

SFO Climate Action Plan

Vision: Continue to Mitigate the Total SFO
Controlled Carbon Emission

MARCH 2013



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Airport Director's Message

The Mayor and the Board of Supervisors of the City and County of San Francisco have been in the forefront of the U.S. movement for addressing climate change issues by reducing greenhouse gas emissions. In 2008 as a result of this commitment the Board of Supervisors adopted and the Mayor signed into law Ordinance No. 81-08 Climate Change Goals and Action Plan, which mandates the achievement of the following greenhouse gas (GHG) emission targets by each City Department:

- 25% below the 1990 emission level by 2017
- 40% below the 1990 emission level by 2025
- 80% below the 1990 emission level by 2050

The Airport Commission has vigorously supported the City's climate change initiatives and has established the total mitigation of the carbon footprint of SFO controlled operations by 2015 as an additional goal for the Airport. SFO management developed a Departmental Climate Action Plan (DCAP) in FY 2008 as the blueprint for meeting the Ordinance 81-08 objectives and achieving total mitigation of the carbon footprint of SFO controlled operations. The current revisions to the DCAP incorporate information related to Airport operations in FY 2012, as well as more detailed data for the GHG emissions of airlines, tenants, concessionaires, and from the commute by airport passengers.

In FY 2012 we were able to reduce our gross baseline carbon footprint to 27.8% below the 1990 emission level for Airport controlled operations. In addition we achieved a GHG emission offset equivalent to 5.9% of the 1990 emission level for a total reduction of 33.7%, exceeding the Ordinance No. 88-01 goal of 25% emission reduction from the 1990 base level by 2017. SFO also voluntarily mitigated over 210% of our FY 2012 net carbon footprint by enabling other SFO enterprises to reduce their own GHG emissions. More information on our achievements is provided in this DCAP and is summarized below:

- In 1990 SFO generated an estimated GHG emission of 50,128 metric tons (tons) from operations that were under the control of the Airport Commission. Accordingly, Ordinance No. 81-08 mandates the following maximum future GHG emission levels for SFO:
 - by 2017 not to exceed a GHG emission of 37,596 tons per year,
 - by 2025 not to exceed a GHG emission of 30,077 tons per year, and
 - by 2050 not to exceed a GHG emission of 10,026 tons per year.
- **Emission Reduction Measures.** In FY 2012 the gross GHG emission from SFO controlled operations was 36,170 tons. This emission level was achieved by implementing a number of emission reduction measures which in FY 2012 reduced the GHG emissions at SFO by 16,474 tons, as itemized below:
 - General reduction in the GHG emission factor for electricity supplied by SFPUC to SFO in FY 2012, and implementation of energy efficiency measures resulted in a GHG emission reduction of 9,904 tons in comparison with the corresponding 1990 emission level
 - GHG emission from SFO Fleet declined by 500 tons from the 1990 level due to improved fuel efficiency of the fleet vehicles and the use of alternate fuels which compensated for the rise in the number of vehicles

- Reducing the quantity of landfilled solid waste from 6,000 tons in 1990 to 2,246 tons in FY 2012 reduced the GHG emissions for landfilling operations by 1,843 tons
- Reducing the emission of fugitive refrigerant gases and using more climate friendly refrigerant gases resulted in an emission reduction of 4,227 tons compared to 1990 emission level.

The above emission reductions were balanced by growth induced increases in consumption of energy and various fuels resulting in a net GHG emission reduction of 13,958 tons from 1990 to FY 2012 or a reduction of 27.8%.

- **Emission Offset Measures.** These measures relate to Airport operations or actions that yield a direct reduction in the GHG emissions to the atmosphere. In FY 2012 the following offsets were achieved by SFO:
 - SFO recycled about 77.7% of the general solid waste collected at the Airport yielding an emission offset of 2,827 tons.
 - SFO has planted 2,020 trees of various species around the Airport which sequester about 121 tons of carbon dioxide from the air per year.

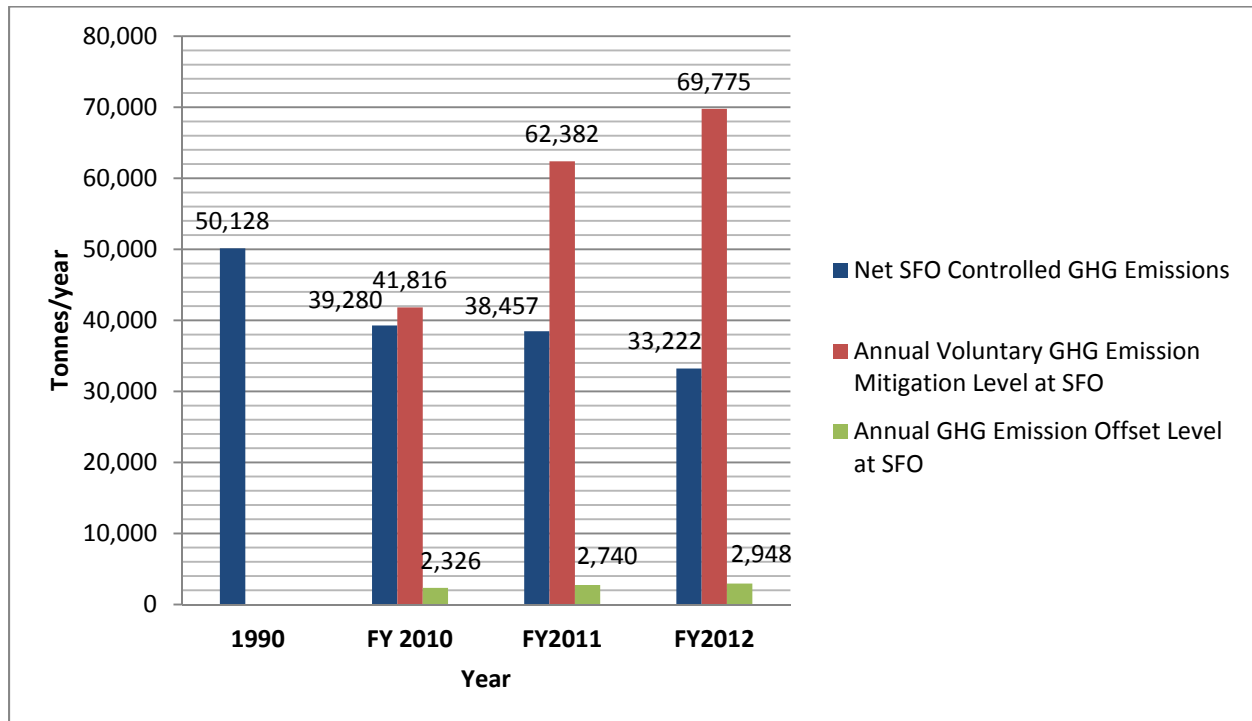
As the result of the above offset measures SFO's Category 1 carbon footprint was reduced by an additional 2,948 tons in FY 2012, thereby yielding an additional 5.9% reduction from the 1990 emission level. The combined emission reduction and offset measures implemented at SFO reduce the GHG emission of SFO controlled operations to 33,222 tons in FY 2012, indicating a reduction of 33.7% from the 1990 emission level.

- **Voluntary Emission Mitigation Measures.** These measures relate to direct or indirect actions taken voluntarily by SFO to reduce the GHG emissions from the operations of airlines, car rental agencies, passengers' travel to and from SFO, etc. We believe that SFO is entitled to claiming the emission mitigation resulting from the expenditure of funds and other resources to enable other entities to save money and reduce their own GHG emissions. In FY 2012 these measures mitigated the GHG emissions at SFO by 69,775 tons or 210% of the net GHG emissions from SFO controlled operations, as itemized below:
 - In FY 2012, the PC Air system mitigated the GHG emissions at SFO by 57,192 tons. The significant increase in the PC Air emission mitigation since FY 2010 was due to the installation of dedicated PC Air units at 12 jet bridges in Boarding Areas C and F and also the installation of 14 PC Air units at the jet bridges during the Terminal 2 renovation. Boarding Area E is currently undergoing renovation and all gates at the renovated Boarding Area will be equipped with PC Air units.
 - In 2009 SFO initiated a three year Green Car Rental Incentive Program (GCRIP) in conjunction with the rental car companies operating at the Airport. This program provided financial incentives to the rental car companies to increase the number of EPA Green cars to 15% of their rental vehicle inventory. The program

also provided a \$15 discount to the customers who rent a Green Car. In FY 2012 the net emission mitigation from the GCRIP was estimated at 8,049 tons.

- SFO provided partial funding for BART extension to SFO which in FY 2012 resulted in a reduction of about 79 million miles of travel by airline passengers based on monthly passenger data provided by BART to SFO staff. SFO shares approximately 9.1% of this mitigation based on the SFO contribution of 200 million dollars to the capital cost for extending BART from Colma to SFO and Millbrae. In FY 2012, it is estimated that BART extension mitigated SFO's GHG emissions by 2,415 tons.
- In 2003 SFO completed the construction of AirTrain which has eliminated the need for the use of shuttle buses by all on-Airport Rental Car Agencies. In FY 2011, the AirTrain system mitigated SFO's GHG emissions by 2,120 tons.

Annual GHG Emissions and GHG Mitigation/Offset Levels at SFO



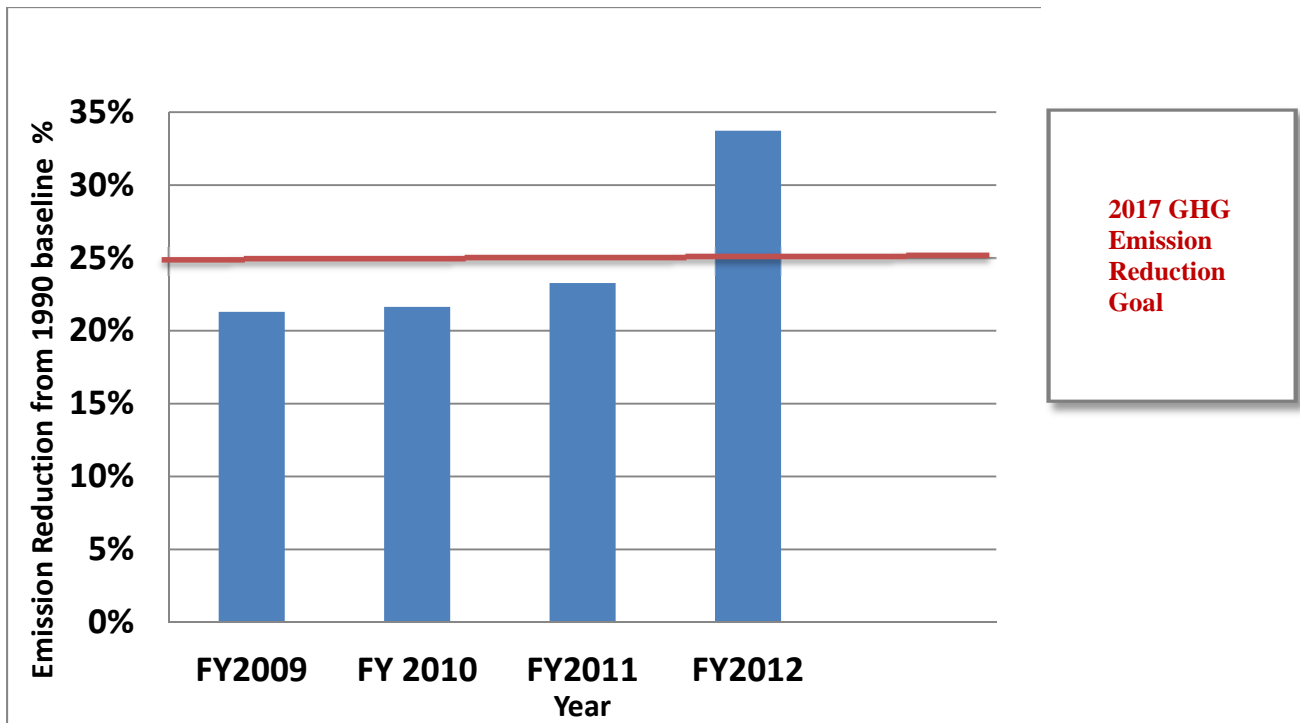
In order to meet Ordinance 88-01 goal of achieving 40% GHG emission reduction by 2025, SFO is currently developing a number of new and expanded GHG emission reduction and offset measures. These planned measures are estimated to yield a combined GHG emission reduction and offset level of 2,165 tons per year by 2017. The planned GHG emission reduction / offset measures include energy efficiency projects, enhanced solid waste recycling, fleet vehicle upgrades, and improved employee commute travel. Additionally, SFO is implementing a number of major facility improvements that would in all probability further improve our energy efficiency.

SFO has also compiled estimated data for GHG emissions from the operations of airlines, airline support services, concessionaires, and other activities at the Airport. Reduction / mitigation of GHG emissions from these operations will be addressed in cooperation with all of the stakeholders as a part of SFO's future climate action initiatives.

John L. Martin

Airport Director

GHG Emission Reduction Levels from 1990 Baseline Emission at SFO



Report Summary

Background

The Board of Supervisors enacted Ordinance No. 81-08 in 2008 entitled Climate Change Goals and Action Plan to establish City greenhouse gas emission (GHG) targets and guidelines for development of departmental climate action plans, and to authorize the Department of Environment (SFE) to coordinate efforts to meet these targets, and to make environmental findings. Ordinance No. 81-08 establishes the following greenhouse gas emission limits for the City and County of San Francisco:

- By 2008, the Commission on the Environment shall determine the 1990 greenhouse gas emission levels within the City and County of San Francisco, including private enterprise activity;
- By 2017, City shall reduce the greenhouse gas emissions by 25% below 1990 levels;
- By 2025, City shall reduce the greenhouse gas emissions by 40% below 1990 levels; and
- By 2050, City shall reduce the greenhouse gas emissions by 80% below 1990 levels.

The Ordinance requires that all City departments shall consider the effect of all decisions and activities within their jurisdiction on greenhouse gas emissions and undertake their responsibilities to the end that the City achieves greenhouse gas emission limits described above.

Section 903 (c) of the Ordinance further states that "On or before January 30, 2009 all City departments shall assess GHG emissions associated with their activities and submit in a format specified by the Department of Environment a written action plan that identifies and makes recommendations on GHG emission reduction / offset measures applicable to:

- Operations of the department and other city greenhouse gas emission sources within its jurisdiction, and
- Private sector greenhouse gas emission sources regulated by the department.

Such plan shall identify potential costs of identified measures and the estimated potential benefits of elements in the plan for reducing greenhouse gases, and may also identify other economic and non-economic impacts to the City's economy and environment."

Section 904 of the Ordinance states that "Beginning at the Close of fiscal year 2008-2009, no later than 90 days after the close of each fiscal year, all City departments shall submit to SFE, in a format specified by the Department of the Environment, a written update of the plans, status of any recommendations required by Section 903, and the GHG emission reductions achieved due to actions taken by the department. Such updates are to provide, to the extent feasible, adequate information to enable the Department of the Environment to calculate the City's progress toward meeting the GHG emission reductions set forth in the Ordinance."

This updated Climate Action Plan for SFO has been developed in the format prescribed by SFE and in compliance with the provisions of Ordinance No. 81-08 of the City and County of San Francisco. A copy of the Climate Change Goals and Action Plan Ordinance is included in Attachment A.

Report Summary

An expanded summary of the first two sections of the Climate Action Plan is provided below, followed by a brief summary of the remaining sections of the Plan.

Section 1. Profile of SFO

San Francisco International Airport (SFO) is Northern California's premiere airport serving hundreds of destinations throughout the United States and abroad. SFO is consistently rated as one of the top airports in the world for the efficiency and quality of service rendered to the travelers.

Located on the shore of San Francisco Bay, 14 miles south of San Francisco, SFO covers approximately 5,200 acres with 2,400 acres developed for Airport use and approximately 2,800 acres remaining as natural tidelands and wetlands. In FY 2012, SFO served 43.1 million passengers with 417,430 takeoffs and landings on 56 airlines. Additionally, 385,113 metric tons of cargo was shipped to and from SFO during the same period. Also, more than 180 vendors operated at SFO to serve the travelers, including restaurants, shops and various services.

SFO is served by the Bay Area Rapid Transit (BART) system and travelers are using BART at an ever increasing rate to travel to and from the Airport. SFO's new AirTrain system provides a seamless connection to BART and rental car facilities for access to all Airport terminals.

SFO is governed by the Airport Commission, a five-member body appointed to four-year terms by the Mayor of San Francisco. The Commission appoints the Airport Director. The Airport personnel are organized in several divisions with each division serving specific needs of the Airport, the travelers, and/or the enterprises operating at SFO.

Section 2. SFO's Carbon Footprint

SFO's carbon footprint can be defined by the following three categories of greenhouse gas (GHG) emissions in the context of Ordinance 81-08 requirements:

Category 1 - SFO Controlled Emissions - GHG emissions from operations that are under the control of SFO, including SFO employees' commute emissions, and emissions from all modes of travel on SFO controlled roads.

Category 2 - Airlines, Concessionaires, and Airline Support Services Emissions - GHG emissions, within the physical boundaries of SFO; by airline operations, including landing and take-off (LTO) cycles; ground service equipment (GSE) and other support services; and by various concessionaires and other tenants.

Category 3 - Optional Emissions - U.S. Environmental Protection Agency (EPA) defines optional emissions as those emissions that are not directly emitted by but are connected with the reporting enterprise's operations. Examples include GHG emissions from: 1) passengers' travel, on public roads or by public transit, to and from SFO, 2) outbound cruising aircraft, 3) delivery trucks, 4) construction equipment, and 5) commute travel by employees of airlines, concessionaires, and airline support services.

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Estimated GHG emissions for the categories listed above are summarized in Table 1. SFO has developed fairly complete and detailed data for Category 1 emissions, whereas some data gaps remain in the estimates of GHG emissions for the remaining two categories.

The focus of the current Climate Action Plan is on the assessment and reduction of Category 1 GHG emissions. Reduction measures for Category 2 and 3 GHG emissions will be evaluated in cooperation with the various stakeholders as a part of SFO's ongoing Environmental Sustainability Program.

Table 1. Summary of Estimated GHG Emissions for 1990 and FY 2010 through FY 2011 at SFO

WRI Emission Category	SFO Emission Category	GHG Emission (Tonnes)			
		1990	FY 2010	FY 2011	FY 2012
Scopes 1, 2, and 3	Category 1- SFO Controlled Emissions	50,128	39,280	38,457	33,222
Scopes 1, 2, and 3	Category 2- Airlines, concessionaires, and Airline Support Services Emissions	839,000	676,169	749,398	898,403
Scope 3	Category 3. Optional Emissions	7,127,543	8,195,369	8,487,665	9,650,529
	Total	8,016,671	8,910,817	9,275,520	10,582,154

Components of Category 1 SFO Controlled GHG Emissions. The net Category 1 GHG emissions in FY 2012 were estimated at 33,222 metric tons indicating a 33.7% reduction from the 1990 baseline and exceeding the 2017 emission reduction goal of 25% established in Ordinance 81-08. The GHG emissions at SFO are generated mainly as the result energy and fuel consumption and to a lesser extent from the release of fugitive refrigerant gases, waste disposal, and wastewater treatment. These emissions reflect the impact of GHG reduction strategies used throughout the year, as well as the impact from offset measures such as solid waste recycling and tree planting at SFO. SFO also mitigates over 220% of its net GHG emissions. The details of GHG emission calculations are provided in Section 2 of this report.

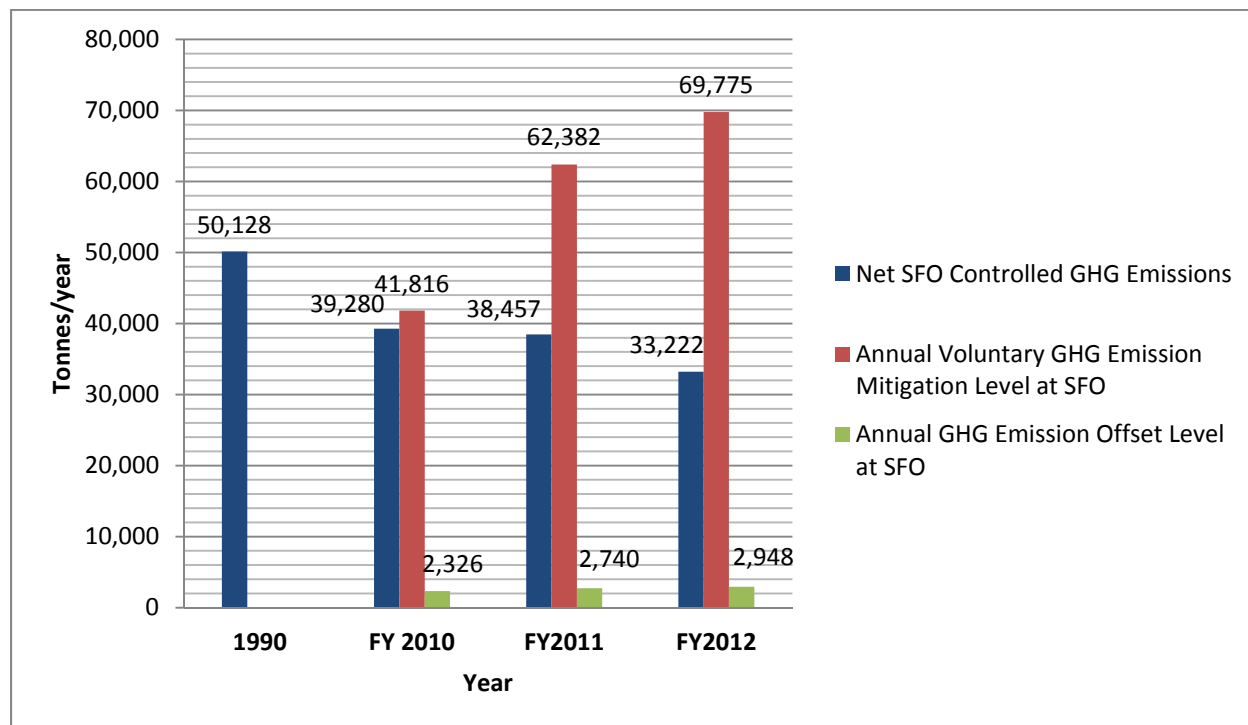
Table 2. Summary of Historical and Current Category 1 GHG Emissions, Emission Offset and Emission Mitigation Levels at SFO

Activity	Category 1 SFO Controlled GHG Emissions (tonnes per year)			
	1990	FY 2010	FY 2011	FY 2012
GHG Emission Levels				
Electric Energy and Natural Gas Consumption^a	29,267	22,478	25,006	19,362
Fuel Consumption^b	13,155	14,513	14,290	14,996
Fugitive Refrigerant Gas Emissions	4,875	3,513	740	649
Solid Waste Disposal	2,596	820	788	753
Wastewater Treatment	235	282	373	410
Total Gross Baseline Category 1 GHG Emission	50,128	41,606	41,196	36,170
GHG Emission Offset Levels				
Solid Waste Recycling Offset	0	-2,205	-2,619	-2,827
Tree Sequestration Offset	0	-121	-121	-121
Total GHG Emission Offsets	0	-2,326	-2,740	-2,948
Net Category 1 GHG Emission	50,128	39,280	38,457	33,222
GHG Emission Mitigation Level				
Total GHG Emission Mitigation	0	-41,817	-62,381	-69,775

^a A GHG emission factor of 0.00 was used for all electric energy consumption at SFO in FY 2012 per California Air Resources Board's designation of SFPUC as a zero GHG emission Electric Utility

^b GHG emission estimates for fuel consumption at SFO for the preceding reporting periods were revised by deducting the SFO Shuttle Bus GHG emissions from the estimated emission for vehicular travel on SFO controlled roads, thereby eliminating the double counting of the Shuttle Bus emissions

Figure 1. Annual GHG Emissions and GHG Mitigation/Offset Levels at SFO



Category 1 GHG Emission Reduction, Offset, and Mitigation (ROM) Measures

SFO has implemented a number of GHG ROM measures in the past several years. Additional emission ROM measures have also been planned for future implementation. The implemented and planned GHG emission ROM measures are summarized below.

Implemented GHG Emission ROM Measures. A number of GHG emission reduction measures have been implemented in the past several years including various energy efficiency measures, fleet vehicle upgrade using hybrid/electric and compressed natural gas (CNG) cars, conversion of buses and trucks to biofuel and CNG, etc. The impacts of these emission reduction measures are indicated in the calculated baseline emission values shown in Table 2. The GHG emission offset and mitigation measures that have been implemented by SFO over the past several years are summarized in Table 3. These data indicate that, in FY 2012, a total GHG emission mitigation of 68,393 tons and a total GHG emission offset of 2,973 tons were generated at SFO, an increase of 12% and 8.5% over the FY 2011 levels, respectively. The mitigation measures included supplying preconditioned air and 400 Htz power to aircraft parked at the gates, providing incentive for rental of green cars, recycling of construction and demolition waste, partial funding for extension of BART to SFO, and construction of AirTrain facility. The offset measures included solid waste recycling and carbon sequestration by SFO landscaping trees. Also even though SFO has deployed 52,000 square feet of photovoltaic panels at the Airport we do not claim an offset or mitigation for the solar power generated by these panels because the funding for the solar power system was provided by San Francisco Public Utilities Commission.

Table 3. Summary of Implemented GHG Emission Mitigation and Offset Measures at SFO

Type of mitigation Measure	Resources Saved			GHG Emission Mitigation or Offset (tonnes per year)		
	FY 2010	FY 2011	FY 2012	FY 2010	FY 2011	FY 2012
GHG Emission Mitigation Measures						
PC Air and 400 Hz Power Supply Installation at International and Domestic Terminals ^a	2,226,413	4,912,280	5,736,092	-21,889	-48,295	-57,192
Green Car Rental Incentive Program ^b	1,224,329	1,118,473	904,787	-11,442	-9,946	-8,049
Construction & Demolition Waste Recycling	13,041	0	0	-4,545	0	0
SFO's Share of GHG Mitigation for BART Extension to SFO ^c	229,753	241,262	267,206	-2,076	-2,180	-2,415
AirTrain Facility ^d	183,856	193,281	208,740	-1,864	-1960	-2,120
Subtotal Emission Mitigation				-41,816	-62,381	-69,775
GHG Emission Offset Measures						
Solid Waste Recycling ^e , tons	19,601	8,339	10,000	-2,205	-2,619	-2,852
Tree Planting Operations ^f	2020	2020	2020	-121	-121	-121
Total GHG Emission Offset				-2,326	-2,740	-2,973

Planned GHG Emission Reduction, Offset, and Mitigation Measures. SFO has planned and developed a number of additional initiatives to further reduce the direct GHG emissions from Airport operations and to offset or mitigate the remaining emissions by reducing the emissions from other sources at or off the Airport. GHG reduction and offset measures are expected to be carried out by 2017 to help

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meet or even exceed the targets established in the City's GHG emission reduction ordinance. The estimated impacts of planned GHG emission ROM measures are summarized in Table 4. The data indicate that about 2,165 tons of GHG emissions per year could be reduced /offset after all of the currently planned measures are implemented.

In addition to these measures, SFO will undertake significant facility improvement projects as described in Section 7. The new facilities would enhance energy efficiency at the Airport and could potentially reduce the baseline GHG emissions. However, the impact of these projects on GHG emissions could not be quantified until the scope of each project is defined in more detail.

Table 4. Summary of Planned GHG Emission Reduction, Offset, and Mitigation Measures at SFO

Activity	Planned GHG Emission Reduction/Offset /Mitigation Measures, tonnes per year
GHG Emission Reduction Measures	
Natural Gas Use Reduction ^a	791
Electric Energy Efficiency Measures ^b	395
Fuel Consumption ^c	754
Subtotal Emission Reductions	1,940
GHG Emission Offset Measures	
Enhanced Solid Waste Recycling ^d	225
Subtotal Offset Measures	225
GHG Emission Mitigation Measures	
PC Air and 400 Hz Power Supply System at B/A E ^e	5,136
Subtotal Mitigation Measures	5,136

^a Based on the Energy Audit Report recommendations

^b Based on the Energy Audit Report's electric energy saving recommendations and completion of airport-wide lighting retrofits

^c Based on scheduled fleet vehicle replacement and enhanced employee commute programs

^d Based on increasing the recycling rate from 75% to 80% by 2017

^e Expected offset generated by PC Air and 400 Hz power supply system at Renovated Boarding Area E.

Projected Category 1 GHG Emissions. Ordinance 81-08 requires the development of estimates for future GHG emissions. In the past, estimates of future GHG emissions at SFO were based on a direct

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correlation to emplaned passenger growth. This approach, however, overestimated future emissions as baseline GHG emissions have remained fairly stable over the past four years. In this report projected GHG emissions for 2017 and 2025 were based on lower bound estimates reflecting the recent past trend in GHG emissions at the Airport. The projections shown in Table 5 indicate that net GHG emission could potentially reach 35,880 tons per year by 2017, assuming the implementation of planned emission reduction/offset measures yielding 2,165 tons of emission savings. It is expected that major new construction and renovation projects, described in Section 7, would also generate some GHG emission reductions. However, assessment of the impact of the planned renovation projects on the overall GHG emissions would require additional details on the scope of these projects. Based on the current projections SFO could be required to implement additional emission reduction/offset measures yielding 7,292 tons by 2025.

Table 5. Projected 2017 and 2025 Category 1 GHG Emission and Emission Reduction Targets for SFO (Tons per Year)

Item	2017	2025
Allowable GHG Emission Level (Ordinance 81-08)	37,596	30,077
Projected GHG Emissions (Lower Bound)	35,880	39,534
Planned Emission Reduction	-1,940	-1,940
Planned Emission Offset	-225	-225
Total GHG Emission Level	33,715	37,369
Required Additional GHG Emission Reduction / Offset Level under Ordinance 81-08	0.00	7,292
Projected GHG Emission Mitigation Measures	-74,911	-74,911

Summary of Other Climate Action Plan Elements

A brief summary of the topics covered in the remaining sections of the Climate Action Plan is provided below:

- Section 3 - SFO Energy Use.** Information on various initiatives for reducing electrical energy and natural gas use at SFO are provided in Section 3 along with a detailed investment grade level estimate of the costs and benefits of energy efficiency measures that would be implemented at SFO over the next several years.

- **Section 4 - Fleet Vehicle Replacement.** Information on fuel consumption level for SFO fleet is provided in this section. The planned fleet improvement program would replace 234 out of the total 354 vehicles over a six year period with new electric and CNG powered vehicles and more energy efficient biodiesel powered vehicles. This program would reduce the GHG emissions from the fleet vehicles by an estimated 528 tons per year.
- **Section 5 – Zero Waste Plan.** Information for SFO's Zero Waste Plan is included in this section. In FY 2012, SFO generated an estimated 10,125 tons of general solid waste, with a recycling rate of 77%. SFO is continuing to enhance the source separation operations with the aim of achieving the City's recycling goals of 80% by 2017 and 100% by 2020.
- **Section 6 – Employee Commute.** Information on SFO Employee commute patterns and transit initiatives are included in this section. The GHG emissions from all modes of commute, by SFO's 1,998 employees, were estimated to be about 2,534 tons in FY 2012.
- **Section 7 – Other Measures.** This section covers the miscellaneous sustainability activities undertaken at SFO as follows:
 - Obtaining LEED GOLD certification for all new construction and major renovation projects
 - Installation of PC Air and 400 Hz power supply facilities at Terminal 2 and at Boarding Areas C, E, and F
 - Implementation of the Pilot Green Car Rental Incentive Program
 - Enhancement of water conservation practice in new and existing buildings.
 - Continued compliance with Precautionary Purchasing Ordinance and Executive Order 08-02 by purchasing the required items from the SF Approved Catalogue to the maximum extent possible.
- **Section 8 – Community-Wide Impacts.** SFO operations and travel by SFO employees, air passengers, taxis, shuttle buses, delivery trucks, BART, Samtrans, etc. to and from the Airport impact the regional and local air quality and contribute to the regional emissions of greenhouse gases. The community-wide impact of SFO operations in the context of GHG emissions are summarized in this section.
- **Section 9 – Measuring Progress.** The vision of SFO is to mitigate its carbon footprint by employing environmentally sound and economic measures. As discussed in this section, SFO has instituted a systematic approach for assessing the GHG emission rates and for quantifying the impact of the various planned emission reduction / offset / mitigation measures.

1. SFO's Profile

Summary

San Francisco International Airport (SFO) is Northern California's premiere airport serving hundreds of destinations throughout the United States and abroad. SFO is consistently rated as one of the top airports in the world for the efficiency and quality of service rendered to the travelers.

Located on the San Francisco Bay, 14 miles south of San Francisco, SFO covers approximately 5,200 acres with 2,700 acres developed for Airport use and approximately 2,500 acres remaining as natural tidelands and wetlands. In FY 2012, SFO served 43.1 million passengers with 417,430 takeoffs and landings on 56 airlines. Additionally, 385,113 metric tons of cargo was shipped to and from SFO during the same period. Also, more than 180 vendors operated at SFO to serve the travelers, including restaurants, shops and various services.

SFO is served by Bay Area Rapid Transit (BART) system and in FY 2012 travelers avoided over 79 million miles of driving by using BART to travel to and from the Airport. SFO's new AirTrain system provides a seamless connection to BART and to rental car facilities for access to all Airport terminals.

SFO is governed by an Airport Commission, a five-member body appointed to four-year terms by the Mayor of San Francisco. The Commission appoints the Airport Director. The Airport personnel are organized in several divisions with each division serving specific needs of the Airport, the travelers, and/or the enterprises operating at SFO.

SFO's Environmental Goals

SFO's Strategic Plan for 2011-2016 establishes the following environmental sustainability goals and objectives:

1. Maintain 100% carbon mitigation and achieve 25% reduction in baseline GHG emissions, below 1990 emission level, from SFO – controlled operations by 2017
2. Achieve LEED Gold certification in all new and renovated buildings.
3. Increase the solid waste recycling rate to 80% by 2015
4. Reduce energy usage year over year
5. Devise and implement other sustainability initiatives.

Airport Operations

There are two major types of operations at SFO i.e. landside operations and airside operations. Both of these operations are carried out within the following organizational structure at SFO:

- Airport Director
 - Business & Finance
 - Communications & Marketing
 - Government Affairs & Sustainability
- Chief Operating Officer
 - Administration
 - Operations & Security

SFO's Profile

- Airport Development & Technology
- Maintenance
- Airport and Environmental Planning
- Museums

Tenant Operations

Airport tenants are classified into the following categories:

- Airlines
- Aviation Support
- Concessionaires
- Federal Government Agencies
- State and Local Government Agencies

Airlines

In FY 2012 fifty six airlines, including domestic and foreign flag airlines and cargo carriers, used SFO as a base of operations. United Airlines is the anchor airline at SFO and operates a major aircraft maintenance and repair facility at the Airport. American Airlines also operates maintenance and repair facilities at SFO.

Aviation Support Services

Tenants providing aviation support services range from aircraft fueling operations to in-flight food services. The major categories of aviation support services at SFO are listed below:

- Aircraft Fuel Suppliers
- Air Cargo Services
- Ground Logistics
- Aircraft Maintenance
- In-Flight Food Services
- Security Services

Concessionaires

Various concessionaires operate in the Airport terminals providing food services, merchandise, gift shops and other conveniences to the travelling public.

Federal Government Agencies

Several Federal government agencies, including the Federal Aviation Administration, Department of Homeland Security, Transportation Security Administration, U.S. Postal Service, US Department of Agriculture and U.S. Department of Justice maintain offices and facilities at SFO.

Local Government Agencies

The Bay Area Rapid Transit (BART) system operates train transportation services to the Airport and City College of San Francisco operates an aviation services campus at SFO. San Mateo County also maintains offices at SFO.

Land Use

Land uses at SFO are broadly categorized as either airside or landside facilities. Airside facilities consist of approximately 1,700 acres of runways, taxiways, and ramp systems. Landside facilities consist of approximately 1,000 acres and are divided into the following functional classes: terminal complex; airport administration; offices and facilities complex; non-terminal airline support; airline support; airline maintenance; general aviation; air freight; airport transport; commercial; transportation; miscellaneous facilities; parking facilities; and roads.

Airside Land Uses

SFO maintains four intersecting runways: two parallel east-west runways and two parallel north-south runways. All four runways are 200 feet wide. The east-west runway 28R/10L is 11,870 feet long; its parallel Runway 28L/10R is 10,600 feet long. The north-south Runway 1R/19L is 9,500 feet long; its parallel Runway 1L/19R is 7,100 feet long. The majority of aircraft landings occur on Runways 28R/28L and the majority of takeoffs occur from Runways 1R/1L.

Landside Land Uses

Prior to 2001, the passenger terminals covered approximately 6 million square feet. In 2000, SFO completed construction of its Master Plan that added more than 5 million square feet of new landside improvements including a new International Terminal, two new boarding areas, a new people-mover (AirTrain) (2003), a new BART station, a new rental car facility, three new parking garages, various other office/administrative buildings, airline maintenance and services support, and air cargo facilities, as well as major roadway, and other transportation related improvements.

Other Airport facilities support public service functions and airport operations. These facilities include airport administration, airport engineering buildings, maintenance facilities, utilities, emergency response facilities, Airport Police Bureau and Fire Department facilities, aircraft fuel tank farms, as well as commercial enterprises and rental car facilities.

Activity Levels

Airport activity levels can be measured by a number of parameters such as aircraft operations, annual passenger count, and annual cargo shipments. The number of Airport and private enterprise employees is another indication of the activity level.

Aircraft Operations, Passenger Activity Levels and Cargo Shipment

In 1997, aircraft operations (aircraft landings and takeoffs) peaked at SFO at 447,000 and remained fairly stable for the following four years, Figure 1-1. The number of operations dropped to as low as 298,000 after the events of September 11, 2001 but recovered in subsequent years. In FY 2012 there were 417,430 flight operations at SFO.

The number of passengers flying to or from SFO peaked at 40.3 million in 2000 and then declined to 28.8 million in 2003. In FY 2012 the passenger traffic at SFO rose up to 43.1 million, as shown in Figure 1-2. Aircraft load factors have continued to increase in response to high fuel costs and other economic factors, and most airlines are flying their aircrafts at the highest historical load factors.

Cargo shipments at SFO peaked at 853,000 metric tons in 2000 and have ranged near 400,000 metric tons in recent years, Figure 1-3. In FY 2012 cargo shipments declined further to 385,113 tons, reflecting the continual impact of the current economic recession.

In 1990 SFO handled 29,939,835 passengers and 558,078 metric tons of cargo with 427,475 aircraft operations (SFO Master Plan, Final Environmental Impact Report, May 1992).

Figure 1-1. Annual Number of Flight Operations at SFO (in thousands)

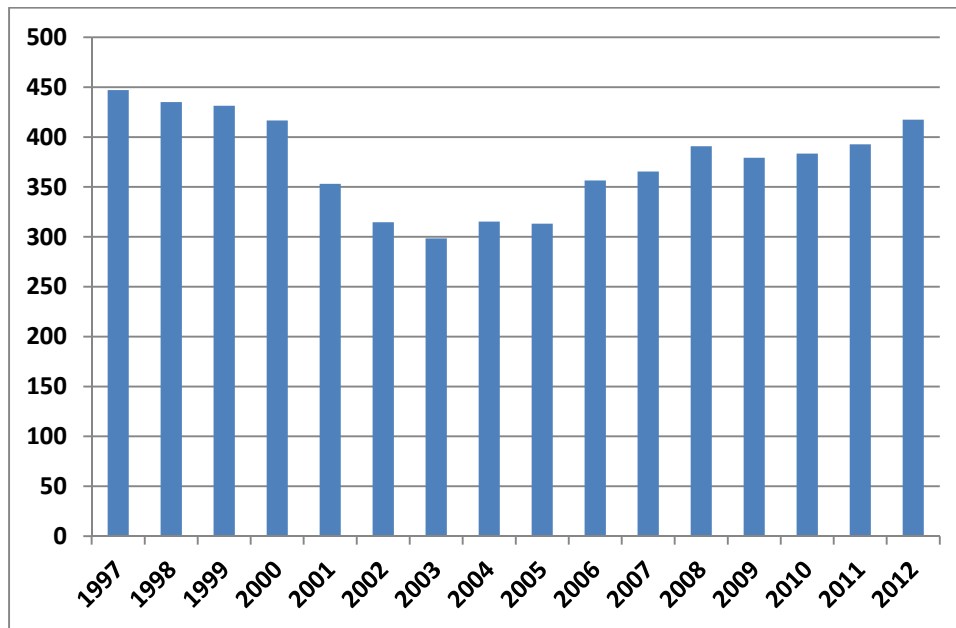


Figure 1-2. Annual Passenger Traffic at SFO (in Millions)

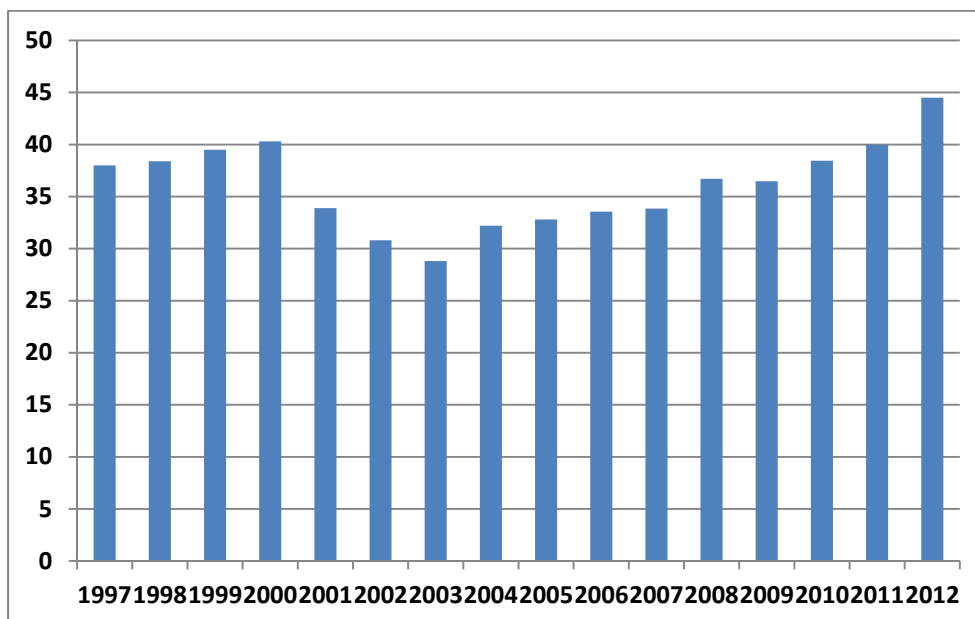
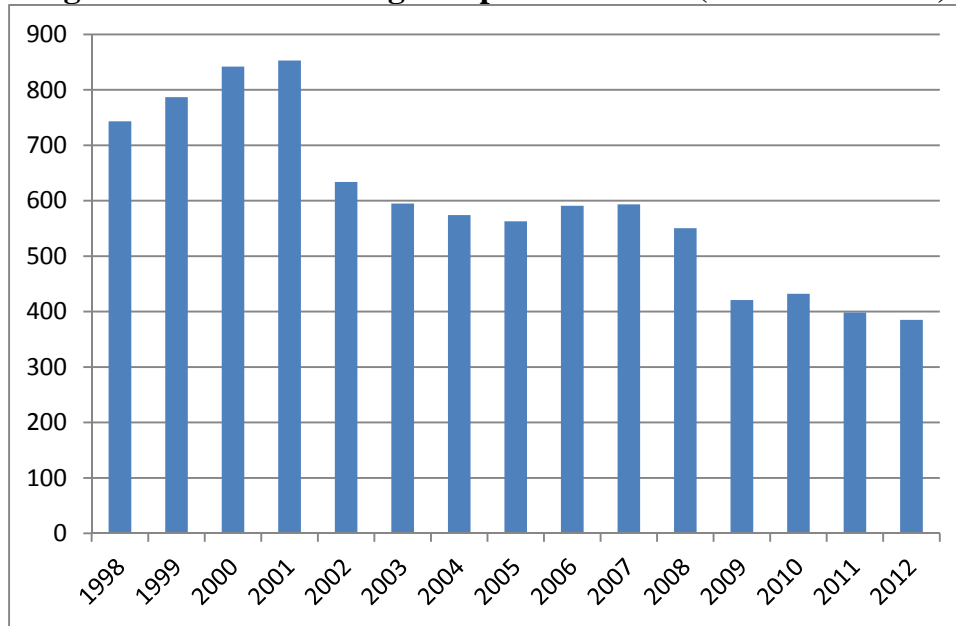
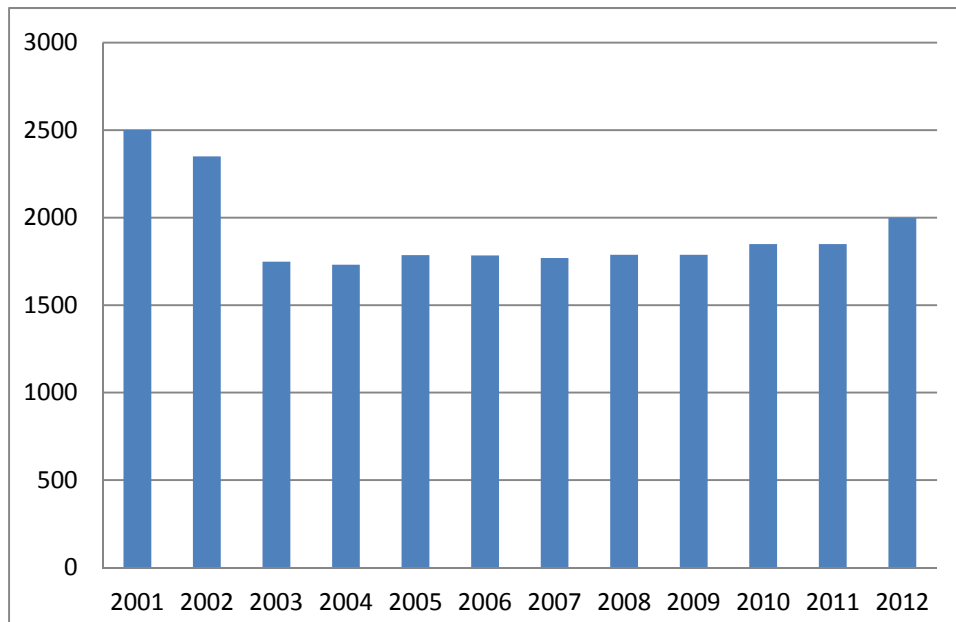


Figure 1-3. Annual Cargo Shipment at SFO (Thousand Tons)

Employment

The number of SFO employees, including the Airport Commission's operating and project positions, Airport Police Bureau, Airport Fire Department, and City Attorney's SFO staff for the period 2001-2012 is shown in Figure 1-4. The combined number of employees was 1,998 in FY 2012.

Figure 1-4. SFO Employee Count for 2001-2012 Period

Key Partners

SFO partners with airlines, tenants, City Departments, local, State, and Federal Government agencies, and community organizations to achieve the various environmental, economic, and social goals. SFO will continue to work cooperatively with the various stakeholders, including airlines and tenants, to develop and implement a broad range of greenhouse gas emission reduction / offset measures in the future.

The San Francisco International Airport/ Community Roundtable is one the longest established community-based airport noise reduction organizations in the country, and is an example of neighborhood groups working cooperatively with the Airport and the aviation industry to reduce aircraft noise impacts on the surrounding communities. SFO has worked closely with San Francisco Public Utilities Commission (SFPUC) to evaluate and implement a broad range of energy efficiency measures, as well as installing extensive photovoltaic panels on the roof of Terminal 3 and Airport Engineering Building. SFO has also worked cooperatively with tenants and airlines to increase the rate of solid waste recycling. Additionally, SFO has installed electric outlets and CNG dispensing facilities to minimize the emission of air pollutants and greenhouse gases from taxis, buses, and passenger cars.

In 2009 SFO initiated a three year Green Car Rental Incentive Pilot Program in conjunction with the rental car companies operating at the Airport. This program provided financial incentives to the rental car companies to increase the number of fuel efficient cars with an EPA score of 17 or higher from 10% to 15% in their rental vehicle inventory. The program also provided a discount to the customers who rented a Green Car. This program was concluded at the end of 2012 calendar year.

2. SFO's Carbon Footprint

Summary

In the context of Airport Cooperative Research Program's Guidebook on Preparing Greenhouse Gas Inventories at Airports¹, SFO's carbon footprint can be defined by the following three categories of greenhouse gas (GHG) emissions:

- Category 1 - SFO Controlled Emissions** - GHG emissions from operations that are under the control of SFO, including SFO employees' commute emissions, and emissions from all modes of travel on SFO controlled roads.
- Category 2 - Airlines, Concessionaires, and Airline Support Services Emissions** - GHG Emissions, within the physical boundaries of SFO; by airline operations, including landing and take-off (LTO) cycles; ground service equipment (GSE) and other support services; and by various concessionaires and other tenants.
- Category 3 - Optional Emissions** - U.S. Environmental Protection Agency (EPA) defines optional emissions as those emissions that are not directly emitted by but are connected with the reporting enterprise's operations. Examples include GHG emissions from: 1) passengers' travel, in personal vehicles or by public transit, to and from SFO, 2) outbound cruising aircraft, 3) delivery trucks, 4) construction equipment, and 5) commute travel by employees of airlines, concessionaires, and airline support services.

Other classifications have been proposed for quantifying the GHG emissions in the context of international global warming initiatives such as the Kyoto Treaty. For example the World Resources Institute (WRI) has proposed GHG emission categories as Scope 1 through Scope 3 as follows:

- Scope 1 Emissions** - These emissions are directly generated by the controlling entity within the defined boundaries of the facility. Examples include emissions from fuel and natural gas consumption.
- Scope 2 Emissions** - Scope 2 emissions which are also called indirect emissions are associated with the energy sources used by the entity, such as electric energy and steam, which are generated at off-site facilities.
- Scope 3 Emissions** - These emissions include both direct and indirect emissions generated by enterprises operating at the reporting facility which are not under the control of the reporting enterprise. At SFO, Scope 3 emissions include emissions from airlines, airline support services, and concessionaires' operations within and outside the defined boundaries of SFO. Examples include emissions from aircraft landing and takeoff operations, cruising aircraft, passenger and enterprise employees travel to and from SFO, etc. Emissions related to solid waste recycling/disposal operations at off-site facilities also fall under this scope.

Carbon dioxide is the major component of the GHG emissions. Other greenhouse gases include methane, nitrous oxide, refrigeration gases, and sulfur hexafluoride. The Transportation Research Board of the National Academies¹ provides the following classifications for GHG emission data depending on the type of gases included in such data:

- Level 1 Emissions** - This level includes only the carbon dioxide emission from the subject facilities and operations.
- Level 2 Emissions** - This level includes the Kyoto Treaty gases including carbon dioxide, methane, nitrous oxide; refrigerant compounds hydrofluorocarbons (HFC) and perfluorocarbons (PFC), and sulfur hexafluoride (SF₆) which is used as an insulator in electrical transmission and distribution systems.

SFO Carbon Footprint

¹ Guidebook on Preparing Airport Greenhouse Gas Emission Inventories, Report 11, Prepared for Airport Cooperative Research Program, Transportation Research Board of the National Academies and Sponsored by the Federal Aviation Administration, By Wyle Laboratories, Ian A. Waitz Consultant, and Synergy Consultants, Inc., 2009

Level 3 Emissions – This level includes the Kyoto Treaty gases plus any precursors and other gases with potential for global warming.

Data on Level 2 Emissions are provided in this report. The physical boundary of SFO's carbon footprint is defined as the geographic boundary of the Airport plus the airspace around SFO to an elevation of 3,000 feet for landing and takeoff (LTO) operations.

In this report data on SFO's carbon footprint are provided for emission Categories 1 through 3 to clearly distinguish the emissions from SFO controlled operations; on-site activities of the airlines, concessionaires, and airline support services; and the off-site emissions of these entities. This information is needed for devising policies and practices for reducing the GHG emissions of SFO as well as the emissions of airlines, concessionaires, and airline support services in the context of Ordinance No. 81-08. Available data on GHG emissions for the categories listed above are summarized in Table 2-1. Correlations between SFO emission categories and the WRI classifications are also provided in this table. Based on this information the GHG emissions at SFO in FY 2012 were 33,222 metric tons (tons), which was 33.7% below the 1990 emission level and exceeding Ordinance 81-08 mandate of 25% reduction by 2017. In addition the voluntary emission mitigation measures implemented by SFO yielded a total mitigation of 69,775 tons in FY 2012, as detailed in Table 2-7 of this chapter. Although these voluntary emission mitigation measures might not strictly meet the definition of emission offsets, nevertheless, these measures compensate for the climate impact of SFO controlled operations.

Table 2-1. Summary of Estimated GHG Emissions for SFO

WRI Emission Category	SFO Emission Category	GHG Emission (Tonnes)			
		1990	FY 2010	FY 2011	FY 2012
Scopes 1, 2, and 3	Category 1- SFO Controlled Emissions	50,128	39,280	38,457	33,222
Scopes 1, 2, and 3	Category 2- Airlines, Concessionaires, and Airline Support Services Emissions	839,000	676,169	749,398	898,403
Scope 3	Category 3. Optional Emissions	7,127,543	8,195,369	8,487,665	9,650,529
	Total	8,016,671	8,910,817	9,275,520	10,582,154

Category 1 SFO Controlled GHG Emissions

GHG emissions are defined in this report as the sum of direct and indirect emissions from operating facilities at SFO.

Direct Emissions

Greenhouse gases are generated on-site at SFO from the operations listed below in approximate quantitative order:

- Consumption of various fuels by vehicular traffic on SFO controlled roads, SFO fleet vehicles, emergency generators, SFO Shuttle buses, etc.
- Consumption of natural gas
- Fugitive refrigerant gas releases, and
- Process emissions at SFO's wastewater treatment facilities

Indirect Emissions

Greenhouse gas emissions generated off-site which are associated with the consumption of resources by SFO controlled operations or by the activities connected to such operations, are classified as indirect emissions. The various categories of indirect emissions for SFO controlled operations are listed below in quantitative order:

- GHG emissions from various modes of commute travel by SFO employees
- Electrical energy consumption
- Solid waste disposal and recycling operations

Data for various elements of SFO controlled Category 1 GHG emissions are provided in the following sections.

Electric Energy and Natural Gas Consumption

As shown on Table 2-2, the combined SFO and tenants' electric energy consumption ranged from 327,000 mWh in FY 2011 to 331,000 mWh in FY 2012, showing an increase of 1.2%. The increase in electric energy consumption is likely due to the increase in construction and passenger activity throughout the airport. The combined natural gas consumption, however, declined from 3,796,000 therms in FY 2011 to 3,640,400 therms in FY 2012 indicating a 4% decrease. This decrease is likely due to the installation of four new boilers at the Central Plant with enhanced operating efficiency features.

Electric energy and natural gas consumption by SFO tenants are also included in Table 2-2 because these utilities are supplied by SFO to the tenants. Based on Ordinance 81-08 and the general GHG emission calculation protocols the emissions associated with these SFO supplied utilities are to be included in the SFO carbon footprint. The increases in energy consumption from the 1990 base year are attributable to the significant expansion of SFO facilities following the completion of the SFO Master Plan Program.

The GHG emissions for electric energy and natural gas consumption decreased slightly from 25,007 tons in FY 2011 to 19,362 tons in FY 2012. The relatively low GHG emissions associated with electric energy consumption at SFO are due to the use of SFPUC supplied hydroelectric power for almost all of the electric energy needs at the Airport. The variations in the GHG emissions for electricity consumption in various years were partly due to the variations in the unit GHG emission for electricity supplied to SFO by SFPUC. These variations reflect the percentage of electricity supply that was purchased on the open market by SFPUC to make up the shortfall in hydroelectricity generation in each year. In FY 2012 a zero emission factor was used for all electricity supplied by SFPUC to the Airport following the designation of SFPUC as a zero emission Electric Utility by California Air Resources Board.

Table 2-2. GHG Emissions from Electric Energy and Natural Gas Consumption at SFO

Activity	Energy Consumption					GHG Emission (Tonnes)				
	1990	FY 2009	FY 2010	FY 2011	FY 2012	1990	FY 2009	FY 2010	FY 2011	FY 2012
Electric Energy Consumption by SFO, mWh	131,435	164,900	173,140	160,569	167,465					
CO ₂ Emission ^a						8,656	3,284	2,545	2,360	0
CO _{2e} for CH ₄ Emission ^b						6.58	2.87	2.14	1.99	0
CO _{2e} for N ₂ O Emission ^c						26.06	11.38	7.30	6.77	0
Subtotal						8,689	3,298	2,554	2,369	0
Electric Energy Consumption by Tenants ^d , mWh	133,807	166,232	149,827	165,950	163,465					
CO ₂ Emission ^a						8,812	3,310	2,202	2,439	0
CO _{2e} for CH ₄ Emission ^b						6.70	2.90	1.86	2.05	0
CO _{2e} for N ₂ O Emission ^c						26.53	11.48	6.32	7.00	0
Subtotal						8,845	3,325	2,210	2,448	0
Total Electric Energy Consumption, mWh	265,242	331,132	322,967	326,519	330,930	17,534	6,622	4,764	4,817	0
Natural Gas Consumption by SFO ^e , therms:										
SFPUC Supply	1,700,000	2,482,924	2,621,643	3,086,496	2,950,745					
CO ₂ Emission						9,020	13,174	13,910	16,376	15,656
CO _{2e} for CH ₄ Emission ^e						17	25	26	31	29
CO _{2e} for N ₂ O Emission ^e						5	7	8	9	9
PG&E ^{f,g} Supply	505,833	660,948	708,912	709,378	689,663					
CO ₂ Emission						2,684	3,507	3,761	3,764	3,659
CO _{2e} for CH ₄ Emission						5	7	7	7	7
CO _{2e} for N ₂ O Emission						1	2	2	2	2
Subtotal	2,205,833	3,143,872	3,330,555	3,795,874	3,640,408	11,732	16,721	17,714	20,189	19,362
Total						29,266	23,343	22,478	25,005	19,362

^a Based on an emission factor of 145.19 lbs of CO₂ per mWh for 1990, 3.67 lbs for 2008, 43.9 lbs for 2009, and 32.4 lbs for 2010 through 2011 for San Francisco Public Utilities Commission's electric power mix for the respective years. For FY 2012 an emission factor of 0.00 lbs per mWh was used per the ruling by California Air Resources Board designating SFPUC as a zero emission Electric Utility for that year.

^b Based on an emissions factor of 0.0302 lbs of CH₄ per mWh for non-hydro portion of San Francisco Public Utilities Commission's power mix for 1990, 2008 and 2009. A factor of 1.3 lbs per GWH was used for 2010 through 2012 per SFPUC communication.

^c Based on an emissions factor of 0.0081 lbs of N₂O per mWh for non-hydro portion of San Francisco Public Utilities Commission's power mix for 1990, 2008 and 2009. An emission factor of 0.3 lbs of N₂O per GWH was used for 2010 through 2012 per SFPUC communication.

^d Electricity is supplied to all Airport tenants by SFO. The GHG emissions attributable to the related energy consumption by tenants are, therefore, included under Category 1 in SFO's carbon footprint

^e Based on an emission factor of 14.7 Kg of Carbon per mmBtu (Direct Emissions from Stationary Combustion Sources, US EPA , EPA430-K-08-003, May 2008). NO₂ and CH₄ emission of 0.095 and 4.75 grams/MMBTU were also used from the same publication <http://www.epa.gov/climateleaders/documents/resources/stationarycombustionguidance.pdf>

^f Natural gas is supplied to most of the tenants by SFO. The GHG emissions attributable to the related energy consumption by tenants are, therefore, included under Category 1 in SFO's carbon footprint

^gThe 1990 natural gas supply by PG&E to SFO was estimated on the basis of the ratio of natural gas supply to electric energy use in FY 2008.

Fuel Consumption

Various types of fuel are consumed at SFO for operating the fleet vehicles, shuttle buses, and the emergency standby generators. A summary of the estimated fuel consumption levels for 1990 and FY 2009 through FY 2012, and the corresponding GHG emissions are shown in Table 2-3. GHG emissions from the consumption of various fuels at SFO increased from 13,154 tons in 1990 to 14,996 tons in FY 2012. In recent years a portion of the fleet vehicles, and all of the SFO shuttle buses, have been converted to biodiesel or compressed natural gas (CNG) use. These actions have been effective in maintaining the GHG emissions from the overall fleet fairly stable and have compensated for any growth in the fleet size. Emissions attributable to biodiesel use are not included in the subtotal and total GHG emission values shown in Table 2-3 due to the biogenic nature of these emissions.

Employee vehicular travel in 1990 was estimated by assuming that all of SFO employees commuted to work by car for 237 days per year, with an average round trip travel of 19 miles and an average gasoline use efficiency of 23.3 miles per gallon. The FY 2012 emissions for all modes of employee travel were developed on the basis of a survey conducted by the Operations Division at SFO in 2012.

Table 2-3. GHG Emissions from Consumption of Various Fuels at SFO

Activity	Consumption					GHG Emission (Tonnes)				
	1990	FY 2009	FY 2010	FY 2011	FY 2012	1990	FY 2009	FY 2010	FY 2011	FY 2012
General Fleet Gasoline Consumption, gallons	166,583	163,778	121,155	94,491	114,094					
CO _{2e} Emission ^a						1,467	1,443	1,067	832	1005
N ₂ O Emission ^{b,c} as CO _{2e}						64.66	28.59	21.15	16.50	13.48
CH ₄ Emission ^{b,c} as CO _{2e}						6.64	2.08	1.54	1.20	0.89
General Fleet Biodiesel Consumption:										
Diesel Fuel, gallons	93,175	42,257	45,230	43,148	43,968					
CO _{2e} Emission ^d						946	429	459	438.02	446.34
N ₂ O Emission ^{b,c} as CO _{2e}						10.81	2.20	2.36	2.25	1.41
CH ₄ Emission ^{b,c} as CO _{2e}						3.81	0.55	0.59	0.56	0.21
100% Biodiesel, gallons	0	10,564	11,307	10,787	10,992					
CO _{2e} Emission ^e						0	100	107	102	104
General Fleet CNG Consumption, GGE	0	36,000	64,909	61,274	83,236					
CO _{2e} Emission ^f						0	218	393	371	504
N ₂ O Emission, as CO _{2e}						0.00	7.26	13.09	12.36	14.64
CH ₄ Emission, as CO _{2e}						0.00	6.58	11.87	11.21	13.91
Total Fleet Consumption / Emission	259,758	252,599	242,601	209,700	252,290	2,499	2,137	1,970	1,685	1,999
SFO Shuttle Fleet Biodiesel Fuel Usage:										
Diesel Fuel^g, gallons	203,413	92,173	102,702	98,714	85,502					
CO _{2e} Emission						2,065	936	1,043	1,002	868
N ₂ O Emission as CO _{2e} , gm/mile		483,730	586,837	547,191	448,720	1.59	0.72	0.87	0.81	0.67

Table 2-3 (Continued). GHG Emissions from Consumption of Various Fuels at SFO

CH ₄ Emission as CO _{2e} , gm/mile		483,730	586,837	653,414	448,720	0.11	0.05	0.06	0.07	0.05
100% Biodiesel, Gallons	0	23,043	25,676	24,678	21,478					
CO _{2e} Emission						0	218	243	234	203
SFO Shuttle Fleet CNG Usage, GGE	0	182,285	190,236	191,066	182,767					
CO _{2e} Emission						0	1,103	1,151	1,156	1,106
N ₂ O Emission as CO _{2e}		665,520	668,843	547,191	667,280	0.00	36.10	36.28	29.69	36.17
CH ₄ Emission as CO _{2e}		665,520	668,843	653,414	667,280	0.00	27.48	27.61	26.98	27.55
Total Shuttle Fleet Consumption / Emission	203,413	297,501	318,614	314,458	289,747	2,067	2,103	2,258	2,216	2,038
Emergency Standby Generators										
Generator Diesel Fuel Consumption, gallons	13,660	19,633	16,366	15,727	18,175					
CO ₂ Emission ^h						139	199	166	160	185
N ₂ O Emission as CO _{2e}						0.33	0.47	0.39	0.38	0.44
CH ₄ Emission as CO _{2e}						0.11	0.16	0.13	0.13	0.15
Total Standby Generator Consumption / Emission						139	200	167	160	185
General Fleet Propane Usage, gallons	5,176									
CO _{2e} Emission ⁱ						30	0	0	0	0
N ₂ O Emission as CO _{2e}						1.29	0	0	0	0
CH ₄ Emission as CO _{2e}						0.05	0	0	0	0
Subtotal						31	0	0	0	0
Fuel Consumption by General Vehicular Travel on SFO Controlled Roads, ^k GGE	693,285	819,543	837,155	849,411	902,882					

Table 2-3 (Continued). GHG Emissions from Consumption of Various Fuels at SFO

CO _{2e} Emission						6,107	7,219	7,374	7,482	7,953
N ₂ O Emission as CO _{2e}						324	177	180	183	274
CH ₄ Emission as CO _{2e}						23.88	9.24	9.44	9.58	11.70
Total SFO Roadway Traffic Consumption / Emission						6,455	7,405	7,564	7,675	8,239
SFO Employees' Commute Fuel Consumption, GGE	210,849	280,854	281,435	281,435	322,332					
CO _{2e} Emission						1,857	2,474	2,479	2,479	2,438
N ₂ O Emission ^m as CO _{2e}						98.54	69.86	70.00	70.00	92.02
CH ₄ Emission ^m as CO _{2e}						7.26	3.99	4.00	4.00	3.98
Total Employee Commute Consumption / Emission						1,963	2,548	2,553	2,553	2,534
Grand Total	1,386,141	1,670,130	1,696,171	1,670,731	1,785,426	13,154	14,393	14,512	14,289	14,996
Total Biogenic GHG Emissions ⁿ	0	33,607	36,983	35,465	32,470	0	318	350	336	307

All emission factors in this table were obtained from: "Direct Emissions from Mobile Combustion Sources, US EPA, EPA430-K-08-004, May 2008"

^a Based on an emission factor of 19.42 lbs of CO₂ per gallon of gasoline

^b CH₄ and N₂O emissions for FY 2009 and FY 2012 were calculated on the basis of the total annual mileage logged by each vehicle, vehicle model; the type of fuel consumed by the vehicle or equipment, as applicable; using the emission factors provided in the U.S. EPA May 2008 publication cited above. FY 2012 emission calculations are shown in the SFO Fleet tab. Related emissions for FY 2010 and FY 2011 reporting periods were estimated by extrapolating the FY 2009-10 data on the basis of consumed fuel volumes in each fiscal year. Details of the FY 2009 emission calculations are shown in Table 4 in the Reference tab.

^c The ratios of CH₄ and N₂O unit emission factors for 1984 -1993 vehicle models to the average of these factors for 1994-2005 (3.1345 and 2.2234, respectively) were used to estimate the corresponding 1990 emission values for these gases

^d Based on an emission factor of 22.38 lbs of CO₂ per gallon of diesel fuel

^e Based on an emission factor of 20.86 lbs of CO₂ per gallon of 100% biodiesel

^f Based on the conversion of 1.00 GGE to 1.14 therms and using a unit GHG emission factor of 11.70 lbs CO₂ per therm

^g Estimated diesel fuel use in 1990 is based on available data for the average usage in 1998-1999 period. See Table 4 in the Reference tab for details of GHG emission calculations for FY 2009. CH₄ and N₂O emission factor are expressed per mile of driving. For other reporting periods the N₂O and CH₄ emissions were estimated on the basis of fuel use ratios to FY 2009.

^h Based on an emission factor of 22.38 lbs CO₂ per gallon of diesel fuel (Direct Emissions from Stationary Combustion Sources, US EPA, EPA430-K-08-003, May 2008). N₂O and CH₄ emission of 0.6 and 3.0 grams/MMBTU were also used from the same publication <http://www.epa.gov/climateleaders/documents/resources/stationarycombustionguidance.pdf>. An energy density level of 128,700 BTU per gallon of diesel fuel was used for CH₄ and N₂O emission calculation.

ⁱ Based on an emission factor of 12.65 lbs CO₂ per gallon of liquid propane. A 12 mile per gallon fuel efficiency was assumed for CH₄ and N₂O emission calculations

^j Based on data developed from annual traffic surveys performed by the SFO Traffic Engineering Group. For FY 2008-2010 an average fuel efficiency of 23.9 miles per gallon (mpg) of GGE, and average N₂O and CH₄ emission factors of 0.0079 and 0.0147 g/mile, respectively, were used based on the corresponding emission factors for the model year 2005. For 1990 an average fuel efficiency of 23.3 mpg and average N₂O and CH₄ emission factors for 1984-1993 model years of 0.0647 and 0.0704 g/mile, respectively, were used. (See Table 2 in the Reference tab for FY 2010 survey data). A similar procedure was used for subsequent reporting periods. Emission data for all reporting periods was revised downward in FY 2012 report by subtracting the GHG emissions for SFO Shuttle Bus Fleet from the total GHG emission for vehicular travel on SFO controlled roads to avoid double counting of these emissions.

^k The 1990 travelled miles was estimated by using the ratio of 1990 to 2007 total passenger traffic at SFO.

^l The 2008-11 values were estimated from the 2007-08 survey data based on a ratio of total employees. See Table 2 in Reference tab for 2008 survey data

^m GHG emissions for employee commute were estimated on the basis of equivalent gasoline gallons combusted using data on vehicular commute travel miles from the Employee Commute Survey (See the Employee Commute tab for details). A gasoline fuel efficiency of 23.3 mpg in 1990 and 23.9 mpg for recent years and a diesel fuel efficiency of 4.5 mpg for buses were used for calculating the CO₂ emission. N₂O and CH₄ average emissions for 1994 through 2005 model years were used for the corresponding emission factors.

ⁿ Biogenic GHG emissions were generated by the use of biofuel in fleet vehicles and SFO shuttle buses and are excluded from the grand total GHG emissions for fuel use

Solid Waste Disposal

Various solid waste disposal practices result in the generation of greenhouse gases. At SFO solid waste has been historically transported to, and disposed of in, landfills. In recent years, however, due to the mandates of State laws and City ordinances, a progressively higher percentage of the solid waste has either been source separated at the Airport or has been sorted at the offsite facilities of the waste haulers and has been recycled. In FY 2012 approximately 77.7% of the general solid waste generated at SFO was recycled. Solid waste generation data and the estimated greenhouse gas emission associated with solid waste disposal / recycling operations for 1990 and FY 2010 through FY 2012 are shown in Table 2-4.

SFO Carbon Footprint

Over the years, GHG emissions from solid waste disposal operations have significantly declined due to increased rates of solid waste recycling and composting at SFO. In FY 2012, the solid waste disposal GHG emission was 753 tons, a significant reduction from 1,065 tons in FY 2009 and 2,596 tons in 1990. Also in this reporting period the recycling and composting activities generated a GHG emission offset of 2,852 tons, an offset level which has been increasing steadily since 2010.

In previous years when construction activity occurred at SFO, about 94% of all construction and demolition (C&D) waste was recycled by construction contractors. Due to the significant variability in generation of C&D waste SFO accounts for GHG emission reductions generated by the recycling of these wastes as mitigation rather than an offset measure. Recycling of construction and demolition waste contributed significant GHG emission mitigation for FY 2009 and FY 2010 (13,096 tons in FY 2009 and 4,545 tons in FY 2010). No appreciable construction & demolition waste was generated at SFO in FY 2012.

Table 2-4. Estimated GHG Emissions from Solid Waste Disposal and Recycling Operations

Activity Type	Solid Waste Generation (Tons)				GHG Emission (Tonnes)			
	1990 ^e	FY 2010	FY 2011	FY 2012	1990	FY 2010	FY 2011	FY 2012
Landfilled Solid Waste:								
General Waste^a	6,000	2,621	2,348	2,279	2,246	785	753	753
Construction/Demolition^b	5,000	500	500	0	350	35	35	0
Subtotal Disposal GHG Emission					2,596	820	788	753
Recycled Solid Waste:								
General Recycling^c	0	3,053	3,300	4,413	0	-1,440	-1,821	-2,053
Composting^d	0	3,507	3,661	3,547	0	-765	-798	-798
Subtotal Regular Recycling						-2,205	-2,619	-2,852
Construction & Demolition^c		13,041	0	0		-4,545	0	0
Subtotal Recycling GHG Emission		19,601	6,961	7,960	0	-6,750	-2,619	-2,852
Total	11,000	22,722	9,809	10,239	2,596	-5,930	-1,831	-2,099

^a Methane emissions from landfilled solid waste were estimated by using Equation 9.1 of the publication: Local Government Operations Protocol Version 1.1, November 2010, California Air Resources Board, et al for a landfill equipped with comprehensive methane collection facilities (See Solid Waste tab)

^b Annual quantities of landfilled construction and demolition waste are based on reports filed by SFO contractors. The corresponding value for 1990 is an estimated quantity.

^c The Scope 3 Spreadsheet developed by ICF Intl for US EPA was used for estimating emission offsets from solid waste recycling. (See Solid Waste worksheet)

^d GHG emission mitigation factor of -0.218 tons/ton for composting operations and an emission factor of 0.07 tons / ton of landfilled construction and demolition (C&D) waste were obtained from the U.S.

EPA's Waste Reduction Model (WARM) Version 11 released in November 2010. The C&D landfilling factor is the average of the related factors for concrete, asphalt shingle, and drywall materials
http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html

^e Solid waste generation rates for 1990 were estimated on the basis of 2007 generation rate of 0.87 lbs per enplaned passenger at SFO. It was also assumed that no solid waste recycling was carried out in 1990 and construction/demolition waste generation was assumed at an estimated 5,000 tonnes for that year

Fugitive Refrigerant Gas Emissions

SFO uses a central plant for providing preconditioned air to all terminal buildings. The central plant is currently equipped with two 3,000 ton and two 6,000 ton capacity chillers. SFO also uses various packaged air conditioning units in other airport buildings and facilities. In 1990 SFO used two 3,000 ton chillers in the central plant each containing a refrigerant charge of 8,800 lbs of R-12. The two 3,000 ton chillers were converted from R-12 to R134A in 2001. In FY 2008 the older of the 6,000 ton chillers was converted from R-500, an ozone depleting gas, to R-134A refrigerant, an ozone safe gas with a lower global warming potential (R-500 refrigerant gas is a blend of 73.8 wt. % R-12 and 26.2 wt. % of R-152A with a global warming potential (GWP) of 6,014). The newest 6,000 ton chiller was installed in 1999 with R-134A refrigerant gas. Currently Chiller No. 2 is offline and will be replaced in 2013/2014.

A portion of the refrigerant gases stored in the central plant chillers and in the packaged air conditioning units is lost each year due to leakage through the shutdown seals. In this reporting period, an estimated 700 lbs of refrigerant gases stored in the chillers was assumed to have been lost by such leakage. This was equal to the loss quantity measured in FY 2011. For 1990 an estimated loss rate equal to 5% of the capacity of chiller units was assumed based on the recommended default loss factor by U.S. EPA. The loss rate for the packaged air conditioning units in the respective fiscal years is based on the quantity of make-up gases purchased during each year. A similar make-up rate was assumed for the packaged air conditioning units in 1990, but in proportion to the estimated number of such units in that year. Data for the capacity of air conditioning units in Fleet vehicles and SFO shuttle buses was used to estimate the corresponding refrigerant gas make up rates and GHG emissions for these equipment.

A summary of the capacities, estimated annual leakage rates, and GHG emissions from the various air conditioning units at SFO is provided in Table 2-5. These data indicate that fugitive refrigerant gases were the source of an estimated 4,874 tons of equivalent carbon dioxide gas emissions at SFO in 1990. The emissions for FY 2010 through FY 2012 have declined from 3,512 to an estimated 649 tons. The estimated GHG emission for FY 2010 reflects the quantity of makeup gas in that year and is not indicative of the actual leakage loss for that fiscal year. The indicated reduction in the GHG emissions from fugitive refrigerant gases after 1990 is in part due to the replacement of Dichlorodifluoromethane (R-12) with a GWP of 8,100 with 1,1,1,2-Tetrafluoroethane (R-134A) and Chlorodifluoromethane (R-22) which have a lower GWP of 1,300 and 1,810, respectively. It should also be noted that Kyoto Treaty only requires the inclusion of fugitive refrigerant gases of hydrofluorocarbons and perfluorocarbons types in the carbon footprint of an enterprise. Releases of fugitive refrigerant gas R -134A were included in the final accounting of SFO's carbon footprint because the inclusion is recommended by Air Resources Board in the publication entitled Local Government Operations Protocol as cited in the footnotes to Table 2-5.

Table 2-5. Estimated GHG Emissions from Refrigerant Gas Losses at SFO

Year	1990		FY 2010				FY 2011 ^d				FY 2012 ^d			
	1	2	1	2	3	4	1	2	3	4	1	2	3	4
Chiller Units	1	2	1	2	3	4	1	2	3	4	1	2	3	4
Chiller Size, Tonnes	3,000	3,000	3,000	3,000	6000	6000	3,000	3,000	6000	6000	3,000	N/A	6000	6000
Estimated Refrigerant Gas in Storage, lbs	8,800	8,800	4,600	0	13,000	10,200	4,600	0	16,000	15,000	8,600	N/A	17,100	21,000
Refrigerant Gas Type ^a	R-12	R-12	R-134A	R-134A	R-134A	R-134A	R-134A	R-134A	R-134A	R-134A	R-134A	N/A	R-134A	R-134A
Estimated Annual Gas Loss Rate, lbs	440	440	420	0	2,900	782	116	0	327	257	116	0	327	257
Combined Annual Gas Loss Rate ^c lbs/year	880		4,102				700				700			
Packaged Air Conditioning Units Make up, lbs/year	375		1,170	25	25	75	330	0	20	0	200	50	0	0
Refrigerant Gas Type ^a	R-12	R-22	R-134A	R-407C	R-410A	R-22	R-134A	R-407C	R-410A	R-22	R-134A	R-407C	R-410A	
Vehicular Air Conditioning Units Make up, lbs/year														
SFO Fleet ^b	34.8		34.8				34.8				34.8			
SFO Shuttle Fleet ^b	36.8		36.8				36.8				36.8			
Estimated Total Refrigerant Gas Loss, lbs/year	1,327		5,469				1,122				1,022			
Estimated Total GHG Emission ^c , Tonnes/Year	4,874		3,512				740				649			

^a R-12 = Dichlorodifluoromethane, R-134A = 1,1,1,2-Tetrafluoroethane, R-410A = Mixture of Difluoromethane, and Pentafluorethane, R-410C = Mixture of Difluoromethane, Pentafluorethane, and 1,1,1,2 Tetrafluoroethane, and R22=Chlorodifluoromethane

^b R-22

^c Global Warming Potential (GWP) for R-12 = 8,100, for R-152A=120, for R-134a = 1,300, for R-22=1,810, for R-407C = 1,526, and for R-410A = 1,725

Source of GWP factors: Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories, California Air Resources Board, et al, September 2008, and US EPA web

site at the following address:

http://www.epa.gov/climatechange/emissions/downloads/ghg_gwp.pdf

^d Chiller No. 2 was removed from service in 2011. A new chiller will be installed in 2013/2014.

^e The refrigerant loss rate for FY 2012 was estimated to have been the same as FY 2011 levels.

SFO Fire Department maintains the various fire extinguishers deployed at the terminals and other buildings and facilities. Fire Department replenishes these extinguishers annually with about 36 lbs of Halon 1211 and 60 lbs of multi-purpose ABC dry chemical extinguishers (consisting of ammonium phosphate and mono-ammonium phosphate). No data is available for the 1990 replenishment rate for the fire extinguishers but it could be assumed that Halon 1211 was used predominantly in 1990 for this purpose. U.S. EPA provides a direct global warming potential of 1,300 for Halon 1211. This gas also manifests a negative GWP ranging from (3,600) to (24,000) because Halon depletes the Ozone in the atmosphere and Ozone is a more potent greenhouse gas than Halon. For this reason no GHG emission values are assigned to fugitive Halon emissions from individual fire extinguishers at SFO. Currently the Fire Department is phasing out the use of Halon 1211 in fire extinguishers due to its harmful effect on the earth's Ozone layer.

Wastewater Treatment Process and Receiving Water Emissions

SFO operates both a Sanitary Wastewater Treatment Plant (SWTP) and an Industrial Wastewater Treatment Plant (IWTP). The SWTP employs a state-of-the-art biological-batch-reactor treatment process with a design capacity of 2.2 million gallons per day (mgd). The average daily discharge from the SWTP has ranged from 0.54 mgd to 0.61 mgd from FY 2010 to FY 2012. The SWTP processes do not include nitrification/de-nitrification treatment.

The IWTP treats wastewater generated at the various vehicular and aircraft maintenance facilities and the first flush of storm water runoff generated in the terminal and industrial areas of the Airport. The dry weather capacity of the IWTP is 1.2 mgd. The average annual discharge from the IWTP ranged from 0.61 mgd to 0.65 from FY 2010 to FY 2012. The influent to and effluent from the IWTP does not contain nitrogen compounds to any appreciable extent and is, therefore, not considered as a source of GHG emissions.

Treated effluent from the two plants is discharged into San Francisco Bay through an offshore outfall. The sludge generated at the sanitary treatment plant is treated by anaerobic digestion process and the treated and dewatered sludge is then shipped to an offsite composting facility. Industrial plant sludge is filter pressed and air dried prior to shipping to a landfill disposal site. Methane and hydrogen sulfide gases generated in the sludge digester are collected and flared at the treatment plant. GHG emissions from treatment processes, the biogas flaring operations, and the receiving water where the effluent is discharged are summarized in Table 2-6 and indicate total GHG emissions of 282 to 410 tons per year for FY 2010 through FY 2012.

Table 2-6. Estimated GHG Emissions from SFO Wastewater Treatment Plants^a

Parameter	Generation Rates				GHG Emissions			
	1990	FY 2010	FY 2011	FY 2012	1990	FY 2010	FY 2011	FY 2012
Sanitary Plant Average Annual Flow ^b , mgd	0.44	0.54	0.63	0.61				
Treatment Process N ₂ O Emission ^c , tonnes / year	0.06	0.07	0.08	0.08	18	22	25	25
Average Annual Ammonia Nitrogen in the Discharged Sanitary Effluent, mg/l	64	64	64	64				
Receiving Water N ₂ O Emission, Tonnes/Year	0.19	0.24	0.28	0.27	61	75	87	84
Digester Gas Flaring Operations ^{d,e} :								
Flared Methane, ft ³	2,156,936	2,567,313	3,621,825	4,176,890	156	185	261	301
Total GHG Emission, Tonnes/Year					235	282	373	410

^a The following Reference was used for all emission calculations shown in this Table:
Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories, Version 1.1, May 2010, Developed in Partnership by California Air Resources Board, et al.

^b The 1990 flow rate was prorated from the 2008-09 flow rate in proportion to the total number of passengers for the respective years

^c Calculated by using formula No. 10-9 from the reference above for N₂O emission from Wastewater Treatment Plant without nitrification/de-nitrification and assuming a per capita sanitary wastewater generation rate of 25 gallons per day and a nitrous oxide generation of 3.2 grams per capita per day

^d Reported FY 2009 annual digester gas generation at SFO's Wastewater Treatment Plants was extrapolated to 1990 on the basis of passenger traffic data (29,939,835 in 1990 versus 36,733,910 in FY 2009). Density values of 0.662 kg/m³ and 1.842 kg/m³, at 20° C and atmospheric pressure, were used for CH₄ and CO₂ gases, respectively. Approximately 99% of the flared methane gas was assumed to be converted to CO₂ and H₂O and a conversion factor of 44/12=3.67 was used for oxidation of CH₄ to CO₂ in the flaring process.

^e Methane gas constitutes 65% of the total gases generated by the digesters and the balance consists mainly of biogenic carbon dioxide.

GHG Emission Reduction, Offset, and Mitigation (ROM) Measures Implemented at SFO

SFO has successfully implemented a number of measures in recent years to reduce, offset, and mitigate the GHG emissions at local and regional levels. The emission reduction measures generally refer to actions that directly reduce the GHG emissions from SFO controlled operations, such as: increasing the fuel efficiency of fleet vehicles, reducing electric energy and natural gas consumption, using biodiesel in SFO fleet vehicles and SFO shuttle buses, etc. Emission reduction measures have been taken into account in the baseline emission values shown in Tables 2-2 through 2-6. Emission offset measures, consisting of solid waste recycling and carbon dioxide sequestration by tree plantings at SFO; reduce the Category 1 carbon footprint of SFO. Several mitigation measures have also been implemented at SFO to reduce the GHG emissions from sources that are not directly related to SFO controlled operations, such as: providing Preconditioned Air and 400 Hz power to aircrafts at the gates, providing partial funding for the extension of Bay Area Rapid Transit (BART) to SFO, constructing the AirTrain system to eliminate the need for rental car shuttle buses, and implementing the Green Car Rental Incentive Program. Each of the above elements is described briefly in the following paragraphs.

Implemented GHG Emission Reduction Measures

These measures directly reduced the GHG emissions from day-to-day operations of the Airport. In FY 2012 these measures reduced the GHG emissions at SFO by 19,222 tons, as itemized below:

- General reduction in the GHG emission factor for electricity supplied by SFPUC to SFO in FY 2012 and implementation of electric energy efficiency measures resulted in a GHG emission reduction of 12,653 tons for electric energy consumption in comparison with the corresponding 1990 emission level
- GHG emission from SFO Fleet declined by 500 tons from the 1990 level due to improved fuel efficiency of the fleet vehicles and the use of alternate fuels which compensated for the rise in the number of vehicles
- Reducing the quantity of landfilled solid waste from 6,000 tons in 1990 to 2,246 tons in FY 2012 reduced the GHG emissions for landfilling operations by 1,843 tons
- Reducing the emission of fugitive refrigerant gases and using more climate friendly refrigerant gases resulted in an emission reduction of 4,226 tons compared to 1990 emission level.

These emission reductions which are summarized in Table 2-7 were in part balanced by growth induced increases in consumption of energy and various fuels resulting in a net GHG emission reduction of 9,076 tons from 1990 to FY 2012 or a reduction of 18%.

Table 2-7. Impact of Implemented GHG Emission Reduction Measures

Activity	GHG Emission Reductions from 1990 Baseline, tonnes/yr
Electric Energy Consumption	12,653
Fuel Consumption	500
Solid Waste Disposal	1,843
Fugitive Refrigerant Gases	4,226
Total	19,222

Implemented GHG Emission Offset Measures

These measures relate to Airport operations or actions taken that yield a direct reduction in the GHG emissions to the atmosphere. In FY 2012 the following offsets were achieved by SFO:

- SFO recycled about 77.7% of the general solid waste collected at the Airport yielding an emission offset of 2,827 tons.
- SFO has planted 2,020 trees of various species around the Airport which sequester about 121 tons of carbon dioxide from the air per year.

As the result of the above offset measures SFO's Category 1 carbon footprint was reduced by an additional 2,948 tons in FY 2012, thereby yielding an additional 5.9% reduction from the 1990 emission level.

The combined emission reduction and offset measures implemented at SFO yielded a net GHG emission of 38,104 tons in FY 2012, indicating 24% reduction from the 1990 emission level.

Implemented Voluntary GHG Emission Mitigation Measures

The following voluntary GHG emission mitigation measures have been implemented at SFO in recent years:

- Installation of preconditioned air supply (PC Air) and 400 Hz power supply equipment at the International Terminal Boarding Areas A and G, and Boarding Areas C, D, and F which have reduced the need for the use of Auxiliary Power Units (APUs) aboard the aircraft, while the aircraft is deplaning and enplaning passengers. SFO regulation 11.4 (B) requires the use of PC Air and 400 Hz power as described below:

"Operators are encouraged to use ground power and air sources whenever practicable. APU's may be used when aircraft are being towed.

(1) At domestic terminals, the use of APU's is prohibited between the hours of 2200 - 0600 except 30 minutes prior to departure, when passengers are aboard, or it is needed to test other aircraft equipment.

(2) At the International Terminal, the following procedures apply:

(a) Aircraft scheduled to be at a gate in Boarding Areas A and G for more than 45 minutes between the hours of 0700 – 2200, are required to use 400Hz ground power and pre-conditioned air, where available. APU's are not authorized without prior permission from Airport Operations, during the use of ground power and pre-conditioned air until 30 minutes prior to push-back.

(b) All aircraft scheduled to be at a gate between 2200 – 0700 hours are required to use 400Hz ground power and pre-conditioned air, where available, regardless of the duration at the gate. APU's are not authorized without prior permission from Airport Operations, during the use of ground power and pre-conditioned air until 30 minutes prior to push-back."

In FY 2012, the PC Air system mitigated the GHG emissions at SFO by 57,192 tons. The significant increase in the PC Air emission mitigation level since FY 2010 was due to the installation of dedicated PC Air units at 12 jet bridges in Boarding Areas C and F and also the installation of 14 PC Air units at the jet bridges during the Terminal 2 renovation. Boarding Area

E is currently undergoing renovation and all gates at the renovated Boarding Area E will be equipped with PC Air units.

- The GHG emission mitigation associated with construction & demolition (C&D) waste recycling operations at SFO were estimated at 462 tons in FY 2008, 13,096 tons in FY 2009, and 4,545 tons in FY 2010. No major C&D waste recycling was carried out in FY 2011 and FY 2012. The variations in the magnitude of these mitigations are associated with the composition of recycled waste and variations in the quantity of construction and demolition waste.
- In 2009 SFO initiated a three year Pilot Green Car Rental Incentive Program (GCRIP) in conjunction with the rental car companies operating at the Airport. This program provided financial incentives to the rental car companies to increase the number of fuel efficient cars with an EPA score of 17 or higher to 15% of their rental vehicle inventory. The program also provided a \$15 discount to the customers who rented a Green Car. On January 1, 2012, SFO discontinued the customer discount, while the financial incentives for the rental car companies remained in effect. In FY 2012, the net emission mitigation from the GCRIP was estimated at 8,049 tons, a decline from 9,946 tons in FY 2011, and 11,442 tons in FY 2010, when the program was initiated. This decline in GHG emissions mitigated was primarily due to the inability of rental car industry to acquire large fleets of green vehicles.
- SFO provided partial funding for BART extension to SFO which in FY 2012 resulted in a reduction of about 79 million miles of travel by airline passengers based on monthly passenger data provided by BART to SFO staff. SFO shares approximately 9.1% of this mitigation based on the SFO contribution of 200 million dollars to the capital cost for extending BART from Colma to SFO and Millbrae. In FY 2012, it is estimated that BART service mitigated SFO's GHG emissions by 2,415 tons.
- In 2003 SFO completed the construction of AirTrain system which has eliminated the need for the use of shuttle buses by all on-Airport Rental Car Agencies. In FY 2011, the AirTrain system mitigated SFO's GHG emissions by 2,120 tons.

The measures listed above yielded a total GHG emission mitigation of 69,775 tons in FY 2012 at SFO, as shown in Table 2-8.

Table 2-8. Summary of Implemented GHG Emission Mitigation and Offset Measures at SFO

Type of mitigation Measure	Resources Saved			GHG Emission Mitigation or Offset (tonnes per year)		
	FY 2010	FY 2011	FY 2012	FY 2010	FY 2011	FY 2012
GHG Emission Mitigation Measures						
PC Air and 400 Hz Power Supply Installation at International and Domestic Terminals ^{a,b}	2,226,413	4,912,280	5,736,092	-21,889	-48,295	-57,192
Green Car Rental Incentive Program ^c	1,224,329	1,118,473	904,787	-11,442	-9,946	-8,049
Construction & Demolition Waste Recycling	13,041	0	0	-4,545	0	0
SFO's Share of GHG Mitigation for BART Extension to SFO ^d	229,753	241,262	267,206	-2,076	-2,180	-2,415
AirTrain Facility ^e	183,856	193,281	208,740	-1,864	-1,960	-2,120
Subtotal Emission Mitigation				-41,816	-62,381	-69,775
GHG Emission Offset Measures						
Solid Waste Recycling ^f , tons	19,601	8,339	10,000	-2,205	-2,619	-2,827
Tree Planting Operations ^g	2,020	2,020	2,020	-121	-121	-121
Total GHG Emission Offset				-2,326	-2,740	-2,948

^a Volume of jet fuel saved by providing PC Air and 400 Hz power supply to aircraft . APU jet fuel usage was calculated for each reporting period on the basis of actual SFO flight operations during a representative 24-hour period in the peak travel month which was then extrapolated to the entire year by using an adjustment factor of 0.82 for converting the peak month-average day passenger traffic to annual-average day passenger traffic. The

duration of APU use for each flight on the Design Day was calculated on the basis of reported turn-around-times (TAT) for these flights. In general for all flights with a TAT less than 60 minutes no preconditioned air usage was assumed. For flights with TATs between 60 and 120 minutes it was assumed that PC Air and ground power was used for all but 30 minutes of the TAT. For flights with TATs exceeding two hours it was estimated that the PC Air and ground power would be used for a total of 90 minutes. The figures for PC Air usage were estimated from the results of a survey of international and domestic carriers at SFO. APU fuel use in 1990 was calculated on the basis of the reported aircraft types, the number of average-day flight operations (Master Plan Program Final Environmental Impact Report, May 1992), and the published APU fuel use levels for the respective aircraft types.

^b In FY 2012, no PC Air units were installed at Boarding Area B, and Boarding Area E was not operational; only 5 of 9 gates and 7 out of 25 gates, in Boarding Areas C and F, respectively, have PC Air units installed.

^c Gasoline savings resulting from the implementation of the Green Car Rental Incentive Program (Green Vehicles Program tab)

^d Gallons of gasoline saved by passengers using BART service to SFO. An estimated one-way average travel distance of 19 miles per BART passenger was used based on 2006 Metropolitan Transportation Commission Survey of SFO and Oakland Airport passengers. The average vehicle fuel efficiency was assumed at 23.9 mpg per US EPA, and a BART per passenger per mile fuel use at 12% of the passenger vehicle per mile was obtained from BART staff. The share of SFO was estimated at 9.1% of the total GHG emission mitigation. (See BART tab in Master Spreadsheet)

^e Gallons of diesel fuel saved by eliminating the need for 800,000 miles of travel by Car Rental Agency shuttle buses in 2007-08. Avoided miles for subsequent years were estimated on the basis of the ratio of total SFO passengers for the respective years to FY 2008. A fuel efficiency of 4.5 mpg was assumed for the shuttle buses. (See Airtrain Mit tab in Master Spreadsheet)

^f Impact of general and construction/demolition solid waste recycling at SFO (See Solid Waste Tab)

^g The impact of carbon sequestration by 2,020 trees planted throughout the Airport as a part of the SFO landscaping program (see Table 3 of Reference Data tab in Master Spreadsheet)

Summary of Category 1 SFO Controlled GHG Emissions

Estimated Category 1 GHG emissions at SFO for 1990 and FY 2010 through FY 2012 are summarized in Table 2-9. These data show that SFO controlled operations generated 50,128 tons of GHG emissions in 1990 and 38,459 tons in FY 2011. In FY 2012 SFO had a net GHG emission of 38,104 tons, a 24% reduction from 1990 level. These emission levels included an annual offset of 2,948 tons, which was consistent with offset levels in the past three years. GHG emission mitigation levels at SFO increased from 39,409 tons in FY 2009 (not shown in the table) to 69,775 tons in FY 2012. The significant increase in GHG emission mitigation levels was, mainly, attributable to expanded PC Air and ground power service to aircraft at additional Boarding Areas, as described previously.

Table 2-9 - Summary of Historical and Current Category 1 GHG Emission and GHG Emission Offset and Mitigation Levels at SFO

Activity	Category 1 SFO Controlled GHG Emissions (tonnes per year)			
	1990	FY 2010	FY 2011	FY 2012
GHG Emission Levels				
Electric Energy and Natural Gas Consumption	29,267	22,478	25,006	19,362
Fuel Consumption^a	13,155	14,513	14,290	14,996
Fugitive Refrigerant Gas Emissions	4,875	3,513	740	649
Solid Waste Disposal	2,596	820	788	753
Wastewater Treatment	235	282	373	410
Total Gross Baseline Category 1 GHG Emission	50,128	41,606	41,197	36,170
GHG Emission Offset Levels				
Solid Waste Recycling Offset	0	-2,205	-2,619	-2,827
Tree Sequestration Offset	0	-121	-121	-121
Total GHG Emission Offsets	0	-2,326	-2,740	-2,948
Net Category 1 GHG Emission	50,128	39,280	38,457	33,222
GHG Emission Mitigation Level				
Total GHG Emission Mitigation	0	-41,817	-62,381	-69,775

^a GHG emission estimates for fuel consumption at SFO for the preceding reporting periods were revised by deducting the SFO Shuttle Bus GHG emissions from the estimated emission for vehicular travel on SFO controlled roads, thereby eliminating the double counting of the Shuttle Bus emissions.

Summary of Planned GHG Emission Reduction, Offset, and Mitigation Measures at SFO

A number of additional GHG emission reduction, offset, and mitigation measures are currently being implemented or are being planned at SFO as follows:

Planned GHG Emission Reduction Measures

- Projected reductions in natural gas consumption could mitigate the GHG emissions by 791 tons per year. In addition, electrical energy efficiency measures are expected to reduce Category 1 GHG emissions by up to 395 tons per year (See Tables 3-2 and 3-5 in Section 3).
- Implementing the planned fleet vehicle replacement program including replacement of 234 of the existing aged vehicles over a six year period mostly with CNG powered vehicles, where available. This program is expected to reduce Category 1 GHG emissions by 528 tons per year upon completion (See Table 4-3 in Section 4)
- Implementing various employee commute programs, including eliminating the BART surcharge fee for travel to the Airport for Commission employees, promoting carpool through use of social ridesharing, and adding new local, ferry and commute bus services. This program is expected to reduce the category 1 GHG emissions by 226 tons per year upon completion.

Planned GHG Emission Offset Measures

- Increasing the solid waste recycling rate to 80% by 2017 from the FY 2012 recycling rate of 77.7%. This measure is expected to yield an additional GHG emission offset of about 225 tons per year.

Planned Voluntary GHG Emission Mitigation Measures

- Full year operation of PC Air units at Boarding Area E in FY 2014. These systems are expected to yield a GHG emission mitigation of 5,136 tons per year

The planned Category 1 GHG emission ROM measures at SFO are summarized in Table 2-9 and indicate that GHG emissions at SFO could be further reduced by the combined impact of planned reduction and offset measures by 2,165 tons per year by 2017.

Table 2-10. Summary of Planned Additional GHG Emission Reduction, Offset, and Mitigation Measures at SFO

Activity	Planned GHG Emission Reduction/Offset /Mitigation Measures, tonnes per year
GHG Emission Reduction Measures	
Natural Gas Use Reduction ^a	791
Electric Energy Efficiency Measures ^b	395
Fuel Consumption ^c	754
Subtotal Emission Reductions	1,940
GHG Emission Offset Measures	
Enhanced Solid Waste Recycling ^d	225
Subtotal Offset Measures	225
GHG Emission Mitigation Measures	
PC Air and 400 Hz Power Supply System at B/A E ^e	5,136
Subtotal Mitigation Measures	5,136

^a Based on the Energy Audit Report recommendations and potential impact of energy saving measures incorporated in the new construction projects

^b Based on the Energy Audit Report's electric energy saving recommendations and completion of airport-wide lighting retrofits

^c Based on scheduled fleet vehicle replacement and enhanced employee commute programs

^d Based on increasing the recycling rate from 77% to 80% by 2017

^e Expected offset generated by PC Air and 400 Hz power supply system at the renovated Boarding Area E.

Category 1 GHG Emission Projections

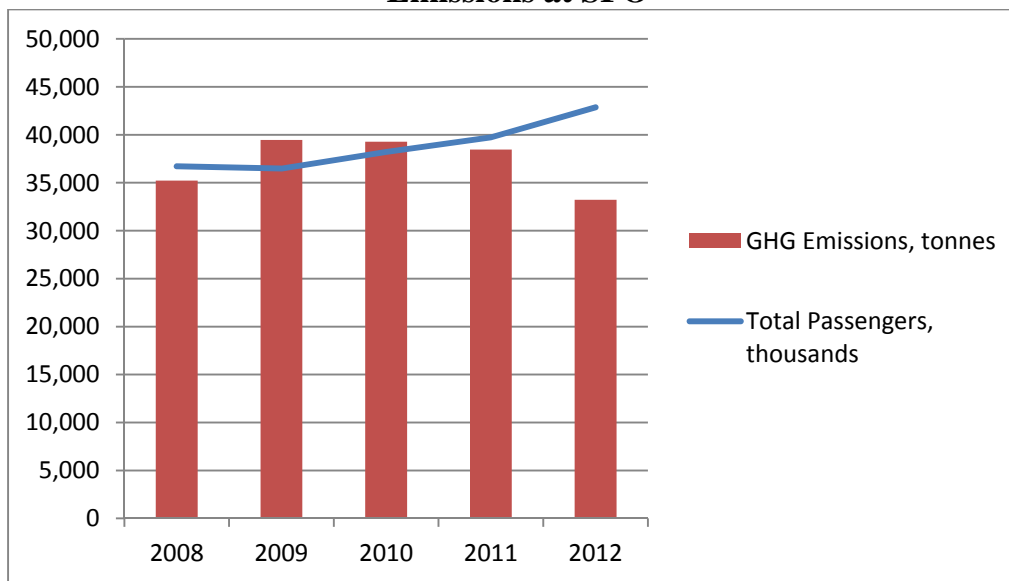
Ordinance No. 81-08 requires a reduction in GHG emissions to 25% below 1990 emission levels by 2017 and 40% below 1990 emission levels by 2025. Therefore, it is necessary to establish baseline estimates for SFO's expected carbon footprint in 2017 and 2025 to assess the magnitude of compliance requirements in the future years.

Basis for GHG Projections

Historically, GHG emission projections were based on a direct correlation between the rate of increase in GHG emissions and passenger growth. The observed correlation reflects the impact of increased

passenger traffic on electric energy consumption for the operation of baggage handling systems, escalators, elevators, and moving walkways. The increased passenger loads could also increase the load on the central air conditioning system during the summer months, coinciding with the peak passenger traffic period at the Airport. Other parameters such as the number of flight operations, impacting PC Air and 400 Hz power supply or APU usage, and solid waste loadings are also related to the passenger traffic level at SFO. However, due to focused efforts aimed at reducing GHG emissions and increasing GHG emission offsets, in recent years the GHG emissions at SFO have declined despite an appreciable increase in the number of enplaned passengers at SFO. Therefore, projected GHG emissions in proportion to passenger growth would constitute a conservative upper limit to such emissions. Accordingly a lower bound for projected GHG emissions were also developed as described below.

Figure 2-1. Plot of Historical Data for Total Number of Passengers and GHG Emissions at SFO



Passenger Projection Levels. Passenger growth scenarios for SFO have been analyzed by the Planning Division and consolidated projections for the number of enplaned passengers have been developed based on FAA and SFO Finance Department growth estimates. The results of these projections are summarized in Table 2-11 and indicate passenger traffic growth of 15.64% by 2017 and 37.62% from 2012 levels by 2025.

Table 2-11. Projected Passenger Enplanements at SFO

Growth Scenario	FY 2012	2017	2025
Enplaned Passengers	21,420,063	24,770,330	29,477,668
% Growth from 2012		15.64%	37.62%

Projected Gross GHG Emissions. An upper and lower bound projections for GHG emissions at SFO are shown in Table 2-12. These projections do not include the impact of any future reduction and offset measures. Upper bound projections are based on the assumption that in the future GHG emissions would increase in proportion to the rate of growth in the number of enplaned passengers. However past data indicate that GHG emissions have increased at a slower rate or have remained stable at SFO. Therefore, a more realistic lower bound projection is also presented in Table 2-12. The adjusted projection was developed by assuming an increase in GHG emissions at about 50% of the rate of increase in passenger traffic at SFO.

Table 2-12. Projected 2017 and 2025 Category 1 Gross GHG Emission Levels at SFO (Tons per Year)

Projection	2017	2025
Upper Bound GHG Emission Level	38,418	45,720
Lower Bound GHG Emission Level	35,880	39,534

The summary of projected gross and net GHG emission levels at SFO for 2017 and 2025 is shown in Table 2-13 and indicate a potential need for developing additional emission reduction/offset levels of 1,323 tons by 2017 and 13,029 tons by 2025 based on adjusted gross GHG emissions of 38,919 and 43,106 tons for the respective years.

Table 2-13. Projected Category 1 GHG Emission and Emission Offset and Mitigation Levels at SFO (Tons per Year)

Item	2017	2025
Allowable GHG Emission Level (Ordinance 81-08)	37,596	30,077
Projected GHG Emissions (Lower Bound)	35,880	39,534
Planned Emission Reduction	-1,940	-1,940
Planned Emission Offset	-225	-225
Total GHG Emission Level	33,715	37,369
Required Additional GHG Emission Reduction / Offset Level under Ordinance 81-08	0	7,292
Projected GHG Emission Mitigation Measures	-74,911	-74,911

Estimated Category 2 GHG Emissions at SFO

Category 2 GHG emissions are defined to include the various emissions from airlines, airline support services, and concessionaires as well as governmental operations such as the U.S. Post Office's vehicle fleet at SFO, etc. A partial list of the emissions included under this category is as follows:

- Natural gas consumption by airlines, Ground Services Operations, and concessionaires which are not delivered under SFO accounts
- Gasoline, diesel, biodiesel, and CNG consumption by fleet vehicles for airlines, concessionaires, and airline support services
- Jet fuel consumption for aircraft landing and takeoff (LTO) cycles.
- Jet fuel consumption for aircraft Auxiliary Power Units (APU)
- Fuel consumption by construction contractors working at SFO for Airport, airlines, and other tenants
- Fuel consumption for vehicular commute by employees of airlines, concessionaires, and airline support services
- Fuel consumption by U.S. Post Office's fleet vehicles
- Fuel consumption by trucks delivering supplies to tenants, concessionaires, airlines, and airline support services

Because the focus of the SFO Climate Action Plan is on activities managed and controlled by the Airport Commission, information on some of Category 2 carbon footprint elements was not available for inclusion in this report. The missing emission data will be collected and will be included in future updates of the Airport CAP. Available data on the carbon footprint of these activities is summarized in Table 2-14 and indicate a reduction in Category 2 GHG emissions from 839,000 tons in 1990 to 898,403 tons in FY 2012. The estimated increase is mainly due to the growth in airline operations and passenger traffic over the years. The 1990 estimates, however, could probably be refined by performing a more rigorous analysis. Some of the aircraft flight emission data included for FY 2008 in this table was developed by Wyle Aviation Services, et al in conjunction with SFO staff, by using FAA's EDMS model. The related emissions for 1990 and for subsequent years were extrapolated from FY 2008 data based on the number of flight operations for the respective years.

The GHG emission data shown in Table 2-14 for such elements as solid waste handling and fugitive refrigerant gas emissions are specific to airline operations and have not been included under Category 1 emissions. The GHG emissions for solid waste handling for food service tenants have been included under Category 1 emissions.

Table 2-14 Estimated 1990, FY 2009 to FY 2012 Category 2 GHG Emissions from Airlines, Airline Support Services, and Concessionaire Operations*

Activity Type	Consumption/Quantity					GHG Emission, Tonnes				
	1990	FY 2009	FY 2010	FY 2011	FY 2012	1990	FY 2009	FY 2010	FY 2011	FY 2012
Commercial Passenger Aircraft LTO Cycle Jet Fuel Use ^a (million gallons)	67.26	54.29	56.87	59.13	79.00	658,688	531,716	556,911	579,105	685,095
Cargo Aircraft ^b LTO Cycle Jet Fuel Use, million gallons	3.24	2.08	2.18	2.26	2.45	31,730	20,338	21,302	22,151	24,032
Aircraft Auxiliary Power Unit Jet Fuel Use ^c gallons	7.75	5.81	6.09	6.33	9.78	75,897	56,928	59,625	62,002	95,823
Employee Commute Fuel Consumption ^d (GGEx106)	2.52	3.27	3.42	3.56	3.86	22,210	28,813	30,178	31,381	34,046
Tenants Independent Natural Gas Use (Therms)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ground Services Equipment Fuel Use ^e (GGEx106)	4.40	3.54	3.71	3.85	4.18	38,779	31,177	32,655	37,731	40,936
Tenants' Fleet Vehicles Fuel Use ^f (GGEx106)	0.64	0.73	0.76	0.79	0.86	5,641	6,393	6,696	7,737	8,394
Landfilled and Recycled Solid Waste ^g (tonnes)	8325	10256	10742	11170	12119	5,016	7,370	7719	8027	8709
Fugitive Refrigerant Gas Emissions ^h (lbs)	TBD	TBD	TBD	TBD	TBD	456	520	544	566	614
Tenants and Concessionaires Fuel Use for Supply Deliveries ^g (GGEx106)	64,026	72856	76355	79298	85550	564	642	673	699	754
Total						838,980	683,897	716,303	749,398	898,403

*Most emission calculations for FY 2009-FY2012 were derived from detailed calculations carried out in deriving the FY 2008 data. The FY 2008 figures were adjusted for each subsequent year by using appropriate metrics such as passenger levels, number of flight

operations, etc. for the respective years except as noted below

^a FY 2012 numbers were estimated by calculating LTO cycle jet fuel use for one day (July 30, 2012) and multiplying it by 365 and adjusted for peak month by a factor of 0.82. The LTO cycle jet fuel use was estimated from the IPCC document:

www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_5_Aircraft.pdf

1990 flight data were obtained from three sources: Landed Fee Reports, SFO Master Plan EIR, and the Official Airline Guide Schedule Data.

^b FY 2012 data derived from FY 2008 calculations by using a ratio of enplaned passengers.

^c APU fuel use for FY 2012 was calculated by SFO staff using actual flight operations data for one 24 hour period (July 30, 2012) at all terminals and extrapolating the data to the entire year. APU fuel use in 1990 was calculated on the basis of reported aircraft types and the number of average day flight operations (SFO Master Plan Final EIR, 1991).

^d Calculated FY 2008 data was extrapolated to 1990, FY 2009- 2012 by SFO staff using the ratios of total passengers for the respective years.

^e FY 2012 data derived from FY 2008 calculations by using a ratio of annual flight operations.

^f Tenant fleet vehicle emissions were calculated on the basis of the survey data obtained by SFO Environmental Services staff in 2009. FY 2009 through FY 2012 data were extrapolated from FY 2008 data.

^g Calculated FY 2008 data was extrapolated to 1990, FY 2009- 2012 by SFO staff using the ratios of total passengers for the respective years.

^h Calculated FY 2008 data was extrapolated FY 2009- 2012 by SFO staff using the ratios of total enplaned passengers for the respective years.

Estimated Category 3 GHG Emissions at SFO

The Category 3 carbon footprint at SFO includes the GHG emissions generated beyond the defined boundary of SFO but which are related to enterprise activities at SFO. Examples of these emission sources for SFO are as follows:

- Jet fuel consumption at cruising altitude by passenger and cargo aircraft flying from SFO to their immediate departure destination. These emissions are included under Category 3 to indicate that they occur outside the geographical boundary of SFO.
- Vehicular and public transit travel by airline passengers to and from SFO
- Emissions from cargo service trucks and from trucks delivering supplies or providing services to SFO and to Airport enterprises
- Emissions from Car Rental Fleets. These emissions pertain to the actual operation of the rental fleets, including the green car fleets. SFO claims mitigation only for the saved fuel in the green car fleets under the Green Car Rental Incentive Program, as described in a previous section.

Table 2-15 shows the Category 3 GHG emissions at SFO, which ranged from seven million tons in 1990 to nine million tons in FY 2012. The estimated increase is mainly due to the fact that passengers are flying more and to further destinations. As shown in Table 2-15, the jet fuel consumed for commercial aircraft flying from SFO to the departure destination has consistently increased by over one-third since 1990.

It is also important to note that these numbers are only estimate using best available data. The annual jet fuel consumption for

commercial and cargo aircraft flying to the departure destination has been estimated based on flight operations for a 24 hour period on June 30, 2012, and extrapolating to the entire year. Comprehensive data analysis was performed in FY 2008 by Wyle Aviation Services, et al in conjunction with the SFO staff to estimate the annual jet fuel consumption for commercial and cargo aircraft flying to the departure destination. The GHG emissions for these activities for FY 2009 through FY 2011 were extrapolated from FY 2008 data by applying a factor based on the ratio of flight operations or cargo tonnage for the respective years. Other Category 3 GHG emission values were developed on the basis of responses received from the airlines, airline support services, and concessionaires to a questionnaire distributed by SFO staff in 2009, data developed by SFO's Traffic Engineering Group for SFO controlled roads, and the tonnage of cargo shipments at SFO. Refer to the footnotes on the Table 2-15 for details of how data were generated.

Table 2-15. Estimated 1990, FY 2008, FY 2009, and FY 2010 Category 3 GHG Emissions

Activity	Consumption				GHG Emission, Tonnes			
	1990	FY 2010	FY 2011	FY 2012	1990	FY 2010	FY 2011	FY 2012
Jet Fuel Consumption for Commercial Aircraft Flying to the Departure Destination^a, (million gallons)	646.94	775	806	896	6,335,565	7,623,413	7,927,120	8,715,084
Jet Fuel Consumption for Cargo Aircraft Flying to the Departure Destination^b, million gallons	41.31	22	21	43	404,513	218,944	201,907	421,191
Fuel Consumption by Multimodal Passenger Travel^c, (millions GGE)	31.61	37	39	42	278,459	331,422	347,123	363,568
Fuel Consumption for Cargo and US Mail Shipment Delivery/Pickup at SFO^d, (gallons)	173,774	134,518	124,050	119,918	1,763	1,365	1,071	840
Emissions from Construction Contractors' On and Off-Road Equipment	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Emission from Rental Car Fleets^e	12,343,605	12,098,689	14,363,056	16,948,842	107,243	100,598	119,426	149,847
Total					7,127,543	8,275,742	8,596,647	9,650,529

^a FY 2012 numbers were estimated by calculating the jet fuel consumption for commercial aircraft flying to the departure destination for one day (July 30, 2012) and multiplying it by 365. The cruise emissions for FY 2010 and FY 2011 were estimated by multiplying the FY 2009 (not shown) fuel use value by the ratio of annual number of flight operations for the respective years. Estimated cruising altitude emissions for FY 2008 were calculated by using the FAA's Emission and Dispersion Modeling System, Version 5.1.1 and the annual flight data base provided by SFO Noise Monitoring Office. 1990 flight data were obtained from three sources: Landed Fee Reports, SFO Master Plan EIR, and the Official Airline Guide Schedule Data.

^b FY 2012 numbers were estimated by calculating the jet fuel consumption for cargo aircraft flying to the departure destination for one day (July 30, 2012) and multiplying it by 365. Data for the number of cargo aircraft flights and aircraft types for FY 2008 (not shown). The FY 2010 and FY 2011 consumption and emissions were estimated by multiplying the FY 2008 consumption by ratio of annual cargo tonnage handled.

^c Based on data developed in 2006 by the Metropolitan Transportation Commission. Estimates for 1990 and other reported years were developed by extrapolating the MTC data on the basis of passenger counts for the respective years (See Table 8-1 for details of MTC data)

^d Estimated by using the reported annual cargo and US Mail shipments at SFO for the respective years and assuming an average roundtrip distance of 25 miles for cargo delivery / pickup in trucks holding 15 tonnes of cargo with a diesel fuel efficiency of 5.9 miles per gallon. The emissions for FY 2010-2012 were estimated on by the ratio of annual cargo tonnage to FY 2008.

^e Estimated on the basis of the reported rental transaction for regular fleet, EPA rated 17+, and EPA 18 rated vehicles. An estimated travel distance of 221 miles per transaction and vehicle fuel efficiencies of 20, 30, and 40 miles per gallon, respectively were used for regular and high efficiency vehicles. The 1990 transactions were estimated by multiplying the 2009 transaction level by the ratio of total passenger traffic for the respective years. Also, an average gas efficiency of 17.5 miles per gallon and a trip length of 221 miles were used for estimating the 1990 GHG emission level. (See Green Vehicle Program tab in spreadsheet)

3. SFO Energy Use

Summary

SFO is the San Francisco Public Utility Commission's (SFPUC) largest purchaser of electric energy and in FY 2012 purchased 330 gWh, or nearly 35% of SFPUC's total electric power supply. The electric energy is used for lighting and for powering equipment (such as people movers and AirTrain system) operating in public spaces; and heating, ventilation, and air conditioning (HVAC) equipment at the terminals, boarding areas, and other SFO facilities. SFO supplies all electric energy needs of airlines, concessionaires, and other Airport tenants; and in FY 2012 their electric consumption accounted for 51% of the electricity purchased from SFPUC.

SFO is also the second-largest purchaser of natural gas from the SFPUC, and in FY 2012 purchased 2.9 million therms of natural gas for use by Airport operations and for meeting the needs of most of the tenants. The local utility also supplied an additional 690,000 therms of natural gas to SFO. The summary of implemented and planned energy saving measures and the greenhouse gas (GHG) emission reductions associated with these measures is shown in Table 3-1. These data indicate that implemented boiler replacement and boiler use optimization projects have yielded about 214,000 therms of annual natural gas savings and GHG emission reduction of 1,432 tons per year. In addition implemented lighting efficiency measures have yielded energy savings of 11,591 mWh / year and a GHG emission reduction of 170 tons per year. Planned energy and lighting efficiency projects are expected to yield an additional energy saving of 22,745 mWh / year and natural gas savings of 149,000 therms per year, with a GHG emission reduction of over 1,124 tons per year.

Table 3-1. Summary of Implemented and Planned Energy Efficiency Projects at SFO

Project Title	Number of Projects	GHG Emission Reduction Tons/year
Implemented Boiler Replacement Projects	3	1,432
Implemented Lighting Efficiency Projects	49	170
Planned Energy Efficiency Projects	6	1,124
Planned Lighting Efficiency Projects	4	TBD

Investment Grade Audit Report

In November 2005, the San Francisco Public Utilities Commission (SFPUC) Power Enterprise approached SFO to participate in its *Clean Energy Clean Air Program* to reduce operating costs and improve efficiency at the airport. SFO has had an ongoing effort to reduce the airport's energy costs, and in support of the Mayor's Executive Directive on Energy Efficiency, is participating in the *Clean Energy Clean Air Program* to advance the Airport Commission's energy conservation goals. As a part of this program, the SFPUC engaged their energy consultants, HDR and Cogent Energy, to complete a Preliminary Energy Audit of the SFO Airport in December of 2006. The results of the preliminary audit were presented to SFO senior management in May 2007. The Airport Director then instructed SFO staff to work with the SFPUC to

develop an implementation plan to move forward with further evaluation and implementation of energy efficiency improvements. As a next step, the SFPUC and Cogent Energy worked with SFO engineering and maintenance staff to complete an investment grade energy audit of the mechanical and Heating, Ventilating and Air Conditioning (HVAC) systems of the airport's main terminal complex.

The Investment Grade Audit (IGA) studied the mechanical and Heating, Ventilating and Air Conditioning (HVAC) systems of the airport's main terminal complex, focusing on the public areas of the domestic and international terminals, boarding areas, the central plant, the parking garages and the car rental center, altogether representing over 9 million square feet. SFO engineering is pursuing lighting and other energy efficiency opportunities that were identified in the Preliminary Energy Audit independent from the SFPUC. The objective of the IGA study was to assess the economic feasibility of the HVAC energy-efficiency measures identified in the Preliminary Energy Audit by providing more accurate energy savings and project cost information. The IGA report describes a package of recommended energy efficiency measures estimated to reduce SFO's energy costs by \$6.1 Million per year. The capital investment required to achieve these savings is estimated to cost \$34 Million providing a simple payback of 6.0 years.

In addition to reducing annual energy costs, implementation of energy efficiency measures will provide the opportunity to upgrade outdated equipment, enhance the airport environment and comfort, reduce operations and maintenance costs, reduce electric demand and provide more efficient operation of the airport's heating and cooling systems. As a further benefit, these measures will support SFO's sustainability program and will aid SFO in achieving the goal of carbon neutrality.

IGA's Recommended Energy Efficiency Measures

The current energy cost to operate SFO's HVAC systems, including the central plant, is estimated at \$10.5 million per year. The following recommended measures were extracted directly from the IGA Report:

- Upgrade and standardize the existing controls system.
- Optimize the new control systems at the International Terminal and Rental Car Center
- Convert constant volume dual duct air handlers in Terminal 3 to dual duct variable air volume (VAV).
- Replace two of the boilers in the central plant.
- Upgrade components of the cooling tower and install variable frequency drives on the cooling tower fans.
- Optimize the chilled water and heating hot water distribution systems and convert them to variable flow systems.
- Install a thermal energy storage system at the central plant to generate and store chilled water at night.
- Optimize the pre-conditioned air plant equipment.
- Reset zone temperature set-points.
- Replace two of the older chillers in the central plant with three new high efficiency units.

More details on these energy efficiency measures (EEMs), along with the results of the energy and economic analysis is provided in Appendix C.

Implemented and Planned IGA Energy Efficiency Measures

SFO's Design and Construction Division has integrated the recommended energy efficiency measures from the IGA Report into the Division's Capital and Maintenance Plan, based on priority, impact, resources and funding. The measures that pertain to Terminal 2 have already been completed during the last major renovation which was completed in April 2012. EEMs that require significant changes to the current infrastructure and controls at Terminal 1 and Terminal 3 have generally been deferred to the next major renovation. Table 3-2 shows the EEMs already implemented and currently planned in 2012-2014. The total GHG emissions reduction from the planned projects is estimated to be 1,126 tons.

Table 3-2. Summary of Implemented and Planned Energy Efficiency Measures

Group	Proposed Energy Efficiency Measure	Annual Electricity Savings mWh/yr	Annual Gas Savings Thousand Therms/yr	Avoided Electricity GHG Emission CO _{2e} tons	Avoided Gas GHG Emission CO _{2e} tons	Status
1	EEM 7a: Boiler Replacement	-29	106.7	0.4	568	Implemented
1	EEM 36: Shut down boiler plant during summer months	10	55.5	0	295.30	Implemented
2	EEM 7b: Boiler Replacement	-29	106.7	0.4	568	Implemented
5	EEM 11: Chilled Water Distribution System - Convert Constant Volume Tertiary Pumps to Variable Flow to Lower Pump Speed during Part-Load Operation ¹	197	0.0	3	0.00	Planned (#8806)
5	EEM 14: Hot Water Distribution System - Convert Constant Volume Tertiary Pumps to Variable Flow; Balance the Speed of Parallel Pumps to Lower Pump Speed during Part-Load Operation ¹	197	-7	3	-37.3	Planned (#8806)
6	EEM 35: Chilled Water Distribution System - Convert Constant Volume Secondary Pumps to Variable Flow to Lower Pump Speed during Part-Load Operation	1,341	0.0	20	0.00	Planned (#9158)
6	EEM 8: Chilled Water Distribution System - Install Check Valve in Central Plant Bypass (De-coupler) Line to Improve Chilled Water Distribution Low Temperature Differential	161	0.0	2	0.00	Planned (#9158)
6	EEM 41: Replace Chillers 1 and 2 with three 1,500 ton Chillers and Tower-Free Cooling	3,795	0.0	56	0.00	Planned (#8492, #8545)
7	EEM 26: Terminal 3 Main Terminal Building - Convert to Dual Duct VAV to Increase Efficiency	17,054	155.6	251	828.09	Planned (#8544)

¹ EEM 14, originally proposed in the IGA, is for conversion of tertiary pumps at Terminals 1, 2 and 3. The planned project here is for Terminal 3 only. Conversion work in Terminal 2 has already been completed.

Lighting Efficiency Projects

SFO's Facility Division has implemented 49 energy efficiency enhancement projects since 1998. These projects have yielded electric energy savings of 10,938 mWh and a GHG emission reduction of 141 metric tons per year (Table 1 in Appendix D). Currently Design and Construction is implementing four lighting enhancement projects in Terminal 1, Domestic Garage and off-site buildings. The energy reduction impact of these projects has not been determined at this time. The completion of these projects by the end of 2013 will comply with the requirements of San Francisco Lighting Efficiency Ordinance No. 103-10.

Table 3-3. Planned Lighting Efficiency Projects

Project	Estimated Completion Date
T1 - Baggage Claim Area (#8599)	Dec-13
T1 - Boarding Areas (#8599)	Dec-13
Domestic Garage - Core A/B, B & C (#8599)	Dec-13
Non Terminal Buildings (#9188)	Dec-13

Information Technology Transfer Section's Energy Saving Measures

Since 2005, SFO ITT has embarked on a carbon footprint reduction program to reduce energy consumption by computers and monitors. The energy efficiency measures implemented in this program include:

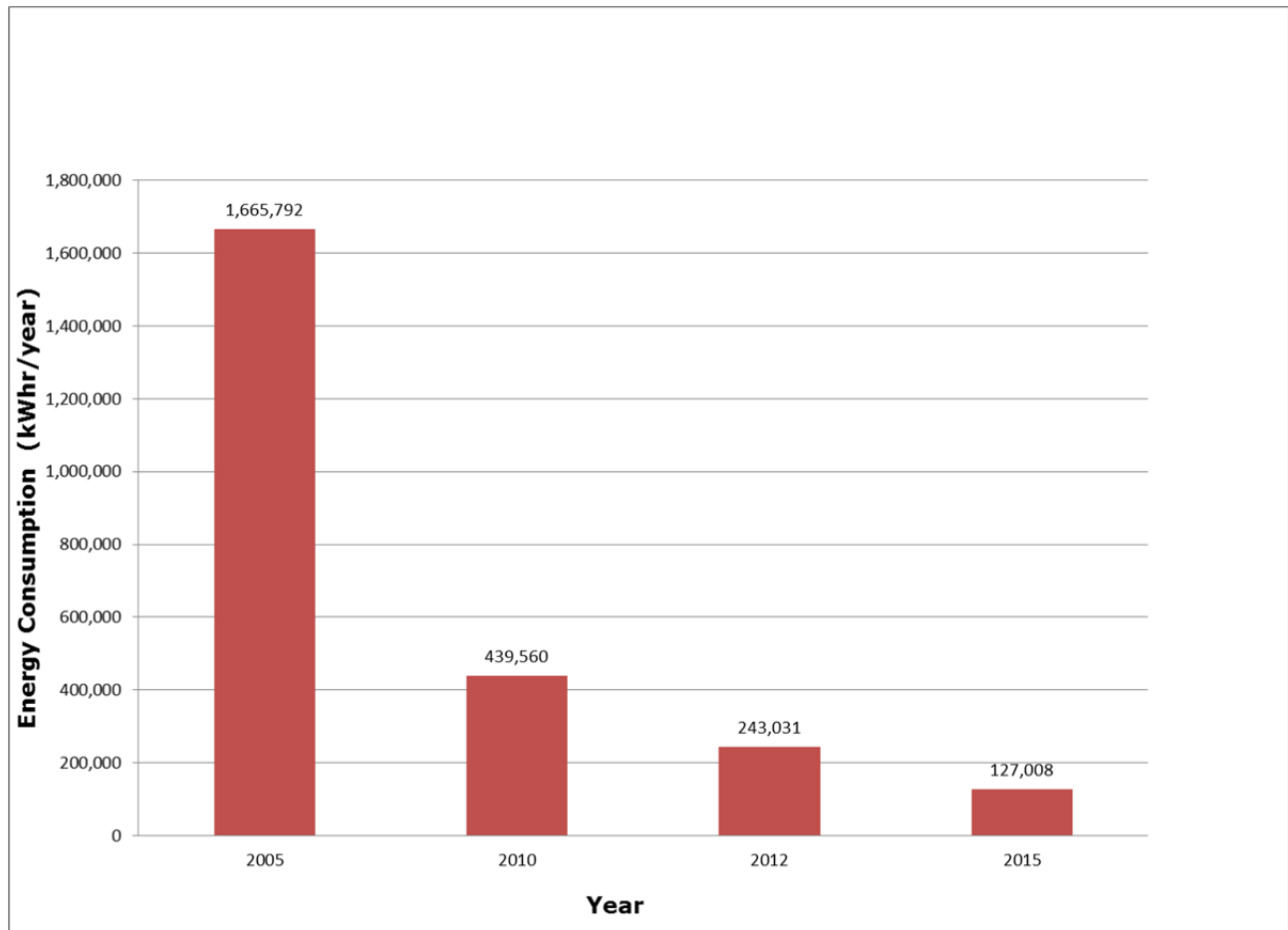
- **Printer Consolidation for reduced energy use** - Starting in 2010, ITT executed a printer consolidation program to reduce the number of printers throughout the Airport Commission. Ninety printers have been eliminated from 340 in 2010 to 250 in 2012.
- **Paper Reduction through Double-Sided Printing-** Double-sided printing setting has been programmed for all printers. This action has reduced SFO's paper consumption by about 50%
- **Energy Star computers and Laptops-** Since 2005, SFO has been gradually replacing older, outdated computers with Energy Star compliant laptops, computers, and monitors. These computers are more energy efficient and reduced SFO's electrical usage.
- **Automated Shutdown of Inactive computers at night-** ITT has also established a PC Power Management Program that turns off all inactive desktop computers at 7:00 PM each night.
- **Server replacement for reduced energy use** – In the Data Centers at SFO, IBM Blade Servers, a rack-based system utilizing common power supplies and network interfaces, have been used for server consolidation and virtualization and replacing older server hardware, while improving CPU utilization and energy consumption.

SFO Energy Use

- **Replacement of LCDs with LEDs** - ITT is gradually converting desktop monitors with LED displays, which require 40% less energy on average than a typical LCD panel. In total, 900 LCDs will be replaced by LED displays during the next three years.

The overall ITT energy efficiency program has yielded a reduction of 74% in energy consumption from 2005 consumption level. A further 47% reduction from current electric energy consumption at ITT are expected by the year 2015 (Figure 3-1).

Figure 3-1. Historical and Projected ITT Annual Energy Consumption at SFO



New Initiatives

- **Implementing the Ground Transportation Management System (GTMS)** - The new GTMS will use real time data along with passenger flow forecasts to optimize taxi service throughout SFO, reducing the number of idling taxis and the associated greenhouse gas emissions.
- **Creating an improved network for the SFO Administration Center** - The new SFO Administration Center will be a wireless campus enabling mobile and tablet devices to access network resources and media reducing the need for paper print outs for meetings and other

business processes. Cloud services and internal resources will improve access to documents, media, and video conferencing. Future enterprise systems can enable increased electronic transactions, workflows and distribution to reduce paper usage.

4. Fleet Vehicles

Summary

SFO's fleet contains 388 light duty vehicles that are licensed for the road and are under 18,000 pounds gross vehicle weight. The fleet includes 99 CNG powered, 17 diesel powered, and 272 gasoline powered vehicles (including 33 hybrid gas / electric vehicles). SFO also operates 28 Neighborhood Electric Vehicles. In FY 2012 SFO's fleet consumed 114,094 gallons of gasoline, 54,959 gallons of biodiesel fuel, and 83,236 gasoline gallons equivalent of compressed natural gas. The combined GHG emission of the fleet was 1,999 metric tons for this period, showing a 6.4% reduction from FY 2011 emission level. SFO is in the process of replacing up to 234 of the least efficient vehicles with new and more efficient, and mostly CNG powered vehicles by 2015. The total cost of this program is estimated at about 10 million dollars and would reduce the fleet's carbon dioxide emission by about 528 tons per year when it is fully implemented.

SFO Fleet Composition

SFO's fleet contains 388 light duty vehicles that are licensed for the road and are under 18,000 pounds gross vehicle weight. In addition SFO operates 34 heavy duty trucks, 16 fire trucks, 6 buses; 45 off road construction equipment, 27 portable light vehicles, 63 lifts, 11 boats, and 14 trailer mounted heavy duty portable generators. SFO also operates 28 Neighborhood Electric Vehicles. Data for fuel consumption and GHG emissions for the fleet vehicles by fuel type are shown in Section 2. The fleet vehicles consumed a total of 252,290 gallons of various fossil fuels in FY 2012 and generated 1,999 tons of GHG emissions.

Table 4-1. Summary of SFO Fleet Vehicles for 2012 Fiscal Year

Fuel Type	Number of Vehicles
Gasoline	322
Biodiesel	137
CNG	145
Total	604

Fleet Vehicles Reduction and Replacement Program

SFO is in the process of replacing 234 of the fleet vehicles with the highest odometer readings. Of these, 220 vehicles are gasoline powered, 13 use diesel fuel and one is a CNG powered vehicle. Information on the fleet vehicles replacement schedule and volume of various fuels consumed by the vehicles is summarized in Table 4-2. The calculated annual greenhouse gas emissions from the vehicles slated for replacement is also shown in this table. The vehicles slated for replacement generated a combined total of 1,020 tons of GHG emissions in FY 2008. Currently 16 gasoline, 34 CNG, 8 diesel, and 2 electric powered vehicles are on order by the Airport.

Table 4-2. Summary Data for SFO Fleet Vehicles Replacement Program

Fiscal Year	Number of Vehicles to be Replaced			FY 2008 Fuel Consumption (Gallons)			FY 2008 Greenhouse Gas Emission ^b (Tons)		
	Gasoline	Diesel	CNG	Gasoline	Biodiesel	CNG ^a	Gasoline	Biodiesel	CNG
2011-13	77	2	1	51,156	2,045	258	451	19	1.6
2013-15	77	1	0	35,578	66.3	0	313	0.63	0
2015-17	66	10	0	21,527	4,660	0	190	44	0
Total	220	13	1	108,261	6,771.3	258	954	64	1.6

^a Gasoline gallon equivalent, ^b Unit emission factors are shown in Section 2 of the report

All City departments are also required by Healthy Air and Clean Transportation Ordinance (HACTO) to reduce the size of the vehicle fleet with 8,000 lbs gross weight by 5% per year over a four year period starting in 2012. Currently 138 vehicles at SFO fall under HACTO provisions. SFO is in the process of implementing a car pool program in which 26 passenger cars will be stationed at four car pool locations and would be available to all employees for temporary use, on an as needed basis, by reserving a car over the intranet. SFO will collect and analyze vehicle use data from the car pool program to evaluate the feasibility of removing some of these vehicles from service in compliance with HACTO.

GHG Emission Reduction Impact of the Proposed Vehicle Replacement Program

The proposed fleet vehicles replacement program would substitute more efficient CNG powered vehicles for the existing gasoline and diesel powered trucks. The impact of the six-year replacement program on reducing the GHG emissions from the SFO fleet is summarized in Table 4-3. Assuming that the new vehicles would achieve a fuel efficiency of 16 miles per gallon, the same as the current CNG powered vehicles, then the GHG emissions from the fleet would be reduced by about 528 tons per year or a 26% percent reduction from the current level of total fleet GHG emission and over 48% reduction from the current emission level from the vehicles that are to be replaced. The cost of the six year replacement program is estimated at \$10,158,300.

Table 4-3. Summary of Fleet Vehicle Replacement Costs and GHG Emission Reduction Levels

Fiscal Year	Number of Vehicles to be Replaced	Planned Capital Funding, Millions	Estimated Annual Mileage	Estimated CNG Consumption (GGE/Yr) ^a	Estimated Future Annual GHG Emission (Tons/Yr) ^b	Current Annual GHG Emission (Tons)	Annual GHG Emission Reduction (Tons)
2011-13	80	\$3.5	634,969	39,686	247	472	225
2013-15	78	\$3.37	361,733	22,608	141	314	173
2015-17	76	\$3.31	268,094	16,756	104	234	130
Total	234	\$10.16	1,264,796	79,050	492	1,020	528

^a Based on the current efficiency of 16 MPG for CNG vehicles in the SFO fleet

^b Based on the estimated carbon dioxide emission of 11.70 lbs per Therm of CNG and a conversion factor of 1.15 therms per gasoline gallon equivalent

A comparison of the data shown in tables 4-2 and 4-3 shows that the new CNG powered vehicles would require approximately 36,240 fewer gallons of fuel per year than the existing vehicles for the same number of miles of usage.

Other Implemented or Planned Emission Reduction / Offset Measures for Fleet Vehicles

The following additional emission reduction / offset measures are planned for SFO's fleet vehicles:

- All diesel powered vehicles that are fuelled at the Airport Auto Shop's fuel island have been converted to Bio-Diesel (B20) fuel
- 50% of "on-road diesel" vehicles have been equipped with a Diesel Particulate Filter (DPF) to reduce 95% of exhaust particulate emissions.
- 40% of "off- road diesel" construction equipment have been equipped with a DPF to reduce 95% of exhaust particulate emissions.
- Any vehicle requiring air-conditioning repair and which uses the R-12 refrigerant, an ozone depleting gas, will be retro-fitted to use the R-134A, an ozone-safe refrigerant gas with a lower global warming potential.
- Neighborhood Electric Vehicles will be purchased for use at SFO whenever possible.
- Administrative and educational measures will be taken to inform all SFO staff to avoid running the fleet vehicle engines in the idle mode, to the maximum extent possible. Unnecessary idling of the vehicle engines is wasteful of fuel and would result in poor mileage efficiency for all vehicles.

SFO is continuing to upgrade the fleet vehicles and replacing the aging vehicles with fuel efficient cars including hybrids and electric vehicles. The budget for fleet replacement program has been included in the Capital Improvement Program and is expected to be completed over the next four years. The following is a summary of planned vehicle replacement and other related energy efficiency measures:

- Continue to purchase alternative fuel vehicles. (Additional cost for CNG conversion to base vehicle price is \$10,500 for a Ford Crown Victoria, \$18,000 for a pickup truck)
- Purchase more NEV (neighborhood electric vehicles)
- Purchase 100% electric powered vehicles. A new breed of electric vehicles is expected to be available in the near future.
- Install DPF's (diesel particulate filter) with N₂O (nitrous oxide) reduction. (Cost \$18,00.00 to \$32,000.00)
- Install DPF's on non-emergency generators to be used in construction.

- Replace towable diesel powered light plants with hydrogen power. Auto Shop is currently working with Sandia Laboratories on this project and hopes to have a prototype in service at SFO late this year when the hydrogen fuel station is expected to open at the south end of the airport.
- Purchase hybrid service trucks. Example: Bucket truck in which the diesel engine can be shut off and the Bucket (or accessories) can be used while powered by on board batteries.
- Reduce vehicle idle time.
- When traffic lanes need to be closed for work, use more solar powered traffic signs. Use battery operated illuminated traffic cones.
- Install a car pool (vehicle sharing) system. Auto Shop is currently working on this program for three locations on SFO property
- Determine if an employee van pool would work from outlying areas. For example employee commuting from South Bay, East Bay, or North Bay could potentially benefit from a car pool van.
- Telecommute from home one day a week, when feasible.

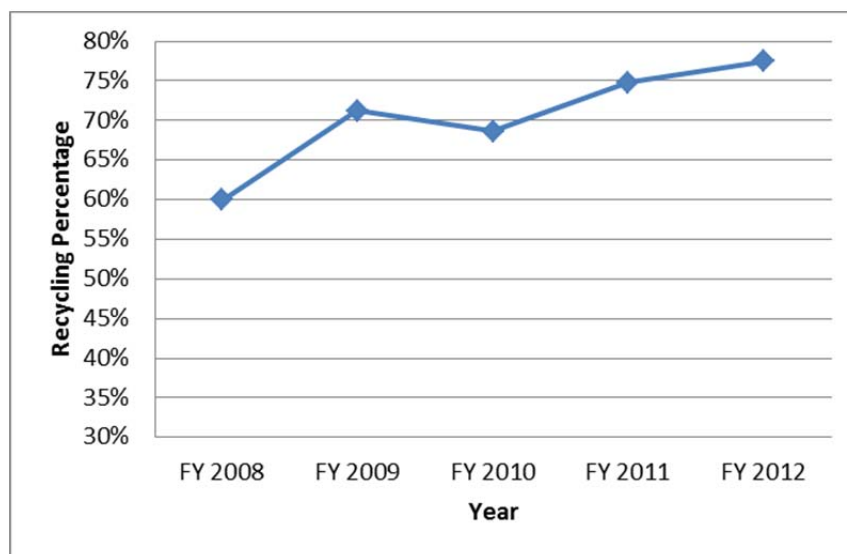
5. Zero Waste Plan

Summary

Solid waste is generated at Airport operated facilities, aboard incoming aircraft, and by various Airport tenants. SFO provides solid waste collection and disposal services in the public areas of all terminals. The Airport also provides solid waste disposal services at the terminals to various concessionaires and to most airlines. Some airlines and concessionaires at SFO maintain independent solid waste handling operations. Most recyclable materials such as cardboard, glass, aluminum, plastic bottles, etc. are collected separately at the Airport and are recycled by the contractor providing solid waste transport and disposal services to the Airport. The mixed solid waste materials collected from the Airport are sorted by the contractor at their offsite facilities where additional recyclable materials are removed from this stream.

As shown in Figure 5-1, the solid waste recycling rate at SFO has gradually increased since 2008. In FY 2012 SFO collected 10,239 tons of solid waste at the terminals and at other facilities. A total of 7,960 tons (77.7%) of this waste was recycled by Airport contractors. On-site source separation contributed 2,254 tons (22%) of the recycled waste. In addition 3,661 tons or 35.7% of the generated solid waste was hauled directly to a composting facility. Recyclable materials from the remainder of the waste separated at off-site facilities of South San Francisco Scavenger Company (SSFSC). The solid waste reduction and recycling programs offset the GHG emissions at SFO by 2,852 tons in FY 2012. SFO is continuing to enhance solid waste recycling operations and is aiming for the goal of 85% recycling by 2017 and 100% recycling by 2020.

Figure 5-1. Historical Solid Waste Recycling Rate at SFO



Waste Profile

In FY 2012 about 10,239 tons of general solid waste was generated at SFO of which 7,960 tons or 77.7% percent was recycled. No additional recycling from construction/demolition waste was recorded as no significant construction activity occurred during this period. Detailed information on the composition of the solid waste and the quantities of recycled wastes is provided in Table 5-1. These data indicate fairly consistent overall recycling rates throughout FY 2012. As shown in Table 5-2, the quarterly recycling rates for the Airport's source separation operations ranged from 16.9% to 31.8% as a percentage of total waste, with an annual average rate of 22%. The wide range in the source separation rate is due to an increase in the amount of wood recycled during the second quarter of 2012. The SSFSC's quarterly offsite recycling rates, varied from 49.2% to 60.0% with an average annual recycling rate of about 56%. The estimated recycled tonnages for the sorting operations performed by SSFSC at their offsite facilities are based on SSFSC's service area characteristics and do not necessarily reflect the composition of the waste materials hauled off from the Airport. Graphical representations of quarterly solid waste generation and recycling rates for FY 2012 are shown in Figures 5-1 and 5-2.

Table 5-1. FY 2012 Solid Waste Generation and Recycling Rates at SFO by Waste Type

Solid Waste Type	Quantity, tons				Total Quantity Recycled, tons
	1st quarter	2nd Quarter	3rd Quarter	4th Quarter	
Cardboard	321	357	312	325	1,315
Wood	90	558	44	30	722
Mixed Recyclables (aluminum, glass, plastics)	68	60	64	75	267
Mixed Paper	20	18	19	16	73
Composted Waste	985	912	854	796	3,547
Newspaper	117	117	102	116	453
Magazines	112	113	99	112	436
Waste Paper	155	156	136	155	601
Glass	46	46	40	45	177
Aluminum	18	18	16	18	70
Plastics	5	5	5	5	21
Scrap Metal	10	10	10	10	40
Clippings	0	0	0	0	0
Industrial Treatment Sludge	23	23	17	63	126
Sanitary Treatment Sludge	29	29	29	29	114
Total Recycled	1,999	2,421	1,746	1,795	7,960
Mixed Waste (landfilled)	696	567	494	522	2,279
Grand Total	2,695	2,988	2,240	2,317	10,239

Table 5-2. Quarterly Solid Waste Generation and Recycling Rates at SFO in FY 2012 (Tons)

Period FY 2012	Solid Waste Generation, Tons			Offsite Recycling Rate ^a	Onsite Source Separation Rate ^a	Combined Recycling Rate
	Mixed	Source Separated	Total Combined			
1st Quarter	2,238	457	2,695	1,542	457	1,999
				57.2%	16.9%	74.2%
2nd Quarter	2,037	951	2,988	1,470	951	2,421
				49.2%	31.8%	81.0%
3rd Quarter	1,837	403	2,240	1,343	403	1,746
				60.0%	18.0%	78.0%
4th Quarter	1,873	444	2,317	1,351	444	1,795
				58.3%	19.2%	77.5%
Total	7,985	2,254	10,239	5,706	2,254	7,960
				56%	22%	77.7%

^a Based on the combined tonnage of general solid waste generated at the Airport

Figure 5-2. FY 2012 Solid Waste Generation and Recycling Rates at SFO

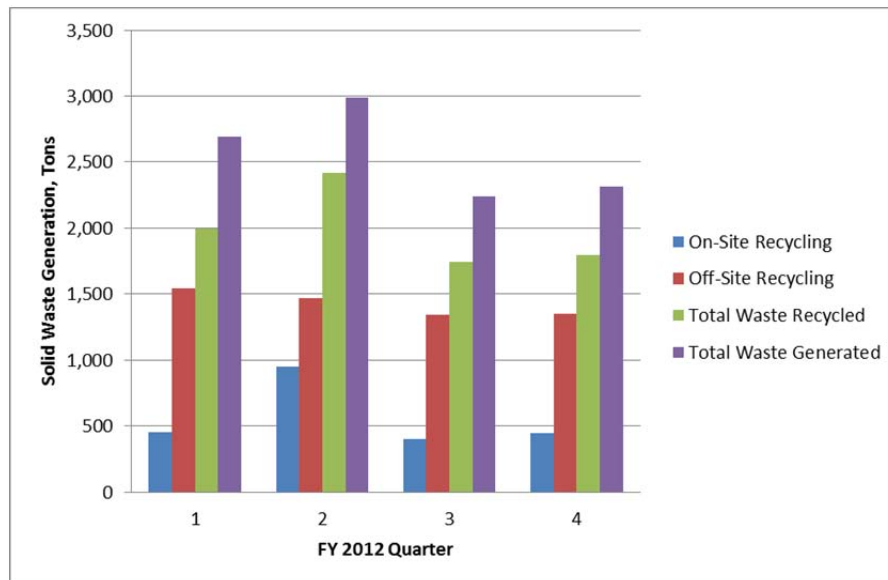
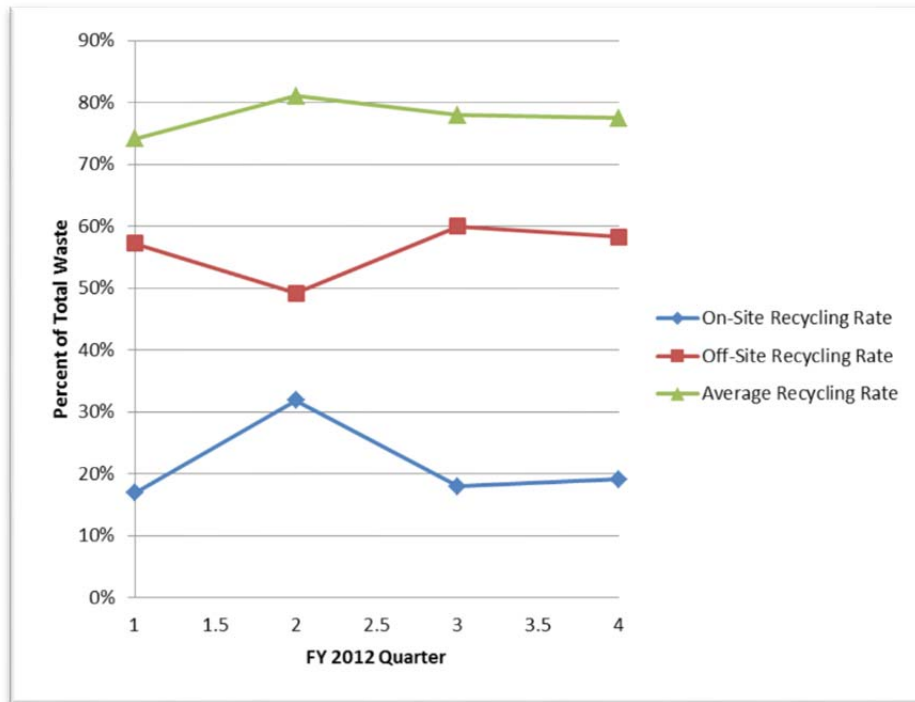


Figure 5-3. FY 2012 Quarterly Solid Waste Recycling Rates at SFO as a Percent of Total Waste



Waste Characterization

In August 2008 SFO performed a waste characterization study in which the contents of all 19 solid waste compactors deployed at various locations around the terminals, and at other Airport facilities, were individually examined at SSFSC recycling facilities during a one week period. In this investigation the net weight of the waste material in each compactor was obtained by weighing the trucks before and after dumping the compactor contents. The waste was then spread evenly on the ground and the volume and weight of the various components of the waste were estimated in up to three representative samples that were isolated from each compactor load. The results of this analysis are summarized in Table 5-3. These results indicate that food waste and other compostable materials comprise 55% of the waste material transported to SSFSC's recycling facilities from SFO. The non-recyclable refuse constitutes about 9.4% of the waste and the balance of 35.6% consists of recyclable materials. The contents of several compactors, however, were composed of up to 99% biodegradable materials. Based on the results of this study SSFSC increased the amount of SFO waste sent to compost from about 30 tons per quarter to over 800 tons per quarter starting in the fourth quarter of 2008 and the amount of waste sent to a composting facility continues to increase every year.

Each year since 2012, SFO conducts an overall waste audit to monitor the constituents in the compactors. The observations from the audit show that the compactor loads contain high levels of recoverable

materials. Using this information, SSFSC continues to send compactors with high compostable content directly to the composting facility. SFO also uses this waste audit to identify opportunities to improve the airport's solid management plan.

Table 5-3. Composition of Representative Samples of Solid Waste Hauled off from SFO^a

Waste Component	Weight (lbs)	Percentage
Paper	41,060	25
Plastic	3,590	2.2
Glass	11,800	7.2
Metal	2,380	1.5
Food Wastes	41,420	25.3
Other Compostable Waste Materials	47,560	29
Refuse (Non-recyclable)	15,930	10
Total	163,740	100

^a Based on visual examination of the contents of all 19 compactors deployed at SFO and transported from SFO to South San Francisco Scavenger Company's recycling facilities in a 2008 study

Solid Waste Management Programs

SFO has undertaken a comprehensive waste reduction program including resource conservation, source separation, and composting. The objective of these reduction measures is to achieve a recycling rate of 85% by 2017 and 100% by 2020.

Enhanced On-Site Source Separation

In FY 2012 approximately 22% of the solid waste generated at the Airport was separated on site and transported directly to the recycling facilities.

SFO Actions

To support enhanced source separation, the Airport has deployed solid waste containers, in sets of three, for depositing paper, bottles and cans, and general trash throughout the terminal spaces. Additionally, SFO has provided separate compactors and storage bins for mixed paper, cardboard, plastic bottles and cans, food waste, trash and grease in solid waste loading areas that are fully accessible by Airport employees and tenants.

Beginning in 2011, SFO has started providing drain stations at the security checkpoints for emptying water bottles and depositing other bottles that could not be brought into the secure areas. These facilities have aided in reducing the disposal of partially full water bottles into waste receptacles in the Terminals. Additionally, hydration stations are provided in key locations at the terminal complex with the goal of decreasing the waste generated from single-use plastic bottles that would otherwise be discarded at the security screening stations.

Airline Actions

SFO has engaged the various airline staffs to encourage source separation of solid waste generated aboard the incoming aircrafts. The response of most airlines has been positive. Further consultation with airlines will be carried out to improve the rate of source separation aboard the aircraft.

Improved Off-Site Separation

In FY 2012, SFO's contractor achieved a recycling rate of 57% for mixed solid waste transported off the Airport. This value represents the average rate of recycling for the combined operation of SSFSC including the offsite composting operations.

Composting

Although the composting rate is captured in the off-site separation recycling rate by SSFSC, it requires the support of the Airport staff and tenants. The following programs have been implemented by the Airport to promote the source separation of compostable materials.

- **Airport-wide** In 2007, SFO initiated a program for separate collection of food waste from food vendors at the terminals. The food waste along with landscaping trimmings and wastewater treatment sludge is transported to offsite composting facilities.
- **Terminal 2** In 2011, SFO implemented an enhanced composting program for the waste generated in the Terminal 2 food court. SFO requires food vendors in Terminal 2 to supply biodegradable tableware, plates and containers, allowing the composting of 100% of the generated waste. SFO plans to phase in this program at other terminals in the future.
- **Tenant Education and Outreach** In 2012, SFO initiated a pilot program to educate food service tenants on recycling and composting in their specific areas. The outreach effort is intended to help increase the source separation of recyclable and compostable material and reduce the quantity of trash generated. Tenant spaces were also evaluated as part of the program to ensure easy access to recycling and composting bins. It is anticipated that this program will continue in 2013.

Material Use Reduction

The goal of the resource conservation program is to educate, encourage, and persuade the Airport staff, tenants, and the general public to generate less waste in the course of their daily activities at or travel through the Airport. This program includes the following elements:

- **Paper Use Reduction.** SFO staff has developed a paper use reduction program, pursuant to the Mayor's Executive Directive, by assigning a paper allocation to each Division at 80% of the

previous year's consumption and requiring the submittal of a special request if the assigned allocation is prematurely exhausted.

- **Double Sided Printing and Copying.** All SFO printers and copiers have been programmed to produce double sided prints or copies. Signs have also been posted at all copying machines exhorting the users to save paper and avoid un-needed copying.
- **Electronic Document Transfer.** SFO is encouraging all staff to transmit various documents electronically.
- **Paper Towel Use Reduction.** SFO has experimented with the use of electric hand dryers in the Airport terminal restrooms. The results of the pilot program have been promising and plans are being made for widespread use of these hand dryers throughout the Airport. The use of electricity by the dryers is mitigated by the benefits derived from saving paper towels.

Construction and Demolition Waste Recycling

The City's Green Building Ordinance calls for recycling a minimum of 75% of non-hazardous construction and demolition waste generated at City construction projects. SFO also maintains a goal to recycle at least 75% of the waste generated at Airport's construction and demolition projects. Additionally, SFO requires all major renovations and construction projects to be LEED® Gold Certified by USGBC. USGBC's LEED® Certification process encourages contractors to recycle and/or salvage at least 50% of non-hazardous construction and demolition debris and awards additional points for achieving a recycling rate of 75% or more. SFO consistently surpasses this goal, achieving construction and demolition waste recycling rates above 90%.

Potential Solid Waste Management Measures

SFO intends to increase the rate of solid waste recycling from the current level of about 77.7% to the target level of 80% by 2015 and 85% by 2017. The potential solid waste management measures that are under consideration at SFO are summarized below.

1. **Training to Custodial Staff** All custodial staff and other employees responsible for collecting and transporting waste materials and recyclables to the appropriate bins should receive additional training on what happens to the materials once it leaves the Airport, and how to properly manage loads with high compostable content, garbage and the recyclable materials.
2. **Install drains throughout Terminals** Currently, passengers dispose of their unfinished liquids in trash cans. In some pre-security areas, containers are placed for passengers to empty water bottles and re-use them after security. To reduce the amount of solid waste generated, drains should be installed in food court and pre-security areas to allow passengers to empty all liquids.
3. **Require the use of Compostable Tableware in all Terminals** Plastic serve-ware from food service vendors is a significant component of the wastes deposited in the compactors. Replacing disposable plastic serve-ware with compostable serve-ware would greatly reduce the amount of waste that has to be disposed of in a landfill. In addition to the food serve-ware provided to customers, the vendors should be required to use reusable or compostable service trays, food containers, cups, plates, etc. to enable composting of 100% of the waste generated by such vendors.

4. **Require Use of Clear Liner Bags:** Black plastic liner bags are still in use in some sections of the Airport. Black plastic bags filled with recyclable materials are likely to be dumped into the garbage compactors since custodial staff would not be able to visually identify the contents of these bags. Eliminating the use of black plastic bags and replacing them with clear bags will reduce the amount of source separated recyclables that would be sent to the offsite sorting facilities.
5. **Require Composting in Employee Lunchrooms** To reduce the amount of waste generated, composting bins and proper signage should be placed in all Commission employee lunchrooms. Outreach will be done to educate employees on composting and recycling.
6. **Recycle materials taken off aircraft**
Some flight crews are collecting recyclables in separate bags on board the airplanes. The sorted materials, however, are then discarded with the trash by custodial contractors. Airlines should be required to train their ground crews to keep the sorted recyclables separate from the remaining trash.

Airlines should be encouraged to discontinue or limit the offering of disposable travel kits and other giveaways (such as eye shades, sleeping socks and toothbrushes) that end up being discarded at the end of the flight without having been used.
7. **Collect materials abandoned at Security Checkpoints:** Textile and leather goods constitute up to 10% of the contents of SFO compactors by weight. Most of these items appeared to be clothing, baggage, and other accessories that may have been discarded by passengers to avoid paying excess luggage charges or for other reasons. Separate collection of these items for donation to a non-profit thrift organization could reduce the quantity of waste produced at the Airport and prevent the waste of a resource.
8. **Donate Surplus Food Items:** Surplus food items are currently deposited by food vendors into the compactors. Airport could encourage the vendors to donate such food items to a food pantry. HDPE cooking oil containers inside cardboard boxes are also being discarded in the compactors. The feasibility of recycling these containers without removing them from the boxes should be explored.
9. **Retail Vendors:** Plastic bags handed out by retail vendors to their customers are often discarded by passengers and end up in the compactor loads. These bags should be replaced by paper bags that could be recycled or composted when discarded.

6. Employee Commute Program

Summary

Since 1993 SFO has implemented a Transit First Policy, intended to promote the use of public transport by SFO employees and by passengers; and by the employees of airlines, airline support services, and concessionaires. Under this program biennial surveys of employees are carried out to assess the modes of transit used by SFO employees and develop appropriate measures to encourage the use of public transit by a greater number of employees. The results of the latest employee survey carried out in July 2012 indicated the following:

- 76% of the 1,592 respondents drive alone to work
- 10.6% use carpool or vanpool
- 12.2% use public transit (BART, Samtrans, and Caltrain)
- 1.2% use other modes (motorcycle, bicycle, walking, etc.)

The GHG emissions from all modes of commute, by SFO's 1,998 employees (including police and fire), were estimated to be about 2,534 tons in FY 2012. Several incentive programs are currently offered to SFO employees to encourage the use of public transit. A BART fare discount has been put in place, and new programs to develop bus service, link to a new ferry terminal, and encouraging bicycle use for on-site work related travel consideration or being implemented.

Employee Survey Results

In June 2012 SFO conducted a survey of employee modes of travel to and from work. A total of 1,592 employees responded to this survey. The results of the survey are summarized below:

- 76.0% of employees drive alone to work
- 10.6% use carpool or vanpool
- 12.2% take public transit
- 1.2% use other modes (motor cycles 0.69%, bikes, etc. 0.30%)
- The average one-way commute time is 35 minutes
- Travel time and convenience are the most important factors in determining the commute mode.

GHG Emissions for Employee Commute in FY 2012

Estimates for GHG emissions from various modes of commute by SFO employees were developed on the basis of information obtained from the June 2012 employee commute survey. The GHG emission impact of the commute travel by SFO employees is summarized in Table 6-1 indicate a regional GHG emission contribution of about 2,790 tons in FY 2012 by SFO employees commuting to work.

Table 6-1 FY 2012 Annual GHG Emissions from Commute Travel by SFO Employees

Commute Mode	Percent of Employees	Miles Travelled	Total
Drive Alone ^{a,b}	76.02	6,839,515	2,505
Carpool ^{b,c}	10.58	317,294	116
Bart/Caltrain/Samtrans ^d	11.5	1,034,654	45
Airport Shuttle	0.65	58,480	132
Motorcycle/Scooter ^f	0.69	62,079	14
Telecommute ^e	0.2	0	0
Bicycle	0.3	0	0
Total	99.94	8,312,023	2,812
Emission Reduction for Compressed Work Week Program^g	0.05	-2,273	-22
Net GHG Emission		8,368,829	2,790

^a Based on a total employee count of 1,998 an average roundtrip commute distance of 19 miles, and 237 work days per year

^b Based on a fuel efficiency of 25 miles per gallon, and a GHG emission of 19.42 lbs per gallon of gasoline

^c Based on an assumed number of 3 passengers per car pool and 237 work days per year

^d Based on the BART emission factor equivalent to 12 percent of the personal auto emission rate

^e Based on an average fuel efficiency of 4.5 miles per gallon of diesel fuel and a GHG emission of 22.37 lbs per gallon of diesel fuel

^f Based on an estimated fuel efficiency of 40 miles per gallon of gasoline

^g Based on the participation of 36 employees in the 9/80 Compressed Work Week Program (CWWP) and 63 employees in the 4/40 CWWP in FY 2012 and using an Airport-wide average GHG emission reduction of 12.86 lbs per employee per avoided commute day

Transit First Program

The goal of SFO's Transit First Policy is to promote public and private high occupancy vehicle (HOV) access to the Airport. Implementation of this policy increases the use of shared-ride modes over driving alone, thereby reducing emissions.

The Transit First Policy includes the following Airport goals and objectives:

Employee Commute Program

- Reduce traffic congestion by encouraging public transportation;
- Develop regional transit services, including rail and ferry;
- Provide preferential parking for employee vanpools; and
- Minimize on-Airport congestion and delays by increasing the efficiency of Airport roadways and ground transportation loading zones.

Existing Transit First Measures

Measures taken by SFO for reducing the GHG emissions from employee commute activities are described below:

1. City Transit Incentive Program and Tenant Commuter Benefit Regulation

Airport Commission employees can purchase up to \$125 per month in transit or vanpool value on a pre-tax basis through the City's payroll deduction program. Most tenants are required to offer a similar program, or can directly pay their employees' transit or vanpool expenses up to the value of a Municipal Railway Fast Pass (currently \$72 per month).

2. Bay Area Rapid Transit (BART) SFO Discount Card

Airport Commission employees and most non-airline tenant employees working at SFO qualify for a BART Discount Card that reduces BART's airport surcharge from \$4.00 to \$1.50 per trip. The surcharge, even at \$1.50 each way, remains a hindrance toward increasing overall ridership; therefore, staff has developed a reimbursement concept to address this issue. Airline employees currently have a separate discount program that provides for a 25% reduction of each total fare which includes the higher \$4.00 surcharge.

3. San Mateo County Transit District (SamTrans) Public Bus Service

SamTrans operates two principal bus routes through SFO, plus a third route offering limited overnight service with Airport financial support. The most important service, local trunk line 292, typically runs every 30 minutes between San Francisco and Redwood City. Route KX, the second principal line, operates hourly nonstop service from downtown San Francisco to the Airport. Overnight hourly Route 397 is a hybrid of these two routes, and is the only public transportation to SFO during BART's nighttime shutdown between midnight and 5:30 a.m. (up to 8:30 a.m. on Sundays).

4. Emergency Ride Home Program

The City's Emergency Ride Home Program is also administered by the Department of the Environment. Airport Commission employees may participate in the City's Emergency Ride Home (ERH) Program. In any emergency, this program provides four free or low-cost rides home per year, for employees who regularly uses carpool, vanpool, public transit, bicycles or would walk to work. ERH eases the worry of being stranded at the office without a car.

5. Direct Terminal Access by Ground Transportation Vehicles

At SFO, passengers using shared-ride and professionally-operated ground transportation services are dropped off and picked up at ground transportation zones at each terminal, except for BART rail service. This contrasts with other airports where these services may be located in a distant center requiring transfer to an intermediate service. Direct terminal access is a major reason why 45% of SFO passengers use shared-ride modes for ground access and egress.

6. Curbside Management Programs

Launched in January 2000, this innovative program improved customer service and traffic flow through the taxi, limousine, and shared-ride van loading zones from early morning until after midnight. As a result, the use of shared-ride services has increased, reducing Airport and freeway congestion. Furthermore, these services are now provided mainly with hybrid-electric and compressed natural gas (CNG) vehicles.

7. Airport Information Booths

For the convenience of air passengers and Airport employees, all Airport information booths provide ground transportation information. Selected SFO booths sell public transit tickets and passes, redeem vouchers for BART transportation, and provide a computer terminal for employees to load their BART SFO Discount Cards and Clipper Cards.

8. New Employee Briefings

New Airport employees receive commute alternatives information from Human Resources when they begin employment at SFO, and then attend an employee briefing on many topics including commute options.

9. Traffic Control Measures

An ongoing priority of Airport staff is to relieve traffic congestion and expedite ground transportation on the Airport roadways. Currently, lanes 1 and 2 of the arrivals level roadway at Terminal 1 are dedicated to taxis, Airporter and SamTrans buses at most hours, so that these services don't have to compete with private motorists. Construction projects in and around the Airport roadways are carefully coordinated to reduce traffic congestion. Project managers, traffic engineers, Landside staff and Airport Duty Managers continue to work together to minimize the effects of roadway construction projects.

10. 511.org Website and Phone Support

Besides providing traffic, transit and ridesharing information for the Bay Area, the Metropolitan Transportation Commission's 511 service also provides ground transportation information for SFO. Airport staff supports this valuable communications tool by providing 511 staff with information on major changes to Airport ground transportation and construction projects with a potential for traffic delay.

11. Compressed Work Week Program (CWWP)

Certain SFO employees may choose to work a compressed schedule of 80 hours over 9 days in each two-week period (9/80 option) or 40 hours in four days per week (4/40 option). Currently a total of 36 SFO employees participated in the 9/80 CWWP and 63 employees participated in the 4/40 CWWP. A unit GHG emission factor of 12.86 lbs per employee per commute day was developed on the basis of the estimated FY 2012 GHG emission of 2,790 tons for commute by 1,998 employees, in the absence of a CWWP. The total GHG emission reduction for the CWWP at SFO was, therefore, estimated at 22 tons per year in FY 2012.

Potential Transit First Initiatives

Although the established programs have served the Airport and surrounding communities well since the Transit First Policy was originally developed in 1996, several new initiatives are now being pursued to update the policy. The following initiatives are being assessed for feasibility and development to further enhance our Public Transit options:

1. Public Information

SFO effectively manages its own website and encourages both the internal and external development of mobile applications. Effective public information about Airport ground transportation involves well-designed websites and mobile applications. These will be implemented for passenger use prior to the end of 2013.

2. Pre-Loaded Clipper Card

SFO is working with the San Francisco Municipal Transportation Agency (MTA) on the development of a visitor Clipper Card, which would be pre-loaded with sufficient value to allow its use for round-trip BART transportation between the Airport and San Francisco, plus unlimited Muni transportation within the City for a period of days. It would address a long-standing problem where, unlike other cities, San Francisco visitor transit passes do not cover Airport transportation costs.

3. Ferry Connection

The Bay Area Water Emergency Transit Authority (WETA) initiated a new ferry service between downtown Oakland, Alameda, and South San Francisco in June 2012. Initially, the service will only operate during weekday peak periods. In summer 2011, Airport staff met with WETA management at their San Francisco offices to discuss the potential for bus and bicycle links between the Oyster Point ferry terminal and SFO. A key motivator for establishing the ferry service is to provide emergency cross-Bay transportation in the event of an earthquake or other disaster which results in closure of a bridge or the BART tunnel. Airport staff continues to look into the feasibility of providing this service through ongoing studies and surveys.

4. Airport Reimbursement of Employee BART Airport Surcharge

The Airport has the only station within BART's system that has a surcharge. Airport employees who ride BART to and from work pay an extra \$3 round trip daily for this service as part of the regular fare. In order to create an additional incentive and increase employee ridership, the Airport is considering a plan that might eliminate this surcharge.

5. New Local and Commute Bus Service

More will be done to develop bus service from residential areas to SFO. Currently, transit and vanpools are more attractive for longer-distance trips involving a Bay crossing or a long drive from Santa Clara County. SamTrans is working with Airport staff on researching employee trip patterns to assess the development of shuttle service from residential sections of northern San Mateo County to the Airport. The Peninsula Commute Alliance can facilitate this research and also encourage carpool formation, with Airport support. Residential areas of San Francisco beyond walking distance from BART might best be served by subscription buses that are less luxurious than those operated by major Silicon Valley employers, but serve the same function. Once the full study is complete, we will determine next best steps before proceeding.

6. Social Ridesharing

Not all employees have a regular daily commute. Solo drivers can adjust their route, and possibly their schedule, to accommodate their personal life. “Social ridesharing” firms like Zimride and Ridespring have formed to allow spontaneity in daily carpool formation. These firms charge employers a membership fee so their staff can post ride offers and needs on a personalized and relatively private electronic bulletin board. The Airport will promote and help facilitate the increased use of these Social rideshare programs.

7. Bicycling

The Airport is moving forward with an on-campus shared bike program which is currently under development. This program will allow Airport Commission employees access to bicycles from six conveniently staged location points throughout Airport property. A pilot for this program is scheduled to begin in August. In addition, the Airport has identified bike access routes linking SFO to the Oyster Point ferry location. Airport staff is working with South San Francisco traffic engineers to refine this route and ensure proper roadway markings are in place.

7. Other Measures

Summary

This section covers the other sustainability activities undertaken at SFO as follows:

- SFO has a policy of securing LEED Gold certification for all new building construction and major renovation projects. In 2011, SFO obtained LEED Gold certification for Terminal 2 Renovation and for Building 575 remodeling project. SFO is currently seeking LEED Gold certification for the following projects:
 - Air Traffic Control Tower and Integrated Facility
 - Boarding Area E Renovation
 - Terminal 3 Security Checkpoint
 - Airport Operations Building
 - West Field Cargo Building
- New PC Air and 400 Hz power supply systems have been installed at the International Terminal A and G gates, 5 gates in Boarding Area C, 6 gates in Boarding Area F, and all gates at Terminal 2. Installation of PC Air and 400 Hz power supply facilities eliminates most of the need for the use of Auxiliary Power Units (APU) on board the aircraft parked at the gates and is expected to save about over 5.7 million gallons of jet fuel and mitigate the GHG emissions by about 57,192 tons per year.
- In 2009 SFO initiated a three-year Pilot Green Car Rental Incentive Program in conjunction with the rental car companies operating at the Airport. This program provided financial incentives to the rental car companies to increase the number of fuel efficient cars in their rental vehicle inventory. During the first two years the program also provided a discount to the customers who rented a Green Car. In FY 2012 car rental agencies at SFO increased the number of transactions for EPA SmartWay rated vehicles to 13.6% of the total transactions and the rental of EPA SmartWay Elite rated cars was increased to 1.0% of the total transactions. These transactions resulted in saving 904,787 gallons of gasoline and mitigated GHG emissions by 8,049 metric tons. This program was completed in December 2012.
- Water conservation has been practiced by SFO over many years. All Terminal complex toilets, urinals, and bathroom sinks are equipped with low flow fixtures and a dual plumbing system has been installed in the renovated Terminal 2 to enable the use of treated wastewater for toilet and urinal flushing purposes. Dual plumbing systems are currently planned in all new buildings at SFO.
- SFO complies with Precautionary Purchasing Ordinance and Executive Order 08-02 by purchasing the required items from the SF Approved Catalogue to the maximum extent possible.

LEED Certification Program

The US Green Building Council's Leadership in Energy and Environmental Design (LEED) certification program for New Construction and Major Renovation provides a set of performance standards for certifying the design and construction of commercial and institutional buildings. The intent of LEED ranking is to assist in the creation of high performance, healthful, durable, affordable and environmentally sound buildings. The ranking system addresses the following project elements:

- Sustainable Sites

- Water Efficiency
- Energy and Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation in Design

Completed Projects

Terminal 2

In 2011, SFO completed the renovation program for Terminal 2 at a cost of 383 million dollars. This project added 14 new gates for use by domestic airlines and created 640,000 square feet of terminal space for use by airlines, concessionaires, SFO, and the general public. Terminal 2 is projected to serve 5.2 million passengers per year. The new terminal achieved the USGBC's LEED Gold certification.

The Terminal 2 Renovation project made use of the existing terminal structure to the maximum extent possible and added new structures only where needed to meet the requirements of a modern airport terminal. The renovated terminal is expected to achieve an overall energy efficiency of 2.3% below the baseline design rating 67,079 MBtu per year. The majority of these savings are achieved by reducing the electric energy consumption by 19.6%.

The water consumption at Terminal 2 is expected to be reduced from the baseline rate of about 17 million gallons per year to 9.2 million gallons per year by installing efficient fixtures in all bathrooms. Additionally, SFO has installed a dual plumbing system in the building to enable the use of treated wastewater for toilet flushing uses when a supply line is constructed in the future. This system would reduce the fresh water consumption by an additional 8 million gallons for an overall reduction of 93.7% below the baseline consumption level.

Building 575 – SFO Business Center

SFO achieved LEED Gold Certification, under the Commercial Interiors rating system, for the recently completed renovation of Building 575 at the Airport. The scope of the renovation project included efficiency upgrades to the existing HVAC system and comprehensive lighting retrofits, resulting in over 20% lighting power reduction from 48,300 watts baseline allowance under the code to 38,330 watts. All installed lighting within 10 feet of windows is equipped with day-lighting controls capable of dimming the lights when sufficient outdoor light is available. To further reduce energy consumption in the building, Energy-Star rated appliances were procured for over 90% of the office equipment and computers. A comprehensive metering system was put in place to monitor the electricity usage in the space after occupancy. To encourage the production of off-site renewable energy sources, SFO agreed to offset 100% of the building's annual energy consumption with Green-e certified renewable energy certificates over a two-year period. Low-flow plumbing fixture used in the bathrooms and break rooms are 40% more water efficient than regular fixtures, and would result in conserving over 153,000 gallons of water per year.

During construction of Building 575 building materials made with recycled content and products that are salvaged or manufactured locally were utilized to the maximum extent possible. The majority of the furnishings in the Building 575 space were either refurbished or reused from existing SFO offices. To promote a healthy indoor environment for the occupants, all of the finishes and materials used in the project

were either low-emitting or contained zero-VOCs. Outdoor air monitors installed on the air handling units, ensure that air quality inside the space is free of pollutants and that sufficient fresh air is introduced into the building. Prior to occupancy, the space underwent a full building flush-out to remove any contaminants that may have been generated during construction.

Ongoing Projects

SFO is currently working on a number of new building construction and major renovation projects as described below:

Air Traffic Control Tower and Integrated Facility

SFO has embarked on a project to replace the existing seismically deficient tower and build a new Air Traffic Control Tower (ATCT) in Courtyard 2, between Terminals 1 and 2 and to improve other Airport Facilities in the project area. The existing tower will be demolished once the new ATCT is commissioned and becomes operational. The new ATCT will be an approximately 68,000 square foot facility. The scope of the project includes the following:

- The Airport Traffic Control Tower and Integrated Facility: The new Federal Aviation Administration (FAA) Air Traffic Control will house FAA and Airport support spaces (including new public restrooms) as well as Secure and Non Secure Corridors connecting Terminals 1 and 2.
- Terminal 1 / Boarding Area C Entrance Area Improvements: A portion of the existing terminal will be reconfigured to provide access to the new public restrooms and Secure and Non Secure Corridors of the Integrated Facility. This modification would optimize concession spaces, meet the increased security requirements and modernize the facility.
- Boarding Area C Airline Club: A new club will be constructed on Level 3 of Boarding Area C within the existing west mechanical room shell structure. The new club will occupy approximately half of the existing mechanical room floor area, and will be served by new elevators, new emergency egress stairs and a new rooftop mechanical room.
- The Secure Connector between the Integrated Facility and Terminal 2: Provide an airside secure link on Level 2 from Terminal 1 / Boarding Area C, through the Integrated Facility, to Terminal 2 / Boarding Area D, allowing passengers and employees to travel between terminals without leaving the secure area.

This project is currently in the design/build construction phase and is expected to be completed by October 2014. The FAA is expected to occupy the new air traffic control tower by October 2015. The completed tower will meet LEED Gold certification requirements and will also be equipped with a dual plumbing system for eventual use of treated wastewater for toilet and urinal flushing purposes.

Boarding Area E Renovation Project

SFO is currently undertaking the Boarding Area E (BAE) Improvement Project to renovate and enhance the existing 100,000 square-foot boarding area. The two main objectives of this project are: 1) to enhance the functionality of the boarding area so that it meets both passengers' needs and SFO's standard of customer care, and 2) to replace or upgrade components and systems that are obsolete or at the end of their useful life. Sustainable features include 400Hz aircraft ground power; pre-conditioned air system, minor fuel

system modifications, clerestory windows throughout the terminal, photovoltaic panels and improved HVAC systems.

The BAE Project includes a building expansion and remodel element that will increase the concourse floor area by approximately 18,000 square feet. The additional space will be used to expand hold rooms; add concession space for food and retail service; and add space for passenger amenities, including a children's play area and commissioned art exhibits. The E Tunnel from the Baggage Claim Area to the Garage will also be remodeled as part of this project. The security system for the terminal will also be improved by enhancing the access control, paging, fire protection and fire alarm systems, and IP-based CCTV systems.

A significant portion of the project consists of replacing or improving terminal systems and building components that have reached the end of their useful life. Specifically, the following critical items are included in the scope of this project:

- Building structural upgrades
- Aircraft apron paving repairs
- Utilities relocations and renovations, including plumbing
- Passenger boarding bridge refurbishment or replacement
- Basement ventilation system modifications
- HVAC system replacement
- Enhanced fire protection and fire alarm upgrades
- New tenant wiring closets
- New fiber optic backbone cabling
- New Airport Wi-Fi infrastructure
- Common use Flight Information Display Systems (FIDS)
- Tenant leasehold electric metering
- New lighting

This project recently issued 100% Construction Documents and had commenced construction. Construction is expected to be completed January 2014. The completed terminal will meet LEED Gold certification requirements and will also be equipped with a dual plumbing system for eventual use of treated wastewater for toilet and urinal flushing purposes.

Terminal 3 Security Checkpoint Project

SFO is currently renovating the existing Terminal 3 East to provide eight new and expanded Security Screening Checkpoint (SSCP) lanes near Boarding Area F. This 340,000 square foot renovation will redesign the SSCP lanes to relieve landside congestion and enhance the customer experience. This project will also expand the footprint of Terminal 3 in the vicinity of the new SSCP by an additional 22,000 square feet to allow for additional circulation space and an expanded Concessions Program. This project scope will also include seismic strengthening of the aging terminal structure, replacement of the HVAC

system and electrical load centers, expansion of the fire sprinklers and alarm coverage, renovation of elevators and escalators, and the modernization of building finishes.

The project's sustainable features include:

- Daylight harvesting
- HVAC and electrical system replacement
- On-site renewable energy
- Use of local materials and FSC wood
- Water use reduction
- Construction waste management
- Cool roofing for new building expansion
- Green building education and public outreach

This project is currently in the design phase. The design is expected to be completed by February 2013 and construction is expected to be completed by July 2015. The renovated Security Check Point facilities will meet LEED Gold certification requirements.

Airfield Operations Facility

SFO is currently designing a new 19,750 square foot Airfield Operations Facility (AOF) to house the entire Airfield Operations staff. This facility would also include space for support functions, emergency and impounded vehicle and equipment parking, and general parking. The construction project would incorporate site development, including utilities and VIP transit and staging facilities. This project replaces the current temporary modular facility which is inadequate for meeting the increased service and security demands and is at the end of its useful life.

Energy efficiency is a top priority for the AOF since this building will be occupied 24 hours a day, 7 days a week. One of the sustainable features of this facility consists of the use of LED Lights which would be regulated by an automatic Lighting Control System with the capability to adjust the artificial lighting level to take advantage of natural lighting provided by wall glazing and solar tubes. This strategy will enable a significant reduction in the lighting energy demand. Additionally, the building design includes a Variable Refrigerant Volume (VRV) HVAC system with multiple zones, as well as the use of passive solar design strategies, to maximize energy efficiency. With the addition of approximately 10KW System of roof mounted photovoltaic panels, the project is estimated to consume 50% less energy than the baseline requirement. Other sustainable elements of this facility include water use reduction by 38-45% below the International Plumbing Code and incorporation of native plant species in the landscaping.

This project is currently at the end of design phase with construction expected to begin in March 2013. Construction is expected to be completed by December 2013. The renovated AOF is targeted to meet LEED Platinum certification requirements.

West Field Cargo Facility

In order to satisfy near-term demand for cost competitive on-Airport cargo facilities, SFO decided to replace the existing Building 632 (Cargo 7) with a modern cargo facility for the West Field Cargo Area. The new

\$35M Cargo facility will have a total gross building area of 105,000 square feet and will include Airfield apron and other civil improvements. The new building will be built over the footprint of existing Building 632.

This project is currently at the schematic design phase with design expected to be completed in July 2013. The project is expected to complete construction by July 2014. This project is expected to meet LEED Gold certification requirements.

Preconditioned Air and 400 Hz Power Supply System Installation Program

SFO currently provides preconditioned air and 400 Hz power to aircrafts at all International Terminal gates, Terminal 2 and at selected gates in Terminals 1 and 3. A survey of the various gates indicated that 10 Airport owned and 29 tenant-owned jet bridges are not currently equipped with PC Air and 400 Hz power supply units. In FY 2012, the PC Air system mitigated GHG emissions by 57,192 tons. The PC Air facilities at Boarding Areas C and F are partially owned and controlled by the tenant airlines and no credit has been taken for the portion of these facilities that are owned by the airlines. As a part of the Boarding Area E renovation, all gates in BAE will be equipped with preconditioned air and 400 Hz Power.

Green Car Rental Incentive Program

In 2009 SFO implemented a three-year Green Car Rental Incentive Program that rewarded customers for renting "green" alternative-fueled vehicles. Customers renting cars with a combined EPA Greenhouse Gas and Air Pollution Ranking of 17 or higher (also known as EPA SmartWay and EPA Ultimate SmartWay), such as the Honda Civic Hybrid, Nissan Altima Hybrid and Toyota Prius, would receive a \$15 discount at the counter. Likewise, airport rental car companies would qualify for financial incentives (20% reduction of Airport rental fees associated with green car rentals) to increase the number of fuel efficient cars in their rental vehicle inventory from 10% to 15%.

In FY 2012 car rental agencies at SFO increased the number of transactions for EPA SmartWay rated vehicles to 13.6% of the total transactions and the rental of EPA Ultimate SmartWay rated cars was increased to 1.0% of the total transactions. These transactions resulted in saving 904,787 gallons of gasoline and in mitigating the GHG emissions by 8,049 metric tons. The total cost of this program to SFO in FY 2012 was \$1,404,861 or about \$174 per ton of GHG emission mitigation claimed by SFO. This program was completed in December 2012.

Summary information for the green car rental incentive program is shown in Table 7-1.

Table 7-1. Estimated Greenhouse Gas Emission Reductions Generated by the SFO Green Vehicle Rental Incentive Program

	EPA SmartWay		EPA Ultimate SmartWay	
	FY 2011	FY 2012	FY 2011	FY 2012
Number of Transactions	243,943	220,394	39,810	16,833
Miles Driven	53,911,414	48,707,074	8,897,994	3,720,093
Gasoline Saved, gallons	898,524	811,785	219,950	93,002
Reduction in Greenhouse Gas Emission^a, metric tons	7,996	7,224	1,951	825
Estimated Program Cost	\$1,230,543	\$1,255,236	\$200,817	\$149,625 ^b
Cost of Gross GHG Emission Reduction \$/ton	\$154	\$174	\$103	\$181

^a The reductions in GHG emission was estimated by using an average fuel efficiency of 20 mpg for regular rental vehicles, 30 mpg for EPA SmartWay rated vehicles, and 40 mpg for EPA Ultimate SmartWay rated vehicles; and a unit GHG emission rate of 19.42 lbs per gallon of gasoline.

^b The program to provide a \$15 discount for customers renting EPA Ultimate Smartway rated vehicles was discontinued in January 2012 and the entire program was completed in December 2012. The estimated program cost is for June 2011- December 2011.

Carbon Sequestration Program

Over the past ten years SFO has developed approximately 50 acres of landscaping around the Airport containing 2,020 trees of different species, excluding the older trees in the undeveloped areas to the west of Highway 101, as shown in Table 7-2. Each tree sequesters carbon dioxide in its biomass over the life span of the tree. The U.S. Forest Service has developed a Carbon Sequestration Model¹ for estimating the annual rate of carbon sequestration for various tree species. SFO staff calculated an estimated sequestration rate of 121 tons per year for the 2,020 trees planted at SFO. The sequestered carbon dioxide would not be released back into the environment because the trees are expected to be sustained for a long time at SFO and the wood would be salvaged when a tree is removed.

Table 7-2. Carbon Sequestration by Landscaping Tree Species Planted at SFO

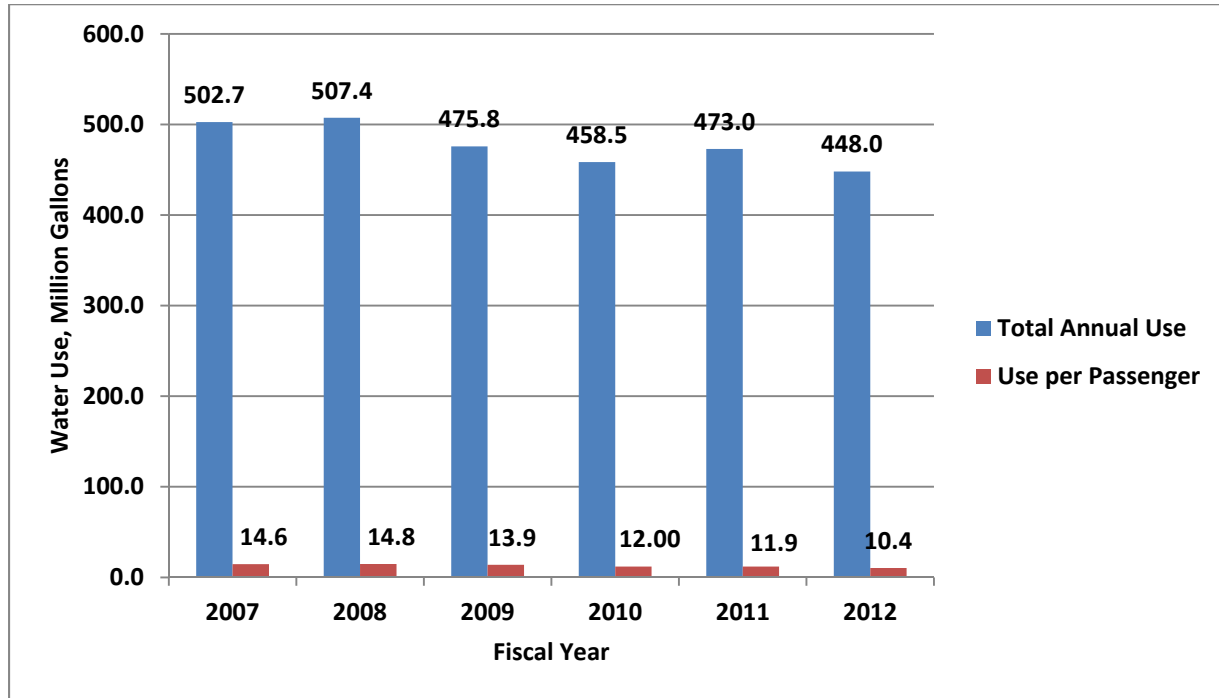
Tree Species	Number Planted	CO2 Sequestration, tons/year	Tree Species	Number Planted	CO2 Sequestration, tons/year
Sequoia	694	73.88	Cypress	22	1.63
Podocarpus (conifer)	458	2.97	Vine Maple	20	0.11
Cercis Tendentis	253	2.79	Eucalyptus	16	5.49
Polar	76	9.05	Incense Cedar	15	0.76
Sycamore	66	4.33	Miscellaneous species	162	9.19
Arbutus	55	2.52	Total	2,020	120.70
Alder	54	3.32			
Prunus	42	1.14			
Buckeye	30	0.37			
Olive	30	1.38			
Melaleuca	27	1.77			

¹ Center for Urban Forest Research, Tree Carbon Calculator, Developed by the Center for Urban Forest Research, Pacific Southwest Research Station, US Forest Service, in partnership with the California Department of Forestry and fire Protection, 2009

Water Conservation Practices

Historic water use data at SFO is shown in Figure 7-1 and indicates a total water use ranging from 502.7 million gallons in FY 2007 to 448 million gallons in FY 2012. The variation in water use at SFO is impacted by the total number of passengers passing through the Airport. Therefore, the water use per passenger is a more effective metric for measuring water efficiency levels at SFO. Water use per passenger has gradually declined from 14.8 to 10.4 gallons per passenger from FY 2008 to FY 2012.

Figure 7-1. Historic Water Use at SFO



The gradual decline in the water consumption can be attributed to the renovation of new buildings and terminal spaces, where projects are typically designed to achieve 30%-40% water savings from the baseline design requirements. Water conservation strategies currently employed at SFO include the installation of water efficient fixtures and the use of landscaping plants that require little or no irrigation. In addition, all new buildings at SFO are dual plumbed for reuse of reclaimed water. As the planned reclaimed water system is connected to the terminals for toilet and urinal flushing, potable water usage will be further reduced.

Green Purchasing

SFO complies with Precautionary Purchasing Ordinance and Executive Order 08-02 by purchasing the required items from the SF Approved Catalogue to the maximum extent possible. The SFO purchasing staff is currently consulting with the DOE staff to further improve the Green Purchasing Program at the Airport.

8. Community-Wide Impacts

Summary

SFO's operations contribute to the global warming impact of the nine-county San Francisco Bay Area in proportion to the GHG emissions generated by Airport activities. In a more direct sense travel by SFO employees, air passengers, taxis, shuttle buses, delivery trucks, BART, Samtrans, etc. to the Airport from all parts of the Bay Area impacts the regional and local air quality and contributes to the regional emissions of greenhouse gases. Regulation and control of air quality impacts of the various modes of travel to SFO fall under the jurisdiction of Bay Area Air Quality Management District and are not directly addressed in the Climate Action Plan. However, any reductions in the emission of global warming gases would also aid in reducing the emission of other air pollutants. The global warming impact of Airport operations has been addressed in Chapter 2 of this Plan and the regional impact of these operations is recapped in this Chapter.

SFO Employees Commute Impact

SFO employee count in FY 2012 was 1,998 showing an 8.4% increase compared to the employee level in FY 2011. These employees commute to and from work by various means including personal vehicles, BART, Samtrans, Caltrain, car pools, etc. As reported in Section 6, commute travel by SFO employees contributed to the regional GHG emission about 2,790 tons per year. SFO is currently working on developing various public transit incentives and rideshare programs to reduce the impact of vehicular emissions from SFO employee commute activities. Descriptions of these programs are also provided in Section 6.

Air Passengers Ground Travel Impact

The results of a bi-annual survey conducted by the Metropolitan Transportation Commission In 2006 are summarized in Table 8-1. These results indicate that air passengers travelled a combined total of 825 million miles to and from SFO in 2006. Travel by private vehicle drop off / pick up and private vehicles parked at the Airport accounted for about 63% of the total mileage, and travel by rental cars accounted for 14% of the total mileage. BART accounted for 6% of the total miles traveled in 2006 or about 53 million miles per year. Taxis, limousines, vans, and Airport bus service accounted for a combined 13% of the annual mileage; and hotel vans, public buses, Caltrain and chartered buses accounted for 2.2% of the total miles travelled.

Table 8-1. Summary of Air Passenger Travel Modes to SFO in 2006

Mode of Travel	All regions				GHG Emission, Tons/Year
	Miles Traveled to SFO	Miles Traveled from SFO	Total Mileage	% of Total Mileage	
Private Vehicle Drop offs	225,350,620	224,892,507	450,243,127	54.5	151,664 ^a
Private Vehicle Parked for Trip	34,248,614	34,178,990	68,427,604	8.3	22,989 ^a
Private Vehicle Disposition Not Stated	1,917,493	1,913,595	3,831,088	0.5	1,290 ^a
Rental Car	59,546,922	59,425,870	118,972,792	14.4	40,076 ^a
Taxi	17,059,919	17,025,238	34,085,156	4.1	20,016 ^b
Limousine	9,341,086	9,322,097	18,663,183	2.2	10,960 ^b
Shared-Ride Van	16,654,258	16,620,402	33,274,660	4.0	19,541 ^b
Scheduled Airport Buses	12,657,704	12,631,972	25,289,676	3.1	17,150 ^c
BART	26,711,117	26,656,817	53,367,934	6.5	2,157 ^d
Caltrain	1,464,332	1,461,355	2,925,687	0.4	118 ^d
Public Transit Bus	1,333,959	1,331,247	2,665,207	0.3	6,010 ^e
Hotel/Motel Courtesy Shuttle	5,012,322	5,002,133	10,014,454	1.2	5,881 ^b
Chartered Bus or Van	1,920,972	1,917,067	3,838,038	0.5	8,655 ^e
Total	413,219,317	412,379,289	825,598,606	100	306,507

^a Based on an assumed fuel efficiency of 23.9 miles per gallon and a GHG emission factor of 19.42 lbs per gallon of gasoline

^b Based on an assumed fuel efficiency of 15 miles per gallon and a GHG emission factor of 19.42 lbs per gallon of gasoline

^c Based on an assumed fuel efficiency of 9 miles per GGE and a GHG emission factor of 13.46 lbs per GGE

^d Based on the estimated BART GHG emission rate at 12 percent of personal vehicle travel

^e Based on an assumed fuel efficiency of 4.5 miles per gallon and a GHG emission factor of 22.37 lbs per gallon of diesel fuel

Data shown in Table 8-1 indicate a contribution of about 306,507 tons of GHG emissions per year in the nine-county San Francisco Bay Area by SFO passengers travelling to and from the Airport in 2006. The GHG emissions from this source could have increased to 309,143 tons in 2007 and to 393,637 tons in FY 2012, assuming a direct correlation between these emissions and the total number of passengers at SFO

Community-Wide Impacts

for the respective years. The passenger levels were 33.56 and 43.1 million for 2006 and 2012, respectively.

Impact of Service and Trade Deliveries

Various types of service and trade deliveries are made to SFO on a daily basis. Some of the examples of these types of travel to SFO are shown below:

1. Cargo pick up from and deliveries to various cargo carriers such as Federal Express, DHL, etc.
2. U.S. Post Office mail and package pick up and deliveries
3. Deliveries of fuels and supplies to Airport, airlines, and concessionaires
4. Deliveries of various materials and equipment to various contractors working at SFO
5. Hauling of solid waste, construction demolition waste, and other waste materials from SFO
6. Other deliveries
7. Travel by car rental customers
8. Commute travel by employees of airlines, airline support service companies, and concessionaires

Estimated GHG emission for these activities is shown under Category 3 GHG emissions in Chapter 2 of this Plan.

9. Measuring Progress

Summary

As described in the preceding sections greenhouse gases generated at SFO can be classified in three distinct categories depending on the ownership and control of the operations that emit such gases.

- Category 1 – SFO Controlled GHG emissions from facilities and operations under the direct control of the Airport Commission
- Category 2 – GHG emissions by all other enterprises operating at SFO
- Category 3 – Optional GHG emissions or emissions that are consequential to the operations at SFO, such as GHG emissions from cruising aircrafts or emissions from passenger commute to and from SFO

Ordinance No. 81-08 calls for the identification and recommendation of GHG emission reduction / offset measures for: “private sector greenhouse gas emission sources regulated by the department”. Although SFO does not directly regulate any air pollutants or GHG emissions from the facilities of the enterprises operating at the Airport, nevertheless in the context of Ordinance No. 81-08 SFO staff has worked with the tenants to develop an estimate of the various GHG emissions from all such enterprises. To this effect SFO staff initially distributed a comprehensive questionnaire to all airlines and other enterprises at the Airport to collect data on the various GHG emitting operations of these enterprises in 2008. The results of these surveys were updated for Category 2 GHG emissions based on the total number of flights or passengers, as appropriate, for the past five fiscal years..

The required steps for measuring progress in mitigating the GHG emissions for each of the above categories are described in this section.

Measuring Progress for SFO Operations

SFO will continue to monitor the rate of GHG emissions from all Airport facilities and operations and the GHG emission reduction, offset, and mitigation generated by existing and planned emission reduction measures. Specifically the following parameters will be monitored and quantified:

GHG Emission Sources

1. Electric energy consumption
2. Natural gas consumption
3. Fossil fuel consumption
4. Refrigerant gas makeup rate
5. Solid waste generation
6. SFO employees commute to and from work

GHG Emission Reduction/Offset/Mitigation Measures

1. Electric energy efficiency measures
2. Natural gas efficiency measures
3. Solid waste reduction and recycling measures
4. Employee green commute measures
5. Resource use reduction measures

6. Green purchasing program
7. LEED certification measures
8. Educational and other measures

Data for GHG emissions and for emission reduction/offset/mitigation levels for each of the above parameters will be collected and compiled regularly. These data will be analyzed for assessing the Airport's progress in reducing the Category 1 GHG emissions and the results of the analysis will be included in future revisions of the Departmental Climate Action Plan.

Measuring Progress for Category 2 and 3 Operations

The airlines, airline support services, concessionaires, and other entities operating at SFO generate GHG emissions both within and outside the physical boundaries of SFO. GHG emissions from these sources are generated by the following broad activities:

1. Electric energy and natural gas consumption
2. Fossil fuel consumption for vehicle fleets, ground services equipment, etc.
3. Jet fuel consumption for landing and take-off cycles and by cruising aircrafts
4. Fugitive refrigerant gas releases
5. Passenger commute to and from SFO
6. Enterprise employee commute to and from SFO
7. Solid waste generation and recycling
8. GHG emission by materials, supplies, and services deliveries
9. Other miscellaneous sources

SFO has developed fairly accurate information for GHG emission from electric energy and natural gas consumption for Category 2 operations based on available internal billing records. Estimates of GHG emissions for LTO cycles and for cruising aircrafts have also been developed by indirect approximation of jet fuel consumption for these operations. SFO has also collected data from the airlines and other enterprises for the remaining items on the list and these data as supplemented by EDMS Modeling and other methods as summarized under Category 3 emissions in Chapter 2 of this Plan.

In future years SFO, in cooperation with all stakeholders, plans to refine and supplement GHG emission estimates for Category 2 and Category 3 activities at the Airport. Recommendations for applicable GHG emission reduction / offset / mitigation measures will also be developed cooperatively for these operations

CLIMATE ACTION PLAN STAFF CONTACT

Climate Action Plan Staff Contact

The name, address, and phone number of SFO's Climate Action Plan staff contact is as follows:

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APPENDIX A
CLIMATE ACTION PLAN MASTER SPREADSHEET

The Mater Spreadsheet file for this report is stored on the SFO intranet. Please contact houshang.esmaili@flysfo for access to these files.

APPENDIX B

San Francisco's Environment Code Chapter 9 Greenhouse Gas Emissions Targets and Departmental Action Plans

10. CHAPTER 9: GREENHOUSE GAS EMISSIONS TARGETS AND DEPARTMENTAL ACTION PLANS

Sec. 900. Findings and Purpose.

Sec. 901. Definitions.

Sec. 902. Greenhouse Gas Emissions Limit.

Sec. 903. Greenhouse Gas Emissions Reduction Plan.

Sec. 904. Mandatory Annual Greenhouse Gas Emissions Reporting.

Sec. 905. Enforcement.

Sec. 906. Market-Based Compliance Mechanisms.

Sec. 907. Local Energy Generation.

Sec. 908. Miscellaneous.

📌 **SEC. 900. FINDINGS AND PURPOSE.**

The Board of Supervisors finds that:

(a) In 2002, the Board of Supervisors adopted Resolution 158-02 that called for the City to develop plans to reduce its greenhouse gas emissions to 20 percent below 1990 levels by the year 2012.

(b) In 2004, the Department of the Environment and the San Francisco Public Utilities Commission issued "The Climate Action Plan For San Francisco," which included an accounting of greenhouse gas emissions associated with City activities, an accounting of greenhouse gas emissions within the City and County of San Francisco but not associated with City operations, and emission reduction recommendations for transportation, energy efficiency, renewable energy and solid waste management sectors.

(c) City Departments, under the leadership of the Department of the Environment and on their own initiative, are engaged in various undertakings to implement the recommendations in "The Climate Action Plan," and are making steady progress in certain areas toward the 2012 goal.

(d) In 2005, Governor Schwarzenegger issued Executive Order S-3-05 which established Statewide greenhouse gas emissions reduction targets for California as follows: by 2010, reduce

greenhouse gas emissions to 2000 levels; by 2020, reduce greenhouse gas emissions to 1990 levels, and by 2050 reduce greenhouse gas emissions to 80 percent below 1990 levels.

(e) In 2006, California enacted AB 32, the California Global Warming Solutions Act of 2006. (CA Health and Safety Code Section 38.500 et seq.) which requires the California Air Resources Board to determine the statewide greenhouse gas emissions level in 1990, set that 1990 level as the statewide greenhouse gas emissions level to be achieved by 2020, and to adopt and implement statewide plans, protocols, rules and regulations to achieve and exceed the 2020 goals.

(f) It is the intent of the Mayor and the Board of Supervisors to protect the health and welfare in a manner that compliments state and federal efforts to improve air quality by exercising a leadership role in mandating local actions to reduce global warming, and, in particular, to call upon City departments and the private sector to integrate emission reduction measures into their standard operating procedures in order that the City meets and exceeds the greenhouse gases emissions established in this Ordinance.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

📖 SEC. 901. DEFINITIONS.

(a) "CARB" means the California Air Resources Board.

(b) "Carbon Dioxide Equivalent" means the amount of carbon dioxide by weight that would produce the same global warming impact as a given weight of another greenhouse gas, based on the best available science, as determined by the Department of the Environment.

(c) "Climate Action Plan" means the "The Climate Action Plan For San Francisco" issued in 2004 by the Department of the Environment and the San Francisco Public Utilities Commission.

(d) "GHG emission reduction measure" means programs, measures, standards, and alternative compliance mechanisms authorized pursuant to Section 903, applicable to sources or categories of sources that are designed to reduce emissions of greenhouse gases.

(e) "GHG", Greenhouse gas" or "greenhouse gases" means and includes all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

(f) "San Francisco Greenhouse Gas Emissions limit" means the combined level of greenhouse gas emissions, expressed in tons of carbon dioxide equivalents, from all sources within the geographic limit of the City and County of San Francisco, whether or not such source is subject to regulation by local law.

(g) "SFPUC" mean the San Francisco Public Utilities Commission.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

SEC. 902. GREENHOUSE GAS EMISSIONS LIMIT.

(a) The following San Francisco greenhouse gas emissions limits are hereby established:

(i) By 2008, determine 1990 City greenhouse gas emissions as provided in Section 902(c) below;

(ii) By 2017, reduce greenhouse gas emissions by 25 percent below 1990 levels;

(iii) By 2025, reduce greenhouse gas emissions by 40 percent below 1990 levels; and

(iv) By 2050, reduce greenhouse gas emissions to 80 percent below 1990 levels. These targets shall remain in effect unless otherwise amended or repealed.

(b) All City departments shall consider the effect of all decisions and activities within their jurisdiction on greenhouse gas emissions and undertake their responsibilities to the end that the City achieves the greenhouse gas emissions limits set forth in this Ordinance.

(c) No later than January 1, 2009, the Commission on the Environment, shall, after one or more public hearings, determine what the greenhouse gas emissions level within the City and County of San Francisco for City and private enterprise activities was in 1990. Such determination shall be the baseline level for determining the greenhouse gas emission limits to be achieved in 2017 and 2050, under subsection (a), above. In determining the 1990 level, the Department of the Environment shall take into consideration the inventory identified in the Climate Action Plan, the methodology adopted by the State Air Board under AB 32, and the best available scientific, technological, and economic information and shall make reasonable efforts, where appropriate, to promote consistency between its methodology and the methodology used by other international, federal and state greenhouse gas emission measurement and reporting programs.

(d) The Department of the Environment is urged to promulgate interim greenhouse gas emissions goals to facilitate the City's achievement of the 2017 and 2050 greenhouse gas emissions limits set forth in Subsection (a), above, provided, however, that such interim goals shall be for purposes of measuring the City's progress toward achieving the targets set forth in subsection (a), above and shall not be independently binding.

(e) The Department of the Environment shall, where appropriate and to the maximum extent feasible, work with other local, State And federal governmental agencies, including but not limited to the CARB, and non-profit entities to develop uniform standards and protocols for measuring, verifying and reporting on greenhouse gas emissions.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

SEC. 903. GREENHOUSE GAS EMISSIONS REDUCTION PLAN.

(a) Consistent with its Charter duty regularly to produce an assessment of San Francisco's environmental condition, the Department of the Environment shall coordinate all departmental action plans, reports of actions taken, and their effectiveness in achieving the greenhouse gas emissions limits provided herein.

(b) The Department of the Environment, in cooperation with the SFPUC, shall manage the City's monitoring and reporting obligations imposed, from time to time, by Federal or State law, including but not limited to requirements imposed by the CARB under AB32.

(c) On or before January 30, 2009, all City departments shall assess GHG emissions associated with their activities and submit, in a format specified by the Department of the Environment, a written action plan that identifies and makes recommendations on GHG emission reduction measures applicable to

(i) operations of the department and other City greenhouse gas emission sources within its jurisdiction, and

(ii) private sector greenhouse gas emission sources regulated by the department. Such Plan shall identify the potential costs of identified measures and the estimated potential benefits of elements in the plan for reducing greenhouse gases, and may also identify other economic and non-economic impacts to the City's economy and environment

(d) In addition to the requirement set forth in subsection (d), above, the following requirements apply to the following City departments:

(i) The San Francisco Planning Department shall:

(A) Review the City's General Plan, including but not limited to the environmental protection, air quality, urban design and transportation elements, for consistency with this Ordinance and, as appropriate, urge the Planning Commission to recommend to the Board of Supervisors amendments to the General Plan to add the greenhouse gas emissions limits in this Ordinance and policies to achieve those targets;

(B) Include consideration of a project's impact on the San Francisco greenhouse gas emissions limits in this Ordinance as part of its review under the California Environmental Quality Act (CEQA); and

(C) In consultation with the Executive Director of the Municipal Transportation Agency, Department of Public Health, San Francisco County Transportation Authority, the Department of the Environment and other affected City departments, review City transit, pedestrian, bicycle, parking, and transportation demand management programs and requirements within their jurisdiction and, as appropriate, recommend legislation to the Board of Supervisors that will enhance the City's "transit first" policy, encourage a shift to sustainable transportation modes for trips to, from, and within the City, and reduce transportation-related emissions to achieve City greenhouse gas emissions targets set forth in this Ordinance.

(ii) The San Francisco Department of Building Inspection shall review and, as appropriate, recommend to the Board of Supervisors amendments to the Building Code or other local laws (A) to improve energy efficiency in new construction and in repairs and alterations to existing buildings, (B) to optimize energy efficiency of HVAC, lighting, and other building systems, and (C) to mandate retrofitting of buildings at time of sale.

(iii) The Department of Public Works shall:

(A) Review maintenance and construction standards, programs and requirements within its jurisdiction and, as appropriate, develop orders, regulations, or amendments to the Department's Standard Plans and Specifications to address the policies of this Ordinance and/or recommend legislation to the Board of Supervisors, including amendments to the Public Works Code or other City codes or ordinances, to achieve the greenhouse gas emissions limits set forth in this Ordinance; and

(B) in consultation with the SFPUC and other affected City Departments, review, and as appropriate recommend changes to street and other public lighting standards to enhance energy efficiency and thereby reduce City greenhouse gas emissions.

(iv) The City Administrator shall:

(A) review, in consultation with the SFPUC, the energy efficiency of City buildings and city occupied leaseholds, and, as necessary, recommend cost effective steps to increase their efficiency, and

(B) in collaboration with the Department of the Environment and other affected City departments, review, and, as appropriate, recommend amendments to City procurement laws and practices, including but not limited to Chapter 2 of this Code (Environmentally Preferable Purchasing Ordinance), to include the impact of City procurement decisions on greenhouse gas emissions.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

SEC. 904. MANDATORY ANNUAL GREENHOUSE GAS EMISSIONS REPORTING.

(a) Beginning at the close of fiscal year 2008-2009, no later than 90 days after the close of each fiscal year, all City departments shall submit, in a format specified by the Department of the Environment, a written update of the plans, status of any recommendation required by Section 903, and the GHG emission reductions from actions taken to the Department of the Environment. Such updates shall, to the extent feasible, provide information to enable the Department of the Environment to calculate the City's progress toward meeting the greenhouse gas emissions limits set forth in this Ordinance.

(b) Beginning in January 2010, and annually thereafter, and based on the written reports required in Section 904(a) and such other reliable data as the Department of the Environment shall compile, the Department of the Environment shall report to the Board of Supervisors on the City's progress toward achieving the San Francisco greenhouse gas emissions limits of this Ordinance. Such annual report shall be consistent with the methodology established by the Department of the Environment under Section 903(c), except that the Department of the Environment may revise such methodology to conform to recognized protocols.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

📌 SEC. 905. ENFORCEMENT.

The Department of the Environment shall report any non-compliance with the reporting requirements of this Ordinance to the Mayor and the Board of Supervisors.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

📌 SEC. 906. MARKET-BASED COMPLIANCE MECHANISMS.

(a) The Department of the Environment, utilizing the expertise of relevant City Departments and Agencies, shall research and, as appropriate, recommend legislation to the Board of Supervisors, concerning whether and how to develop or utilize available market-based compliance mechanisms, such as greenhouse gas emissions exchanges, banking, credits, and other similar transactions governed by rules and protocols established by the City, CARB or other recognized governmental or non-profit entity as credit toward City greenhouse gas emission reductions.

(b) The Department of the Environment shall provide technical assistance, and coordinate City applications for, any approved market-based mechanisms that the City intends to use in furtherance of achieving the San Francisco greenhouse gas emissions limit.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

📌 SEC. 907. LOCAL ENERGY GENERATION.

The Board of Supervisors urges the SFPUC to develop and to implement an energy action plan that includes at least the following:

(a) In coordination with the Department of the Environment, develop a plan to achieve the goal of San Francisco becoming fossil fuel free by 2030;

(b) In coordination with the Department of the Environment, setting annual goals for generating electricity locally through renewable generation; and

(c) Integrating the greenhouse gas emissions targets and policies of this Ordinance into the Sewer Master Plan.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

📖 **SEC. 908. MISCELLANEOUS.**

(a) **Severability.** If any section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held to be invalid or unconstitutional by a decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of the Ordinance. The Board of Supervisors hereby declares that it would have passed this Ordinance and each and every section, subsection, sentence, clause, or phrase not declared invalid or unconstitutional without regard to whether any portion of this Ordinance would be subsequently declared invalid or unconstitutional.

(b) **No Conflict With Federal Or State Law.** Nothing in this Ordinance shall be interpreted or applied so as to create any requirement, power or duty in conflict with any Federal or State law. Any and all greenhouse gas reduction activities adopted and implemented under this Ordinance are intended to be complementary and nonduplicative of measures required or to be adopted by any State or Federal agency under State or Federal law. Nothing in this Ordinance shall relieve any person, entity, including any City Department or City Official of compliance with other applicable Federal, State, or local laws or regulations, including Federal or State air and water quality requirements, and other requirements for protecting public health or the environment.

(c) **Undertaking For The General Welfare.** In undertaking the implementation of this Ordinance, the City is assuming an undertaking only to promote the general welfare. It is not assuming, nor is it imposing on its officer and employees, an obligation for breach of which it is liable in money damages to any person who claims that such breach proximately caused injury.

(Added by Ord. 81-08, File No. 071294, App. 5/13/2008)

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APPENDIX C

Investment Grade Audit : Recommended Energy Efficiency Measures for SFO Terminals Complex

Table 1. Recommended Energy Efficiency Measures for SFO Terminals Complex

Group	Proposed Energy Efficiency Measure	Annual Electricity Savings mWh/yr	Annual Gas Savings Thousand Therms/yr	Estimated Project Cost Thousand dollars	Simple Payback Period yrs	Avoided Electricity GHG Emission CO _{2e} tons	Avoided Gas GHG Emission CO _{2e} tons
1	Measures to be Completed FY 08-09:						
	EEM 4: Central Plant Cooling Towers-Apply VFDs on the Cooling Tower Fans	245	0.0	175	3.2	4	0.00
	EEM 7a: Boiler Replacement (50% complete by FY 08-09)	-29	106.7	2,521	18.8	-0.4	568
	EEM 31a: Controls – System Optimization (IT/RAC- New Front End, Honeywell Integration, Optimize Sequences; 25% complete by FY 08-09)	704	15.1	377.4	4.0	10	80
	EEM 32a: Controls - Upgrade (Corrective Actions by SFIA)	43	12.2	41	2.1	1	64.71
	EEM 33a: Controls - Install Zone Level DDC Controls (Corrective Actions by SFIA)	50	2.0	25.6	3.3	1	10.82
	EEM 36: Shut down boiler plant during summer months	10	55.5	0	0.0	0.2	295.30
	EEM 40: Air Handlers - Change Zone Setpoints	1,033	184.6	5	0.0	3	982.26
	EEM 42: Chiller Plant Shut-down during Winter Nights	849	0.0	0	0.0	13	0.00
	Group 1 Total:	2,905	376.1	3,145	3.8	43	2,001.52
2	EEM 7b: Boiler Replacement (remaining 50%)	-29	106.7	2,521	18.8	-0.4	567.89
	Group 2 Total:	-29	106.7	2,521	18.8	-0.4	567.89
3	EEM 31b: Controls - System Optimization (Implementation Phase of Optimization Project; remaining 75%)	2,113	45.4	1,132	4.0	31	241.59
	Group 3 Total:	2,113	45.4	1,132	4.0	31	241.59
4	EEM 32b: Controls - Upgrade Pneumatic Controllers to DDC	2,116	595.8	4,070	4.3	31	3,170.82
	Group 4 Total:	2,116	595.8	4,070	4.3	31	3,170.82
5	EEM 10: Chilled Water Distribution System - Remove or Modify De-couplers in Terminals to Increase System Temperature Differential	805	0.0	164	1.7	12	0.00
	EEM 11: Chilled Water Distribution System - Convert Constant Volume Tertiary Pumps to Variable Flow to Lower Pump Speed during Part-Load Operation	591	0.0	946	13.2	9	0.00
	EEM 12: Chilled Water Distribution System - Replace Three-way Air Handler Chilled Water Valves with Two-Way Valves; Clean Cooling Coils to Increase System Temperature Differential	322	0.0	406	10.4	5	0.00

Table 1 (Continued). Recommended Energy Efficiency Measures for SFO Terminals Complex

Group	Proposed Energy Efficiency Measure	Annual Electricity Savings mWh/yr	Annual Gas Savings Thousand Therms/yr	Estimated Project Cost Thousand dollars	Simple Payback Period yrs	Avoided Electricity GHG Emission CO _{2e} tons	Avoided Gas GHG Emission CO _{2e} tons
	EEM 13: Chilled Water Distribution System - Implement Chilled Water Differential Pressure Reset Control or Relocate Differential Pressure Sensors to Optimize Pump Speed Control	232	0.0	134.5	4.7	3	0.00
	EEM 14: Hot Water Distribution System - Convert Constant Volume Tertiary Pumps to Variable Flow; Balance the Speed of Parallel Pumps to Lower Pump Speed during Part-Load Operation	592	-21.0	768	19.4	9	-111.91
	EEM 15: Hot Water Distribution System - Implement Hot Water Differential Pressure Reset Control or Relocate Differential Pressure Sensors to Optimize Pump Speed Control	51	-1.3	134.5	31.7	1	-6.76
	Group 5 Total:	2,593	-22.3	2,553.5	9.1	38	-118.67
6	EEM 35: Chilled Water Distribution System - Convert Constant Volume Secondary Pumps to Variable Flow to Lower Pump Speed during Part-Load Operation	1,341	0.0	454.7	2.8	20	0.00
	EEM 8: Chilled Water Distribution System - Install Check Valve in Central Plant Bypass (De-coupler) Line to Improve Chilled Water Distribution Low Temperature Differential	161	0.0	84	4.3	2	0.00
	EEM 41: Replace Chillers 1 and 2 with three 1,500 ton Chillers and Tower-Free Cooling	3,795	0.0	6,645	11.8	56	0.00
	Group 6 Total:	5,297	0.0	7,184	9.6	78	0.00
7	EEM 33b: Controls - Install Zone Level DDC Controls (Cascaded from EEM 32)	2,447	99.6	2,530.5	6.8	36	530.28
	EEM 26: Terminal 3 Main Terminal Building - Convert to Dual Duct VAV to Increase Efficiency	17,054	155.6	8,054.8	4.0	251	828.09
	Group 7 Total:	19,501	255.3	10,585	4.5	287	1,358.37
8	EEM 2a: Central Chiller Plant - Install a Thermal Energy Storage System at the Central Plant to Generate and Store Chilled Water at Night (CHW TES)	-94	0.0	5,561	10.8	-1	0.00
	Group 8 Total:	-94	0.0	5,561	10.8	-1	0.00
9	EEM 16: PCA System - Optimize the Ice Storage System Operation	63	0.0	15	2.3	1	0.00
	EEM 17: PCA System - Improve PCA System Pumping	73	0.0	75	10.0	1	0.00
	Group 9 Total:	137	0.0	90	6.4	2	0.00
10	EEM 24a: Terminal 1- Remove Pre-Filters to Reduce Fan Energy	55	-0.2	6	0.8	1	-0.80

Table 1

(Continued). Recommended Energy Efficiency Measures for SFO Terminals Complex

Group	Proposed Energy Efficiency Measure	Annual Electricity Savings mWh/yr	Annual Gas Savings Thousand Therms/yr	Estimated Project Cost Thousand dollars	Simple Payback Period yrs	Avoided Electricity GHG Emission CO _{2e} tons	Avoided Natural Gas GHG Emission CO _{2e} tons
	Group 10 Total:	55	-0.2	6	0.8	1	-0.80
	Total (All Measures):	34,593	1,356.9	36,849	6.0	508	7,220.73
	Total Measures in Construction:	2,905	376.1	3,145	3.8	43	2,001.52
	Total Remaining Measures	31,688	980.8	33,704	6.4	456	5,219.21

* EEMs designated "New Measures" are measures added to the IGA analysis that were not analyzed during the Preliminary Energy Audit.

Note: The following factors were used to calculate CO₂ reductions:

SF Community factor 2010 (used to estimate "global system effect" of savings): 32.4 lbs eCO₂/MWh

Source: derived by SFPUC, includes all sources (PG&E, local generation, direct access, Hetch Hetchy hydro, purchased power)

Natural Gas Savings factor: 11.732 lbs eCO₂/therm

Source: CARROT (CCAR software) default factor

APPENDIX D

Lighting Efficiency Projects Implemented by SFO Division

Table 1. Energy Efficiency Projects Implemented by SFO Facilities Division

Task No.	Project Location	Date Completed	No. of Old Fixtures	Old Load (kW)	No. of New Fixtures	New Load (kW)	Yearly Energy Reduction (kWhr)
1	T3 Mezzanine Level- 8" Downlights	Jun-04	500	103.5	500	18	748,980
2	ITB Ticket Counters	Oct-04	1,728	72.6	144	39.6	288,870
3	West Underpass - Roadway	June-03	58	12	30	6.2	25,386
4	ITB - Elevator Cab Lighting	June-02	26	31.2	26	3.9	239,148
5	ITB - 3rd Floor Above Escalators	March-03	72	8.4	72	4.2	36,372
6	FOM Engineering Building	September-01	250	60	Linear	28	210,240
7	ITB - 2nd Floor South Bridge Art Display	June-02	48	12	12	0.7	98,603
8	T3 Mezzanine Level - Uplights Pre/Post Security	March-05	820	49.2	820	34.4	129,298
9	Traffic Signal Conversion to LED	June-00	16	1	16	0.1	5,782
10	Domestic Terminal - Central Garage Parking	June-98	15,440	849.2	15440	648.5	1,758,307
11	Domestic Terminal F&B - Host Decommissioning	March-13	-	120	-	45	657,000
12	T1 - Departures Canopy	September-05	500	50	500	31	166,440
13	T3 - Arrival/Departure Level- 8" Down lights (FOM)	June-06	811	167.9	500	16	1,330,443
14	Domestic Terminal - Viaduct Lighting (#3560A)	December-06	600	124.2	600	64.8	520,344
15	T3 - Baggage Claim Area (#4200R2)	December-06	1,993	199.3	1993	123.6	663,430
16	T3 - Level 2 Pre-Security (#4200R2)	December-06	163	16.3	163	10.1	54,259
17	B/A F Connector Fluorescent (#4200R2)	June-07	234	23.4	234	14.5	77,894
18	T3 - High Level Ceiling Fluorescent (#4200R2)	June-07	1,128	112.8	1128	69.9	375,489
19	T3 - High Level Ceiling 8" Downlights (#4200R2)	October-07	116	30.7	116	12.5	159,537
20	T3 - High Level Ceiling 10" Down Lights (#4200R2)	March-08	18	7.5	18	1.9	48,408
21	T3 - Boarding Area 'E' Fluorescent (#4200R2)	March-08	558	55.8	556	34.5	186,833
22	T3 - Boarding Area 'E' 8" Downlights (#4200R2)	March-08	29	6	29	1	43,441
23	Central Garage Parking - LED Exit Signs (FOM)	June-08	135	8.1	135	0.7	65,043
24	ITB B/A G HVAC Penthouses (FOM)	June-08	70	3.9	70	2.6	11,038
25	AirTrain Maintenance - LED	December-08	11	3.1	11	1.5	7,082

	Exterior Lights (FOM)						
26	Facilities - Fuel Station Canopy	June-09	16	6.9	10	0.6	27,822
27	Central Plant - High Bay Flourescent (#8592)	December-09	36	30.5	36	12.6	156,419
28	North Access Road - LED Roadway Fixtures (#8592)	December-09	28	7.9	28	4.8	13,490
29	North Access Road - LED Roadway Fixtures (#8592)	December-09	54	15.2	54	6.2	39,735
30	North McDonnell Road - LED Roadway Fixtures (#8592)	March-10	55	15.5	45	7.7	34,033
31	North McDonnell Road - LED Roadway Fixtures (#8592)	March-10	43	12.1	43	4.9	31,641
32	West Field Road - LED Roadway Fixtures (#8592)	March-10	5	1.4	5	0.9	2,409
33	West Field Road - LED Roadway Fixtures (#8592)	March-10	23	6.5	23	2.6	16,924
34	South Checkpoint - LED Roadway Fixtures (#8592)	March-10	14	3.9	10	1.9	8,839
35	Domestic Garage - Fluorescent Core F/G, F & E (#8771)	June-10	773	73.1	773	47.2	227,322
36	Domestic Garage - Fluorescent Core F & E (#8771)	September-10	24	2.4	24	1.5	8,234
37	T3 - Boarding Area 'F' Ramp Wall Pack (#8771)	December-10	157	44.3	157	24.6	171,915
38	T3 - Boarding Area 'F' Fluorescent Departures Ceiling(#8771)	December-10	1,546	154.6	1,546	95.9	514,632
39	T3 - Boarding Area 'F' Ramp Level Low Bays (#8771)	December-10	254	69.9	275	25.9	385,440
40	Central Plant - Main Floor Fluorescent (#8592)	December-10	14	2.3	14	1.5	6,328
41	T3 - Pendant Mounted MV (#8771)	April-11	270	135	270	30.7	913,668
42	T3 - Public Areas T5HO (#8771)	April-11	1968	157.4	1968	106.2	448,512
43	T3 -8" Downlight CFL (#8771)	April-11	346	34.6	346	11.2	204,984
44	9" Downlight CFL (#8771)	April-11	44	4.4	44	1.4	26,280
45	12" Downlight MH (#8771)	April-11	117	29.3	117	11.7	154,176
46	12" Downlight CFL (#8771)	April-11	56	9.8	56	3.2	57,816
47	Wall Pack MH (#8771)	April-11	148	37	148	22.3	128,772
48	N. McDonnell Road - LED Roadway Fixtures (#8592)	June-11	67	18.9	67	14.5	38,150
49	S. McDonnell Road - LED Roadway Fixtures (#8592)	June-11	50	14.1	50	8.3	50,808
50	Domestic Garage - Stairwells Fluorescent (#8592)	June-11	100	5.5	100	3.7	15,768
51	AirTrain Domestic Stations - CFL Wattage (FOM)	March-11					TBD
Total Annual Electrical Energy Saved							11,591,784