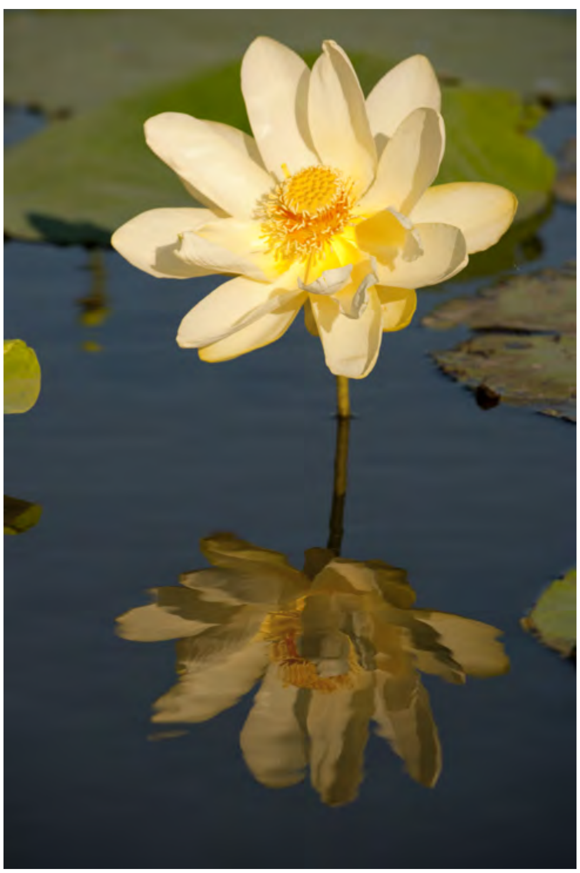
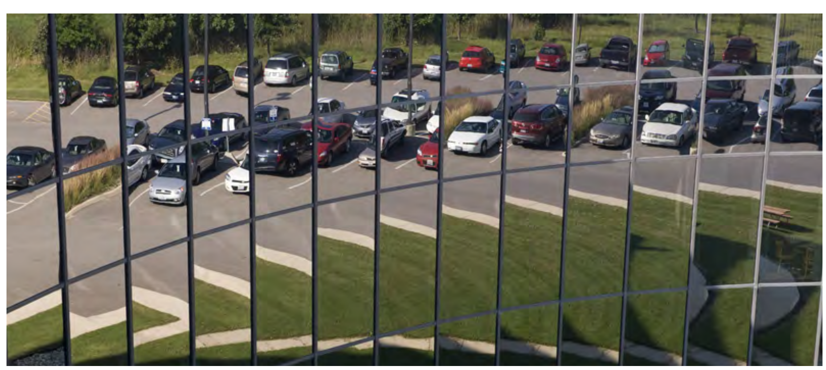
2012 Fermi National Accelerator Laboratory Site Sustainability Plan





Fermilab

U.S. DEPARTMENT OF ENERGY | Office of Science

Table of Contents

List of Acronyms

AFV	Alternative Fuel Vehicle
ARRA	American Recovery and Reinvestment Act
CDF	Collider Detector Facility
CEDR	Consolidated Energy Data Report
CRAC	Computer Room Air Conditioner
ECM	Energy Conservation Measure
EISA	Energy Independence and Security Act
EMS	Environmental Management System
EPACT	Energy Policy Act
EPEAT	Electronic Product Environmental Assessment Tool
ESCO	Energy Service Company
ESPC	Energy Service Provider Contract
FIMS	Facility Inventory Management System
GHG	Greenhouse Gas
GSA/CFL	General Services Administration/Computers for Learning
HEMSF	High Energy Mission Specific Facility
HPC	High Performance Computing
HPSB	High Performance Sustainable Building
ICW	Industrial Cooling Water
LBNE	Long Baseline Neutino Experiment
LEED-NC	Leadership in Energy and Environmental Design - New Construction
LHC	Large Hadron Collider
MINOS	Main Injector Neutrino Oscillation Search
NoVA	NuMI Off-axis [nu] Appearance
NPDES	National Pollutant Discharge Elimination System
NuMI	Neutrinos at Main Injector
OSF	Other Site Facilities
OTE	Office Technical and Education
PUE	Power Utilization Effectiveness
REC	Renewable Energy Certificate
SRI	Solar Reflectance Index
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
T&D	Transmission and Distribution
UESC	Utility Energy Service Contract
UIP	Utility Infrastructure Program
UPS	Uninteruptable Power Supply
USGBC	U.S. Green Building Council

I. Executive Summary

Fermilab Vision for Sustainability

Fermilab remains committed to our tradition of excellent environmental stewardship. The site is home to more than 1000 acres of restored tall grass prairie. Conservation of the site's forests, wetlands and surface water features is institutionalized in the Fermilab Ecological Land Management Plan. Fermilab's land and water management practices minimize contamination of the environment, ensure the efficient use of resources to complete our science mission, and conserve biodiversity. By its very existence, Fermilab stands as a " green island" of open and natural land in a region dominated by industrial, commercial and residential development.

The surrounding communities recognize the laboratory as a good neighbor, in part for this attitude toward the environment that we share with them. Because of the nature of Fermilab, our neighbors are afforded the opportunity to share the natural environment as well as other amenities like cultural events, lectures and learning opportunities. In this way, Fermilab is a leader and model in demonstrating sustainable practices and policies.

Fermilab's scientific community is naturally attracted to the challenge of carrying out the mission with less energy. However, since much of the technology used in the accelerator complex is unique, it is difficult to identify a benchmark against which to compare our efficiency data. Comparisons to historic power consumption data can be misleading, owing to changes in the science mission and the resulting volatility of electrical and thermal loads. Figure 8 in this report demonstrates that Fermilab's strategic plan for research dictates that electrical energy usage is expected to decrease by nearly 40%, then increase by over 100% within six years, as we develop new experimental facilities and bring them on line. Single facilities may house equipment with dramatically different energy requirements from year to year as they are modified and re-purposed to meet scientific goals.

Nevertheless, over the course of Fermilab's history, we have consistently developed new technology to become more efficient. The Main Ring proton accelerator at Fermilab was replaced by the super-conducting Tevatron in 1983, which raised the beam energy available for physics from 400GeV to 1 TeV using 50% less electrical energy. In 1999, the "recycler" anti-proton storage ring was constructed using permanent magnet technology to dramatically increase the availability of anti-protons at lower cost. Current plans for the G minus 2 experiment include re-using a detector salvaged from Brookhaven National Laboratory instead of building a new detector.

Planning and funding assumptions

As stated above, the mission of Fermilab is characterized by change. As new discoveries are made and understood by the scientific community, new questions emerge and new experiments are proposed, designed and built to provide answers to them. The current plan for the future at Fermilab is articulated in the publication titled "Fermilab: A Plan for Discovery 2011-2030" (Plan for Discovery). Since the transfer of most research at the

"Energy Frontier" from Fermilab to the LHC at CERN, the emphasis of research has shifted to the Intensity and Cosmic Frontiers and to new projects in the coming decades that depend on much higher beam intensities.

Additional funding that may become available for projects specifically designed to meet the sustainability goals of DOE is less certain. Fermilab has had some success in the past using third-party financing (i.e., UIP, ESPC) to fund energy efficiency retrofits and utility upgrades. In FY2012, we plan to initiate another comprehensive ESPC study to explore where retrofits could contribute to bringing existing buildings into compliance with the High Performance Sustainable Building Guiding Principles.

Fermilab is scheduled to begin receiving Science Laboratory Infrastructure funding in FY2013 to fund infrastructure upgrades that will have positive impacts on water and electrical energy efficiencies. Operating or general plant project funds may be used to improve operating efficiencies in existing buildings based on building assessments.

Successes and Challenges

Fermilab has always embraced the concept of stewardship of our resources, including the environmental resources. From the beginning, Fermilab has held to a philosophy of simplicity and economy of design for buildings and projects, using minimalist strategies to conserve all our resources.

Land and water management strategies and practice are models. Management of land includes restoring some portions to native ecosystems that were destroyed nearly 200 years ago, restoring the health of the land and increasing biodiversity dramatically. We have developed numerous land management strategies, utilizing agriculture, composting, and prescribed burning, to manage the site efficiently, safely and economically. Fermilab's Ecological Land Management Committee regularly advises Laboratory management on impacts of programmatic decisions on the natural landscape.

Although northern Illinois has an abundance of fresh water available, water management, especially Industrial Cooling Water (ICW) is an important factor in managing the Laboratory. Experimental equipment demands large volumes of cooling water to dissipate high thermal loads. At Fermilab, we rely heavily on capturing and retaining rainwater in surface water features to provide adequate ICW. Water is retained and recycled many times before returning naturally through evaporation to the natural cycle. This practice minimizes the amount of water we are required to extract from external sources. We also supplement the ICW system by capturing and utilizing water from the underground MINOS facility that would otherwise run off the site. As a matter of policy, no treated potable water is used for agricultural or landscape uses at Fermilab.

Waste minimization and pollution prevention have been areas of active improvement at the Laboratory for more than two decades. We currently have developed a sitewide recycling program administered by our custodial sub-contractors, and as of FY2011, we are diverting nearly 50% of "household" waste from the landfill. We have operated a very successful scrap metal program for decades, which has recouped significant savings for the Laboratory over the years, and conserved tons of virgin metals.

In pursuit of energy efficiency, Fermilab has successfully utilized third party financing to leverage operating dollars. Between 1998 and 2001 five UESC (UIP) projects totaling $58M were completed, which resulted in significant improvements to laboratory infrastructure and energy and water savings. During FY2011 a $3M ESPC project also funded a new high efficiency boiler in the Central Utility Building and numerous lighting retrofits, which are expected to result in significant energy savings in the future.

These successes notwithstanding, many of the goals of Executive Orders 13423 and 13514 and the 2011 DOE Strategic Sustainability Performance Plan are problematic for a site whose mission dictates the use of large amounts of energy. The Fermilab SSP for FY2012 illustrates that more than 94% of our GHG emissions are due to electrical power purchases, and more than 85% of that power is used to operate High Energy Mission Specific Facilities (HEMSF) that are necessary to produce scientific results. Clearly, Fermilab cannot substantially reduce our GHG emissions without incurring severe adverse impacts on our planned scientific mission for FY2020 and beyond.

Fermilab is currently dependent upon purchasing Renewable Energy Certificates (RECs) to offset our GHG emissions to meet the goal of a 28% reduction by FY2020 relative to FY2008. The purchase of RECs implies an actual reduction of GHG emissions nationwide, under the assumption that REC purchases have the effect of lowering the cost of producing renewable energy, toward the end of making it competitive with conventional energy generation. We are proposing to allow this method of mitigation for Scope 3 Transmission and Distribution (T&D) losses as well, as discussed in Section 2.1 of this plan. The current method of calculating these losses severely penalizes sites such as Fermilab by using national average T&D loss rates, which are nearly three times the actual rates as provided by our energy providers.

Fermilab supports the goal of making buildings energy efficient, comfortable, and safe as well as minimizing the use of non-renewable materials in their construction and maintenance. We are striving to find ways to upgrade 15% of our existing buildings with more than 5000 sq.ft. floor area as required by the SSPP, using the Guiding Principles as a guideline. Achieving this goal by FY2015 will be a challenge, both on budget and other resources. As stated in section 3.1, we expect to be able to use the ESPC vehicle to finance some of the necessary modifications to existing buildings on the site.

We are currently planning the construction of the Office Technical and Education (OTE) facility as a LEED-NC Gold building, following DOE guidance on new buildings. For other projects planned for construction in the future, it is clear that the LEED standard is not appropriate, due to high process electrical and thermal loads and/or the fact that these buildings are not intended for full time occupancy. Beginning with the Executable Plan in 2009, we have advocated using the applicable portions of the Guiding Principles instead of LEED certification.

We believe that to a significant extent, high energy research facilities such as Fermilab resemble industrial sites more than commercial or institutional sites, for which the Guiding Principles and the LEED standards are intended. The energy and GHG reduction goals of the DOE SSPP for 2011 also are most easily attained for more conventional sites, such as office buildings. While there are characteristics of our site that present difficult challenges, we believe that our proposals fulfill the spirit of the program to reach sustainability for DOE and the federal government as a whole.

SSPP Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
1.1	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline	Cumulative reduction at the end of FY2011: -5.2% FY2008 Baseline: 354,804 MT CO_2e FY2020 Goal: 255,459 MT CO_2e	REC purchases	L
1.2	30% energy intensity reduction by FY 2015 from a FY 2003 baseline	Increased from 94,947 BTU/gsf in FY2010 to 96,011 BTU/gsf in FY2011 (1.12%) Cumulative reduction from FY2003: 19.6% Baseline:119,446 BTU/gsf FY2015 Goal: 84,766 BTU/gsf	Rely on ESPC initiative to find sufficient ECMs to attain goal.	M (Financial, Technical)
1.3	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) where life cycle cost effective. The site *may* also report on potable water and chilled water as applicable.	Additional meters installed in FY11: 5 14 Advanced meters currently installed (83%) All NG meters are installed No steam on Fermilab site	Upgrade 3 meters to advanced status, bringing to 17 the total number of advanced electrical meters (100%).	L
1.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30	Area of cool roofs in FY11: 16,913 Area of cool roofs installed to date: 26,659	Continue our current policy, including evaluation of cool roofs for new buildings.	L
1.5	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – 2012)	Achieved with REC purchases for 7.95% of total <1% of total use is renewable on site.	Continue to purchase RECs for this goal while continuing to investigate RE technologies for use at Fermilab.	L
1.6	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline	FY05 baseline:31,621 GGE % increase: 49% Increase in FY11: 9.4%	Continue to pursue opportunities, but constrained by requirement to purchase hybrids and general fleet reductions.	M (Technical)
1.7	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	FY05 baseline:79,102 GGE Cumulative decrease: 43% Decrease in FY11: 9.4%	Continue to pursue opportunities, but constrained by requirement to purchase hybrids and general fleet reductions.	L
1.8	75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2000 and thereafter. Starting in FY 2015 100%	No vehicles purchased in FY11	Unlikely to purchase vehicles in FY2012	L
1.9	Reduce fleet inventory by 35% within the next 3 years relative to a FY 2005 baseline	FY11 Interim Goal has been met	Cannot meet future interim goals without severely impacting the scientific mission	H (Technical, Management)

SSPP Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
2.1	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline	FY2008 baseline: 22,288 CO2e FY11 reduction: -5.2%	Unlikely to be able to meet this goal without credit for RECs	M (Financial)
3.1	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015	No. needed: 15 No. compliant: 0 No. added in FY11: 0	Continue the scheduled assessments and explore strategies to meet the GP	M (Financial)
3.2	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds $5 million, each are LEED ® – NC Gold certification or equivalent	Buildings completed in FY2011 comply with the majority of the elements of the Guiding Principles	Continue to apply the Guiding Principles as applicable and cost effective.	L
4.1	26% water intensity reduction by FY 2020 from a FY 2007 baseline	Goal is met	Maintain usage << 2020 goal	L
4.2	20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline	Baseline (2010): 81 Mgal FY2020 Goal: 65 Mgal FY2011: 116 Mgal	Modify practices to retain more storm water	H
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	FY2011: 49.7% diverted – goal met	Continue current program	L
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	Goal is met for Fermilab managed waste.	Manage sub-contractors to document recycling of C&D waste for sub-contracted jobs.	L
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	Training completed	Modification of Procurement documents	L
7.1	All data centers are metered to measure a monthly PUE (100% by FY 2015)	2 of 3 meet the goal	Complete metering plan for remaining data center	L
7.2	Maximum annual weighted average Power Utilization Effectiveness (PUE) of 1.4 by FY 2015	PUE = 1.5 – 1.7	Incremental upgrades and efficiency improvements	M (Financial)
7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	Working on implementing Windows 7 to enable PM	Continue changeover	L

II. Performance Review and Plan Narrative

1.1 28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline

Performance Status

Scope 1 and 2 emissions are reported in Tab 3.2 of the Comprehensive Energy Data Report (CEDR). Scope 1 emissions are shown for FY 2008 through FY 2011 in Figure 1. Scope 1 emissions since FY 2008 have been almost entirely due to fugitive emissions of refrigerants and gasses (e.g., SF_6, CF_4, CH_4) used in experimental equipment. Losses are estimated from mass balance calculations, so applications that require new purchases for initial equipment filling can be recorded as releases. Thus, the reported volumes and consequent GHG emissions are extremely conservative.

The current inventory of SF_6 in the accelerator complex is approximately 7500 pounds, distributed among 8 locations. The most significant volume of SF_6 is located at a 6MV Pelletron electrostatic accelerator, associated with the Main Injector. The Pelletron accounts for more than 6000 lbs of SF_6 (80% of the total inventory at Fermilab). Since 2008, a major leak has been repaired and a complex monitoring and detection system has been installed.

During 2011 between 105 and 320 pounds of SF_6 were inadvertently released to the atmosphere due to accessing the Pelletron for maintenance. Each access of the Pelletron releases between 7 and 25 pounds of SF_6. These releases are unavoidable, due to limitations on the vacuum that electronics in the containment can withstand.

The balance of SF_6 at Fermilab is located in various relatively small applications. Several small ($\leq$ 1 lb.) leaks in these distributed sources have been repaired. A substantial source of leaks in a RF waveguide system was tracked down to a faulty connector and repaired. There have been no losses in this system since the repairs were completed in April, 2011. A relatively minor amount of SF_6 at Fermilab is located in various pieces of high voltage electrical distribution equipment. There have been no losses of SF_6 from these sources.

Procurement documents indicate the purchase of 1150 lb. of SF_6 during FY2011. At the end of FY2011, 830 lb. were returned to supply when the Pelletron was opened for the last time. The CEDR report of GHG emissions from SF_6 therefore is based on the assumed loss of 320 lb. The remaining gas is in storage or remains in equipment.

Total fugitive emissions of GHG in FY2011 were slightly less than those reported in FY2010. Additional emissions were due to two sources, the Wide Angle Muon System (WAMUS) and Muon Drift Tube projects. These two projects accounted for large emissions of CH_4 and CF_4 during the year, equivalent to 6390 MT CO_2e.

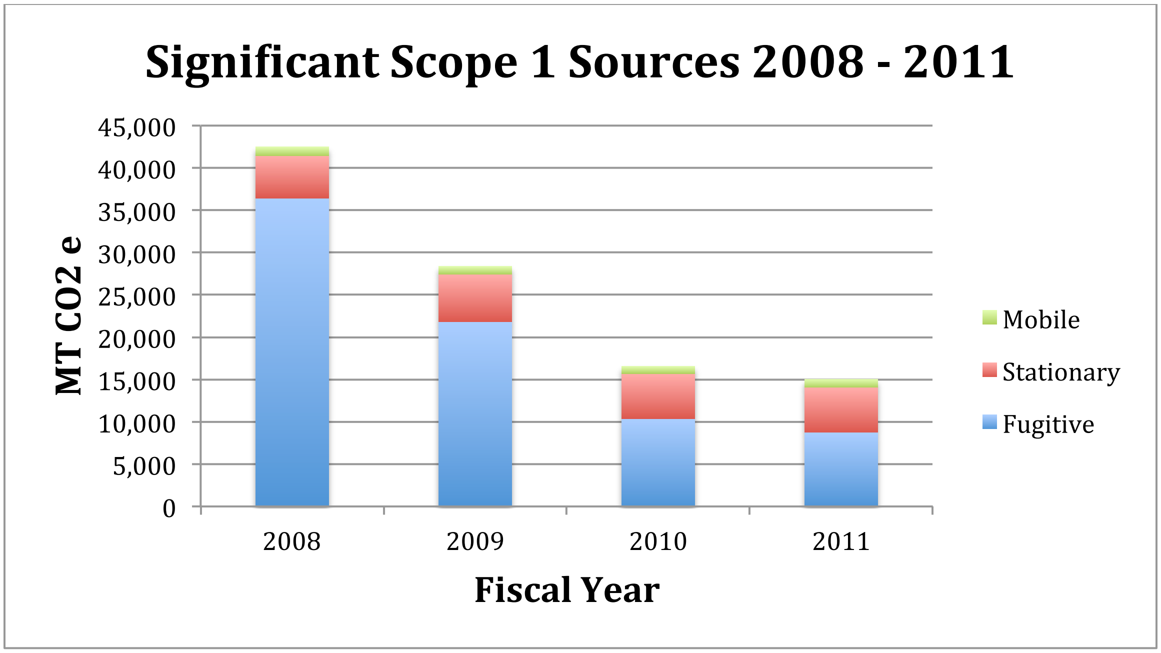


Figure 1. Significant Scope 1 GHG sources expressed in metric tons of CO_2e. These sources account for only about 7.5% of the combined Scope 1 & 2 GHG emissions.

Scope 2 emissions are an order of magnitude greater than Scope 1 and are shown in Figure 2. Scope 2 emissions at Fermilab are due exclusively to purchased electrical power, 85% of which is used to operate the HEMSF particle accelerator complex and high performance mission specific computing facilities. Of the total GHG emissions in FY 2011 at Fermilab (Scope 1 – 3), 94.5% result directly from the purchase of electrical power or indirectly from off site transmission and distribution (T&D) losses reported in Scope 3. The overall distribution of GHG sources at Fermilab is depicted in Figure 3.

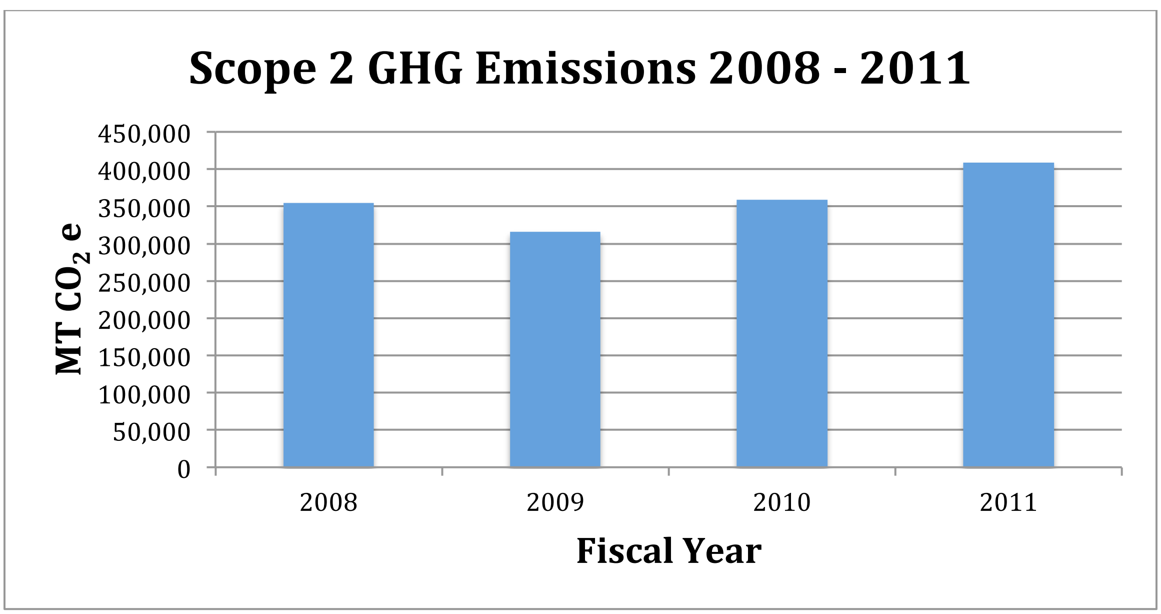


Figure 2. Scope 2 GHG emissions expressed as metric tons of CO_2e. Scope 2 emissions from previous years were re-calculated using the correct RFCW EGRID factor.

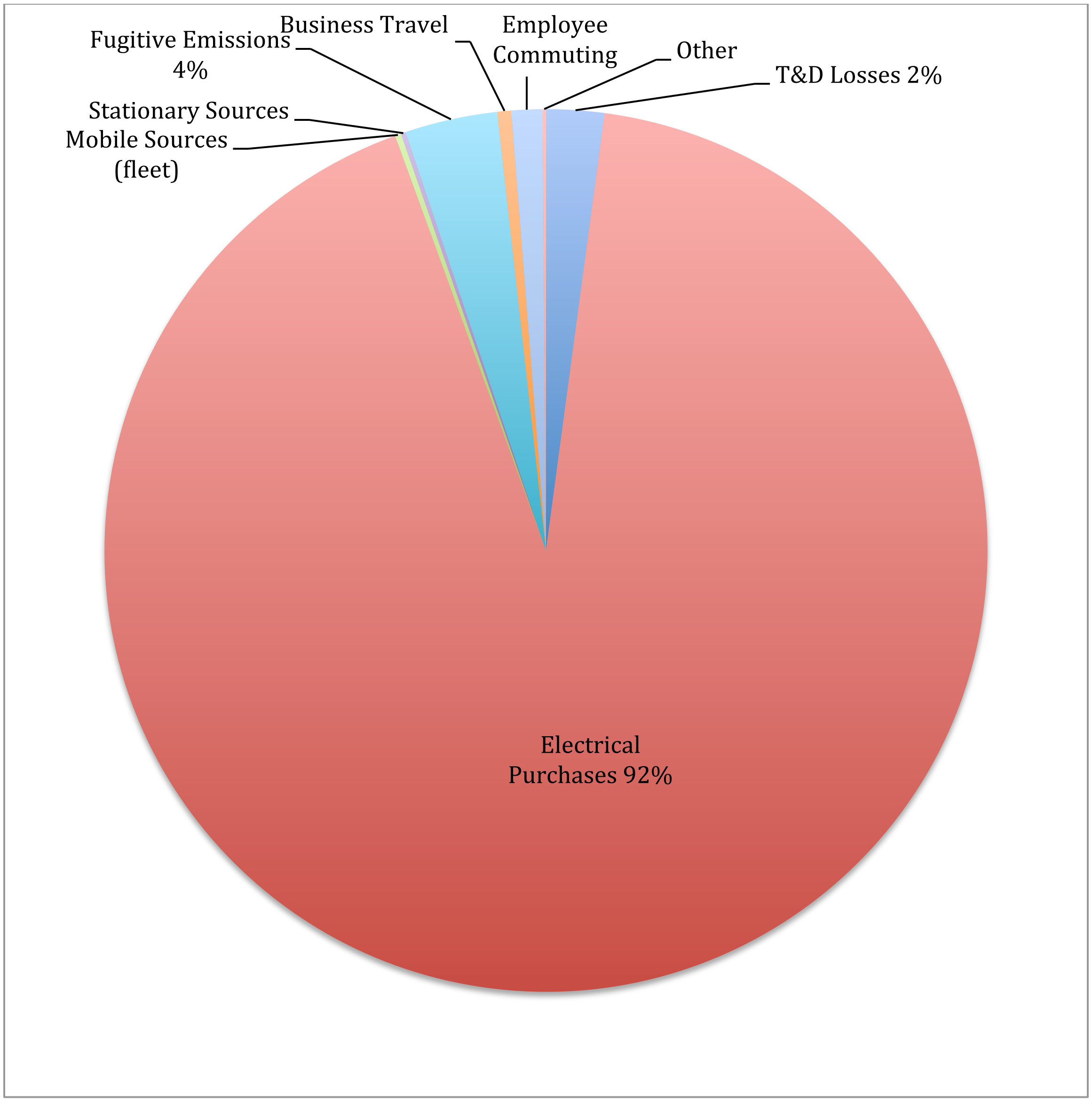


Figure 3. Overall distribution of GHG sources at Fermilab. The combined GHG for electrical purchases and T&D losses exceeds 94% of the total. Percentage contribution for the top three sources are shown.

Planned Actions

Energy use during 2012 will decrease significantly due to the cessation of Tevatron operations and a year-long shutdown of the remaining accelerator complex for maintenance and upgrades. After 2012, anticipated new projects would increase Scope 2 GHG emissions relative to the 2008 baseline year by roughly 25% by 2015. The NOvA, SCRF, CMTF and SeaQuest experiments are scheduled to begin operation in 2013-14. The chart of "Electricity Projections for Fermilab" (Figure 8 in Section V) shows that the overall Scope 2 emissions in 2020 are expected to exceed the 2008 baseline by 28%, as NOvA and SeaQuest terminate operations but are replaced by the new Mu2e and LBNE startup phase in 2019. The new g minus 2 project is to begin operation in 2016 and end in 2019, so it is not anticipated to impact the 2020 goal. The initiation and cessation of projects in the period from 2012 to 2020 will have an obvious impact on the level of GHG emissions unrelated to efforts to improve energy efficiency. Fermilab's projected energy use for 2020 has been substantially modified from the projection in last year's SSP. Project X and full LBNE operations have been pushed beyond the 2020 horizon due to funding constraints as recently documented in Fermilab's Plan for Discovery.

Given the energy-intensive nature of Fermilab's mission, it is not currently feasible to reduce the purchase of electrical power to the level required by the SSPP goal without compromising the science mission. Fermilab plans to purchase sufficient RECs to offset Scope 1 and 2 emissions of GHG to meet the 2015 and 2020 goals. Following the schedule in the Goal 1 DOE Planning Table on page 42 of the 2011 DOE SSPP, the GHG reduction goal is now 15% for 2012, 17% for 2013, and 19% for 2014-15, with an ultimate goal of 28% in 2020. Additional RECs will be purchased accordingly.

The 2011 DOE SSPP (p.42) and the Guidance for FY2012 Site Sustainability Plans (Appendix D) indicate a goal of 14% reduction in GHG for 2011. Since this guidance was not available until the end of the fiscal year, Fermilab's FY 2011 REC purchases covered only the 7.5% renewable energy goal exemption, following the FY2010 DOE SSPP. Anticipated energy use will require REC purchases equivalent to nearly 280 GWH by 2020. At the 2011 rate, that would equate to a cost of approximately $185K. The plan for future REC purchases is shown in Table 1.

	Actual FY11	Planned FY 12	FY13	FY14	FY15	FY16	FY17	FY 18	FY19	FY20
Renewable Energy (MWHs) Plan	5	5	5	5	5	5	5	5	5	5
Renewable Energy Credits (MWHs)* Plan	40,000	31,903	31,152	225,706	222,107	221,297	231,409	237,840	278,327	278,832
Actual/Planned/ Estimated Cost ($)	26,560	21,184	20,685	149,869	147,492	146,941	153,656	157,926	184,809	185,145
Unit Costs ** ($/MWHs)	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66

*Table 1. Planned REC purchases. * Purchase plan is based on the strategic plan for meeting GHG reduction goal 1 and the T&D losses accounted for in goal 2.1. ** REC unit cost is based upon current unit cost.*

The amount of renewable energy currently produced on site is less than 5 MWH/yr. This is not expected to change significantly in the foreseeable future, because renewable energy production has not generally proven to be life cycle cost effective at Fermilab.

Fermilab anticipates meeting the DOE goals for GHG reduction each year through the purchase of RECs, but will continue to look for onsite opportunities for renewable power generation as new technologies develop. Fermilab's site-specific measurable goal in this area for 2012 will be the purchase of RECs to cover a 15% reduction of Scope 1 and 2 GHG emissions from a 2008 baseline. We have also included in REC purchase plans sufficient amounts to match T&D losses, included in Scope 3. The gap analysis for all GHG emissions and proposed mitigation is illustrated in Figure 4.

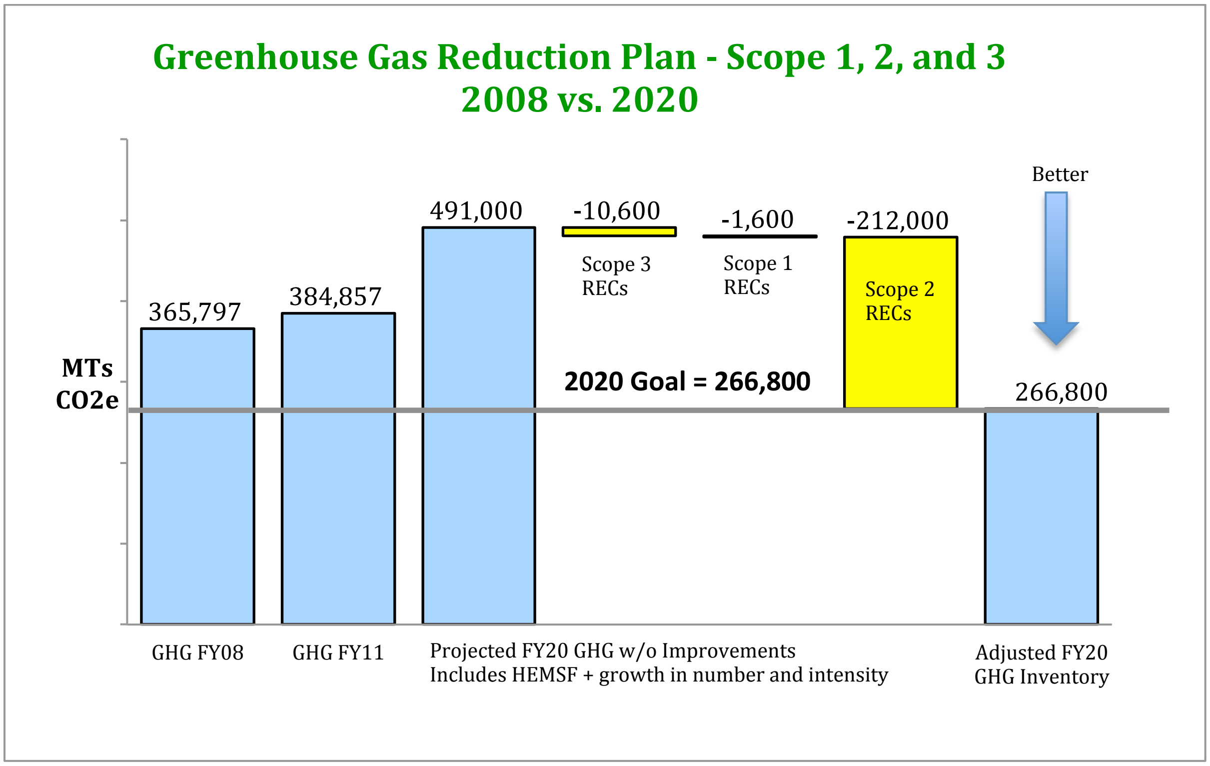


Figure 4. Fermilab actions to mitigate GHG emissions by 2020 consist of REC purchases. This plan is consistent with the proposal to allow REC purchases to offset Scope 3 Transmission and Distribution (T&D) emissions. 94.6% of Fermilab's total emissions are from purchased electrical power under Scope 2.

After the shutdown of the Tevatron in 2011, the Pelletron is no longer needed, and will be decommissioned during 2012. SF_6 remaining in this equipment will be reclaimed and returned to the vendor. We anticipate having the SF_6 from the Pelletron removed from the Fermilab inventory early in FY2012. During FY2012, other elements of the particle accelerators will be upgraded or replaced, including the Cockroft-Walton accelerator, which contains approximately 20 lbs. of SF_6. This gas will also be returned to the vendor.

Fermilab is investigating the feasibility of replacing SF_6 with dry air or nitrogen in other equipment, in order to reduce the liability from this potent GHG. Once the bulk of SF_6 is removed from the Fermilab inventory, management of remaining SF_6 on the site for other projects will consist of tracking purchases needed to make-up losses. Any losses will be investigated and leaks repaired. In addition, applications in which SF_6 is used will be monitored to ensure that any leaks will be detected in a timely manner.

Likewise, both WAMUS and the Drift Tube project have been discontinued following the Tevatron shutdown, thus removing additional GHG from the Laboratory's inventory.

1.2 30% energy intensity reduction by FY 2015 from a FY 2003 baseline

Performance Status

Fermilab's current energy intensity of 96,011 BTU/gsf is a 19.6% reduction from the 2003 baseline of 119,446 BTU/gsf as shown on Tab 3.2 of the CEDR. This is consistent with the 2011 goal of 18% outlined in Appendix D of the Guidance for FY 2012 DOE Site Sustainability Plans and in the Goal 1 DOE Planning Table on page 41 of the 2011 DOE SSPP. This is also an improvement of 0.3% over the 19.3% reduction achieved last year, in spite of more severe weather. Fermilab's site-specific measurable goal in this area for 2012 will be the selection of a successful ESCo and completion of facility audits pending timely execution of new DOE ESPC contracting requirements.

Acceptance of a $3M ESPC installation was completed in FY2011, which increased energy efficiency by 6%, but much of the gain was already seen in FY2010 through partial project acceptance. It included the replacement of an aging boiler at the Central Utility Building, power distribution modifications, and lighting retrofits in various buildings.

Fermilab audited 244,065 ft^2 of facilities this year, bringing its current 3-year running total to 2,960,107sf, which represents 87.5% of the covered EISA facilities on site.

The Fermilab Energy Manager was recertified as a Certified Energy Manager (CEM) this year and is currently the only Fermilab individual so qualified.

Planned Actions

Fermilab is working with DOE under its new contracting requirements to select an ESCo to complete audits of facilities on site and develop another ESPC initiative to implement additional retrofits. Although cost-effective recommendations from HPSB studies of the CDF and D0 office buildings may be implemented under the ESPC, the remainder and the retro-commissioning of 4 other buildings on site will only be implemented if funding becomes available. The scope of the next ESPC initiative is constrained by determining the future usefulness of facilities on site. Tab 3.5 of the CEDR summarizes projects that, if implemented, contribute to reducing energy intensity by 25.3% by the end of FY 2015.

We anticipate that retrofit opportunities needed to make up the additional 4.7% to achieve the 30% goal by 2015 will be identified in the audits to be performed during FY2012. Implementation costs and savings estimates in Tab 3.5 of the CEDR in many cases are based simply on scaling by area the opportunities identified in the HPSB studies for the D-0 and CDF Office Buildings. Additional cost savings have been added as needed to make the projects show an Savings Investment Ratio (SIR) greater than 1.0, as noted in the Additional Information (bf) column of Tab 3.5 of the CEDR. Better estimates will be available when the ESPC audits are completed.

Fermilab uses the results from audits conducted by ESCo's in the preparation of ESPC proposals every 4 years to identify cost-effective energy and water conservation opportunities, because the ESPC provides financing for the implementation of ECMs. The next cycle of audits is expected to be accomplished by June of 2012 to meet the EISA 4-year audit cycle for covered facilities, and can be accomplished on time if a successful ESCo can be identified early in FY 2012. However new DOE contracting requirements on ESCo selection are more involved than in previous years, and may cause delays.

The next ESPC initiative will evaluate potential cost-effective conservation measures in buildings currently identified to be upgraded for the site 15% HPSB requirement, and will also assess opportunities for conservation and consolidation associated with the recent permanent shutdown of the site's largest accelerator, the Tevatron. It will also evaluate new technology applications for conservation and renewable energy.

ESPC contracting cannot be expected to fund all of the costs needed for the site 15% HPSB requirement. Neither can it be expected to fund the estimated $1.3M cost of retro-commissioning the four buildings on site that fall under the EISA 4-year cycle requirement due in 2012. No alternative source of funding has yet been identified to meet these requirements in a timely fashion.

Fermilab intends to keep facilities associated with the Tevatron accelerator, which was permanently shut down in September, in the Excluded category until the disposition of these facilities is identified. Currently these facilities are engaged in post shutdown activities and some are intended to continue research for several years. There are also various plans being vetted for the possible use of many of these facilities in accelerator physics, much as has happened historically at Fermilab's Fixed Target area.

Fermilab anticipates meeting the DOE 30% goal for energy intensity reduction largely through ESPC contracting, but this will result in little progress in 2012 followed by improvements in subsequent years due to the ESPC cycle of approval and implementation.

Starting in FY2012, all metered buildings will be tracked using the EPA Energy Star Portfolio Manager software.

1.3 Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)

Performance Status

Fermilab has completed the installation of all cost-effective electricity metering identified at the building/process level, covering 97.4% of the power used on site as reported on Tab 2.1 of the CEDR, thus fulfilling the goal requirement. These meters are primarily used for energy use diagnostics, emergency response (especially curtailment), and for planning and reporting, as outlined in this year's site metering plan. Additional metering will be added as new buildings are constructed and as needed to meet HPSB requirements.

Fermilab has also completed the installation of all identified cost-effective natural gas metering at the building/process level, covering 31% of the annual usage on site as reported on Tab 2.1 of the CEDR. These are used primarily for energy use diagnostics and planning and reporting purposes. There are no further plans to expand the number of gas meters on site unless cost-effective opportunities are identified, other than those installed in new buildings and as needed to meet HPSB requirements.

There is currently no steam usage on site or practical applications for chilled water metering as reported on Tab 2.1 of the CEDR. However, as reported on the same CEDR Tab, potable and ILA water usage is metered for the largest users on site as a best management practice. These users together account for 59% of the total water usage on site. The data are primarily used for diagnostics, planning and reporting purposes.

Planned Actions

Fermilab plans to upgrade the 3 standard electricity meters reported on Tab 2.1 of the CEDR to have advanced workstation capabilities. Fermilab's site specific measurable goal in this area for 2012 will be the completion of at least one of these standard meter upgrades, contingent on the opportunity to interrupt scientific operations long enough to complete the work.

In order to meet other DOE requirements to meet the Guiding Principles in existing buildings, additional advanced meters may be required even if not life cycle cost effective under the criteria applied for the metering plan. Such meter installations would be evaluated under a plan to utilize metering data to drive the behavior of occupants to reduce consumption.

1.4 Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30.

Performance Status

Fermilab has not historically invested in cool roofs. Because of the normally high process-related thermal loads encountered in the many of our buildings, the cost of heating is low and cooling in process spaces is typically achieved through ventilation. The advantages of cool roofs in our climate are marginal, and given the low cost for electrical energy, life cycle cost analyses are typically not favorable.

During FY2011, the Housing Department installed 13,700 sq. ft. of composite shingles with a Solar Reflective Index (SRI) of 31, on residences within the Fermilab Village. This product was identified in the FY2010 SSP. One programmatic building (PS-3) had a new cool roof installed. The area of this roof is 3913 sq. ft.

Planned Actions

We will continue to evaluate replacing roofs with cool roof technology. For all new construction in the future, cool roofs, including R30 insulation will be specified unless it is demonstrated to be infeasible or not life cycle cost effective. The Office, Technical and

Education Building, which will be completed in FY2014 will be certified as LEED-NC Gold and will have a cool roof.

The Fermilab Housing Department will continue to employ the reflective shingles for roof replacements, which is expected to result in replacing from 1 to 4 roofs in the Village annually until all of the approximately 80 roofs are compliant. This product will also be evaluated for use on other high slope shingle roofs on site.

1.5 7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – 2012).

Performance Status

Renewable energy produced on site currently amounts to less than 5 MWH/year as listed in Tab 3.3 of the CEDR. At this time further renewable energy production on site is not economically viable.

Fermilab conducted discussions with New Generation Power Corp. this year regarding the feasibility of installing a large 50MW solar power installation on site to determine whether there were economies of scale that might make renewable power generation on site practical. Unfortunately, no cost-effective opportunities were discovered, due to the low cost of purchased power at the site, shutdowns, and the stiffness of the power grid needed to accommodate accelerator power spikes. Fermilab also assessed the feasibility of installing solar water heating in all new construction, but this has also not proven cost-effective due to the freezing potential in the site's climate zone. Simple payback calculations on a range of solar water heating options resulted in paybacks of between 63 and 70 years.

In lieu of on site renewable energy generation Fermilab purchased RECs in FY 2011 equivalent to 7.95% of the site's total annual electric and thermal energy consumption this year, as documented in Tab 3.4 of the CEDR.

Planned Actions

Fermilab plans to continue purchasing RECs to meet the DOE goals each year, but will continue to look for onsite opportunities for renewable power generation as new technologies develop. The procurement of RECs to cover each year's GHG requirement will simultaneously cover the percentages required under this goal and more. Therefore, Fermilab's site specific measurable goal in this area for 2012 will be the purchase of RECs equivalent to a 15% reduction of Scope 1 and 2 GHG emissions from a 2008 baseline and the renewable energy goal. Fermilab plans to continue purchasing RECs to fulfill this goal for FY 2012 and subsequent years. We will continue to look for technical or market developments that would make renewable energy projects cost-effective on site. However, given the power costs for the foreseeable future, this does not seem promising.

1.6 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline

Performance Status

Fermilab continues to meet the EPACT and Department of Energy's Strategic Sustainability Performance Plan goals of decreasing petroleum use and increasing the use of alternative fuels. Prior to the implementation of the mandated goals, the Laboratory had already begun developing and building the infrastructure necessary to utilize alternative fuels. The Laboratory has increased the use of alternative fuels by 49% since the baseline year of 2005. During the same time period, Fermilab has reduced dependence on petroleum consumption by 43%. The Laboratory was able to add to these gains by 9.4% in FY2011. The Laboratory has met or exceeded all the requirements of the Energy Policy Act of 2005 as it pertains to petroleum reduction and alternative fuel usage.

Planned Actions

Fermilab currently has a fleet of 219 vehicles. The action that will have the most impact is the fleet reduction covered in section 1.9 of this document. The Laboratory plans to continue giving priority to acquiring alternative fueled vehicles as the fleet is reduced and as budgets allow. Eighty per cent of the Fermilab fleet is alternatively fueled currently, and our goal is to increase the percentage to 100%. There are several medium and heavy-duty vehicles operating on biodiesel fuels (included in the 80%). The Laboratory will continue to work to meet the increasingly difficult challenge of finding suitable alternatively fueled replacement vehicles that meet the goals for petroleum reduction and that fulfill operational needs.

1.7 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline

Performance Status

Fermilab has reduced petroleum consumption by 43% since FY2005 and reduced petroleum usage by 9.4% in FY2011. The Laboratory has been very successful in surpassing the requirements for the petroleum reduction. Fermilab has never requested or needed a Section 701 AFV waiver since it is in full compliance with EPACT 2005.

Planned Actions

Fermilab will continue to be diligent in replacing petroleum-fueled vehicles with alternative fueled vehicles. Funding will play a major role in our ability to be proactive in the procurement of AFVs going forward. The Laboratory has acquired hybrid vehicles with plans to purchase more hybrids and E85 vehicles while maintaining the use of biofuels where practical. Purchasing hybrids will lead to an increase in petroleum fuel use over E85 vehicles. Since most of the light duty acquisitions will replace E85 vehicles with hybrids, the results will include an increase in petroleum fuel usage.

1.8 75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2000 and thereafter

Performance Status

Fermilab has always met or exceeded the requirement to specify alternative fueled light duty vehicles for 75% of our purchases. The Laboratory has been very aggressive in past years and now has a fleet of predominantly alternative fueled vehicles. In FY2011 we were unable to order any replacement vehicles due to operating budget constraints.

Planned Actions

It is unclear at this time what FY2012 budgets will allow due to continuing funding uncertainties. The reduction in fleet (see section 1.9) will have a major impact on the fleet and future vehicle replacement orders. When possible, future purchases of light duty vehicles will be either hybrid or E85. Fermilab continues to support the utilization of alternative fuels by requiring the sub-contracted guard service to use alternatively fueled vehicles in their fleet.

1.9 Reduce fleet inventory by 35% within the next 3 years relative to a FY 2005 baseline

Performance Status

Fermilab has met the first phase of the fleet reduction of 15% by the end of calendar year 2011. The Laboratory maintains a very efficient fleet, having already reduced the size of the fleet by 12% prior to this most recent reduction initiative.

Planned Actions

Prior to the beginning of CY2012, Fermilab expects to reduce the fleet by 15% (34 vehicles) from the 229 vehicles in our fleet in the baseline year of 2005. This number represents a reduction of 15.5% of the existing (FY2011) fleet of 219 vehicles. Because these reductions must come primarily from vehicles directly involved in maintenance and operational activities, we expect that the projected reductions will result in compromised effectiveness and efficiency. Reductions beyond those planned for FY2012 would severely jeopardize the ability of the Laboratory to perform its mission.

2.1 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline

The most significant sources of Scope 3 emissions at Fermilab are T&D losses, business air travel, and employee commuting, as illustrated in Figure 5, below. The minor contributions of off site waste treatment are not shown.

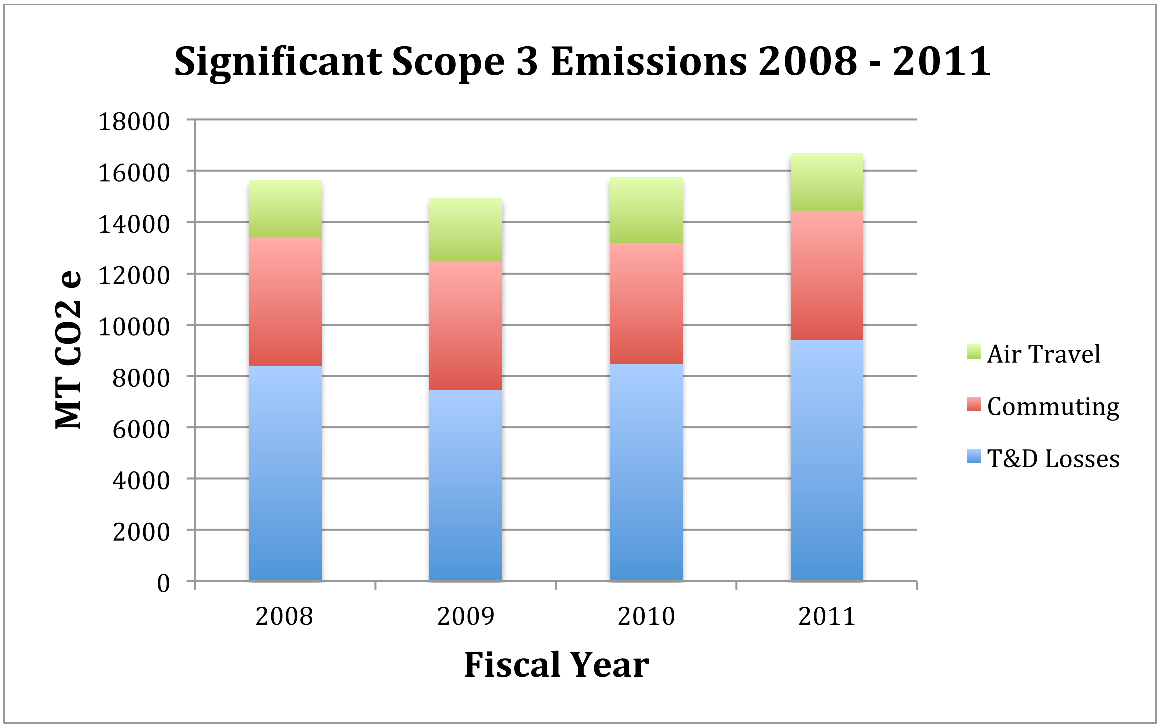


Figure 5. The three most significant contributors of Scope 3 GHG at Fermilab. T&D losses in this figure were calculated using actual loss factors supplied by our energy suppliers, rather than the much higher national default factor.

Performance Status

- Employee commuting
  Fermilab employs approximately 2000 people, the majority of whom commute by automobile to work from an average distance of 14 miles. Public transportation to the Laboratory is limited and rarely used. No bus routes serve Fermilab and the nearest train station is 4 miles from Wilson Hall, the Main Administrative building. As a result, Fermilab's GHG emissions due to employee commuting remain relatively constant at approximately 5000 metric tons per year. Fermilab has an active commuter bicycling group, some of whom track their mileage to and from work. Riders maintain an interactive website and in 2011 they logged 39,000 miles commuting to and from work. The Fermilab campus supports a network of bike trails and bike lanes that encourages this mode of alternative transport.

- Business ground and air travel
  Fermilab's place in the high energy physics community dictates that employees and visitors travel, much of which is international. In 2011, employee airline trips totaled over 11 million miles and accounted for 2246 metric tons of GHG emissions. This represents a reduction of over 21% from FY2010. Fermilab employees accumulated 1693 total automobile trips using rental (77%) and personal car use (23%) and the weighted average of 191 miles per trip resulted in the emission of 122 metric tons of GHG.

Fermilab has developed eight fully equipped conference rooms to accommodate video-conferencing, and a significant number of meetings, seminars and training sessions are conducted via web-based meeting software and/or tele- and video-conferencing means. In 2008 we completed the Remote Operations Center in Wilson Hall. This facility allows North American scientists at Fermilab to participate directly in experimental operations of the accelerator at CERN in Switzerland. This capability makes trips to CERN unnecessary and thereby avoids significant GHG emissions from air travel.

- Transmission and distribution (T&D) losses
  Transmission and distribution (T&D) losses associated with purchased electric power are Fermilab's most significant source of Scope 3 emissions. In conformance with Section 2.1 on page 8 of the Guidance for FY 2012 DOE Site Sustainability Plans, T&D losses reported in the CEDR were calculated from the MWH of electricity purchased, using a loss factor of 6.18%, taken from the EGRID national standard. However, in the Fermilab GHG Inventory, T&D losses for baseline 2008 and subsequent years were re-calculated using the 2.22% actual loss figure supplied by the site's electrical energy providers, Com Ed and PJM, rather than the national default value of 6.18%. In 2011, this amounts to reporting almost 17,000 metric tons of CO_2e above actual generation emissions, reflecting the large amount of purchased power used on site. The fact that Fermilab receives power from the grid at the 345kV level accounts for the disparity from the national average, which is based primarily on low voltage supply.

- Contracted (off-site) waste water treatment
  Fermilab sanitary wastewater is treated off site at two Publicly Owned Treatment Works located in the cities of Batavia and Naperville, which are located to the west and east of the Laboratory respectively. There is no on site wastewater treatment at Fermilab. During 2011, wastewater treated off site resulted in GHG emissions of approximately 205 MT CO_2e.

- Contracted (off-site) municipal waste disposal
  In 2011 Fermilab generated 318 metric tons of sanitary waste. Fermilab has an established recycling program for a variety of materials and actively seeks out opportunities to expand the program where it is feasible. Over 158 metric tons (49.7%) were diverted from landfills in 2011. This figure does not include materials from the scrap metal program, or electronics recycling (see section 7.1). There is no treatment of solid waste on site at Fermilab.

Planned Actions

- Employee commuting
  Attempts in the past to encourage carpooling and vanpooling have been unsuccessful. Various options for alternative work schedules continue to be evaluated, but for a significant majority of employees, the necessity of access to tools, information and collaborators are prohibitive. Alternative scheduling for non-exempt employees is

often prohibited by overtime rules. Fermilab will continue to explore the feasibility of alternate work arrangements for some employees.

- Business ground and air travel
  Fermilab's place in the high energy physics community dictates that employees and visitors travel, much of which is international. Fermilab will continue to investigate ways to minimize travel and utilize remote meeting technology.

- T&D Losses
  T&D losses could be covered by RECs just as is the delivered power they represent, if allowed under DOE guidance. Otherwise they will continue to exercise a disproportionate effect on attaining DOE Scope 3 goals at all sites that use large amounts of power. Because there are no means of reducing these losses without reducing purchased power, Fermilab proposes to offset the losses due to T&D by purchasing an equivalent amount of RECs. Fermilab has chosen to incorporate this additional investment in renewable energy into our REC purchasing plan in Table 1 of this plan.

- Contracted (off-site) waste water treatment
  Fermilab continues to implement various upgrades to the sanitary sewer system designed to reduce the volume of wastewater treated off site by minimizing the infiltration of groundwater into the sanitary sewers.

3.1 15% of the number of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the five guiding principles of HPSB by FY 2015

Performance Status

Two buildings, the CDF and D-Zero office buildings, have undergone a retro-commissioning study. Preliminary assessments have been made for them and the appropriate fields have been updated in the FIMS database. Evaluation of existing buildings toward meeting the 15% goal is formally incorporated into the Fermilab EMS as an Environmental Management Plan with specific milestones and goals.

Among the challenges to meeting the Guiding Principles is establishing relevant benchmark data for energy and water usage against which to evaluate compliance. Most of the over 300 buildings at Fermilab have never been individually metered for electricity or natural gas. Many process-related buildings are fed by multiple electrical feeders, so economical metering is a challenge. Until this and other issues are resolved, uncertainties will remain as to whether/how the goals will be met.

Wilson Hall accounts for more than 15% of the total gross square foot area for the Laboratory. The previous strategy was to concentrate on meeting the requirements in this single building. However, new guidance in 2010 changed the goal to 15% of the number of buildings. Fermilab has 102 buildings over 5000 gsf, and revising the strategy to require meeting the Guiding Principles in 15 buildings by 2015 places a severe burden on the Laboratory. Few existing buildings have the necessary electrical and natural gas meters, and installing these systems is demanding on funding and human resources already stretched thin. We have tentatively identified 14 existing buildings that are the most likely viable candidates, based on function, size, cost to retrofit, and anticipated status after 2015. Due to existing policies, over 40% of the Guiding Principles are already met for each of these buildings. The OTE building is scheduled to be constructed in time to qualify as an existing building in 2015 and will be certified as a LEED-NC Gold project. These existing buildings and the planned new building are listed in Tab 5.3 of the 2011 CEDR.

Planned Actions

In order for Fermilab to bring 15% of our buildings into compliance, the candidate buildings must formally be assessed against the Guiding Principles, beginning in FY2011. Figure 6, below, illustrates the current plan to assess the candidate buildings and enter them into the Energy Star Portfolio Manager database. Based on the findings of the formal assessments, Fermilab will devise a strategy to retrofit 15 buildings to meet the Guiding Principles by FY2015.

The total building area at Fermilab is 2,383,427sf, which excludes the FIMS OSF Research Accelerator Ring/Tunnel and the NuMI Tunnel. The cumulative square footage of the candidate buildings is greater than 375,000 g.s.f., exceeding 15% of the total gross floor area.

We will continue to incorporate sustainable practices into site policy and planning. New building design and construction has been modified to include building commissioning, electric, water and natural gas metering, and sustainable acquisition for materials and items in projects where feasible and practical. Fermilab will continue our past sustainable practices, such as a formal Integrated Pest Management Plan, Zero potable water for landscaping policy, no smoking policy, and prohibition of CFCs in new projects.

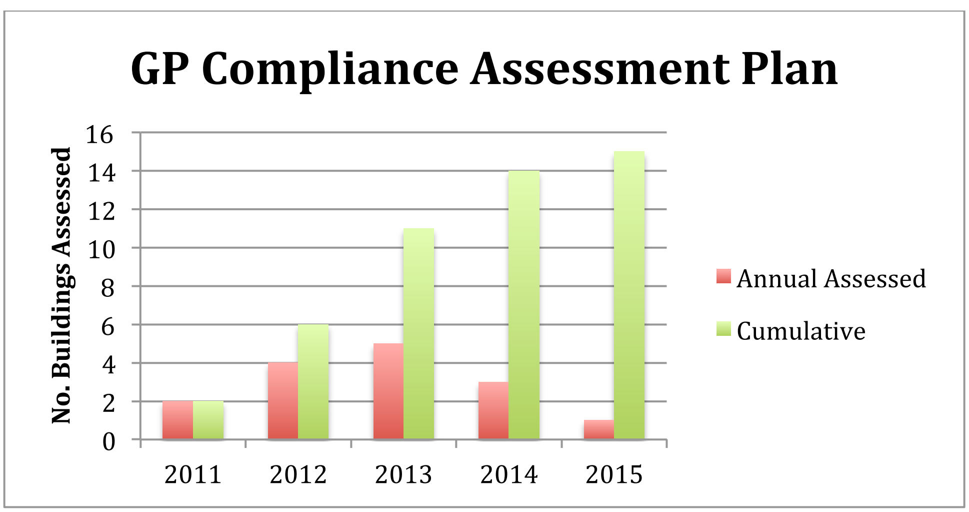


Figure 6. Planned annual and cumulative assessments planned to achieve guiding principle compliance for 15 buildings by 2015.

3.2 All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds $5 million, each are LEED–NC Gold certification or equivalent

Performance Status

Fermilab currently lists 5 projects in Tab 5.2, "New Bldg Construction" of the CEDR that either have or are anticipated to receive CD-1 in 2011. The Office, Technical and Education Building (OTE) at the Illinois Accelerator Research Center (IARC) will be designed to achieve LEED-NC Gold certification. As previously noted in the 2009 Executable Plan, the remaining projects are heavily process-oriented, so applying the LEED-NC and ASHRAE criteria is problematic. However, all will achieve some portion of the Guiding Principles.

All construction designs are analyzed at the conceptual design review stage for conformance to the Guiding Principles. Results of these analyses are included as a part of respective Project Plans. Incorporation of sustainable building/design practices into the Fermilab EMS is included in the policies of the Facilities Engineering Services Section's Engineering Department.

Many new projects at Fermilab or other high energy scientific facilities do not fall under the categories "commercial, institutional, or high-rise residential buildings" required by the USGBC to qualify for LEED registration. For these projects, meeting the USGBC Minimum Program Requirements can be challenging or infeasible. In addition, the ASHRAE 90.1 standard states that it should not be applied to "…portions of building systems that use energy primarily to provide for industrial manufacturing, or commercial processes." (ASHRAE 90.1 – 2007, section 2.3.c.). Fermilab is working with its Architectural and Engineering contractors to provide rational estimates of building energy usage for these projects.

Fermilab has elected to demonstrate its compliance with the guiding principles of Executive Order 13423 by preparing and maintaining a "DOE High Performance and Sustainable Buildings Assessment and Compliance Tool for New Construction" spreadsheet for each of the first four projects listed in Tab 5.2 of the CEDR. The projects are expected to meet from 60 to 90% of the 34 measures required by the tool. Fermilab is committed to implement as nearly as possible all the measures necessary to demonstrate its adherence to the guiding principles. The tool will be used as a roadmap for attaining documented compliance with the guiding principles for these and future projects.

Planned Actions

Future planning of buildings and major building renovations will be designed to obtain LEED Gold certification where feasible, if the Total Project Cost is greater than $5M. Smaller projects will meet 100% of the guiding principles as appropriate. Projects will be designed to achieve the greatest number of the Guiding Principles possible under the Maximum Extent Practicable criterion.

4.1 26% water intensity reduction by FY 2020 from a FY 2007 baseline

Performance Status

As reported on Tab 3.2 of the CEDR, the 26% goal for potable water reduction relative to a 2007 baseline has been significantly exceeded. Since the baseline year of 2007, Fermilab has reduced domestic water use by 52.5%, primarily through monitoring and management of leak detection in its large network of onsite water mains. The management plan to monitor and appraise potable water consumption was updated again for this year's analysis.

Planned Actions

Fermilab has far exceeded this goal and plans to maintain the WUI level necessary to meet the goal (see Figure 7, below). Our site-specific measurable goal in this area for 2012 will be to maintain the usage of potable water at a level that far exceeds the reduction goal compared to the 2007 baseline.

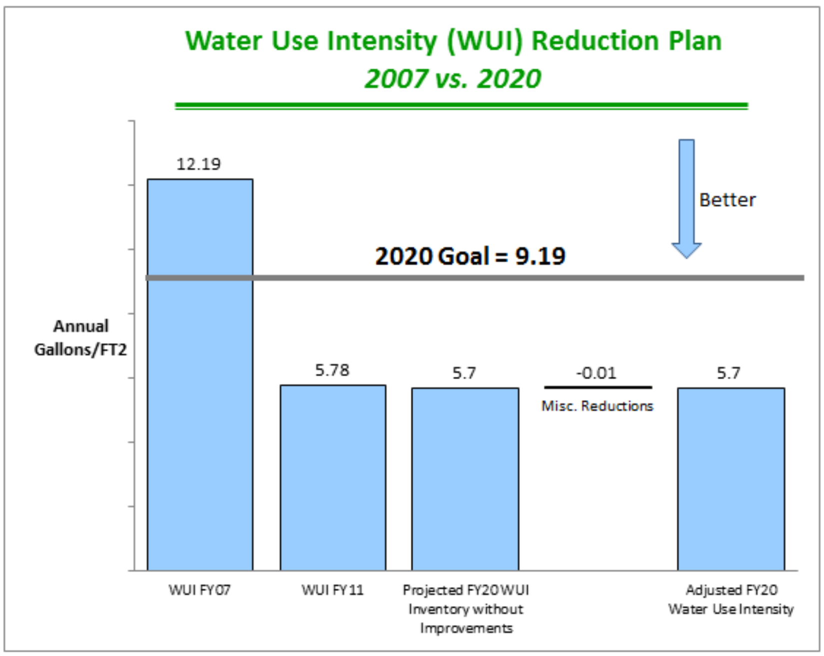


Figure 7. Fermilab Water Use Intensity status and goals. Note: Since the goal is already met, no table of strategies to meet the goal is included for this chart.

4.2 20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline

Performance Status

As reported on Tab 3.2 of the CEDR, ILA water use during FY2011 increased by 42.8% over last year. ILA water is obtained principally from storm water capture and reused as Industrial Cooling Water (ICW). Additional water from the bedrock formation is captured in the tunnel associated with the MINOS facility and injected into the ICW system at a rate of approximately 76 Mgal/year. During 2011, 24.9 Mgal was pumped from the Fox River, and 15.1 Mgal from an onsite deep well to help make up for losses of surface water. The surface water management plan was updated this year in an effort to help minimize surface water runoff losses.

Cooling ponds were configured in 2011 to allow special operations to be performed at the Tevatron accelerator just prior to its permanent shutdown that occurred in September. These included the accommodation of SeaQuest preparations and MuCool cryogenics, which contributed to water losses. Fermilab administers NPDES permits for all discharges of process water off site.

Fermilab has adopted a site-wide strategy of natural landscaping and native grassland management that requires a minimum amount of landscape watering. Minor amounts of non-potable Industrial Cooling Water (ICW) are used during times of drought to water ornamental trees. In 2011, this amounted to approximately 6600 gallons.

There is no use of potable or non-potable water for landscaping or the irrigation of crops at Fermilab. This practice is formalized by a memorandum from the Head of the Facilities Engineering Services Section, which includes the Roads and Grounds Department.

Planned Actions

Attainment of the DOE goal for 2020 will depend upon the resumption of natural attenuation of the flow of water pumped from the MINOS facility and the reduction of excess surface water runoff to creeks.

Attainment of the DOE 20% ILA reduction goal by 2020 does not currently seem possible. This is primarily due to the cessation of the natural attenuation of water pumped from the Minos facility that had been seen for several years prior. Although the reduction of excess runoff to creeks can contribute to as much as a 6% reduction from the FY 2010 baseline, current projections indicate that there will be excess water from Minos which cannot be used.

Fermilab has a new set of challenges in 2012 trying to minimize runoff to creeks while preventing complications from freezing conditions as limited post-shutdown operations reduce the overall heat load on the ponds. Modifications to ponds and cooling systems are being made as noted on Tab 3.5 of the CEDR to help conserve both energy and ILA water. Fermilab's site specific measurable goal in this area for 2012 will be the reduction of this year's increased losses by at least 50%.

5.1 and 5.2 Recycling and waste diversion (50% by FY 2015)

Performance Status

In 2011 Fermilab generated 318 metric tons of sanitary waste. Fermilab has an established recycling program for a variety of materials and actively seeks out opportunities to expand the program where it is feasible. Over 158 metric tons were diverted from waste in 2011. This includes a paper, plastic, aluminum can recycling, as well as specific items recycled through our Business Services Section. A pilot polystyrene recycling program has been in effect for the past year. The impact isn't fully realized as recycling and waste numbers are reported in weight, but dumpster space has been saved because of this program. The Laboratory has a well-established site-wide alkaline battery recycling program as well. Modular office walls and work surfaces are also reused. In 2011, over 16 offices were reconfigured or newly built by reusing pieces from previous offices. All electronics are either recycled or donated. See section 7.1 for more information.

Fermilab has a mature scrap metal recycling program. In 2011, 552 metric tons of metal were sent off site for recycling. Since the July 2000 suspension on recycling metal from radiological control areas, Fermilab has accumulated over 2722 metric tons of various metals that would otherwise be available for recycling as scrap. Approximately 10,000 square feet of extra space is required to store this scrap metal and the quantity of material and space required to store it continues to increase.

Construction projects generate construction and demolition (C&D) waste, much of which is available for recycling. Currently, Fermilab maintains a series of dumpsters that sub-contractors can utilize to dispose of small amounts of C&D wastes. During 2011, 106 metric tons of C&D waste was removed from the site and 82% of that total was ultimately recycled.

Local surrounding municipalities dispose of their fall leaf refuse on Fermilab's agricultural farm fields. In 2011, 9000 cubic yards (roughly 408 metric tons) were spread on the fields as a soil amendment after composting.

All computers that are connected to the Fermilab network have been set to default duplex printing. All copy paper purchased through Fermilab's stock room contains at least 30% post-consumer fiber.

Through division/ section/ center's procurement processes, environmental officers review purchase orders to determine whether a less toxic alternative would be applicable. Fermilab has targeted ethylene glycol with a goal to convert all remaining chillers on site to propylene glycol by 2015. We have also retrofit or replaced any equipment on site that uses R12 refrigerant, which is the last CFC in our inventory.

Fermilab adheres to integrated pest management to minimize pollution and adverse environmental impacts. Fermilab has a prairie restoration program. Native plants are used in landscaping.

Planned Actions

Fermilab plans to continue our aggressive waste minimization programs throughout the Laboratory. We intend to explore more efficient means to track and report the recycling of C&D waste for large, fixed price contracts in FY2012.

6.1 Procurements Meet Sustainability Requirements by including necessary provisions and clauses (95% each year)

Performance Status

SA training has been developed to educate employees about requesting sustainable products in contracts and for all other purchases, and over 90% of the employees have received the training.

Planned Actions

Fermilab will incorporate applicable language from the DOE Sustainable Acquisition regulations (FR Vol. 75 No. 183 57690 – 57696) into our procurement documents, including sub-contracts, the Fermilab Procurement Manual and construction specifications.

7.1 Data Centers and Electronic Stewardship

Performance Status

Fermilab is committed to managing computers in accordance with environmentally sustainable practices. To support this effort, all Fermilab employees, visitors and contractors are required to adhere to the Personal Computing Environmental Policy. We have been members of the Federal Electronics Challenge since 2007, and as of June 2008, all purchased computing equipment must meet the Electronic Product Environmental Assessment Tool (EPEAT) registration requirements. Since this requirement was implemented, 99% of PCs/monitors purchased were EPEAT registered. Requisitioners must provide justification for all requisitioned equipment that is not EPEAT registered. Justifications must be reviewed and approved by a designated approver and purchases that jeopardize these goals may be denied. Specifications on energy efficiency for scientific computer purchases are included in solicitations and the bid award process.

The policy requires that computing assets be operated in an energy efficient manner. Procedures define standards for power management of monitors, laptop displays, processing units, and resource utilization standards for printers. Energy saver recommendations for desktop operating systems can be found in the respective baseline documentation and printers are purchased and installed with power saving features enabled.

Electronic equipment at end of life is either donated or recycled. Laptops, desktops, monitors, printers, multi-function devices, televisions, servers, personal digital assistants, and cellular phones are all managed responsibly at the end of their life at Fermilab through the Property Office. During FY2011, 174 units of electronics were donated or transferred for reuse, and 1093 units of electronics were recycled.

Fermilab lists all desktop and laptop computers that are in working condition on the GSA/CFL Excess System. After the computers go through the GSA/CFL system, they are sent to an electronics recycling company. The recycler has completed the “Federal Electronics Challenge Work Sheet for On-Site Review of Electronics Recycling Facility”.

Energy efficiency improvement is a key goal in upgrading Fermilab’s existing data centers and in building new ones. Efficiency measures we have used include hot and cold aisles, cold aisle containment on row ends, blanking and threshold panels, higher cold aisle temperatures, no cabling under raised floors, air conditioner ducting to hot air layer, matching air conditioning to temperature sensors in front of computer racks and use of UPS units with greater than 90% efficiency. The Power Utilization Effectiveness ratings (PUE) for our computing centers are in the range of 1.5 to 1.7.

During FY 2010, we submitted one of the Fermilab data centers (Grid Computing Center) for an Energy Star award, which was received in December, 2010. During the past year, we have improved cooling efficiency with better air management. The Computer Room Air Conditioner (CRAC) set point temperatures have been increased 4 degrees Fahrenheit. Electrical efficiency has been improved by leveraging more 208V distribution instead of 120V distribution. The recent ARRA funded projects added a high availability computer room that employs top-down cooling with no raised floor and all 208V electrical distribution.

We also replaced end-of-life, low efficiency air conditioners in Feynman Computing Center with newer, higher efficiency units. We are realizing significant water savings after replacing outdated cooling equipment of over one million gallons per year. The Recovery Act funded project allowed the transition from water-cooled chillers to air-cooled CRAC units.

The primary computer room on the second floor of the Feynman Computing Center was collapsed into a single space, thereby retiring space on the first floor (~4600 sqft) and the tape vault mezzanine (~1500 sq. ft.).

The Feynman Computing Center had two 480V services added in 2011. All three services now have modern power monitoring on the 480V building entrances. All three of these meters are able to be read out over the network. Each 480V service at the Grid Computing Center and Lattice Computing Center has similar, modern power meters. However, they still need to be configured to be readable on the network.

Planned Actions

The Windows XP operating system is being replaced by Windows7 to support centralized power management features. All computers in the Fermilab domain will have these standards automatically applied. New equipment is replacing older equipment and has power management features enabled. Software has been installed that monitors progress on energy settings and usage. A PC refresh plan is being developed that aligns with the fiscal responsibilities of the Laboratory.

All print queues for standard formats (8 ½ x 11 plain paper) for printers on the central print server are set to default duplex, except special purpose printers such as paycheck/paystub printers, transparency printers, etc. Any requests for setting a printer currently configured to duplex printing to default single sided printing must go through the variance request and approval process described on the Computing Division web site at http://computing.fnal.gov/xms/Services/Think_Green.

In FY 2011, we are again submitting the Grid Computing Center for an Energy Star Data Center Efficiency award. During the next year, we plan to improve cooling efficiency with better cold aisle containment systems and increasing cold aisle temperatures. Electrical efficiency will be improved by transitioning more 120V electrical load to 208V distribution. The Laboratory will continue its stringent maintenance program for peak efficiency of electrical and mechanical systems. An older 125kVA UPS is being retired and the electrical load is being transferred to a larger UPS which will improve the overall efficiency.

We plan to investigate other potential energy efficiency improvements for future computer rooms, including air-side cooling, flywheel UPS, liquid or gas rack cooling, bus bar power distribution and variable speed air conditioning units.

All 480V electrical service power monitors will be on the network in this next reporting period and we will extend the power monitoring to other key points within the electrical power system. We will continue to use DC Pro and the Energy Star profiler to help track electrical usage.

7.2 Maximum annual weighted average Power Utilization Effectiveness (PUE) of 1.4 by FY2015

Performance Status

The Power Utilization Effectiveness ratings (PUE) for our data centers are in the range of 1.5 to 1.7.

Planned Actions

We expect to improve the PUE during the next year with several small improvements and by operating the rooms at a fuller capacity. There are also two upgrade projects that are being considered that will improve the efficiency at GCC. The projects are the GCC Cooling Upgrade and the GCC Computer Room A upgrade.

7.3 Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with Power Management actively implemented and in use by FY 2012

The Windows XP operating system is currently being replaced by Windows7 to support centralized power management features. All computers in the Fermilab domain will have these standards automatically applied.

II-a. Supplemental Goals: Departmental Qualitative Goals

The following two goals are discussed relative to a department-wide effort, to which Fermilab will contribute local efforts.

3.3 Regional and local planning

Performance status

Current Fermilab practice includes participation in regional transportation and related sustainability planning. As an integral partner in regional and local planning activities, Laboratory personnel meet with community leaders, public transit leaders, working groups, and regional planning groups, to ensure that Fermilab's mission is aligned with local and regional goals. For larger projects, Fermilab convenes formal Community Advisory Boards to ensure that community and Laboratory goals are consistent.

Fermilab maintains an excellent cooperative relationship with our neighboring communities. We operate a program to assist local communities dispose of leaf litter on our site where it is composted (see this plan, section 5.1 and 5.2). This avoids hundreds of miles of transportation that communities would otherwise have to bear to dispose of leaves.

In 2008, we cooperated with a neighboring community to significantly upgrade the reliability of their electrical distribution system by routing redundant high voltage lines on Fermilab property.

Planned Actions

Fermilab will continue to work closely with local communities.

8 Site Innovation and Government-Wide Support

There is no sustainability related research being conducted at the site for demonstration or implementation purposes. Fermilab is a single purpose high energy physics laboratory.

III. Climate Change Adaptation

Fermilab has elected not to comment on this voluntary section of the SSP.

IV. Site Sustainability Transformation Teams

Because Fermilab is a single-purpose high-energy physics laboratory, energy efficiency research is not explicitly part of our mission. However, the operation of the apparatus necessary to conduct high-energy physics experiments requires large amounts of electrical power, and Fermilab recognizes a commitment to conduct this research as responsibly as possible.

The Accelerator Physics Center was instituted at Fermilab in 2007 "to provide enhanced emphasis on, and support of, accelerator R & D activities aimed at Fermilab's future beyond the end of the current decade." Part of the mission is to fulfill the spirit of the Sustainability Transformation Teams by investigating new technologies to make accelerator operations more energy-efficient in the future.

Fermilab is no stranger to such dramatic efficiency improvements. The Main Ring proton accelerator at Fermilab was replaced by the super-conducting Tevatron in 1983, which raised the beam energy available for physics from 400GeV to 1 TeV using 50% less electrical energy.

V. High Energy Mission Specific Facilities (HEMSF)

The Office of Science has identified 3 HEMSF initiatives at Fermilab representing world-leading, core-mission relevant capabilities funded by DOE and used by scientists and engineers across the globe to conduct research and development, as follows:

Particle Accelerators

These include accelerators, detectors and support facilities (including power and cooling) for the Laboratory's multi-stage accelerator complex consisting of the Cockcroft-Walton Unit, Linac, Booster, Recycler, PBar Accumulator/Debuncher, Main Injector, and Tevatron. The Tevatron completed its mission and this stage was permanently shut down in September, but ongoing research and other activities will continue in many of its facilities for the foreseeable future.

In FY 2011, the following facilities were included under this HEMSF, all of which are designated as "excluded" facilities under FIMS. FIMS designations are given in parentheses after facility names. Anti-Proton facilities (201, 202, 203 & 204), Booster Gallery (206), MuCool facility (210), Linac, Cross-Gallery, Transfer Gallery (212), Central Utility Building (214), A0 facilities (216, 217 & 218), Accelerator Service Buildings (220, 221, 222, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 267 & 283), Refrigeration facilities (299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322 &

324), Collider Detector Facility (323), D-0 Assembly Building (325), Meson facilities (402, 404, 406, 408, 410, 412, 414, 418, 426, 428, 430 & 434), KTeV/NM4 facility (630), Main Injector facilities (708, 710, 712, 713, 720, 730, 731, 740, 750, 752, 760 & 762), SciBooNE facility (714), NuMI (765) facility, MiniBooNE facility (780), MINOS facility (785), CHL facility (851), Master Substation (854), Kautz Road Substation (860), Research Accelerator Ring/Tunnel, and NuMI Tunnel (OSF).

High Performance Computing

These include 3 HPC clusters consisting of 1283 individual HPC servers housed primarily in two existing facilities designated as "excluded" under the FIMS identifiers in parentheses: Lattice Computing Center (LCC) at Muon Laboratory (700), and Grid Computing Center (GCC) (628).

LCC uses High Performance parallel computing to calculate Lattice Quantum Chromodynamics (Quantum QCD) in the study of how quarks and gluons interact through the strong force. Physicists compare the calculations to measurements from experiments to seek hints of new physics beyond the Standard Model.

LCC at one time housed all of the Lattice (HPC) computing, however, in the last year LCC is approximately 50% Lattice and 50% enterprise computing. Lattice also has HPC computing in Computer Room C at GCC. GCC also has HTC computing so that about 90% of GCC fits the HPC designation. The new Cloud Computing Center, which is scheduled to come online in FY 2014 is expected to be upwards of 80% High Performance Mission Specific computing.

Experiments like those at the Large Hadron Collider (LHC) collect more data than any computing center in existence could process, so Fermilab initiated the FermiGrid to take part in a large consortium grid called Open Science Grid. Grid computing is essential to experiments at the LHC and Fermilab is responsible for storing, processing, and redistributing a significant portion of the data from the CMS experiment there.

Future Accelerators

New experiments and facilities are anticipated to come online through FY2020 as Fermilab pursues the Intensity Frontier of High Energy Physics and the study of neutrinos. However, as outlined in Fermilab's Plan for Discovery, funding constraints have pushed back the schedule for several new HEMSF facilities. The centerpiece of this initiative is the Project X accelerator, which has been moved just beyond the 2020 horizon. Another key initiative, the Long Baseline Neutrino Experiment (LBNE) will only begin preliminary operations within the 2020 horizon.

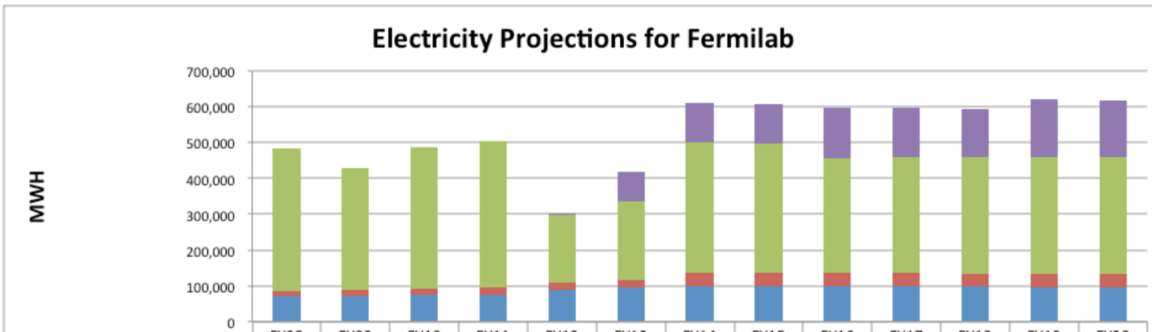
In the near-term, new facilities such as SCRF/NML and CMTF will come online to develop the technologies needed to construct Project X, and ultimately the International Linear Collider (ILC). Other new facilities such as NOvA and MicroBooNE will expand neutrino studies through intensity upgrades to the existing Main Injector that will help prepare the way for LBNE and Project X.

In the mid-term, the new g minus 2 facility will re-use accelerator equipment from Brookhaven to expand testing of the Standard Model by measuring the Anomalous Magnetic Moment of the Muon.

Toward the end of the 2020 horizon, Mu2e will look for dramatic new evidence of physical processes beyond our current understanding of particle physics by searching for the coherent, neutrino-less conversion of a muon to an electron in the coulomb field of a nucleus. The new LBNE will explore interactions and transformations of the world's highest-intensity neutrino beam by sending it more than 1000 km through the earth to the largest particle detectors ever built, to answer some of the most fundamental questions about the nature of our universe.

Figure 8 represents the anticipated effects on Fermilab electricity usage through FY 2020 from the following HEMSF activities:

- FY 2012 – Discontinuation of Tevatron accelerator operations, and an extended shutdown of the entire accelerator complex for many months
- FY 2013 – Restart of the remaining accelerator complex, and startup of the new SCRF/NML and CMTF facilities
- FY 2014 – Boosting of intensity levels at the existing Main Injector complex, and startup of the new NOvA, SeaQuest, MicroBooNE, Holometer and Cloud Computing Center
- FY 2016 – Discontinuation of the existing NuMI and the new SeaQuest, and startup of the new g-2 experiment
- FY 2017 – Discontinuation of the existing PBar, MiniBooNE, MINOS, and MINERvA, and discontinuation of the new Holometer
- FY 2018 – Discontinuation of the new MicroBooNE
- FY 2019 – Startup of the new Mu2e and LBNE preliminary, and discontinuation of the new g-2 experiment
- FY 2020 – Discontinuation of the new NOvA



	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
New Accelerators HEMSF	0	0	0	0	876	84,096	110,376	110,376	141,036	135,780	131,400	162,060	157,680
Existing Accelerators HEMSF	395,627	341,569	394,742	407,331	188,497	218,171	361,422	358,762	318,320	324,471	326,125	326,018	326,731
Existing HPC HEMSF	16,759	17,426	17,430	19,925	19,925	19,925	37,445	37,445	37,445	37,445	37,445	37,445	37,445
Site Base	70,060	70,966	75,366	75,922	88,302	96,508	100,457	99,617	98,799	98,004	97,230	96,477	95,744

Figure 8. Site Base loads include goal subject building loads, metered process building and OSF enclosure loads calculated on a square foot basis based upon goal subject building loads per sf, and estimated percentages of metered process loads not specifically identified as HEMSF or

applicable support system facilities, such as enterprise computing facilities.