consumption is shown in units of terajoules (TJ). GHGs include CO_2, CH_4, and N_2O emissions that are summed into a CO_2e total.

Future Improvements to the ES Sector Baseline

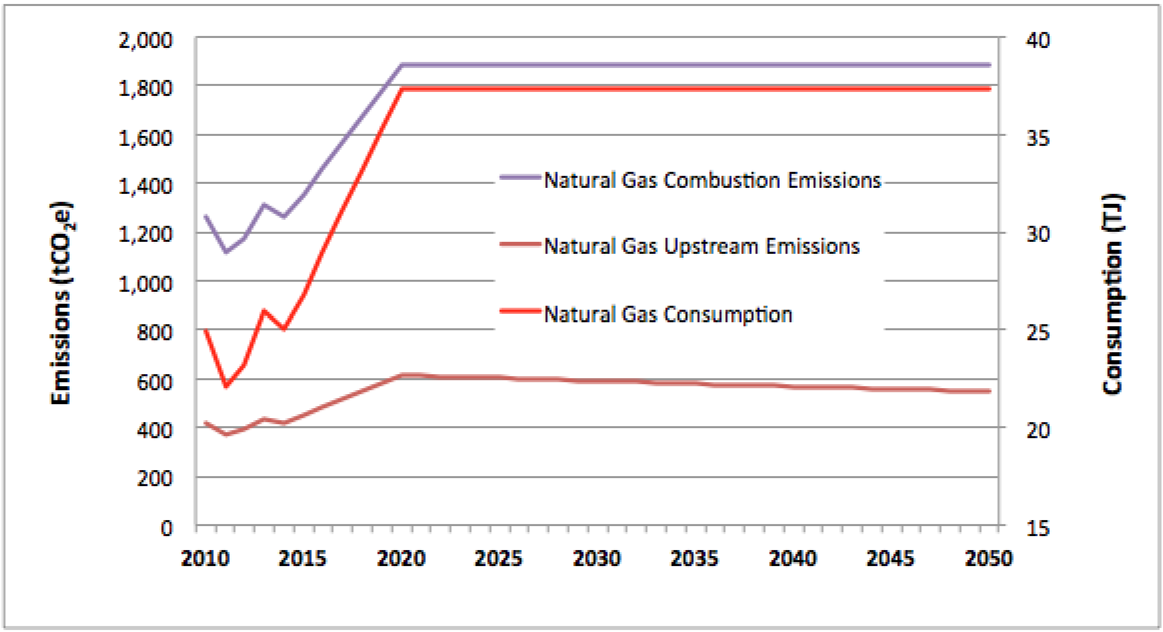
There are three areas that should receive focused attention during future updates to the GHG baseline:

1. *Post-2020 Buildings*: additional input from USFSP planners is needed to better understand the long-term build-out of campus facilities. This includes additional growth beyond the early to mid-2020's to meet expected long-term campus needs (i.e. through 2050). Current estimates presume no additional growth beyond that currently embodied within the Campus Development

[5] IPCC AR5: https://www.ipcc.ch/report/ar5/wg1/.

Agreement with the City of St. Pete. Additionally, for any longer-term additional building needs, an assessment of the energy intensity for these structures should be included (e.g. would any be required to meet specific energy efficiency targets?).

Figure 1-4. USFSP BAU Stationary Fuel Consumption and Scope 1 GHG Emissions and Upstream Scope 3 Emissions



2. *Long-term carbon intensity of grid power:* additional communications with DEF could provide some insight in coming years regarding longer-term plans for regional power supply. For example, Florida's approach to compliance with the national Clean Power Plan could require DEF to further ratchet down carbon intensity before 2030.
3. *Other planned retrofits or upgrades to campus facilities:* of most importance here is any long-term plan for the CUP. Some visioning is needed regarding the mid- to long-term chilled water system and what type of technology is likely to replace the aging CUP, as well as the likely timing of this change.

Recommendations to be included in the Climate Action Plan (CAP) are also expected to affect future GHG baseline updates. For example, metering of building-level power and chilled water consumption will allow the campus to better evaluate energy efficiency (EE) measures at the building level. As well, this higher level of detail in energy consumption will allow for more detailed modeling of future energy consumption at the building level, which is not currently possible.

Chapter 2. Transportation

Sector Description

This sector addresses GHG emissions associated with energy use in campus vehicles, along with the emissions associated with students, professors, and staff commuting to USFSP. Campus vehicles are considered a Scope 1 (direct) emissions source (any Scope 2 electricity consumption by electric campus vehicles, such as golf carts, will be captured within the Electricity Supply & Use sector). Commuting vehicles are considered Scope 3 (indirect) sources. As with any electric campus vehicles, use of power supplied by campus charging facilities to charge commuting vehicles will be captured in the Electricity Supply & Use sector as Scope 2 sources. While charging-related emissions that occur away from campus to charge a commuter's vehicle are not included in this initial GHG baseline, this issue might need to be re-evaluated in future baseline updates as vehicle electrification gains in popularity.

In addition to campus and road vehicles mentioned above, the only other source in this sector is a single power boat. Activity and emissions for this boat are reported along with the campus vehicles below.

Future GHG baseline efforts will also involve gathering data on business travel-related emissions by the campus community (Scope 3). Data gathering procedures are currently being put in place to support GHG baseline development.

Fuel Consumption: Campus Vehicles

Based on the information provided by University of South Florida St. Petersburg, the inventory separates the vehicle and fuel use by departments. These departments are: Police Department, Office of Campus Computing, Campus Recreation, Parking Services, Facilities Services, College of Marine Science, College of Arts and Sciences and Faculty/Research Group Owned.

The fuel use estimates, of every vehicle for the base year 2014, are calculated by the driving mileage of 2014 divided by estimated real world Mileage Per Gallon (MPG).

Fuel Use=Mileage/Real World MPG

Most of the 2014 driving mileage information are from vehicle logs, which are provided by the university. The exception is the information for the Police Department. The university provides a constant yearly driving mileage per vehicle for this department, which is 2500 miles per patrol per year and 250 per ATV per year. In addition, for vehicles with no logs for mileage, the assumption, that each vehicle drives 2500 miles per year, is made.

Meanwhile, the inventory uses the *estimated real world MPG* for each vehicle. Originally, the MPG is the city MPG of each vehicle, and the information is from *Edmunds.com*. The real world MPG is the city

MPG of each vehicle times the *estimated real world MPG factor(0.817)*, which is from the VISION model.

Table 2-1: 2014 Campus Vehicle Fuel Consumption

Department	Model/Make	Fuel (Gallons)	
		Gas	Diesel
Police Dept.	2005 Ford Crown Victoria Interceptor	191.25	
	2011 Ford Crown Victoria Interceptor	191.25	
	2011 Ford Crown Victoria Interceptor 2	191.25	
	2013 Polaris RZR ATV	24.48	
	2014 Ford Explorer Utility	180.00	
	2014 Ford Explorer Utility 2	180.00	
	2015 Ford Explorer Utility	180.00	
Campus Recreation	2013 Chevrolet Silverado Hybrid Crew Cab	153.00	
Office of Campus Computing	2001 GMC Jimmy	180.00	
	2007 Chevrolet Impala	145.71	
Parking Services	2010 Smart Car Model: Pure Coupe	92.73	
College of Marine Science	1995 Ford Taurus	64.14	
	1997 Ford F250	28.38	
	2005 Dodge Ram 1500	191.09	
Faculty/Research Group Owned	1999 Chevy Suburban	218.57	
	2004 Ford F150	204.00	
	2012 GMC Sierra 2500	218.57	
Facilities Services	1997 Chevy S-10	177.90	
	2001 Dodge Ram Truck	81.16	
	2006 Jeep Liberty	98.92	
	2011 Isuzu N Series		23.50
	2002 Chevy Astro Van	180.00	
	2012 Dodge Ram Cargo Van	180.00	
	2012 Vantage	235.38	
College of Art & Science	2006 Jeep Liberty	245.37	
TOTAL:		3833.14	23.50

There are three types of fuel types: gasoline, diesel, and electricity. However, the electric vehicles are excluded as they should be captured in electricity inventories. This means two electric golf carts and the 2011 Wheego electric car are excluded from this inventory. Therefore, campus vehicle fuel use inventory only captures gasoline and diesel use.

Forecast: Campus Vehicles

There are three important assumptions are made for the fuel use forecast.

1. The vehicle fleet grows at the same pace at the university student body growth rate. Based on this assumption, the gasoline and diesel use grows at the same growth rate as the student body growth rate.

2. In 2014, the average age of vehicles is 8 years old (based on the year of vehicle models), and the forecast assumes the vehicle fleet maintains the vehicle age mix. In the forecast, the Fuel

Efficiency Standards for New Vehicles, which are based on the Corporate Average Fuel Economy (CAFE) Standards, are used to forecast the emissions more accurately. As it assumes the average vehicle age is 8 years old, the base year for fuel efficiency vehicle is 2006, and the total amount of fuel use is calculated using the growth rate of fuel efficiency.

3. The logic used was that the overall USFSP owned fleet is, on average, 8 years old. Because we do not have specific information about the University's vehicle-turnover policies for each of its different departments, we assumed that the fleet, as it stands, represents the age mix their turnover policy intends to maintain. Thus we kept the fleet average of 8 years old throughout the forecast.

   We used the fuel-efficiency data for an 8-year-old fleet (i.e. new vehicles bought 8 years prior) for each year of the forecast. This is weighted by the ratio of cars to light trucks in the fleet currently owned by USFSP. We applied to this an assumption that total VMT of the overall USFSP fleet (representing departmental activity levels) would grow in line with population of the student body.

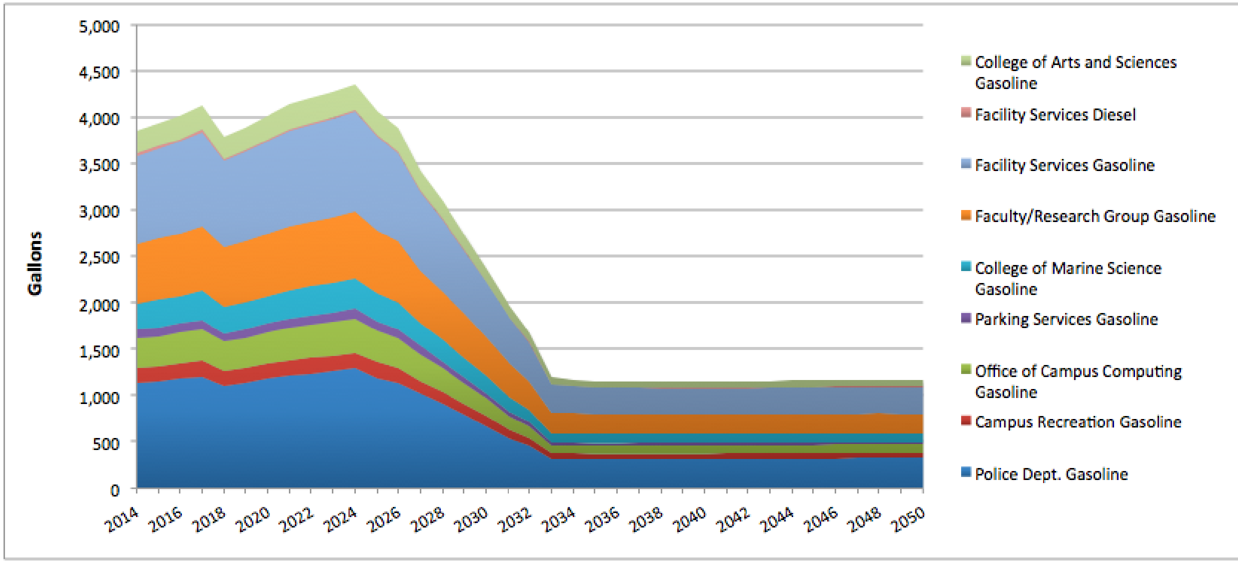
The result shows that despite steady growth in the level of activity, fuel use actually begins to fall rapidly in the period starting in 2018. This is because VMT rises more slowly than MPG, which begins to reflect CAFE standards changes. Both the campus size and the new-vehicle MPG forecasts stabilize in or around 2025. As as higher MPG vehicles become the standard vehicles, the forecast becomes a long flat line in about 2033.

Future refinements or updates of this component could adjust or revise any or all of the assumptions. This analysis made assumptions about the annual mileage for several vehicles for which data was not readily available. This analysis also made a single assumption about the fleet activity levels and vehicle turnover; a more detailed effort might separately analyze the police fleet, which is likely to have a different use profile, fuel-use profile, and turnover program associated with it.

The fraction of fuel use for trucks and cars in each department holds constant. This assumption is used to calculate the fuel efficiency growth rate for each department and each fuel type every year.

The forecast shows the fuel use decreases from 2017 to 2018, but starts to grow again. This is because, according to the fuel efficiency standards for new vehicles, the fuel efficiency growth is more than 10% from 2009 vehicle to 2010 vehicle, while the fuel use only grows 4.29% from 2017 to 2018. Even though the size of vehicle fleet is growing, this major fuel efficiency jump with the vehicle made in 2010 causes the total fuel use decrease in 2018.

Figure 2-1. USFSP Campus Vehicle Fuel Consumption by Department and Fuel



The forecast also predicts that, around the year 2024, the yearly fuel use will start to drop. The explanation is that the university projects the goal of student body expansion to be completed on 2024. This also means, the campus vehicle fleet will stop to grow in 2024. While the fuel efficiency is still growing each year for new vehicles, the total fuel use for all vehicles decrease each year.

In the end, the forecast shows the fuel use holds constant after the year 2033. This is because, the year 2025 marks the end of the CAFE standards and there has not been renewed. Since the forecast assumes the average age of vehicles in the fleet is 8 years old, the end of this regulation will show its effect in the year 2033.

All in all, the conclusion based on the inventory and forecast is, although the size of vehicle fleet will grow with the university expansion, the yearly fuel use will be lower than the fuel use in 2014.

Fuel Consumption: Commuter Vehicles

CCS designed and developed a survey to collect sample data from a representative subset of USFSP students, faculty and other staff regarding their commuting habits. This survey, delivered and taken via an online survey tool, collected data regarding trip distance, trip frequency, trip mode (driving vs. walking, biking or transit use), and any carpooling or ridesharing activity. Further, the survey collected data regarding the type of vehicle used for these trips in order to develop a custom fuel-use and emissions estimate rather than simply defaulting to average assumptions regarding vehicle fuel efficiency.

The survey was distributed, and responses collected, over the course of about three and a half weeks in April and May of 2015. Overall, the survey garnered about 450 responses, of which around 330 were from students, and the rest were from faculty, instructors, and other staff. Almost all responses were complete and largely free of contradictory information or other bases for response invalidation, and the survey was judged to be a successful effort.

For each of the three groups (students, faculty/instructors, and other staff), the commute-related emissions were totaled, with each respondent being assessed commute-related fuel use and emissions that were specifically calculated based upon his or her travel behavior, travel mode and vehicle type. For each group, this total was then scaled up to the total population, relying on the assumption that our subset of responses was a valid random sample of sufficient size to fairly represent the larger population from which it was extracted. The scaled-up volumes of fuel use and emissions for each of the three groups were summed to establish the 2014-15 commuter inventory.

Forecast: Commuter Vehicles

CCS utilized the forecast for student population growth toward the target of 10,000 students in 2024, and assumed proportional growth in the staff and faculty & instructor populations over the same time as well.

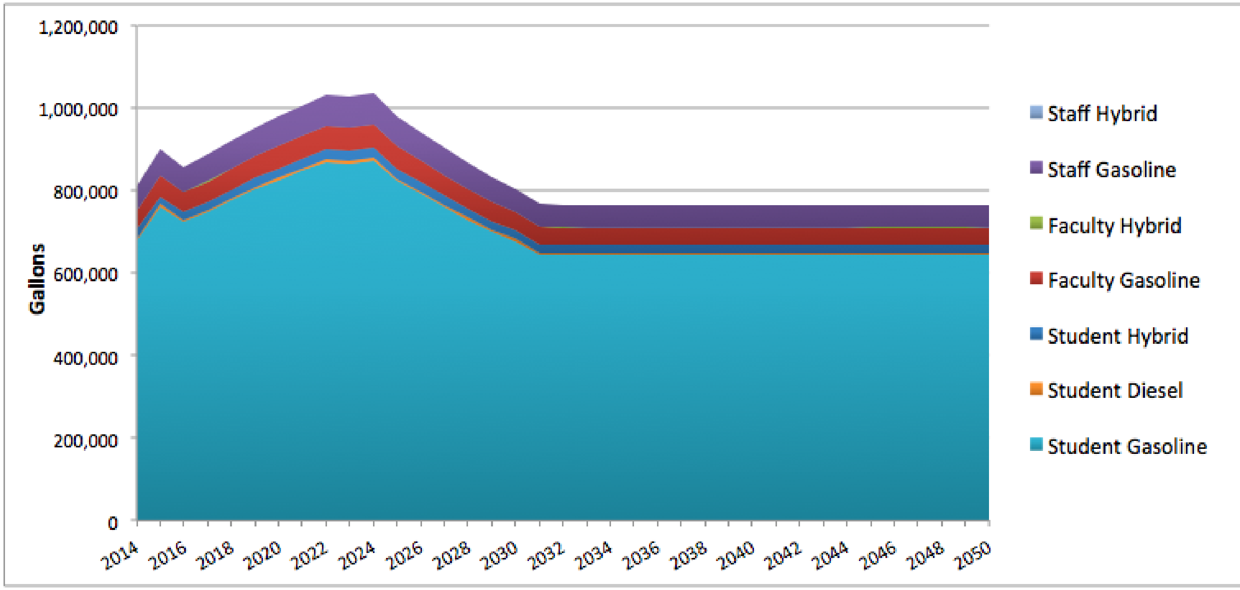
Because students are expected to leave school and be replaced by other students as years pass, we utilized our survey data to create a general profile of student commuting factors that are pertinent to emissions generated. The mix of vehicle types and ages established in the inventory was held constant, and projected to move forward and gradually become more efficient as vehicle standards take hold. The same process was applied to the profile of vehicle and commute activity established for the other two categories, on the assumption that these positions (while not designed to turn over as students do) will nevertheless experience many cycles of turnover between the base year and 2050.

A similar profile of travel distance was established for each of the three groups, and CCS elected to hold the average distance per commuter in each group constant over time. Also, the frequency of trips per person (measured in trips to campus per week) was also held constant over time.

The most central assumption is that the survey respondents constitute a valid random sample of sufficient size to accurately represent the three parts of the university population in question. The survey response pool represented about 7% to 8% of the student body, and approximately 15% to 20% of the faculty, instructors and other staff.

The second set of key assumptions regard the applicability of the profile of survey respondents to future populations of USFSP commuters. This method assumes that commute lengths will not meaningfully change, on average, over time for any of the three groups. It also assumes each group will continue to engage in the same types of trips, utilizing the same types of vehicles, over time, with only the existing regulations on fuel efficiency causing a reduction over time in the emissions intensity of this activity.

Figure 2-2. USFSP Commuter Vehicle Fuel Consumption by User and Fuel



GHG Inventory

Emissions for the Transportation Sector were estimated based on fuel consumption (CO_2) and vehicle miles travelled (CH_4 and N_2O). Combustion emissions factors were taken from The Climate Registry's General Reporting Protocol.[6] Upstream fuel emissions, those associated with production and distribution of fuel, were estimated based on emission factors from the GREET model[7]. The emission estimate results for campus and commuter vehicles are shown in Figures 2-3 and 2-4, respectively. As shown, the vast majority of transportation sector emissions are from commuter vehicles, which are 2 orders of magnitude larger than emissions from campus vehicles.

[6] The Climate Registry, General Reporting Protocol, Default Emission Factors (downloaded 3-22-2010). Table 12.1, http://www.theclimateregistry.org/tools-resources/reporting-protocols/general-reporting-protocol/.

[7] Argonne National Laboratory and U.S. Department of Energy. Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model, https://greet.es.anl.gov/.

Figure 2-3. Campus Vehicle Combustion Scope 1 Emissions and Upstream Scope 3 Emissions

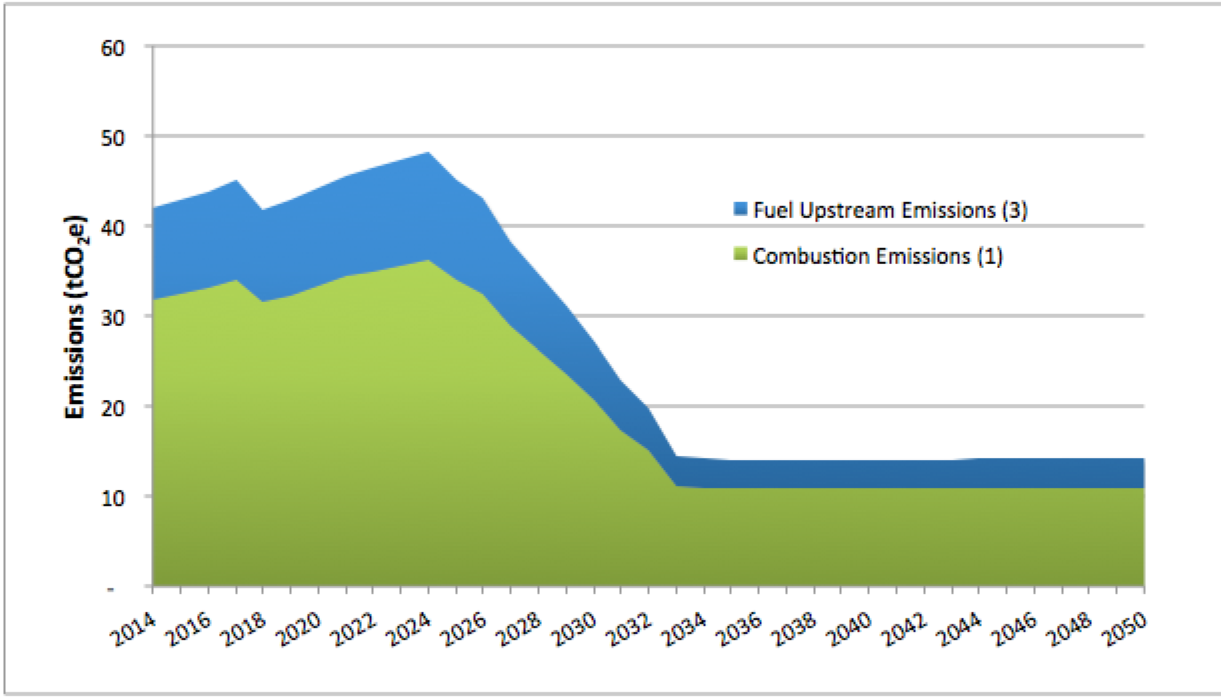
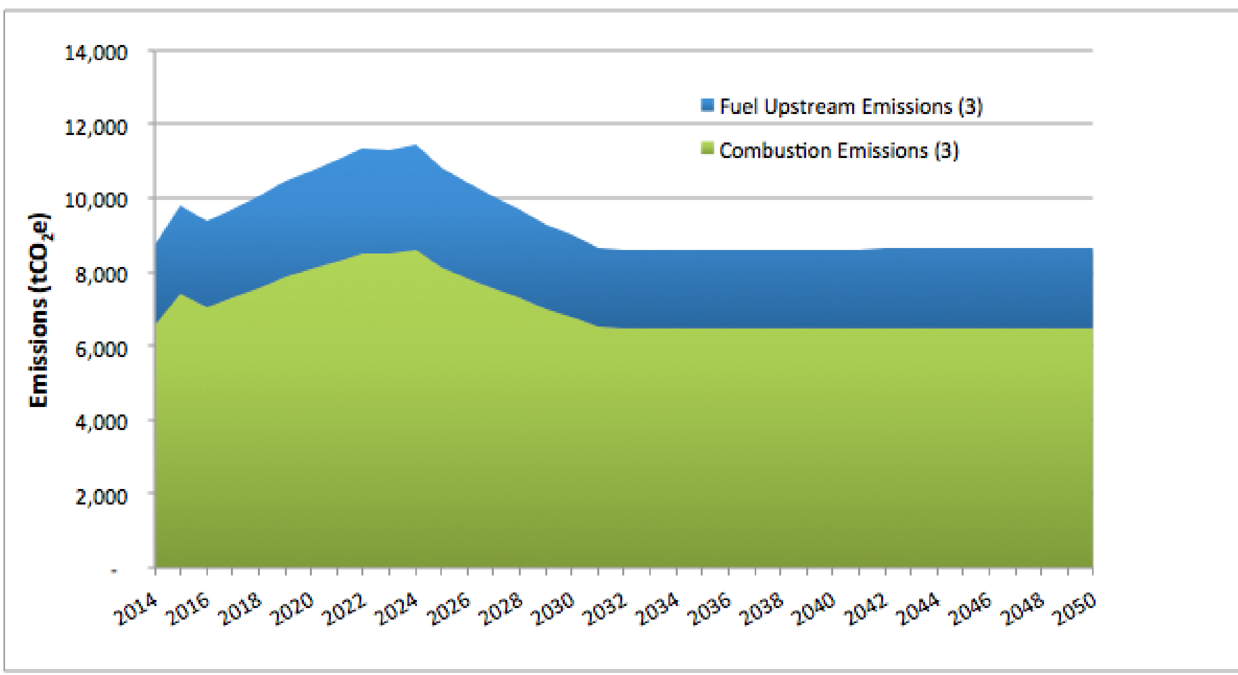


Figure 2-4. Commuter Vehicle Combustion and Upstream Scope 3 Emissions



Future Improvements to the Transportation Sector Baseline

In the future USFSP, hopes to send out an updates survey with the purchase of a parking pass so that more students, staff and faculty can be surveyed on their driving habits. This will be done through a collaboration of the Office of Sustainability along with the Department of Transportation at USFSP. The Office of Sustainability will work with the purchasing department at the University of South Florida in Tampa to get a report on all new vehicles purchased every six months; this will allow the GHG inventory to be up to date with every update. Additionally, CERCC and the Office of Sustainability will work on a tool to gather all mileage logs on a semester basis, to allow plenty of time to analyze it and make recommendations for the next baseline report.

Chapter 3. Waste Management

Sector Description

This sector addresses GHG emissions associated with the generation and management of municipal solid waste (MSW) at USFSP. The accounting approach taken here attempts to more fully characterize the GHG impacts of the full energy-cycle of waste materials, rather than the common approach of only addressing the downstream impacts of how waste is managed (e.g. via waste transport and final management via combustion, landfilling, or composting). Instead, USFSP adopts an approach whereby all waste generation is characterized and both the downstream emissions and upstream emissions are quantified. By using a full energy-cycle emissions accounting approach, the mitigative effects of all waste management activities can be quantified, including reduced generation, re-use, and recycling. Since no waste management emissions occur on-site, all GHG emissions are from Scope 3 sources.

There are 3 solid waste streams at USFSP: recycled waste (paper, plastic, and aluminum placed in recycle containers); campus or “municipal” solid waste (MSW) placed in waste bins around campus; and green waste (landscape debris) generated by campus grounds-keeping staff. Additional descriptions of each of these streams and summaries of data gathered on current generation volumes and characteristics are presented in the subsections below. Data gathered in 2015 are presumed to be consistent with waste generation activity for the 2014 baseline year.

MSW. Pinellas County Solid Waste operates a waste to energy (WTE) plant located adjacent to the county landfill (approximately 11.8 miles from campus). All of the campus MSW is delivered to this facility for use in producing electricity (see Figure 3-1). The WTE plant has a net capacity of 60 MW and burns 3,000 short tons of waste per day. Based on 24 hours of operation, the plant would then produce a net 0.48 MWh/short ton of waste[8].

[8] Note that we don’t assume a credit for renewable electricity produced by the WTE plant from waste provided by USFSP. This is because the emissions from this plant have already been netted into the electricity grid carbon intensity values used to estimate emissions for electricity consumption. So, to add in renewable credits from biomass combustion would be to double count these reductions.

Figure 3-1. Pinellas County Waste to Energy Plant[9]

Scope 3 Emissions

Figure 3-2 shows the Waste Management sector emissions by emissions source and gas (where applicable):

- *Combustion CO_2 (non-biogenic)*: these are emissions associated with the combustion of waste at the Pinellas County WTE. These emissions are only for the combustion of fossil-based CO_2. Emissions of CO_2 from biogenic carbon in the waste material (e.g. paper, cardboard, wood) is considered to be carbon neutral in the USFSP baseline.
- *Combustion N_2O and CH_4:* these are emissions that also occur at the WTE plant; however, unlike CO_2, emissions from all wastes combusted are included.
- *Recycling:* these are the net emissions from waste that is recycled (i.e. emissions avoided).
- *Landscape waste composting (mulching)*: net emissions from chipping and mulching of landscape waste, transport and carbon storage. The overall net is slightly negative; although additional study is warranted to better understand actual chipping/shredding and mulching net emissions.
- *Upstream emissions:* these are emissions associated with the manufacture and transport of each of the waste materials in the MSW and recycled waste streams.

[9] Source: Pinellas County Solid Waste; http://www.pinellascounty.org/solidwaste/contact-us.htm.

Figure 3-2. Waste Management Sector Scope 3 Emissions

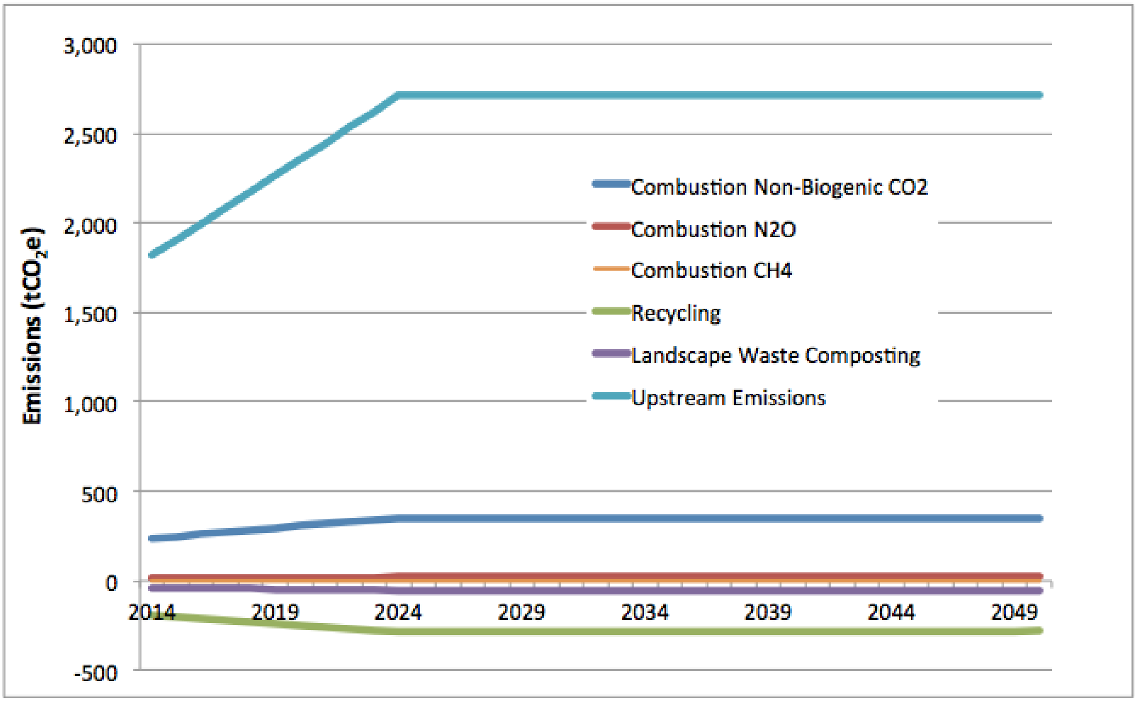
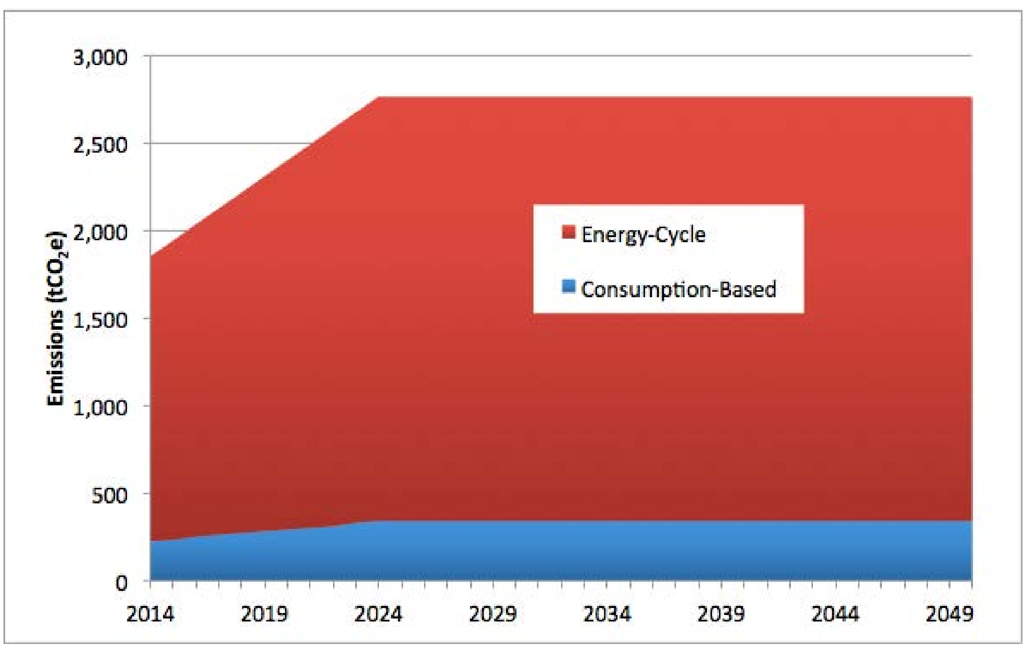


Figure 3-3 shows *energy-cycle* emissions, which include recycling credits and upstream emissions for all of the waste components. The remaining *consumption-based* emissions refer to those associated with downstream waste management, which includes combustion and composting emissions.

Figure 3-3. Waste Management Sector Consumption-Based and Energy-Cycle Emissions



Recycled Waste

The USFSP campus collects recycled waste across the campus in 96 gallon receptacle bins on wheels. These are gathered behind the USC building for collection by the recycling company (Progressive Waste Solutions). Volume measurements were estimated visually on Mondays before pick-ups on Tuesday. Measurements were taken only during the month of March (2015). For the month of March, there were a total of 19.5 paper bins and 20.25 plastic/aluminum bins collected for pick up by the recycling company.

Cardboard is separated from recyclable waste and traded for credit with Progressive Waste Solutions. There are 12-15 bales produced monthly and 20 total during the summer period. The bales weigh approximately 800 lbs each.

To characterize waste in recycling bins, bags were obtained from bins and spread onto a tarpaulin. Four of 100 bins were full on the day of characterization. Three plastic/aluminum bins and one paper bin. Students sorted the waste into plastic, paper, metal (aluminum), and MSW piles and weighed (some examples are shown in Figures 3-4 and 3-5 below). The resulting weight values are shown in Table 3-1.

Plastic may be overestimated based on this characterization because; Bin 1 had 7.8 lbs of reusable plastic bottles from a dance marathon event over the weekend (Figure 3-6). Many of the plastic bottles contained significant amounts of liquid, which was not removed prior to weighing; therefore, the weight of plastic was adjusted to account for the weight of liquid. The plastic weight was estimated to be 50% of the measured value for plastic.

The annual number of cardboard bales was estimated to be 132.5 based on estimates of 12.5 bales per month and 20 bales in the summer session provided by the recycling company. These bales are 800 lbs/bale, resulting in an estimate of 53 tons of cardboard waste in 2015 (2015 values are used as proxy estimates for waste generation in the 2014 base year).

The annual number of collected recycling bins in 2015 was estimated to be 207 paper bins and 215 paper/plastic bins based on the number of bins collected during the month of March. The same ratio of fall/spring to summer waste generation from the cardboard waste data was applied to the recycling bins. The mass of each type of waste (metal, paper, and plastic) was estimated by applying the characterization results in Table 3-1 to the number of bins. The estimated annual mass of recycled waste by waste type for 2015 is shown in Table 3-2.

Emissions for recycling and transport and the upstream stream emissions associated with products in the waste stream were developed using the estimated waste weights and emission factors from EPA's WAste Reduction Model (WARM)[10], shown in Table 3-3. "Upstream" emissions refer to the embedded GHGs within each type of waste material. Using aluminum as an example, these emissions would address aluminum ore mining, smelting, manufacturing into the final product and transport. "Transport" refers to transportation emissions of the recycled material to the recycling facility. "Recycling credit" emissions refers to the net difference in total emissions between those sourced from virgin inputs and those sourced from recycled inputs. Essentially, this factor acts as a credit of emissions avoided for every short ton of

[10] Documentation for Greenhouse Gas Emissions and Energy Factors Used in the Waste Reduction Model (WARM), http://epa.gov/epawaste/conserve/tools/warm/SWMGHGreport.html.

waste recycled. Emission factors from WARM are provided in total CO_2e, so GHG specific estimates for recycling are not possible.

Figure 3-4. Sorted Waste from 96 Gallon Recycling Bins

(Left to Right: Students Todd Waldorf, Alyssa Winston, and Carly Chaput) Photo: Office of Sustainability

Table 3-1. USFSP Campus Recycle Bin Characterization

Waste Class	Recycle Bin 1 (lbs)	Recycle Bin 2 (lbs)	Recycle Bin 3 (lbs)	Average of Bins 1-3 (lbs)	Paper Bin 1 (lbs)
Metal	0.8	0.8	0.8	0.8	
Plastic	28.2	24.2	19.6	12[1]	<.0001
Paper					88.1
Cardboard					<.0001
MSW	4.4	2.2	2	2.87	0.01

[1]12 lbs of plastic estimated from average of 24 lbs of plastic and liquid.

Figure 3-5. Plastic and Aluminum Recycling Waste Sample

Figure 3-6. Plastic Bottles from Dance Marathon Event

Table 3-2. 2015 Estimated Annual Mass of Recycled Waste by Type

Waste Type	Short Tons
Cardboard	53
Paper	9.11
Plastic	1.29
Metal	0.09
MSW in Recycling	0.31
Total	**64**

Table 3-3. Recycled Waste Emission Factors (tCO_2e/short ton waste)

Waste Type	Upstream Emissions	Transport	Recycling Credit
Mixed Metals	3.71	0.03	-4.38
Corrugated Containers	5.59	0.03	-3.12
Mixed Paper (general)	6.75	0.03	-3.53
Mixed Plastics	1.92	0.03	-1.03

The recycling characterization study found a small amount of non-recyclable waste in the recycling bin. This waste is sent to the Pinellas WTE plant by the recycling facility; therefore, this amount of waste was added into the estimates for MSW described below.

MSW Generation at USFSP

The USFSP campus disposes solid waste in 11 dumpsters; of these, 8 dumpsters have a capacity of 8 cubic yards, 2 dumpsters have a capacity of 6 cubic yards and 1 dumpster has a capacity of 2 cubic yards. The dumpsters are at a total of 6 sites (see Table 3-4).

The annual volume of campus MSW was estimated based on an observational study of campus dumpsters conducted from February 22, 2015 to April 1, 2015. Observations on the percent fullness of dumpsters were used to estimate the average volume of waste on collection days. When dumpsters were recorded to be 0% full, it was assumed that the observation had taken place after the dumpster was emptied and not included in the calculation of average volume. Dumpster observations during Spring Break week were used to estimate waste volumes during break weeks, and the ratio of summer to fall/spring enrollment was used to estimate waste volumes during the summer session. The total estimated volume for MSW for 2015 is shown in Table 3-5.

Table 3-4. USFSP Campus MSW Dumpsters

Name (location-bin I.D.)	Data Retrieval Days (after 3pm)	Volume (Cubic Yd)	Building Type
RHO1-C800415	Su-M-Tu-Th	8	Residence Hall
RHO2-C80055S	Su-M-Tu-Th	8	Residence Hall
MSL-I87230	Su-Tu-Th	8	Laboratory

Name (location-bin I.D.)	Data Retrieval Days (after 3pm)	Volume (Cubic Yd)	Building Type
USC-I87322	Su-Th	8	Residence Hall, Student Center
USC-I87507	Su-Th	8	Residence Hall, Student Center
USC-E80087	Su-Th	8	Residence Hall, Student Center
USC-E80074	Su-Th	8	Residence Hall, Student Center
USC-E80089	Su-Th	8	Residence Hall, Student Center
CRI-I62894	M-Th	6	Research Institute
HarbH-E40071	Tu-F	6	Harbor Hall, Arts
BookSt-F30263	Su	2	Bookstore

Table 3-5. 2015 Estimated Volume of MSW Collected from Campus Dumpsters

USC Site	RHO Site	CRI Site	HH Site	MSL Site	Bookstore Site	Total
(cubic yards)						
1,440	1,200	116	193	629	45	3,622

A limited waste characterization study was conducted by sampling waste at 5 of the sites. Samples comprising 25% of the waste from each site on the day of the study were obtained. The waste was spread onto a tarpaulin, and long-armed tongs were used to sort into: plastic, paper, metal (aluminum), compostable material and MSW landfill piles (see Figure 3-7). Each of these was then weighed. The results of the MSW waste characterization are shown in Table 3-6.

Table 3-6. USFSP Campus MSW Dumpster Waste Characterization

Waste Class	USC Site (lb.)	RHO Site (lb.)	CRI Site (lb.)	HH Site (lb.)	MSL Site (lb.)	Bookstore Site (lb.)
Plastic/Aluminum	7	2	2	1.5	NA	3
Compostable	15	3.3	5	2.4	NA	1
Paper	17.6	0.8	4.2	4.8	NA	-

Waste Class	USC Site (lb.)	RHO Site (lb.)	CRI Site (lb.)	HH Site (lb.)	MSL Site (lb.)	Bookstore Site (lb.)
Landfill (plastic bag)	9.8	-	2.8	-	NA	-
Landfill (other)	31.6	14.3	4.4	-	NA	18.7
Total	**81.0**	**20.4**	**18.4**	**8.7**	NA	**22.7**

The waste characterization data shown in Table 3-3 were applied to the annual waste volumes in Table 3-7 using default EPA waste density values.[11] Since no characterization was conducted on waste from the MSL site, the characterization from the CRI site was applied to the MSL site. Plastic and aluminum were not separated in the characterization study, so this portion of waste was assumed to be 75% plastic, 25% aluminum. The estimated total annual mass of waste by waste type is shown in Table 3-7.

Table 3-7. 2015 Estimated Mass of MSW by Waste Type

Waste Type	Short Tons
Plastic/Aluminum	41.2
Compostable	82.5
Paper	73.2
Mixed MSW	219
Total	**416**

[11] EPA, Standard Volume-to-Weight Conversion Factors, http://www.epa.gov/osw/conserve/tools/recmeas/docs/guide_b.pdf.

Figure 3-7. Municipal Solid Waste Characterization Piles

(Left to Right: Todd Waldorf, Jennifer Winter, Carly Chaput, Alyssa Winston, and David Vasquez)

Emissions associated with transport and combustion of MSW and the upstream emissions associated with products that end up in the waste stream were estimated based on emission factors from EPA's WAste

Reduction Model (WARM)[12], shown in Table 3-8. WARM does not include methane emissions, so the methane emission factor for combustion of mixed MSW was taken from EPA's State Inventory Tool (SIT).[13]

Table 3-8. MSW Emission Factors (tCO_2e/short ton waste)

Waste Type	Upstream Emissions	Transport	Combustion		
			Non-biogenic CO_2	N_2O	CH_4
Glass	0.28	0.03			
Mixed Metals	3.71	0.03			
Food Waste	3.66	0.03		0.04	
Mixed Paper (general)	6.75	0.03		0.04	
Mixed Plastics	1.92	0.03	2.33		
PCs	50.8	0.03	0.38		
Mixed MSW	1.06	0.03	0.36	0.04	0.0005[1]

[1]Methane emission factor from EPA's State Inventory Tool (SIT).

Landscape Waste

The amount of landscaping waste was estimated based on trip logs and an estimation of fullness based upon the experience of staff that transport these materials (via prior method of pickup truck bed and current method of trailer hauling). The resulting volume estimates were then used to estimate total mass of landscaping waste. Trailer dimensions are 6x10x3 feet with average load weight of 6,933 lb which assumes an average 80% fill capacity given by staff (total fill capacity of trailer is approximately 8,667 lb). Trip logs were provided for the calendar year of 2014. A total of 238 trips were made during the year (208 by truck bed and 30 by new trailer). The total distance of each trip was approximately 6 miles.

Landscape waste is chipped and then stored to be applied later as mulch. Emission factors for this process are not available, so for this initial baseline, it was assumed that composting emission factors for

[12] Documentation for Greenhouse Gas Emissions and Energy Factors Used in the Waste Reduction Model (WARM), http://epa.gov/epawaste/conserve/tools/warm/SWMGHGreport.html.
[13] EPA State Inventory and Projection Tool, http://epa.gov/statelocalclimate/resources/tool.html.

landscape waste would be reasonable to obtain estimates of the potential size of emissions for mulching. Composting emission factors were taken from EPA's WARM model.

Table 3-9. USFSP Landscaping Waste Data

Date	Method	Weight (lb.)	Distance (mi.)	Total Trips
1/2/14 – 10/19/14	Truck Bed (old)	1,849	6	208
10/20/14 – 12/23/14	Trailer	6,933	6	30

Table 3-10. Composting Emission Factors (tCO_2e/short ton waste)

Material Type	Transportation and Turning of Compost	Fugitive Emissions	Soil Carbon Storage	Net Emissions (Post-Consumer)
Landscape Waste	0.040	0.070	-0.24	-0.12

Waste Generation and Management Forecasts

Waste generation amounts for 2014 were estimated by scaling the waste amounts estimated for 2015 by enrollment values for 2014 and 2015. Similarly, for the forecast years (2016 and beyond), the 2015 waste amount was scaled by the forecasted enrollment from the Campus Enrollment Plan.

Future Improvements to the WM Sector Baseline

There are several uncertainties in the Waste Management sector estimates that could be reduced through improved data collection methods.

MSW Dumpster Monitoring:

- Mark measurement lines on dumpsters so that volume readings are consistent and not dependent on the observer.
- Sample all dumpsters from all 6 sites. In the current inventory, one site was not sampled for characterization, and not all dumpsters were sampled from the other sites. Since, different dumpsters may be receiving waste from different types of buidings (i.e., residence hall vs. classroom building), each dumpster should be sampled.
- Take Friday readings of Harbor Hall MSW bin fullness.

- Resolve the bin outside of the MSL building issue. It is receiving trash from non-USFSP organizations. Consider signage on the bin.
- Review CRI bin. All records show it has been nearly empty during our monitoring. Determine whether the listed collection day is correct. Further, if we do have the correct collection day, where is the remainder of the CRI waste stream going if not in this bin? *Recent updates indicate this site will see more volume in the future as staff is minimal at the time of initial reading.*

Waste characterization studies:

- Separate plastic from aluminum in the next MSW characterization.
- Measure volume, as well as weight.
- Empty liquids from plastic bottles before weighing.

Other:

- Research Strong Waste Stream in grounds-keeping to determine volume and characteristics.

Chapter 4. Miscellaneous Sources

Sector Description

This sector addresses GHG emissions of miscellaneous sources at USFSP that do not fit into the sectors covered in Chapters 1 - 3. For this initial GHG baseline effort, these sources include refrigerants used in campus air conditioning equipment. Other possible sources that will be addressed in future updates to the USFSP baseline include laboratory chemicals or fire suppressants that could include reportable GHGs and nitrous oxide emissions from application of chemical fertilizers.

Use of Refrigerants

The team found that refrigerants are used in the central plant and by individual air conditioning systems around the campus. Additional small amounts would also be present in the air conditioning systems of campus vehicles. No recordkeeping system is currently in place to document any campus purchases of refrigerants or for the amounts of refrigerants re-charged into campus systems by contracted services. Hence, a recommendation from this initial GHG baseline effort is that USFSP sets up internal procedures and data management practices that capture this information by the Sustainability Coordinator.

Future revisions to the GHG baseline could incorporate estimates of refrigerant losses by typical air conditioning systems after an inventory has been completed of the individual systems that contain reportable GHGs. These GHGs are the hydrofluorocarbons that are commonly used in modern systems (e.g. heat pumps). Overall, the team expects that these sources would contribute only small amounts to the overall campus GHG footprint.

Other Sources

Future GHG baseline efforts could also address emissions from the use of nitrogen-containing fertilizers (emissions of N_2O that result from volatilization of ammonia and additional nitrogen entering the soil nitrification/de-nitrification cycle). A full energy-cycle accounting of emissions (as has been done with fuels in this baseline) would also address the GHGs associated with nitrogen fertilizer manufacturing and transport.

GHG Inventory

The USFSP team will develop emissions estimates for this sector in future updates to the GHG baseline.

Chapter 5. Carbon Sequestration

Sector Description

This sector addresses net flux of CO_2 within campus trees (also referred to as carbon sequestration). The trees addressed in this sector are those expected to remain permanently and have the potential to store significant amounts of carbon (i.e. smaller forms of vegetation are not included).

Campus Tree Inventory

The USFSP tree inventory data, hereafter described as the Leggett tree inventory, was a timber cruising analysis designed and implemented by Michael Leggett of USFSP. Leggett divided the USFSP campus into 88 grids, and conducted an inventory of all trees within 5 randomly selected grids. An initial inventory of tree species, tree diameter, above-ground wood volume, and above-ground biomass was conducted on 5 randomly grids.

GHG Inventory

The Leggett tree inventory was used to estimate the number of trees in each of the size classes shown in Table 5-1. The inventory covered 5 of 88 campus grids; therefore, the number of trees in each size category was multiplied by 17.6 (88/5) to produce a campus-wide estimate of the number of trees.

Table 5-1. Number of Campus Trees by Size Class in 2014

Tree Diameter at Breast Height (DBH) (in)	Number of Trees
0-6	53
7-12	352
13-18	563
19-24	141
25-30	53

Tree Diameter at Breast Height (DBH) (in)	Number of Trees
31+	0

Average per tree sequestration rates and storage by size class were developed from data in studies of urban forests in three Florida cities from the University of Florida.[14,15,16] Based on the average sequestration rates and per tree carbon storage, the number of years to reach the next size class and the per year growth in diameter was estimated. This diameter growth rate was applied to the Leggett tree inventory data to develop forecasts in the number of USFSP trees in each size class.

In 2015, 40 and 32 trees were removed during construction at the soccer field and business school sites, respectively. These numbers of trees were subtracted from the total number of campus trees in those years and going forward. These trees were assumed to have the same size distribution as the estimates in Table 5-1. There was a one-time release of carbon from the USFSP forest carbon stock in 2015 from the removal of these trees. For the 32 business school trees, 75% of the wood was stored in durable wood products. It was assumed that no other trees will be removed over the forecast period, since the university has purchased additional property where new construction can happen between existing trees.

Estimates of carbon sequestration by USFSP campus trees was estimated by applying the per tree sequestration rates the number of trees estimated for each size for each year.

Table 5-2. Sequestration and Growth Rates by Size Class

Tree Diameter at Breast Height (DBH) (in)	Per Tree Net Sequestered (C kg/year)	Per Tree C Storage (kg)	Years to reach next DBH class	DBH growth (in/yr)
0-6	2.6	17	23	0.26
7-12	11	174	24	0.25
13-18	16	502	17	0.36

[14] Escobedo, et. al. *Pensacola and Escambia County, Florida's Urban Forests*. School of Forest Resources and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/fr293.

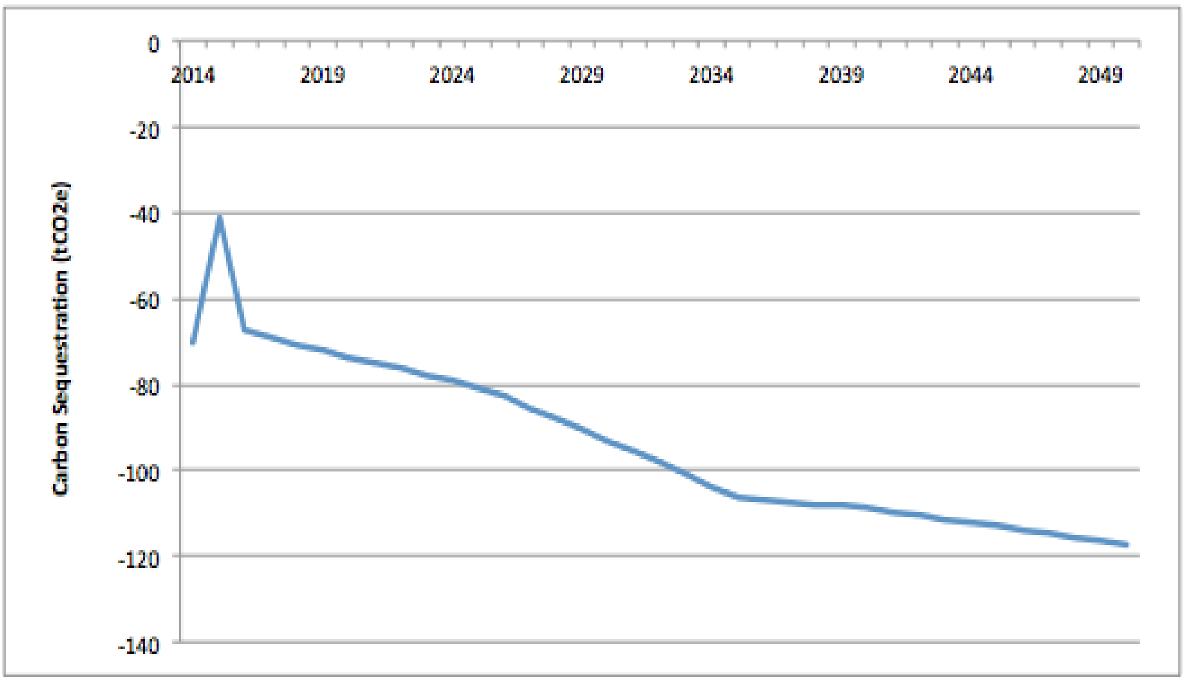
[15] Escobedo, et. al. *Carbon Sequestration and Storage by Gainesville's Urban Forests*. School of Forest Resources and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/fr272.

[16] Escobedo, et. al. *Miami-Dade County's Urban Forest and Their Ecosystem Services*. School of Forest Resources and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/fr347.

Tree Diameter at Breast Height (DBH) (in)	Per Tree Net Sequestered (C kg/year)	Per Tree C Storage (kg)	Years to reach next DBH class	DBH growth (in/yr)
19-24	24	840	38	0.16
25-30	48	2,216	79	0.08
31+	120	8,847		

Carbon sequestration over the forecast period is shown in Figure 5-1. The peak at 2015 is the one-time release of carbon from removal of trees at the business school and soccer field sites. Over time, sequestration increases as trees mature and are able to sequester more carbon.

Figure 5-1. Forest Carbon Sequestration Scope 1 Emissions



Future Improvements to the Carbon Sequestration Baseline

The carbon sequestration estimates could be refined with a second tree inventory. First, the new property recently acquired by the university would be included. Second, if the trees in the same grids are inventoried, sequestration rates specific to USFSP could be calculated.